NRC FORM 464 Part I (6-1998) U.S. NUCLEAR REGULATORY COMMISSION

RESPONSE TO FREEDOM OF INFORMATION ACT (FOIA) / PRIVACY ACT (PA) REQUEST

FOIA/PA	RESPONSE NUMBER
2000-0080	1

RESPONSE TYPE: √ FINAL ___ PARTIAL

REQUESTER: Jay W. Davis

DATE: FEB 08 2000

PART I. -- INFORMATION RELEASED

___ No additional agency records subject to the request have been located.

___ Requested records are available through another public distribution program. See Comments section.

APPENDICES ___ Agency records subject to the request that are identified in the listed appendices are already available for public inspection and copying at the NRC Public Document Room.

√ APPENDICES A&B Agency records subject to the request that are identified in the listed appendices are being made available for public inspection and copying at the NRC Public Document Room.

___ Enclosed is information on how you may obtain access to and the charges for copying records located at the NRC Public Document Room, 2120 L Street, NW, Washington, DC.

√ APPENDICES A&B Agency records subject to the request are enclosed.

___ Records subject to the request that contain information originated by or of interest to another Federal agency have been referred to that agency (see comments section) for a disclosure determination and direct response to you.

___ We are continuing to process your request.

___ See Comments.

PART I.A -- FEES

AMOUNT *

$ 244.59

* See comments for details

___ You will be billed by NRC for the amount listed.

√ You will receive a refund for the amount listed.

___ None. Minimum fee threshold not met.

___ Fees waived.

PART I.B -- INFORMATION NOT LOCATED OR WITHHELD FROM DISCLOSURE

___ No agency records subject to the request have been located.

√ Certain information in the requested records is being withheld from disclosure pursuant to the exemptions described in and for the reasons stated in Part II.

√ This determination may be appealed within 30 days by writing to the FOIA/PA Officer, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001. Clearly state on the envelope and in the letter that it is a "FOIA/PA Appeal."

PART I.C COMMENTS (Use attached Comments continuation page if required)

The actual fees for the processing of your request are:

Professional Search	**- 1 hr. @ $36.93 per hr.**	**= $ 36.93**
Professional Review	**- 2 hrs. @ $36.93 per hr.**	**= 73.86**
Duplication	**- 669 pgs. @ $0.20 per pg.**	**= 133.80**
Total		**244.59**
Total Received		**4 29.26**
Refund		**$184.67**

SIGNATURE, FREEDOM OF INFORMATION ACT AND PRIVACY ACT OFFICER

Carol Ann Reed for Sherri L. Pugh

NRC FORM 464 Part II (6-1998) U.S. NUCLEAR REGULATORY COMMISSION RESPONSE TO FREEDOM OF INFORMATION ACT (FOIA) / PRIVACY ACT (PA) REQUEST	FOIA/PA 2000-0080	DATE FEB 08 2000

PART II.A -- APPLICABLE EXEMPTIONS

APPENDICES B

Records subject to the request that are described in the enclosed Appendices are being withheld in their entirety or in part under the Exemption No.(s) of the PA and/or the FOIA as indicated below (5 U.S.C. 552a and/or 5 U.S.C. 552(b)).

- ☐ Exemption 1: The withheld information is properly classified pursuant to Executive Order 12958.
- ☐ Exemption 2: The withheld information relates solely to the internal personnel rules and procedures of NRC.
- ☐ Exemption 3: The withheld information is specifically exempted from public disclosure by statute indicated.
  - Sections 141-145 of the Atomic Energy Act, which prohibits the disclosure of Restricted Data or Formerly Restricted Data (42 U.S.C. 2161-2165).
  - Section 147 of the Atomic Energy Act, which prohibits the disclosure of Unclassified Safeguards Information (42 U.S.C. 2167).
  - ☐ 41 U.S.C., Section 253(b), subsection (m)(1), prohibits the disclosure of contractor proposals in the possession and control of an executive agency to any person under section 552 of Title 5, U.S.C. (the FOIA), except when incorporated into the contract between the agency and the submitter of the proposal.
- ☐ Exemption 4: The withheld information is a trade secret or commercial or financial information that is being withheld for the reason(s) indicated.
  - ☐ The information is considered to be confidential business (proprietary) information.
  - ☐ The information is considered to be proprietary because it concerns a licensee's or applicant's physical protection or material control and accounting program for special nuclear material pursuant to 10 CFR 2.790(d)(1).
  - ☐ The information was submitted by a foreign source and received in confidence pursuant to 10 CFR 2.790(d)(2).
- ☐ Exemption 5: The withheld information consists of interagency or intraagency records that are not available through discovery during litigation. Applicable privileges:
  - Deliberative process: Disclosure of predecisional information would tend to inhibit the open and frank exchange of ideas essential to the deliberative process. Where records are withheld in their entirety, the facts are inextricably intertwined with the predecisional information. There also are no reasonably segregable factual portions because the release of the facts would permit an indirect inquiry into the predecisional process of the agency.
  - ☐ Attorney work-product privilege. (Documents prepared by an attorney in contemplation of litigation)
  - ☐ Attorney-client privilege. (Confidential communications between an attorney and his/her client)
- ☑ Exemption 6: The withheld information is exempted from public disclosure because its disclosure would result in a clearly unwarranted invasion of personal privacy.
- ☐ Exemption 7: The withheld information consists of records compiled for law enforcement purposes and is being withheld for the reason(s) indicated.
  - ☐ (A) Disclosure could reasonably be expected to interfere with an enforcement proceeding (e.g., it would reveal the scope, direction, and focus of enforcement efforts, and thus could possibly allow recipients to take action to shield potential wrongdoing or a violation of NRC requirements from investigators).
  - ☐ (C) Disclosure would constitute an unwarranted invasion of personal privacy.
  - ☐ (D) The information consists of names of individuals and other information the disclosure of which could reasonably be expected to reveal identities of confidential sources.
  - (E) Disclosure would reveal techniques and procedures for law enforcement investigations or prosecutions, or guidelines that could reasonably be expected to risk circumvention of the law.
  - ☐ (F) Disclosure could reasonably be expected to endanger the life or physical safety of an individual.
- ☐ OTHER (Specify)

PART II.B -- DENYING OFFICIALS

Pursuant to 10 CFR 9.25(g), 9.25(h), and/or 9.65(b) of the U.S. Nuclear Regulatory Commission regulations, it has been determined that the information withheld is exempt from production or disclosure, and that its production or disclosure is contrary to the public interest. The person responsible for the denial are those officials identified below as denying officials and the FOIA/PA Officer for any denials that may be appealed to the Executive Director for Operations (EDO).

DENYING OFFICIAL	TITLE/OFFICE	RECORDS DENIED	APPELLATE OFFICIAL EDO	SECY	IG
Ellis W. Merschoff	Regional Administrator, RIV	App. B	✓		

Appeal must be made in writing within 30 days of receipt of this response. Appeals should be mailed to the FOIA/Privacy Act Officer, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, for action by the appropriate appellate official(s). You should clearly state on the envelope and letter that it is a "FOIA/PA Appeal."

Re: FOIA 2000-80

APPENDIX A
RECORDS BEING RELEASED IN THEIR ENTIRETY
(If copyrighted identify with *)

NO.	DATE	DESCRIPTION/(PAGE COUNT)
1.	02/05/98	Letter to Nuclear Materials Licensing Branch, U.S. Nuclear Regulatory Commission, Region IV, from Dixie J. Wells, RSO, Aguirre Engineers, Inc., Subject: Application for an NRC Specific License of Broad Scope for Byproduct Material with various attachments, 47 pages.
2.	02/05/98	Volume 1 - Radioactive Materials License Application, 277 pages.
3.	02/05/98	Volume 2 - Radioactive Material License Application, 301 pages.
4.	03/18/98	Telephone or Verbal Conversation Record between Dixie Wells and Beth Prange, Subject: Aguire Engineers, Inc., 2 pages.
5.	03/25/98	Telephone or Verbal Conversation Record between Dixie Wells and Beth Prange, Subject: Aguirre Engineers, Inc. 6 pages.
6.	03/26/98	Letter to Aguirre Engineers, Inc. ATTN: Dixie Wells from Beth Prange, Subject: License Application, 2 pages.
7.	03/31/98	Letter to Ms. Beth Prange from Dixie J. Wells, RSO, Subject: Response to Questions with regard to AEI's application for an NRC Specific License of Broad Scope for Byproduct Material, 7 pages.
8.	04/07/98	Telephone or Verbal Conversation Record between Dixie Wells and Beth Prange, Subject: Aguirre Engineers, Inc. 2 pages.
9.	04/07/98	Letter to Ms. Beth Prange from Dixie J. Wells, RSO, Subject: Response to Final Questions regarding AEI's application for an NRC License, 13 pages.
10.	04/08/98	Letter to Aguirre Engineers, Inc., ATTN: Dixie J. Wells from Beth A. Prange, Subject: New License, 4 pages.

Re: FOIA-2000-80

APPENDIX B
RECORDS BEING WITHHELD IN PART

NO.	DATE	DESCRIPTION/(PAGE COUNT)/EXEMPTIONS
1.	Undated	Training and Experience Authorized User or Radiation Safety Officer Application for Thomas J. O'Dou, CHP, Subject: Aguiree Engineers, Inc., 4 pages. **(EXEMPTION 6)**
2.	Undated	Training and Experience Authorized User or Radiation Safety Officer Application for Dixie J. Wells, Subject: Aguiree Engineers, Inc., 4 pages. **(EXEMPTION 6)**

AGUIRRE ENGINEERS, INC.
Environmental * Management * Geotechnical * High Hazard Services

February 5, 1998

Nuclear Materials Licensing Branch
U. S. Nuclear Regulatory Commission, Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

Subject: Application for an NRC Specific License of Broad Scope for Byproduct Material

This letter forwards AEI's request for review of the enclosed application for a "Type A Broad Scope" Radioactive Materials license. The primary document is the completed Application for Material License (Form 313). This letter and the written response to Items 5 through 11, as instructed in Section 2 of Draft Regulatory Guide DG-0005 (Second Proposed Revision 2 to Regulatory Guide 10.5) serve as attachments to Form 313.

As instructed in Section 2 of DG-0005, each separate sheet or document submitted is identified and keyed to the item number by direct reference - *(Item 5, 7, etc)* and/or preceded by an annotated divider page (usually in an other than white color).

The AEI Controlled Procedures, Manuals, Work Plans, etc. have been sent to you in hardcover notebooks, which is to be the normal form that Controlled Procedures are distributed. As instructed, you have been sent two (2) complete copies of our submittal; both sets of procedures have been assigned to NRC Region IV in accordance with ARP-30 - Document Control. As the faction accountable for document control, I am aware that based on the current structure of Region IV, Ms. Beth Prange will probably be my reviewer. As I have worked with her in the past, I am looking forward to it again.

Thank you for your support and guidance in our initial licensing effort. AEI looks forward to a productive relationship with the Nuclear Regulatory Commission. As you review this application, please call me for immediate assistance with any questions, concerns, comments, or clarifications. I may be reached by phone at (702) 645-9292 or by fax at (702) 645-9313.

Sincerely,

Dixie J. Wells, RSO
Las Vegas Operations
AEI High Hazard Division

Approved By:

Thomas J. O'Dou, CHP
Las Vegas Operations
AEI High Hazard Division

6461 Plumcrest Road Suite 100 * P.O. Box 36441 * Las Vegas, Nevada 89108 * USA 702-395-2814 * FAX 702-395-2824

A/1

In accordance with the instructions given in DG-0005, each section of the discussion will be referenced to a particular part of the application. If a referenced portion of the application is answered by a specific section of a procedure or manual, the part or parts of the procedure will be noted.

In addition to the instructions given in DG-0005, we have submitted an application of this type previously. Please reference NRC License Number 27-29103-01, issued in December 1996 to Gutierrez-Palmenberg, Inc. Aguirre Engineering has a State of Colorado Radioactive Materials License Number 375-01. Both licenses have been audited one or more times, without problems.

One of the primary purposes of this license is to provide a complete radioactive materials license package that includes; possession limits, an approved AEI Radiation Protection Program, regulatory auditability, professional staff, and, of course, NRC review of activities. This complete service would be for clients and/or facilities that require radioactive materials work to be performed, but do not have either the resources of or access to an approved radioactive materials license.

An additional purpose of this license is to provide a legal basis for work involving radioactive material remediation services which will be performed at the generator or client/generator's site. These services may consist of site characterization for radioactive wastes, sampling, decontamination of buildings, equipment and the environment, and surveillance for release. These services would be performed at the client's request by contract for the intention of releasing an area or areas to public use or simply to aid the client in recovering greater control of their work spaces. Our primary guidance document for our decontamination efforts is NUREG/CR-5849, *Manual for Conducting Radiological Surveys in Support of License Termination*, June 1992; as well as release levels as defined in other guidance documents such as, *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material* and *Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors*, or any future release requirements published by the USNRC.

This license will be entered into as a Type A Broad Scope in accordance with 10 CFR Parts 30 and 33. Our license will have a Radiation Safety Committee with Thomas J. O'Dou, CHP as Chairperson, as well as a Radiation Safety Officer, Dixie J. Wells, as listed on Form 313. The designated Alternate RSO for the purposes of this license will be Thomas J. O'Dou, CHP. The license is designed for use in all areas of NRC jurisdiction and Agreement States.

AEI has no laboratory facilities and has entered into verbal contracts with licensed qualified laboratories for these service needs. These contracts have been executed with General Engineering Laboratories (GEL) located in Charleston, South Carolina, Mountain States in Salt Lake City, Utah, and Yankee Atomic in Westborough, Massachusetts. As a matter of information, Yankee Atomic was recently purchased by Duke Power Company located in Seneca, South Carolina. I have included the laboratory materials with the Yankee logos, but the laboratory capabilities and staff have not been changed, just the name. A summary sheet with these laboratories has been included for your review and files.

ITEM 3

Necessary explanations in this application need to begin before the expected norm of Items 5-11. This is due to the unusual nature of this license request. As discussed with Jack Whitten and Billie Krysinski in the initial stages of the license preparation of license number 27-29103-01, the design of this license also is:

- to extend help to 'facilities' whose existing license may not fully cover the expected scope of a project involving radioactive materials, or;
- to extend coverage (of a radioactive materials license) to 'facilities' that may be required to undertake a project involving radioactive materials and they would not normally have a license for handling radioactive materials, (i.e., scrap yards that have discovered Radium dials, gauges, etc. years after it was placed in the yard), or;
- to work, and share responsibility for radioactive materials controls, with an existing NRC or Agreement State licensee.

Therefore, in response to *ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED*, the answer/address will vary with the project or contract. In all cases, a Work Package consisting of a; 1) Detailed Work Plan, 2) Health and Safety Plan, and 3) Quality Assurance (QA) Plan, as outlined and described in Section II, Volume I of this response, will be presented for review/approval prior to beginning a project. In License 27-29103-01, *License Condition 13* addressed this specifically. In this submittal, the Detailed Work Plan example is for a Characterization - it would be written in the same format for a remediation, decontamination, etc. Decommissioning documents are normally written to conform to the NRC Guidelines in RG 3.66 and 3.67.— Emergency Plans financial assurance mechanisms

ITEM 5

The byproduct material at any given facility with each contract will vary; therefore the Item 5 requirements are requested to provide the widest possible latitude without provision of a Certified Emergency Plan. In the event that the Item 5 limits are invoked to cover contract work or a contract project, control of the possession limits will be maintained at *Unity* as discussed in several CFR references and which indicates that the total amount of activity present at any one time, when factored and summed, would add up to a number that would be less than 1. This will be implemented by including site wide inventory of contracted radioactive materials and an appropriate set of Unity Calculations. As discussed with the Walnut Creek Field Office, there is a standard format used to assign these amounts. This format was implemented in the Item 5 response in 27-29103-01 and, as has been explained to me, is the NRC preferred response. It is equally sufficient in this request, as well.

ITEM 6

As previously discussed, the byproduct material will be as a result of remediation services. These services may consist of site characterization for radioactive and hazardous wastes; sampling; decontamination of buildings; equipment and the environment; and surveillance for release. These services would be performed at the client's request by contract. Decontamination, onsite solidification, packaging and transportation of wastes, and other services of this nature will be performed in accordance with AEI procedures (which are provided for review in Section II, Volume II) and applicable client, state, and federal regulations. As you may note in *Authorized Use* portion of NRC License Number 27-29103-01, it mentions receipt and storage, this is as it applies to work at the client's facility/site or for transport to an authorized storage or burial site.

ITEM 7

Certification and identification of these individuals, is submitted on the enclosed Training and Experience Forms. This format lists their training, where it occurred, whether it was *formal course* or *on-the-job*, and the length of time it lasted. In addition, the types and amounts of radioactive material handled, and a synopsis resume of each is included on the Training and Experience (T&E) Form.

Complete resumes for the Corporate Health Physicist, Thomas O'Dou, CHP, and the Radiation Safety Officer, Dixie Wells have been included. All T&Es and resumes are provided for your review.

Other aspects of this requirement are found in the AEI Radiation Safety Manual which introduces the management commitment to the radiation safety program, illustrates the line organization, and discusses the management roles. It also focuses on the Radiation Safety Officer responsibilities as the implementer of the license.

ITEM 8

Compliance with this item is included in the T&E specifications as noted in Item 7 for all initial personnel. For continuing qualification and for initial training and/or retraining of all additional radiation workers, the AEI Radiation Safety Training Manual will be implemented. This manual is provided for your review.

ITEM 9

AEI does not have an operational facility for waste handling or processing. All functions of this nature are contracted by the client/generator or by AEI for the client/generator.

separate + present in different format.

AEI currently contracts with GTS Duratek and Environmental Restoration Group for counting instrumentation. An inventory of the type, counting range, model number, and other essential information regarding the instruments available to AEI is shown in Table 1 ~~in Volume III of this application~~ Item 9 + 11 of this

AEI's dosimetry provider and processor is ICN Dosimetry. As with the laboratories, there is a verbal contract with ICN. I used them in conjunction with the operation of license number 27-29103-01 and AEI uses them in support of the State of Colorado license, 375-01. AEI's bioassay sample analysis will be provided by Teledyne Midwest Laboratory, a division of TEI. As with the other vendor factions in this application, I have used them for several years, have confidence in their capabilities, and know them to be recognized and approved.

Specific and sample counting information requiring the use of laboratory facilities is provided by the laboratories previously listed.

ITEM 10

The most efficient method for addressing the objectives in Item 10 will be in narrative form, but may seem disjointed in the areas that do not apply to this license application specifically. Most of those areas will be with regard to facilities and procurement.

AEI has a State of Colorado radioactive materials license which covers the 'Troxler' type gauges used in their highway, etc. building division located in Denver. They have performed remediation work with regard to radioactive materials, hazardous waste, and unexploded ordnance, but these efforts were performed as a subcontractor to another company and under their license. AEI has extensive experience in work in the areas mentioned and now seeks to expand their knowledge through a NRC license.

AEI has a complete set of administrative and operational procedures for the work it performs. These documents have been provided in two (2) volumes for review. Volume I contains procedures ARP-001 through ARP-025, Volume II contains ARP-026 through ARP-040, the Radiation Safety Manual, the Radiation Safety Training Manual, the Test Question Bank, and a Generic Work Package consisting of the Detailed Work Plan, the Health and Safety Plan, and the QA Plan. Volume III contains the laboratory QA information. As instructed, there are two (2) complete sets of three (3) books.

Procurement of any radioactive materials will be done in accordance with procedure. Currently AEI has no plan to obtain licensed sources. AEI's radioactive sources will normally fall into the exempt category and will be used for checking radiation detection instrumentation. The only radioactive materials owned by AEI are exempt instrument check sources. These sources were ordered by the RSO; all original records are maintained by the RSO, and all records are in an auditable format.

The mechanism for verification of the Safety Evaluations is contained in the certification of the Corporate Health Physicist and the Radiation Safety Officer (resumes attached). One or both of these persons will evaluate and authorize any additions to the *authorized users* list. Auditable documentation, in accordance with AEI procedures, will be maintained. This records will normally be in the form of the submitted T&E Forms.

Contained within the Radiation Safety Manual are the provisions for management and radiation safety audits.

Compliance with item 10.6 will be provided in the form of a Work Package for each job or project. The Work Package, at a minimum, will consist of; *The Detailed Work Plan, The Health and Safety Plan, and The Quality Assurance Plan.* Since the content of the Work Package will vary with each project, you have been given the generic format for each of these documents for review in Volume III.

ITEM 11

As with Section 10.6 of Item 10, the manner of waste management will vary from project to project and as such, will always be made a matter addressed in the Work Package.

Finally, as has been discussed with the Region IV office, was discussed with the Region I office in the preparation of such a license for Teledyne in early 1996, and as implemented with license number 27-29103-01, this is a request for a normal Type A License of Broad Scope for Byproduct Material with a less than normal end use. We believe that the method in which this license will be applied provides for a greater than normal degree of control. The NRC has initial control in the approval of AEIs procedures and how they are implemented. It then is able to exercise additional control in the review of the Work Package associated with each project.

AEI and I would like to take this opportunity to express appreciation to the professionals in the various NRC offices that have helped in understanding of the requirements in the preparation of this license application. We look forward to continued operations with the NRC in the ongoing effort to help 'clean up' our environment.

Thank you.

AEI High Hazard Services

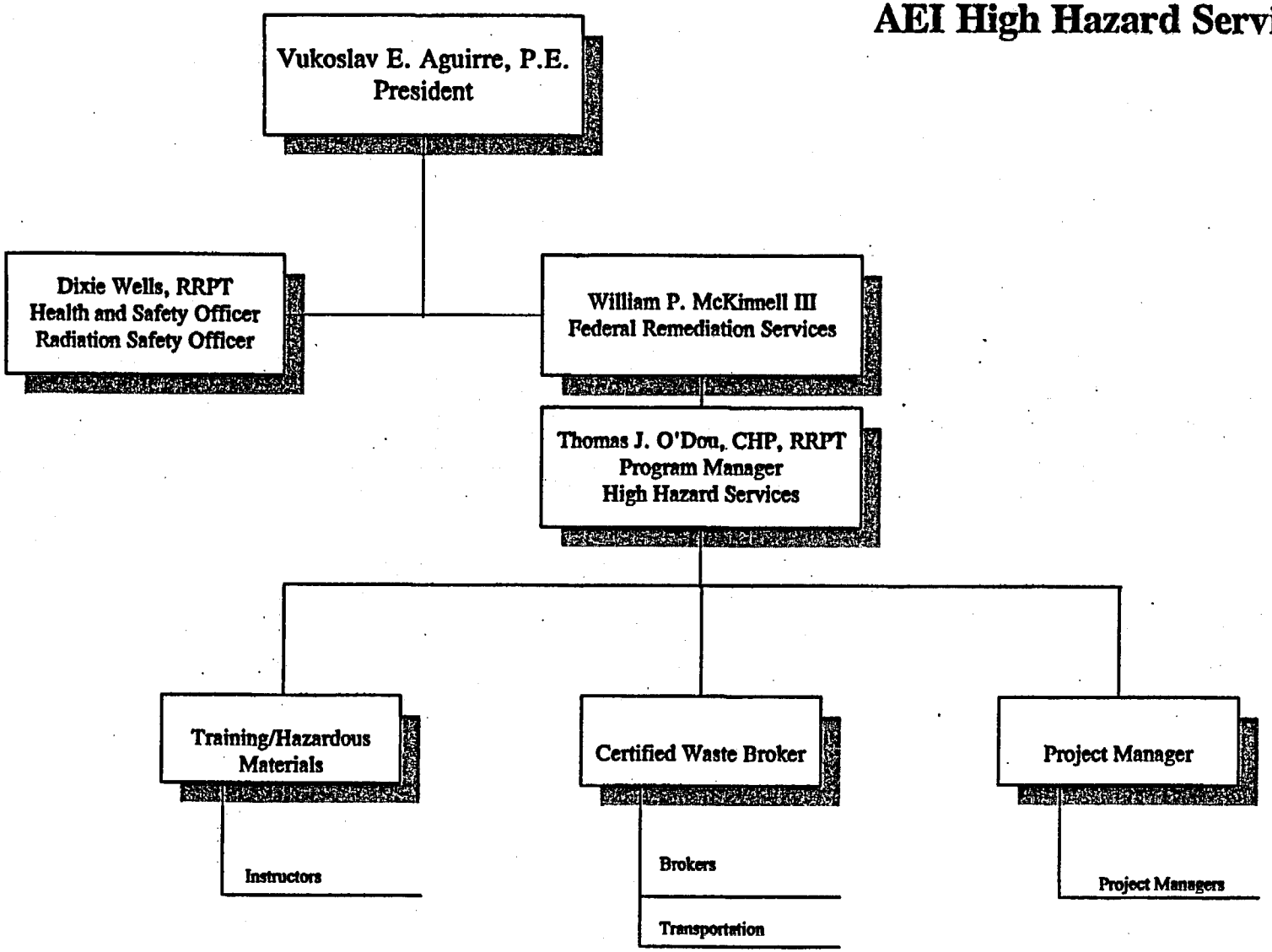


Figure 2b

Approved/Date: Vukoslav E. Aguirre January 28, 1998

1NRC FORM 313 (6-93)
10 CFR 30,32,33 34,35,36,39 AND 40

U.S. NUCLEAR REGULATORY COMMISSION

29119
020-34654

APPLICATION FOR MATERIAL LICENSE

APPROVED BY OMB: NO. 3150-0120
EXPIRES 6-30-96

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST 9 HOURS SUBMITTAL OF THE APPLICATION IS NECESSARY TO DETERMINE THAT THE APPLICANT IS QUALIFIED AND THAT ADEQUATE PROCEDURES EXIST TO PROTECT THE PUBLIC HEALTH AND SAFETY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0120), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

APPLICATION FOR DISTRIBUTION OF EXEMPT PRODUCTS FILE APPLICATIONS WITH:

DIVISION OF INDUSTRIAL AND MEDICAL NUCLEAR SAFETY
OFFICE OF NUCLEAR MATERIALS SAFETY AND SAFEGUARDS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS: FEB - 9 1998

IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND, MASSACHUSETTS, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, PENNSYLVANIA, RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

LICENSING ASSISTANT SECTION
NUCLEAR MATERIALS SAFETY BRANCH
U.S. NUCLEAR REGULATORY COMMISSION REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PA 19406-1415

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION II
101 MARIETTA STREET, NW, SUITE 2900
ATLANTA, GA 30323-0199

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION III
799 ROOSEVELT ROAD
GLEN ELLYN, IL 60137-5927

ARKANSAS, COLORADO, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA, TEXAS, UTAH, OR WYOMING, SEND APPLICATIONS TO:

NUCLEAR MATERIALS LICENSING SECTION
U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TX 76011-8064

ALASKA, ARIZONA, CALIFORNIA, HAWAII, NEVADA, OREGON, WASHINGTON, AND U.S. TERRITORIES AND POSSESSIONS IN THE PACIFIC, SEND APPLICATIONS TO:

RADIOACTIVE MATERIALS SAFETY BRANCH
U.S. NUCLEAR REGULATORY COMMISSION, REGION V
1450 MARIA LANE
WALNUT CREEK, CA 94596-5368

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTIONS.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*

- [■] A. NEW LICENSE
- [ ] B. AMENDMENT TO LICENSE NUMBER _____
- [ ] C. RENEWAL OF LICENSE NUMBER _____

2 NAME AND MAILING ADDRESS OF APPLICANT (Include Zip code)

Aguirre Engineers, Inc.
6461 Plumcrest Rd. Ste 100
Las Vegas Nevada 89108

3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

At individual customer/client-generator facility.

See Letter dated February 5, 1998

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

Ms. Dixie J. Wells,
Radiation Safety Officer

TELEPHONE NUMBER

702-645-9292

SUBMIT ITEMS 5 THROUGH 11 ON 8-1/2 X 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE

5.	RADIOACTIVE MATERIAL. a. Element and mass number, b. chemical and/or physical form, and c. Maximum amount which will be possessed at any one time.	6.	PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED
7.	INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING EXPERIENCE	8.	TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS.
9.	FACILITIES AND EQUIPMENT	10.	RADIATION SAFETY PROGRAM
11.	WASTE MANAGEMENT	12.	LICENSE FEES *(See 10 CFR 170 and Section 170.31)* FEES CATEGORY 1D, 2C, 3N, 4B AMOUNT $9180.00

13. CERTIFICATION. *(Must be completed by applicant)*. THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30,32,33,34,35,36,39 AND 40, AND THAT ALL INFORMATION CONTAINED HEREIN IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING:18 U.S.C.SECTION 1001 ACT OF JUNE 25,1948 62 STAT.749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION

CERTIFYING OFFICER - TYPED/PRINTED NAME AND TITLE	SIGNATURE	DATE
Vukoslav E. Aguirre, P.E. President, Aguirre Engineers, Inc.		February 1, 1998

FOR NRC USE ONLY

TYPE IF FEE	FEE LOG	FEE CATEGORY	AMOUNT RECEIVED	CHECK NUMBER	COMMENTS
APPROVED BY				DATE	

NRC FROM 313 (6-93)

PRINTED ON RECYCLED PAPER

572623

ITEMS 9 AND 11

INSTRUMENTATION DISCUSSION

A. INSTRUMENTATION/MAINTENANCE INFORMATION

Instrumentation used on projects for measurement of radiation and characterization of radioactive material and other hazardous materials is rented or leased from GTS or Teledyne Brown Engineering Services. These companies have been evaluated by AEI and provide instruments for which AEI has procedures.

The instruments are maintained with calibration traceable to the National Institute of Standards and Technology, and they are well maintained by the manufacturer and the lessor.

A list of the instruments which AEI has leased or may be provided to AEI for use on projects is provided as Table 1. These instruments may be used in any of the four categories, Decommissioning, Transportation /Brokering, and/or Processing and Disposal.

TABLE 1
Instrumentation for the Measurement/Characterization of
Radioactive and Mixed Materials

Instrument	Model Number	Serial Number	Date Calibrated	Manufacturer	Owner/ Lessor
Rate Meter	3	92104	2-15-96	Ludlum	*GTS
GM Probe	44-9	094811	2-15-96	Ludlum	*GTS
uR Meter	19	115870	2-15-96	Ludlum	*GTS
Ion Chamber	RO-2	3729	3-19-96	Eberline	*GTS
Ion Chamber	9	127138	5-17-96	Ludlum	*GTS
Gas Proportional Counter	This is a portable gas flow counter rental instrument NIST calibrated prior to rental.				Teledyne Brown
External NaI Crystal	This is a portable sodium iodide detector with ratemeter NIST calibrated prior to rental.				Teledyne Brown
Pressurized Ion Chamber	This is a self contained PIC with calibration traceable to NIST for low dose rate measurement				Teledyne Brown
Portable MCA with NaI	This is a portable MCA with sodium iodide detector NIST calibrated prior to use.				Teledyne Brown
Portable MCA with GeLi	This is a portable MCA with high resolution GeLi detector or intrinsic Ge detector calibrated prior to use.				Teledyne Brown
Micro-Rem	Micro Analyst	7751	**	Bicron	GTS

TABLE 1
Instrumentation for the Measurement/Characterization of
Radioactive and Mixed Materials

Instrument	Model Number	Serial Number	Date Calibrated	Manufacturer	Owner/ Lessor
Alpha Detector	PAC-4G	1512	**	Eberline	GTS
Neutron Detector	PNR-4	4485	**	Eberline	GTS
GM Detector	E-520	155	**	Eberline	GTS
Multiple Detector	ESP-1	879	**	Eberline	GTS
NaI Detector	PRM-6	1542	**	Eberline	GTS
Rascal	RAS-1	0186	**	Eberline	GTS
Frisker	RM-14	7751	**	Eberline	GTS
Ion Chamber	RO-2	901	**	Eberline	GTS
GM Detector	3	37127	**	Ludlum	GTS
GM Detector	12	12287	**	Ludlum	GTS
NaI Analyzer	18	30717	**	Ludlum	GTS
Alarm Ratemeter	177	113645	**	Ludlum	GTS
Scaler SCA	2200	92416	**	Ludlum	GTS
Portable SCA	2221	94954	**	Ludlum	GTS
Alpha/Beta Scaler	2929	95575	**	Ludlum	GTS
Air Sampler	HV-1	1515	**	Ludlum	GTS
Air Sampler	TF-1A	17695N	**	Staplex	GTS

Table 1 Notes: * = currently leased by AEI
** = calibrated when needed for lease
Other instruments with NIST calibration may be used as needed to support the contract specifications and scope.

B. LABORATORY FACILITIES DOCUMENTATION

Laboratory support for IOC projects is provided by a number of possible laboratories in order for AEI to provide the most accurate, expeditious, and cost effective analyses for our clients. A complete description of the services available through subcontractors is provided. Table 2 provides the name of each laboratory contractor which will

be used to provide analytical services. These laboratories provide services and have certifications which could enable their services to be used for both Characterization/Verification and Decontamination/Decommissioning analysis work.

Table 2
Laboratory Analytical Services Companies which may be used on Decontamination and Decommissioning Projects

Name	Location	Services	Contact
Yankee Atomic Labs	Westborough MA	Analysis of Samples Including: Alpha and Beta Counting Specific Radium Analysis Specific Uranium Analysis I-125, I-131 in milk or other media Gamma Spectroscopy Alpha Spectroscopy H-3, P-32, Fe-55, Ni-63, Sr-89/90 C-14, Tc-99, Pu-241, Pb-210 Rn-222 in water Pu, Th, Am, or Cm by Alpha Spec	Contact: Ed Moreno 580 Main Street Bolton, MA 01740-1398 phone: 508-779-6711 Fax: 508-568-3700
General Engineering Labs	Charleston, SC	Analysis of Samples Including: Low level radiochemical and mixed waste preparation and analysis. Types of analysis include: Alpha spectrometry Gas Proportional Counting Liquid Scintillation Counting Lucas Cell Analysis Laser Kinetic Phosphorescence Gamma Spectrometry Inorganic analysis including digestion, extraction and general preparation of inorganic samples. RCRA sample characterization, TCLP extraction, metals analysis by Atomic Absorption, mercury analyzer, and ICP/MS. Ion Chromatography and wet chemistry services.	Nancy A. Slater 2040 Savage Road Charleston, SC 29407 phone: 803-556-8171 fax: 803-766-1178

Table 2 Laboratory Analytical Services Companies which may be used on Decontamination and Decommissioning Projects			
Name	Location	Services	Contact
Mountain States Analytical	Salt Lake City Utah - agreement State of	Analysis of Samples including: Gross Alpha Counting Non-volatile Beta counting Total Radium (Gas Flow Prop) Radium Emanation - Gamma Spec Ra-228 gas flow prop/gamma spec Radon-222 liquid scintillation C-14, H-3, Tc-99 liquid scintillation Alpha Spectroscopy Total Uranium TCLP, CCW, CCWE, RCRA, BTEX, GC/MS, D-list, GC Fingerprint, TPH by API/EPA Protocol, PAN	Charles Seehafer Mountain States Analytical 1645 West 2200 South Salt Lake City, UT 84119 Phone: 800-973-8724 fax: 801-972-6278

C. TRANSPORTATION DOCUMENTATION

AEI does not own or lease transportation vehicles for movement of radioactive or hazardous materials. AEI relies solely on experienced subcontractors for radioactive and hazardous material transportation support. The subcontractors are evaluated in accordance with AEI's Quality Control Plan.

AEI relies primarily on Tri-State Motor Transport (TSMT) for transportation of radioactive and hazardous materials. TSMT has been in the business of transporting hazardous materials for many years and has a demonstrated excellent safety record.

The audited transportation support used is appropriate for Transportation/Brokering and Processing/Disposal of radioactive or hazardous materials.

WASTE MANAGEMENT

D. WASTE PROCESSING EQUIPMENT DOCUMENTATION

At the current time, AEI does not possess waste processing equipment for radioactive waste. Our own processing is limited to segregation and repackaging of the waste at a customer's facility or transfer to a subcontractor facility for further processing such as decontamination, drum crushing, cutting of metals, metal melting, or incineration of combustible materials. AEI contracts with such companies as Allied Technology Group, Scientific Ecology Group, or Envirocare, etc. as needed for processing services.

ALARA Program

Aguirre Engineers, Inc.

February 1, 1998

1. Management Commitment

   a. We, the management of Aguirre Engineers, Inc. (AEI), are committed to the program described herein for keeping individual and collective doses as low as reasonably achievable (ALARA). In accord with this commitment, we hereby describe an administrative organization for radiation safety and will develop the necessary written policy, procedures, and instructions to foster the ALARA concept within our organization. The organization will include a Radiation Safety Committee (RSC) and a Radiation Safety Officer (RSO).

   b. We will perform a formal annual review of the radiation safety program, including ALARA considerations. This will include reviews of operating procedures and past dose records, inspections, etc., and consultations with the radiation safety staff or outside consultants.

   c. Modifications to operating and maintenance procedures and to equipment will be made if they will reduce exposures unless the cost, in our judgement, is considered to be unjustified. We will be able to demonstrate, if necessary, that improvements have been sought, that modifications have been considered, and that they have been implemented when reasonable. If modifications have been recommended but not implemented, we will be prepared to describe the reasons for not implementing them.

   d. In addition to maintaining doses to individuals as far below the limits as is reasonably achievable, the sum of the doses received by all exposed individuals will also be maintained at the lowest practicable level. It would not be desirable, for example, to hold the highest doses to individuals to some fraction of the applicable limit if this involved exposing additional people and significantly increasing the sum of radiation doses received by all involved individuals.

2. Radiation Safety Committee

   a. Review of Operations

      (1) The RSC will thoroughly review operations with respect to types and quantities of materials and methods of use to ensure that appropriate measures have been taken to maintain exposure ALARA.

      (2) The RSC will ensure through their procedures that operations will maintain individual and collective doses ALARA.

b. Delegation of Authority

(1) The RSC will delegate authority to the RSO for enforcement of the ALARA concept.

(2) The RSC will support the RSO when it is necessary for the RSO to assert authority. If the RSC has overruled the RSO, it will record the basis for its action in the minutes of the quarterly meeting.

c. Review of ALARA Program

(1) The RSC will encourage the review of current procedures and the development of new procedures, as appropriate, to implement the ALARA concept.

(2) The RSC will perform a quarterly review of occupational radiation exposure with particular attention to instances in which the investigational levels in Table 1 are exceeded. The principal purpose of this review is to assess trends in occupational exposure as an index of the ALARA program quality and to decide if action is warranted when investigational levels are exceeded.

Table 1

Investigational Levels

	Investigational Levels (mrems per calendar quarter)	
	Level I	Level II
1. Whole body; head and trunk; active blood-forming organs; lens of eyes; or gonads	125	375
2. Hands and forearms; feet and ankles	1875	5625
3. Skin of whole body	750	2250

(3) The RSC will evaluate AEIs overall efforts for maintaining doses ALARA on an annual basis. This review will include the efforts of the RSO, operations, and workers as well as those of management.

3. Radiation Safety Officer

a. Annual and Quarterly Review

(1) Annual review of the radiation safety program. The RSO will perform an annual review of the radiation safety program for adherence to ALARA concepts. Reviews of specific methods of operation may be conducted on a more frequent basis.

(2) Quarterly review of occupational exposures. The RSO will review at least quarterly the external radiation doses of all badged individuals to determine that their doses are ALARA in accordance with the provisions of this program and will prepare a summary report for the RSC.

(3) Quarterly review of records of radiation surveys. The RSO will review radiation surveys in unrestricted and restricted areas to determine that dose rates and amounts of contamination were at ALARA levels during the previous quarter and will prepare a summary report for the RSC.

b. Education Responsibilities for ALARA Program

(1) The RSO will schedule briefings and educational sessions to inform workers of ALARA program efforts.

(2) The RSO will ensure that operations, workers, and ancillary personnel who may be exposed to radiation will be instructed in the ALARA philosophy and informed that management, the RSC, and the RSO are committed to implementing the ALARA concept.

c. Cooperative Efforts for Development of ALARA Procedures

Radiation workers will be given opportunities to participate in formulating the procedures that they will be required to follow.

(1) The RSO will be in close contact with all users and workers in order to develop ALARA procedures for working with radioactive materials.

(2) The RSO will establish procedures for receiving and evaluating the suggestions of individual workers for improving health physics practices and will encourage the use of those procedures.

d. Reviewing Instances of Deviation from Good ALARA Practices

The RSO will investigate all known instances of deviation from good ALARA practices and, if possible, will determine the causes. When the cause is known, the RSO will implement changes in the program to maintain doses ALARA.

4. Authorized Operations

a. New Operations Involving Potential Radiation Doses

(1) Project Managers will consult with the RSO and/or RSC during the planning stage before using radioactive materials in any new method.

(2) Project Managers, Coordinators, and Supervisors will review each planned method of radioactive materials use to ensure that doses will be kept ALARA. Trial runs may be helpful.

b. Project Management Responsibility to Supervised Individuals

(1) Project Managers will explain application of the ALARA concept as used on a particular project, and the need to maintain exposures ALARA to all supervised individuals.

(2) Project Managers and the RSO will ensure that supervised individuals who are subject to occupational radiation exposure are trained and educated in good health physics practices and in maintaining exposures ALARA.

5. Individuals Who Receive Occupational Radiation Doses

a. Workers will be instructed in the ALARA concept and its relationship to work procedures and work conditions.

b. Workers will be instructed in the recourses available if they feel that ALARA is not being promoted on the job.

6. Establishment of Investigational Levels in Order to Monitor Individual Occupational External Radiation Doses

AEI hereby establishes investigational levels for occupational external radiation doses which, when exceeded, will initiate review or investigation by the RSC and/or the RSO. The investigational levels that we have adopted are listed in Table 1. These levels apply to the exposure of individual workers.

The RSO will review and record on Form NRC-5, "Current Occupational External Radiation Exposures," or an equivalent form (e.g., dosimeter processor's report) results of personnel monitoring not less than once in any calendar quarter as required by 20.2206 of 10 CFR Part 20. The following actions will be taken at the investigational levels as stated in Table 1:

annual report to NRC ?

a. Personnel dose less than Investigational Level I.

Except when deemed appropriate by the RSO, no further action will be taken in those cases where an individual's dose is less than Table 1 values for Investigational Level I.

b. Personnel dose equal to or greater than Investigational Level I but less than Investigational Level II.

The RSO will review the dose of each individual whose quarterly dose equals or exceeds Investigational Level I and will report the results of the reviews at the first RSC meeting following the quarter when the dose was recorded. If the dose does not equal or exceed Investigational Level II, no action related specifically to the exposure is required unless deemed appropriate by the Committee. The Committee will, however, review each such dose in comparison with those of others performing similar tasks as an index of ALARA program quality and will record the review in the Committee minutes.

c. Personnel dose equal to or greater than Investigational Level II.

The RSO will investigate in a timely manner the causes of all personnel doses equaling or exceeding Investigational Level II and, if warranted, will take action. A report of the investigation, any actions taken, and a copy of the individual's Form NRC-5 or its' equivalent will be presented to the RSC at its' first meeting following completion of the investigation. The details of these reports will be included in the RSC minutes.

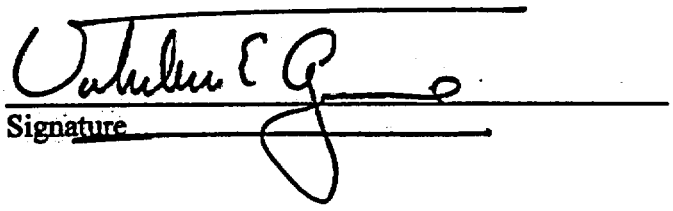
d. Reestablishment of investigational levels to levels above those listed in Table 1.

In cases where a worker's or a group of workers' doses need to exceed an investigational level, a new, higher investigational level may be established for that individual or group on the basis that it is consistent with good ALARA practices. Justification for new investigational levels will be documented.

The RSC will review the justification for and must approve or disapprove all revisions of investigational levels.

7. Signature of Certifying Official

I hereby certify that AEI has implemented the ALARA Program set forth above.



Signature

Vukoslav E. Aguirre
Name (print or type)

President, Aguirre Engineers, Inc.
Title

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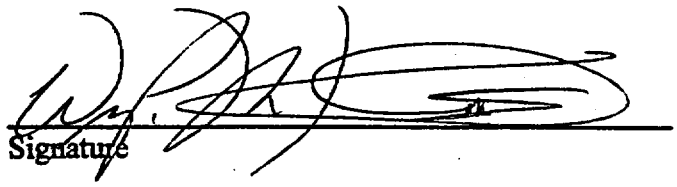

Signature

William P. McKinnell, III
Name (print or type)

Vice President, High Hazard Services, AEI
Title

APPENDIX F

RADIATION SAFETY OFFICER CERTIFICATION

We certify that the individual to be named on this license to perform the function of Radiation Safety Officer:

1. Has read and understands the NRC regulations applicable to this license and the specific conditions in the license,
2. Has sufficient technical knowledge to perform the duties of a Radiation Safety Officer,
3. Has and will continue to have sufficient time to perform the duties of the Radiation Safety Officer,
4. Has and will continue to get sufficient resources to accomplish the tasks of the Radiation Safety Officer,
5. Is completely willing to perform the functions of the Radiation Safety Officer, and
6. Has and will continue to receive the support of the management of this license in ensuring that all licensed activities will be conducted in accordance with NRC regulations and the specific terms of the license.

Radiation Safety Officer Applicant Dixie J. Wells
Date 3 February 1998

Corporate Officer/Certifying Official
Date 3 February 1998

APPENDIX H

DUTIES AND RESPONSIBILITIES OF A BROAD SCOPE SAFETY OFFICER

1. Maintain surveillance of overall activities involving radioactive material, including monitoring and surveys of all areas in which radioactive material is used.

2. Determine compliance with rules and regulations, license conditions, and the conditions of project approvals authorized by the Radiation Safety Committee.

3. Monitor and maintain absolute and other special filter systems associated with the use, storage, or disposal of radioactive material.

4. Provide necessary information on all aspects of radiation protection to personnel at all levels of responsibility, pursuant to 10 CFR 19.12, 10 CFR Part 20, and 10 CFR Part 35 (if applicable).

5. Oversee proper delivery, receipt, and conduct of radiation surveys of all shipments of radioactive material arriving at or leaving from the institution, as well as packaging and labeling all radioactive material leaving the institution.

6. Distribute and process personnel radiation monitoring equipment, determine the need for and evaluate bioassays, monitor personnel radiation exposure and bioassay records for trends and high exposures, notify individuals and their supervisors of radiation exposures approaching maximum permissible amounts, and recommend appropriate remedial action.

7. Conduct training programs and otherwise instruct personnel in the proper procedures for the use of radioactive material prior to use, at periodic intervals (refresher training), and as required by changes in procedures, equipment, regulations, etc.

8. Supervise and coordinate the radioactive waste disposal program, including effluent monitoring and recordkeeping on waste storage and disposal records.

9. Store radioactive materials not in current use, including wastes.

10. Perform or arrange for leak tests on all sealed sources and calibration of radiation survey instruments.

11. Maintain an inventory of all radioisotopes at the institution and limit the quantity of radionuclides at the institution to the amounts authorized by the license.

12. Immediately terminate any activity that is found to be a threat to public health and safety or property.

13. Supervise decontamination and recovery operations.

14. Maintain other records not specifically designated above, for example, records on receipts, transfers, and surveys as required by 10 CFR 30.51, "Records, " and Subpart L, "Records," of 10 CFR Part 20.[1]

15. Hold periodic meetings with and provide reports to licensee management and the Radiation Safety Committee.

    Note: If this request is for a medical broad scope license, the description of the RSO's duties and responsibilities must include the requirements of 10 CFR 35.22

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[1]See NUREG-1450, "Guide to NRC Reporting and Recordkeeping Requirements" (USNRC, November 1992), which provides information on compliance with the requirements specified in Title 10 of the Code of Federal Regulations. Copies are available for inspection or copying for a fee from the NRC Public Document Room at 2120 L Street NW., Washington, DC: the PDR's mailing address in Mail Stop LL-6, Washington, DC 20555; telephone (202) 634-3273; fax (202) 634-3343. Copies may be purchased at current rates from the U.S. Government Printing Office, Mail Stop SSOP, Washington, DC 20402-9328 (telephone (202) 512-2249 or (202) 512-2409); or from the National Technical Information Service by writing NTIS at 5285 Port Royal Road, Springfield, VA 22161.

MRCP-MAT-1 Page 1 of 6 pages

THE COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC HEALTH
RADIATION CONTROL PROGRAM
MATERIALS LICENSE

Pursuant to Massachusetts General Laws Chapter 111, Sections 3, 5M, 5N, 5O and 5P and Massachusetts Regulations for the Control of Radiation, Section 120.100, Licensing of Radioactive Material, and in reliance on statements and representation heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer radioactive materials designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations 105 CMR 120.000. This license shall be deemed to contain the conditions specified in 105 CMR 120.000 and is subjected to all applicable rules, regulations of the Department of Public Health, Commonwealth of Massachusetts, now or hereafter in effect and to any conditions specified below.

Licensee	
1. Duke Engineering and Services	3. License Number: 14-5971 is amended in its entirety in accordance with letter dated November 21, 1997, as follows: Amendment No: 01
2. 580 Main Street Bolton, MA 01740-1398	4. Expiration Date: September 30, 2004
	5. Docket No: 99-0463

6. Radioactive Material	7. Chemical /Physical Form	8. Maximum Possession Limit
A. Any radioactive material with atomic number 1 through 83	A. Any	A. Not to exceed 100 millicuries per radionuclide and 1 curie total
B. Any radioactive material with atomic number 84 through 98	B. Any	B. Not to exceed 1 millicurie per radionuclide and 10 millicuries total
C. Chlorine 36	C. Any	C. 20 millicuries
D. Strontium 90	D. Any	D. 30 millicuries
E. Technetium 99	E. Any	E. 20 millicuries
F. Xenon 133	F. Any	F. 50 millicuries
G. Promethium 147	G. Any	G. 20 millicuries
H. Thallium 204	H. Any	H. 20 millicuries

COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH RADIATION CONTROL PROGRAM MATERIALS LICENSE SUPPLEMENTARY SHEET	LICENSE NUMBER: 14-5971 DOCKET NUMBER: 99-0463 AMENDMENT NUMBER: 01

I. Cobalt 60	I. Sealed sources	I. 500 millicuries
J. Cesium 137	J. Sealed sources	J. 500 millicuries
K. Cesium 137	K. Sealed source (3M Company Model 4F6H)	K. 1500 millicuries
L. Cesium 137	L. Sealed source (Amersham Model CDC 3822)	L. 2000 millicuries
M. Cesium 137	M. Sealed source (ORNL)	M. 50 curies
N. Americium 241	N. Sealed sources (Amersham Model AMC.16)	N. 250 millicuries

9. Authorized use

A. through H. For laboratory measurements, tracer studies, preparation and distribution of calibration standards, and instrument and dosimetry device calibrations.

I. through K. and N. Calibration and testing of instruments and dosimetry devices.

L. Calibration and testing of dosimetry devices.
M. For use in a Technical Operations Model 682 calibrator.

COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH RADIATION CONTROL PROGRAM MATERIALS LICENSE SUPPLEMENTARY SHEET	LICENSE NUMBER: 14-5971 DOCKET NUMBER: 99-0463 AMENDMENT NUMBER: 01

CONDITIONS

10. A. Licensed materials listed in 6.A. through 6.H. may be used only at the licensee's facilities located at 25 Research Drive, Westborough, Massachusetts and at temporary jobsites of the licensee anywhere in the Commonwealth of Massachusetts.

    B. Licensed material listed in 6.I. through 6.N. may be used at the licensee's facilities located at 25 Research Drive, Westborough, Massachusetts.

11. This license is subject to an annual fee as determined by the executive office for Administration and Finance.

12. The Radiation Safety Officer for the activities authorized by this license is James E. Rohrbacher.

13. Licensed material listed in Item 6 above is only authorized for use by, or under the supervision of, individuals designated in writing by the Radiation Safety Committee, Edward F. Maher, Chairperson.

14. Licensed material shall not be used in or on human beings.

15. A. Sealed sources and detector cells containing licensed material shall be tested for leakage and/or contamination at intervals not to exceed six months or at such other intervals as are specified by the certificate of registration referred to in 105 CMR 120.128 (N) or equivalent regulations of the U.S. Nuclear Regulatory Commission or any Agreement State, not to exceed three years.

    B. Notwithstanding Paragraph A of this Condition, sealed sources designed to emit alpha particles shall be tested for leakage and/or contamination at intervals not to exceed three months.

    C. In the absence of a certificate from a transferor indicating that a leak test has been made within six months

COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH RADIATION CONTROL PROGRAM	LICENSE NUMBER: 14-5971
MATERIALS LICENSE SUPPLEMENTARY SHEET	DOCKET NUMBER: 99-0463
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prior to the transfer, a sealed source or detector cell received from another person shall not be put into use until tested.

D. Each sealed source fabricated by the licensee shall be inspected and tested for construction defects, leakage, and contamination prior to any use or transfer as a sealed source.

E. Sealed sources and detector cells need not be leak tested if:

(i) they contain only hydrogen-3; or

(ii) they contain only a radioactive gas; or

(iii) the half-life of the isotope is 30 days or less; or

(iv) they contain not more than 100 microcuries of beta and/or gamma emitting material or not more than 10 microcuries of alpha emitting material; or

(v) they are not designed to emit alpha particles, are in storage, and are not being used. However, when they are removed from storage for use or transfer to another person, and have not been tested within the required leak test interval, they shall be tested before use or transfer. No sealed source or detector cell shall be stored for a period of more than 10 years without being tested for leakage and/or contamination.

F. The test shall be capable of detecting the presence of 185 Bq (0.005 μCi) of radioactive material on the test sample. If the test reveals the presence of 185 Bq (0.005 μCi) or more of removable contamination, the source shall be removed from service and decontaminated, repaired or disposed of. A report of this shall be filed with the Director of the Radiation Control Program within five (5) days of the date the leak test result is known. The report shall specify the source or detector cell involved, the

COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH RADIATION CONTROL PROGRAM	LICENSE NUMBER: 14-5971
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	AMENDMENT NUMBER: 01

test results, and corrective action taken. Records of leak test results shall be kept in units of becquerel or microcurie and shall be maintained for inspection by the Agency.

G. The licensee is authorized to collect leak test samples for analysis by the licensee. Alternatively, tests for leakage and/or contamination may be performed by persons specifically licensed by the Commission or an Agreement State to perform such services.

16. Sealed sources or detector cells containing licensed material shall not be opened or sources removed from source holders by the licensee.

17. The licensee shall not acquire licensed material in a sealed source or device unless the source or device has been registered with the U.S. Nuclear Regulatory Commission pursuant to 10 CFR 32.210 or equivalent regulations of an Agreement State.

18. The licensee shall conduct a physical inventory every six months to account for all sealed sources and devices containing licensed material received and possessed under the license.

19. The licensee shall not use licensed material in field applications where activity is released except as provided otherwise by specific condition of this license.

20. The licensee shall only transport radioactive material or deliver radioactive material to a carrier for transport in accordance with the provisions of 49 CFR Parts 170 through 189, 10 CFR Part 71, and 105 CMR 120.770 "Transportation of Radioactive Material."

21. Except as specifically provided otherwise by this license, the licensee shall conduct its program in accordance with statements, representations and procedures contained in the documents, including any enclosures, listed below. The Massachusetts Regulations for the Control of Radiation (105

COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH RADIATION CONTROL PROGRAM	LICENSE NUMBER: 14-5971
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	AMENDMENT NUMBER: 01

CMR 120.000) shall govern, unless statements, representations and procedures in the licensee's application and correspondence are more restrictive than the regulations.

A. U.S. Nuclear Regulatory Commission License No. 20-14597-01 transferred to Massachusetts on March 21, 1997
B. Letter dated November 21, 1997

FOR THE COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC HEALTH
RADIATION CONTROL PROGRAM

Date 11-26-97

By Robert M. Hallisey
Robert M. Hallisey, Director

of eight radiological control technicians. He received his M. S. degree in physics and has passed Part 1 of the Health Physics Certification Examination.

Mr. William Walland is a senior health physics technician currently working on a site undergoing decontamination and decommissioning. He has worked for one year at ERG. His prior experience includes approximately three years working in nuclear power plants as a radiation control technician and two years doing asbestos abatement. He has an associates degree in health physics and is an ANSI certified technician.

ERG has standard operating procedures for implementing its respiratory protection program and dosimetry programs. All field personnel are medically certified to wear respirators. All personnel are current in HAZWOPPER training.

Detailed resumes for these key employees are provided in the Attachments.

II. Equipment/Facilities

ERG owns a large inventory of equipment for use in its projects as well as to lease to other environmental companies. Table 1 (in Attachments) shows the model number, dates purchased, and quantity of equipment currently owned. Standard Operating Procedures are available for the maintenance and calibration of all equipment. Calibration frequencies are at a minimum of once in six months. Equipment is inspected and function checked daily while on projects. No preventative maintenance is required for this electronic equipment other than cleaning. All equipment is less than six years old with the majority being less than three years old.

ERG also owns two high accuracy Global Positioning units, manufactured by Trimble Navigation, and a base receiver unit for site characterization work. These units have been employed on three large uranium processing sites where several thousand acres have been cleaned to meet the unrestricted use criteria. As many as 13,000 data records have been made per day while conducting radiation surveys. Large colored maps are prepared within a few hours where the data are presented with isocontours, etc. ERG also employees the services of Anderson Engineering Company for assistance in data processing. A company brochure describing the capabilities of these units has been attached.

Electronic calibrations of ratemeters/scalers are done by ERG personnel using a pulser calibrated to a NIST traceable standard. Voltage plateaus and efficiency determinations are done by ERG personnel using NIST traceable radioactive sources. Dose rate instruments such as ion chambers and microR meters are sent to the manufacturer for calibration. Copies of typical radiation source certifications are attached.

ERG routinely establishes field laboratories for gross alpha, gross beta, and gamma-ray spectral analyses. ERG owns two NaI gamma-ray spectrometers. *In situ* measurements have been made on one project using an High Purity Ge detector, borrowed from the manufacturer.

ERG has no fixed laboratories.

Table 1. Radiological Instruments Owned by Environmental Restoration Group, Inc.

MFG / MODEL	INSTRUMENT	MEASURES	PURCHASED	QUANTITY
		RATE METERS/SCALERS/ION CHAMBERS/TRAYCOUNTERS		
Ludlum 3	Rate Meter	Used with probes to measure rates	1995	3
Ludlum 12	Rate Meter	Used with probes to measure rates	1992–1995	7
Ludlum 2221	Rate Meter / Scaler	Used with probes or 43–10 to measure rates/counts	1992–1995	37
Ludlum 2221 with ear phones	Rate Meter / Scaler	Used with probes or 43–10 to measure rates/counts	1992–1995	4
Ludlum 2241–2	Rate Meter/Scaler	Used when two probes are desired	1998	1
Ludlum 1000	Scaler (120 V AC powered)	Used with probes or 43–10 for counting	1992–1995	4
Ludlum 2000	Scaler (D cells or 120 V AC powered)	Used with probes or 43–10 for counting	1995	1
Ludlum 19	Micro-R-Meter	Gamma-ray exposure rates (Calibrated to Cs-137)	1992–1995	9
Ludlum Model 3 / 44–2	Micro-R-Meter	Gamma-ray exposure rates (Calibrated to Cs-137)	1995	2
Ludlum 2350	Data Logger with Key Pad	Used as portable rate meter/scaler with data storage	1995	1
Ludlum 2929 With 43–10–1 detector	Dual Scaler/Phoswich Detector	For counting alpha and beta/gamma	1995–1996	2
Ludlum 9	Ion Chamber	Exposure rate measurements (0–5 mR/h)	1996	1
		RADIATION MEASUREMENT PROBES (USED WITH SCALERS OR RATE METERS)		
Ludlum 44–1	Beta Scintillator	For measurement of beta particles	1995	2
Ludlum 44–10	NaI 2 x 2 inch Probe	High sensitivity gamma surveys–may use with polyshield as collimator	1992–1995	15
Ludlum 44–116	Beta Scintillator	For measurement of beta particles (100 sq. cm.)	1995	2
Ludlum 43–5	Alpha Probe	Zinc sulfide (76 sq cm) used for surface contamination monitoring	1992–1995	16
Ludlum 43–[illegible]	Alpha Probe	Zinc sulfide (63 sq cm) used for surface contamination monitoring	1995	1

Table 1 Radiological Instruments Owned by Environmental Restoration Group, Inc.

MFG / MODEL	INSTRUMENT	MEASURES	PURCHASED	QUANTITY
Ludlum 43-44-*	Air Proportional Detector	For measurement of alpha (100 sq. cm)	1995	2
Ludlum 43-10	Alpha Tray Counter	Zinc sulfide counter for wipe and air samples	1992-1995	4
Ludlum 43-68	Gas Proportional Detector	126 sq cm portable alpha/beta detector	1995	2
Ludlum 44-9	G-M Pancake Probe	Thin window detector used for alpha, beta, gamma monitoring	1992-1995	17
Ludlum 44-40	Shielded G-M Pancake Probe	Same as above but shielded for use in high gamma shine areas	1992-1995	2
Eberline HP210L	Shielded G-M Pancake Probe	Same as above but shielded for use in high gamma shine areas	1992	4
Teledyne FIDLER	Large Thin NaI Detector	For measurement of low-energy photons	1994	1
Ludlum 239-1F Floor Monitor	425 Sq cm Gas Proportional Counter with Cart & Ludlum 2221	For measurement of surface alpha and/or beta contamination	1994-1995	2
	OTHER EQUIPMENT/SUPPLIES			
Eberline FAS-1	Intermediate Volume Air Sampler	Air quality measurements (sampling rate up to 60 liters per minute)	1992	8
MSA Flow-Lite Air Sampler	Lapel Air Sampler with Battery Charger and Filter Holders	Sample airborne contaminants up to 3 liters/minute	1992	8
Canberra MCA	Gamma-Ray Multichannel Analyzer	3-in by 3-in NaI detector 386 computer with Canberra Accuspec Software	1992	1
EG&G Ortec MCA	MicroNOMAD Field Protable MCA with Laptop 486 Computer	3-in by 3-in NaI Detector/Battery Powered	1995	1
Polyshield	Lead Collimator(0.5 inch thick)	Used with Ludlum 44-10 for gamma surveys	1992	2

1. All instruments are calibrated on 6-month intervals by ERG using NIST traceable electronic pulser or source.
2. Ludlum Model 5, Ludlum Model 3 44-2, and Ludlum Model 19 are calibrated by manufacturer.

TMA
Thermo Analytical Inc.

TMA/Eberline Albuquerque Laboratory
7021 Pan American Hwy NE
Albuquerque, NM 87109
(505) 345-3461 • FAX # (505) 761-5416

CERTIFICATE OF CALIBRATION

Electroplated Beta Standard

S.O.# S-02871
P.O.# 94-00186

Description of Standard:

Model No. DNS-14 Serial No. 1873-94 Isotope Strontium Yttrium 90

Electroplated on polished nickel disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2 pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source S/N 2148/90.

Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was

17300 ± 520

The total disintegration rate (dpm) assuming 40 % backscatter of beta particles from the surface of the disc, was

24,800 ± 743 (0.0112 µCi)

The uncertainty of the measurement is 3 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Charles Lamborn
Calibration technician: Charles Lamborn
Calibration date: 6-24-94

Reviewed by: Arlen A Sitting
Q.A. Representative: Kathy Burnham
Reviewed date: 6-24-94

TMA
Thermo Analytical

TMA/Eberline Albuquerque Laboratory
7021 Pan American Hwy. NE
Albuquerque NM 87109
(505) 345-3461 • FAX # (505) 761-5416

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-03022
P.O.# ERG 95-006

Description of Standard:

Model No. DNS-26 sp Serial No. 2071-95 Isotope 238 Uranium depleted

Electroplated on polished stainless steel disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was

226 ± 7

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc. was

452 ± 14 (0.000204 μCi)

The uncertainty of the measurement is 3 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Charles Lamborn

Calibration technician: Charles Lamborn

Calibration date: 6-28-95

Reviewed by:

Q.A. Representative: Kathy Burnham

Reviewed date: 6-28-95

Thermo NUtech

7021 Pan Americ... ...
Albuquerque, NM ...
(505) 345-3461 • FAX (505) ...

CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# S-03096
P.O.# 96-0074

Description of Standard:

Model No. DAS-11 Serial No. 2127-96 Isotope Thorium-230

Electroplated on polished Stainless Steel disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The 2 pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N 2393/91.

Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was

9,530 ± 381

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc. was

19,100 ± 762 (0.00858 μCi)

The uncertainty of the measurement is 4 % which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: Charles Lamborn

Calibration technician: Charles Lamborn

Calibration date: 5/17/96

Reviewed by: Robert Autry

Q.A. Representative: Kathy Burnham

Reviewed date: 6-5-96

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PENNSYLVANIA 19406-1415

FEB 27 1997

Stephen P. Schultz
Vice President, Engineering Services
Yankee Atomic Electric Company
580 Main Street
Bolton, MA 01740-1398

Dear Mr. Schultz:

This refers to your license amendment request. Enclosed with this letter is the amended license. Please note that, in accordance with information provided during a telephone conversation by your Radiation Safety Officer, Mr. James Rohrbacher, the authorized use for the americium-241 sources is limited to calibration and testing of instruments and dosimetry devices.

Please review the enclosed document carefully and be sure that you understand and fully implement all the conditions incorporated into the amended license. If there are any errors or questions, please notify the U.S. Nuclear Regulatory Commission, Region I Office, Licensing Assistance Team, (610) 337-5093 or 5239, so that we can provide appropriate corrections and answers.

Thank you for your cooperation.

Sincerely,

Penny Lanzisera

Penny Lanzisera
Division of Nuclear Materials Safety

License No. 20-14597-01
Docket No. 030-11075
Control No. 124170

Enclosure:
Amendment No. 16

NRC FORM 374 (7-94) U.S. NUCLEAR REGULATORY COMMISSION PAGE 1 OF 4 PAGES

MATERIALS LICENSE

Amendment No. 16

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee	In accordance with the letter dated January 21, 1997,
1. Yankee Atomic Electric Company	3. License Number 20-14597-01 is amended in its entirety to read as follows:
2. 580 Main Street Bolton, Massachusetts 01740-1398	4. Expiration Date September 30, 2004
	5. Docket or Reference No. 030-11075

6. Byproduct, Source, and/or Special Nuclear Material	7. Chemical and/or Physical Form	8. Maximum Amount that Licensee May Possess at Any One Time Under This License
A. Any byproduct, source or special nuclear material with atomic number 1 through 83	A. Any	A. Not to exceed 100 millicuries per radionuclide and 1 curie total
B. Any byproduct, source or special nuclear material with atomic number 84 through 98	B. Any	B. Not to exceed 1 millicurie per radionuclide and 10 millicuries total
C. Chlorine 36	C. Any	C. 20 millicuries
D. Strontium 90	D. Any	D. 30 millicuries
E. Technetium 99	E. Any	E. 20 millicuries
F. Xenon 133	F. Any	F. 50 millicuries
G. Promethium 147	G. Any	G. 20 millicuries
H. Thallium 204	H. Any	H. 20 millicuries
I. Cobalt 60	I. Sealed sources	I. 500 millicuries
J. Cesium 137	J. Sealed sources	J. 500 millicuries
K. Cesium 137	K. Sealed source (3M Company Model 4F6H)	K. 1500 millicuries
L. Cesium 137	L. Sealed source (Amersham Model CDC 3822)	L. 2000 millicuries
M. Cesium 137	M. Sealed source (ORNL)	M. 50 curies
N. Americium 241	N. Sealed sources (Amersham Model AMC.16)	N. 250 millicuries

9. Authorized use

A. through H. For laboratory measurements, tracer studies, preparation and distribution of calibration standards, and instrument and dosimetry device calibrations.
I. through K. and N. Calibration and testing of instruments and dosimetry devices.
L. Calibration and testing of dosimetry devices.
M. For use in a Technical Operations Model 682 calibrator.

NRC FORM 374A (7-84) U.S. NUCLEAR REGULATORY COMMISSION

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License Number: 20-14597-01

Docket or Reference Number: 030-11075

Amendment No. 16

CONDITIONS

10. A. Licensed material listed in 6.A. through 6.H. may be used only at the licensee's facilities located at 25 Research Drive, Westborough, Massachusetts and at temporary jobsites of the licensee anywhere in the United States where the U.S. Nuclear Regulatory Commission maintains jurisdiction for regulating the use of licensed material.

B. Licensed material listed in 6.I. through 6.N. may be used only at the licensee's facilities located at 25 Research Drive, Westborough, Massachusetts.

11. A. Licensed material shall be used by, or under the supervision of, individuals designated in writing by the Radiation Safety Committee, Mark A. Kralian, Chairperson.

B. The Radiation Safety Officer for this license is James E. Rohrbacher.

12. Licensed material shall not be used in or on human beings.

13. A. Sealed sources and detector cells containing licensed material shall be tested for leakage and/or contamination at intervals not to exceed six months or at such other intervals as are specified by the Certificate of registration referred to in 10 CFR 32.210, not to exceed three years.

B. Notwithstanding Paragraph A of this Condition, sealed sources designed to emit alpha particles shall be tested for leakage and/or contamination at intervals not to exceed three months.

C. In the absence of a certificate from a transferor indicating that a leak test has been made within six months prior to the transfer, a sealed source or detector cell received from another person shall not be put into use until tested.

D. Each sealed source fabricated by the licensee shall be inspected and tested for construction defects, leakage, and contamination prior to any use or transfer as a sealed source.

E. Sealed sources and detector cells need not be leak tested if:

(i) they contain only hydrogen-3; or

(ii) they contain only a radioactive gas; or

(iii) the half-life of the isotope is 30 days or less; or

(iv) they contain not more than 100 microcuries of beta and/or gamma emitting material or not more than 10 microcuries of alpha emitting material; or

(v) they are not designed to emit alpha particles, are in storage, and are not being used. However, when they are removed from storage for use or transfer to another person, and have not been tested within the required leak test interval, they shall be tested before use or transfer. No sealed source or detector cell shall be stored for a period of more than 10 years without being tested for leakage and/or contamination.

F. The test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. If the test reveals the presence of 0.005 microcurie or more of removable contamination, a report shall be filed with the U.S. Nuclear Regulatory Commission and the source or detector cell shall be removed immediately from service and decontaminated, repaired, or disposed of in accordance with Commission regulations. The report shall be filed within five days of the date the leak test result is known with the U.S. Nuclear Regulatory Commission, Region I, ATTN: Chief, Nuclear Materials Safety Branch, 475 Allendale Road, King of Prussia, Pennsylvania 19406. The report shall specify the source or detector cell involved, the test results, and corrective action taken.

G. The licensee is authorized to collect leak test samples for analysis by the licensee. Alternatively, tests for leakage and/or contamination may be performed by persons specifically licensed by the Commission or an Agreement State to perform such services.

14. Sealed sources or detector cells containing licensed material shall not be opened or sources removed from source holders by the licensee.

15. The licensee shall not acquire licensed material in a sealed source or device unless the source or device has been registered with the U.S. Nuclear Regulatory Commission pursuant to 10 CFR 32.210 or equivalent regulations of an Agreement State.

16. The licensee shall conduct a physical inventory every six months to account for all sealed sources and devices containing licensed material received and possessed under the license.

17. The licensee shall not use licensed material in field applications where activity is released except as provided otherwise by specific condition of this license.

18. The licensee is authorized to transport licensed material in accordance with the provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

NRC FORM 374A (7-94) U.S. NUCLEAR REGULATORY COMMISSION

MATERIALS LICENSE
SUPPLEMENTARY SHEET

PAGE 4 OF 4 PAGES

License Number
20-14597-01

Docket or Reference Number
030-11075

Amendment No. 16

19. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The Nuclear Regulatory Commission's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.

A. Letter dated October 15, 1985
B. Letter dated January 30, 1986
C. Letter dated September 15, 1994
D. Letter dated October 20, 1995
E. Letter dated March 21, 1996
F. Letter dated July 3, 1996

Date FEB 27 1997

For the U.S. Nuclear Regulatory Commission

By _____
Division of Nuclear Materials Safety
Region I
King of Prussia, Pennsylvania 19406

NRC FORM 374 (7-94)

U.S. NUCLEAR REGULATORY COMMISS...

MATERIALS LICENSE

Amendment No. 42

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974 (Public Law 93-438), and Title 10, Code of Federal Regulations, Chapter I, Parts 30, 31, 32, 33, 34, 35, 36, 39, 40, and 70, and in reliance on statements and representations heretofore made by the licensee, a license is hereby issued authorizing the licensee to receive, acquire, possess, and transfer byproduct, source, and special nuclear material designated below; to use such material for the purpose(s) and at the place(s) designated below; to deliver or transfer such material to persons authorized to receive it in accordance with the regulations of the applicable Part(s). This license shall be deemed to contain the conditions specified in Section 183 of the Atomic Energy Act of 1954, as amended, and is subject to all applicable rules, regulations, and orders of the Nuclear Regulatory Commission now or hereafter in effect and to any conditions specified below.

Licensee	In accordance with the application dated May 31, 1995,
1. Teledyne Environmental, Inc. dba Teledyne Brown Engineering- Environmental Services 2. 50 Van Buren Avenue Westwood, New Jersey 07675	3. License Number 29-00055-06 is amended in its entirety to read as follows:
	4. Expiration Date September 30, 2002
	5. Docket or Reference No. 030-05219

6. Byproduct, Source, and/or Special Nuclear Material	7. Chemical and/or Physical Form	8. Maximum Amount that Licensee May Possess at Any One Time Under This License
A. Any byproduct material with atomic number 1 through 84, inclusive	A. Any	A. Not to exceed 200 millicuries per radionuclide and 10 curie total, except as listed below
B. Any non-alpha emitting byproduct material with Atomic Numbers between 1 and 84, inclusive, with a half-life of 15 days or less	B. Any	B. Not to exceed 500 millicuries per radionuclide and 25 curies total, except as listed below
C. Any byproduct or source material with atomic number 85 through 103, inclusive	C. Any	C. Not to exceed 10 millicuries total, except as listed below
D. Hydrogen-3	D. Any	D. 5 curies
E. Hydrogen-3	E. Foil in detector cells	E. 2 curies
F. Argon-41	F. Any	F. 2 curies
G. Scandium-46	G. Any	G. 500 curies
H. Iron-55	H. Sealed sources	H. Not to exceed 1 millicurie and 10 millicuries total
I. Cobalt-60	I. Sealed sources	I. Not to exceed 1 curie per source and 2 curies total
J. Nickel-63	J. Foil in detector cells	J. Not to exceed 10 millicuries per source and 200 millicuries total
K. Krypton-85	K. Any	K. 6 curies
L. Strontium-90	L. Sealed sources	L. Not to exceed 50 millicuries per source and 500 millicuries total

NRC Form 374A (9-84) U.S. NUCLEAR REGULATORY COMMISSION

License number 29-00055-06

Docket or Reference number 030-05219

Amendment No. 42

MATERIALS LICENSE
SUPPLEMENTARY SHEET

M. Technitium-99	M. Sealed sources	M. Not to exceed 1 millicurie per source and 10 millicuries total
N. Cesium-137	N. Sealed sources	N. Not to exceed 10 curies per source and 15 curies total
O. Iridium-192	O. Sealed source	O. 20 curies
P. Americium-241	P. Am-Be source	P. 500 millicuries
Q. Americium-241	Q. Sealed sources	Q. Not to exceed 1 curie per source and 1.2 curies total
R. Americium 241	R. Sealed sources	R. Not to exceed 10 microcuries per source and 100 microcuries total

9. Authorized use

A. through R. Research and development as defined in 10 CFR 30.4; sample analysis, calibration of instruments and dosimeters for clients, and as reference samples in tracer studies.

CONDITIONS

10. Licensed material may be used only at the licensee's facilities located at 50 Van Buren Avenue and 69 Woodland Avenue, Westwood, New Jersey, and at temporary job sites of the licensee anywhere in the United States where the U.S. Nuclear Regulatory Commission maintains jurisdiction for regulating the use of licensed material.

11. A. Licensed material shall be used by, or under the supervision of, individuals designated in writing by the Radiation Safety Committee, Donald F. Schutz, Ph.D., Chairperson.

B. The Radiation Safety Officer for this license is Steven A. Black.

12. In addition to the possession limits in Item 8, the licensee shall further restrict the possession of licensed material at a single location to quantities below the limits specified in 10 CFR 30.72 which require consideration of the need for an emergency plan for responding to a release of licensed material.

13. Licensed material shall not be used in or on human beings.

14. A. Sealed sources and detector cells containing licensed material shall be tested for leakage and/or contamination at intervals not to exceed six months or at such other intervals as are specified by the certificate of registration referred to in 10 CFR 32.210, not to exceed three years.

B. Notwithstanding Paragraph A of this Condition, sealed sources designed to emit alpha particles shall be tested for leakage and/or contamination at intervals not to exceed three months.

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License number 29-00055-06

Docket or Reference number 030-05219

Amendment No. 42

C. In the absence of a certificate from a transferor indicating that a leak test has been made within six months prior to the transfer, a sealed source or detector cell received from another person shall not be put into use until tested.

D. Each sealed source fabricated by the licensee shall be inspected and tested for construction defects, leakage, and contamination prior to any use or transfer as a sealed source.

E. Sealed sources and detector cells need not be leak tested if:

(i) they contain only hydrogen-3; or

(ii) they contain only a radioactive gas; or

(iii) the half-life of the isotope is 30 days or less; or

(iv) they contain not more than 100 microcuries of beta and/or gamma emitting material or not more than 10 microcuries of alpha emitting material; or

(v) they are not designed to emit alpha particles, are in storage, and are not being used. However, when they are removed from storage for use or transfer to another person, and have not been tested within the required leak test interval, they shall be tested before use or transfer. No sealed source or detector cell shall be stored for a period of more than 10 years without being tested for leakage and/or contamination.

F. The test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. If the test reveals the presence of 0.005 microcurie or more of removable contamination, a report shall be filed with the U.S. Nuclear Regulatory Commission and the source or detector cell shall be removed immediately from service and decontaminated, repaired, or disposed of in accordance with Commission regulations. The report shall be filed within five days of the date the leak test result is known with the U.S. Nuclear Regulatory Commission, Region I, ATTN: Chief, Nuclear Materials Safety Branch, 475 Allendale Road, King of Prussia, Pennsylvania 19406. The report shall specify the source or detector cell involved, the test results, and corrective action taken.

G. The licensee is authorized to collect leak test samples for analysis by the licensee. Alternatively, tests for leakage and/or contamination may be performed by persons specifically licensed by the Commission or an Agreement State to perform such services.

15. Sealed sources or detector cells containing licensed material shall not be opened or sources removed from source holders by the licensee.

16. The licensee shall not acquire licensed material in a sealed source or device unless the source or device has been registered with the U.S. Nuclear Regulatory Commission pursuant to 10 CFR 32.210 or equivalent regulations of an Agreement State.

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License number 29-00055-06

Docket or Reference number 030-05219

Amendment No. 42

17. The licensee shall conduct a physical inventory every six months to account for all sealed sources and devices containing licensed material received and possessed under the license.

18. A. Detector cells containing a titanium tritide foil or a scandium tritide foil shall only be used in conjunction with a properly operating temperature control mechanism which prevents the foil temperatures from exceeding that specified in the certificate of registration referred to in 10 CFR 32.210.

B. When in use, detector cells containing a titanium tritide foil or a scandium tritide foil shall be vented to the outside.

19. The licensee shall not use licensed material in field applications where activity is released except as provided otherwise by specific condition of this license.

20. Pursuant to Section 32.11 of 10 CFR Part 32, and in accordance with letters dated October 24, 1985 and November 6, 1986 the licensee is authorized to introduce byproduct material as contaminates in tracer studies and to transfer ownership and possession of the product or material containing byproduct material to persons exempt from the requirements for a license as provided in Section 30.14 of 10 CFR Part 30. The concentrations of byproduct material at the time of transfer shall not exceed the concentrations in Section 30.70 of 10 CFR Part 30 nor shall the product be incorporated in any food, beverage, cosmetic, or other commodity or product designed for ingestion or inhalation by, or application to, a human being. The licensee shall report such transfers in accordance with Section 32.12, 10 CFR Part 32.

21. The licensee is authorized to hold radioactive material with a physical half-life of less than or equal to 120 days for decay-in-storage before disposal in ordinary trash, provided:

A. Waste to be disposed of in this manner shall be held for decay a minimum of ten half-lives.

B. Before disposal as ordinary trash, the waste shall be surveyed at the container surface with the appropriate survey instrument set on its most sensitive scale and with no interposed shielding to determine that its radioactivity cannot be distinguished from background. All radiation labels shall be removed or obliterated.

C. A record of each such disposal permitted under this License Condition shall be retained for three years. The record must include the date of disposal, the date on which the byproduct material was placed in storage, the radionuclides disposed, the survey instrument used, the background dose rate, the dose rate measured at the surface of each waste container, and the name of the individual who performed the disposal.

22. The licensee is authorized to transport licensed material in accordance with the provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

NRC Form 374A (5-84) U.S. NUCLEAR REGULATORY COMMISSION

MATERIALS LICENSE
SUPPLEMENTARY SHEET

License number: 29-00055-06

Docket or Reference number: 030-05219

Amendment No. 42

23. Except as specifically provided otherwise in this license, the licensee shall conduct its program in accordance with the statements, representations, and procedures contained in the documents, including any enclosures, listed below. The Nuclear Regulatory Commission's regulations shall govern unless the statements, representations, and procedures in the licensee's application and correspondence are more restrictive than the regulations.

A. Letter dated October 24, 1985
B. Letter dated November 6, 1986
C. Application dated May 31, 1995
D. Letter dated January 31, 1997
E. Letter dated May 9, 1997
F. Letter dated August 15, 1997

Date SEP 25 1997

For the U.S. Nuclear Regulatory Commission

By _____

Division of Nuclear Materials Safety
Region I
King of Prussia, Pennsylvania 19406

AGUIRRE ENGINEERS, INC.

High Hazard Services * Remediation * Environmental * Training

Volume 1

Radioactive Material License Application

Submitted to

The United States Nuclear Regulatory Commission

February 5, 1998

1A/2

LIST OF PROCEDURES

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ARP-002 Alpha-Beta Sample Counting Instrumentation
ARP-003 Operation of Micro-R Meter Survey Meters
ARP-004 Operation of Ionization Chambers
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ARP-006 Radiation Work Permits
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ARP-010 ALARA - As Low As Reasonably Achievable
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ARP-023 Opening Radioactive Material Containers
ARP-024 Decontamination of Equipment and Tools
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ARP-026 Soil and Sediment Sampling
ARP-027 Water Sampling
ARP-028 Material Sampling
ARP-029 Sample Chain of Custody
ARP-030 Document Control
ARP-031 Project Control
ARP-032 Respiratory Protection
ARP-033 Bioassay
ARP-034 Dosimetry
ARP-035 Emergency Response
ARP-036 Training
ARP-037 Radiological Compliance Audits
ARP-038 Procurement, Receipt, and Opening of Radioactive Material
ARP-039 Radiological Conditions Awareness Report
ARP-040 Leak Tests for Non-Exempt Sources of Radioactive Material

Attachment 2

OK

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Operation of Contamination Survey Meters

ARP-001

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 001
Operation of Contamination Survey Meters

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This table provides the most recent changes to pages in this document. A '0' means the original page is valid, a date in the revision level box indicates the date of the most recent change to the page indicated.

ARP-001
Operation of Contamination Survey Meters

1.0 Purpose and Scope

1.1 This procedure provides the methods for operating alpha/beta survey meters when performing contamination surveys. Adherence to this procedure will provide reasonable assurance that the surveys performed have reproducible results.

1.2 These procedures will be used by Aguirre Engineers Inc. (AEI) personnel and sub-contractors on projects to measure fixed and removable alpha and/or beta emitting radioactive material on facility surfaces, equipment, waste packages, personnel and personnel protective clothing.

2.0 General

2.1 Definitions

2.1.1 Restricted Area - An area containing radioactive materials to which access is controlled to protect individuals from exposure to ionizing radiation.

2.1.2 Alpha/Beta Contamination Survey - A survey technique to determine fixed plus removable alpha/beta contamination.

2.1.3 Acceptance Range - A range of values that describe an acceptable daily instrument source check result.

2.2 Precautions

2.2.1 Technicians will ensure that the thin Mylar or mica window on the probe face is protected from punctures during survey operations.

2.2.2 Check sources will be controlled in accordance with ARP-020 at all times, to prevent accidental loss or release of radioactive materials.

2.2.3 If any instrument inconsistencies are observed (e.g., unusually high or low background counts, source checks outside the acceptable range, etc.), remove the instrument from use, label it "OUT OF SERVICE" and report the condition to the site supervisor.

2.2.4 A battery check, general observation of instrument condition and source check shall be performed each day before instrument use and daily, following work activities, as a final verification.

2.2.5 Survey instrument calibrations shall be performed by a NRC or Agreement State approved calibration facility with NIST traceable sources.

2.3 Quality Control

2.3.1 Contamination survey meters will be checked prior to each shift or daily with an alpha or beta check source as applicable to ensure the instrument is operating within the calibrated specifications.

2.3.2 Contamination survey meters will have current/valid calibration documentation attached to the meter or in the storage case.

3.0 References, Records and Equipment

3.1 References

RSM	Radiation Safety Manual
ARP-008	Radiation and Contamination Surveys
ARP-020	Use and Control of Radioactive Check Sources
ANSI N323-1978	*Radiation Protection Instrumentation Test and Calibration*
NUREG/CR-5849	*Manual for Conducting Radiological Surveys in Support of License Termination*

3.2 Records

ARP Form 1-1	Survey Meter Source Check
ARP Form 8-1	Radiation/Contamination Survey

3.3 Equipment

For Alpha Surveys Ludlum Model 43-5 probe and Ludlum Model 3 survey meter or equivalent meter/probe combination.

For Beta Surveys Ludlum Model 44-9 probe and Ludlum Model 3 survey meter or equivalent meter/probe combination.

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for insuring that all personnel assigned the task of operating contamination survey meters are familiar with this procedure and are adequately trained with the specific instrument being used to perform surveys.

4.2 Radiation Safety Officer (RSO) - The RSO is responsible for monitoring compliance with this procedure and training personnel in the use of the contamination survey meters. The RSO can also assist in the interpretation of results obtained during surveys.

4.3 Project Manager (PM)- The PM is responsible for ensuring a copy of this procedure is available at the job site and that field technicians follow this procedure.

4.4 Technicians - Technicians using contamination survey meters are responsible for knowing and complying with this procedure.

5.0 Procedure

5.1 Initial Preparations

5.1.1 Select the contamination survey meter and probe to be used in the survey and verify that the instrument is complete, has a valid calibration and that it has no visible damage or defects.

5.1.2 Turn the instrument selector switch to BATTERY TEST position and verify meter indication falls within the shaded region of the dial indicating the batteries have proper voltage to operate the instrument. Replace the "D" cell batteries if the indication is below the shaded region.

5.1.3 Turn the instrument selector switch to the X 0.1 position and let the instrument warm up for one minute.

5.1.4 Switch the audio toggle switch to "ON" and the response toggle switch to "FAST".

5.1.5 Check alpha detectors for light leaks by pointing the sensitive area on the detector toward a light source and observe the meter indication and listen for an increase of audible clicks on the speaker. If the meter indication or the audible clicks are above 10 counts per minute (CPM) contact the supervisor or RSO.

5.1.6 Check instrument response by placing probe over the check source and observing the meter indication. Record the meter indication on ARP Form 1-1 and determine if indication is within stated values. If indication is not within stated values contact supervisor for instructions.

5.1.7 If the acceptable range for source checks hasn't already been calculated on ARP Form 1-1, then follow the instructions below:

- Ensure the source and detector are in documented reproducible positions, which will be used each time this check is performed.
- Use the check source in a low background area to obtain a measurement (allow the meter to stabilize approximately 90 seconds) in net CPM.
- Multiply the measured net CPM value by 0.8 and 1.2 and record the values as the acceptable range on ARP Form 1-1.

5.2 Contamination Survey Techniques

CAUTION: The window area of alpha detectors are covered with a very thin (1 mg/cm^2) aluminized Mylar window and beta detector windows are 1.7 mg/cm^2 mica. Either window can be easily punctured; avoid surveying areas which have protruding fragments that might puncture the detector face. Remove these fragments before performing surveys. Be sensitive to the fact that any area you cannot see can contain something that will break the detector.

NOTE: Although beta particles travel several feet in air, the detection efficiency is calibrated with the detector probe held ½ inch from the calibration source. Therefore, the detector must be held at ½ inch from the survey surface to maintain calibrated detection efficiency. Alpha particles travel only a few centimeters in air. The detector must be held within ¼ inch of the survey surface to detect alpha particles.

NOTE: Touching the surface with the detector may contaminate the detector - avoid contact with the surface to be surveyed.

5.2.1 Verify the instrument selector switch is in the X 0.1 position.

5.2.2 For a stationary reading, place the detector over the area to be measured and allow meter to stabilize. Record the average meter indication in either CPM α/PA (probe area) or CPM β/PA (probe area) as applicable on the forms provided in procedure ARP-008.

5.2.3 For a scan survey move the detector slowly over the surface (less than one detector width per second). Observe meter indication and listen for increases in audible clicks from the speaker. If increased readings are observed, return to the area and obtain a stationary reading. Record maximum area meter indication in either CPM α/PA or CPM β/PA as applicable on the forms provided in procedure ARP-008.

5.3 Interpretation of Results

The meter reading on the alpha and beta survey meters must be corrected for detector efficiency and detector surface area before comparing results with the contamination limits in Section 3.6 of the Radiation Safety Manual. The conversion from CPM α or β/PA (Probe Area) to DPM α or β/100 cm^2 is performed using the following equation.

$$(DPM/100cm^2) = \frac{(A \times B)}{C}$$

Where: A = Alpha or Beta survey meter indication in net CPM α or β/PA (i.e. Gross Alpha or Beta Survey Counts minus background counts = Net CPM/PA)

B = 100 cm^2 divided by the effective detector surface area in cm^2. With an effective surface area of 50 cm^2 for the Ludlum 43-5 alpha detector, the value of *B* is ~2 or for the 15 cm2 for the Ludlum 44-9 beta detector, the value of *B* is~ 6.7.

C = Detector efficiency (expressed as decimal).

NOTE: This is an important concept which demonstrates why 2" diameter GM detectors are typically not adequate for release surveys. If required to detect 5000 dpm/100 cm2 for fixed activity, then you must be able to detect (assuming a 10% detector efficiency and 44-9-type detector):

$$\frac{(5000\times0.1)}{6.7} = 74.6cpm(net)$$

In order to do this, background must be very low and the normal fluctuations with a GM can make detection of such an activity concentration, very difficult.

6.0 Attachments

ARP Form 1-1 Survey Meter Source Check

Aguirre Engineers, Inc.

Survey Meter Source Check

Instrument _____ Serial No. _____

Source _____ Acceptable Range _____ to _____

Date	Cal Due	Reading	Tech Initials	Date	Cal Due	Reading	Tech Initials	Date	Cal Due	Reading	Tech Initials

Page ____ of ____

p. 5 - typo

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Alpha - Beta Sample Counting Instrumentation

ARP-002

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, CRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 002
Alpha-Beta Sample Counting Instrumentation

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
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6	0	2/3/98						
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ARP-002
Alpha-Beta Sample Counting Instrumentation

1.0 Purpose and Scope

1.1 This procedure provides the methods utilized in operation of the alpha/beta sample counter to determine alpha and beta activity on smear samples and air samples. Adherence to this procedure will provide reasonable assurance that the surveys performed have reproducible results.

1.2 This procedure will be used by Aguirre (AEI) personnel to operate the alpha/beta sample counter during surveys at customer facilities. Types of surveys that may use the alpha/beta sample counter are as follows:

1.2.1 Smear surveys performed to determine the removable alpha and beta contamination on facility surfaces, equipment, waste and source packages containing alpha and beta emitting radioactive materials.

1.2.2 Air sample surveys performed in the workers breathing zone to determine alpha and beta air concentrations.

2.0 General

2.1 Definitions

2.1.1 Restricted Area - An area containing radioactive materials to which access is controlled to protect individuals from exposure to ionizing radiation.

2.1.2 Smear sample survey - A survey technique using two inch diameter filter papers to determine the activity of alpha and beta emitting radioactive material which can be removed from facility surfaces and waste packages.

2.1.3 Air sample survey - A survey technique in which particulates are collected from a known volume of air drawn through a filter paper and the concentrations of airborne alpha and beta activity associated with the particulates is determined by counting.

2.1.4 Plateau - The level portion of the counting rate-voltage curve where changes in operating voltage introduce minimum changes in the counting rate.

2.1.5 Chi-Square test - A statistical test to evaluate the operation of a sample counter by determining the goodness of fit of a series of counts to a Poisson distribution.

2.1.6 Daily calibration - A determination of the alpha and beta sample counting efficiency by counting certified activity standards.

2.2 Precautions

2.2.1 If any instrument inconsistencies are observed (e.g., unusually high or low background counts, source checks outside the tolerance range, etc.), remove the instrument from use and report the condition to the site supervisor.

2.2.2 A battery check (if needed), general observation of instrument condition and source check shall be performed each day before instrument use.

2.2.3 Survey instrument calibrations shall be performed by a NRC or Agreement State approved calibration facility with NIST traceable sources.

2.2.4 This instrument should be set up for use in a low background area as determined by the site supervisor.

2.3 Quality Control

2.3.1 The alpha/beta sample counter will be checked for proper calibration daily with a NIST traceable source.

2.3.2 Chi-Square and plateau tests are verified and noted as currently valid.

3.0 References, Records and Equipment

3.1 References

RSM	Radiation Safety Manual
ARP-008	Radiation and Contamination Surveys
ARP-022	Packaging Radioactive Material

3.2 Records

ARP Form 2-1	Plateau Data Sheet
ARP Form 2-2	Chi-Square Data Sheet
ARP Form 2-3	Daily Calibration Log
ARP Form 2-4	Sample Calculation Worksheet
ARP Form 8-1	Radiation/Contamination Survey

3.3 Equipment

Ludlum model 2929 or equivalent

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned the task of operating alpha-beta sample counters are familiar with this procedure and are adequately trained with the specific instrument being used to perform surveys.

4.2 Radiation Safety Officer (RSO) - The RSO is responsible for monitoring compliance with this procedure and training personnel in the use of the alpha-beta sample counters. The RSO can also assist in the interpretation of results obtained during surveys.

4.3 Project Manager (PM)- The PM is responsible for ensuring a copy of this procedure is available at the job site and that field technicians follow this procedure.

4.4 Technicians - Technicians using beta survey meters are responsible for knowing and complying with this procedure.

5.0 Procedure

5.1 Initial Startup

5.1.1 Turn high voltage potentiometer to its lowest position or reading (fully counterclockwise).

5.1.2 Turn main instrument switch on.

5.1.3 The operator can select one of four operational procedures depending on the function to be performed.

a) Plateau Curve - The proper operating voltage for the instrument must initially be selected and verified every six months. This procedure is performed only if the plateau curve date posted on the instrument has expired, or if eratic instrument response indicates possible calibration problems.

b) Chi-Square Test - The sample counter is statistically evaluated against a Poisson distribution every month that the instrument is used for counting samples. This procedure is performed only if the Chi-Square test date posted on the instrument has expired.

c) Daily Calibration - This procedure is performed before samples are counted on any day the instrument is in use.

d) Routine Operation - This procedure describes the method for counting samples.

5.2 Plateau Curve

NOTE: Before beginning, record the calibration high voltage values from the manufacturer.

5.2.1 Set up the instrument in a low background area.

5.2.2 Rotate the high voltage potentiometer clockwise until the meter indicates 500 volts.

5.2.3 Set time multiplier switch to X1.

5.2.4 Set the instrument preset timer to one (1) minute.

5.2.5 Insert alpha calibration standard into the center of the sample tray, slide the sample tray under the detector and depress the "COUNT" button to obtain a one minute count.

5.2.6 Upon completion of the count, record high voltage reading and digital counts appearing in the instrument alpha display in the indicated columns on ARP 2-1 (Plateau Data Sheet).

5.2.7 Continue increasing high voltage by 50 volt increments, completing counts and recording data until the end of the plateau is reached. If a rapid increase in count rate is observed, immediately reduce the high voltage.

5.2.8 Remove the alpha source and replace with a beta source.

5.2.9 Reduce high voltage reading to 500 by turning potentiometer counterclockwise.

5.2.10 Perform one minute counts at each 50 volt increment and record the data on ARP Form 2-1 until the end of the plateau is reached. If a rapid increase in count rate is observed, immediately reduce the high voltage.

5.2.11 Using linear graph paper, plot alpha and beta counts on the "Y" axis and the voltage for the indicated count on the "X" axis.

5.2.12 Select an operating voltage 1/3 the distance beyond the knee of the plateau curve by marking the voltage on the graph and on the Plateau Data Sheet. Record the operating voltage and date of test on an adhesive label and attach to alpha/beta sample counter.

5.2.13 The preparer shall sign and date ARP Form 2-1 and forward the entire results to AEI Health Physics Management for review.

5.3 Chi-Square Test

5.3.1 Set up the instrument in a low background area.

5.3.2 Rotate the high voltage potentiometer clockwise until meter indicates voltage posted on instrument label.

5.3.3 Set time multiplier switch to X1.

5.3.4 Set the instrument preset timer to one (1) minutes.

5.3.5 Insert alpha calibration standard into center of the sample tray, slide sample tray under the detector and depress the "COUNT" button to obtain a one minute count.

5.3.6 Upon completion of the count, record digital counts appearing in the alpha or beta display in the "X" column on ARP Form 2-2 (Chi-Square Data Sheet).

5.3.7 Repeat counting sequence without changing settings until a total of 20 counts have been taken and recorded in the "X" column of the Chi-Square Data Sheet.

5.3.8 Add the 20 counts entered in the "X" column and divide by 20 to obtain the mean number of counts (X_m).

5.3.9 Calculate the individual count "(X)" difference from the mean (X_m)value and record in the "($X-X_m$)" column of the Chi-Square Data Sheet.

5.3.10 Calculate "$(X-X_m)^{2n}$" as indicated on the data sheet and sum the "$(X-X_m)^{2n}$" column.

5.3.11 Calculate the value of Chi-Square using the following formula.

$$X^2 = \frac{\Sigma(X-X_m)^2}{X_m}$$

5.3.12 The value of Chi-Square should be between 7.63 and 36.2 which represent a probability between 0.1 and 0.9. If the Chi-Square value falls outside the indicated range, contact the RSO for further instructions.

5.3.13 Write the date of the Chi-Square test and preparer initials on an adhesive label and attach it to the alpha/beta sample counter.

5.3.14 The preparer shall sign and date ARP Form 2-2 and forward the results to AEI Health Physics Management for review.

5.4 Daily Calibration

5.4.1 Verify that the plateau curve and Chi-Square test have not expired by observing the due date for these tests posted on the instrument label.

5.4.2 Rotate high voltage potentiometer clockwise until meter indicates voltage posted on the instrument label.

5.4.3 Set time multiplier switch to X1.

5.4.4 Set the instrument preset timer to five (5) minutes.

5.4.5 Record the source efficiency type to be calculated as alpha or beta in the column indicated on ARP Form 2-3. Use separate lines of the form for each source efficiency to be calculated.

5.4.6 Insert a blank sample into the center of the sample tray, slide the sample tray under the detector and depress the "COUNT" button to obtain a five minute background count.

5.4.7 Calculate as below and record the "BKG CPM" results for alpha or beta (or both on separate lines of the form) in the field indicated on ARP Form 2-3 (Daily Calibration Log).

CPM=Counts per minute or count time/in minutes

5.4.8 Remove the blank sample and insert the alpha or beta calibration standard into the center of the sample tray, slide the sample tray under the detector and depress the "COUNT" button to obtain a five minute count.

5.4.8 Upon completion of the measurement, calculate CPM as in Section 5.4.7 and record the "Gross Source CPM" on ARP Form 2-3 (Daily Calibration Log).

5.4.9 Calculate "Net Source CPM" as below and record on ARP Form 2-3.

Net Source CPM (CCPM) = Gross source CPM - BKG CPM

NOTE: Obtain activity (DPM) value for source efficiency calculation from the source certification paperwork. Decay correct activity, if needed.

5.4.10 Use the source disintegrations per minute (DPM) to calculate the efficiency as shown below and record as a percentage (%) or in decimal form on ARP Form 2-3.

Efficiency (%) = Net Source CPM + DPM

5.4.11 To calculate the next source efficiency, remove the current source standard, insert a new source standard and repeat Sections 5.4.4 through 5.4.10 as necessary.

5.4.15 The preparer shall record their initials in the proper field on ARP Form 2-3.

5.4.16 Remove calibration standards and place in source holders. Place sources in secure area to prevent loss and unauthorized use.

5.4.17 The counting efficiencies determined in the above procedure will be used in Section 5.5 of this procedure to determine activity of unknown samples.

5.5 Routine Operation

5.5.1 Set up the instrument in a low background area.

5.5.2 Verify that the plateau curve and Chi-Square test have not expired by observing the due date for these tests posted on the instrument label.

5.5.3 Fill out the date, time, instrument model #, serial #, and alpha and beta efficiencies, at the top of ARP 2-4 (Sample Calculation Worksheet).

5.5.4 Rotate high voltage potentiometer clockwise until the meter indicates the voltage posted on sticker.

5.5.5 Set time multiplier switch to X1.

5.5.6 Set the instrument preset timer to ten (10) minutes.

5.5.7 Insert a blank sample into the center of the sample tray, slide the sample tray under the detector and depress the "COUNT" button to obtain a 10 minute background count.

5.5.8 Calculate Background CPM (as performed in Section 5.4) from the alpha and beta background count results appearing in the instrument alpha and beta digital displays and record on ARP Form 2-4 (Sample Calculation Worksheet).

5.5.9 Set the correct instrument sample count time:

- Smear samples-1 minute or as directed by the work plan,
- Air samples-5 minutes or as directed by the work plan

5.5.10 Insert the smear sample or air sample into the center of sample tray, slide the sample tray under the detector and depress "COUNT" button to begin the counting sequence.

5.5.11 Calculate CPM as in Section 5.4 and record the sample counts appearing in the instrument alpha and beta displays as "Gross Alpha CPM" and "Gross Beta CPM" , respectively, on ARP Form 2-4 (Sample Calculation Worksheet).

5.5.12 Calculate (and record on ARP Form 2-4) net counts per minute for the "Net Alpha CPM" and "Net Beta CPM" using the following formula:

$$Net\ (\alpha\ or\ \beta)\ CPM = (Gross\ Sample\ (\alpha\ or\ \beta) - Background\ (\alpha\ or\ \beta)\ CPM)$$

5.5.13 Calculate sample disintegrations per minute (DPM) for the net alpha and net beta count rates using the respective alpha and beta efficiencies as calculated on ARP Form 2-3 (Daily Calibration Worksheet) and the following formula:

$$DPM = \frac{NetCPM}{Efficiency}$$

5.5.13 Enter the alpha and beta DPM values and your initials in the indicated columns on ARP Form 2-4.

6.0 Attachments

ARP Form 2-1	Plateau Data Sheet
ARP Form 2-2	Chi-Square Data Sheet
ARP Form 2-3	Daily Calibration Log
ARP Form 2-4	Sample Calculation Worksheet

Aguirre Engineers, Inc.

Plateau Data Sheet

Date _____ Recommended Operating Voltage _____

Instrument _____ Serial No. _____

Alpha Source Serial No. _____ Source Strength _____

Beta Source Serial No. _____ Source Strength _____

Voltage Setting	Alpha Counts	Voltage Setting	Alpha Counts	Voltage Setting	Beta Counts	Voltage Setting	Beta Counts

Prepared By: _____ / _____ Date: _____
Print/Sign

Reviewed By: _____ / _____ Date: _____
Print/Sign

Aguirre Engineers, Inc.

Chi-Square Data Sheet

Date _____ Instrument _____ Serial No. _____ X^2 = _____

Alpha Serial No./Strength _____ / _____ Beta Serial No./Strength _____ / _____

Count No.	X	$(X - X_m)$	$(X - X_m)^2$
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
Totals			

Prepared By: _____ / _____ Date: _____
Print/Sign

Reviewed By: _____ / _____ Date: _____
Print/Sign

Page ___ of ___

Aguirre Engineers, Inc.

Daily Calibration Log

Instrument _____ Serial No. _____

Alpha Serial No./Strength _____/_____ Beta Serial No./Strength _____/_____

	Background Information			Source Information				
Date/Time	Total Time	Total Cts	CPM	Total Time	Total Cts	CPM	Net CPM	% Eff

Prepared By: _____/_____ Date: _____
Print/Sign

Reviewed By: _____/_____ Date: _____
Print/Sign

Aguirre Engineers, Inc.

Sample Calculation Worksheet

Date/Time _____ Instrument _____ Serial No. _____

Alpha Efficiency _____ Beta Efficiency _____

Alpha Background (CPM) _____ Beta Background (CPM) _____

Sample No.	Gross Alpha CPM	Gross Beta CPM	Net Alpha CPM	Net Beta CPM	Alpha DPM	Beta DPM	Technician Initials

Prepared By: _____ / _____ Date: _____
Print/Sign

Reviewed By: _____ / _____ Date: _____
Print/Sign

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Operation of Micro-R Survey Meters

ARP-003

Revision 0

Reviewed By: _____ 2/2/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 003
Operation of Micro-R Survey Meters

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
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4	0	2/3/98						

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ARP - 003
Operation of Micro-R Survey Meters

1.0 Purpose and Scope

1.1 This procedure provides the methods AEI utilizes in operation of the micro-R-meter for gamma radiation surveys. Adherence to this procedure will provide reasonable assurance that the surveys performed have reproducible results.

1.2 This procedure will be used by AEI personnel to operate the micro-R-meter during gamma radiation surveys. Surveys performed to determine the gamma radiation levels from facility surfaces, equipment, waste and source packages containing gamma emitting radioactive materials. Surveys performed in facilities and on land masses to determine levels of gamma radiation.

2.0 General

2.1 Definitions

2.1.1 Restricted Area - An area containing radioactive materials to which access is controlled to protect individuals from exposure to ionizing radiation.

2.1.2 Gamma radiation survey - A survey technique to determine gamma radiation levels from radioactive materials in facilities, materials, or land masses.

2.1.3 Acceptance Range - A range of values that describe an acceptable daily instrument source check result.

2.2 Precautions

2.2.1 If any instrument inconsistencies are observed (e.g., unusually high or low background readings, source checks outside the acceptable range, etc.), remove the instrument from use, label it "OUT OF SERVICE" and report the condition to the site supervisor.

2.2.2 A battery check, general observation of instrument condition and source check shall be performed each day before instrument use and daily, following work activities, as a final verification.

2.2.3 Survey instrument calibrations shall be performed by a NRC or Agreement State approved calibration facility with NIST traceable sources.

2.3 Quality Control

2.3.1 The micro-R-meter will be source checked with an appropriate source each day before the instrument is used to perform surveys and daily, after work activities, for verification of proper operation.

2.3.2 Contamination survey meters will have current/valid calibration documentation attached to the meter or in the storage case.

3.0 References, Records and Equipment

3.1 References

RSM	Radiation Safety Manual
ARP-008	Radiation and Contamination Surveys
ARP-020	Use and Control of Radioactive Check Sources
ANSI N323-1978	Radiation Protection Instrumentation Test and Calibration
NUREG/CR-5849	Manual for Conducting Radiological Surveys in Support of License Termination

3.2 Records

ARP Form 1-1	Survey Meter Source Check
ARP Form 8-1	Radiation/Contamination Survey

3.3 Equipment

Ludlum Model 19 or equivalent detector

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for insuring that all personnel assigned the task of operating micro-R survey meters are familiar with this procedure and are adequately trained with the specific instrument being used to perform surveys.

4.2 Radiation Safety Officer (RSO) - The RSO is responsible for monitoring compliance with this procedure and training personnel in the use of the micro-R survey meters. The RSO can also assist in the interpretation of results obtained during surveys.

4.3 Project Manager (PM)- The PM is responsible for ensuring a copy of this procedure is available at the job site and that field technicians follow this procedure.

4.4 Technicians - Technicians using Micro-R meters are responsible for knowing and complying with this procedure.

5.0 Procedure

5.1 Initial Preparations

5.1.1 Select the Micro-R meter to be used in the survey, observe the physical appearance (i.e., no broken parts and instrument is complete) and verify that the instrument has a currently valid calibration.

5.1.2 Depress the BATTERY TEST button and verify the meter indication falls within the shaded region of the dial indicating the batteries have proper voltage to operate the instrument. Replace the "D" cell batteries if the indication is below the shaded region.

5.1.3 Turn the instrument selector switch to the lowest scale position (usually 25 μR/hour) and let the instrument warm up for one minute. With the selector switch in this position, use the 0 to 25 μR/hr scale on the dial for obtaining instrument readings.

5.1.4 Switch the audio toggle switch to "ON" and the response toggle switch to "SLOW".

5.1.5 If acceptable range values for source checks haven't already been calculated on ARP Form 1-1, then follow the instructions below:

- Use the check source in a low background area to obtain a measurement (the meter reaches 90% of its final reading in 22 seconds) in net CPM.
- Multiply the measured net CPM value by 0.8 and 1.2 and record the values as the acceptable range on ARP 1-1.

NOTE: Do not use malfunctioning or out of tolerance instruments to perform surveys.

5.1.6 Check the instrument response (in a low dose area) by placing the probe window over the check source or predetermined position in the facility and observing the meter reading (the meter reaches 90% of its final reading in 22 seconds). Record the meter reading in net CPM on ARP Form 1-1 and determine if the measurement is within the acceptable range listed in ARP 1-1. If the measurement is not within the acceptable range for the source used, contact the site supervisor.

5.2 Survey Technique

5.2.1 Grid surveys

a) Verify the instrument selector switch is on the lowest scale (usually the 25μR position). Turn the instrument selector switch to the next higher scale only if meter indication is off scale.

b) For a stationary grid reading in a facility or land mass, position the instrument one meter above the surface to be surveyed and allow meter to stabilize. With the instrument toggle switch set in the "SLOW" position, the meter reaches 90% of its final reading in 22 seconds. Record the average meter indication in μR/hr on the forms provided in procedure ARP-008.

NOTE: Two survey methods (step c or d) can be used to obtain contact readings in the survey grids. The survey method used will be specified in the site specific work plan.

c) For a scan survey, make sure the meter response is set to fast and suspend the instrument from a strap which locates the detector is located at surface or ground level. Move the instrument slowly over the surface while walking in an "S" pattern or as described in the characterization work plan. Observe meter indication and listen for increases in audible clicks from the speaker. Areas which could concentrate radioactive materials such as drainage ditches, floor cracks and wall/floor joints should always be surveyed. If elevated readings above background

are observed, a stationary survey shall be performed (at 1 meter height and also at the surface)at the point of elevated activity . Record area meter indications above background in mR/hr on the forms provided in procedure ARP-008.

d) As an alternate to the "S" pattern survey used in step c), the survey grid can be divided into subgrids and readings taken as directed by the site work plan. Determine readings elevated above background the same manner as above (i.e., measurements at one meter and at the surface). The readings from each measurement are recorded on the forms provided in procedure ARP-008.

5.2.2 Waste container surveys

a) Set the instrument scale to accommodate the highest expected radiation level. If radiation levels may approach 5000 µR/hr (5 mR/hr) obtain an instrument with appropriate range prior to performing any radiation surveillance.

b) Slowly scan the total surface of the package and record the maximum contact reading obtained on the forms provided in procedure ARP-008.

c) Obtain instrument readings at 1 meter from all sides of the package and record the maximum reading obtained on the forms provided in ARP-008.

5.3 Interpretation of Results

5.3.1 In a uniform background radiation field (without interfering sources of radiation), methods such as; selectively shielding the detector, soil sample analysis, etc., can be used to differentiate between extraneous radioactive sources(e.g., skyshine or radioactive waste shipment containers), naturally occurring radioactive material and/or radioactive contamination.

5.3.2 Note the location of installed devices which contain radioactive material and could cause elevated radiation survey levels in localized areas.

5.3.3 Land mass surveys might contain areas with naturally occurring radioactive materials which will elevate background radiation levels.

6.0 Attachments

None

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Operation of Ionization Chambers

ARP-004

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 004
Operation of Ionization Chambers

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
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3	0	2/3/98						
4	0	2/3/98						

This table provides the most recent changes to pages in this document. A '0' means the original page is valid, a date in the revision level box indicates the date of the most recent change to the page indicated.

ARP-004
Operation of Ionization Chambers

1.0 Purpose and Scope

1.1 This procedure provides the methods AEI utilizes in operation of the ion chamber for dose rate surveys. Adherence to this procedure will provide reasonable assurance that the surveys performed have reproducible results.

1.2 This procedure will be used by AEI to operate Ionization chambers during dose rate surveys, these surveys may encompass the following activities;

1.2.1 Surveys performed to determine the exposure rates in personnel work areas.

1.2.2 Surveys performed in restricted areas to define boundaries of radiation areas.

1.2.3 Surveys performed on shipping containers containing radioactive materials.

2.0 General

2.1 Definitions

2.1.1 DDE - Deep Dose Equivalent applies to external whole body exposure, and is the dose equivalent at a tissue depth of 1.0 cm (1000 mg/cm$_2$).

2.1.2 Restricted Area - An area containing radioactive materials to which access is controlled to protect individuals from exposure to ionizing radiation.

2.1.3 Radiation Area. - Any area accessible to personnel in which there exists ionizing radiation at dose-rate levels such that an individual could receive a deep dose equivalent in excess of 5 mrems in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

2.1.4 SDE EX - Shallow Dose Equivalent/Extremities. The shallow dose equivalent for the skin of the extremity receiving the maximum dose.

2.1.5 SDE WB - Shallow Dose Equivalent/Whole Body. The shallow dose equivalent to the skin of the whole body.

2.2 Precautions

Technicians will exercise care not to puncture the thin Mylar window during survey operations.

2.3 Quality Control

The ion chamber will be checked with a gamma standard twice daily and verified to have a current valid calibration.

3.0 References, Records and Equipment

3.1 References

RSM	Radiation Safety Manual
ARP-008	Radiation and Contamination Surveys
ARP-020	Radioactive Check Source Use and Control

3.2 Records

ARP Form 8-1	Radiation/Contamination Survey
ARP Form 1-1	Instrument Source Check

3.3 Equipment

Ludlum Model 9 Ionization Chamber or equivalent.

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for insuring that all personnel assigned the task of operating ionization chambers are familiar with this procedure and are adequately trained with the specific instrument being used to perform surveys.

4.2 Radiation Safety Officer (RSO) - The RSO is responsible for monitoring compliance with this procedure and training personnel in the use of the ionization chambers. The RSO can also assist in the interpretation of results obtained during surveys.

4.3 Project Manager (PM)- The PM is responsible for ensuring a copy of this procedure is available at the job site and that field technicians follow this procedure.

4.4 Technicians - Technicians using ionization surveys are responsible for knowing and complying with this procedure.

5.0 Procedure

5.1 Initial Preparations

5.1.1 Select the ion chamber to be used in the survey and verify that the instrument has a currently valid calibration.

5.1.2 Turn the instrument selector switch to BATTERY TEST position and verify meter indication falls within the shaded region of the dial indicating the batteries have proper voltage to operate the instrument. Replace the "D" cell batteries if the indication is below the shaded region.

5.1.3 Turn the instrument selector switch to the X1 position and let the instrument warm up for five minute.

5.1.4 Move the instrument to a low background area and adjust "Zero Adjust" knob until meter indicates zero.

5.1.5 Switch the audio toggle switch to the "ON" position.

5.1.6 Check instrument response by placing probe over the check source and observing the meter indication. Record meter indication on ARP Form 1-1 and determine if indication is within stated values. If indication is not within stated values contact supervisor for instructions.

5.2 Gamma Survey Technique

5.2.1 Ensure the beta shield is covering the Mylar window.

5.2.2 When entering a radiation area of unknown radiation levels turn the range selector switch to the highest scale or the highest scale for the dose rate expected. Rotate the range selector switch downscale until an upscale meter needle deflection is observed.

5.2.3 When obtaining a gamma exposure rate place the entire detector volume in and perpendicular to the radiation field.

5.2.4 Gamma exposure rates are obtained in the area where a workers will be located during work activities. If only a portion of the workers body will be exposed to the field, the highest exposure rate will be used to determine working time.

5.2.5 Gamma exposure rates on waste packages are obtained by placing the center line of the detector at the indicated distance from the package and perpendicular to the radiation field.

5.2.6 Record the highest meter indication in mR/hr and its' location on the forms provided in procedure ARP-008.

5.3 Beta Survey Technique

CAUTION: The window area of the detector is covered with a 7 mg/cm^2 aluminized Mylar covering and can be easily punctured. Avoid protruding fragments that might puncture the detector face.

5.3.1 When a higher reading is obtained with the beta shield open compared with the beta shield closed, this indicates the presence of beta radiation.

5.3.2 To obtain the beta exposure first obtain a reading with the beta shield closed (CW) as described in Section 5.2. Open the beta shield and obtain a reading (OW) at the same location holding the meter in the same configuration.

$\beta+\gamma$ γ

5.3.3 Determine the beta exposure using the following formula: $(OW - CW)$

$$True\ \beta\ Exposure = (CW - OW) \times BCF$$

Where: OW = Open Window reading (beta shield open)
CW = Closed Window reading (beta shield closed)
BCF = Beta Correction Factor
BCF = 2 for reading taken at 30 centimeters
BCF = 5 for reading taken at 4 centimeters

5.3.4 Beta dose rates to the skin of whole body or lens of the eye are obtained in the area where a workers will be located during work activities. If only a portion of the workers body will be exposed to the field, the highest exposure rate will be used to determine working time.

5.3.5 Beta exposure rates to the extremities are obtained by obtaining measurements at 4 centimeters from the surface contacted by the worker.

5.3.6 Record the beta dose rates in mR/hr (β) and location on the forms provided in procedure ARP-008.

6.0 Attachments

None

OK

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Direct Reading Dosimeters (DRD)

ARP-005

Revision 0

Reviewed By: _____ 2/5/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 005
Direct Reading Dosimeters (DRD)

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

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ARP-005
Direct Reading Dosimeters (DRD)

1.0 Purpose and Scope

1.1 This procedure will be used by AEI personnel when using direct reading dosimeters (DRD) on radiological projects. These dosimeters can be used to provide an immediate readout of personnel gamma radiation exposure.

1.2 This procedure will apply to all projects where DRDs are used. The requirement for use will be described in the job-specific work plan. This procedure applies to all operations that may require the use of pocket ionization chambers. The requirements for use will be described in job-specific radiation work permits (RWPs)

The following activities are described in Section 5 of this procedure:

a) Zeroing the DRD
b) Wearing the DRD
c) Reading the DRD
d) Off-Scale Direct DRD

2.0 General

2.1 Definitions

2.1.1 Off-Scale DRD - A DRD that either displays the hairline past the maximum numerical value shown on the scale or is completely outside the viewing area.

2.1.2 Restricted Area - An area containing radioactive materials to which access is controlled to protect individuals from exposure to ionizing radiation.

2.2 Precautions

2.2.1 Technicians issued DRD should take care not to jar, drop, or otherwise cause the instrument to show false readings.

2.2.2 DRDs will be periodically checked during restricted area operations, if the hairline scale is at or past action levels immediately evacuate to the control point and notify the Radiation Safety Officer.

2.3 Quality Control

DRDs will be zeroed each day prior to use or if the DRD exceeds 75% of full scale response during work operations, following the directions in this procedure.

3.0 References, Records and Equipment

3.1 References

RSM	Radiation Safety Manual
ARP-006	Radiation Work Permits
ARP-034	Dosimetry

3.2 Records

Various records may be generated during the performance of this procedure. Dosimeter readings should be logged on the RWP sign-in sheet when departing the restricted area where the dosimeter is used. The original of all records generated as a result of this procedure will be retained in the project files.

ARP Form 6-1 RWP Sign-in Sheet

3.3 Equipment

Pocket ion chambers calibrated to traceable gamma standards.

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned a task using DRDs are familiar with this procedure and are adequately trained with the specific instrument used to perform radiation surveys.

4.2 Radiation Safety Officer (RSO) - The RSO is responsible for monitoring compliance with this procedure and training personnel in the use of DRDs.

4.3 Project Manager (PM)- The PM is responsible for ensuring a copy of this procedure is available at the job site and that field technicians follow this procedure.

4.4 Technicians - Technicians using DRDs are responsible for knowing and complying with this procedure.

5.0 Procedure

5.1 Zeroing the DRD

5.1.1 Remove the protective cap from the dosimeter and place the contact point on the dosimeter charger.

5.1.2 Place the dosimeter on the charging contact and press down firmly. Look through the dosimeter eyepiece and adjust the charging control until the dosimeter hairline is on zero. Remove the dosimeter from the charger.

5.1.3 Look through the eyepiece of the dosimeter, ensuring that the scale is horizontal and check that the dosimeter hairline is still on zero.

5.1.4 If the hairline has moved significantly away from the zero mark, as necessary, recharge the dosimeter and adjust the hairline above or below zero to compensate for the shift. Recheck after each adjustment.

5.2 Wearing the DRD

5.2.1 The DRDs should be worn, secured to the chest area near the TLD badge. The dosimeter shall be positioned so that it is not in front of the TLD.

5.3 Reading the DRD

5.3.1 Dosimeters should be checked periodically (such as every hour in a radiation area, every quarter hour in a high radiation area) by the user or a Radiation Protection Technician (RPT).

5.3.2 Hold the dosimeter horizontally toward a light source or as directed on a dosimeter reader. Look through the eyepiece, rotate the dosimeter until the scale is also horizontal. If the hairline is off-scale (It cannot be seen when looking through the eyepiece), leave the area immediately and contact a RPT for instructions. If there is more than one person working in the same area, they should all check their dosimeters. Note position of the hairline on the scale, the corresponding reading is the exposure.

5.4 Off-Scale DRD

5.4.1 Attempt to determine why the dosimeter went off-scale and other pertinent information such as:

- Did the individual drop or hit the dosimeter?
- Has the dosimeter been responding as anticipated?
- Where was the individual working and for how long?
- What were the exposure rates in the area?
- How long has it been since the user read the dosimeter?
- What was the last dosimeter reading that the individual remembers?
- Were there any other workers in the same area wearing DRDs? If so, what were their DRD readings?

5.4.2 If the individual recalls hitting or dropping the dosimeter, and in leaving the area immediately remembers the reading prior to the occurrence, this reading may be recorded on the RWP Sign-in Sheet. Replace the dosimeter, initiate an investigation, and have the questionable unit drift-tested and response checked.

5.4.3 If the individual does not remember dropping or hitting the dosimeter or if there is any doubt about the circumstances concerning the occurrence, initiate an investigation and have the TLD badge processed, if there is an estimated exposure greater than 100 millirem.

5.4.4 If the sum of the exposure estimate from Step 5.4.3 exceeds project administrative exposure limits, do not permit the individual to enter the Controlled Area until the TLD results are known and all exposure records have been updated; otherwise, an individual may be permitted entry into controlled areas after issue of a new dosimeter. If an exposure in excess of limits is suspected or verified, notify the RSO.

6.0 Attachments

None

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Radiation Work Permits

ARP-006

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 006
Radiation Work Permits

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
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6	0	2/3/98						
7	0	2/3/98						

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ARP - 006
Radiation Work Permits

1.0 Purpose and Scope

1.1 This procedure describes the circumstances when a Radiation Work Permit (RWP) is required on AEI Projects and addresses the requirements for planning, developing, issuing, using, modifying, and terminating RWP's. The RWP provides a complete document addressing existing radiological conditions, work scope, radiological limitations, specific protective requirements, ALARA considerations, and instructions to radiation workers. Adherence to this procedure will provide reasonable assurance that personnel exposures will be below specified limits, personnel will remain free of contamination and contamination will not be spread beyond the designated contaminated area.

1.2 This procedure will be used to initiate a RWP prior to jobs where GPI personnel enter areas where contamination is present above the limits specified in the Radiation Safety Manual, when radiation exposure rates classify the work area as a Radiation Area, when Air concentrations could exceed 10% of the Derived Air Concentration, and at the discretion of the Health Physics Technician or Project Manager. This procedure describes the radiological surveys required to generate a RWP and provides guidelines to specific protective measures required based upon the radiological conditions in the work area.

2.0 General

2.1 Definitions

2.1.1 Airborne Radioactivity Area. - A room, enclosure or area in which radioactive material is dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases and the concentration of the dispersed radioactive materials is in excess of:

a) The derived air concentrations (DAC's) specified in Table 1, column 3 of Appendix B, Title 10 Part 20 of the Code of Federal Regulations.

b) Concentrations such that an individual present in the area without respiratory protective equipment could exceed, during the hours the individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI).

2.1.2 Contaminated Area - A restricted area that has radioactive materials above the limits specified in the Radiation Safety Manual in the form of dusts, particulates, and sorbed contaminants that could adhere to personnel clothing and skin while working in the area.

2.1.3 Radiation Area. - Any area accessible to personnel in which there exists ionizing radiation at dose-rates such that an individual could receive a deep dose equivalent in excess of 5 mrems in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

2.1.4 Restricted Area - An area containing radioactive materials to which access is controlled to protect individuals from exposure to ionizing radiation.

2.1.5 Personnel Survey - A survey with radiation detection instruments that measures the amount of radioactive materials on personnel clothing or skin surfaces.

2.1.6 LDE - Lens Dose Equivalent. Exposure to the lens of the eye taken as the dose equivalent at a tissue depth of 0.3 cm.

2.1.7 SDE EX - Shallow Dose Equivalent/Extremities. The shallow dose equivalent for the skin of the extremity receiving the maximum dose.

2.1.8 SDE WB - Shallow Dose Equivalent/Extremities. The shallow dose equivalent to the skin of the whole body.

2.1.9 TEDE - Total Effective Dose Equivalent. Total effective dose equivalent is the sum of the deep dose equivalent (external dose) and the committed effective dose equivalent (internal dose).

2.1.10 TODE - Total Organ Dose Equivalent. Total organ dose equivalent is the sum of the external component (deep dose equivalent) and the internal component (committed dose equivalent to an organ or tissue).

2.2 Quality Control

Instrumentation used in the surveys will be checked with standards daily and verified to have current valid calibration

3.0 References, Records and Equipment

3.1 References

RSM	Radiation Safety Manual
ARP-001	Operation of Contamination Survey Meters
ARP-002	Alpha-Beta Sample Counting Instrumentation
ARP-003	Operation of Miro-R Survey Meters
ARP-004	Operation of Ionization Chambers
ARP-005	Direct Reading Dosimeters
ARP-007	Air Sampling and Sample Analysis
ARP-008	Radiation and Contamination Surveys
ARP-010	ALARA - As Low As Reasonably Achievable
ARP-014	Radiologically Restricted Areas
ARP-015	Personnel Protective Equipment

3.2 Records

ARP Form 2-4	Sample Calculation Worksheet
ARP Form 6-1	Radiation Work Permits
ARP Form 6-2	RWP Access Sheets
ARP Form 7-1	Air Sample Data Sheet
ARP Form 8-1	Radiation and Contamination Survey

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for insuring that all personnel assigned the tasks of working in Contaminated Areas, Radiation Areas, and Airborne Radioactivity Areas are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Officer-The Radiation Safety Officer (RSO) is responsible for monitoring compliance with this procedure and training of personnel working in Contaminated Areas, Radiation Areas, and Airborne Radioactivity Areas. The RSO ensures the Health Physics Technician are qualified by training and experience to perform the requirements of this procedure. The RSO is responsible for issue, control, and termination of RWPs.

4.3 Project Manager - The Project Manager is responsible for initiating the RWP. The Project Manager periodically reviews RWP practices to ensure procedural compliance.

4.4 Health Physics Technicians - Health Physics Technician is responsible for performing the necessary surveys in support of the RWP's, and job coverage of RWP's. The Health Physics Technician has the responsibility to stop work if any unsafe condition exists in the work area, non-compliance with procedural requirements occurs, or significant changes in radiological conditions occur.

4.5 Radiation Workers - Radiation workers are responsible to read, understand, sign, and comply with the provisions of the RWP.

5.0 Procedure

5.1 Planning the RWP.

5.1.1 The Project Manager initiates the RWP process by filling in the description of work section of the RWP. A detailed work plan is encouraged but not required and can be attached to the RWP with appropriate reference in the description of work section.

5.1.2 The Health Physics Technician enters the date the RWP was initiated and assigns a consecutive RWP number to the document. Enter the end date which will correspond to the estimated completion date for the project.

5.1.3 The Project Manager meets with the RSO or designee to describe as much as possible about the nature of the work to be performed, the specific components or equipment to be worked on, the positions the workers may take to perform the work, the possibility of releasing radioactive contamination during the work activities, and the potential for changing radiation dose rates as work progresses.

5.1.4 The Health Physics Technician and Project Manager shall:

- Obtain and review any previous surveys performed in the work area.
- They obtain all information available on the identity, form and quantities of radionuclides present in the work area.

- Review facility drawings, if available to determine ventilation flows, component and equipment layouts, and building structures which can be used for contamination barriers.

5.1.5 The Radiation Safety Officer selects the necessary instrumentation, equipment and protective clothing to perform surveys in the work area. If contamination is expected in the work area, wrap equipment taken into work area to prevent contamination of equipment.

5.1.6 If anticipated contamination levels are above the limits specified in the Radiation Safety manual, establish a contaminated area as described in procedure ARP-014 before entry into the area.

5.2 The RWP Pre-Job Survey

5.2.1 After entering the specified work area, The Health Physics Technician obtains radiation exposure rates in the area where the workers will be positioned during work activities. Also survey the adjacent area and path route to the work area to identify any "hot spots" where elevated readings are observed. Record readings on survey forms as specified in procedure ARP-008.

5.2.2 Obtain smear samples from the work area, adjacent areas and along the path route to the work area. The number of smear samples in the work area should be 2 to 3 per 3 meter by 3 meter grid. If there is a specific piece of equipment which will be worked on, obtain an additional number of smear samples on the equipment to adequately characterize the activity distribution on the item. The number of smear samples in adjacent areas and along the path route to the work area should be one per 3 meter by 3 meter area. (see procedure ARP-008).

5.2.3 Determine what additional safety hazards may be encountered during the work. (Confined space entry, electric equipment or mechanical equipment requiring lock out tags, falling objects, bumping hazards, slippery surfaces, fire hazards, etc.) An analysis of each hazard and precautions to be taken is included in the Site Health and Safety Plan.

5.2.4 Exit the area using procedures established in ARP-015.

5.2.5 Count smear samples and any air samples collected in the area.

5.2.6 Authorize the RWP Survey section by signature.

5.3 Issuing the RWP.

NOTE: When the RWP request is received from the PM, the RSO will assign an RWP number.

5.3.1 A Health Physicist, the RSO or a Health physics Technician who surveyed the work area or obtained information from records, enters exposure rates measured during survey of work area in the radiation conditions section of the RWP. Also note any "hot

spots" found during the survey in this section. Calculate working time in the specified locations and enter the time in the area provided on the RWP. Attach survey forms if necessary.

5.3.2 Enter the smearable contamination conditions found in the work area and other areas with elevated contamination in the contamination conditions section of the RWP.

5.3.3 Enter results of air sample (s), if taken, in the Area Air Concentration section of the RWP.

5.3.4 Based on current and anticipated contamination conditions in the area, the Health Physics Technician determines the required protective clothing to protect workers during work activities.

5.3.5 Based on contamination conditions and anticipated resuspension, determine respiratory protection requirements on the RWP.

5.3.6 Select air sampling requirements if air concentrations are likely to exceed 10% of the Derived Air Concentration (DAC).

5.3.7 Determine and mark the dosimetry requirements on the RWP form.

5.3.8 Determine Monitoring Requirements for HP coverage and job observation by marking appropriate boxes on the RWP.

5.3.9 Select or enter training requirements for workers on the project.

5.3.10 Indicate if pre-job or ALARA briefings are required for workers.

5.3.11 Authorize the ALARA/Radiological Protection requirements section by signature.

5.4 Hold Points/Special Instructions

5.4.1 Note any safety hazards in the Hold Points/Special Instructions section of the RWP and check any permits of lock out tags required.

5.4.2 Indicate any special precautions associated with PPE, dosimetry, monitoring, respiratory protection, training or ALARA.

5.4.3 Authorize this section by signature.

5.5 Approvals

The RWP shall be approved by the project manager and the RSO as a minimum, prior to work. AEI Health Physics Management approval shall be required for high exposure work.

5.6 Using the RWP

5.6.1 A pre-job briefing is held with the individuals performing the work described in the RWP. The following topics will be discussed in the pre-job briefing:

a) Complete description of the work tasks to be performed and method to minimize exposures to radiation and contamination while performing these work tasks.

b) Discussions of the radiation, contamination, and airborne radioactive materials in the work area and situations which could result in increased levels of these components.

c) Safety concerns which could be encountered during work activities.

d) Emergency procedures.

e) Discussions of the protective equipment requirements and the monitoring requirements of the RWP.

5.6.2 The Health Physics Technician will compile the current year dose for the individuals performing RWP work to verify the radiation exposure received during the work activities will not result in the individuals dose exceeding the limits specified in the Radiation Safety Manual. The current radiation exposures are listed on the RWP sign in sheet.

5.6.3 Each individual entering the RWP work area is required to read the RWP and sign the RWP sign in sheet indicating the individual understands the provisions of the RWP and will comply with the RWP requirements.

5.6.4 The Health Physics Technician (or individual) logs the time the individual entered the work area along with the reading on the individuals Pocket Ion Chamber (PIC) or Direct Reading Dosimeter (DRD), if worn. The health physics Technician (or individual) also indicates if the individual wore a respirator during the work activities.

5.6.5 When the individual exits the work area, the Health Physics Technician (or individual) will log the time the individual leaves the area and the individuals DRD reading. If the individual returns to the work area, another signature entry (and corresponding line entries) must be made on the sign in sheet.

5.7 Modifying the RWP.

5.7.1 In the event that conditions or scope of the work changes that do not justify the generation of a new RWP, modifications of the RWP may be made by the Health Physics Technician and the Project Manager.

5.7.2 To modify the RWP, each change will be made with a single line cross out of the text or item. The RSO representative and the Project Manager shall both initial and date adjacent to each change.

5.7.3 The RSO representative shall communicate all changes to the individuals working under the RWP.

5.8 Terminating the RWP.

5.8.1 The RWP is terminated when the end date of the RWP is reached or can be terminated by one of the following reason

a) The job has been completed,
b) There is a significant change in the scope of work,
c) There is a significant change in the radiological conditions,
d) There has been violations of the RWP requirements,
e) The RWP is revised.

5.8.2 When the RWP is terminated before the end date, a single line is drawn through the end date and a new end date recorded in its place. The person terminating the RWP initials adjacent to the change. The RWP can be terminated by the Health Physics Technician, RSO representative, or the Project Manager.

6.0 Attachments

ARP Form 6-1 Radiation Work Permit
ARP Form 6-2 RWP Access Log

Aguirre Engineers, Inc.

HIGH HAZARD SERVICES

RADIOLOGICAL WORK PERMIT

RSO USE ONLY	
Permit Number	PA-98-1
Effective Date: 2/04/1998	Expiration Date: 5/15/1998

GENERAL INFORMATION (to be completed by the requester)

Requested by	Request Number	Group	Phone No.	Mail Stop
Thomas J. O'Dou	1	HHS	0-2814	100

Work Location	Building	Substructure	Room No.
Picatinney Arsenal	B	NA	NA

Site QA Plan	Site Health and Safety Plan	Site Work Plan	Requested Start Date	Expected End Date
PA-QA-1	PA-HS-1	PA-WP-1	2/11/1998	5/15/1998

Work to be performed *(add attachment if necessary)* ☐ An RSC review is needed ☐ An RSC review is attached

Decontaminate facility to releaseable specifications in accordance with the decommissioning plans.

PRE-JOB RADIOLOGICAL CONDITIONS (to be completed by the RCT/HPT)

☐ Anticipated radiological conditions (enter anticipated conditions if survey cannot be performed before work begins), or

☐ Measured radiological conditions *(Record all readings as highest / general area.)* ☐ See attached map

Surface Contamination (dpm/100 sq cm)

	Direct	Smear	LAS (large area swipe)
Alpha	1000	1000	5000
Beta/gamma	10000	10000	20000
Tritium			

External Dose Rate (mrem/hr in work area)

Beta + gamma	0.1
Neutron	0
Total (b + g + n)	0.1

Identify anticipated radionuclides:
U-238 U-234 Th-234
Pa-234 Pa-234m

Airborne Radioactivity — Radionuclide U238, DAC 1 MAX — ☐ Anticipated ☐ Measured

Identify any contamination under paint or on inaccessible surfaces:
Embedded into concrete surfaces

Completed by RCT / HPT	Name	Signature	Date
☐ Completed	Thomas J. O'Dou	Thomas J. O'Dou	2/04/1998

ALARA/RADIOLOGICAL PROTECTION REQUIREMENTS (to be completed by the RCT)

Protective Clothing Requirements

- [ ] None
- [ ] Level I (Coveralls, 2 pair surgeon's gloves, and booties)
- [x] Level II (2 Coveralls, 2 pair surgeon's gloves, and 2 pair booties)
- [ ] Lab coat
- [ ] Hood
- [ ] Skull cap
- [ ] Taped openings
- [ ] Booties
- [ ] Gloves
- [ ] Other: When scabbling

Respiratory Requirements

- [ ] None
- [ ] SCBA
- [ ] Full-face respirator
- [ ] Ventilation
- [ ] Chemical cartridge
- [ ] Particulate cartridge
- [ ] Respiratory fit test card
- [ ] Supplied air suit
- [ ] Job-specific air monitoring
- [ ] Supplied air mask
- [ ] Combination cartridge
- [ ] Other: AS needed for personal comfort

Dosimetry Requirements

- [ ] TLD finger rings
- [ ] None
- [x] WB dosimeter
- [ ] Supplemental dosimeter
- [ ] Special urinalysis
- [ ] Nasal swipes
- [ ] Neutron dosimeti
- [ ] Alarming dosimeter
- [ ] Whole-body count
- [ ] Other:

Monitoring Requirements

- [ ] None
- [ ] Notify RCT before job starts (
- [ ] Intermittent coverage
- [ ] Personnel before leaving job
- [ ] Notify RCT at job end
- [x] Continuous coverage
- [ ] Self-frisking
- [ ] RCT monitor doffing of anti-Cs
- [ ] Equipment and tools before removal
- [x] Other When inside containment

Training Requirements

- [ ] Rad worker 1
- [ ] Rad worker 2
- [ ] Other:

Additional ALARA Requirements

- [ ] None
- [ ] ALARA pre-job briefing
- [ ] Alara review (see attachment)

Completed by RCT	Name	Signature	Date
[ ] Completed	Thomas J. O'Dou	Thomas J. O'Dou	2/04/1998

HOLD POINTS / SPECIAL INSTRUCTIONS (to be completed by the RCT)

Hold Points or Special Instructions:

When outside containment structure, and deconning, then a single set of PCs is allowed.

When outside the containment structures and no work is going on then booties are allowed when in the work area.

Completed by RCT	Name	Signature	Date
[ ] Completed	Thomas J. O'Dou	Thomas J. O'Dou	2/04/1998

Radiological Work Permit PA-98-1

APPROVALS

	Name	Signature	Group	Date
1. Line Manager ☐ Approved	Thomas J. O'Dou	Thomas J. O'Dou		2/04/1998
2. RCT Supervisor ☐ Approved	Dixie J. Wells	Dixie J. Wells		2/04/1998
3. Facility Manager ☐ Approved				
4. Other ☐ Approved				

POST-JOB RADIOLOGICAL CONDITIONS (to be completed by the RCT/HPT)

Measured Radiological Conditions *(Record all readings as highest / general area.)* ☐ See attached map

Surface Contamination (dpm/100 sq cm)

	Direct	Smear	LAS (large area swipe)
Alpha			
Beta/gamma			
Tritium			

External Dose Rate

Beta + gamma	
Neutron	
Total (b + g + n)	

Airborne Radioactivity

DAC ☐ Estimated

Radionuclide ☐ Measured

Survey of Personnel Leaving Job Site

☐ Any personnel contaminated above applicable limits *(If yes, attach the Radiological Incident Report.)*

Completed by RCT / HPT)	Name	Signature	Date
☐ Completed			

REVIEW

Associated reports for this job *(indicate the ones that apply):*

☐ CAM results	☐ Nasal swipe data	☐ RWP acknowledgement log
☐ Job-specific air monitoring	☐ Urinalysis report	☐ Dose tracking report
☐ Pre-job survey data	☐ Whole-body count	☐ Radiological occurrence/incident report
☐ Post-job survey data	☐ Wound count	☐ Changes in ALARA/rad protection reqs
☐ Finger-ring data	☐ Skin contamination	☐ ALARA pre-job briefing
☐ Special dosimetry results	☐ Personal clothing survey	☐ Formal ALARA review
☐ Other		

☐ Lessons learned (If Yes, then briefly explain. Add attachment if necessary.

Reviewed by RCT	Name	Signature	Date
☐ Reviewed			
Reviewed by RCT Supervisor	**Name**	**Signature**	**Date**
☐ Reviewed			

Aguirre Engineers, Inc.

RWP Access Log

RWP No. _____ Revision No. _____ Date _____

Work Location _____ Start Date _____ End Date _____

Date	Name	SSN/IDN	Badge/TLD	PIC/DRD #	Time In	Time Out	Dose In	Dose Out	Total Dose	Resp (✓)

Page ____ of ____

Form ARP 6-2 - RWP Access Log - 1/98

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Air Sampling and Sample Analysis

ARP-007

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist Date

Aguirre Engineers, Inc.

Procedure ARP 007
Air Sampling and Air Sample Analysis

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

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5	0	2/3/98						
6	0	2/3/98						
7	0	2/3/98						
8	0	2/3/98						

This table provides the most recent changes to pages in this document. A '0' means the original page is valid, a date in the revision level box indicates the date of the most recent change to the page indicated.

ARP - 007
Air Sampling and Sample Analysis

1.0 Purpose and Scope

1.1 This procedure provides the methods AEI utilizes in operation of air samplers and calculation of radioactive particulate activity in air samples. This procedure describes the method used to calculate DAC hour exposures to workers. Adherence to this procedure will provide reasonable assurance that the surveys performed have accurate and reproducible results.

1.2 This procedure will be used by AEI to operate air samplers during surveys and work activities at customer facilities and calculate and record DAC-Hour exposures to workers. Air samples are performed when the average removable alpha and beta contamination on facility surfaces, equipment and waste packages exceed the contamination limits specified in table 1 of the radiation safety manual. Air monitoring shall be performed in areas with the potential to exceed 10 percent of any derived air concentration (DAC

2.0 General

2.1 Definitions

2.1.1 Restricted Area - An area containing radioactive materials to which access is controlled to protect individuals from exposure to ionizing radiation.

2.1.2 Smear sample survey - A survey technique using filter papers (smears) to determine quantities of alpha and beta emitting radioactive material which can be removed from facility surfaces and waste packages.

2.1.3 Air sample survey - A survey technique which collects particulates from a known volume of air and determines the concentrations of radioactive materials associated with the airborne particulates.

2.1.4 Annual Limit on Intake (ALI). - The annual limit on intake (ALI) of radioactive materials is the smaller amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year (40 hours per week for 50 weeks) that would result in a committed effective dose equivalent (CEDE) of 5 rem or a committed dose equivalent (CDE) of 50 rems to any individual organ or tissue.

2.1.5 Derived Air Concentration (DAC). - Derived air concentration is the concentration of a given radionuclide in air which, if breathed by the "reference man" for a working year (40 hours per week for 50 weeks) under the conditions of light work (inhalation rate of 1.2 cubic meters of air per hour), results in an intake of one ALI.

2.1.6 DAC-Hour - The product of the concentration of radioactive material in air (expressed as a multiple of the derived air concentration for each nuclide) and the time of exposure to that nuclide, in hours. 2000 DAC-Hours represents one ALI.

2.1.7 Airborne Radioactivity Area. - A room, enclosure or area in which radioactive material is dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases and the concentration of the dispersed radioactive materials is in excess of:

a) The derived air concentrations (DAC's) specified in Table 1, column 3 of Appendix B, Title 10 Part 20 of the Code of Federal Regulations (Also noted in Appendix B of this manual), or

b) Concentrations such that an individual present in the area without respiratory protective equipment could exceed, during the hours the individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI).

2.2 Quality Control

The alpha/beta sample counter used to count air samples will be calibrated daily with a radioactive source with activity traceable to the National Institute of Standards and Technology (NIST).

3.0 References, Records and Equipment

3.1 References

RSM	Radiation Safety Manual
ARP-002	Alpha-Beta Sample Counting Instrumentation
RG 8.25	*Air sampling in the Workplace*

3.2 Records

ARP Form 1-1	Daily Calibration Log.
ARP Form 2-4	Sample Calculation Worksheet.
ARP Form 7-1	Air Sample Data Sheet
ARP Form 7-2	Daily Air Sample Record
ARP Form 7-3	Daily Air Sample Record Continuation Sheet
ARP Form 7-4	Airborne Particulate Radiological Survey Form

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for insuring that all personnel assigned the task of air sampling and air sampling analysis are familiar with this procedure and are adequately trained with the specific instrument being used to perform surveys.

4.2 Radiation Safety Officer (RSO) - The RSO is responsible for monitoring compliance with this procedure and training personnel in the use of the air sampling and air sampling analysis. The RSO can also assist in the interpretation of results obtained during surveys.

4.3 Project Manager (PM)- The PM is responsible for ensuring a copy of this procedure is available at the job site and that field technicians follow this procedure.

4.4 Technicians - Technicians performing air sampling and air sampling analysis are responsible for knowing and complying with this procedure.

5.0 Procedure

5.1 Initial Preparations

5.1.1 Select the air sampler to be used for the type of sample and verify that the instrument has a currently valid calibration. If the work area contains radioiodine or radioactive gases of tritium, contact the radiation safety officer for special sampling procedures before proceeding.

a) Area air samples are normally collected with a low volume sampler having a nominal air flow of 1 CFM to 5 CFM.

b) Breathing zone air samples are normally collected using lapel air samplers which have a nominal air flow of 1 to 3 liters per minute.

c) All air sampling devices shall be calibrated to ensure accurate sample volumes are collected. The frequency of calibration shall not exceed one (1) year.

5.1.2 Attach the air sampling head to the air intake of the low volume sample pump or to the tygon tubing of the lapel sampler.

5.1.3 Obtain the filter paper to be used in the sample and mark the back side of the filter with a unique number which will represent the sample. During collection and handling of air sample filter papers, caution must be used to prevent the samples from being contaminated by other radioactive materials.

5.1.4 Place the filter paper in the holder and position the sampler as indicated below:

a) Area air samples are collected by placing the sample head at a distance of 3 to 6 feet above the floor and as close to the work location as practical. If there is an air flow in the work area the sampler should be placed "down wind" of the area where workers will be resuspending radioactive particulates into the workers atmosphere.

b) Lapel air samples are collected from the workers breathing zone. The sample head is attached to the shoulder of the worker with the sample head facing forward. The tygon tubing connecting the sample head to the pump is run down the back of the worker with the sample pump attached to the workers belt.

5.2 Collecting the sample

5.2.1 When the sample head is in position, start the sample pump and adjust the flow rate to the highest flow rate which can be maintained without flow rate fluctuations.

5.2.2 Record the time the sample was started and the initial flow rate of the sample pump on ARP Form 7-1, the Air Sample Data Sheet.

5.2.3 If possible, identify the radionuclides which will be encountered in the work area and record the radionuclides along with the DAC for each radionuclide in the space provided on the Air Sample Data sheet. If a mixture of radionuclides are present, the DAC used in calculations of DAC-Hours will be the most restrictive concentration.

5.2.4 Collect the sample for the maximum time possible which represents the exposure encountered by the worker.

5.2.5 At the end of the collection period, note flow rate of the sample pump and record this flow rate and the time which sampling stopped on the Air Sample Data sheet.

Caution: Be sure not to remove activity from the sample surface. Handle the filter carefully.

5.2.6 Remove the sample filter and place the filter in an individual envelope or poly bag to ensure no possibility of contamination by other sources of radioactivity.

5.2.7 Record the names of workers who were in the area and the time spent in the work area on the Air Sample Data sheet.

5.2.8 Determine the average sample flow rate by adding the starting sample flow rate and the ending sample flow rate and dividing by 2. Record the average sample flow rate in the space provided on the Air Sample Data sheet.

5.2.9 Calculate the total air volume sampled by multiplying the average sample flow rate in cubic centimeters per minute by the total minutes the sampler operated using the indicated spaces on the Air Sample Data sheet.

5.3 Determining minimum detectable activities (MDA). - During calculations of air concentrations in the following sections, the MDA for each analysis is calculated to determine the statistical significance of the calculated air concentrations.

5.3.1 For each air concentration calculation (alpha and beta) in the following sections, calculate the MDA using the following formula:

$$MDA\ in\ uCi/cm^3 = \frac{2.71 + 3.29\sqrt{\frac{R_B}{T_B} + \frac{R_B}{T_{S+B}}}}{(2.22X10^6)(E)(V)}$$

Where:

E = Counter efficiency in CPM/DPM
R_B = Background Count Rate in CPM
T_B = Background Counting Time in minutes
T_{S+B} = Sample Counting Time in minutes
V = Sample Volume in cm^3
2.22×10^6 = Disintegrations per minute per microCurie (DPM/μC)

5.3.2 If the MDA is larger than 10% of the Derived Air Concentration, recount the background to lower the MDA. (The maximum counting time should not exceed 1 hour for background and 30 minutes for the sample.) Enter the MDA for each air concentration calculated in the space provided on the Air Sample Data sheet.

5.4 Initial air sample analysis - The initial analysis of the air sample provides the air concentrations for short lived radionuclides and a first estimate of the long lived air concentrations. In situations in which there is a potential for worker intakes to exceed 40 DAC-hours in a week or if the radionuclides of interest are short lived, air samples should be analyzed promptly (within 15 minutes)on a daily basis. Sample results should be available before work resumes the following day.

5.4.1 Air particulate samples are to be analyzed as a minimum for gross alpha and gross beta activity using a Ludlum Model 2929 Dual Channel Scaler or equivalent.

5.4.2 Place the air sample in the sample counter with the collection side toward the detector. Count the air sample and calculate sample activity as described in ARP-002 and record results on ARP Form 2-4.

5.4.3 Record the Alpha and Beta sample DPM results from AEI form 2-4 to the Air Sample Data sheet.

5.4.4 Calculate the alpha and beta air concentrations using the following formula.

$$AIR\ CONCENTRATION\ IN\ uCi/CM^3 = \frac{ALPHA\ or\ BETA\ DPM}{(2.22X10^6\ DPM/uCi)(\ SAMPLE\ VOLUME\ IN\ CM^3)}$$

5.4.5 Enter the alpha and beta air concentrations on the Air Sample Data sheet in the space provided for initial air concentrations.

NOTE: If the air sample concentration is greater than 10% of the DAC value, notify the RSO and control the exposure to workers to minimize intake of radioactive materials.

5.4.6 If the air concentration is less than 10 percent of the most restrictive DAC, no further analysis of the air sample is required. If the air concentration exceeds 10% of the DAC concentration, proceed with the analysis in section 5.5.

5.5 Air sample analysis for long lived radionuclides - This analysis allows for the decay of naturally occurring radionuclides and provides equations for correcting air concentrations for naturally occurring radionuclides.

5.5.1 Air particulate samples are analyzed following 4 hours, 24 hours and one week of decay for gross alpha and gross beta using a Ludlum Model 2929 Dual Channel Scaler or equivalent.

5.5.2 Place the air sample in the sample counter with the collection side toward the detector. Count air sample and calculate sample activity as described in ARP-002 and record results on AEI Form 2-4. In the Sample No. Column also record the time when the air sample was counted.

5.5.3 Record the Alpha and Beta sample DPM results from ARP Form 2-4 to the Air Sample Data sheet.

5.5.4 Calculate the alpha and beta air concentrations using the following formula.

$$AIR\ CONCENTRATION\ IN\ uCi/CM^3 = \frac{ALPHA\ or\ BETA\ DPM}{(2.22X10^6\ DPM/uCi)(\ SAMPLE\ VOLUME\ IN\ CM^3)}$$

5.5.5 Enter the alpha and beta air concentrations on the Air Sample Data sheet in the space provided for 4 hour decay air concentrations. If the 4 hour decay air concentration is below 10% of the DAC no further analysis is required.

5.5.6 If the 4 hour air concentration is above 10% of the DAC value, recount the air sample following 24 hours of decay from the time the sample was stopped. Calculate the air concentration using the formula in step 4. and record the air concentrations in the space provided for the 24 hour decay concentration on the Air Sample Data sheet. If the 24 hour decay air concentration is below 10% of the DAC value no further analysis is required.

5.5.7 If the air concentration is above 10% of the DAC the sample concentrations are corrected for radon using the following formula:

$$A_{LL} = \frac{A_{24} - A_4\,(e^{-0.0655(\Delta T)})}{(1 - e^{-0.0655(\Delta T)})}$$

Where:

A_{LL} = Long lived air concentration
A_4 = Air concentration following 4 hour of decay
A_{24} = Air concentration following 24 hour of decay
0.0655 = Pb-212 decay constant
ΔT = Elapsed time (in hours) between 4 hour decay count and 24 hour decay count

5.5.8 Record the long lived air concentration obtained using the above formula in the calculated air concentration space on the Air Sample Data sheet. If the calculated long lived air concentration is below 10% of the DAC value no further analysis is required.

5.5.9 If the calculated long lived air concentration (A_{LL}) is above 10% of the DAC, save air sample and recount following one week of decay.

5.5.10 Calculate the air concentration using the following formula and record the results in the one week decay space on the Air Sample Data sheet.

$$AIR\ CONCENTRATION\ IN\ uCi/CM^3 = \frac{ALPHA\ or\ BETA\ DPM}{(2.22X10^6\ DPM/uCi)(\ SAMPLE\ VOLUME\ IN\ CM^3)}$$

5.5.11 If air concentrations exceed 10% of the DAC values notify the RSO for further instructions. Save the air sample for possible further analysis. For air samples which exceed 10% of the DAC values, an exposure is assigned to the workers residing in the area where the sample was taken.

5.6 *Assignment of DAC-Hour exposures to workers*

5.6.1 For air samples which exceed 10% of the DAC values, calculate the workers DAC-Hour exposure using the following formula:

$$Exposure\ in\ DAC\text{-}Hours = \frac{A \times B}{C}$$

Where:

A = Area or Lapel air sample concentration in uCi/cm^3
B = Hours worker was in the calculated air concentration
C = DAC air concentration in uCi/cm^3 from regulatory reference

5.6.2 Enter DAC-Hour exposure in the column provided on the Air Sample Data sheet. If respiratory protection was used during the exposure period, contact the RSO for the protection factor used to adjust DAC-Hour exposure.

6.0 Attachments

ARP Form 7-1	Air Sample Data Sheet
ARP Form 7-2	Daily Air Sample Record
ARP Form 7-3	Daily Air Sample Record Continuation Sheet

Aguirre Engineers, Inc.

Air Sample Data Sheet

Sample # _____ Date _____

Description: _____

_____

Radionuclides: _____ DAC value: _____

_____ DAC value: _____

_____ DAC value: _____

_____ DAC value: _____

_____ DAC value: _____

Initial sample flow rate: _____ Time sampler on: _____

Final sample flow rate: _____ Time sampler off: _____

Average sample flow rate: _____ Total sample time: _____hours

Total sample volume: _____cm^3

Initial Air Concentration:

Alpha = _____$\mu Ci\ \alpha/cm^3$ Beta = _____$\mu Ci\ \beta/cm^3$

MDA = _____$\mu Ci\ \alpha/cm^3$ MDA = _____$\mu Ci\ \beta/cm^3$

4 Hour Decay Air Concentration:

Alpha = _____$\mu Ci\ \alpha/cm^3$ Beta = _____$\mu Ci\ \beta/cm^3$

MDA = _____$\mu Ci\ \alpha/cm^3$ MDA = _____$\mu Ci\ \beta/cm^3$

24 Hour Decay Air Concentration:

Alpha = _____$\mu Ci\ \alpha/cm^3$ Beta = _____$\mu Ci\ \beta/cm^3$

MDA = _____$\mu Ci\ \alpha/cm^3$ MDA = _____$\mu Ci\ \beta/cm^3$

Calculated Long Lived Air Concentration:

Alpha = _____$\mu Ci\ \alpha/cm^3$ Beta = _____$\mu Ci\ \beta/cm^3$

MDA = _____$\mu Ci\ \alpha/cm^3$ MDA = _____$\mu Ci\ \beta/cm^3$

One Week Decay Air Concentration:

Alpha = _____$\mu Ci\ \alpha/cm^3$ Beta = _____$\mu Ci\ \beta/cm^3$

MDA = _____$\mu Ci\ \alpha/cm^3$ MDA = _____$\mu Ci\ \beta/cm^3$

Worker Name	Time In	Time Out	Total Time (Hrs)	DAC-Hour Exposure

Aguirre Engineers, Inc.

Daily Air Sample Record

DATE:_____ PAGE ___ OF ___

COUNTING and AIR SAMPLING INSTRUMENTATION

METER MODEL/SERIAL NO		CAL DUE DATE	PROBE MODEL NO	SERIAL NO
A/ SAMPLER MODEL #		SERIAL NO	AIR FLOW RATE	CAL DUE DATE

COUNTER BACKGROUND AND EFFICIENCY DATA

COUNT TIME (minutes)		SOURCE S/N	ACTIVITY (dpm)	RADIONUCLIDE
BKGD COUNTS	BKGD CPM	EFF. COUNTS	CORRECTED CPM	% EFFICIENCY

TECHNICIAN (Print/*Sign*): _____

AIR SAMPLE DATA

SAMPLE I.D.			
A/S FLOW (cfm)	A/S TIME ON	A/S TIME OFF	NET TIME (min)
TIME COUNTED	COUNT TIME	TOTAL COUNTS	ACTIVITY uCi/cc

TECHNICIAN (Print/*Sign*): _____

AIR SAMPLE DATA

SAMPLE I.D.			
A/S FLOW (cfm)	A/S TIME ON	A/S TIME OFF	NET TIME (min)
TIME COUNTED	COUNT TIME	TOTAL COUNTS	ACTIVITY uCi/cc

TECHNICIAN (Print/*Sign*): _____

REVIEWED BY (Print/*Sign*): _____

ACTIVITY FORMULA FOR 2" FILTER PAPER:

$$\frac{\text{CORRECTED COUNTS PER MINUTE}}{\text{6.2E10*NET SAMPLE TIME*FLOW RATE*EFFICIENCY}}$$

Aguirre Engineers, Inc.

Daily Air Sample Record
Continuation Sheet

DATE:____________ PAGE ___ OF ___

AIR SAMPLE DATA

SAMPLE I.D.			
A/S FLOW (cfm)	A/S TIME ON	A/S TIME OFF	NET TIME (min)
TIME COUNTED	COUNT TIME	TOTAL COUNTS	ACTIVITY uCi/cc

TECHNICIAN (Print/*Sign*): ________________________

AIR SAMPLE DATA

SAMPLE I.D.			
A/S FLOW (cfm)	A/S TIME ON	A/S TIME OFF	NET TIME (min)
TIME COUNTED	COUNT TIME	TOTAL COUNTS	ACTIVITY uCi/cc

TECHNICIAN (Print/*Sign*): ________________________

AIR SAMPLE DATA

SAMPLE I.D.			
A/S FLOW (cfm)	A/S TIME ON	A/S TIME OFF	NET TIME (min)
TIME COUNTED	COUNT TIME	TOTAL COUNTS	ACTIVITY uCi/cc

TECHNICIAN (Print/*Sign*): ________________________

AIR SAMPLE DATA

SAMPLE I.D.			
A/S FLOW (cfm)	A/S TIME ON	A/S TIME OFF	NET TIME (min)
TIME COUNTED	COUNT TIME	TOTAL COUNTS	ACTIVITY uCi/cc

TECHNICIAN (Print/*Sign*): ________________________

REVIEWED BY (Print/*Sign*):________________________

Aguirre Engineers, Inc.

Airborne Particulate Radiological Survey Form

Location/Area	Purpose	RWP#	Date	Time

Type ☐ Lapel/Breathing Zone ☐ General Area ☐ Alpha ☐ Beta ☐ Media	Requestor

Instrument and Probe Type and Serial Number		Surveyor(s) Printed Name	Surveyor(s) Signature

SAMPLING INFORMATION

#	Name (BZ) or Specific Location (GA)	Sampler Type	Sampler S/N	Cal Date	Start Time	Stop Time	Rotometer Start	Rotometer Stop	Start Flow Rate (L)	Stop Flow Rate (L)	Average Flow Rate (L)	Total Volume (ml) *V*

COUNTING INFORMATION

Beta-Gamma Airborne Radioactivity

Efficiency (*E*) _____ $\frac{cpm}{dpm}$ / Isotope _____

Counting Data Attached ☐ Yes ☐ No

#	Count Date/Time	Gross cpm (*S*)	Bkgd cpm (*B*)	µCi/ml (*I*)	MDA (µCi/ml)	DAC	DAC Fraction (*2*)	DAC Hours (*3*)

Alpha Airborne Radioactivity

Efficiency (*E*) _____ $\frac{cpm}{dpm}$ / Isotope _____

Counting Data Attached ☐ Yes ☐ No

Count Date/Time	Gross cpm (*S*)	Bkgd cpm (*B*)	µCi/ml (*I*)	MDA (µCi/ml)	DAC	DAC Fraction (*2*)	DAC Hours (*3*)

Conversions: ft^3 x 2.8E4 = ml m^3 x 1E6 = ml liter x 1E3 = ml FA = 1.05 (Glass Fiber Filter)

NOTE: If DAC fraction using gross alpha and.or beta activity is greater than 0.1 for most limiting radionuclide, may prform nuclide identification (w.g., gamma spectroscopy) to determine actual limit.

Remarks:

Completed By: Date	Reviewed/Approved By: Date

Last form

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Radiation and Contamination Surveys

ARP-008

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist Date

Aguirre Engineers, Inc.

Procedure ARP 008
Radiation and Contamination Surveys

LIST OF EFFECTIVE PAGES
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6	0	2/3/98						

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ARP - 008
Radiation and Contamination Surveys

1.0 Purpose and Scope

1.1 This procedure provides the methods AEI uses to perform and document radiation and contamination surveys. Adherence to this procedure will provide reasonable assurance that the surveys performed have reproducible results. Adherence to this procedure also provides adequate control of radiation exposures which meets AEI's goal of maintaining radiation exposures As Low As Reasonably Achievable (ALARA).

1.2 This procedure will be used by AEI personnel to perform radiation and contamination surveys at customer facilities. The following types of surveys may be performed using this procedure;

1.2.1 Surveys performed for shipping radioactive materials.

1.2.2 Surveys performed to characterize facilities, sites, and items contaminated with radioactive materials.

1.2.3 Surveys performed to provide direction in decontamination and decommissioning facilities and sites.

2.0 General

2.1 Definitions

2.1.1 Restricted Area - An area containing radioactive materials to which access is controlled to protect individuals from exposure to ionizing radiation.

2.1.2 Contamination Survey - A survey technique to determine fixed and removable radioactive contamination on components and facilities.

2.1.3 Radiation Survey - A survey technique to determine radiation exposure rates to individuals working in areas containing radioactive materials.

2.1.4 ALARA - An approach to radiation exposure control to maintain personnel exposures as far below the federal limits as technical, economical and practical considerations permit.

2.2 Quality Control

2.3.1 Instrumentation used in the surveys will be checked with standards daily and verified to have current valid calibration.

2.3.1 All radiation and contamination surveys will be reviewed by the Radiation Protection Supervisor and the RSO for accuracy and completeness.

3.0 References, Records and Equipment

3.1 References

10 CFR 20, Subpart F	*Surveys and Monitoring*
10 CFR 20.2103	*Records of Surveys*
RSM	Radiation Safety Manual
ARP-001	Operation of Contamination Survey Meters
ARP-002	Alpha-Beta Sample Counting Instrumentation
ARP-003	Operation of Micro-R Survey Meters
ARP-004	Operation of Ionization Chambers
ARP-015	Personnel Protective Clothing
ARP-016	Radioactive Materials Brokering

3.2 Records

ARP Form 8-1	Radiological Survey Report
ARP Form 8-2	Radiation and Contamination Survey
ARP Form 8-3	Radiation and Contamination Survey Results

3.3 Equipment

Radiation and Contamination Survey Meters will be selected based on job-specific requirements and will be identified in the Site Specific Work Plan.

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for insuring that all personnel assigned the task of performing radiation and contamination surveys are familiar with this procedure and are adequately trained with the specific instrument being used to perform surveys.

4.2 Radiation Safety Officer (RSO) - The RSO is responsible for monitoring compliance with this procedure and training personnel in performing radiation and contamination surveys. The RSO can also assist in the interpretation of results obtained during surveys.

4.3 Waste Broker - The Waste Broker is responsible to interpret and utilize the results of surveys in the shipment and characterization of waste to comply with applicable federal regulations.

4.4 Project Manager (PM)- The PM is responsible for ensuring a copy of this procedure is available at the job site and that field technicians follow this procedure.

4.5 Technicians - Technicians performing radiation and contamination surveys are responsible for knowing and complying with this procedure.

5.0 Procedure

5.1 Initial Preparations

5.1.1 Obtain and review any previous surveys performed in the area to determine radiation conditions which will be encountered.

5.1.2 Obtain appropriate survey instruments and prepare the instruments for use.

5.1.3 Obtain the necessary forms, smears, and protective clothing which will be used during the survey.

5.1.4 Plan the strategy for performing the survey before entering the area to reduce exposure time in the area.

5.1.5 If smearable contamination is expected to be above allowable limits, set up an anticipated contamintion entry into the area which will prevent the spread of contamination from the area.

5.2 Radiation Surveys

5.2.1 If radiation levels are unknown or previous surveys are in question, first measure general radiation levels in the area with the Micro-R-Meter or the Dose Rate Meter to determine if elevated radiation levels exist in the survey area. Alert personnel who will be working in the area of any elevated levels.

5.2.2 Small Areas/Items/Waste Containers - This survey technique is used to establish exposure rates from small areas, items or containers which contain radioactive materials.

a) Scan the entire surface area of the area, item, or container with a Micro-R-Meter or Dose Rate Meter and record the location and readings found on ARP Form 8-1.
b) Measure the exposure rate at 1 meter from all surfaces or sides of the area, item or container and record the location and readings on ARP Form 8-1.

5.2.3 Facility Surveys - This survey technique is used to release facilities (buildings, etc) to "unrestricted" status or determine status of facilities requiring decontamination and decommissioning.

a) Establish a 1 meter by 1 meter grid system of the facility surfaces using marking system which assigns a unique number/letter system to the center of each grid. Graphically illustrate the location of the grid system on ARP Form 8-2.

b) Using a Micro-R-Meter obtain radiation levels at 1 meter from the grid center point and at contact with the grid center point. Record reading on ARP Form 8-3. If elevated readings are noted, scan the surface of the grid and note location of any elevated areas with marker and on ARP Form 8-3.

c) Obtain four Micro-R-Meter readings from locations surrounding the facility or within the facility which do not contain activity. This establishes a background level for comparison to the reading taken in step b above.

5.2.4 Area Surveys - This survey technique is used to release land masses to "unrestricted" status or determine status of areas requiring decontamination before release.

a) Establish a 10 meter by 10 meter grid system of the area to be surveyed using surveyor stakes which are numbered with a unique number/letter system to identify the center of each grid. Graphically illustrate the location of the grid system on ARP Form 8-2.

b) Using a Micro-R-Meter obtain radiation levels at 1 meter from a grid corner point and at contact with the surface of the ground. Record readings on ARP Form 8-3.

c) Survey the remainder of the grid at the surface using a "S" walking pattern. If elevated readings are noted above or below the grid center point reading, subdivide the grid into 9 subgrids (3 subgrids X 3 subgrids) and obtain readings at 1 meter above the ground surface, and obtain contact readings in the center of each subgrid. Record readings on ARP Form 8-3.

5.3 Contamination Surveys

5.3.1 If removable contamination is suspected or previous surveys are in question, first scan likely contaminated surfaces with an α and/or β probe to determine if elevated areas of contamination exist. Obtain smear samples from any elevated areas and count smears in sample counter. If smearable contamination is found use appropriate protective clothing and entry control techniques to prevent the spread of contamination.

5.3.2 Small Areas/Items/Waste Containers - This survey technique is used to establish contamination levels on small areas, items and containers which contain radioactive materials.

a) If the area, item or waste container contains alpha activity, scan the area with an alpha probe at ¼ inch above the surface. Note readings on survey ARP Form 8-1.

b) Hold the ß probe at approximately ½ inch above the surface to be surveyed and obtain reading following meter stabilization. Record meter reading on ARP Form 8-1. The surface of a waste container can be surveyed for beta activity only if the radiation level from the container does not elevate the beta probe background. If the background level is below 200 CPM, scan the surface of the container and note readings on survey ARP Form 8-1.

c) To determine the removable surface contamination on areas or items first take a large area smear (LAS) using a paper hand towel or masslin cloth and count the smear in a low background area using the alpha and beta probes. If no contamination is found on the LAS, take 100 cm^2 swipe for every 2 square foot of surface area and count swipes for α and β activity in sample counter. Record the results of smear activity on ARP Form 8-1.

d) For waste containers, a LAS should be taken from the bottom, top, and sides of the container. If no contamination is found on the LAS, take 300 cm^2 swipe for every 2 square foot of surface area and count swipes for α and β activity in sample counter. Take one smear each from the container sealing area, lid, and container contact points with ground or floor. Record results of smear activity on ARP Form 8-1. If contamination levels are above limits, decontaminate surface of container and repeat survey.

5.3.3 Facility Surveys - This survey technique is used to release facilities (buildings, etc) to "unrestricted" status or determine status of facilities requiring decontamination and decommissioning.

a) The grid system established in section 5.2.3, step a) will also be utilized for contamination surveys.

b) Hold the ß probe at approximately ½ inch above the grid center point and obtain reading following meter stabilization. Record meter reading on ARP Form 8-3.

c) If readings are at background levels, randomly scan the remainder of grid concentrating on cracks, floor/wall joints, top of horizontal surfaces, ventilation ducts/grills, and other areas that might collect radioactive materials. Mark any locations above the release criteria on survey ARP Form 8-2.

d) If readings are at or neat the release levels scan grid surface and identify portion of the grid that is above release criteria. Note these areas on the survey form and mark the area of the grid with spray marker and on ARP Form 8-2.

e) Repeat steps b) through d) with an α probe.

If sufficient documentation of previous history is known about the facility, the α survey may not be required if;

- the α contamination is known not to be present, or
- the α measurements can be randomly taken of every 10th grid.

f) One smear sample from an 100 cm^2 area will be taken in each grid. If the above survey found no elevated readings in the grid, the smear sample will be taken in the center of the grid. If elevated readings are found, the smear sample will be taken from the area where the highest reading was obtained.

g) Each smear sample will be labeled with the grid location and counted for α and β activity in the sample counter. The smear sample results will be recorded on ARP Form 8-3.

5.3.4 Area Surveys - This survey technique is used to release land masses to "unrestricted" status or determine status of areas requiring decontamination before release.

a) The grid system established in section 5.2.4, step a) will also be utilized for contamination surveys.

b) Hold the β probe at ½ inch above the grid center point and obtain reading following meter stabilization. Record the meter reading on ARP Form 8-3.

c) If readings are at background levels, randomly scan the remainder of grid. Mark any locations above release criteria on survey ARP Form 8-2.

d) If readings are at or near the release levels scan grid surface and identify portion of the grid that is above release criteria. Note these areas on the survey ARP Form 8-2.

e) Areas contaminated with radioactive materials will require soil samples to determine the activity concentration. The quantity and location of samples will be determined on a case by case basis.

6.0 Attachments

ARP Form 8-1	Radiological Survey Report
ARP Form 8-2	Radiation and Contamination Survey
ARP Form 8-3	Radiation and Contamination Survey Results

Aguirre Engineers, Inc.

Radiological Survey Report

DATE: TIME:	INSTRUMENTATION USED				
SURVEY NUMBER:	MODEL	S/N	% EFF.	CAL DUE	BKG
LOCATION:					
SURVEYOR:					
REVIEWED BY:					
RSO/HP:					

Smear locations circled; Dose Rates = µR/hr, mR/hr, R/hr (Circle appropriate)

Survey Drawing:

LOCATIONS AND FIXED/SMEARABLE RESULTS

RESULTS = DPM/100 CM^2 SMEARABLE
or CPM/Probe Area FIXED
INDICATE FIXED (F) or SMEARABLE (S) on each

#	Alpha	Beta/Gamma

Description of Drawing: _____

Routine☐ (Daily/Weekly/Monthly) Nonroutine☐

Comments: _____

Page ___ of ___

Aguirre Engineers, Inc.

Radiation and Contamination Survey

DATE: TIME:	INSTRUMENTATION USED				
SURVEY NUMBER:	MODEL	S/N	% EFF.	CAL DUE	BKG
LOCATION:					
SURVEYOR:					
REVIEWED BY:					
RSO/HP:					

Number and Circle Survey Locations.

Survey Drawing of Grid Layout:

Description of Drawing: _____

Routine☐ (Daily/Weekly/Monthly) Nonroutine☐

Comments: _____

_____

_____

_____

Aguirre Engineers, Inc.

cpm or dpm?

Radiation and Contamination Survey Results

Date:	Time:	Survey Number:
Location:		Reviewed By:
Surveyor:		RSO/HP:

Location	Exposure Rate		Fixed + Removable		Removable		Comment
	Contact mR/hr	1 Meter mR/hr	Alpha cpm/probe	Beta/Gamma cpm/probe	Alpha dpm/100cm²	Beta/Gamma cpm/probe	

Description of Drawing: _____

Routine☐ (Daily/Weekly/Monthly) Nonroutine☐

Comments: _____

page 2-5
ARP or RWP ?

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Routine Radiological Surveys

ARP-009

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
P.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 009
Routine Radiological Surveys

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ARP - 009
Routine Radiological Surveys

1.0 Purpose and Scope

1.1 The purpose of this procedure is to establish the framework and define the requirements for AEI personnel performing routine radiological surveys. This procedure is primarily meant to be used at sites where radiological remediation or removal work is taking place.

1.2 This procedure provides the requirements for identifying, scheduling, and performing routine, clean area, radiation, contamination, and airborne surveys by radiation safety personnel. All remediation and facility areas that are radiologically controlled as well as non-radiologically controlled areas containing fixed contamination and areas adjacent to contaminated areas are within consideration for routine survey performance. This procedure does not include survey requirements for radiation generating devices and survey requirements specified in radiation work permits (RWPs).

The following activities are described in Section 5.0 of this procedure:

- Frequency Requirements for Routine Surveys
- Identifying and Scheduling Routine Surveys
- Using As Low As Reasonably Achievable (ALARA) Principles For Scheduling and Performing Surveys
- Performance of Routine Surveys
- Periodic Evaluation of Routine Surveys
- Management Notification

2.0 General

2.1 Definitions

2.1.1 Restricted Area - An area containing radioactive materials to which access is controlled to protect individuals from exposure to ionizing radiation.

2.1.2 Contamination Survey - A survey technique to determine fixed and removable radioactive contamination on components and facilities.

2.1.3 Radiation Survey - A survey technique to determine radiation exposure rates to individuals working in areas containing radioactive materials.

2.1.4 ALARA - An approach to radiation exposure control to maintain personnel exposures as far below the federal limits as technically, economically and practical considerations permit.

2.2 Safety Considerations

The safety requirements specified in the job specific HASP and Work Plans, along with the Radiation Safety Program Manual, and other safety documentation must be adhered to when performing routine surveys.

2.3 Quality Control

Instruments used to perform routine radiological surveys will be inspected for serviceability each day and checked against check sources to verify they are in proper working conditions per the applicable ARP. RWP ?

3.0 References, Records and Equipment

3.1 References

10 CFR 20, Subpart F	*Surveys and Monitoring*
10 CFR 20.2103	*Records of Surveys*
RSM	Radiation Safety Manual
ARP-001	Operation of Contamination Survey Meters
ARP-002	Alpha-Beta Sample Counting Instrumentation
ARP-003	Operation of Micro-R Survey Meters
ARP-004	Operation of Ionization Chambers
ARP-015	Personnel Protective Clothing
ARP-016	Radioactive Materials Brokering

3.2 Records

Radiological survey records, routine survey schedules, and tracking forms are generated during the performance of this procedure. The original of the records is the record copy for the Project files. The records are stored, arranged, indexed, retrieved, scheduled, retained, and disposed of in accordance with the project filing system.

3.3 Equipment RWP

All instruments used to perform routine surveys shall be used in accordance with the applicable ARP. All instruments will be supplied by the authorized suppliers of properly calibrated and maintained equipment.

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for insuring that all personnel assigned the task of performing routine radiological surveys are familiar with this procedure and are adequately trained to use the required instruments to perform surveys.

4.2 Radiation Safety Officer (RSO) - The RSO is responsible for monitoring compliance with this procedure and training personnel in the performance of routine radiological surveys. The RSO can also assist in the interpretation of results obtained during surveys.

4.3 Project Manager (PM)- The PM is responsible for ensuring a copy of this procedure is available at the job site and that field technicians follow this procedure.

4.4 Technicians - Technicians performing routine radiological surveys are responsible for knowing and complying with this procedure.

5.0 Procedure

5.1 Frequency Requirements for Routine Surveys

Appropriate routine radiological surveys shall be performed at the following frequencies as a minimum:

5.1.1 Radiation surveys:

- Daily, in the office spaces located in Radiological Buffer Areas where the potential exists for personnel to be exposed to external radiation.
- Weekly, in the routinely occupied Radiological Buffer Areas adjacent to the areas posted for the control of personnel having exposure to any external radiation and to the Radiation Areas.
- Upon initial entry after extended periods of closure.
- Daily, during continuous operation, and when levels are expected to change in High Radiation Areas.
- Weekly, for operating HEPA-filtered ventilation units.
- Weekly, for any temporary Radiation Area boundaries to ensure that the Radiation Areas do not extend beyond posted boundaries.
- Monthly, or upon entry if entries are less frequent than monthly, for Radioactive Material Storage Areas.
- Monthly, for potentially contaminated ducts, piping, and hoses in use outside the radiological facilities.

5.1.2 Contamination surveys:

- Daily, at contamination control points, radiological change areas, or step-off pads, when in use; or once per shift in high-use situations.
- Daily, in office spaces located in the Radiological Buffer Areas used with the Radiological Areas posted for the control of contamination or airborne radioactivity.
- Daily, in lunch rooms or eating areas adjacent to the Radiological Buffer Areas used with Radiological Areas posted for the control of contamination or airborne radioactivity.
- Weekly, for all designated lunchrooms for the project.
- Weekly, in routinely occupied Radiological Buffer Areas and in locker rooms or the shower areas adjacent to Radiological Buffer Areas used with the Radiological Areas posted for the control of contamination or airborne radioactivity.
- Weekly, or upon entry if entries are less frequent, in the areas where radioactive materials are handled or stored.
- Weekly, or upon entry if entries are less frequent, in the Radiological Buffer Areas used with radiological areas posted for the control of contamination or airborne radioactivity.
- Weekly, or upon entry if entries are less frequent, in the Controlled Areas adjacent to contamination boundaries or postings (i.e., Contamination Areas, High Contamination Areas, Airborne Radioactivity Areas, Radioactive Material Areas where material is used in the unsealed form in quantities exceeding the surface activity guidelines).

- Monthly, in areas with fixed contamination located outside of the controlled area boundaries.
- All project offices will be surveyed weekly.

5.1.3 Airborne Surveys:

Airborne survey frequency, locations, and methods are determined by the radiation work permits (RWPs) and by the RSO.

5.2 Identifying and Scheduling Routine Radiological Surveys

5.2.1 The RSO or designee shall identify and schedule routine surveys as required by the radiological conditions and work activities.

5.2.2 Routine survey schedules shall be developed using a standard system for designating surveys as follows:

Frequency of survey.

• Daily	D
• Weekly	W
• Monthly	M
• Quarterly	Q
• Semi-Annually	S
• Annually	A
• Upon Entry	U

Type of survey.

• Radiation	R
• Contamination	C
• Area TLD	T
• Air Sample	A/S
•	

Example: DRC-1

Where:

D: is the survey frequency (Daily in this example),
R: is a type of survey (Radiation in this example), and
C: is a type of survey (Contamination),
1 corresponds to the numerical sequence of the survey.

5.2.3 Routine survey schedules shall be submitted to and approved by the RSO.

5.2.4 Prepare routine survey tracking forms using the approved routine survey schedules.

5.2.5 Changes to any routine survey schedule shall be submitted to and approved by the RSO.

5.2.6 Typical forms are included in this procedure. Task Leaders may elect alternate forms containing, as a minimum, the information included on the typical forms.

5.3 Using As Low As Reasonably Achievable (ALARA) Principles for Scheduling and Performing Surveys

5.3.1 Routine surveys should not be performed in High Radiation Areas unless other work necessitates entry. Boundary verification surveys would be appropriate if an entry is not required.

5.3.2 Routine surveys should be performed in conjunction with other work surveys as much as practicable.

5.4 Performance of Routine Surveys

5.4.1 HPTs shall perform routine surveys in accordance with the applicable ARP.

5.4.2 Upon completion of a routine survey, the HPT shall initial the appropriate Routine Survey Tracking Form.

5.5 Periodic Evaluation of Routine Surveys

5.5.1 Routine survey schedules shall be reviewed and updated periodically to ensure that all areas within the project boundaries are receiving appropriate routine survey coverage.

5.5.2 Changes of conditions within the project area will be reported to the RSO and may require a modification of the routine radiological survey schedule.

5.6 Management Notification

5.6.1 The RSO shall be notified, in writing by the project manager, of any failure to complete a routine survey as scheduled. The missed survey will be completed within 24 hours of discovery that it was missed.

6.0 Attachments

ARP Form 9-1 Routine Survey Schedule
ARP Form 9-2 Daily/Weekly Routine Survey Tracking Form
ARP Form 9-3 Monthly Routine Survey Tracking Form

Aguirre Engineers, Inc.

Routine Survey Schedule

Project: _____

Survey Designation	Location of Survey

Prepared/Submitted By: _____
Technician Date

Reviewed/Approved By: _____
RSO/Manager Date

Page ___ of ___

Aguirre Engineers, Inc.

Daily/Weekly Routine Survey Tracking Form

Month _____ Survey Location _____ Survey Designation _____

Day	RWP # (If Applicable)	Survey Form Number	Comments	HPT
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				

Reviewed/Approved: _____

RSO/Manager

Date

Page ___ of ___

Aguirre Engineers, Inc.

Monthly Routine Survey Tracking Form

Month ____________________

Date	Survey Designation	Survey Location	RWP # (If Applicable)	Comments	HPT

Reviewed/Approved: ____

RSO/Manager Date

Page ___ of ___

p. 3 + attachments missing

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

ALARA
As Low As Reasonably Achievable

ARP-010

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/4/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 010
ALARA - As Low As Reasonably Achievable

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(Revision Level 0 = Original Document)

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ARP - 010
ALARA - As Low As Reasonably Achievable

1.0 Purpose and Scope

1.1 This procedure defines the requirements and methods for conducting As Low As Reasonably Achievable (ALARA) reviews and briefings.

1.2 This procedure applies to ALARA reviews and briefings conducted by radiation safety personnel, including the Radiation Safety Officer (RSO), and includes pre-job, job-in-progress, and post-job reviews.

The following activities are described in Section 5.0 of this procedure:

- General
- Trigger Levels for Performance of Formal, Documented ALARA Reviews and Briefings
- Conducting ALARA Pre-Job Reviews
- Conducting ALARA Pre-Job Briefings
- Conducting ALARA Job-In-Progress Reviews
- Conducting ALARA Post-Job Reviews

2.0 General

All work activities performed under this procedure shall be in accordance with the Specific Project Health and Safety Plan (HASP) and the Radiation Safety Program Manual.

3.0 References, Records and Equipment

3.1 References

10 CFR 20	*Standards for Protection Against Radiation*
RSM	Radiation Safety Manual
ARP-030	Document Control

3.2 Records

ALARA review and briefing records are generated during the course of implementing this procedure. The original copy is the record copy and is forwarded to the RSO for processing, including arrangement and filing. Working copies of the records may be made as required and should be disposed of when no longer needed.

These records are used by project safety personnel to document evaluation of working conditions and radiological protection requirements associated with work activities.

The records are stored, arranged, indexed, retrieved, scheduled, retained, and disposed of in accordance with the Document Control Procedures in ARP-030.

3.3 Equipment

3.3.1 Most current radiological data.

3.3.2 Work control documents to include radiation work permits (RWPs), standard operating procedures (SOPs), etc

3.3.3 ALARA Checklist

3.3.4 ALARA Briefing Attendance Record

3.3.5 Dose histories for site workers, as appropriate

4.0 Responsibilities

4.1 The RSO is responsible for:

- Reviewing and approving the ALARA documents generated in performance of this procedure.
- Implementing this procedure.
- Providing oversight and assistance for technicians and Project Managers performing actions governed by this procedure.
- Reviewing, approving, and transmitting documentation generated during the performance of this procedure.
- Conducting, reviewing, and/or approving ALARA reviews and briefings as described in this procedure.
- Ensuring that HPTs are trained on this procedure and that the training is documented.

4.2 HPTs are responsible for:

- Performing the requirements established in this procedure.
- If an HPT is unable to perform this procedure due to errors, extenuating circumstances, or for any other reason, the HPT shall immediately stop and notify the RSO.

4.3 Task managers are responsible for:

- Performing the requirements established in this procedure.

4.4 The Project Manager is responsible for:

- Reviewing and approving the ALARA documents generated in the performance of this procedure.

5.0 Procedure

5.1 General

5.1.1 This procedure sets the minimum standards for performance of ALARA reviews and briefings and does not prohibit the performance of any reviews by the Client Radiation Protection Department that are in addition to those established in this procedure. In all cases, project radiation safety personnel:

a.. Are expected to consider and discuss with the Project Manager and site workers the dose reduction techniques pertinent to the work to be performed for those jobs not meeting the criteria for the performance of formal reviews.
b. Are expected to participate in and support the efforts of the project in performance of ALARA related activities.

5.2 Trigger Levels for Performance of Formal, Documented ALARA Reviews and Briefings

5.2.1 Formal, documented ALARA Pre-Job Reviews shall be conducted and documented, using the attached Pre-Job Review Form, if work is expected to result in:

a. An individual dose exceeding 100 millirem (mrem).
b. The collective dose for the job exceeding 0.5 person rem.
c. Airborne exposures exceeding 40 DAC-hrs per person.
d. General area dose rates exceeding 1 rem/hr.
e. Contamination levels exceeding 100 times the values in Attachment 6-1, Surface Activity Guidelines.
f. Use of supplemental engineering controls (portable high efficiency particulate air (HEPA) systems, gloves bags, tents, or other similar devices) or respiratory protection to reduce potential internal exposures.
g. Installation, removal, or modification of temporary shielding.

5.2.2 Formal, documented pre-job briefings shall be conducted for work involving conditions in 5.2.1 above.

a. Pre-job briefings shall be attended by all project personnel expected to work the job, the Task Manager, HPTs, and project radiation safety personnel supporting job performance, and the individual performing the pre-job review.
b. Pre-job briefings shall be performed and documented using the attached ALARA Briefing Record and the ALARA Briefing Attendance Record.

5.2.3 Pre-job reviews and briefings shall be conducted as indicated below. Briefings shall be conducted jointly by designated radiation safety personnel and the Project Manager.

Table 10-1
Pre-job Review Matrix

Conditions	Review Conducted By	Review Approved By	Briefing Conducted By
Conditions listed in 5.2.1	Lead HPT	RSO/PM	Lead HPT
5X Conditions in 5.2.1 a-e	RSO	RSO	RSO
10X Conditions in 4.2.1 a-e	RSO/Corporate CHP (CCHP)	Radiation Safety Committee	RSO/CCHP

5.2.4 ALARA job-in-progress reviews should be performed for any long duration work (>1 week) for which formal pre-job reviews and briefings are required.

a. Job-in-progress reviews should be tentatively scheduled during the ALARA pre-job briefings.
b. Job-in-progress reviews should be conducted jointly by the radiation safety personnel conducting pre-job briefing, and the Project Manager responsible for the job.
c. Job-in-progress reviews shall be conducted and documented using the attached ALARA Job-In-Progress Review Form

5.2.5 Post-job reviews shall be conducted for any jobs exceeding the criteria in 5.2.1.

a. The post-job review should be, if possible, tentatively scheduled during the pre-job review.
b. Attendance at post-job reviews should include, as a minimum, radiation safety personnel knowledgeable of work performance and the Project Manager responsible for the job. The individual conducting the post-job review shall be, if practicable, the radiation safety individual conducting the pre-job review.
c. Document information obtained during the performance of the job that could reduce collective or individual dose rates for future work performance. This information may be recorded on the post-job review form or on pages attached to the form.
d. Post-job reviews shall be documented on the Post-Job Review Form.

5.3 Conducting Pre-Job Review

5.3.1 Obtain all the documentation needed for the pre-job review. This should include the following documents as appropriate.

a. RWP Request and Review Form.
b. Survey records.
c. Records of previous job performance.
d. Technical work control documents.

5.3.2 Review the work to be performed using criteria on ALARA Pre-Job Review Form as a guide.

5.3.3 Coordinate with the Project Manager, as required, to obtain pertinent job information.

5.3.4 Identify and record dose rate reduction methods to be employed before and during job performance.

5.3.5 Revise initial dose rate estimates and record the revised estimates in Section D.

5.3.6 Annotate the basis for any change on the form or on extra sheets attached to the review form.

5.3.7 Forward the completed review form for approval.

a. The designee indicated in Section 5.2.3 should conduct the review.

b. The person with approval authority shall return the review form to the individual designated to perform the pre-job briefing.

5.4 Conducting ALARA Pre-Job Briefings

5.4.1 Pre-job briefings shall be conducted jointly by the designated project radiation safety personnel and the Project Manager. The Project Manager shall address the job-specific aspects, and the radiation safety personnel shall address radiological concerns.

5.4.2 Record attendance at the briefing on the ALARA Briefing Attendance Record Form, attachment 5.

5.4.3 Conduct the briefing using Attachment 4 as a guide.

5.4.4 If additional ALARA requirements are identified during the briefing add the requirements to the Special Instructions Section of the RWP.

5.4.5 Forward briefing records, RWPs, attendance records, and any other documentation to the RSO and the Project Manager for review and approval.

5.5 Conducting ALARA Job-In-Progress Reviews

5.5.1 Obtain the ALARA Job-In-Progress Review Form (Attachment 2).

5.5.2 Obtain and record the collective dose and man-hour data.

5.5.3 Observe the work in-progress, using the review form as a guide

5.5.4 Record observations.

5.5.5 Discuss, as appropriate, the ALARA concerns and the work-in-progress with the Project Manager and radiation safety personnel involved with the job-in-progress review.

5.5.6 Revise the RWP, as appropriate, to correct any deficiencies noted.

5.5.7 Forward the completed review form, indicating any corrective actions taken, for review and approval in accordance with paragraph 5.2.3.

5.6 Conducting ALARA Post-Job Reviews

5.6.1 Obtain the ALARA Post-Job Review Form (Attachment 3).

5.6.2 Obtain and record the job-dose and man-hour data.

5.6.3 Complete the Post-Job Review Form.

5.6.4 Annotate any additional information obtained from the ask workers or radiation safety personnel involved with the job performance in the Corrective Action Section of the form.

5.6.5 Forward completed review form to the RSO and the Task Manager for review and approval.

6.0 Attachments

Attachment 10-1	Surface Activity Guidelines
ARP Form 10-2	ALARA Pre-Job Review
ARP Form 10-3	ALARA Job-In-Progress Review
ARP Form 10-4	ALARA Post-Job Review
ARP Form 10-5	ALARA Briefing Record
ARP Form 10-6	ALARA Briefing Attendance Record

None.

ok

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Containment Devices

ARP-011

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 011
Containment Devices

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
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ARP - 011
Containment Devices

1.0 Purpose and Scope

1.1 The purpose of this procedure is to provide AEI requirements for the control and use of containment devices.

1.2 This procedure provides requirements for construction, inspection, certification, control, use, and removal of temporary containment devices, including modular containment buildings and temporary drain rigs, during the performance of radiological work within all facility areas. This procedure does not apply to permanent or installed containment enclosures such as glove boxes.

The following activities are described in Section 5.0 of this procedure:

- Control of Containment Devices
- Water Leak Testing
- Inspection of Containment Devices
- Use of Containment Devices
- Removal of Containment Devices

2.0 General

2.1 Definitions

A containment device is defined as any temporary enclosure specified as a supplemental engineering control in a radiation work permit (RWP) or other technical work document used to contain the spread radioactive material.

2.2 Safety Considerations

When establishing ventilation flow for containment devices designed for personnel entry, ensure no personnel are inside the containment when initiating flow. All work performed under this procedure must be in accordance with the Site Specific HASP.

2.3 Quality Control

Workers and radiation safety personnel shall receive site specific training on the use of containment devices.

3.0 References, Records and Equipment

3.1 References

NUREG 0914	*Radiological Containment Handbook*
RSM	Radiation Safety Manual
ARP-006	Radiation Work Permits
ARP-007	Air Sampling and Sample Analysis
ARP-008	Radiation and Contamination Surveys
ARP-012	Portable HEPA Systems and Vacuum Cleaners
ARP-022	Packaging radioactive Material
ARP-023	Opening Radioactive Material Containers

3.2 Records

Survey records are generated during the performance of this procedure. The original record copy is filed in the permanent project file. Copies of the records may be made for information purposes.

3.3 Equipment

A variety of pre-constructed commercial containment systems are available, additionally containment systems may be constructed for job-specific requirements.

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for insuring that all personnel assigned the task using containment devices are familiar with this procedure.

4.2 Radiation Safety Officer (RSO) - The RSO is responsible for monitoring compliance with this procedure and training personnel in the use of containment devices.

4.3 Project Manager (PM)- The PM is responsible for ensuring a copy of this procedure is available at the job site and that field technicians follow this procedure.

4.4 Technicians - Technicians using containment devices are responsible for knowing and complying with this procedure.

5.0 Procedure

5.1 Control of Containment Devices

5.1.1 All work involving the use of containment devices shall be controlled under an RWP or an approved technical document.

5.1.2 Maintain a Radiological Containment Log using AEI Form 11-1 or an equivalent to document all containment devices, used in the applicable work area. Use the last two digits of the year when numbering containments on the log (98XXXX); 98-the year containment was constructed; and XXXX-the containment number, starting with 0001 at the beginning of the year.

5.1.3 Use a suitable, self- adhesive label that has a green or light green background color for identifying certification and weekly re-certification of containment devices printed with the following information:

CERTIFIED FOR USE
Containment #: _____ Date: _____
RSO: _____

5.1.4 Use a suitable, self-adhesive label that has a red background color for identifying containment devices that fail inspection, that are installed and not in use, or that are not ready for use, printed with the following information:

DO NOT USE
Containment #: _____ Date: _____
RSO: _____

5.2 Water Leak Testing

5.2.1 Observe the performance of a water leak test in newly constructed or modified containment devices that are specified by the RWP or approved technical work document to contain contaminated liquid.

5.2.2 Ensure that an adequate amount of pure water (approximately 1 pint) is allowed to settle into the component/containment seal area(s) or drain connection.

a. Inspect for leakage as the containment is manipulated to realistically simulate the intended work task(s).
b. Ensure that the water is allowed to stand for a minimum of three minutes before checking for leakage.
c. After the leak test is concluded ensure that all water is removed and the containment is dry.

5.2.3 Observe the performance of retesting in accordance with 5.2.1 and 5.2.2 on containment devices after repair or adjustments to correct for leaking seals detected during leak testing.

5.3 Inspection of Containment Devices

5.3.1 Perform inspections to certify containment devices at the following frequencies:

- Initially for certification that it will provide proper containment.
- Following modification or repair that affects containment integrity.
- Weekly when in use.
- Prior to use if the containment has not been inspected each day.

5.3.2 Conduct the inspection for certification of containment devices using the applicable criteria from the lists below and specific instructions in the RWP or approved technical work document.

- Inspection criteria for containment devices (other than tents) are in Attachment 2.
- Inspection criteria for containment tents and modular buildings are in Attachment 3.

5.3.3 Update the Radiological Containment Log Attachment 1 in accordance with 5.1 above for all newly certified containment devices after a satisfactory inspection.

5.3.4 Place the appropriate label on the containment device in accordance with 5.1 above following inspection.

5.3.5 A pre-use inspection shall be performed prior to each time a certified containment device is used.

- Include the requirements for appropriate pre-use inspections in the RWP or technical work document using Attachments 4 and 5 as well as any other specific requirements.

5.4 Use of Containment Devices

5.4.1 Perform radiation and contamination surveys on containment devices daily, as a minimum, when in use or as specified in the RWP or other technical work document.

5.4.2 Monitor airborne radioactivity during the use of containment devices as specified in the RWP or approved technical work document.

5.5 Removal of Containment Devices

5.5.1 Ensure that all work to be accomplished is completed using the particular containment device prior to the removal of that containment device.

- Include verification from the work group of completion in the RWP or other technical work document.

5.5.2 Perform radiation and contamination surveys on internal surfaces of containment devices prior to removal.

5.5.3 Include requirements and instructions for decontamination of containment device internals in the RWP or technical work document as required following pre-removal surveys to prevent the spread of contamination during removal.

6.0 Attachments

ARP Form 11-1 Radiological Containment Log
ARP Form 11-2 Portable Containment Inspection Criteria for Certification
ARP Form 11-3 Containment Tent Inspection Criteria for Certification
ARP Form 11-4 Portable Containment Pre-use Inspection Checklist
ARP From 11-5 Containment Tent Pre-use Inspection Checklist

Aguirre Engineers, Inc.

Radiological Containment Log

Project: _____

Containment Number	Type	Date Installed	RPT	RWP #	Location/Component	Date Removed	RPT

Page ___ of ____

Aguirre Engineers, Inc.

Portable Containment Inspection Criteria for Certification

	Inspection Criteria	Yes	No	N/A
1.	The containment is free of holes, tears or other defects.			
2.	The containment is properly oriented relative to the component(s) for work including drain line.			
3.	Appropriate radiological postings are in place.			
4.	The gravity drain/hand pump suction is properly installed at the low point of the containment.			
5.	Drain rig equipment is securely connected to an appropriate collection facility.			
6.	Poly bottles are secured to prevent tipping and are properly labeled.			
7.	Sufficient volume remains in poly bottle for work and is less than 80% full.			
8.	Drain tubing is not damaged or restricted and is properly labeled.			
9.	Drain area inside containment is free and clear of materials, especially absorbent, that could plug the drain			
10.	Service leads to the containment are independently supported and are properly sealed.			
11.	The containment is properly supported using elastic material when appropriate.			
12.	Containment support eyelet's are not over-stressed.			
13.	The HEPA filter is installed at the highest point in the containment and is properly supported.			
14.	A higher capacity HEPA filter (30 cfm, e.g.) is installed for work using air operated tools.			
15.	Installed rubber gloves are properly attached and oriented for work to be performed.			
16.	Zippers, Velcro, and access points are properly sealed with tape.			
17.	Transfer sleeves are installed in high areas of the containment and are properly sealed, supported, and stowed.			
18.	The inside and outside of the containment is protected against damage from sharp or hot objects.			
19.	Hoses for portable HEPA ventilation and/or vacuum cleaners are not damaged and are properly oriented for work.			

Containment #: _____ Type: _____

Date Installed: _____ RWP #: _____

Comments: _____

_____

Inspected by: _____ _____
Print Name Signature

Reviewed by: _____ _____
Print Name Signature

Aguirre Engineers, Inc.

Containment Tent Inspection Criteria for Certification

	Inspection Criteria	Yes	No	NA
1.	The containment tent is properly oriented for work and is supported to hold its own weight and internal negative pressure.			
2.	The containment floor is properly supported and protected from tears and punctures.			
3.	All seams are complete and no holes or tears are present in the fabric.			
4.	Service leads inside the tent are covered with sleeving where appropriate.			
5.	External lighting is sufficient for work to be accomplished in the containment as determined by the work group.			
6.	Negative ventilation within the containment is adequate as demonstrated by a smoke tube test or equivalent.			
7.	Sharp objects are properly covered to prevent tears or punctures to the tent.			
8.	A change area or enclosure separate from the work area is provided.			
9.	Piping or equipment near the exit are covered.			
10.	Radiological postings and instructions are prominently displayed at the entrance/exit.			
11.	All tent-to-component and tent-to-service lead seals are properly made.			
12.	The HEPA ventilation suction on the tent is located to establish air flow that draws potentially contaminated air from the source away from worker and into exhaust.			
13.	The HEPA ventilation system capacity is adequate to provide negative pressure in the tent.			
14.	All Velcro and/or zippered entrances are working properly.			

Containment #: _____ Type: _____

Date Installed: _____ RWP #: _____

Comments: _____

_____

Inspected by: _____ _____
Print Name Signature

Reviewed by: _____ _____
Print Name Signature

Aguirre Engineers, Inc.

Portable Containment Pre-Use Inspection Checklist

	Inspection Criteria	Yes	No	N/A
1.	The containment has been certified by RSO within the last seven days.			
2.	Inspect the containment, including sleeves, gloves, and ports for any holes or damage.			
3.	All service and component seals are properly made-up.			
4.	No hazardous materials are present in the containment unless the RSO has given approval for their use.			
5	The containment can be used in the current configuration including proper glove installation and orientation, adequate lighting, and all needed services.			
6.	No unnecessary items are in the containment and housekeeping is satisfactory.			
7.	All sharp edges on items in the containment have been covered.			
8.	Heat sources, sharp items, and surroundings pose no hazard to the containment.			
9.	All items in the containment have been prepared in accordance with RWP or approved technical document instructions.			
10.	HEPA ventilation and/or vacuum cleaner hose is not damaged and unit(s) is running prior to the start of work.			
11.	Drain path from containment is unobstructed and is not damaged.			
12.	Poly bottle receiving drainoff is less than 80% full and has adequate volume remaining to perform work.			
13.	Proper posting is present (includes RWP).			
14.	RWP criteria and requirements are met.			

Containment #: _____ Type: _____

Date Installed: _____ RWP #: _____

Comments: _____

_____

Inspected by: _____ _____
Print Name Signature

Reviewed by: _____ _____
Print Name Signature

Aguirre Engineers, Inc.

Containment Tent Pre-Use Inspection Checklist

	Inspection Criteria	Yes	No	N/A
1.	The containment tent has been certified by RSO within the last seven days.			
2.	Inspect the tent, including sleeves and ports, for any holes or damage.			
3.	All service and component seals are properly made-up.			
4.	No hazardous materials are present in the containment unless the RSO has given approval for their use.			
5.	The tent can be used in the current configuration including adequate lighting and all needed services.			
6.	No unnecessary items are in the and housekeeping is satisfactory.			
7.	All sharp edges on items in the tent have been covered.			
8.	Heat sources, sharp items, and surroundings pose no hazard to the tent.			
9.	All items in the tent have been prepared in accordance with RWP or approved technical document instructions.			
10.	HEPA ventilation and/or vacuum cleaner hose is not damaged and unit(s) is running prior to the start of work.			
11.	Proper posting is present (includes RWP).			
12.	RWP criteria and requirements are met			

Containment #: _____ Type: _____

Date Installed: _____ RWP #: _____

Comments: _____

_____

Inspected by: _____ _____
Print Name Signature

Reviewed by: _____ _____
Print Name Signature

ok

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Portable HEPA Systems and Vacuum Cleaners

ARP-012

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 012
Portable HEPA Systems and Vacuum Cleaners

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
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ARP - 012
Portable HEPA Systems and Vacuum Cleaners

1.0 Purpose and Scope

1.1 The purpose of this procedure is to provide guidance and requirements for use and control of portable high-efficiency particulate air filtered (HEPA) ventilation systems and vacuum cleaners that are used to accomplish radiological work. This procedure specifies the radiological controls and the requirements for safe operation, maintenance, and storage involved with portable HEPA ventilation systems and vacuum cleaners used for radiological work. Installed or permanent ventilation systems are not within the scope of this procedure. Vacuum cleaners used solely for purposes or hazards other than radiological, such as asbestos, are also not covered by this procedure.

2.0 General

2.1 Precautions

2.1.1 Exercise caution when handling energized portable HEPA ventilation equipment, being aware of rotating fan blades that could be accessible through the outlet connection.

CAUTION: Do not operate portable HEPA ventilation systems and vacuum cleaners in explosive atmospheres.

2.1.2 Operate portable HEPA ventilation units in the position designated by the specific component technical manual. Any other position of operation may cause failure of the blower assembly resulting in severe personnel injury, or may retard operating efficiencies

2.1.3 Improper use of portable ventilation systems and vacuum cleaners can result in the spread of loose surface contamination, the generation of airborne radioactivity, or high dose rates.

2.1.4 Change-out of HEPA filters and vacuum cleaner emptying operations have a high potential to spread loose surface contamination and generate airborne radioactivity.

2.1.5 Generally portable HEPA ventilation systems or vacuum cleaners should not be used for work where tritium is the major radiological concern. Notify the RSO prior to the use of HEPA ventilation or vacuum cleaners in situations involving tritium

2.1.6 Do not use portable HEPA ventilation systems or vacuum cleaners without a current dioctyl phthalate (DOP) test inspection sticker for radiological work. A DOP test is valid for 12 months provided integrity of the unit is maintained.

2.1.7 If the particle size of the contaminant has the possibility to be ≤ 0.3 µm, the use of portable HEPA ventilation systems or vacuum cleaners should be referred to the RSO for evaluation. DOP testing media for HEPA filters uses particles with an average size of 0.3 µm.

2.1.8 Notify the RSM prior to the use of a HEPA vacuum cleaner for fissile materials. to the use of a HEPA vacuum cleaner for fissile materials.

3.0 References, Records and Equipment

3.1 References

ARP-007 Air Sampling and Sample Analysis
ARP-008 Radiation and Contamination Surveys

3.2 Records

Survey records are generated during the performance of this procedure. The original of the records is the record copy for the project file. The record copy is given to the RSO for processing, including arrangement and filing. Copies of the records may be made for information purposes.

These records are used by the Radiation Safety Program to document radiological surveys.

3.3 Equipment

HEPA ventilation unit and HEPA filtered vacuum cleaner

4.0 Responsibilities

4.1 The Radiation Safety Officer has responsibilities for:

- The overall radiological control of portable HEPA ventilation systems and vacuum cleaners.
- The use of portable HEPA ventilation systems and vacuum cleaners by radiation safety personnel.
- Implementation of this procedure.
- Ensuring that Health Physics Technicians (HPTs) are qualified to perform this procedure and are documented as such.
- Providing oversight and guidance in the performance of this procedure.
- Ensuring that training on this procedure is developed, kept up-to-date, and offered to radiation safety personnel needing it.
- Documentation of training completion.

4.2 The HPTs are responsible for:

- The direct radiological control of portable HEPA ventilation systems and vacuum cleaners used by all facility organizations.
- Properly operating portable HEPA ventilation systems and vacuum cleaners. In addition, if for any reason an HPT is unable to follow this procedure, the HPT shall immediately stop and notify the RSO.

5.0 Procedure

5.1 Prior to use, inspect the equipment for:

- Any physical damage.
- Properly made hose connections.
- Electrical connections and cables in good condition.
- A DOP test inspection sticker certifying the test has been performed within the last 12 months.
- Differential pressure (d/p) gauge reads zero, if installed.
- Integrity of tamper seal on unit.

5.2 Ensure that the d/p across the HEPA filter in portable ventilation units equipped with d/p gauges is less than 3 in. wg (inches of water, gauge; clean filter d/p is 1 in. wg) when operating. Pressures greater than 3 in. wg indicate the possible need for HEPA filter replacement.

5.3 Ensure that portable ventilation system exhaust is directed away from contamination or airborne areas.

5.4 Contain suction hose end(s) when portable ventilation systems are secured to prevent the spread of loose surface contamination.

5.5 Use of HEPA Vacuum Cleaners

5.5.1 Prior to use, inspect the equipment for:

- Any physical damage.
- Properly made hose connections.
- Electrical connections and cables in good condition.
- A DOP test inspection sticker certifying the test has been performed within the last 12 months.
- Integrity of tamper seal on unit.

5.5.2 Ensure that vacuum cleaner exhaust is directed away from loose surface contamination.

5.5.3 Contain suction hose end(s) when vacuum cleaners are secured to prevent the spread of loose surface contamination

5.6 Control and Storage of HEPA Ventilation Systems and Vacuum Cleaners of HEPA Ventilation Systems and Vacuum Cleaners

5.6.1 Portable HEPA ventilation systems and vacuum cleaners used for radiological work shall be positively controlled to prevent unauthorized use (e.g. locked storage room, locked to a structure at the storage or work area, etc.).

5.62 Maintain an inventory log using Attachment -1 or equivalent for all portable HEPA ventilation systems and vacuum cleaners used for radiological work within the area of responsibility.

5.7 Maintenance of Equipment

5.7.1 Any work performed on portable HEPA ventilation systems and vacuum cleaners such as filter replacement, repairs, or emptying operations shall be accomplished under a separate RWP

5.7.2 Perform any maintenance or replacements on portable HEPA ventilation systems and vacuum cleaners in accordance with the specific equipment technical manual(s)

5.7.3 Stage all replacement parts (prefilters, filters, etc.) prior to the disassembly of any equipment.

5.7.4 Place an Out Of Service tag on any equipment whose HEPA filter has been replaced, integrity violated, or is in question until a DOP test is performed satisfactorily.

5.7.5 Upon completion of DOP testing, prior to placing unit in service, place Radiation Safety Tamper Seal Tape on unit to provide indication of unit integrity.

5.8 Radiological Controls

5.8.1 Provide specific instructions within the RWP or technical work document detailing the work step(s) requiring the use of portable HEPA ventilation systems or vacuum cleaners.

5.8.2 Monitor portable HEPA ventilation system exhaust by grab sample in accordance with procedures specified in the RWP.

5.8.3 Monitor for airborne radioactivity when HEPA vacuum cleaners are used in High Contamination Areas using breathing zone sampling in accordance with ARP-007 and as specified in the RWP.

5.8.4 Obtain radiation and contamination measurements in accordance with ARP-008 at least daily on HEPA vacuum cleaners during the performance of radiological work to detect any changes in vacuum cleaner and work area dose rates or contamination levels. The frequency of radiation surveys will depend on the evolution(s) during which the vacuum cleaner is used and shall be specified in the RWP.

5.8.5 Portable HEPA ventilation systems and vacuum cleaners used for radiological work shall be controlled and labeled as Radioactive Material, Internal Contamination when in use or when stored after use unless released in accordance with ARP-025.

6.0 Attachments

ARP Form 12-1 Portable HEPA Ventilation System and Vacuum Cleaner Inventory Log

Aguirre Engineers, Inc.

Portable HEPA Ventilation System and Vacuum Cleaner Inventory Log

Technical Area: _____ Project Name: _____

Date	HPT	Type	Serial #	DOP Date	RWP #	Location/Work Area	Date Removed	HPT

Reviewed/Approved: _____

Radiation Safety Officer/Designee/Manager Date

ok

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Step-Off Pads

ARP-013

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 013
Step-Off Pads

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
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3	0	2/3/98						

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ARP - 013
Step-Off Pads

1.0 Purpose and Scope

This Procedure instructs AEI field personnel project personnel in the proper use of step-off pads. This procedure applies to all AEI Radiological Remediation Projects or operations that use step-off pads for radiological contamination control.

2.0 General

2.1 Precautions

These pads should always be placed in the Radiological Buffer area just outside the contamination area as a control to prevent the spread of contamination.

3.0 References, Records and Equipment

3.1 References

RSM	Radiation Safety Manual
ARP - 008	Radiation and Contamination Surveys
ARP - 009	Routine Radiological Surveys
ARP - 025	Release of Materials from Radiological Control

3.2 Records

All records generated by this procedure are used in the Radiation Safety Program to document contamination levels of work areas and materials onsite.

3.3 Equipment

Step off pads

4.0 Responsibilities

4.1 The Radiation Safety Officer (RSO) is responsible for:

- Ensuring that Health Physics Technicians (HPTs) are qualified to perform this procedure.
- Reviewing, approving, and transmitting documentation generated during the performance of this procedure.
- Maintaining knowledge of contents of operating procedures affecting the conduct of contamination surveys and communicating pertinent requirements to HPTs performing this procedure.

4.2 HPTs are responsible for:

- Performing contamination swipe analysis in accordance with this procedure.
- Discussing specific project contamination survey requirements with the RSM.

- If a Radiation Protection Technologist (RPT) is unable to perform this procedure due to errors, extenuating circumstances, or any other reason, the RPT shall immediately stop and notify the Radiation Safety Manager (RSM). All changes in sampling and survey protocol must be documented in field logbooks and on appropriate survey forms.

5.0 Procedure

5.1 Location of Step-Off Pads

5.1.1 Radiation safety personnel will specify the placement of step-off pads based on the requirements listed below

- A single step-off pad should be installed at exit points to areas where loose surface contamination levels exceed 1000 dpm/100cm^2
- Two step-off pads, separated by a covered area where possible, should be installed at exit points to areas where contamination levels exceed 100,000 dpm/100cm^2.

5.1.2 Consideration must be given to other radiological conditions and general safety precautions when installing step-off pads:

- Step-off pads should be positioned at personnel control points in such a manner that they do not cause individuals to remain in significant radiation fields while removing protective clothing. In these cases, the step-off pad should be separated from the actual point of exit, by a covered area.
- Step-off pads should be placed in such a manner that they do not constitute a safety hazard. For example, step-off pads should not be placed on steep ground, slippery surfaces, etc.
- Step-off pads should not be placed at Emergency Exits or at Equipment Entrances/Exits.

5.2 Use of Step-Off Pads

5.2.1 Step-off pads shall be considered uncontaminated surfaces in the case of a single step-off pad; or as surfaces of lower contamination than the contaminated area, in the case of first of two step-off pads (when exiting the posted area). The step-off pad needs to be surveyed periodically in accordance with ARP-009.

5.2.2 Before stepping out of the Contamination Area or Airborne Radioactivity Area to the step-off pad, the worker should:

- Remove exposed tape.
- Remove rubber overshoes.
- Remove outer pair of gloves.
- Remove hood from front to rear.
- Remove respiratory protection, as applicable.
- Remove coveralls, inside out, touching the inside only.
- Take down barrier closure, as applicable.
- Remove tape or fastener from inner shoe cover.

- Remove each shoe cover, place the shoe cover into the container for contaminated shoes, and step onto clean step-off pad.
- Remove cloth glove liners.
- Replace barrier closure, as applicable.
- Commence whole body frisking.
- Monitor badge and dosimeter.

The sequence for the removal of primary and supplemental dosimetry is dependent upon where the dosimetry was worn and the potential for contamination.

5.2.3 Use of Multiple Step-off Pads

- Multiple step-off pads should be used to control exit from high surface contamination areas. These pads define interim control measures within the posted area to limit the spread of contamination. The following controls apply:
- The inner step-off pad should be located immediately outside the highly contaminated work area, but still within the posted area.
- The worker should remove highly contaminated outer clothing prior to stepping on the inner step-off pad.
- Additional secondary step-off pads, still within the posted area, may be used as necessary to restrict the spread of contamination out of the immediate area.
- The final or outer step-off pad should be located immediately outside the contamination area.

6.0 Attachments

None

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AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Radiologically Restricted Areas

ARP-014

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 014
Radiologically Restricted Areas

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
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4	0	2/3/98						
5	0	2/3/98						

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ARP - 014
Radiologically Restricted Areas

1.0 Purpose and Scope

1.1 This procedure provides the methods GPI uses to control radioactive materials. Adherence to this procedure will provide reasonable assurance that personnel will remain free of contamination, contamination will not spread beyond the designated contamination area, and personnel exposures will be maintained As Low As Reasonably Achievable (ALARA).

1.2 This procedure will be used by GPI personnel to control and contain radioactive materials. The following are types of control methods that will be employed;

- Posting requirements for radioactive materials.
- Establishing and posting radiation areas.
- Establishing and posting contaminated areas.
- Establishing and posting airborne radioactivity areas.

2.0 General

2.1 Definitions

2.1.1 Restricted Area - An area containing radioactive materials to which access is controlled to protect individuals from exposure to ionizing radiation.

2.1.2 Radioactive materials - Materials containing or capable of emitting alpha particles, beta particles, gamma rays, X rays, neutrons and/or other ionizing radiations.

2.1.3 Radiation area -Any area accessible to personnel in which there exists ionizing radiation at dose-rate levels such that an individual could receive a deep dose equivalent in excess of 5 mrems in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

2.1.4 Contaminated Area - A restricted area that has radioactive materials above the limits specified in the Radiation Safety manual in the form of dusts, particulates, and sorbed contaminants that could adhere to personnel clothing and skin while working in the area.

2.1.5 Airborne radioactivity area - A room, enclosure or area in which radioactive material is dispersed in the form of dusts, fumes, particulates, mists, vapors, or gases and the concentration of the dispersed radioactive materials is in excess of:

a) The derived air concentrations (DAC's) specified in Table 1, Column 3 of Appendix B, Title 10 Part 20 of the Code of Federal Regulations.

b) Concentrations such that an individual present in the area without respiratory protective equipment could exceed, during the hours the individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI).

2.1.6 ALARA - An approach to radiation exposure control to maintain personnel exposures as far below the federal limits as technical, economical and practical considerations permit.

2.2 Quality Control

Instrumentation used in the surveys will be checked with standards daily and verified to have current valid calibration.

3.0 References, Records and Equipment

3.1 References

10 CFR 20	*Standards for Protection Against Radiation*
RSM	Radiation Safety Manual
ARP-001	Operation of Contamination Survey Meters
ARP-002	Alpha-Beta Sample Counting Instrumentation
ARP-003	Operation of Micro-R Survey Meters
ARP-004	Operation of Ionization Chambers
ARP-007	Air Sampling and Sample Analysis
ARP-008	Radiation and Contamination Surveys

3.2 Records

3.2.1 Record any radioactive materials postings made in the project log book. Include the date, location, and all information posted.

3.2.2 Record the date and location of any radiation areas established in the project log book. Include a sketch of the area and radiation area boundary on survey forms.

3.2.3 Record the date and location of any contaminated areas established in the project log book. Include a sketch of the area and contaminated area boundary on survey forms.

3.2.4 Record the date and location of any airborne radioactivity areas established in the project log book. Include a sketch of the area on survey forms. Indicate time and date of any notifications required by this procedure.

3.3 Equipment

None Required

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for insuring that all personnel assigned the tasks of establishing and posting restricted areas are familiar with this procedure, adequately trained in the use of protective clothing, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer is responsible for training personnel in the procedures for establishing and posting restricted areas.

4.3 Technicians - Technicians establishing and posting restricted areas are responsible for complying with provisions of this procedure.

5.0 Procedure

5.1 Posting requirements for radioactive materials

5.1.1 Any area or room in which there is used or stored an amount of licensed material exceeding 10 times the quantity of such material specified in Appendix C, Title 10 Part 20 of the Code of Federal Regulations shall be posted with a sign or signs "CAUTION, RADIOACTIVE MATERIALS AREA" or "DANGER, RADIOACTIVE MATERIALS AREA".

5.1.2 When posting a room as required in step one, a sign should be placed on each entrance door to the room. If the area to be posted is not a room, the area containing the licensed material shall be bounded by a yellow and magenta/black rope or ribbon securely fastened to stanchions, posts or other durable devices and signs shall be displayed in all accessible directions.

5.1.3 Any container which contains licensed material in quantities equal to or greater than the quantities listed in Appendix C, Title 10 Part 20 of the Code of Federal Regulations shall be posted with a sign or label bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIALS" or "DANGER, RADIOACTIVE MATERIALS".

5.1.4 When posting a container as required by step three, the label should also state the radionuclide present in the container, the activity in the container, the date at which the activity was determined, the radiation levels emanating from the unshielded radioactive source, and the radiation levels from the container holding the radioactive source. The label shall also state the mass enrichment if different from natural enrichment and the kind of material (Encapsulated source, liquid, powder, etc.).

5.1.5 Posting of containers is not required if containers are in transport and packaged and labeled in accordance with the regulations of the Department of Transportation (See Title 49 Parts 172 and 173 of the Code of Federal Regulations). Containers which are awaiting shipment at a facility are subject to posting requirements as specified in step one.

5.2 Establishing and posting radiation areas.

5.2.1 Any area accessible to personnel in which there exists ionizing radiation at dose-rate levels such that an individual could receive a deep dose equivalent in excess of 5 mrems in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates shall be identified and posted with a sign "CAUTION, RADIATION AREA".

5.2.2 A Micro-R-Meter or other calibrated dose rate meter is used to identify the boundary location of the 5 mrem/hr dose rate.

5.2.3 If an entire room or most of the room is at or above the 5 mrem/hr level, a sign should be placed on each entrance door to the room. If the area to be posted is not a room, the area at or above the 5 mrem/hr level shall be bounded by a yellow and magenta/black

rope or ribbon securely fastened to stanchions, posts or other durable devices and signs shall be displayed in all accessible directions.

5.2.4 An exemption to this posting requirement is allowed in areas or rooms containing radioactive materials for periods of less than 8 hours, if each of the following conditions is met:

a. The materials are constantly attended during these periods by an individual who takes the precautions necessary to prevent the exposure to radiation or radioactive materials in excess of the limits specified in the Radiation Safety Manual; and

b. The area or room are subject to the licensee's control.

For example, the area around a truck loading radioactive waste does not require posting if the above conditions are met.

5.2.5 If dose rates above 100 mrem/hr are encountered control access to the area and contact the Radiation Protection Supervisor or RSO for posting instructions.

5.3 Establishing and posting contaminated areas.

5.3.1 A restricted area that has fixed and removable radioactive materials in the form of dusts, particulates, and sorbed contaminates which are above the limits specified in the Radiation Safety Manual shall be identified and posted with a "CONTAMINATED AREA" sign.

5.3.2 Contamination levels are determined using procedure ARP-008 (Radiation and Contamination Surveys) and the results of the survey measurements compared to the contamination limits specified in the Radiation Safety Manual.

5.3.3 If an entire room or most of the room is at or above the contamination criteria, a sign should be placed on each entrance door to the room. If the area to be posted is not a room, the area above the contamination criteria shall be bounded by a yellow and magenta/black rope or ribbon securely fastened to stanchions, posts or other durable device and signs displayed in all accessible directions.

5.3.4 A single entry point shall be established to access the contaminated area. A step off pad is placed at the entry point which provides a defined boundary between contaminated and unrestricted areas.

5.3.5 Receptacles for protective clothing and waste materials shall be placed just inside the entry point to collect protective clothing from personnel exiting the area.

5.3.6 If work activities in the area are likely to generate significant dusts containing radioactive materials, the area should be enclosed within a containment to prevent the spread of contamination beyond the identified contaminated area.

5.4 Establishing and posting airborne radioactivity areas.

5.4.1 AEI's policy is to minimize (and protect, if practical) the amount of radioactive materials taken into a workers body. In order to accomplish this, Airborne Radioactivity Areas are posted at 10% DAC, as specified in Table 1, Column 3 of appendix B of 10 CFR Part 20. Maintaining the airborne activity below these limits will eliminate any posting requirements.

5.4.2 To verify that these limits are not exceeded, an air sample is taken during each work activity which could create an airborne radioactivity hazard. The results of these samples are compared with the above limits to verify the limits are not exceeded. If the limits are exceeded, immediately contact the Radiation Protection Supervisor at the site or the RSO.

5.4.3 A room, enclosure or area shall be posted with a "CAUTION, AIRBORNE RADIOACTIVITY AREA" or "DANGER, AIRBORNE RADIOACTIVITY AREA" if radioactive material is dispersed in the form of dusts, fumes, particulates, mists, vapors, or gases and the concentration of the dispersed radioactive materials is in excess of:

a. The derived air concentrations (DAC) specified in Table 1, column 3 of Appendix B, Title 10 Part 20 of the Code of Federal Regulations.

b. Concentrations such that an individual present in the area without respiratory protective equipment could exceed, during the hours the individual is present in a week, an intake of 0.6 percent of the Annual Limit on Intake (ALI).

5.4.4 If an room, enclosure, or area requires posting as specified in step 3, immediately stop work activities and contact the Radiation Protection Supervisor at the site or the RSO for instructions.

6.0 Attachments

None

02

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Personnel Protective Equipment (PPE)

ARP-015

Revision 0

Reviewed By: _____ 2/18/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 015
Personnel Protective Equipment (PPE)

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
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ARP - 015
Personnel Protective Equipment (PPE)

1.0 Purpose and Scope

1.1 This procedure provides the methods AEI uses to wear and remove protective clothing while working in and exiting from contaminated areas. Adherence to this procedure will provide reasonable assurance that personnel will remain free of contamination and contamination will not be spread beyond the designated contaminated area.

1.2 This procedure will be used by AEI personnel to enter, work in and exit from areas contaminated with radioactive materials.

Description of procedures and requirements for using protective clothing in contaminated areas.

1.2.1 Selection requirements and procedural methods for wearing protective clothing in contaminated areas.

1.2.2 Procedures for preventing personnel contamination during work in contaminated areas.

1.2.3 Procedures for the removal of protective clothing and personnel surveys required when exiting contaminated areas.

2.0 General

2.1 Definitions

2.1.1 Restricted Area - An area containing radioactive materials to which access is controlled to protect individuals from exposure to ionizing radiation.

2.1.2 Contaminated Area - A restricted area that has radioactive materials above the limits specified in the Radiation Safety manual in the form of dusts, particulates, and sorbed contaminants that could adhere to personnel clothing and skin while personnel are working in the area.

2.1.3 Personnel Survey - A survey with radiation detection instruments that measures the amount of radioactive materials on personnel clothing or skin surfaces.

3.0 References, Records, and Equipment

3.1 References

RSM	Radiation Safety Manual
ARP-001	Contamination Survey
ARP-008	Radiation and Contamination Surveys

3.2 Records

Record results of equipment surveys on survey forms. If contamination is found on personnel following exiting contaminated area, record levels found before and after decontamination on the personal contamination worksheet.

3.3 Equipment

As required by the job.

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned the tasks of working in contaminated areas are familiar with this procedure, adequately trained in the use of protective clothing, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training of personnel in the selection, use, and removal of protective clothing. The RSO is also responsible to train personnel in proper personnel survey techniques when exiting a contaminated area.

4.3 Technicians - Technicians using protective clothing are responsible for complying with provisions of this procedure.

5.0 Procedure

5.1 Selection and methods of dressing in protective clothing

NOTE: Dress/undress instructions are based on the assumption of using zippered or buttoned protective clothing.

5.1.1 Protective clothing is selected to provide a barrier between personnel clothing/skin and radioactive materials that exist in a contaminated area as defined in the Radiation Safety Manual.

5.1.2 Boots or overshoes are used to prevent contamination from adhering to shoes and tracking contamination beyond the designated contamination area.

5.1.3 Cloth or vinyl coveralls are used to intercept contamination before contacting personnel clothing and skin.

5.1.4 Cotton, vinyl, or latex gloves are used to prevent contamination from adhering to hands while handling contaminated surfaces and items in a contaminated area.

5.1.5 Cloth or vinyl caps or hoods are worn to prevent contamination from overhead surfaces from contaminating hair and exposed skin while working in contaminated areas.

5.1.6 Plan all work activities before putting on protective clothing and obtain all necessary supplies, instruments, and tools to be used in work activities. This equipment is placed at the entrance to the contaminated area so it can be taken into the area when entry is made. Instrumentation should be placed at the exit or be available for personnel surveys when exiting the area.

5.1.7 All protective clothing is selected and put on before entering the contaminated area.

5.1.8 First put on coveralls and close flaps provided on the coveralls. If specified on the Radiation Work Permit (RWP), place a strip of 2 inch masking tape over pocket openings and front zipper or button flaps. Fold over the tape at one end to provide a tab for easier removal of the tape when exiting the area.

5.1.9 Put cloth or plastic booties on over personal shoes, overshoes over booties and place coverall pant legs over the overshoe tops. Tape the overall pant legs to the bootie tops leaving a tape tab for later removal.

5.1.10 Place cloth cap or hood on head. If using a hood tape hood flap to outside of coveralls. If wearing a respirator, ensure hood is taped to respirator.

5.1.11 Put on gloves with coverall sleeves over the gloves. Tape coverall cuffs to gloves to provide a seal at the joint. Leave tab at the end of the tape for easy removal. If high levels of contamination are anticipated, a second pair of gloves may be worn under the taped pair.

5.1.12 After entering the contaminated area, a complete survey of clothing must be made as described in section 5.3 before exiting the area.

5.1.13 If light work activities (such as surveys) are performed in the contaminated area, tapping coverall sleeves, cuffs, and flaps is not required.

5.2 Work techniques and contamination area hygiene.

5.2.1 All surfaces and items contacted in a contaminated area are considered contaminated and contact with surfaces and items will transfer contamination to protective clothing. While working in a contaminated area, minimize contact to the extent possible with surfaces and items.

5.2.2 While in the contaminated area, do not touch face, glasses or exposed skin with gloves or other protective clothing.

5.2.3 If clothing becomes torn or ripped during work activities, tape opening with 2 inch masking tape to prevent contamination from further penetrating the protective clothing.

5.2.4 Avoid work activities to the extent possible which will create airborne activity.

5.2.5 Workers shall not eat, drink, chew or smoke while wearing protective clothing and working in a contaminated area.

5.3 Procedures for exiting a contaminated area.

5.3.1 Tools and equipment used in a contaminated area shall be surveyed and decontaminated as necessary before release to unrestricted areas.

5.3.2 Protective clothing is removed when exiting a contaminated area in such a manner as to control contamination from spreading beyond the designated boundary of the contaminated area.

5.3.3 If a second set of gloves is used, the outer set of gloves are removed before starting the unsuiting procedure.

5.3.4 Remove tape from hood, coverall cuffs, and coverall pant legs if used.

5.3.5 Remove hood or cap by handling external surfaces and place in a protective clothing receptacle.

5.3.6 Remove overshoes by handling external surfaces and place in a protective clothing receptacle. With the overshoes removed, retain plastic booties and remain inside the area to continue removing protective clothing.

5.3.7 Undo the coveralls flap and remove by handling external surfaces of the coveralls. Slip coverall pant legs over booties and place in a protective clothing receptacle.

5.3.8 With your back toward the step-off pad, remove the plastic booties and step onto step-off pad with personal shoes.

5.3.9 While standing on the step-off pad remove gloves by handling external surfaces and deposit in a protective clothing receptacle.

5.3.10 Perform personnel survey by first surveying hands with an alpha and/or beta survey meter. After determining hands are free of contamination, pick up instrument and survey shoes, personal clothing, face, and hair with a survey meter to determine no surfaces are contaminated. If contamination is found above limits in the Radiation Safety Manual, contact RSO or Radiation Protection Supervisor at the site for decontamination instruction.

6.0 Attachments

None

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Radioactive Materials Brokering

ARP-016

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 016
Radioactive Materials Brokering

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
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ARP-016
Radioactive Materials Brokering

1.0 Purpose and Scope

1.1 This procedure provides the methods and procedures AEI utilizes in shipping radioactive materials. Adherence to this procedure will provide reasonable assurance that radioactive materials will be shipped in accordance with applicable regulations.

1.2 This procedure will be used by AEI to prepare required shipping papers, secure loads, and ship radioactive materials.

1.3 Types of radioactive material shipments covered by this procedure.

1.3.1 Shipment of Limited Quantities of radioactive materials.

1.3.2 Shipments of Low Specific Activity (LSA) radioactive materials.

1.3.3 Shipment of Surface Contaminated objects (SCO).

1.3.4 Shipment of radioactive materials in Type A and Type B packages.

1.3.5 Shipment of Highway Route Controlled Quantities of radioactive materials.

1.3.6 Shipment of empty packages

2.0 General

2.1 Definitions.

2.1.1 *A_1 Activity* - The maximum activity of special form Class 7 (radioactive) materials permitted in a Type A package.

2.1.2 *A_2 Activity* - The maximum activity of Class 7 (radioactive) materials, other than special form, LSA or SCO permitted in a Type A package.

2.1.3 *Carrier* - Any individual or organization engaged in the transportation of passengers or property.

2.1.4 *Closed Transport Vehicle* - A transport vehicle or conveyance equipped with a securely attached exterior enclosure that during normal transport restricts the access of unauthorized persons to the cargo space containing Class 7 (radioactive) materials. The enclosure may be either temporary or permanent, and in the case of packaged materials may be of the "see-through" type, and must limit access from top, sides and bottom.

2.1.5 *Consignee* - Any individual or organization that receives material from a carrier.

2.1.6 *Consignor* - Any individual or organization that furnishes material to a carrier for transportation.

2.1.7 *Depleted Uranium* - Uranium containing less uranium-235 than the naturally occurring distribution of uranium isotopes.

2.1.8 *Exclusive Use* - The sole use of a conveyance by a single consignor and for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee. Any loading or unloading must be performed by personnel having radiological training and resources appropriate for safe handling of the consignment. Specific instructions for maintenance of exclusive use shipment controls must be issued in writing and included with the shipping paper information provided to the carrier by the consignor. Also referred to as *Sole Use* or *Full Load.*

2.1.9 Fissile Material - Any material consisting of or containing one or more fissile radionuclides. Fissile radionuclides are plutonium-238, plutonium-239, plutonium-241, uranium-233, and uranium-235. Neither natural nor depleted uranium are fissile material. Fissile materials are classified according to the controls needed to provide nuclear criticality safety during transportation, as provided in 49 CFR 173.455.

2.1.10 *Freight Container* - A reusable container having a volume of 1.81 cubic meters (64 cubic feet) or more, designed and constructed to permit being lifted with its contents intact and intended primarily for containment of packages in unit form during transport. A small freight container is one which has either one outer dimension less than 1.5 meters (4.9 feet) or an internal volume of not more than 3.0 cubic meters (106 cubic feet). All other are designated as large freight containers.

2.1.11 *Highway route controlled quantity (HRCQ)* - The quantity of radioactive material within a single package which exceeds the following:

a. The quantity of radioactive material is 3,000 times the A_1 value of the radionuclides for special form Class 7 (radioactive) material;

b. The quantity of radioactive material is 3,000 times the A_2 value for normal form Class 7 (radioactive) material;

c. The quantity of radioactive material is equal to or exceeds 27,000 Curies, whichever is least.

2.1.12 *Limited Quantity of Class 7 (Radioactive) Material (LQ)* - A quantity of Class 7 (radioactive) material not exceeding the materials package limits specified in 49 CFR 173.425 and which conform with requirements specified in 49 CFR 173.421.

2.1.13 *Low Specific Activity Materials (LSA)* - LSA materia means Class 7 (radioactive) material with limited specific activity which satisfies the descriptions and limits set forth below. Shielding materials surrounding the LSA material may not be considered in determining the estimated average specific activity of the package contents. LSA material must be in one of the three groups:

LSA-I

a. Ores containing only naturally occurring radionuclides (e.g., uranium and thorium) and uranium and thorium concentrates of such ores; or

b. Solid unirradiated natural or depleted uranium or natural thorium .

c. Class 7 (radioactive) material, other than fissile material, for which the A_2 value is unlimited; or

d. Mill tailings, contaminated earth, concrete, rubble, other debris, and activated material in which the Class 7 (radioactive) material is essentially uniformly distributed and the average specific activity does not exceed $10^{-6}A_2/g$.

LSA-II

a. Water with tritium concentration up to 20 curies per liter; or

b. Material in which the Class 7 (radioactive) material is essentially uniformly distributed and the average specific activity does not exceed $10^{-4}A_2/g$ for solids and gases, and $10^{-5}A_2/g$ for liquids.

LSA-III Solids (e.g., consolidated wastes, activated materials) that meet the requirements of 49 CFR 173.468 and which:

a. The Class 7 (radioactive) material is essentially uniformly distributed throughout a solid or a collection of solid objects, or is essentially uniformly distributed in a solid compact binding agent (such as concrete, bitumen, ceramic, etc.); and

b. The Class 7 (radioactive) material is relatively insoluble, or it is intrinsically contained in a relatively insoluble material, so that, even under loss of packaging, the loss of Class 7 (radioactive) materials per package by leaching when placed in water for seven days would not exceed 0.1 A_2; and

c. The average specific activity of the solid does not exceed $2X10^{-3}A_2/g$.

2.1.14 *Non-Fixed Radioactive Contamination* - Radioactive contamination that can be readily removed from a surface by wiping with an absorbent material. Non-fixed (removable) radioactive contamination is not significant if it does not exceed the limits specified in 49 CFR 173.443 and in table A, section 5.2 of this procedure.

2.1.15 *Normal Form Radioactive Material* - Radioactive material which has not been demonstrated to qualify as special form radioactive material.

2.1.16 *N.O.S.* - Abbreviation denoting "Not Otherwise Specified" which is used on shipping papers to generic describe radioactive materials.

2.1.17 *Radioactive Material* - Materials having a specific activity greater than 0.002 microcuries per gram (uCi/g).

2.1.18 *Special Form Radioactive Material* - Radioactive material which satisfies the following conditions:

a. It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;

b. The piece or capsule has at least one dimension not less than 5 millimeters (0.197 inches); and

c. It satisfies the test requirements of 49 CFR 173.469. (Also see special requirements in 49 CFR 173.389)

2.1.19 *Specific Activity* - The activity of the radionuclide per unit mass of that nuclide. The specific activity of a material in which the radionuclide is essentially uniformly distributed is the activity per unit mass of the material.

2.1.20 *Surface Contaminated Object (SCO)* - A SCO means a soled object which is not itself radioactive but which has Class 7 (radioactive) materials distributed on any of its surfaces. SCO must be in one of two groups with surface activity not exceeding the following limits:

SCO-I. A solid object on which:

a. The non-fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 10^{-4} microcurie/cm^2 for beta and gamma and low toxicity alpha emitters, or 10^{-5} microcurie/cm^2 for alpha emitters;

b. The fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 1.0 microcurie/cm^2 for beta and gamma and low toxicity alpha emitters, or 0.1 microcurie/cm^2 for all other alpha emitters; and

c. The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 1.0 microcurie/cm^2 for beta and gamma and low toxicity alpha emitters, or 0.1 microcurie/cm^2 for all other alpha emitters.

SCO-II. A solid object on which the limits for SCO-I are exceeded and on which:

a. The non-fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 10^{-2} microcurie/cm^2 for beta and gamma and low toxicity alpha emitters, or 10^{-3} microcurie/cm^2 for alpha emitters;

b. The fixed contamination on the accessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 20 microcurie/cm^2 for beta and gamma and low toxicity alpha emitters, or 2 microcurie/cm^2 for all other alpha emitters; and

c. The non-fixed contamination plus the fixed contamination on the inaccessible surface averaged over 300 cm^2 (or the area of the surface if less than 300 cm^2) does not exceed 20 microcurie/cm^2 for beta and gamma and low toxicity alpha emitters, or 2 microcurie/cm^2 for all other alpha emitters.

2.1.21 Transport Index - A dimension less number (rounded up to the first decimal place) placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation. The transport index is determined as following:

a. The number expressing the maximum radiation level in millirem per hour at one meter (3.3 feet) from the external surface of the package; or

b. For Fissile Class packages, the number expressing the maximum radiation level at one meter (3.3 feet) from the external surface of the package, or the number obtained by dividing 50 by the allowable number of packages which may be transported together, whichever is larger.

2.1.22 *Type A Package* - A Type A packaging that, together with its radioactive contents limited to A_1 or A_2 as appropriate, meets the requirements of 49 CFR 173.410 and 173.412 and is designed to retain the integrity of containment and shielding required by this part under normal conditions of transport as demonstrated by test set forth in 49 CFR 173.465 and 173.466, as appropriate. A Type A package does not require competent authority approval.

2.1.23 *Type B Package* - A Type B packaging together with its radioactive contents, is designed to retain the integrity of containment and shielding required by this part when subjected to the normal transport and hypothetical accident test conditions set forth in 10 CFR Part 71.

Type B(U) package - Means a Type B packaging that, together with its radioactive contents, for international shipments requires unilateral approval only of the package design and of any stowage provisions that nay be necessary for heat dissipation.

Type B(M) Package - Means Type B packaging, together with its radioactive contents, that for international shipments requires multilateral approval of the package design, and may require approval of the conditions of shipment.

2.1.24 *Type A Quantities* - A quantity of Class 7 (radioactive) material, the aggregate radioactivity which does not exceed A_1 for special form Class 7 (radioactive) material, or A_2 for normal form Class 7 (radioactive) material.

2.1.25 *Type B Quantities* - Means a quantity of material greater than a Type A quantity.

2.2 Quality Control

Instrumentation used in the surveys will be checked with standards daily and verified to have current valid calibration.

3.0 Reference, Records, and Equipment

3.1 References

49 CFR Parts 172 to 178.	DOT Transportation Regulations
10 CFR Part 71.	NRC Packaging and Transportation of Radioactive Materials.
RSM	Radiation Safety Manual
ARP-001	Contamination Survey Meters
ARP-002	Alpha/beta sample counters
ARP-003	Micro-R Meters
ARP-008	Radiation and contamination surveys
ARP-015	Personnel Protective Clothing

3.2 Records

A copy of all radiation surveys, contamination surveys and shipping documents will be retained in shipment specific files. The basic records which would be included in a shipping file include:

ARP Form 8-1	Radiological Survey Report
ARP Form 8-2	Radiation and Contamination Survey
ARP Form 8-3	Radiation and Contamination Survey Results
ARP Form 16-1	Shipping Report
Shipment Manifest	Carriers bill of lading

3.3 Equipment

None Required

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for insuring that all personnel assigned the tasks of shipping radioactive materials are familiar with this procedure, adequately trained in the appropriate regulations, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer is responsible for training of personnel in the shipment of radioactive materials.

4.3 Waste Broker - The Waste Broker is responsible for waste characterization, negotiations with carriers, packaging of waste, and negotiations with disposal facilities.

4.4 Technicians - Technicians shipping radioactive materials are responsible to comply with provisions of this procedure.

5.0 Procedure

5.1 Determining the Type of Shipment

5.1.1 Determine the radionuclide(s) and quantity of activity to be shipped.

5.1.2 Determine the radiation level which will be present at the external surface of the package. (See ARP-008 for survey procedures)

5.1.3 Determine if material is special or normal form (see definitions in section 2.1 of this procedure).

5.1.4 Determine the A_1 or A_2 values for the radionuclides to be shipped. A partial list of A_1 and A_2 values commonly encountered is presented in table 1 of the appendix to this procedure. If the radionuclide is not found in table 1, refer to 49 CFR 173.434 to obtain values. If there is a mixture of radionuclides use the formulas presented in 49 CFR 173.433 to determine the A_1 and A_2 values.

5.1.5 Use figures 1 through 4 found in the appendix of this procedure to determine the type of shipment required for the material being shipped.

5.1.6 Transportation of radioactive materials by passenger carrying aircraft is not allowed.

5.2 Shipping Limited Quantity Radioactive Materials

5.2.1 Prior to consigning radioactive material for transport, have the RSO or Waste Broker verify that the receiver possesses a license issued by the NRC or licensing agency of an agreement state to take possession of the type, form, and quantity of material to be transferred. Written confirmation shall be received by the RSO or Waste Broker prior to shipment.

5.2.2 Materials must be packaged in a strong, tight package that will not leak any of the radioactive materials during conditions normally incident to transportation.

5.2.3 The radiation level at any point on the external surface of the package must be less than or equal to 0.5 millirem per hour. ok - 173.421

5.2.4 The non-fixed (removable) radioactive surface contamination on the external surface of the package shall not exceed the limits specified in table A. (See ARP-008 for survey procedure)

See 173.443 wipes over 300 cm²

Table A

Maximum Permissible Surface Contamination

Contaminant	Maximum Limits dpm/100 cm²
Beta-gamma emitting radionuclides: all radionuclides with half-lives less than ten days: natural uranium; natural thorium; uranium-235; uranium-238; thorium-232; thorium-228; and thorium-230; when contained in ores or physical concentrates.	2200
All other alpha emitting radionuclides.	220

5.2.5 The outside of the inner packaging or if there is no inner packaging the outside of the packaging itself must bear the marking **"RADIOACTIVE"**.

5.2.6 The package must contain less than 15 grams of uranium-235 unless it is an excepted article or instrument containing natural uranium.

5.2.7 Any package which has a gross weight in excess of 110 pounds shall be plainly marked with the package weight.

5.2.8 Packages which contain liquid radioactive materials with a liquid volume not to exceed 50 cubic centimeters, must include a plastic or leak resistant inner container and be surrounded by sufficient absorbent material to adsorb at least twice the volume of liquid containing the radioactive material. The absorbent material shall be compatible with the package contents.

5.2.9 Verify all closure devices (including gaskets) are properly installed and free of defects.

5.2.10 Complete the **"SHIPPING REPORT"** (AEI form 16-1) and enclose the report with the packing papers of the shipment. Retain a copy of the **"SHIPPING REPORT"** for the home office files.

5.2.11 Complete the **"LIMITED QUANTITY CERTIFICATION"** (AEI form 16-2) and enclose the form with the packing papers of the shipment. Retain a copy of the **"LIMITED QUANTITY CERTIFICATION"** for the home office files.

5.3 Shipping Low Specific Activity Materials and Surface Contaminated Objects as Mixed Lading by Common Carrier.

5.3.1 Prior to consigning radioactive material for transport, have the RSO or Waste Broker verify that the receiver possesses a license issued by the NRC or licensing agency of an agreement state to take possession of the type, form, and quantity of material to be transferred. Written confirmation shall be received by the RSO or Waste Broker prior to shipment.

5.3.2 Materials must be packaged in a DOT Specification 7A Type A package. NRC regulated LSA-II, LSA-III and SCO-II must be packaged in a "Type B" package.

5.3.3 The non-fixed (removable) radioactive surface contamination on the external surface of the package shall not exceed the limits specified in table A of section 5.2. (See ARP 008 for survey procedure)

5.3.4 The radiation level at any point on the external surface of the package and at a distance of one meter must conform with the radiation level requirements shown in Table B. The table also specifies the labeling requirements for packages. Each package must have two labels attached to opposite sides of the package. The shipping label is completed by entering the name of radionuclide(s), the quantity of activity and the transport index on the label using a durable weather resistant means of marking.

Table B

Radiation Levels and Labeling requirements for LSA-I, LSA-II, LSA-III, SCO-I AND SCO-II shipments by common carrier.

Radiation Levels	Label Requirements
Radiation levels are ≤ 0.5 mrems/hr anywhere on external surface of package	Radioactive (White) - I
Radiation levels are > 0.5 mrems/hr but are ≤ 50 mrems/hr anywhere on external surface of package, and are ≤ 1.0 mrems/hr at one meter from the external surface of the package.	Radioactive (Yellow) - II
Radiation levels are > 50 mrems/hr but are ≤ 200 mrems/hr anywhere on external surface of package, and are ≤ 10 mrems/hr at one meter from the external surface of the package.	Radioactive (Yellow) - III
Radiation Levels are > 200 mrems/hr.	Not Allowed

5.3.5 Any package which has a gross weight in excess of 110 pounds shall be plainly marked with the package weight.

5.3.6 Each package must be marked with the Consignee's name and address.

5.3.7 Verify all closure devices (including gaskets) are properly installed and free of defects.

5.3.8 Complete the "SHIPPING REPORT" (AEI form 16-1) and enclose the report with the packing papers of the shipment. Retain a copy of the "SHIPPING REPORT" for the home office files.

5.3.9 Complete the transport carriers bill of lading. Retain a copy of the bill of lading for the Las Vegas office files.

5.3.10 The sum of the transport index from the individual packages must be less than 50 for a single carrier.

5.3.11 The transport vehicle must be posted with a "RADIOACTIVE" placard if the shipment contains Radioactive (Yellow) - III labeled packages.

5.4 Shipping Low Specific Activity Materials and Surface Contaminated Objects in Exclusive Use Vehicles.

5.4.1 Prior to consigning radioactive material for transport, have the RSO or Waste Broker verify that the receiver possesses a license issued by the NRC or licensing agency of an agreement state to take possession of the type, form, and quantity of material to be transferred. Written confirmation shall be received by the RSO or Waste Broker prior to shipment.

5.4.2 Materials must be packaged in strong tight packages such that there will be no leakage of radioactive contents under normal conditions of transport. Typical containers include B-6 boxes, B-12 boxes and 55 gallon drums. For bulk shipments the freight container can be the package. NRC regulated LSA-II, LSA-III and SCO-II must be packaged in a "Type A" package.

5.4.3 The non-fixed (removable) radioactive surface contamination on the external surface of the package shall not exceed the limits specified in table A of section 5.2. (See ARP-008 for survey procedure)

5.4.4 The radiation level at any point on the external surface of the package, the transport vehicle, and at a specified distances must conform with the radiation level requirements shown in Table C. The table also specifies the labeling requirements for packages.

Table C

Radiation Levels and Labeling requirements for LSA shipments by Exclusive Use Vehicles

Radiation Levels on Packages	Radiation levels on/in transport vehicle	Type of Shipment	Package Label Requirements
Radiation levels are ≤ 200 mrems/hr anywhere on external surface of package, and are ≤ 10 mrems/hr at one meter from the external surface of the package.	≤ 10 mrems/hr at 2 meters from the vertical planes projected from outer edges of transport vehicle. ≤ 2 mrems/hr in any normally occupied position in the transport vehicle.	Package Shipment in Open Transport Vehicle	Radioactive LSA or Radioactive SCO
Radiation levels are ≤ 1000 mrems/hr anywhere on external surface of package. (SEE NOTE 1 BELOW)	≤ 10 mrems/hr at 2 meters from the vertical planes projected from outer edges of transport vehicle. ≤ 200 mrems/hr at any point on the outer surface of the vehicle. ≤ 2 mrems/hr in any normally occupied position in the transport vehicle.	Package Shipment in Closed Transport Vehicle	Radioactive LSA or Radioactive SCO
Radiation levels are ≤ 200 mrems/hr anywhere on external surface of package.	≤ 10 mrems/hr at 2 meters from the vertical planes projected from outer edges of transport vehicle. ≤ 200 mrems/hr at any point on the outer surface of the vehicle. ≤ 2 mrems/hr in any normally occupied position in the transport vehicle.	Bulk Shipments in Closed Transport Vehicle	Radioactive LSA or Radioactive SCO on transport container
Note 1. The package must be secured so its position remains fixed during transport. There will be no loading or unloading operations between the beginning and end of the transport.			

5.4.5 Any package which has a gross weight in excess of 110 pounds shall be plainly marked with the package weight.

5.4.6 Packages, with a capacity of 110 gallons or less, that contain a hazardous substance, must be stenciled or otherwise marked with the letters "RQ" in addition to the "Radioactive LSA" or "Radioactive SCO" label.

5.4.7 The shipment must be braced so as to prevent shifting of lading under conditions normally incident to transportation. Shipments of 55 gallon drums are secured by nailing 2" by 4" by 8' lumber to the floor of the vehicle bed between each row of drums. B-12 and B-6 boxes are secured with 2" by 4" by 8' lumber nailed to the vehicle floor and come-along over the boxes.

5.4.8 Shipments must be loaded by consignor and unloaded by consignee from the conveyance or freight contained in which originally loaded.

5.4.9 Verify all closure devices (including gaskets) are properly installed and free of defects.

5.4.10 Complete the "SHIPPING REPORT" (AEI form 16-1) and enclose the report with the packing papers of the shipment. Retain a copy of the "SHIPPING REPORT" for the home office files.

5.4.11 Complete the carriers bill of lading. Retain a copy of the bill of lading for the home office files.

5.4.12 Complete the "DRIVER INSTRUCTIONS" (AEI form 16-3) and "SPECIFIC INSTRUCTIONS FOR MAINTENANCE OF EXCLUSIVE USE SHIPMENTS" (AEI form 16-4). Explain the conditions on the forms to the driver and enclose these forms with the packing papers of the shipment. Retain a copy of the forms for the home office files.

5.4.13 The transport vehicle must be posted with a 'RADIOACTIVE" placard. (Shipments of unconcentrated uranium or thorium ores are exempt from the "Radioactive" placard requirement.)

5.5 Shipping Type A and Type B Packaged Radioactive Materials as Mixed Lading by Common Carrier.

5.5.1 Prior to consigning radioactive material for transport, have the RSO or Waste Broker verify that the receiver possesses a license issued by the NRC or licensing agency of an agreement state to take possession of the type, form, and quantity of material to be transferred. Written confirmation shall be received by the RSO or Waste Broker prior to shipment.

5.5.2 Materials must be packaged in a DOT Specification 7A Type A package. If the quantities of activity requires a Type A package, each package shall not contain a quantity of radioactivity greater than A_1 for special form radioactive materials and greater than A_2 for normal form radioactive materials. If the quantity of radioactivity exceeds the A_1 or A_2 quantities a Type B package is required. The exterior of the packages which conform to the requirements for Type A and Type B packaging must be marked (using at least ½" high lettering) "Type A" or "Type B".

5.5.3 The non-fixed (removable) radioactive surface contamination on the external surface of the package shall not exceed the limits specified in table A of section 5.2. (See ARP-008 for survey procedure)

5.5.4 The radiation level at any point on the external surface of the package and at a distance of one meter must conform with the radiation level requirements shown in Table D. The table also specifies the labeling requirements for packages. Each package must have two labels attached to opposite sides of the package. The shipping label is completed by entering the name of radionuclide(s), the quantity of activity and the transport index on the label using a durable weather resistant means of marking.

Table D

Radiation Levels and Labeling requirements for Type A and Type B package shipments by common carrier

Radiation Levels	Fissile Class Restrictions	Label Requirements
Radiation levels are ≤ 0.5 mrems/hr anywhere on external surface of package	Package does not contain Fissile Class II or III materials. Packages can contain Fissile Class I materials.	Radioactive (White) - I
Radiation levels are > 0.5 mrems/hr but are ≤ 50 mrems/hr anywhere on external surface of package, and are ≤ 1.0 mrems/hr at one meter from the external surface of the package.	Package does not contain Fissile Class III materials. Packages can contain Fissile Class I or II materials having a transport index of 1.0 or less.	Radioactive (Yellow) - II
Radiation levels are > 50 mrems/hr but are ≤ 200 mrems/hr anywhere on external surface of package, and are ≤ 10 mrems/hr at one meter from the external surface of the package.	Packages can contain Fissile Class II or III materials having a transport index > 1.0, but ≤ 10.	Radioactive (Yellow) - III

5.5.5 Any package which has a gross weight in excess of 110 pounds shall be plainly marked with the package weight.

5.5.6 Each package must be marked with the Consignee's name and address.

5.5.7 Verify all closure devices (including gaskets) are properly installed and free of defects.

5.5.8 Complete the "SHIPPING REPORT" (AEI Form 16-1) and enclose the report with the packing papers of the shipment. Retain a copy of the "SHIPPING REPORT" for the home office files.

5.5.9 Complete the transport carriers bill of lading. Retain a copy of the bill of lading for the home office files.

5.5.10 The sum of the transport index from the individual packages must be less than 50 for a single carrier (See additional restrictions in 10 CFR 173.417 for Fissile Class shipments).

5.5.11 The transport vehicle must be posted with a 'RADIOACTIVE" placard if the shipment contains Radioactive (Yellow) - III labeled packages.

5.6 Shipping Type A and Type B Packaged Radioactive Materials by Exclusive Use Vehicle.

5.6.1 Prior to consigning radioactive material for transport, have the RSO or Waste Broker verify that the receiver possesses a license issued by the NRC or licensing agency of an agreement state to take possession of the type, form, and quantity of material to be transferred. Written confirmation shall be received by the RSO or Waste Broker prior to shipment.

5.6.2 Materials must be packaged in a DOT Specification 7A Type A package. If the quantities of activity requires a Type A package, each package shall not contain a quantity of radioactivity greater than A_1 for special form radioactive materials and greater than A_2 for normal form radioactive materials. If the quantity of radioactivity exceeds the A_1 or A_2 quantities a Type B package is required. The exterior of the packages which conform to the requirements for Type A and Type B packaging must be marked (using at least ½" high lettering) "Type A" or "Type B".

5.6.3 The non-fixed (removable) radioactive surface contamination on the external surface of the package shall not exceed the limits specified in table A of section 5.2. (See ARP-008 for survey procedure)

5.6.4 The radiation level at any point on the external surface of the package, the transport vehicle, and at a specified distances must conform with the radiation level requirements shown in Table E. The table also specifies the labeling requirements for packages.

Table E

Radiation Levels and Labeling requirements for Type A and Type B Packages in Exclusive Use Shipments.

Radiation Levels on Packages	Radiation levels on/in transport vehicle	Type of Shipment	Package Label Requirements
Radiation levels are ≤ 0.5 mrems/hr anywhere on external surface of package.	≤ 10 mrems/hr at 2 meters from the vertical planes projected from outer edges of transport vehicle. ≤ 2 mrems/hr in any normally occupied position in the transport vehicle.	Package Shipment in Open Transport Vehicle	Radioactive I
Radiation levels are ≤ 50 mrems/hr anywhere on external surface of package, and are ≤ 1.0 mrems/hr at one meter from the external surface of the package.	≤ 10 mrems/hr at 2 meters from the vertical planes projected from outer edges of transport vehicle. ≤ 2 mrems/hr in any normally occupied position in the transport vehicle.	Package Shipment in Open Transport Vehicle	Radioactive II
Radiation levels are ≤ 200 mrems/hr anywhere on external surface of package, and are ≤ 10 mrems/hr at one meter from the external surface of the package.	≤ 10 mrems/hr at 2 meters from the vertical planes projected from outer edges of transport vehicle. ≤ 2 mrems/hr in any normally occupied position in the transport vehicle.	Package Shipment in Open Transport Vehicle	Radioactive III
Radiation levels are ≤ 1000 mrems/hr anywhere on external surface of package. (SEE NOTE 1 BELOW)	≤ 10 mrems/hr at 2 meters from the vertical planes projected from outer edges of transport vehicle. ≤ 200 mrems/hr at any point on the outer surface of the vehicle. ≤ 2 mrems/hr in any normally occupied position in the transport vehicle.	Package Shipment in Closed Transport Vehicle	Radioactive III
Note 1. The package must be secured so its position remains fixed during transport. There will be no loading or unloading operations between the beginning and end of the transport.			

5.7.4 The radiation level at any point on the external surface of the package, the transport vehicle, and at a specified distances must conform with the radiation level requirements shown in Table F. The table also specifies the labeling requirements for packages.

Table F

Radiation Levels and Labeling requirements for Highway Route Controlled Quantity shipments (exclusive use vehicle)

Radiation Levels on Packages	Radiation levels on/in transport vehicle	Type of Shipment	Package Label Requirements
Radiation levels are ≤ 1000 mrems/hr anywhere on external surface of package. (SEE NOTE 1 BELOW)	≤ 10 mrems/hr at 2 meters from the vertical planes projected from outer edges of transport vehicle. ≤ 200 mrems/hr at any point on the outer surface of the vehicle. ≤ 2 mrems/hr in any normally occupied position in the transport vehicle.	Package Shipment in exclusive use Vehicle	Radioactive III
Note 1. The package must be secured so its position remains fixed during transport. There will be no loading or unloading operations between the beginning and end of the transport.			

5.7.5 Any package which has a gross weight in excess of 110 pounds shall be plainly marked with the package weight.

5.7.6 Verify all closure devices (including gaskets) are properly installed and free of defects.

5.7.7 The shipment must be braced so as to prevent shifting of lading under conditions normally incident to transportation.

5.7.8 Shipments must be loaded by consignor and unloaded by consignee from the conveyance or freight contained in which originally loaded.

5.7.9 Complete the "SHIPPING REPORT" (AEI Form 16-1) and enclose the report with the packing papers of the shipment. The shipping report must be marked with "HIGHWAY ROUTE CONTROLLED QUANTITY". Retain a copy of the "SHIPPING REPORT" for the home office files.

5.7.10 Complete the carriers bill of lading. Retain a copy of the bill if lading for the Las Vegas office files.

5.7.11 Complete the "DRIVER INSTRUCTIONS" (AEI form 16-3) and "SPECIFIC INSTRUCTIONS FOR MAINTENANCE OF EXCLUSIVE USE SHIPMENTS" (AEI form 16-4). Explain the conditions on the forms to the driver and enclose these forms with the packing papers of the shipment. Retain a copy of the forms for the home office files.

5.7.12 The transport vehicle must be posted with a 'RADIOACTIVE" placard on a SQUARE BACKGROUND as specified in 49 CFR 172.527.

5.8 Shipping Empty Packages.

5.8.1 Prior to transport, any packaging, container or accessory which has been used for shipment of radioactive materials and contains residual amounts of material must be adequately sealed to prevent leakage of radioactive material during transport.

5.8.2 The non-fixed (removable) radioactive surface contamination on the external surface of the package shall not exceed the limits specified in table A of section 5.2. (See ARP-008 for survey procedure)

5.8.3 The radiation level on the external surface of the package must be equal to or less than 0.5 mrems/hr.

5.8.4 The residual amounts of radioactive materials must not exceed 100 times the limits specified in table A of section 5.2.

5.8.5 Remove, obliterate or cover any labels previously applied and apply an **"EMPTY"** label.

5.8.6 The outside of the inner packaging or if there is no inner packaging, the outside of the packaging itself must bear the marking **"RADIOACTIVE"**.

5.8.7 Complete the **"SHIPPING REPORT"** (AEI Form 16-1) and enclose the report with the packing papers of the shipment. Retain a copy of the **"SHIPPING REPORT"** for the home office files.

6.0 Attachments

Figure 1.	Shipping category for special form materials
Figure 2	Shipping category for normal form solids
Figure 3	Shipping category for normal form liquid and gases
Figure 4	Type A and Type B shipments
Appendix A	Specific Shipping Requirements/Barnwell
Appendix B	Specific Shipping Requirements/Hanford
Appendix C	Specific Shipping Requirements/EnviroCare
Appendix D	Copy of Distribution Checklists
Appendix E	CWB Work Forms
Appendix F	Sipping Papers and Supporting Documents
Appendix G	Packaging Pyrophoric Materials
Appendix H	Packaging Biological Waste
Appendix I	Packaging Scintillation Liquids
Appendix J	Encapsulation of Sources
Appendix K	Prepackaged Waste Certification
ARP 16-1	Shipping Report

ARP Figure 1

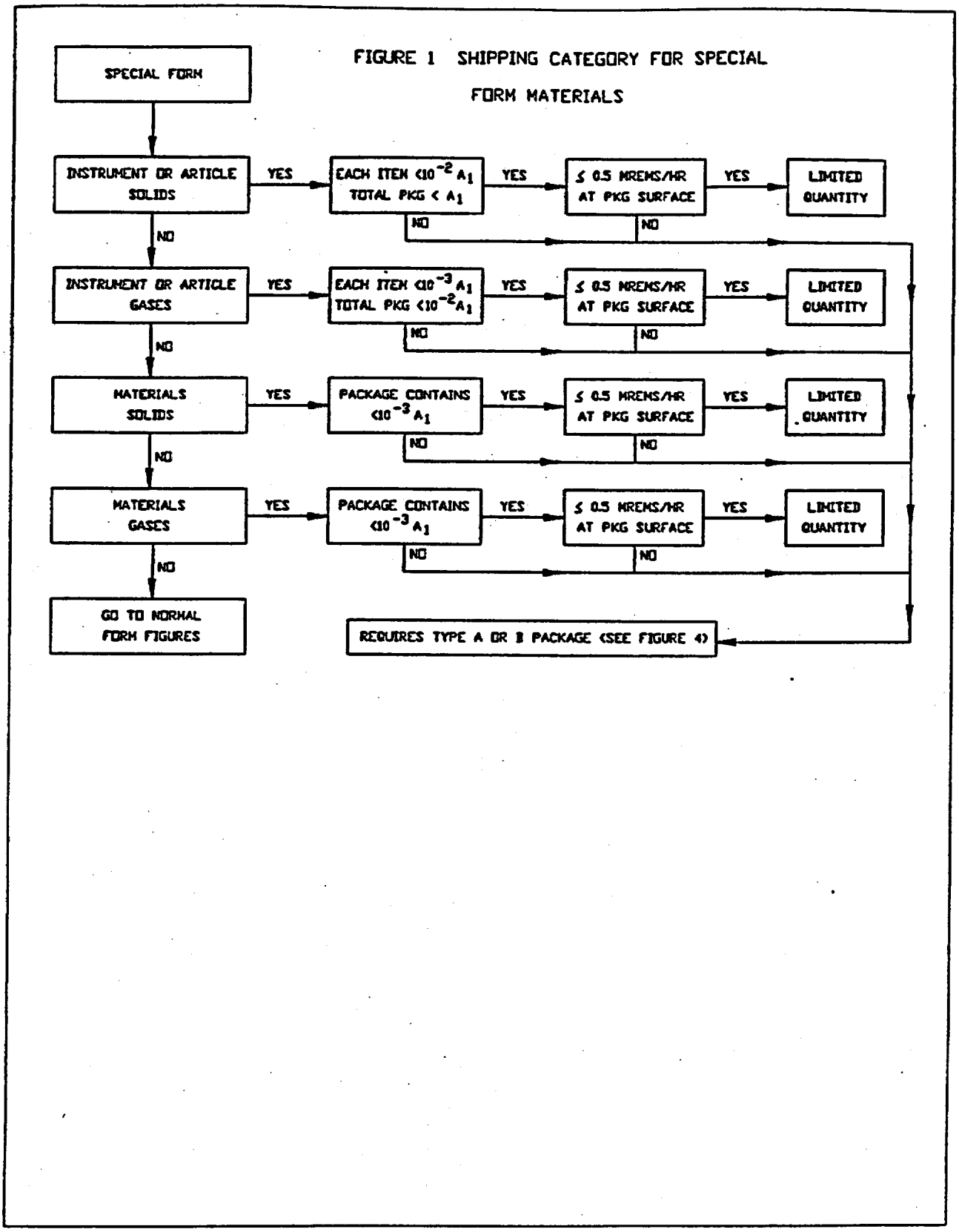
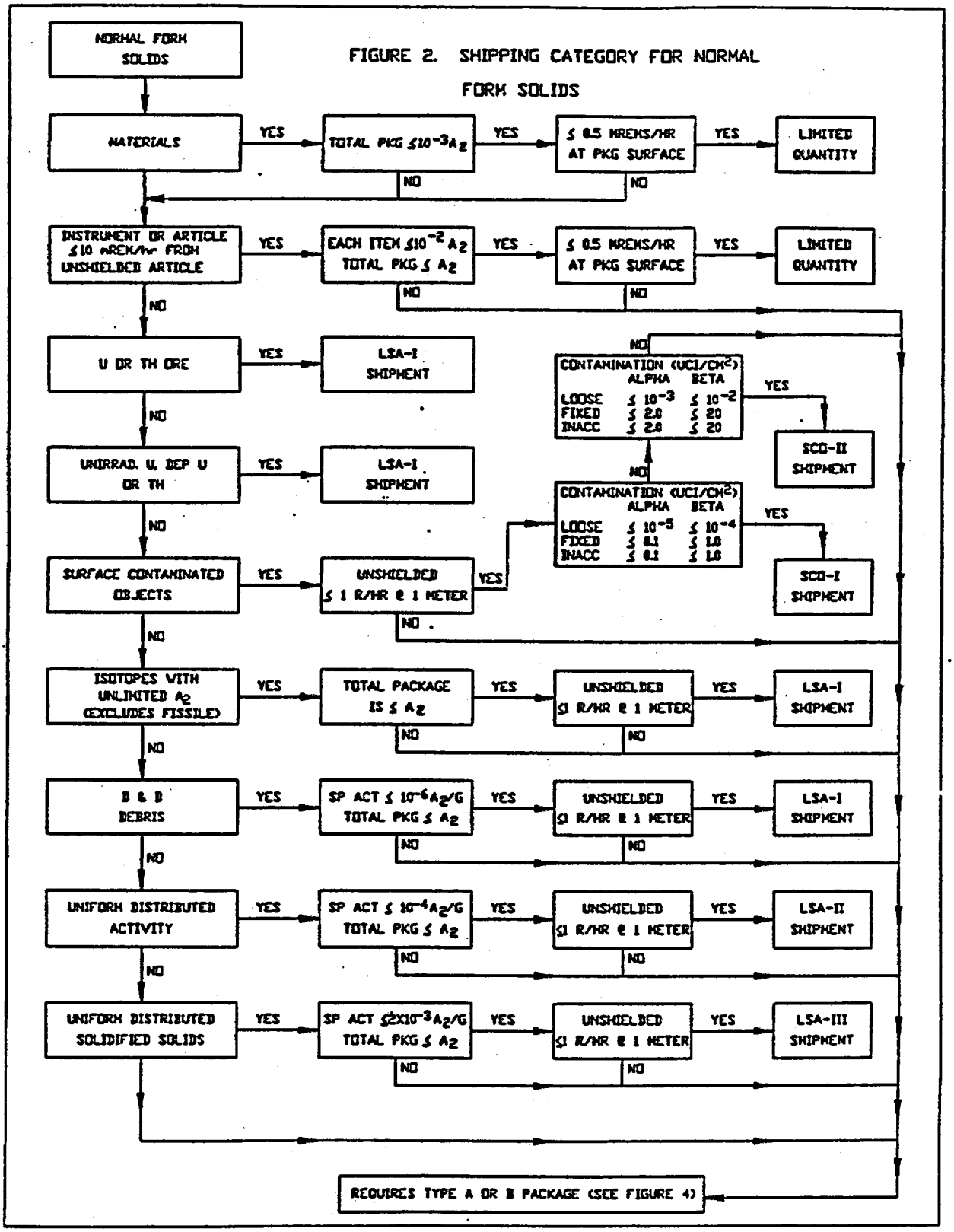


FIGURE 1 SHIPPING CATEGORY FOR SPECIAL FORM MATERIALS

ARP Figure 2


NORMAL FORM SOLIDS
FIGURE 2. SHIPPING CATEGORY FOR NORMAL FORM SOLIDS
MATERIALS
YES
TOTAL PKG ≤10⁻³A₂
YES
≤ 0.5 MREMS/HR AT PKG SURFACE
YES
LIMITED QUANTITY
NO
NO
INSTRUMENT OR ARTICLE ≤10 mREM/hr FROM UNSHIELDED ARTICLE
YES
EACH ITEM ≤10⁻² A₂ TOTAL PKG ≤ A₂
YES
≤ 0.5 MREMS/HR AT PKG SURFACE
YES
LIMITED QUANTITY
NO
NO
U OR TH ORE
YES
LSA-I SHIPMENT
NO
CONTAMINATION (UCI/CM²)
ALPHA BETA
LOOSE ≤ 10⁻³ ≤ 10⁻²
FIXED ≤ 2.0 ≤ 20
INACC ≤ 2.0 ≤ 20
YES
SCO-II SHIPMENT
NO
UNIRRAD. U, DEP U OR TH
YES
LSA-I SHIPMENT
NO
CONTAMINATION (UCI/CM²)
ALPHA BETA
LOOSE ≤ 10⁻⁵ ≤ 10⁻⁴
FIXED ≤ 0.1 ≤ 1.0
INACC ≤ 0.1 ≤ 1.0
YES
SCO-I SHIPMENT
SURFACE CONTAMINATED OBJECTS
YES
UNSHIELDED ≤ 1 R/HR @ 1 METER
YES
NO
ISOTOPES WITH UNLIMITED A₂ (EXCLUDES FISSILE)
YES
TOTAL PACKAGE IS ≤ A₂
YES
UNSHIELDED ≤1 R/HR @ 1 METER
YES
LSA-I SHIPMENT
NO
NO
NO
D & D DEBRIS
YES
SP ACT ≤ 10⁻⁶A₂/G TOTAL PKG ≤ A₂
YES
UNSHIELDED ≤1 R/HR @ 1 METER
YES
LSA-I SHIPMENT
NO
NO
NO
UNIFORM DISTRIBUTED ACTIVITY
YES
SP ACT ≤ 10⁻⁴A₂/G TOTAL PKG ≤ A₂
YES
UNSHIELDED ≤1 R/HR @ 1 METER
YES
LSA-II SHIPMENT
NO
NO
NO
UNIFORM DISTRIBUTED SOLIDIFIED SOLIDS
YES
SP ACT ≤2X10⁻³A₂/G TOTAL PKG ≤ A₂
YES
UNSHIELDED ≤1 R/HR @ 1 METER
YES
LSA-III SHIPMENT
NO
NO
NO
REQUIRES TYPE A OR B PACKAGE (SEE FIGURE 4)

ARP Figure 3

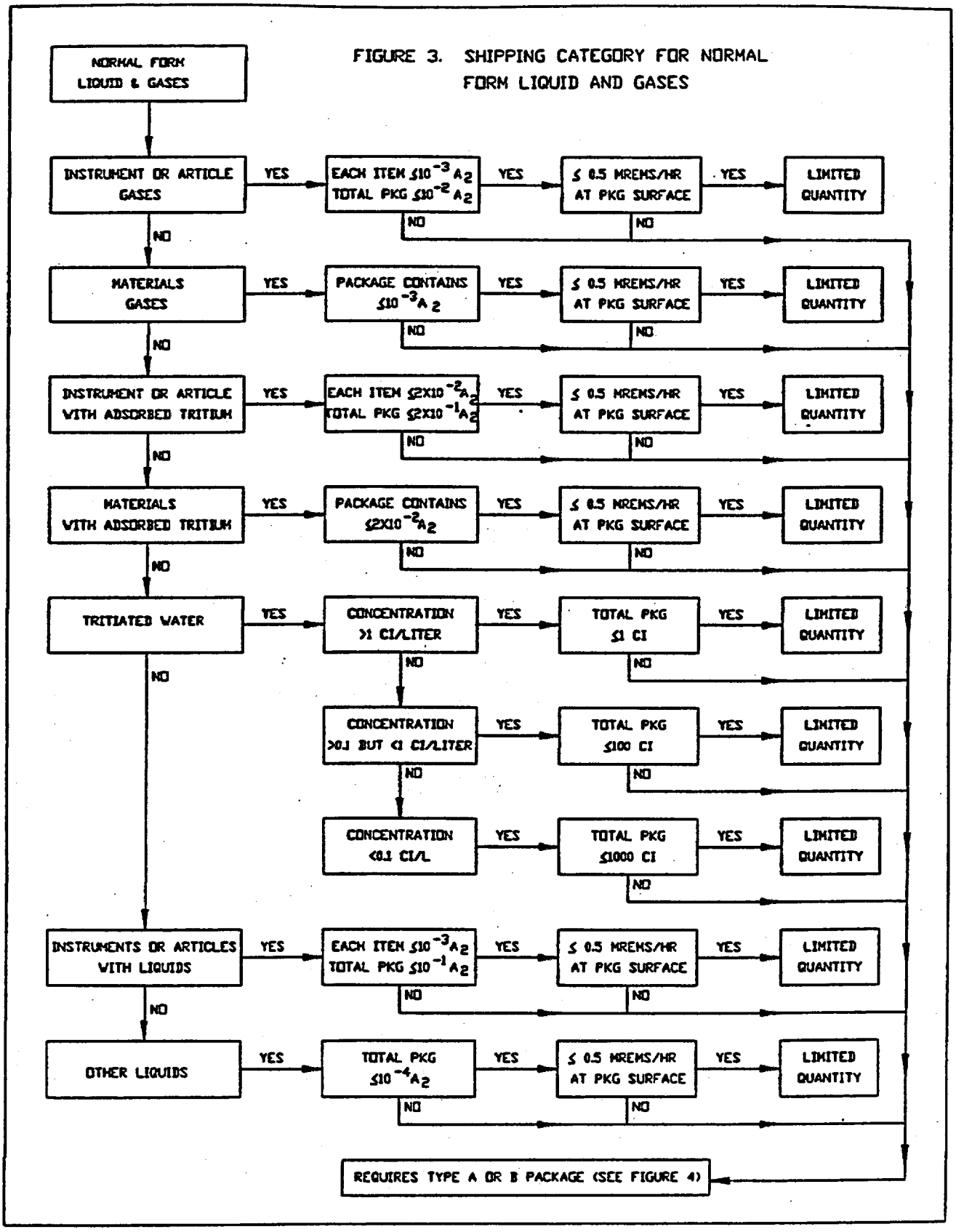


FIGURE 3. SHIPPING CATEGORY FOR NORMAL FORM LIQUID AND GASES

ARP Figure 4

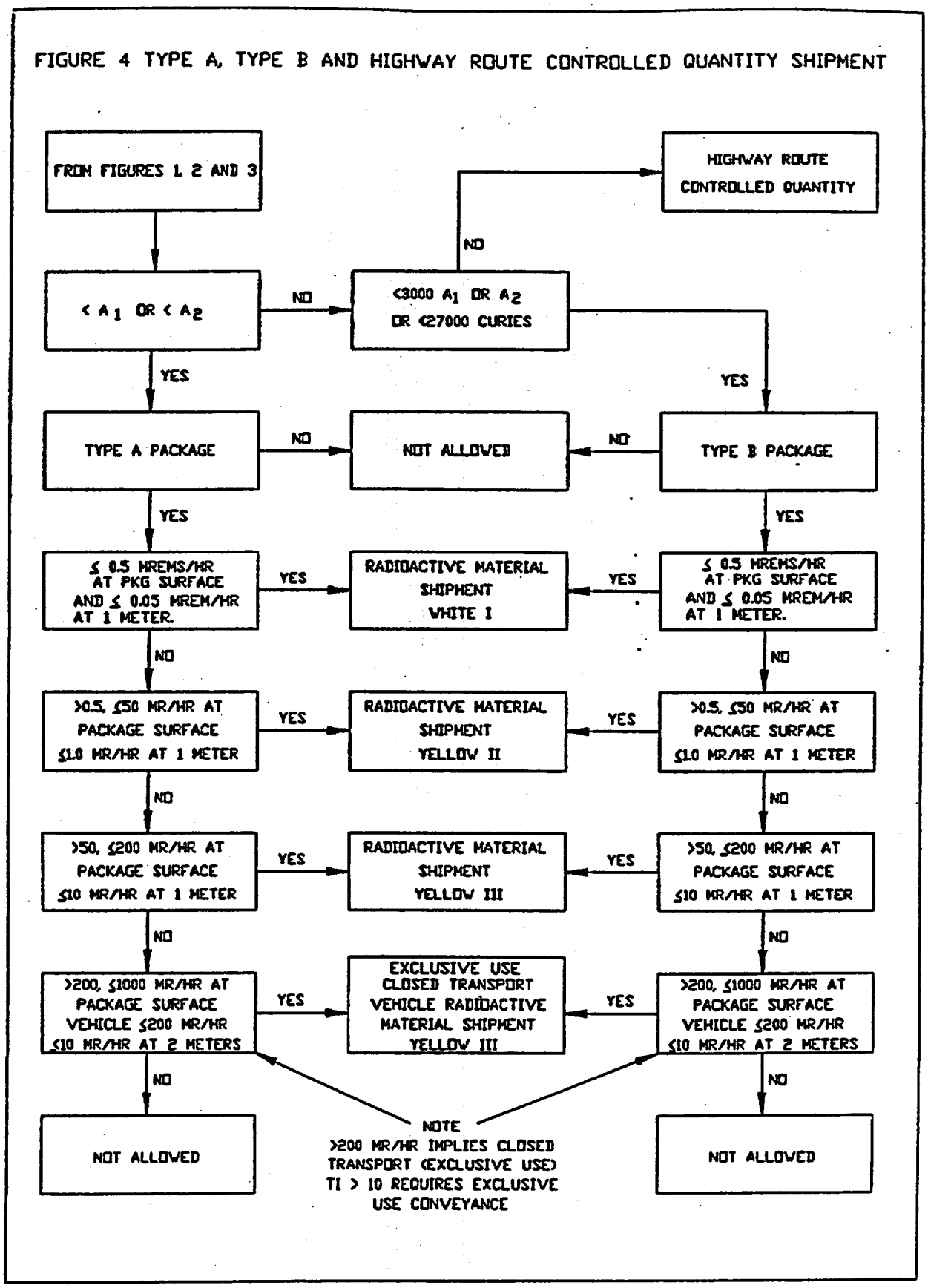


FIGURE 4 TYPE A, TYPE B AND HIGHWAY ROUTE CONTROLLED QUANTITY SHIPMENT
FROM FIGURES 1, 2 AND 3
HIGHWAY ROUTE CONTROLLED QUANTITY
NO
< A1 OR < A2
NO
<3000 A1 OR A2 OR <27000 CURIES
YES
YES
TYPE A PACKAGE
NO
NOT ALLOWED
NO
TYPE B PACKAGE
YES
YES
≤ 0.5 MREMS/HR AT PKG SURFACE AND ≤ 0.05 MREM/HR AT 1 METER.
YES
RADIOACTIVE MATERIAL SHIPMENT WHITE I
YES
≤ 0.5 MREMS/HR AT PKG SURFACE AND ≤ 0.05 MREM/HR AT 1 METER.
NO
NO
>0.5, ≤50 MR/HR AT PACKAGE SURFACE ≤1.0 MR/HR AT 1 METER
YES
RADIOACTIVE MATERIAL SHIPMENT YELLOW II
YES
>0.5, ≤50 MR/HR AT PACKAGE SURFACE ≤1.0 MR/HR AT 1 METER
NO
NO
>50, ≤200 MR/HR AT PACKAGE SURFACE ≤10 MR/HR AT 1 METER
YES
RADIOACTIVE MATERIAL SHIPMENT YELLOW III
YES
>50, ≤200 MR/HR AT PACKAGE SURFACE ≤10 MR/HR AT 1 METER
NO
NO
>200, ≤1000 MR/HR AT PACKAGE SURFACE VEHICLE ≤200 MR/HR ≤10 MR/HR AT 2 METERS
YES
EXCLUSIVE USE CLOSED TRANSPORT VEHICLE RADIOACTIVE MATERIAL SHIPMENT YELLOW III
YES
>200, ≤1000 MR/HR AT PACKAGE SURFACE VEHICLE ≤200 MR/HR ≤10 MR/HR AT 2 METERS
NO
NO
NOT ALLOWED
NOTE
>200 MR/HR IMPLIES CLOSED TRANSPORT (EXCLUSIVE USE) TI > 10 REQUIRES EXCLUSIVE USE CONVEYANCE
NOT ALLOWED

APPENDIX A
SPECIFIC SHIPPING REQUIREMENTS
BARNWELL WASTE MANAGEMENT

1.0 SCDHEC transportation permits must be renewed by the first of January o each year. Ensure that these permits are current.

2.0 Weight and volume dilution of the activity concentration is not acceptable for aqueous filters and sources that have been encapsulated.

3.0 Encapsulation for stability requires a minimum specific thickness (4 inches) of cement all around the item being encapsulated. Consult Barnwell's acceptance criteria or the Materials Management Supervisor.

4.0 Absorbed fluids are not acceptable.

5.0 SCDHEC 802, Prior Notification Form, is not required if the activity in the shipment is less than one (1) curie and the volume is less than 75 cubic feet.

6.0 A shipment ID# must be obtained by the 10th of the month from the Barnwell WSSP/PNP department for every shipment being sent to Barnwell Site for disposal. This allows enough time to ensure concrete "overpacks" are prepared.

7.0 Generators must provide a documented Radwaste Program certification as included in the Barnwell manifest and manifest coversheet.

NOTE: CNSI has been granted an exemption by the USDOT to use their manifest as shipping papers. For generators/brokers to use the exemption number, it must be written on all pages of the manifest and other shipping papers.

8.0 Generators must provide a P.O., contract or written letter of authority to CNSI marketing prior to shipment.

9.0 The SCDHEC 802, Prior Notification Form, must be faxed to CNSI/NSSI/PNP and SCDHEC in Columbia, at least 72 hours in advance of shipment.

APPENDIX B
SPECIFIC SHIPPING REQUIREMENTS
HANFORD NORM/LLRW SITE

1.0 The disposal Site User's Permit is valid, not expired, and will not expire prior to the shipments arrival at the disposal site.

2.0 The Broker Site Users Permit is valid, not expired, and will not expire prior to the shipment's arrival at the disposal site.

3.0 Solidified oil must be segregated by ten (10) feet in the disposal trench and the segregation volume may be reflected in the disposal charges. Stabilized oil does not have to be segregated.

4.0 The Hanford LLRW RSM will be used, however, some handwritten changes must be made prior to use.

5.0 Concrete for the encapsulation of sources must be cured for 28 days and must achieve a minimum compressive strength of 2500 psi.

6.0 ALL Radium waste is considered NORM, however prior to burial, the Washington Department of Health (WDOH) must document an official *Norm Determination Letter* (certification). This documentation must be received and ready for inspection prior to presenting the NORM for burial.

7.0 Consumer products (including smoke detectors) require a specific exception in Reference 8.5 or proof the original manufacturer has been licensed by the NRC or an Agreement State agency to manufacture the product as a consumer product and the consumer does not have or need a specific license to possess the product. This proof must accompany the shipping papers.

8.0 Lead may be permitted, as shielding on a case-by-case basis, in waste packages destined for Hanford.

9.0 Properly sorbed liquids are accepted for burial. The acceptable sorbents are listed in the site license as noted in Reference 8.5.

APPENDIX C
SPECIFIC SHIPPING REQUIREMENTS
ENVIROCARE

1.0 The waste forms and radionuclides must be homogeneous except in the case of structural debris superficially contaminated with licensed materials.

2.0 No sealed sources are acceptable.

3.0 Free standing liquid shall in no case shall exceed 1.0% by volume per container.

4.0 The authorized forms of materials are volumetric bulky materials or structural debris. The use of bulk closed transport vehicles is encouraged.

5.0 Structural debris is limited to <12 inches in at least one direction, and not greater than 8 feet in any one direction.

6.0 The waste is required to be characterized through a wide battery of analyses. Consult with EnviroCare's Radiation Safety Officer (RSO) and/or the Material Management Supervisor (MMS)/ Waste Management Supervisor (WMS).

7.0 Intensive preliminary sampling per EnviroCare guidance is required prior to issuance of the notification to ship. These samples' results will be presented to EnviroCare, if requested, prior to issuance of the notification.

APPENDIX D
COPY DISTRIBUTION CHECKLIST
BARNWELL WASTE MANAGEMENT

	Disposal Site	Shipper	Carrier	M.M.S.	CWB	Mail Copy
RSM	orig	2nd orig	3rd orig	copy	copy	copy
Bill of Lading	copy	copy	orig	copy	copy	N/A
DHEC 803	orig	copy	copy	copy	copy	N/A
DHEC 802	orig	copy	copy	copy	copy	N/A
*Driver Instruction Exclusive Use	copy	copy	orig	copy	copy	N/A
Waste Inventory Sheet	N/A	copy	N/A	copy	orig	N/A
Truck Survey	copy	copy	copy	copy	orig	N/A
Admin Info	N/A	N/A	N/A	copy	orig	N/A
*HIC Certification	copy	copy	N/A	copy	copy	N/A
*NRC Form 741	orig	copy	N/A	copy	copy	N/A
*Isotopic Analysis	copy	copy	N/A	copy	copy	N/A
Class C Cert.	orig	copy	N/A	copy	copy	N/A
*Compact Export Certification	orig	copy	N/A	copy	copy	N/A
*Variance Letter	copy	copy	N/A	copy	copy	N/A
Radwaste Program Certification	orig	copy	N/A	copy	copy	N/A
Emergency Action	copy	copy	orig	copy	copy	copy

* Only if applicable

APPENDIX D
COPY DISTRIBUTION
HANFORD NORM/LLRW SITE

	Disposal Site	Shipper	Carrier	M.M.S.	CWB	Mail
RSM	orig & 3rd orig	4th orig	5th orig	copy	copy	2nd orig
Bill of Lading	copy	copy	orig	copy	copy	N/A
WA Certification DHS-RHF-31B	orig	copy	copy	copy	copy	N/A
Prior notification call sheet	copy	copy	copy	copy	orig	N/A
*Driver Instruction	copy	copy	orig	copy	copy	N/A
Waste Inventory	N/A	copy	N/A	copy	orig	N/A
Truck Survey	copy	copy	copy	copy	orig	N/A
Admin. Info	N/A	N/A	N/A	copy	orig	N/A
* Compact Export Certification	orig	copy	N/A	copy	copy	N/A
*Variance Letter	orig	copy	N/A	copy	copy	N/A
*NRC Certification	orig	copy	N/A	copy	copy	N/A
*Port of Entry (CVSA)	orig	copy	N/A	copy	copy	N/A
Emergency Action	copy	copy	orig	copy	copy	copy

* Only as Applicable

APPENDIX D
COPY DISTRIBUTION
ENVIROCARE of UTAH

	Consignee	Shipper	Carrier	M.M.S.	CWB	Mail
RSM	orig	copy	copy	copy	copy	copy
Bill of Lading	copy	copy	orig	copy	copy	N/A
*Driver Instructions	copy	copy	orig	copy	copy	N/A
Waste Inventory	N/A	copy	N/A	copy	orig	N/A
Truck Survey	copy	copy	copy	copy	orig	N/A
Admin. Info	N/A	N/A	N/A	copy	orig	N/A
*NRC Form 741	orig	copy	N/A	copy	copy	N/A
LDR Notification	orig	copy	N/A	copy	copy	N/A
Emergency Action	copy	copy	orig	copy	copy	copy

* Only as Applicable

APPENDIX D
COPY DISTRIBUTION
NON-WASTE SHIPMENTS

	Consignee	Shipper	Carrier	M.M.S.	CWB
RSR	orig	copy	copy	copy	copy
Bill of Lading	copy	copy	orig	copy	copy
*Driver Instruction	copy	copy	orig	copy	copy
Waste Inventory	N/A	copy	N/A	copy	orig
Truck Survey	copy	copy	copy	copy	orig
Admin Info.	N/A	N/A	N/A	copy	orig
*NRC Form 741	orig	copy	N/A	copy	copy
Emergency Action	copy	copy	orig	copy	copy

* Only as Applicable

APPENDIX E
CWB WORK FORMS

CWB PRE-DEPARTURE GUIDE

I. Initial contact with generator (ph#) _____

A. Description of mat'l _____

B. Amount - Volume _____

C. Activity _____

D. Tentative dates _____

E. Permit number _____

F. Directions to Site _____

G. Handling equipment available (if required) _____

II. Office Workup

A. Planning Job
1. Classification of material
2. How will it be shipped
3. Waste category
4. Man hours and equipment needed
5. Shipping arrangements (materials)
6. Shipping ID #/Generator number _____
7. Permission or Permit to Export/Import to Compact
8. Submit DHEC 802
9. Submit DHEC 800: if necessary
10. Transportation arrangements

B. Re-contact Generator
1. Changes since last contact - additional information
2. Shipping dates _____
3. Materials to be supplied by customer

III. Material needed for job

A. Instruments
1. Dose rate w/ suitable range for job
2. β - γ "frisker" w/ suitable range for job
3. α "frisker" w/suitable range for job
4. Additional instruments as necessary

B. Markings
1. Specification
a. Proper shipping name and ID #.
b. Consignor/consignee name and address
c. Item number/weight
d. Container Specification
e. Reportable Quantity - RQ
f. Bulk package IAW 49CFR172.302 & 172.332

2. Non-specification
a. Radioactive
b. Radioactive LSA (exclusive use vehicle)

APPENDIX E
CWB WORK FORMS

CWB PRE-DEPARTURE GUIDE

(continued)

2. Non-specification - continued

   c. Waste class: A___ B___ C___

   d. Stable ____ Unstable ____

   e. Dry Solid
   f. Absorbed liquids
   g. Biological
   h. Certification Statement (limited Quantity)
   I. *This End Up*
   j. Overpack Statement

D. Paperwork Required
   1. Barnwell site
      a. RSM and continuation pages
      b. Completed DHEC 802
      c. Blank DHEC 803
      d. Broker/Processor forms as applicable

   2. Hanford site
      a. RSM, continuation and compact tabulation pages
      b. Washington State Certification, commercial
      c. Washington State Certification, government
      d. Broker/Processor forms as applicable

   3. EnviroCare Utah
      a. RSM and continuation pages
   4. Non Disposal Shipments
      a. RSR and continuation pages
   5. Bill of Lading and Continuation Sheets
   6. CWB Packages
   7. Extra CWB Surveys
   8 HIC Operating Procedures
   9. Stabilization/encapsulation/solidification process procedures
   10. Export Permission (if applicable)
   11. Packaging Certification

E. Other Materials Needed
   1. Tools
   2. Office Supplies
   3. RP Forms
   4. Instrumentation
   5. Batteries
   6. Placards
   7. Time sheets and expense reports

F. Travel Arrangements
   1. Confirm flight reservations
   2. Confirm hotel reservations
   3. Confirm car reservations
   4. Passport
   5. Visa

APPENDIX E
CWB WORK FORMS

ADMINISTRATIVE INFORMATION

Shipper:			
Facility:			
Address:			
Phone #s			
CWB:			
Radwaste Supv/ Generator			
Gen Shipment #:		Carrier Control #:	
Carrier:			
Driver(s):			
Tractor #(s):			
Trailer #(s):			
Mat'l Descrip:			
Container #/Type	Container #/Type	Container #/Type	Container #/Type
Comments:			
Departure Date:			
Est Arrival Date:			
Name:(Print/Sign)	/		Date:

APPENDIX E
CWB WORK FORMS

WASTE INVENTORY SHEET

Package ID	Activity, mCi	Class AS,AU,B,C	Contamination	Weight	mR/hr @ contact	mR/hr @ 1 meter	Container Spec.	Marking/ Labeling	Inspected/ Loaded

Survey Performed by:_____ Shipment #:_____

Instrument Type(s):_____ Serial#:_____ Cal Due Date:_____

Instrument Type(s):_____ Serial#:_____ Cal Due Date:_____

Instrument Type(s):_____ Serial#:_____ Cal Due Date:_____

Page_____ of _____

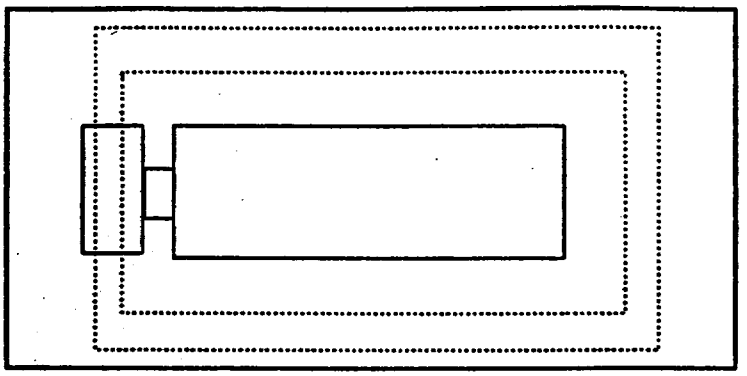
APPENDIX E
CWB WORK FORMS

VEHICLE RADIATION / CONTAMINATION SURVEY

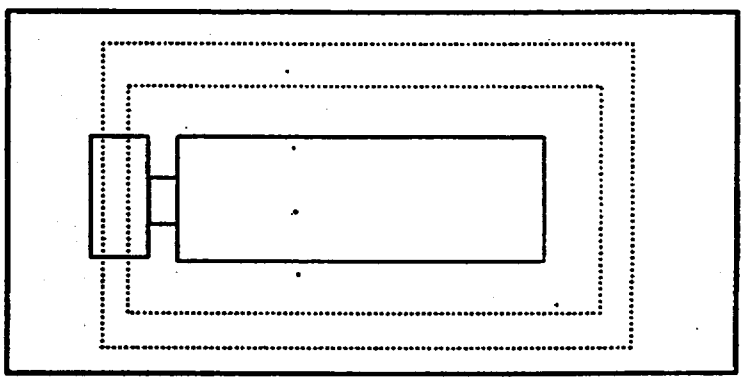
Fdsk / Smear	β γ	α	Fixed (CPM)

βγ and α readings given in DPM/100cm²

Incoming Survey



Outgoing Survey



Incoming:

Tractor #_____ Trailer #_____

Outgoing:

Tractor #_____ Trailer #_____

DO NOT EXCEED 200 mR/hr ON CONTACT, 10 mR/hr @ 2 METERS, 2 mR/hr IN TRACTOR CAB /SLEEPER

□/Smear Location O/Contact ___#___/Area Highest Contact _____ Highest Gen Area _____
(All Dose Rates in mR/hr)

SURVEY INSTRUMENT/TYPE	SERIAL #	CAL. DUE DATE
_____	_____	_____
_____	_____	_____
_____	_____	_____

Surveyor: _____/_____
Sign/Print Date

DATE/TIME OF SURVEY: _____/_____ REVIEWED BY: _____/_____
Sign/Print

POST CHECKLIST OF BROKER'S WORK

Check or N/A as applicable

A. Container Inspection

____ 1. Integrity satisfactory
____ 2. Clean, contents inspected, no free-standing liquid
____ 3. Solidified drums tapped
____ 4. Wooden boxes banded (wooden boxes to Hanford not acceptable
____ 5. Metal boxes clipped and sealing surfaces caulked
____ 6. Caulking visible on boxes
____ 7. Drum lids sealed
____ 8. Lock nuts tight
____ 9. Tamper seal (if required to be placed on package)
____ 10. Survey container
____ 11. Dose rate recorded on container
____ 12. Item/weight label completed
____ 13. Waste classification/stability
____ 14. Proper shipping name and I.D. number marking
____ 15. Specification labels (both sides)
____ 16. Other)list): _____

B. Loading

____ 1. Conduct and record initial survey of trailer
____ 2. Hot containers shielded from exterior
____ 3. Drums weighing greater than 1000 Lbs. palletized
____ 4. Check with driver about weight placement
____ 5. Load properly braced and secured
____ 6. Truck placarded (as applicable)
____ 7. Conduct and record final truck survey
____ 8. Seal doors on trailer

C. Cask Inspection

____ 1. Tie downs:
____ a. Tightness (no slack)
____ b. Turnbuckles/ratchet binders (handles secure)
____ c. Cable clamps properly installed
____ d. No sharp objects to damage cable or chains
____ e. Tie-down attachment welds (no cracks)
____ f. Cable/chain conditions (do not touch)

____ 2. Liner:
____ a. Type_____; Serial No._____
____ b. Barrel top covers (pipe caps in place)
____ c. QA inspection sticker (on liner)
____ d. Liner properly marked for Class (A,B,C)

____ 3. Cask Cover/Lid
____ a. Nuts/bolts/washer (condition, lubricated, torqued)
____ b. Lids bolted/cask seal affixed
____ c. Rain cover installed
____ d. Lid lifting shackles/rings, lugs properly covered
____ e. Lid top surface clean

POST CHECKLIST OF BROKER'S WORK
CONTINUED

____ 4. General
____ a. Cask trailer base retainer plates in place
____ b. Cask in proper location on trailer
____ c. Paint appearance/nameplate/cleanliness of cask

D. Shipping Papers
____ 1. RSM continuation sheets completed

____ 2. Cover sheet:
____ a. Driver's signature
____ b. Both release signatures
____ c. Check for entries in every block
____ d. Verify totals
____ e. Ensure generator's state & compact is identified appropriately
____ f. Ensure Emergency Response information is entered

____ 3. Complete the CWB administrative sheet

____ 4. Bill of lading
____ a. Number of packages
____ b. Hazardous material column
____ c. Proper shipping name, hazard class, and I.D. number
____ d. RQ entered
____ e. Fissile excepted, as applicable
____ f. Weight
____ g. Description
____ h. Radionuclides
____ I. Total activity
____ J. Physical Form
____ k. Chemical Form
____ l. Specification label or non-specification marking
____ m. T.I.
____ n. Container Type
____ o. Limited Quantity/Inst. & Articles certification statement
____ p. Time/date - arrived/departed
____ q. Exclusive use statement
____ r. Page numbers if continuation used
____ s. Driver's signature
____ t. Shipper's signature

____ 5. Complete radioactive waste shipment certification forms:
____ a. Shipper's signature
____ b. Driver's signature
____ c. CWB's signature (Hanford)

____ 6. Complete Driver's Instructions for exclusive use shipments. Check driver's signature
____ 7. Corrections to DHEC 802 -- FAX corrections per Reference 8.5
____ 8. Shipping papers and copies legible

____ 9. Reproduce copies:
____ a. Shipper's copy
____ b. Carrier's copy

POST CHECKLIST OF BROKER'S WORK
CONTINUED

____ c. site copy
____ d. CWB's copy
____ e. M.M.S./WMS 's copy
____ f. Mail (RSM cover sheet to disposal site)
____ g. EnviroCare (Fax RSM to 801/537-7345)

____ 10. Prior notification calls:
____ a. Hanford - 509/377-2411
____ b. Barnwell - 803/259-1781
____ c. DHEC - 803/896-4247/4240
____ d. CWB - 602/234-0696

Signature (Print/Sign) Date

APPENDIX E
CWB WORK FORMS

PRIOR NOTIFICATION CALL SHEET
SHIPMENT OF LLRW or NORM/NARM TO
U.S. ECOLOGY (HANFORD, WA)
509-377-2411

Date & Date of Call: _____ / _____

Name of Person Contacted: _____

MESSAGE:

"This is to inform you that the _____ facility at _____ will make a truck shipment of _____ drums, _____ boxes of radioactive materi burial in accordance with your license at the Hanford, Washington, site throug arrangements with AEI."

Plant shipment number is _____

GPI Control number is _____

Carrier is _____

Driver's name is _____

Trailer ID number is _____

Tractor number is _____

Date of departure is _____

Estimated date of departure is _____

Estimated date of arrival at Hanford, Washington, is _____

ADDITIONAL MESSAGE

_____

_____

_____

_____

COMMENTS of CONTACT

_____

_____

_____

_____

_____ / _____

Prepared By Date

VEHICLE INSPECTION SHEET

GPI Shipment # _____ Disposal Shipment # _____ USDOT Hazmat Reg # _____

Carrier name/address _____ Tractor # _____

_____ Trailer # _____

Driver's Name: State: License #: Exp Date:

1	Operator's License	( )SAT	( )UNSAT	Driver possesses valid commercial driver's license (with a tank vehicle /hazardous materials endorsement)
2	Windshield, Side Glass & Mirror	( )SAT	( )UNSAT	No cracked or broken glass that would affect the driver's vision. Mirror(s) in place and usable.
3	Wipers	( )SAT	( )UNSAT	Wipers operate and are in good condition.
4	Horn	( )SAT	( )UNSAT	Air/electric horn works.
5	Suspension	( )SAT	( )UNSAT	Visually check for loose, broken, or damaged spring leaves, "U" bolts, shackles, pads, torque arms, and locking pins.
6	Brake Lines	( )SAT	( )UNSAT	Brake lines and connectors do not have cracks, crimps, restrictions, or evidence of damage or audible air leaks.
7	Brake Pots & Cams	( )SAT	( )UNSAT	Brake pots are in good physical condition and mechanical linkages are intact and in good condition.
8	Exhaust System	( )SAT	( )UNSAT	No loose or broken brackets and no evidence of leaks which would affect driving/sleeping compartment.
9	Fuel System	( )SAT	( )UNSAT	No damage affecting fuel tank integrity, no visible leaks, no loose or broken mounting brackets, no evidence of damage to vents, and fuel cap is securely in place.
10	Structure&Welds	( )SAT	( )UNSAT	No cracks in load bearing welds or assemblies.
11	Frame	( )SAT	( )UNSAT	No cracked, loose, sagging, or broken frame.
12	Van/Trailer Floor	( )SAT	( )UNSAT	No holes or projecting nails. Capable of bearing weight of load and fork truck (if used).
13	Van walls, ceiling	( )SAT	( )UNSAT	No holes, severe dents, or buckling.
14	Van doors	( )SAT	( )UNSAT	Can be closed and secured properly.
15	Rims	( )SAT	( )UNSAT	Rims are not bent or cracked, and stud nuts are in
16	Tires	( )SAT	(UNSAT	Tires appear properly inflated, tread depths appear greater than minimmm (major tread depth at least 1/8" on front and 1/16" on all others) and show no evidence of cuts or damage affecting the placard.
17	Hubs	( )SAT	( )UNSAT	Oil level visible, no visible oil leakage from seals.
18	Head lights	( )SAT	( )UNSAT	Both low beams working.
19	Running Lights	( )SAT	( )UNSAT	All affixed running lights operable.
20	Turn Signals	( )SAT	( )UNSAT	Front and back working.
21	Brake Lights	( )SAT	( )UNSAT	Must work on tractor and trailer.
22	Bracing	( )SAT	( )UNSAT	Bracing/shoring must be sufficient to prevent shifting of lading during conditions normally incident to transportation.

Tractor & Trailer ( ) are ( ) are not acceptable for use.

RADIOACTIVE MATERIALS GUIDE - LOW LEVEL RADIATION

POTENTIAL HAZARDS

HEALTH

- Radiation presents minimal risk to transport workers, emergency response personnel, and the public during transportation accidents. Packaging durability is related to potential hazards of material.
- Low-level radioactive material; very low radiation hazard to people. Quantity of material presents low radiation hazard if released from package during accident.
- Some radioactive materials cannot be detected by commonly available instruments.
- Packages do not have RADIOACTIVE I, II, or III labels; while some may have EMPTY labels and/or the work "Radioactive" in the package marking.
- If any radioactive contamination occurs, it will be extremely low level.

FIRE OR EXPLOSION

- Some of these materials may burn, but most do not ignite readily.
- Radioactivity does not change flammability or other properties of the materials.

PUBLIC SAFETY

- CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC, 1-800-424-9300 or for Military Shipments, 1-800-851-8061
- Priorities for rescue, life-saving, first aid, and control of fire and other hazards are higher than the priority for measuring radiation levels.
- Radiation Authority must be notified of accident conditions, and is usually responsible for radiological decisions.
- Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions; keep unauthorized personnel away; stay upwind.
- Detain or isolate uninjured persons or equipment suspected to be contaminated; delay decontamination and cleaning until instructions are received from Radiation Authority.

EVACUATION

Large Spill

- Consider initial downwind evacuation for at least 100 meters (330 feet).

Fire

- When a large quantity of this material is involved in a major fire, consider an initial evacuation distance of 300 meters (1000 feet) in all directions.

EMERGENCY ACTION

FIRE

- Presence of radioactive material will not change effectiveness of fire control techniques.
- Move containers from fire if you can do it without risk.
- Do not move damaged containers; move undamaged containers out of fire zone.

Small Fires: Dry chemical, CO_2, water spray or regular foam.

Large Fires: Water spray, fog (flooding amounts).

SPILL OR LEAK

- Do not touch damaged containers or spilled material.

Liquid Spills

- Cover with sand, earth or other noncombustible absorbent material.
- Cover powder spill with plastic sheet or tarp to minimize spreading.

FIRST AID

- Medical problems take priority over radiological concerns; use first aid treatment according to the nature of the injury.
- Do not delay care and transport of a seriously injured person.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Injured persons who contacted released material may be a minor contamination problem to contacted persons, equipment, and facilities.
- Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

This Emergency Response Guide applies to the following Identification Numbers :

- ☐ UN2910 Radioactive Material, Excepted Package - Articles Manufactured from Natural or Depleted Uranium or Natural Thorium
- ☐ UN2910 Radioactive Material, Excepted Package - Empty Packaging
- ☐ UN2910 Radioactive Material, Excepted Package - Instruments or Articles
- ☐ UN2910 Radioactive Material, Excepted Package - Limited Quantity of Material

RADIOACTIVE MATERIALS GUIDE - LOW to MODERATE LEVEL RADIATION

POTENTIAL HAZARDS

HEALTH

- Radiation presents minimal risk to transport workers, emergency response personnel, and the public during transportation accidents. Packaging durability is related to potential hazards of material.
- Undamaged packages are safe; contents of damaged packages may cause external and/r internal radiation exposure.
- Low radiation hazard when material is inside container. If material is released from package or bulk container, hazard will vary from low to moderate. Level of hazard will depend on the type and amount of radioactivity, the kind of material it is in, and/or the surfaces it is on.
- Some material may be released from packages during accidents of moderate severity. This poses little risk to people.
- Released radioactive materials or contaminated objects usually will be visible if packaging fails.
- Some radioactive materials cannot be detected by commonly available instruments.
- Some exclusive use shipments of bulk and packaged materials will not have "RADIOACTIVE" labels. Placards, markings, and shipping papers provide identification. Some packages may have a "Radioactive" label and a second hazard label. The second hazard is usually greater than the radiation hazard; so follow this guide as well as a response guide for the second label.
- Runoff from control of cargo fire may cause low-level pollution.

FIRE OR EXPLOSION

- Some of these materials may burn, but most do not ignite readily.
- Uranium and Thorium metal cuttings or granules may ignite spontaneously of exposed to air.
- Nitrates are oxidizers and may ignite other combustibles.

PUBLIC SAFETY

- CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC, 1-800-424-9300 or for Military Shipments, 1-800-851-8061
- Priorities for rescue, life-saving, first aid, and control of fire and other hazards are higher than the priority for measuring radiation levels.
- Radiation Authority must be notified of accident conditions, and is usually responsible for radiological decisions.
- Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions; keep unauthorized personnel away; stay upwind.
- Detain or isolate uninjured persons or equipment suspected to be contaminated; delay decontamination and cleaning until instructions are received from Radiation Authority.

EVACUATION

Large Spill

- Consider initial downwind evacuation for at least 100 meters (330 feet).

Fire

- When a large quantity of this material is involved in a major fire, consider an initial evacuation distance of 300 meters (1000 feet) in all directions.

EMERGENCY ACTION

FIRE

- Presence of radioactive material will not change effectiveness of fire control techniques.
- Move containers from fire if you can do it without risk.
- Do not move damaged containers; move undamaged containers out of fire zone.

Small Fires: Dry chemical, CO_2, water spray or regular foam.

Large Fires: Water spray, fog (flooding amounts). Dike fire-control water for later disposal.

SPILL OR LEAK

- Do not touch damaged containers or spilled material.

Liquid Spills

- Cover with sand, earth or other noncombustible absorbent material.
- Dikes to collect large spills.
- Cover powder spill with plastic sheet or tarp to minimize spreading.

FIRST AID

- Medical problems take priority over radiological concerns; use first aid treatment according to the nature of the injury.
- Do not delay care and transport of a seriously injured person.
- In case of contact with substance, wipe from skin immediately, flush skin or eyes with running water for at least 20 minutes.
- Injured persons who contacted released material may be a minor contamination problem to contacted persons, equipment, and facilities.
- Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

This Emergency Response Guide applies to the following Identification Numbers :

☐ UN2912 Radioactive Material, Low Specific Activity

RADIOACTIVE MATERIALS GUIDE - LOW to HIGH LEVEL RADIATION

POTENTIAL HAZARDS

HEALTH

- Radiation presents minimal risk to transport workers, emergency response personnel, and the public during transportation accidents. Packaging durability is related to potential hazards of material.
- Undamaged packages are safe; contents of damaged packages may cause external and/r internal radiation exposure.
- Type A packages (cartons, boxes, drums, articles, etc.) identified as "Type A" by marking on packages or by shipping papers contain non-life endangering amounts. Partial releases might be expected if "Type A" packages are damaged in moderately severe accidents.
- Type B packages (large and small, usually metal) identified as "Type B" by marking on packages or by shipping papers contain potentially life endangering amounts. Because of design, evaluation, and testing of packages, life endangering releases are not expected in accidents involving "Type B" packages except those of utmost severity.
- Radioactive White-I labels indicate radiation levels outside undamaged packages are very low (less than 0.005 mSv/h (o.5 mrem/h)).
- Radioactive Yellow-II and Yellow-III labeled packages have higher radiation levels. The transport index (TI) on the label identifies the maximum radiation level in mrem/h 1 meter from the package.
- Some radioactive materials cannot be detected by commonly available instruments.
- Runoff from control of cargo fire may cause low-level pollution.

FIRE OR EXPLOSION

- Some of these materials may burn, but most do not ignite readily.
- Radioactivity does not change flammability or other properties of materials.
- Type B packages are designed and evaluated to withstand total engulfment in flames at temperatures of 800°C (1475°F) for a period of 30 minutes.

PUBLIC SAFETY

- CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC, 1-800-424-9300 or for Military Shipments, 1-800-851-8061
- Priorities for rescue, life-saving, first aid, and control of fire and other hazards are higher than the priority for measuring radiation levels.
- Radiation Authority must be notified of accident conditions, and is usually responsible for radiological decisions.
- Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions; keep unauthorized personnel away; stay upwind.
- Detain or isolate uninjured persons or equipment suspected to be contaminated; delay decontamination and cleaning until instructions are received from Radiation Authority.

EVACUATION

Large Spill

- Consider initial downwind evacuation for at least 100 meters (330 feet).

Fire

- When a large quantity of this material is involved in a major fire, consider an initial evacuation distance of 300 meters (1000 feet) in all directions.

EMERGENCY ACTION

FIRE

- Presence of radioactive material will not change effectiveness of fire control techniques.
- Move containers from fire if you can do it without risk.
- Do not move damaged containers; move undamaged containers out of fire zone.

Small Fires: Dry chemical, CO2, water spray or regular foam.

Large Fires: Water spray, fog (flooding amounts). Dike fire-control water for later disposal.

SPILL OR LEAK

- Do not touch damaged containers or spilled material. Slightly damaged or damp outer surfaces seldom indicate failure of packaging since most have an inner container.

Liquid Spills

- Cover with sand, earth or other noncombustible absorbent material.

FIRST AID

- Medical problems take priority over radiological concerns; use first aid treatment according to the nature of the injury. Do not delay care and transport of a seriously injured person.
- Injured persons who contacted released material may be a minor contamination problem to contacted persons, equipment, and facilities.
- Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

This Emergency Response Guide applies to the following Identification Numbers :

- ☐ UN2918 Radioactive Material, Fissile, n.o.s.
- ☐ UN2974 Radioactive Material, Special Form, n.o.s.
- ☐ UN2982 Radioactive Material, n.o.s.

RADIOACTIVE MATERIALS GUIDE - SPECIAL FORM/LOW to HIGH LEVEL RADIATION

POTENTIAL HAZARDS

HEALTH

- Radiation presents minimal risk to transport workers, emergency response personnel, and the public during transportation accidents. Packaging durability is related to potential hazards of material.
- Undamaged packages are safe; contents of damaged packages may cause external and/r internal radiation exposure.
- Contamination and internal radiation hazards are not expected, but not impossible.
- Type A packages (cartons, boxes, drums, articles, etc.) identified as "Type A" by marking on packages or by shipping papers contain non-life endangering amounts. Partial releases might be expected if "Type A" packages are damaged in moderately severe accidents.
- Type B packages (large and small, usually metal) identified as "Type B" by marking on packages or by shipping papers contain potentially life endangering amounts. Because of design, evaluation, and testing of packages, life endangering releases are not expected in accidents involving "Type B" packages except those of utmost severity.
- Radioactive White-I labels indicate radiation levels outside undamaged packages are very low (less than 0.005 mSv/h (0.5 mrem/h)).
- Radioactive Yellow-II and Yellow-III labeled packages have higher radiation levels. The transport index (TI) on the label identifies the maximum radiation level in mrem/h 1 meter from the package.
- Commonly available instruments can detect most of these materials.
- Runoff from cargo fire is not expected to cause pollution.

FIRE OR EXPLOSION

- Packaging can burn completely without risk of content loss from sealed source capsule.
- Radioactivity does not change flammability or other properties of materials.
- Radioactive source capsules and Type B packages are designed and evaluated to withstand total engulfment in flames at temperatures of 800°C (1475°F) for a period of 30 minutes.

PUBLIC SAFETY

- CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC, 1-800-424-9300 or for Military Shipments, 1-800-851-8061
- Priorities for rescue, life-saving, first aid, and control of fire and other hazards are higher than the priority for measuring radiation levels.
- Radiation Authority must be notified of accident conditions, and is usually responsible for radiological decisions.
- Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions; keep unauthorized personnel away; stay upwind.
- Delay final cleanup until instructions are received from Radiation Authority.

EVACUATION

Large Spill

- Consider initial downwind evacuation for at least 100 meters (330 feet).

Fire

- When a large quantity of this material is involved in a major fire, consider an initial evacuation distance of 300 meters (1000 feet) in all directions.

EMERGENCY ACTION

FIRE

- Presence of radioactive material will not change effectiveness of fire control techniques.
- Move containers from fire if you can do it without risk.
- Do not move damaged containers; move undamaged containers out of fire zone.

Small Fires: Dry chemical, CO_2, water spray or regular foam.

Large Fires: Water spray, fog (flooding amounts).

SPILL OR LEAK

- Do not touch damaged containers or spilled material. Slightly damaged or damp outer surfaces seldom indicate failure of packaging since most have an inner container.
- If source is identified as being out of package; stay away and await advice of Radiation Authority.

FIRST AID

- Medical problems take priority over radiological concerns; use first aid treatment according to the nature of the injury. Do not delay care and transport of a seriously injured person.
- Injured persons who contacted released material may be a minor contamination problem to contacted persons, equipment, and facilities.
- Persons exposed to special form sources are not likely to be contaminated with radioactive material.

This Emergency Response Guide applies to the following Identification Numbers :

- ☐ UN2981 Uranyl Nitrate, Solid
- ☐ UN2980 Uranyl Nitrate Hexahydrate Solution
- ☐ UN2976 Thorium Nitrate, Solid

RADIOACTIVE MATERIALS GUIDE - FISSILE/LOW to HIGH LEVEL RADIATION

POTENTIAL HAZARDS

HEALTH

- Radiation presents minimal risk to transport workers, emergency response personnel, and the public during transportation accidents. Packaging durability is related to potential hazards of material.
- Undamaged packages are safe; contents of damaged packages may cause external and/r internal radiation exposure.
- Packages (drums or boxes) identified as "Type AF" or "IF" by marking on packages or by shipping papers contain materials that are not life endangering if released. External radiation levels are low and packages are designed, evaluated, and tested to control releases and to present a fission chain reaction under severe transport accident conditions.
- Packages (metal and usually very heavy) identified as "Type B(U)F" or "B(U)F" by marking on packages or by shipping papers contain potentially life endangering amounts. Because of design, evaluation, and testing of packages, fission chain reactions are prevented and releases are not expected to be life endangering for all accidents except those of utmost severity.
- The transport index (TI) on the labels or shipping paper might not indicate the radiation level at 1 meter from the package, instead, it may indicate controls needed during transport because of the fissile properties of the materials.
- Some radioactive materials cannot be detected by commonly available instruments.
- Runoff from control of cargo fire may cause low-level pollution.

FIRE OR EXPLOSION

- These materials are not flammable and packagings are designed to withstand fires without damage to contents.
- Radioactivity does not change flammability or other properties of materials.
- Type AF, Type IF, and Type B packages are designed and evaluated to withstand total engulfment in flames at temperatures of 800°C (1475°F) for a period of 30 minutes.

PUBLIC SAFETY

- CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC, 1-800-424-9300 or for Military Shipments, 1-800-851-8061
- Priorities for rescue, life-saving, first aid, and control of fire and other hazards are higher than the priority for measuring radiation levels.
- Radiation Authority must be notified of accident conditions, and is usually responsible for radiological decisions.
- Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions; keep unauthorized personnel away; stay upwind.
- Detain or isolate uninjured persons or equipment suspected to be contaminated; delay decontamination and cleaning until instructions are received from Radiation Authority.

EVACUATION

Large Spill

- Consider initial downwind evacuation for at least 100 meters (330 feet).

Fire

- When a large quantity of this material is involved in a major fire, consider an initial evacuation distance of 300 meters (1000 feet) in all directions.

EMERGENCY ACTION

FIRE

- Presence of radioactive material will not change effectiveness of fire control techniques.
- Move containers from fire if you can do it without risk.
- Do not move damaged containers; move undamaged containers out of fire zone.

Small Fires: Dry chemical, CO2, water spray or regular foam.

Large Fires: Water spray, fog (flooding amounts).

SPILL OR LEAK

- Do not touch damaged containers or spilled material. Slightly damaged or damp outer surfaces seldom indicate failure of packaging since most have an inner container.

Liquid Spills

- Package contents are seldom liquid. If any radioactive contamination resulting from a liquid release is present, it probably will be low-level.

FIRST AID

- Medical problems take priority over radiological concerns; use first aid treatment according to the nature of the injury. Do not delay care and transport of a seriously injured person.
- Injured persons who contacted released material may be a minor contamination problem to contacted persons, equipment, and facilities.
- Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

This Emergency Response Guide applies to the following Identification Numbers :

- ☐ UN2975 Thorium Metal, Pyrophoric
- ☐ UN2979 Uranium Metal, Pyrophoric

RADIOACTIVE MATERIALS GUIDE-CORROSIVE - URANIUM HEXAFLUORIDE/WATER SENSITIVE

POTENTIAL HAZARDS

HEALTH

- Chemical hazard greatly exceeds radiation hazard.
- Substance reacts with water and water vapor in air to form toxic and corrosive hydrogen fluoride gas and an extremely irritating and corrosive, white-colored, water-soluble residue. If inhaled, may be fatal. Direct contact causes chemical burns to skin, eyes, and respiratory tract.
- Low-level radioactive material; very low radiation hazard to people.
- Runoff from control of cargo fire may cause low-level pollution.
- Radiation presents minimal risk to transport works, emergency response personnel, and the public during transportation accidents. Packaging durability is related to potential hazards of material.

FIRE OR EXPLOSION

- Substance does not burn.
- Containers in protective overpacks (Horizontal cylindrical shape with short legs for tie-downs), also identified as "Type AF" or "B(U)F" on shipping papers or by marking on the overpack, are designed and evaluated to withstand severe accidents including total engulfment in flames at temperatures of 800°C (1475°F).
- Container may explode in heat of fire. The material may react violently with fuels.
- Radioactivity does not change flammability or other properties of the materials.

PUBLIC SAFETY

- CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC, 1-800-424-9300 or for Military Shipments, 1-800-851-8061
- Priorities for rescue, life-saving, first aid, and control of fire and other hazards are higher than the priority for measuring radiation levels.
- Radiation Authority must be notified of accident conditions, and is usually responsible for radiological decisions.
- Isolate spill or leak area immediately for at least 25 to 50 meters (80 to 160 feet) in all directions; keep unauthorized personnel away; stay upwind.
- Detain or isolate uninjured persons or equipment suspected to be contaminated; delay decontamination and cleaning until instructions are received from Radiation Authority.

EVACUATION

Large Spill

- Consider initial downwind evacuation for at least 100 meters (330 feet).

Fire

- When a large quantity of this material is involved in a major fire, consider an initial evacuation distance of 300 meters (1000 feet) in all directions.

EMERGENCY ACTION

FIRE

- DO NOT USE WATER OR FOAM ON MATERIAL ITSELF.
- Move containers from fire if you can do it without risk.

Small Fires: Dry chemical, CO_2.

Large Fires

- Water spray, fog (flooding amounts). Cool containers with flooding quantities of water until well after fife is out. If this is impossible, withdraw from area and let fire burn.
- ALWAYS stay away from the ends of tanks.

SPILL OR LEAK

- Do not touch damaged packages or spilled material.
- Without fire or smoke, leak will be evident by visible and irritating vapors and residue foaming at the point of release. Residue buildup make self-seal small leaks.
- Use fine water spray to reduce vapors; do not put water directly on point of material release from container.
- Dike far ahead of spill to collect runoff water.

FIRST AID

- Medical problems take priority over radiological concerns; use first aid treatment according to the nature of the injury.
- Do not delay care and transport of a seriously injured person.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Effects of exposure (inhalation, ingestion, or skin contact) to substance may be delayed.
- Injured persons who contacted released material may be a minor contamination problem to contacted persons, equipment, and facilities.
- Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

This Emergency Response Guide applies to the following Identification Numbers :

- ☐ UN2977 Uranium Hexafluoride, Fissile
- ☐ UN2978 Uranium Hexafluoride

DRIVER'S INSTRUCTIONS FOR
EXCLUSIVE USE VEHICLES

The Code of Federal Regulations, 49CFR173.403(I) and 173.441(c and e) requires that spe instructions for maintenance of exclusive use shipment controls be provided by the shi the carrier. These instructions must be included with the shipment documents.

The following instructions shall be complied with for all exclusive use vehicles:

- Do not move or transfer packages within the conveyance or between conveyanc while enroute to destination, without documented approval of shipper.
- The shipment must be loaded by consignor and unloaded by consignee from the transport vehicle in which originally loaded.
- Shipments must be braced so as to prevent leakage or shifting of load under conditions normally incident to transportation.
- The vehicle must be placarded " RADIOACTIVE " on all four sides when applic until shipment is unloaded.

If the vehicle is involved in an accident or is required to make emergency braking whic would shift the load and change radiation levels, notify the shipper immediately.

In case of an accident, vehicle malfunction, or deviation from the above instructions immediately contact one of the following AEI Employees;

William McKinnell [redacted]

Timothy Gotto [redacted]

Any deviation from these instructions is a violation of State and Federal laws and coul result in carrier penalty.

Carrier's Representative _____ Date _____

DRIVER'S INSTRUCTIONS FOR
EXCLUSIVE USE VEHICLES
HANFORD

The Code of Federal Regulations, 49CFR173.403(I) and 173.441(c and e) requires that specific instructions for maintenance of exclusive use shipment controls be provided by the shipper to the carrier. These instructions must be included with the shipment documents.

The following instructions shall be complied with for all exclusive use vehicles:

- Do not move or transfer packages within the conveyance or between conveyances while enroute to destination, without notifying shipper.
- The shipment must be loaded by consignor and unloaded by consignee from the transport vehicle in which originally loaded.
- Shipments must be braced so as to prevent leakage or shifting of load under conditions normally incident to transportation.
- The vehicle must be placarded " RADIOACTIVE " on all four sides when applicable until shipment is unloaded.
- Notify the Richland, Washington (Hanford) burial site within 24 hours of arrival: (509) 377-2411
- Notify Washington Port of Entry four (4) hours prior to arrival. I-90: (509) 226-3360; I-84: (509)783-4014.

If the vehicle is involved in an accident or is required to make emergency braking which would shift the load and change radiation levels, notify the shipper immediately.

In case of an accident, vehicle malfunction, or deviation from the above instructions immediately contact one of the following REI employees:

William McKinnell [redacted]

Timothy Gotto [redacted]

Any deviation from these instructions is a violation of State and Federal laws and could result in carrier penalty.

_____ _____

Carrier's Representative Date

APPENDIX G
PACKAGING METHODOLOGY for PYROPHORIC MATERIALS
(MgTh & DEPLETED URANIUM TURNINGS)

1.0 Purpose

The purpose of this document is to suggest an effective means of packaging pyrophoric Magnesium-Thorium (MgTh) or Depleted Uranium (DU) to make inert for shipment and disposal. Other methods can be employed provided such method complies with 49CFR173.418 and is acceptable to the disposal site.

NOTE: THE INERTING PROCESS SHALL BE APPROVED BY THE BARNWELL LICENSING DEPARTMENT PRIOR TO SHIPPING.

2.0 Method

2.1 Inspect the material for acceptability to the applicable disposal site criteria and the following:

2.1.1 Less than 1% unintentional oil is allowable on the material.

2.1.2 No water is acceptable (DU oxidizes rapidly with H_2O to form free hydrogen).

2.1.3 If the material is oxidized by incineration, then follow conditions of applicable site in Reference 8.5, regarding readily dispersable material and ash (if applicable).

2.1.4 If the material is oxidized naturally, then treat it with regard for loose contamination.

2.2 Using care to prevent the spread of contamination, mix the material in a 10:1 ratio of "DRY" sand to pyrophoric material (10 parts dry sand to 1 part MgTh/DU) and place in a DOT 7A TYPE A container. Leave a 4" void at the top of the container.

2.3 Add 3" of dry sand to top of drum.

2.4 Seal drum.

2.5 Prepare package for shipment in accordance with this procedure.

APPENDIX H

METHODOLOGY for PACKAGING BIOLOGICAL WASTE

1.0 Purpose

The purpose of this document is to provide the methodology for consistent packaging of biological waste.

2.0 Requirements

2.1 Verify the biological waste to be disposed of is acceptable to the applicable disposal site.

2.2 Biological waste considered pathogenic or infectious shall be previously treated to reduce to the maximum extent practicable, the potential hazard from non-radiological materials.

2.3 The inner containers shall be specification DOT 7A Type A packages. The outer containers shall be a strong, tight container or 7A Type A, as appropriate, per Reference 8.2.

2.4 Volume of outer container shall be at least 40% greater than the inner container (e.g. a 30-gallon container inside a 55-gallon container).

2.5 Shipments to US Ecology sites shall comply with applicable site license for approved absorbents, to be used in addition to the slaked lime.

For shipments to Barnwell, use slaked lime and agricultural grade 4 vermiculite or medium grade diatomaceous earth

2.6 A refrigerated van shall be used to ship biological radwaste between April 1 and October 1, if transit time will exceed 48 hours from the time the waste is first removed from cold storage until arrival at the Barnwell site.

3.0 Method

NOTE: PLANTS, ANIMALS, AND BY-PRODUCTS THEREOF ARE CONSIDERED BIOLOGICAL MATERIAL. GLASSWARE, ETC... THAT AT ONE TIME CONTAINED THESE MATERIALS ARE ALSO CONSIDERED BIOLOGICAL. ALL BIOLOGICAL WASTE MUST BE PACKAGED IN ACCORDANCE WITH THIS SECTION.

3.1 The inner container shall have a watertight liner (i.e., polyethylene or equivalent) of at least 4 mils thickness.

3.2 The addition of lime and absorbent to biological material should be in a ratio of one part lime to ten parts absorbent to thirty parts biological material.

3.3 The biological material shall be placed in the inner container and thoroughly layered with absorbent and slaked lime.

3.4 Formaldehyde is strictly prohibited.

3.5 The watertight liner shall be hermetically (airtight) sealed by taping, tying, or heat sealing.

3.6 The ring-and-bolt closure device shall be closed with an appropriate wrench.

3.7 The bottom of the outer container shall be covered by a minimum of four (4) inches of absorbent.

3.8 Inner container shall be placed upright in the outer container.

3.9 After placing the inner container in the outer container, the inner container shall be completely surrounded by absorbent (including the top). The lid will be placed on the outer container and the ring and bolt closure device secured.

3.10 The outer container shall be equipped with a tamper-proof seal.

3.11 Prepare the package for shipment in accordance with this procedure.

APPENDIX I

METHODOLOGY for PACKAGING SCINTILLATION LIQUIDS

1.0 Purpose

1.1 The purpose of this document is to provide the methodology for consistent packaging of liquid scintillation fluids.

1.2 This methodology applies to the packaging of scintillation fluids for shipment to Perma-Fix, Gainsville, Florida, NSSI, Houston, TX, or any similar facility.

2.0 Requirements

This methodology is subject to frequent change in accordance with the latest rules, regulations, and guidance from regulatory bodies and changes implemented by change in present vendor (s) procedures. Therefore, prior to shipping scintillation fluids for incineration, always review references or other license(s) as applicable and consult with the proposed incineration facility.

3.0 Method

3.1 Packaging Requirements

3.1.1 Vials - The container must be at least a strong tight container in good condition; preferably either a DOT 7A Type A or an approved UN performance oriented package, as applicable.

a. Place a 4 mil (minimum) plastic liner inside the drum.

b. Place 5 inches of absorbent (i.e. vermiculite) in the bottom of the liner.

c. Place another 4 mil liner inside the first liner.

d. Make sure all the vial tops are tight and carefully place the vials in the inner liner. Fill the liner with vials, leaving enough room to seal when finished plus 6 inches of free space from the top of the drum. Seal the inner liner.

e. Place 5 inches of absorbent on top of the liner, then seal the outer liner.

f. Place the lid on the drum and secure the closure device appropriately.

3.1.2 Bulk Liquids

a. Place a 4 mil (minimum) plastic liner inside the outer container if smaller containers are to be placed inside the outer container.

b. Put sufficient cushioning/absorbent material in the bottom of the liner to absorb all of the liquid present. If glass jugs are packaged inside a strong tight container, sufficient padding will be used to separate the jugs to preclude breaking of the containers.

c. Ensure all inner container tops are tight, then place them in the drum.

d. Seal or tie the liner before placing lid on drum.

e. Ensure that the drum lid is firmly in place and secured.

f. Do not overfill packages. There must be space to allow expansion during handling, transporting, and storage. At least 5% volume is to be provided for expansion (49CFR173.116(h)).

3.2 Determining Hazard Class

NOTE: THESE STEPS ARE MORE RESTRICTIVE THAN 40 CFR. IF DUE TO LOGISTICS THESE METHODS CANNOT BE MET, CONTACT THE PM/CWB OR YOUR IMMEDIATE SUPERVISOR TO INFORM THEM OF THE PROBLEM.

3.2.1 Radioactive

The material must be declared as "RADIOACTIVE-LSA" or "RADIOACTIVE" if the radionuclide concentration is .002 μCi/g or greater of isotopes other than C-14 and H-3. For the isotopes C-14 and H-3 the limit of .05 μCi/g shall not be exceeded.

a. Radioactive Material, LSA, n.o.s., UN2912; Exclusive Use Only

a.1 Package requirements of 49CFR173.427(b)(3) apply.

a.2 Package vials in accordance with 3.1.1 and package the bulk fluid in accordance 3.1.2.

b. Radioactive Materials, n.o.s., UN2982

b.1 Packaging: Specification USA DOT 7A TYPE A, refer to 49CFR173.412 (k).

b.2 Package vials in accordance with 3.1.1 and package the bulk fluid in accordance with 3.1.2.

3.2.2 Flammable Liquids, n.o.s., UN1993

If the scintillation fluid contains less than .05 μCi/g H-3 or C-14 and less than .002 μCi/g for other acceptable isotopes then the material must be declared flammable liquid.

If the scintillation fluid is limited quantity, then the material must be declared flammable liquid with LQ as the subsidiary hazard.

Package vials in accordance with 3.1.1 and package bulk fluid in accordance with 3.1.2.

3.3 Marking, Labeling, & Shipping Documents

3.3.1 When packaged in accordance with Step 3.2.1.1:

a. Mark in accordance with Reference 8.4 for Radioactive Material LSA, n.o.s., UN2912 [49CFR173.427(a)(1)(vi) "RADIOACTIVE LSA"; 172.312 "specification orientation marking arrows"; and 40CFR202.32 "Hazardous Waste"]

b. Label in accordance with Reference 8.2 [49CFR172.403c "Flammable Liquid"]

c. Label in accordance with Reference 8.4 for subsidiary hazards.

3.3.2 When packaged in accordance with Step 3.2.1(b):

a. Mark in accordance with References 8.2 and 8.4 for Radioactive Material, n.o.s., UN2982 [49CFR172 Subpart D, 172.402(d), 172.406, and 40CFR202.32"Hazardous Waste"]

b. Label in accordance with Reference 8.4 (Radioactive and Flammable Liquid)

NOTE: PAY PARTICULAR ATTENTION TO MULTIPLE HAZARD LABEL REQUIREMENTS OF 49CFR172.404.

3.3.3 When packaged in accordance with Step 3.2.2:

a. Mark in accordance with References 8.2 & 8.4 for Flammable Liquid, n.o.s., UN1993 [49CFR172.202 and 172.312 and 40CFR262.32]

b. Label in accordance with Reference 8.2 for Flammable Liquid, n.o.s., UN1993 [49CFR172 Subpart E-Labeling].

3.3.4 Additional Manifesting for Hazardous Waste

In addition to the DOT shipping paper requirements of Reference 8.2, hazardous waste must be manifested in accordance with Reference 8.4 (40CFR262 Subpart B).

APPENDIX J

METHODOLOGY for ABSORPTION of SMALL VOLUMES of CLASS A LIQUIDS

1.0 Purpose

The purpose of this document is to provide the methodology to be used to prepare small amounts of class A liquid waste for disposal at Hanford, WA. (The preferred method of preparing liquids for disposal is solidification.)

NOTE: ABSORBED (SORBED) LIQUIDS ARE NOT ACCEPTED FOR BURIAL AT THE BARNWELL SITE.

2.0 Requirements

2.1 Except as permitted under the specific site's license(s), untreated liquids are not allowed for disposal. Liquids shall be rendered non-corrosive ($4 < pH < 11$) prior to treatment. Acceptable treatments are stabilization, solidification, or absorption; depending on waste class and disposal facility.

2.2 Liquids treated by absorption shall be processed in such a manner as to leave zero percent (0%) free-standing liquid.

2.3 Use only approved "absorbents" in accordance with applicable site's license.

2.4 Consult the Broker Program Manager for guidance.

3.0 Method

3.1 Package liquid volume not exceeding 50 millliliters as Radioactive LSA Exclusive Use

3.1.1 Use a container that meets US DOT 7A Type A specification package requirements.

3.1.2 Line the container with a minimum of 4 mil plastic liner, except as noted in Appendix F of Washington State License WN-1019-2.

3.1.3 Contain the liquid in enough absorbent material to absorb at least twice the volume of liquid (use a ratio of 4 to 1, absorbent to liquid).

3.2 Package liquid volume exceeding 50 millliliters shipped as other than Exclusive Use LSA

Packages with absorbed liquids having volume exceeding 50 millliliters shall have a containment system composed of a primary inner and a secondary outer containment, and the components designed to assure retention of the liquid contents within the secondary outer components in the event that the primary inner components leak [49CFR173.412(n)].

3.2.1 Assure the liquid is sealed and contained in a primary inner container consisting of at least 4 mil plastic.

3.2.2 Use enough approved absorbent to absorb at least twice the volume of the liquid contained in the package (see 3.1.3).

3.2.3 Assure absorbed liquid in the primary inner container is homogeneously distributed with no detectable free-standing liquid.

3.2.4 The primary inner container will then be overpacked into a US DOT 7A Type A package.

APPENDIX K

METHODOLOGY for ENCAPSULATION OF SOURCES

1.0 Purpose

The purpose of this document is to provide a method of in-situ encapsulation of sources.

NOTE: FOR BURIAL IN SOUTH CAROLINA WHICH REQUIRES SOURCE ENCAPSULATION, IN EVERY CASE. THE METHOD OF ENCAPSULATION MUST BE SPECIFICALLY APPROVED BY BARNWELL's LICENSING DEPARTMENT AS PER REFERENCE 2.5.

2.0 Prerequisites/Precautions

2.1 QA approved Pre-encapsulated drums or equivalent;

2.2 Pre-encapsulated drums can be obtained from an approved vendor.

2.3 Personnel using this procedure shall use all necessary means available to minimize their exposure to As Low As Reasonably Achievable.

3.0 Requirements

3.1 Hanford

3.1.1 General Guidelines

a. Class A unstable - average the radionuclide concentration over the entire cement matrix - up to 55 gallon drum and less than Class A waste limit.

b. Class B stable - average the radionuclide concentration over the entire cement matrix - up to 55 gallon drum (limited to 1000 lbs) and less than Class B waste limit.

c. Class C stable - average the radionuclide concentration over the entire cement matrix - up to 55 gallon drum (limited to 1000 lbs) and less than Class C waste limit.

NOTE: IF TRANSURANICS AND RADIUM ARE NOT HOMOGENEOUS OR ARE MORE THAN 10 nCi/g BUT LESS THAN 100 nCi/g SPECIAL APPROVAL IS REQUIRED IN EITHER OR BOTH CASES.

3.1.2 Radium Requirements

a. 7A type A package is required.

b. 2500 psi structural concrete necessary.

c. Assume all sources to be normal form (A_2).

d. Stabilize Radium 226 source in 2R container with structural concrete.

e. Geometrically center 2R container in 7A Type A package and encapsulate with stable, structural concrete, per section 4.0 of this Appendix.

f. Cure for 28 days.

g. Ensure 7A Type A test documentation is available for package based on weight and configuration.

h. Ensure waste form is free of liquids and voids.

I. If the concentration, when averaged over concrete matrix is > 10 but ≤ 100 nCi/g, special Washington State approvals must be obtained for shipment as Class C stable waste.

3.2 Barnwell

3.2.1 The radionuclide concentration must be averaged over the source volume, for Class A unstable, Class B, Class C sources.

3.2.2 Greater than Class C limits require special approval.

4.0 Procedure

4.1 Inspect the container for foreign materials and damage. Record the container condition in your log.

4.2 Place the source in the container in the geometric center or as such to ensure 4 inches of cement surrounding the source in all directions; as applicable.

4.3 Fill the cavity of container to within 2"of the top with structural grade cement.

NOTE: STRUCTURAL CEMENT WILL CONSIST OF 1 PART "PORTLAND" CEMENT MIX TO 2 PARTS SAND; UNLESS OTHERWISE SPECIFIED BY THE WMS/WMS OR DISPOSAL SITE LICENSING DEPARTMENT.

4.4 Following a 6 to 24 hour cement cure time, verify the billet in accordance with Section 5.0, before proceeding to section 4.5.

NOTE: IF IT IS NECESSARY TO ADD ADDITIONAL CEMENT TO THE CONTAINER DUE TO ABSORPTION OR SHRINKAGE, AN ADDITIONAL BATCH MAY BE MIXED AND ADDED.

4.5 After the acceptance criteria of section 5.0 have been met, the encapsulation liner may be closed.

5.0 Acceptance Criteria

Radioactive waste encapsulated in a disposal container shall be considered acceptable if the following conditions are met:

5.1 Visual inspection of the end product, normally 6 to 72 hours after process completion, shows a uniform product with no free-standing water.

5.2 The end product, after satisfactory visual inspection, resists penetration when probed with a rod approximately 1" in diameter.

NOTE: VERIFY PSI AND CURE TIME REQUIREMENTS FOR THE FACILITY OR BURIAL SITE BEING USED.

6.0 Records and Reports

6.1 A copy of the log and QA inspection forms shall be sent to the PM/CWB with the shipping papers.

Appendix L

PREPACKAGED WASTE CERTIFICATION

The rules and regulations that authorize licensees, waste processing operations, transport, storage and / or burial of radioactive materials have been and continue to be changing. To meet the needs of our clients, the regulators, and various storage and / or burial facilities, Aguirre Engineers, Inc. (AEI) has established procedural guidance regarding prepackaged waste. In order to allow AEI to properly and efficiently complete brokering of your waste, please provide the following information. If the waste has been packaged by AEI personnel, the generator is required to respond to the questions in section 1 only.

S Date: _____ Generator Business Name: _____
E Address: (Facility Location) (Mailing, if different)
C _____ _____
T _____ _____
I Phone No.(s) _____ _____ Fax No. _____
O Waste Destination: Storage _____ Burial _____ Other _____
N Destination Facility/Contact Person: _____

To Help Us Help You

1 Do you have Process Knowledge Documentation for waste? Is it available? Yes ____ No ____
Is there a Sampling Analysis Plan? Is it available? Yes ____ No ____

Container type(s): (drums, boxes, B-25s, etc) _____
The number of containers, by type, and date or dates on which they were packaged:
_____
_____

(Waste Acceptance criteria may have been modified since date of original process)

Does the waste contain any of the following:	Yes	No
RCRA/CERCLA/TSCA materials		
Biological and/or Pathogenic hazards Which one(s)		
Lead (other than as pre-approved shielding)		
Free-standing liquids % of volume		
Absorbed Liquids Sorbent Type		
Oil or similar hydrocarbons Which one(s)		
Encapsulated waste Media PSI		
Solidified waste Media PSI		
Compacted or Supercompacted waste		
Scintillation fluids		
NORM/NARM Which/Type		
Other hazard or Special Waste Form. What?		
Any waste form whose physical characteristics could be altered by certain transport/storage conditions. What?		

The packaged waste being brokered by AEI is verified to meet the Conditions and Limitations of the Waste Acceptance Criteria and the Radioactive Materials license of the destination facility; or a deviation has been granted, in writing, by the appropriate regulatory authority.

Authorized Generator Signature: _____ Date: _____
Print / Sign Title or Position

AEI Broker: _____ Waste Packager: _____
Print / Sign Print / Sign

Aguirre Engineers, Inc.

Shipping Report

Consigned to: Date_____ Page ____of____
Name:_____ Address:_____ City:_____
State:_____ Zip:_____ Consignee License #:_____ Telephone #:_____

Shipped by:
Name:_____ Address:_____ City:_____
State:_____ Zip:_____ Shippers License #:_____ Telephone #:_____

Carrier:
☐Common Carrier ☐Contract Carrier ☐Air Carrier ☐Postal Service (LQ Only) ☐United Parcel Service (LQ Only) ☐Cargo Aircraft
Name:_____ Address:_____ City:_____
State:_____ Zip:_____ Telephone #:_____ Driver(s):_____

Description of Items:

Total No. of Packages	Weight (LBS.)	Shipping Name & Hazard Class (Per 49 CFR 172.101)	ID Number
		Radioactive Material, excepted package, limited quantity of material	UN2910
		Radioactive Material, low specific activity, LSA, n.o.s.	UN2912
		Radioactive Material, n.o.s.	UN2982
		Radioactive Material, special form, n.o.s.	UN2974
		Radioactive Material, excepted packaging, Instruments or articles	UN2910
		Radioactive Material, excepted package, empty packaging	UN2910
		Radioactive Material, fissile, n.o.s.	UN2918

Specify Item Number → →	Item	Item	Item	Item	Item	Item	Item
Isotope							
Activity (nanoCuries, microCuries, or milliCuries)							
Chemical form							
Physical form							
Weight (lbs.)							

Aguirre Engineers, Inc.

Shipping Report

Consigned to: Date_____ Page ____of____
Name:_____ Address:_____City:_____
State:_____Zip:_____Consignee License #:_____ Telephone #:_____

Shipped by:
Name:_____ Address:_____City:_____
State:_____Zip:_____Shippers License #:_____ Telephone #:_____

Carrier:
☐Common Carrier ☐Contract Carrier ☐Air Carrier ☐Postal Service (LQ Only) ☐United Parcel Service (LQ Only) ☐Cargo Aircraft
Name:_____ Address:_____ City:_____
State:_____Zip:_____Telephone #:_____ Driver(s):_____

Description of Items:

Volume (Cu.Ft.)							
Container Type and /or Specification							
Source Material (kgs)							
Special Nuclear Material (grams)							
Radiation Levels at Contact (mr/hr)							
Transport Index = mr/hr at 1 Meter							
Alpha Surface Contamination (DPM/100CM^2)							
Beta Surface Contamination (DPM/100CM^2)							
Fissile Class (I, II ,III or N/A)							
Labels/Markings (LSA, W-I, Y-II, Y-III, or N/A)							

This is to certify that the above materials are properly classified, described, packaged, marked, labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation. 49CFR 172.204(a)

Authorized Signature_____Title_____Date_____

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Empty Transport Vehicle Radiological Surveys

ARP-017

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 017
Empty Transport Vehicle Radiological Surveys

LIST OF EFFECTIVE PAGES
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Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
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ARP-017
Empty Transport Vehicle Radiological Surveys

1.0 Purpose and Scope

1.1 This procedure provides instructions for AEI personnel performing pre-loading surveys and release surveys of empty transport vehicles. Radiation and contamination surveys shall be performed on empty vehicles prior to entering the restricted area to ensure acceptance criteria are met, and prior to leaving the facility to ensure release criteria are met. Adherence to this procedure will provide reasonable assurance that transport vehicles have contamination levels below the specified limits before loading and following unloading of transport vehicles.

1.2 This procedure will be followed to survey all vehicles used to transport radioactive materials prior to loading and following the unloading of radioactive materials before the vehicle is released for other uses.

1.3 Description of procedures in Section 5

- Survey procedures for Closed Transport Vehicles.
- Survey procedures for Open Transport Vehicles.
- Action levels based on survey results.

2.0 General

2.1 Definitions

2.1.1 Closed Transport Vehicle - A transport vehicle or conveyance equipped with a securely attached exterior enclosure that during normal transport restricts the access of unauthorized persons to the cargo space containing Class 7 (radioactive) materials. The enclosure may be either temporary or permanent, and in the case of packaged materials may be of the "see-through" type, and must limit access from top, sides and bottom.

2.1.2 Non-Fixed (smearable) Radioactive Contamination - Radioactive contamination that can be readily removed from a surface by wiping with an absorbent material. Non-fixed (removable) radioactive contamination is not significant if it does not exceed the limits specified in 49 CFR 173.443 and in table A, section 5.2 of this procedure.

2.1.3 Open Transport Vehicle - A transport vehicle or conveyance which has no exterior enclosure around the cargo carrying area.

2.2 Quality Control

Instrumentation used in the surveys will be checked with standards daily and verified to have current valid calibration.

3.0 References, Records, and Equipment

3.1 References

49 CFR Parts 172 to 178.	*Transportation*
10 CFR Part 71	*Packaging and Transportation of Radioactive Materials.*
RG 1.86	*Termination of Operating Licenses for Nuclear Reactors*
RSM	Radiation Safety Manual
ARP-001	Operation of Contamination Survey Meters
ARP-002	Alpha-Beta Sample Counting Instrumentation
ARP-003	Operation of Micro-R Survey Meters
ARP-008	Radiation and Contamination Surveys

3.2 Records

ARP Form 8-1	Radiological Survey Report
ARP Form 8-2	Radiation and Contamination Survey

3.3 Equipment

Survey Meters
Smears or wipes

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for insuring that all personnel assigned the tasks of surveying transportation vehicles are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training of personnel performing radiation surveys described in this procedure. The RSO ensures that Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure.

4.3 Project Manager - The Project Manager is responsible for identifying transportation vehicles needing survey.

4.4 Health Physics Technicians - Health Physics Technicians are responsible for performing the surveys described in this procedure

5.0 Procedure

5.1 Closed Transport Vehicles

5.1.1 At a minimum, the following areas should be surveyed by direct frisk for alpha and beta-gamma contamination:

a. Inside surfaces of driver's area, particularly floorboards, pedals, steering wheel, driver's seat, door handles of cab, and dash area;
b. All tires and tire wells;
c. Inside surfaces of trailer walls and floor that were in contact with waste packages and exterior and interior door handles.

5.1.2 The areas in Section 5.1.1 above, are surveyed for removable contamination by disk smears. All smears are counted for beta-gamma and alpha contamination.

NOTE: Large area wipes or smears (LAS) may be used in conjunction with disc smears.

5.1.3 A dose rate survey is performed on the inside area of the trailer at 1 cm from surface area.

5.2 Open Transport Vehicles.

5.2.1 At a minimum, the following areas shall be surveyed by direct frisk for alpha and beta-gamma contamination:

a. Inside surfaces of driver's area, particularly floorboards, pedals, steering wheel, driver's seat, door handles, and dash area;
b. All tires and tire wells;
c. Trailer deck surface.

5.2.2 The areas in Section 5.2.1 above, are surveyed for removable contamination by disk smear. All smears are counted for beta-gamma and alpha contamination. Note: Large area wipes may be used in conjunction with disc smears.

5.2.3 A dose rate survey is performed on the trailer at one (1) cm from the surface area.

5.3 Action levels

5.3.1 If direct frisk beta-gamma instrument readings exceed 100 cpm above background (with background less than 200 cpm) or 25 cpm alpha, those areas shall be surveyed as follows:

- Perform a smearable contamination survey using 100 cm^2 of affected areas, and count the smears for beta-gamma and alpha contamination to determine if contamination is "fixed" or "removable".

5.3.2 Any vehicle with removable contamination exceeding the site limits listed below shall be brought to the attention of the Project Manager and handled appropriately.

5.3.3 Any vehicle with removable contamination exceeding the DOT limits listed below shall be brought to the attention of the RSO for release or acceptance approval.

- 2,200 dpm/100 cm^2 beta-gamma, limits are 300 cm^2
- 220 dpm/100 cm^2 alpha.

5.3.4 Dose rate surveys which exceed 0.2 mR/hr shall be brought to the attention of the RSO for release or acceptance approval.

5.3.5 Radiation levels exceeding 0.5 mR/hr at each accessible surface shall be brought to the attention of the RSO for release or acceptance approval.

5.4 Indication (manifest paperwork, truck logs, etc.) of the presence of difficult to detect radionuclides such as Tritium (^{3}H) or Nickel (^{63}Ni) shall be reported to the RSO for further evaluation. Detection of these isotopes may require the use of liquid scintillation counting.

5.5 The results of the survey shall be documented on survey forms (ARP 8-1 and 8-2).

6.0 Attachments

None

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Classifying Radioactive Waste

ARP-018

Revision 0

Reviewed By: _____ 3/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 018
Classifying Radioactive Waste

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
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6	0	2/3/98						

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ARP-018
Classifying Radioactive Waste

1.0 Purpose and Scope

1.1 The purpose of this procedure is to establish instructions used to classify waste for disposal, complete the shipment manifests and verify waste receipt criteria. Adherence to this procedure will provide reasonable assurance that waste will be properly classified pursuant to 10 CFR 61.

1.2 This procedure will be used to classify wastes pursuant to 10 CFR 61. Waste classification considerations for disposal at a licensed facility require:

1.2.1 Consideration must be given to the concentration of long-lived radionuclides (and their shorter-lived precursors).

1.2.2 Consideration must be given to the concentration of shorter-lived radionuclides for which requirements on institutional controls, waste form, and disposal methods are effective.

1.3 Description of procedures.

1.3.1 Use of this procedure will demonstrate the methodology for determining:

a. If the waste is acceptable for near-surface disposal,

b. If acceptable for near-surface disposal, whether the waste is classified as Class A, Class B, or Class C waste.

1.3.2 Using this procedure AEI personnel will be able to determine whether the waste complies with any additional waste form, package or content requirement which may be in place at the particular disposal facility to which the waste is to be shipped.

2.0 General

2.1 Definitions

2.1.1 Class A Waste - Class A waste is waste that is usually segregated from other waste classes at the disposal site. The physical form and waste characteristics of Class A waste must meet the minimum requirements set forth in 10 CFR 61.56(a). If Class A waste also meets the stability requirements set forth in 10 CFR 61.56(b), it is not necessary to segregate the waste for disposal.

2.1.2 Class B Waste - Class B waste is waste that must meet more rigorous requirements on waste form to ensure stability after disposal. The physical form and characteristics of Class B waste must meet both the minimum and stability requirements set forth in 10 CFR 61.56.

2.1.3 Class C Waste - Class C waste is waste that not only must meet more rigorous requirements on waste form to ensure stability but also requires additional measures at the disposal facility to protect against inadvertent intrusion. The physical form and characteristics of Class C waste must meet both the minimum and stability requirements set forth in 10 CFR 61.56.

2.2 Precautions and Prerequisites

2.2.1 Minor differences may exist between individual disposal facilities and the Waste Class tables presented in this procedure. ALWAYS classify waste per the destined facilities criteria.

2.2.2 The Barnwell facility has a Class C determination form that must be completed and forwarded with the shipment.

2.2.3 US Ecology facilities has a NARM determination required to be completed before shipment.

2.2.4 Certain waste streams such as filter resins etc., also require isotopic analysis to be completed before shipment.

2.3 Quality Control

Instrumentation used to perform measurements required by this procedure will be checked with standards and verified to have a current calibration.

3.0 References, Records, and Equipment

3.1 References

10 CFR part 61
CNSI Barnwell Waste Management Facility License
US Ecology Hanford License

3.2 Records

3.2.1 Waste classification will be documented on ARP Form 18-1, (may be computer generated).

3.2.2 Waste classification will be documented when shipping radioactive material to the burial site in accordance with ARP-016.

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned the tasks of waste classification are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for quality audits of waste classification performed by the Waste Broker.

4.3 Waste Broker - The Waste Broker is responsible to collect all required information about the waste and classifying the waste as outlined in this procedure.

5.0 Procedure

5.1 Procedural methods

Methods for determination of concentration may be made by using the following individually or in combination.

5.1.1 Compliance through materials accountability, a given quantity (and resulting concentration) of radioactive material may be known to be contained within a given waste or may be inferred through determining the difference between the quantity of radioactive material entering and exiting a given process.

5.1.2 Classification by source is similar to the above method of materials accountability and involves determining the radionuclide content and classification of waste through knowledge and control of the source of the waste.

5.1.3 Gross radioactivity measurements is an acceptable method for all classes of waste provided that:

a. The gross radioactivity measurements are correlated on a consistent basis with the distribution of radionuclides within the particular waste stream analyzed, and

b. The radionuclide distributions are initially determined and periodically verified by direct measurement techniques.

5.1.4 Measurement of specific radionuclides may establish an inferential measurement program whereby concentrations of radioisotope which cannot be readily measured (through techniques such as gamma-spectral analysis) are projected through ratioing to concentrations of radioisotopes which can be readily measured.

5.1.5 The concentration of a radionuclide may be averaged over the volume of the waste, or weight of the waste if the units are expressed as nanocuries per gram (using NRC Branch Technical Position Paper on Waste Classification current revision).For double packaged containers, only the inner package volume may be used for classification.

5.2 Preferred waste classification procedure

This algorithm for waste classification is performed using a computer when available. When using a computer, ensure data entry is accurate. Waste classification is to be performed by the Waste Broker with quality review performed by the RSO.

5.2.1 Classification determined by long-lived radionuclides. If the waste contains only radionuclides listed in Table 1, classification is be determined as follows:

a. If the concentration does not exceed 0.1 times the value in Table 1, the waste is Class A.

b. If the concentration exceeds 0.1 times the value in Table 1, but does not exceed the value in Table 1, the waste is Class C.

c. If the concentration exceeds the value in Table 1, the waste is not generally acceptable for near-surface disposal.

d. For waste containing mixtures of radionuclides listed in Table 1, the total concentration shall be determined by the sum of fractions rule described in Section 4.5.

e. Site specific variations to Tables 1 and 2 may exist. Prior to classifying waste verify that correct numbers are being used for the planned disposal facility.

Table 1

Radionuclide	Concentration Curies/Cubic Meter
C-14	8
C-14 in activated metal	80
Ni-59 in activated metal	220
Nb-94 in activated metal	0.2
Tc-99	3
I-129	0.08
Alpha emitting transuranic radionuclides with T½ >5 years	100[1]
Pu-241	3,500[1]
Cm-242	20,000[1]
Ra-226	100[1]

[1]Units are nanocuries per gram, to convert to becquerels (Bq) per gram multiply by 37, to convert from curies to gigabecquerels (GBq) multiply by 37. Specific approval of SCDHEC (So Carolina) is required for disposal of these radionuclides if their concentration is greater than ten percent of the Table 1 value.

5.2.2 Classification determined by short-lived radionuclides. If the waste does not contain any of the radionuclides listed in Table 1, classification shall be determined based on the concentrations shown in Table 2. If the radioactive waste does not contain any radionuclides listed in either Table 1 or 2, it is Class A.

a. If the concentration does not exceed the value of Column 1, the waste is Class A.

b. If the concentration value exceeds the value in Column 1, but does not exceed the value in Column 2, the waste is Class B.

c. If the concentration exceeds the value in Column 2, but does not exceed the value in Column 3, the waste is Class C.

d. If the concentration exceeds the value in Column 3, the waste is not generally acceptable for near-surface disposal.

e. For wastes containing mixtures of the radionuclides listed in Table 2, the total concentration shall be determined by the sum of fractions rule described in (4.5).

f. Site specific variations to Table 2 may exist. Prior to classifying waste verify that correct numbers are being used for the planned disposal facility.

Table 2

Radionuclide	Concentration Curies/Cubic Meter		
	Column 1	Column 2	Column 3
Total of all radionuclides with T½ <5 years	700	(*)	(*)
H-3	40	(*)	(*)
Co-60	700	(*)	(*)
Ni-63	3.5	70	700
Ni-63 in activated metal	35	700	7,000
Sr-90	0.04	150	7,000
Cs-137	1	44	4,600

(*) There are no limits established for these radionuclides in Class B or C wastes. Practical consideration such as the effects of external radiation and internal heat generation on transportation, handling, and disposal will limit the concentrations for these wastes. These wastes are Class B unless the concentration of other radionuclides in Table 2 determine the waste to be Class C independent of these radionuclides. Specific approval of SCDHEC is required prior to packaging of Class B tritium waste.

5.2.3 Classification determined by both long-lived and short-lived radionuclides. If the waste contains a mixture of radionuclides, some of which are listed in Table 1, and some of which are listed in Table 2, classification shall be determined as follows:

a. If the concentration of a radionuclide listed in Table 1 is less than 0.1 times the value listed in Table 1 the class shall be that determined by the concentration of radionuclides listed in Table 2.

b. If the concentration of a radionuclide listed in Table 1 exceeds 0.1 times the value listed in Table 1, the waste shall be Class C, provided the concentration of radionuclides listed in Table 2 does not exceed the value shown in Column 3 of Table 2.

5.2.4 Classification of waste with radionuclides other than those listed in Tables 1 and 2. If the waste does not contain any radionuclides listed in either Table 1 or 2, it is Class A.

5.2.5 The sum of fractions rule for mixtures of radionuclides. For determining classification for waste that contains a mixture of radionuclides, it is necessary to determine the sum of fractions by dividing each radionuclide's concentration by the appropriate limit and adding the resulting values. The appropriate limits must all be taken from the same column of the same table. The sum of the fractions for the column must be less than or equal to 1.0 if the waste class is to be determined by that column.

EX: A waste contains Sr-90 in a concentration of 50 Ci/m³ and Cs-137 in a concentration of 22 Ci/m³. Since the concentrations both exceed the values in Column 1, Table 2, they must be compared to Column 2 values. For Sr-90 fraction, 50/150 = 0.33; for Cs-137 fraction, 22/44 = 0.5; the sum of the fractions = 0.83. Since the sum is less than 1.0, the waste is Class B.

5.2.6 Determine package type in accordance with 49 CFR 173.431, 173.433 and 173.435.

5.2.7 Determine if R.Q. marking is required using 49 CFR 172.101 Appendix Table 2.

5.2.8 Verify LSA concentrations with 49 CFR 173.403 (N).

5.2.9 Any items exceeding a destination facility license shall not be shipped, refer to destination facility license. If material does not comply with license for the facility the shipment is going to, the waste will not be accepted.

6.0 Attachments

ARP Form 18-1 Waste Classification Form

Aguirre Engineers, Inc.

Waste Classification Worksheet

GENERATOR: _____

CONTAINER NUMBER: _____

CONTAINER WEIGHT: _____

CONTAINER VOLUME: _____

PACKAGE TYPE: _____

TYPE A FRACTION: _____

RQ LABELING: _____

LSA CONCENTRATION: _____

TABLE 1 CLASS: _____

TABLE 2 CLASS: _____

RADIONUCLIDE QUANTITIES IN THIS CONTAINER (mCi's)

_____

_____

_____

_____

_____

TOTALS: _____ WEIGHT OF WASTE = _____ LBS.

Performed By: _____ Date: _____

p. 3 - clarify what if
< 5 sources or units ⇒
sources will be carried on
home office 6 mo. physical
inventory.

02

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Radioactive Material Tracking

ARP-019

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 019
Radioactive Material Tracking

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	1	2/3/98						
2	1	2/3/98						
3	1	2/3/98						

This table provides the most recent changes to pages in this document. A '0' means the original page is valid, a date in the revision level box indicates the date of the most recent change to the page indicated.

ARP-019
Radioactive Material Tracking

1.0 Purpose and Scope

1.1 This procedure describes the requirements associated with tracking radioactive material at AEI job sites and during any work at customer facilities where procedures for radioactive material tracking are not available in the customer's radioactive material license. Adherence to this procedure will provide reasonable assurance that personnel exposures will be below specified limits, personnel will remain free of contamination and contamination will not be spread beyond the designated contaminated area.

1.2 This procedure will be used to ensure tracking of radioactive material is done in accordance with State, Federal, and Licensee requirements.

2.0 General

2.1 Precautions and Prerequisites

2.1.1 Ensure receipt documents have been reviewed and shipments to be received have been approved by the project manager prior to initiation of unloading.

2.1.2 Any time the site inventory exceeds or potentially may exceed the limits in the facility license, inform the RSO.

2.1.3 Accurate and timely handling of all documentation including inventory updates are essential to maintaining radioactive material tracking.

2.1.4 No material may be placed within 10 feet of a Radiological Control Area (RCA) boundary.

2.1.5 Material may not be placed such that exposure rates at the restricted area boundary exceed 100 μR/hr.

2.1.6 If any material is found or moved that does not have legible identification contact material controllers or the RSO immediately.

2.1.7 All forms and attachments may be computer files and reports.

2.2 Quality Control

2.2.1 Instruments used for measurements required by this procedure shall be checked with standards and verified to have current calibration.

2.2.2 Surveillance shall be performed at least annually to verify that operations are within the guidelines of this procedure.

3.0 References, Records and Equipment

3.1 References

RSM	Radiation Safety Manual
ARP-001	Operation of Contamination Survey Meters
ARP-002	Alpha-Beta Sample Counting Instrumentation
ARP-003	Operation of Micro-R Survey Meters
ARP-008	Radiation and Contamination Surveys

3.2 Record

- A current radionuclide inventory record shall be produced monthly.
- Record results of equipment surveys on survey forms in accordance with procedure ARP-008.
- Maintain TRACK-1 tracking forms for at least three months after the material has been shipped from the work site.

3.3 Equipment

None Required

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for insuring that all personnel assigned the tasks of control and tracking of radioactive material, are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training of personnel working with radioactive material. The RSO ensures Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure.

4.3 Project Manager - The Project Manager is responsible for ensuring the conditions of this procedure are complied with during all project operations.

4.4 Health Physics Technicians - Health Physics Technicians are responsible for control of radioactive material.

5.0 Tracking and Movement of Radioactive Material

5.1 Anytime licensed radioactive material is moved, the person who performed the operation or directed the operation shall ensure completion of the Material Tracking Documentation, Form TRACK.1.

5.2 The following are requirements for Material Tracking Documentation, Form TRACK.1:

a. Refer any questions to the material controller or project manager;

b. Any item moved across a radiological contamination boundary is surveyed and the survey documented;

c. All forms should be returned to material controllers by the end of each work day;

d. For material transferred to another area such as another work zone or facility, a copy shall be sent to the supervisor of that area.

e. An item generated from another item such as a large container into smaller boxes should be numbered with the original number, a dash (-), and a sequential number.

f. Any item which can not be easily numbered shall be referred to the material controller for resolution as soon as possible;

g. Any item for disposal or return shall be indicated in description;

h. The inventory system should be updated within 48 hours.

5.3 This procedure shall be in effect at all AEI work sites where the total activity is greater than 10 mCi, there are more than 5 sources of radioactive materials on-site, or the project manager determines that tracking is needed.

6.0 Attachments

ARP Form 19-1 TRACK-1

Aguirre Engineers, Inc.

TRACK-1

Note on this form any movement of radioactive material on the site. This is to prevent the loss of control of radioactive material.

Item Number	Item Name	Original Location	Current Location

Performed By: _____ Date: _____

Reviewed By: _____ Date:: _____

Page ____ of ____

OK

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Use and Control of Radioactive Check Sources

ARP-020

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 020
Use and Control of Radioactive Check Sources

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
2	0	2/3/98						
3	0	2/3/98						
4	0	2/3/98						

This table provides the most recent changes to pages in this document. A '0' means the original page is valid, a date in the revision level box indicates the date of the most recent change to the page indicated.

ARP-020
Use and Control of Radioactive Check Sources

1.0 Purpose and Scope

1.1 This procedure describes methods for control of instrument check sources used on jobs involving radioactive material. These sources are used to ensure proper radiation detection instrument operation. Adherence to this procedure will provide reasonable assurance that personnel exposures will be below specified limits, sources will not be lost or misplaced, personnel will remain free of contamination and contamination will not be spread beyond any designated contaminated area.

1.2 This procedure will be used to ensure proper control, use, and storage of radioactive check sources used for portable radiation detectors.

2.0 General

2.1 Precautions

2.1.1 Individual source quantities shall not exceed exempt quantity limits without permission of the Radiation Safety Officer.

2.1.2 When performing a leak test on non-exempt quantity sources, use specific license procedures.

2.1.3 If non-exempt quantity sources are used, the RSO will determine any additional precautions (i.e., finger rings, etc.).

2.1.4 Radioactive sources shall be controlled by GPI Radiation Protection personnel.

2.1.5 The storage location will be approved by the Radiation Safety Officer for protection against loss, leakage, or dispersion by the effect of fire or by water.

2.2 Quality Control

The methods specified in this procedure will be audited annually to ensure compliance with the requirements to control and inventory radioactive sources.

3.0 References, Records, and Equipment

3.1 References

Basic Radiation Protection Technology	Gollnick, 1994
RSM	Radiation Safety Program Manual
ARP-001	Contamination Survey Meters
ARP-002	Alpha-Beta Sample Counters
ARP-003	Micro-R Meters
ARP-004	Ionization Chambers
ARP-008	Radiation and Contamination Surveys

3.2 Records

ARP Form 20-1 Sealed Source Inventory and Leak Test Form

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for insuring that all personnel assigned the tasks of control and leak testing of sealed sources of radioactive material, are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training of personnel working with radioactive sources. The RSO ensures the Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure.

4.3 Project Manager - The Project Manager is responsible for ensuring the conditions of this procedure are complied with during all project operations.

4.4 Health Physics Technicians - Health Physics Technicians is responsible for control and use of radioactive check sources.

5.0 Procedure

5.1 Only qualified Radiation Protection personnel may use or have possession of AEI radioactive check sources.

5.2 The Radiation Safety Officer (RSO) prepares and maintains a source file which shall, at a minimum, consist of the following:

- Procurement history of each source including copies of seller certification;
- Status change - damage, sale or transfer, or disposal, or recalibration;
- A completed "Sealed Source Inventory and Leak Test" ARP Form 20-1; and
- Any other correspondence related to the sources.

5.3 A physical inventory of all instrument check sources will be conducted by the RSO or designee at least once each quarter and whenever a new check source is received or an old check source is disposed. The results shall be recorded on the "Sealed Source Inventory and Leak Test" ARP Form 20-1 and shall be retained in the source file for a period of not less than three years.

5.4 Although leak tests are not required for exempt quantity sealed sources, in the event a source is suspected of having a loss of encapsulation or other possible leakage, the following procedure shall be followed, wearing gloves or using tongs:

5.4.1 A visual inspection of the source shall be made for physical damage;

5.4.2 One of the following tests shall be used to determine source leakage when it is required:

NOTE: Any evaluation of the leakage of radioactive material from sources shall not cause violation of the source container in any way.

CAUTION: High activity sources have very high exposure rates on contact. Sources containing activity in excess of the exempt limits shall never be touched except with a remote means to ensure exposure is maintained As Low As Reasonably Achievable.

a. Dry Wipe Test - This test will be performed on encapsulated sources or adjacent surfaces of plated or foil sources. The sources shall be wiped with dry disc smear with the application of moderate pressure. Removal of any radioactive material from the source or adjacent surfaces will be determined by counting the filter appear with appropriate instrumentation.

b. Wet Wipe Test - This test will be performed on encapsulated sources only. The entire surface of the source shall be wiped with disc smear moistened with water, with the application of moderate pressure. Removal of any radioactive material from the source will be determined by counting the filter paper with an appropriate detection instrument after the filter paper has dried out.

5.4.3 When any contamination or leak test reveals the presence of 0.005 μCi or more of removable contamination, or activity removed is above the minimum sensitivity of the detecting instrument the source shall be retested. The source will be either repaired, if possible, or disposed of as radioactive waste if the second test is unsatisfactory. The results of the leak test for the sources are recorded on the "Sealed Source Inventory and Leak Test" ARP Form 20-1 and shall be retained for a minimum of three years.

5.5 The on-contact radiation level exterior to the source storage locker shall be maintained at less than 2 millirem per hour on any accessible surface. A radiation survey of the storage locker shall be performed at least quarterly and immediately after the receipt of any additional check sources.

5.6 Action Levels

5.6.1 Inventory

The RPS shall be notified immediately if it has been determined that a source is missing. An immediate search shall be conducted and the Radiation Safety Officer notified.

5.6.2 Leakage

If a source is suspected to have lost integrity, the Radiation Safety Officer shall be notified immediately. Corrective action shall be taken to repair the source or dispose as radioactive waste.

5.6.3 Radiation Levels

Radiation levels shall be maintained at less than 2 millirem per hour on contact on the source storage area.

6.0 Attachments

ARP Form 20-1 Sealed Source Inventory and Leak Test Form

Aguirre Engineers, Inc.

Sealed Source Inventory and Leak Test

Inventory Period: First Qtr ☐ Second Qtr ☐ Third Qtr ☐ Fourth Qtr ☐

Date Performed _____ By: _____
Print/Sign

Reviewed/Approved By: _____ Date: _____
Print/Sign

Isotope	Source (Type/Form)	Serial Number	Location	Initial Activity	Corrected Activity	Leak Test dpm/smear	Leak Test uCi/smear

Note and provide discussion for any problems that are encountered.

_____

_____

_____

ok

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Solidification of Radioactive Liquids/Sludges

ARP-021

Revision 0

Reviewed By: _____ 2/3/98

D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98

T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 021
Solidification of Radioactive Liquids/Sludges

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
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4	0	2/3/98						
5	0	2/3/98						
6	0	2/3/98						
7	0	2/3/98						
8	0	2/3/98						
9	0	2/3/98						

This table provides the most recent changes to pages in this document. A '0' means the original page is valid, a date in the revision level box indicates the date of the most recent change to the page indicated.

ARP-021
Solidification of Radioactive Liquids/Sludges

1.0 Purpose and Scope

1.1 This procedure provides the basic steps used to solidify aqueous based waste using Aquaset and Aquaset II solidification media, and oil based waste using Petroset and Petroset II solidification media, or combinations of the four media types. Adherence to this procedure will provide reasonable assurance that waste solidified with Aquaset and Petroset will meet waste acceptance criteria at the disposal site.

1.2 This procedure will be used to solidify aqueous based and oil based wastes using Aquaset and Petroset.

2.0 General

2.1 Precautions

2.1.1 Solution to be solidified must have a pH between 5 and 11 prior to testing and solidifying.

2.1.2 When solidifying any salt based solution with Aquaset, place a liner (at least 2 mil) in the drum prior to solidification activities.

2.1.3 Bench test is to be performed at similar temperature as solidification (above 60°F and below 140°F).

2.1.4 A 48-hour cure time at room temperature is required prior to any further testing (i.e., Freeze/Thaw and Free-Standing Solid Performance Test).

2.1.5 The media load rates (pounds per gallon of liquid) suggested in Tables 1 and 2 will, in most cases, produce acceptable results. However, the wide variability of waste characteristics in practice makes worthwhile the preparation of three samples as follows:

a. One at the recommended rate;

b. One at .75x the recommended rate; and

c. One at 1.33x the recommended rate.

This requires extra time, however, these three samples could eliminate delays due to repeat testing.

2.1.6 When using a combination of the solidification medias, add the materials (while mixing) in the following sequence:

a. Waste;

b. Petroset II;

c. Petroset;

d. Aquaset II (then Aquaset, if needed);

e. Alcohol Activator (if required).

2.1.7 All of the solidification agents in this procedure produce, as a final result, a slightly alkaline, inert, non-corrosive, and non-biodegradable solid matrix.

2.2 Quality control

Instrumentation used in this procedure will be checked daily with standards and verified to have a current valid calibration.

3.0 References, Records and Equipment

3.1 References

Manual .001	Fluid Tech, Inc.
RSM	Radiation Safety Manual
ARP-014	Radiologically Restricted Areas

3.2 Records

Forms generated from this procedure will be filed in the permanent project record.

3.3 Equipment

3.3.1 Shipping container

3.3.2 4 mil Liner

3.3.3 Solidification Media (Aquaset, Aquaset II, Petroset, or Petroset II)

3.3.4 Mixer (If Needed)

3.3.5 Plastic Beaker - 400 ml

3.3.6 Scale or Balance

3.3.7 Graduated Cylinder - 100 ml or 250 ml

3.3.8 Graduated Cylinder - 10 ml

3.3.9 Spatula/Spoon - Stainless - For Stirring

3.3.10 Electric Drill with Stirring Attachment (Optional)

3.3.11 Freezer - Capable of -29°C (-20°F)

3.3.12 Vernier Caliper

3.3.13 Numbered Plastic Disks

3.3.14 Modified Syringe

3.3.15 Desiccator - 250 mm/10' Diameter (i.e., Fisher Scientific Co. Number 08-615B)

3.3.16 Sample Plate

3.3.17 Cup of Water to be Used in Free-Standing Solid Performance Test

3.3.18 600 ml Beaker

3.3.19 Approved Absorbent Media

3.3.20 pH Testing Material (i.e., pH Paper)

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned the tasks of solidifying waste using Aquaset and Petroset are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training personnel working with radioactive materials.

4.3 Project Manager - The Project Manager is responsible for identifying waste requiring solidification by this procedure and ensuring the conditions of this procedure are complied with during all project operations.

4.4 Health Physics Technicians - Health Physics Technicians are responsible for performing surveys and to establish contamination and radiation control areas as needed to perform this procedure.

4.5 Radiation Workers - Radiation workers are responsible to read, understand, and comply with the provisions of this procedure.

5.0 Procedure

5.1 Aquaset Bench Test

5.1.1 See Table 1 or Table 2 for Aquaset Applications.

5.1.2 Place 200 ml of well mixed, representative waste sample in a 400 ml plastic beaker.

5.1.3 If the pH is less than 5 or more than 11, neutralize the sample. Record the amount and type of neutralizers used.

5.1.4 Place the beaker on the scale and either record the gross weight indicated or tare the scale.

5.1.5 Add Aquaset by scattering it uniformly across the top surface of the sample to a depth of approximately one quarter (50 ml) of the waste volume.

5.1.6 Wait 2 to 3 minutes and repeat step 5.1.5 to a depth of approximately one-half (100 ml) of the waste volume.

5.1.7 Repeat step 5.1.6 to a depth of approximately three-quarters of the waste volume (150 ml).

5.1.8 Repeat step 5.1.6 adding enough Aquaset to produce a dry top on the waste.

5.1.9 Determine and record the amount of Aquaset used by subtracting the original gross weight of the waste and beaker from the final weight, or by means of the tare/net weight shown on the scale.

5.1.10 Divide the weight (in grams) of Aquaset used by 24. The result is the loading rate in pounds of Aquaset to be used per gallon of original waste (assuming a 200 ml test sample).

5.1.11 Determine and record the final volume.

$$Efficiency = \frac{Original\ Volume\ (\ 200\ ml\ )}{Final\ Volume}$$

$$ExpansionFactor = \frac{Final\ Volume}{Original\ Volume\ (\ 200\ ml\ )}$$

5.1.12 Record all data on the Process Control Data Sheet, ARP Form 21-1.

5.1.13 Continue to 5.2 to process waste if it has passed the bench test.

NOTE: If 200 ml of liquid waste cannot be solidified into a putty-like state with less than 120 grams of Aquaset (equivalent to 5 pounds per gallon), then the waste shall not be treated with Aquaset. It will require Aquaset II or a combination of Petroset and Aquaset II with power mixing.

5.2 Waste Solidification Using Aquaset

5.2.1 If the pH is less than 5 or greater than 11, neutralize the sample. Record the amount and type of neutralizers used.

5.2.2 Place liner inside drum.

5.2.3 Discard test material into 55 gallon drum (if desired, the sample may be kept for use in 5.7 and 5.8).

NOTE: While this procedure is directed primarily toward the treatment of waste in 55 gallon drums, the same basic techniques are applicable to bulk, batch or continuous operations.

5.2.4 Add desired volume of waste to drum (it is recommended that only 2 to 10 gallons be processed at a time to ensure mixture is setting up properly).

5.2.5 Add approximately ⅓ of the pre-determined (from bench test) Aquaset needed for solidifying desired volume of waste.

5.2.6 After 5 minutes, add another ⅓ of the pre-determined Aquaset.

5.2.7 Add the remaining pre-determined Aquaset after another 5 minutes.

5.2.8 Allow the mixture to set for an additional 5 minutes and inspect the mixture to ensure it is setting up properly.

NOTE: The Aquaset is setting up properly if the mixture resembles a solid clay-like mass with the consistency similar to that of shortening. Small amounts of free-standing liquid on the surface of the mixture can be solidified with additional Aquaset. If there is a large amount of free-standing liquid, the Aquaset is not setting up properly and the processing must be stopped to determine what the problem is and how it is to be corrected.

5.2.9 Repeat steps 5.2.3 through 5.2.7 until all waste is solidified or the drum is full.

5.2.10 Allow the drum to stand for 48 hours before sampling to ensure it has solidified into a free-standing solid and has no free-standing liquids.

5.3 Petroset and/or Aquaset II Bench Test

5.3.1 See Table 1 or 2 for recommended media and loading rates (pounds per gallon).

5.3.2 Place 200 ml of well mixed representative waste sample in a 400 ml plastic beaker.

5.3.3 If the pH is less than 5 or more than 11, neutralize the sample. Record the amount and type of neutralizers used.

5.3.4 Add media while stirring vigorously. Break up clumps or clots so that uniform dispersion of the media is achieved. Stir at least one minute after the mixture has become smooth or until stirring is no longer possible. If the mixture becomes too stiff for further mixing before complete dispersion of the media is achieved, reduce the loading rate and start another sample mix.

5.3.5 Divide the amount of each medium added (in grams) by 24. This will be the loading rate (pounds per gallon) of each medium.

5.3.6 Determine and record the final volume.

$$Efficiency = \frac{Original\ Volume\ (\ 200\ ml\ )}{Final\ Volume}$$

$$ExpansionFactor = \frac{Final\ Volume}{Original\ Volume\ (\ 200\ ml\ )}$$

5.3.7 Record all data on the Process Control Data Sheet, ARP Form 21-1.

5.3.8 Continue to 5.4 to process waste if it has passed the bench test.

5.4 Waste Solidification Using Petroset and/or Aquaset II

5.4.1 If the pH is less than 5 or greater than 11, neutralize the sample. Record the amount and type of neutralizers used.

5.4.2 Discard test material into 55 gallon drum (if desired, sample may be kept for use in 5.7 and 5.8).

NOTE: While this procedure is directed primarily toward the treatment of waste in 55 gallon drums, the same basic techniques are applicable to bulk, batch, or continuous operations.

5.4.3 Add desired volume of waste into drum (it is recommended that no more than 10 gallons be processed at a time to ensure mixture is setting up properly).

5.4.4 Mix vigorously enough to break up clumps and clots of solidification media desired so that uniform dispersion of the media is achieved.

5.4.5 Continue to stir at least one minute after the mixture has developed a texture similar to bench test sample; i.e., smooth.

5.4.6 If all waste was not originally placed in a drum, continue adding waste and solidification media until drum is full or all waste is mixed and has become smooth.

5.4.7 Allow drum to stand for 48 hours uncovered before sampling to ensure it has solidified into a free-standing solid and has no free-standing liquids.

5.5 Petroset II Bench Test

5.5.1 See Table 1 or Table 2 for recommended load rates (pounds per gallon).

5.5.2 Place 200 ml of a well mixed representative waste sample in a 400 ml plastic beaker.

5.5.3 If the pH is less than 5 or more than 11, neutralize the sample. Record the amount and type of neutralizers used.

5.5.4 Add the recommended amount of Petroset II while stirring vigorously for at least one minute (solidification at this stage is unlikely).

5.5.5 If solidification is obtained, proceed to 5.5.8.

5.5.6 Add 10 ml (5% of the waste volume) of polar activator (any light alcohol such as methanol) and continue stirring vigorously. The waste should now be "setting up."

5.5.7 Continue stirring until no more polar activator can be seen.

5.5.8 Determine and record the final volume.

$$Efficiency = \frac{Original\ Volume\ (\ 200\ ml\ )}{Final\ Volume}$$

$$ExpansionFactor = \frac{Final\ Volume}{Original\ Volume\ (\ 200\ ml\ )}$$

5.5.9 Record all data on the Process Control Data Sheet, AEI Form 21-1.

5.6 Waste Solidification Using Petroset II

5.6.1 If the pH is less than 5 or greater than 11, neutralize the sample. Record the amount and type of neutralizers used.

5.6.2 Discard test material into 55 gallon drum (if desired, sample may be kept for use in 5.7 and 5.8).

NOTE: While this procedure is directed primarily toward the treatment of waste in 55 gallon drums, the same basic techniques are applicable to bulk, batch, or continuous operations.

5.6.3 Add desired volume of waste into the drum. Mix for approximately 2 min.

5.6.4 Add Petroset II slowly while stirring vigorously.

5.6.5 Continue stirring for at least one minute after Petroset II is visually mixed into waste (~7 minutes).

5.6.6 Add polar activator, if bench test determines that this is needed, (5% of waste volume) and continue stirring vigorously.

5.6.7 Continue stirring until polar activator is no longer visible (~6 minutes).

5.6.8 Allow drum to stand for 48 hours uncovered before sampling to ensure it has solidified into a free-standing solid and has no free-standing liquids.

5.7 Freeze/Thaw Testing

5.7.1 If the solidified waste may be subject to freezing in storage or in shipment, the bench test procedure shall include the Freezer/Thaw portion. If not, proceed to 5.8.

5.7.2 Allow bench test specimens to sit at process room temperature for 48 hours.

5.7.3 Freeze a new sample or original bench test sample at -20°F for 24 hours.

5.7.4 Thaw to greater than 68°F for 48 hours.

5.7.5 Repeat 5.7.2 and 5.7.3 through 6 cycles.

5.7.6 After cycling, there shall be no free-standing liquid observable in test beaker.

5.7.7 Invert the beaker and verify that no free-standing liquid is present.

5.8 Free-Standing Solid Performance Test

5.8.1 See Fluid Tech manual, Test Apparatus, to show test equipment needed for this test.

5.8.2 Using the aforementioned equipment, take a test plug from solidified waste as needed (waste should have already set for at least 48 hours) or use the original bench test sample.

5.8.3 Push the sample plug forming tube through the solidified waste approximately 2 inches.

5.8.4 Spin the tube several times to break the sample free.

5.8.5 Plug the top of the sample tube to create a vacuum and pull sample tube with the sample plug.

5.8.6 Prepare numbered plastic disc to identify plug. See Fluid Tech Manual, Test Sample Handling.

5.8.7 Place the properly numbered plastic disc on top of the sample. See Fluid Tech Manual, Test Sample Handling.

5.8.8 Place plunger into sample tube and press the sample plug, along with the plastic disc on top, to transfer it onto the sample holding plate.

5.8.9 Repeat steps 5.8.2 through 5.8.8 for each of the test samples.

5.8.10 Using the Vernier Caliper, determine the height of each test plug to the nearest 0.01 inch and record on Test Data Chart, AEI Form 21-2.

5.8.11 Place approximately ⅛ inch of tap water in the bottom of the desiccator.

5.8.12 Set the sample holding plate with the test samples in the desiccator as shown in the Test Apparatus.

5.8.13 Place the lid on the desiccator and wait 24 hours.

5.8.14 Remove lid and test samples.

5.8.15 Using the Vernier Caliper, determine the height of the test plugs, again using the reference dot.

5.8.16 Record the information and determine the percent difference in height as required on the Test Data Chart, AEI Form 21-2.

5.8.17 Determine whether the height measurement differences are within 5% of the first measurement.

5.8.18 All sample test plugs which maintain a height difference of less than 5% over the 24 hours have passed the free-standing solid test requirement.

5.8.19 If any of the sample plugs show a height change over 5%, the mix is a failure. In such cases, a new mix must be done and tested using a heavier media loading rate.

5.8.20 After sample plugs have been removed and solidified waste has been standing for 24 hours, examine the hole where plug originated for free liquid.

5.8.21 Examine plugs of solidified waste for consistency and pockets of liquid.

6.0 Attachments

Attachment 1/Table 1	Recommended Media and Loading Rates
Attachment 2/Table 2	Recommended Media and Loading Rates
ARP Form 21-1	Process Control Data Sheet
ARP Form 21-2	Free-Standing Solid Test Data Chart

Table 1
RECOMMENDED MEDIA AND LOADING RATES

(Pounds per Gallon)

	Aquaset	Petroset	Aquaset II	Aquaset II + Petroset	Petroset II	Petroset II + Petroset	Petroset II + Aquaset II	Reference Attachment 316-1.2
Water - With Low Levels of Dissolved Solids	5 lbs/gal	4 lbs/gal	-	-	-	-	-	(a)
Neutralized Strong Acids	7-10 lbs/gal <0.1 M	5 lbs/gal <0.1 M	5-6 lbs/gal	5 lbs/gal SO_4 <1.0M NO_3 <1.0M	-	-	-	(b)
Neutralized Weak Acids	7-10 lbs/gal ≤0.3M	5 lbs/gal <0.5M	5 lbs/gal	4.5 lbs/gal PO_4 <1.0M Ac <1.0M B <0.1M	-	-	-	©
Water Miscible Organics	6 lbs/gal ≤5,000 mg/l	-	5 lbs/gal	4 lbs/gal	-	-	-	(d)
Oils, Hydrocarbon	-	-	-	-	2-3 lbs/gal	-	-	(e)
Oils, Synthetic	-	-	-	-	3-4 lbs/gal	-	-	(f)
Silicone Emulsions	-	-	5 lbs/gal	-	-	-	-	(g)
Solvents	-	-	-	-	3-5 lbs/gal	-	-	(h)
Other Non-Aqueous Liquids	-	-	-	-	2-5 lbs/gal	-	-	(I)
Evaporator Concentrations BWR and PWR	-	-	4 lbs/gal	4 lbs/gal	-	-	-	(j)
Slurries - Ion Exchange Resins - Filter Precoat	-	4 lbs/gal	-	-	-	-	-	(k)
Ethylene Glycol Solutions 0% - 35% EG	-	-	5 lbs/gal	-	-	-	-	(l)
Ethylene Glycol Solutions 35% - 60% EG	-	-	5 lbs/gal	-	-	-	-	(m)
Ethylene Glycol Solutions 60% - 90% EG	-	-	6 lbs/gal	-	-	-	-	(n)

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Table 2
RECOMMENDED MEDIA AND LOADING RATES

(Pounds per Gallon)

REFERENCE	LIQUID WASTE	PREFERRED MEDIA	ADDITIONAL INFORMATION
a	Water - With Low Levels of Dissolved Solids	Aquaset or Petroset	Petroset (which requires mixing) offers better volumetric efficiency than Aquaset. Some organic contaminants in very low concentrations may require the use of a combination of Petroset and Aquaset II. Bench tests will help determine the appropriate recipe.
b	Neutralized Strong Acids (Nitric, Sulfuric, Hydrochloric, etc..) and Bases	Aquaset II or a Combination of Petroset and Aquaset II	Preferred Neutralizers are: Sodium Hydroxide, Sodium Carbonate, or Phosphoric Acid
c	Neutralized Weak Acids (Boric, Phosphoric, etc..) and Bases	Aquaset II or a Combination of Petroset and Aquaset II	Preferred Neutralizers are: Sodium Hydroxide, Sodium Carbonate, or Phosphoric Acid
d	Miscible Organics	Aquaset II or a Combination of Petroset and Aquaset II	
e	Oils, Hydrocarbon	Petroset II	In some cases, activator (alcohol) is not necessary. Activator, if used, will be 5% of the volume of the oil.
f	Oils, Synthetic	Petroset II	Synthetic oils are treated in a similar fashion to Hydrocarbon oils. Synthetics tend to require heavier media loading rates than Hydrocarbon oils. Activator (alcohol) may or may not be necessary.
g	Silicone Emulsions		Some silicone fluids can be solidified with Fluid Tech, Inc. media. Emulsions (such as UCC-710) can be solidified with Aquaset II. Pure silicone fluids (polydimethylsiloxane polymers such as DOW 200 fluids) cannot.
h	Solvents	Petroset II	Most solvents can be solidified with Petroset II. Activator (alcohol) may or may not be required.
i	Other Non-Aqueous Liquids	Petroset II	Most Hydrocarbons, and many other non-water miscible organic liquids, can be solidified with Petroset II. Activator (alcohol) may or may not be required.
j	Evaporator Concentrates - BWR and PWR	Aquaset II	
k	Resin Slurries - Filter Precoat Slurries	Aquaset	These slurries can be solidified by Aquaset in 55 gallon open top drums without mixing. In this mode, the slurry and the Aquaset are fed into the drum simultaneously at rates determined by observation during the pour. Aquaset II can also be used with continuous mixing.
l, m, n	Ethylene Glycol Solutions	Aquaset II	

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Process Control Data Sheet

BENCH SCALE TEST DATA

Date of Test: _____

(Raw) Waste Test Sample Volume: _____ ml Sample Weight: _____ gm

Neutralization of Sample: Raw Waste pH: _____ Neutralizer Used: _____

Quantity Used: _____ gm Final pH: _____

MEDIA: Aquaset: _____ gm Petroset: _____ gm Mixing Temperature: _____

Petroset-H: _____ gm Aquaset II: _____ gm Curing Temperature: _____

Aquaset II-H: _____ gm Petroset II: _____ gm

Other Reagent(s): _____ gm _____ gm

Activator (if required): _____ ml Added Water (if required): _____ ml

Freeze/Thaw Cycles (if required): _____ Freeze: _____ °C Thaw: _____ °C

Measured Solidified Volume: _____ ml

Hardness (if required): _____ Tons/Square Feet (Penetrometer)

CERTIFICATION	NO FREE-STANDING LIQUID 24 HOURS AFTER MIXING		
CERTIFIED BY		DATE	

CERTIFICATION	NO FREE-STANDING LIQUID AFTER FREEZE/THAW TEST.		
CERTIFIED BY		DATE	

CERTIFICATION	PHYSICAL CHARACTERISTICS HAVE BEEN MET.		
CERTIFIED BY		DATE	

CONVERSION OF BENCH SCALE DATA TO FULL SCALE MIXING VALUES

$$\frac{\text{Measured Solidified Volume (ml)}}{\text{(RAW) Test Sample Volume (ml)}} = \_\_\_\_\_ \text{ Expansion Factor (XF)}$$

- OR -

$$\frac{\text{(RAW) Test Sample Volume (ml)}}{\text{Measured Solidified Volume (ml)}} = \_\_\_\_\_ \text{ Efficiency}$$

Aguirre Engineers, Inc.

Free-standing Solid Test Data Chart

FIRST MEASUREMENT				SECOND MEASUREMENT			
SAMPLE NUMBER	DATE	TIME	HEIGHT	DATE	TIME	HEIGHT	% CHANGE

Page ___ of ___

2.3.2 - Safety measures for opening previously packaged mail?
reference
ARP procedures?

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Packaging Radioactive Material

ARP-022

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 022
Packaging Radioactive Material

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

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ARP-022
Packaging Radioactive Material

1.0 Purpose and Scope

1.1 This procedure describes the methods used by trained AEI employees at customer facilities to package material for disposal as radioactive waste. Adherence to this procedure will provide reasonable assurance that personnel exposures will be ALARA, personnel will remain free of contamination and contamination will not be spread beyond the designated contaminated area.

1.2 This procedure will be used to ensure packaging of radioactive waste meets Federal, State, Customer, and Waste Site requirements.

2.0 General

2.1 Definitions

2.1.1 No detectable free-standing liquid - As little liquid as reasonably achievable, but in no case shall the liquid exceed 0.5% of the waste volume.

2.1.2 Sorbent Material - Sorbent material approved by applicable regulatory body for use at designated disposal site. Approved sorbents are listed in the applicable disposal facility license.

2.1.3 Strong Tight Container - Container capable of transporting radioactive material to the disposal facility without loss of material.

2.1.4 Heavy Duty Closure Ring - Closure ring for drums of 55-gallons or larger capacity secured by a bolt having a 5/8" or larger diameter.

2.1.5 Container - Outer package which meets strong tight criteria. Containers are most commonly steel drums of 55-gallons capacity or larger.

2.2 Precautions

2.2.1 Ensure that a Radiation Work Permit (RWP) has been issued to control the evolution. The RWP may be written to govern multiple tasks.

2.2.2 All personnel packaging waste shall comply with RWP requirements.

2.2.3 If loose surface contaminated material is to be handled, ensure the evolution is set up in an approved area AND that the ventilation system for the area is in operation, AND respiratory protection requirements have been determined and specified in the RWP.

2.2.4 Disposal Container Checklist, Form DCC-1, is at the packaging site to be completed as the package is assembled.

2.3 Quality Control

2.3.1 Q.C. verification of packaging activities will be performed on a recurring surveillance basis and will be documented on a QA Surveillance Report.

2.3.2 Surveillance may be performed during packaging or by opening and inspecting previously packaged material.

2.3.3 Instrumentation used for measurements required by this procedure will be checked with standards and verified to have current calibration.

3.0 References, Records and Equipment

3.1 References

RSM	Radiation Safety Manual
ARP-001	Operation of Contamination Survey Meters
ARP-002	Alpha-Beta Sample Counting Instrumentation
ARP-003	Operation of Micro-R Survey Meters
ARP-004	Operation of Ionization Chambers
ARP-006	Radiation Work Permits
ARP-008	Radiation and Contamination Surveys
ARP-014	Radiologically Restricted Areas
ARP-015	Personnel Protective Equipment
ARP-016	Radioactive Materials Brokering
ARP-019	Radioactive Material Tracking

3.2 Records

ARP Form DCC-1 Disposal Container Checklist.

3.3 Equipment

Appropriate containers
Packaging materials, as needed
Tools, for securing containers

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned the tasks of packaging of radioactive material, are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training personnel working with radioactive material. The RSO ensures Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure.

4.3 Project Manager - The Project Manager is responsible for ensuring the conditions of this procedure are complied with during all project operations.

4.4 Health Physics Technicians - Health Physics Technicians are responsible for control of radioactive material.

5.0 Procedure

5.1 The project manager will initiate a RWP describing the work to be done. The Health Physics Technician will perform all required surveys and prescribe requirements as specified in procedure ARP-006.

5.2 Packaging Dry Material

5.2.1 Ensure container:

a. Has a heavy closure ring which is free of defects;

b. Exhibits no holes, damage, or deformation which renders the container non-strong tight;

c. Gasket exhibits no apparent damage.

d. Ensure the package meets the appropriate performance testing criteria for the material being packaged per Title 49 of the Code of Federal Regulations.

5.2.2 Place a thin layer of approved sorbent material in the bottom of the container.

5.2.3 Place pellets or other material into the container, filling as much of the volume as practical.

5.2.4 Fill void spaces within the container with dry material to the maximum extent practical.

5.2.5 Ensure the container contains no detectable free-standing liquid.

5.2.6 Install lid and fasten closure ring securely. Tap the closure ring with a hammer around the edges while tightening the closure ring bolt.

5.2.7 Ensure drainage/sample bung is closed securely, and cover bung joint with waterproof caulk.

5.2.8 Weigh the completed container.

5.2.9 Provide tracking information as required by ARP-019.

5.2.10 Label container with following information:

a. Radioactive Material;

b. Container identification number;

c. Gross weight.

5.2.11 Complete Disposal Container Checklist, Form DCC-1.

5.2.12 Have radiation protection personnel perform a dose rate survey on completed containers.

5.2.13 Place completed container in appropriate storage area as directed by the project manager.

5.3 Packaging Biological Material (excluding animal carcasses)

WARNING

Containers with biological, pathogenic, or infectious material or equipment used in handling of such material shall be kept sealed except when an appropriate work area has been established and specific procedures are written to repackage the material.

5.3.1 Ensure that the shipper has provided certification to ensure the following:

a. Each received container meets DOT 7A Performance Specifications or was Manufactured to DOT 17H Specifications;

b. Each received container is lined with a sealed plastic liner, minimum 4 mil thickness.

5.3.2 Select a container with a capacity of at least:

a. 40% greater than the received container for disposal in Washington;

b. 50% greater than the received container for disposal in South Carolina.

5.3.3 Ensure the outer container:

a. Meets DOT 7A Performance Specifications and test records are on file;

b. Has a heavy duty closure ring which is free of defects;

c. Exhibits no holes, damage or deformation which renders the container non- strong tight;

d. Has a gasket which exhibits no damage.

e. Ensure the package meets the appropriate performance testing criteria for the material being packaged per Title 49 of the Code of Federal Regulations.

5.3.4 Place a layer of approved sorbent material in the bottom of the outer container.

5.3.5 Place received container into the outer container.

5.3.6 Fill void spaces within the container with approved sorbent material, and ensure there is no detectable free-standing liquid.

5.3.7 Install lid and fasten closure ring securely.

5.3.8 Ensure drainage/sample bung is closed securely, and cover bung joint with waterproof caulk.

5.3.9 Weigh the completed container.

5.3.10 Provide tracking information as required by ARP-019.

5.3.11 Label container with the following information:

a. Radioactive Material;

b. Container identification number;

c. Gross weight.

5.3.12 Complete Disposal Container Checklist, Form DCC-1.

5.3.13 Have radiation protection personnel perform a dose rate survey on completed containers.

5.3.14 Place the completed container in an appropriate storage area.

5.4 Packaging Animal Carcasses

WARNING

Containers with animal carcasses shall not be opened at other than approved facilities. Overpacking of the inner package shall only be accomplished for burial purposes. Caution is necessary with animal carcasses as the animal may have been used for experimentation with chemicals or drugs.

5.4.1 Ensure the shipper has provided certification to ensure the following:

a. Each received container meets DOT 7A Performance Specifications or was Manufactured to DOT 17H Specifications;

b. The biological material within the received container is layered with absorbent and lime.

5.4.2 Select a container with a capacity of at least: 50% greater than the container received for disposal.

5.4.3 Ensure that the outer container:

a. Meets DOT 7A Performance Specifications and test records are on file.

b. Has a heavy duty closure ring which is free of defects;

c. Exhibits no holes, damage, or deformation which renders the container non strong-tight;

d. Has a gasket which exhibits no apparent damage.

e. Ensure the package meets the appropriate performance testing criteria for the material being packaged per Title 49 of the Code of Federal Regulations.

5.4.4 Place a layer of approved sorbent material in the bottom of the outer container (Perlite sorbents may not be used when packaging animal carcasses in the void space between the inner and outer container).

5.4.5 Place the received container into the outer container.

5.4.6 Fill void spaces within the outer container with approved sorbent material and ensure there is no detectable free-standing liquid.

5.4.7 Install the lid and fasten the closure ring securely.

5.4.8 Ensure drainage/sample bung is closed securely, and cover bung joint with waterproof caulk.

5.4.9 Weigh the completed container.

5.4.10 Provide tracking information as required by procedure ARP-019.

5.4.11 Label the container with following information:

a. Radioactive Material;

b. Container identification number;

c. Gross weight.

5.4.12 Complete the Disposal Container Checklist, Form DCC-1.

5.4.13 Have radiation protection personnel perform a dose rate survey on completed containers.

5.4.14 Place completed container in an appropriate storage area.

5.5 Packaging Bulk Dry Materials

NOTE: This section is intended for use in preparing large containers (50 ft^3 or more) for disposal. Items which can be placed in drums should be packaged as described in Section 5.2.

5.5.1 Inspect container to be used as a burial container to ensure:

a. No holes, damage, or deformation which renders the container non-strong tight;

b. Lid gasket exhibits no apparent damage;

c. Closure devices are free of defects.

d. Ensure the package meets the appropriate performance testing criteria for the material being packaged per Title 49 of the Code of Federal Regulations.

5.5.2 Place waste material inside the container, filling as much of the volume as practical.

5.5.3 Ensure the container has no detectable free-standing liquid.

5.5.4 Install lid and fasten securely using one or more of the following:

a. Clips;

b. Mechanical fasteners;

c. Clamping rings

d. Metal banding.

5.5.5 Ensure drainage/sample plug is closed securely, and cover drain plug with weatherproof caulk.

5.5.6 Weigh the completed container.

5.5.7 Provide tracking information as required by ARP-019.

5.5.8 Label container with following information:

a. Radioactive Material;

b. Generator(s) identification and receipt number(s);

c. Container identification number;

d. Gross weight.

5.5.9 Complete the Disposal Container Checklist, Form DCC-1.

5.5.10 Have radiation protection personnel perform a dose rate survey on completed containers.

5.5.11 Place completed containers in appropriate storage area designated by the project manager.

5.6 Packaging Solidified or Stabilized Liquid

NOTE: This section does not constitute a solidification or stabilization process plan. This section is provided to ensure proper packaging for disposal of liquids which have been stabilized/solidified in accordance with an approved procedure. This section may be performed concurrent with the stabilization /solidification process.

5.6.1 Review process information and maintain records to ensure:

a. Liquid was rendered non-corrosive ($4 \leq pH \leq 11$);

b. Liquid has been acceptably stabilized or solidified using material authorized in applicable disposal facility license.

5.6.2 Ensure container:

a. Has a heavy duty closure ring which is free of defects;

b. Exhibits no holes, damage, or deformation which renders the container non-strong tight;

c. Gasket exhibits no apparent damage.

d. Ensure the package meets the appropriate performance testing criteria for the material being packaged per Title 49 of the Code of Federal Regulations.

5.6.3 Fill container with material to be stabilized or solidified.

5.6.4 Fill void spaces within the container with sorbent material, and ensure there is no detectable free-standing liquid. Void space shall be less than 15% of container volume.

5.6.5 Install lid and fasten closure ring securely.

5.6.6 Ensure drainage/sample bung is closed securely, and cover bung joint with waterproof caulk.

5.6.7 Weigh completed container.

5.6.8 Provide tracking information as required by ARP-019.

5.6.9 Label container with following information:

a. Radioactive Material;

b. Container identification number;

c. Gross weight.

5.6.10 Complete the Disposal Container Checklist, Form DCC-1..

5.6.11 Have radiation protection personnel perform a dose rate survey on completed containers.

5.6.12 Place completed containers in an appropriate storage area designated by the project manager.

5.7 Packaging Sorbed Liquid

NOTE: This section does not constitute a sorption process plan. This section is provided to ensure proper packaging for disposal of liquids which have been sorbed in accordance with an approved procedure. This section may be performed concurrent with the sorption process. For disposal at other than the Barnwell site.

5.7.1 Review process information and maintain records to ensure:

a. Liquid was rendered non-corrosive ($4 \leq pH \leq 11$);

b. Liquid has been acceptably sorbed using material authorized in the applicable disposal facility license;

c. Liquid is contained in enough sorbent material to sorb at least twice the volume of the liquid content;

d. Volume and weight of unprocessed liquid has been recorded.

5.7.2 Ensure container:

a. Meets DOT 7A Performance specifications and test records are on file;

b. Has a heavy duty closure ring which is free of defects;

c. Exhibits no holes, damage, or deformation which renders the container non-strong tight;

d. Gasket exhibits no apparent damage.

5.7.3 Line the container with a minimum 4 mil plastic liner unless liquid has been sorbed in Petroset or Aquaset.

5.7.4 Fill container with sorbed material as fully as possible.

5.7.5 Fill void spaces within the container with sorbent material and ensure there is no detectable free-standing liquid.

5.7.6 Close plastic liner.

5.7.7 Install lid and fasten closure ring securely.

5.7.8 Ensure drainage/sample bung is closed securely, and cover bung joint with waterproof caulk.

5.7.9 Weigh completed container.

5.7.10 Provide tracking information as required by GPI-14.

5.7.11 Label container with the following information:

a. Radioactive Material;

b. Container identification number;

c. Gross weight.

5.7.12 Complete the Disposal Container Checklist, Form DCC-1.

5.7.13 Have radiation protection perform dose rate survey on completed container.

5.7.14 Place completed container in an appropriate storage area.

6.0 Attachments

ARP Form 22-1 (DCC-1) Disposal Container Checklist

Aguirre Engineers, Inc.

Disposal Container Checklist
(DCC-1)

CONTAINER NUMBER: _____

CONTAINER DESCRIPTION: _____

GENERATOR(S): _____

RECEIPT NO.(S): _____

		SAT	N/A
1)	CONTAINER PROPER FOR CONTENTS	☐	☐
2)	CONTAINER HAS:		
	– NO HOLES, DAMAGE, OR DEFORMATION RENDERING IT NON-STRONG TIGHT.	☐	☐
	– ACCEPTABLE CLOSURE EQUIPMENT	☐	☐
	– ACCEPTABLE CLOSURE GASKET	☐	☐
3)	NO FREE-STANDING LIQUID	☐	☐
4)	CONTAINER CLOSURE HARDWARE INSTALLED SECURELY	☐	☐
5)	CONTAINER LABELED WITH FOLLOWING:		
	– RADIOACTIVE MATERIAL	☐	☐
	– GENERATOR IDENTIFICATIONS	☐	☐
	– CONTAINER IDENTIFICATION NUMBER	☐	☐
	– GROSS WEIGHT	☐	☐

ITEMS ABOVE COMPLETED: _____ / _____
OPERATOR SIGNATURE DATE

REVIEWED BY: _____ / _____ DATE: _____
PRINT/SIGN

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Opening Radioactive Material Containers

ARP-023

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 023
Opening Radioactive Material Containers

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
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ARP-023
Opening Radioactive Material Containers

1.0 Purpose and Scope

1.1 This procedure describes the methods used by trained AEI employees at customer facilities to open packages containing radioactive material. Adherence to this procedure will provide reasonable assurance that personnel exposures will be below specified limits, remain free of contamination and contamination will not be spread beyond the designated contaminated area.

1.2 This procedure will be used to ensure safety in the opening of containers which require control as radioactive material. This procedure provides instructions for opening shipping containers which contain radioactive material. Containers which contain material which has been decontaminated, such that loose surface contamination has been removed, are not subject to this procedure.

2.0 General

2.1 Precautions

2.1.1 Ensure a Radiation Work Permit (RWP) has been issued to control the evolution. The RWP may be written to govern multiple tasks (e.g., packing and loading containers).

2.1.2 All personnel opening containers or working in the area of container opening shall comply with RWP requirements.

2.1.3 If loose surface contaminated material is to be handled, ensure the evolution is set up in an approved area, per ARP-011, AND that the ventilation system for the area is in operation, AND respiratory protection requirements have been determined. Containment to control the spread of radioactive material shall be established prior to opening a shipping container with internal loose surface contamination.

2.1.4 If there is any indication of hazardous or dangerous material - cease work and notify the RSO immediately.

2.2 Quality Control

Elements of this procedure will be audited during opening operations at least annually.

2.2.1 Q.C. verification of packaging activities will be performed on a recurring surveillance basis and will be documented on a QA Surveillance Report.

2.2.2 Surveillance shall be performed during opening and inspecting previously packaged material.

3.0 References, Records and Equipment

3.1 References

ARP-008 Radiation and Contamination Surveys
ARP-011 Containment Devices
ARP-016 Radioactive Material Brokering
ARP-019 Radioactive Material Tracking

3.2 Equipment

- Hand Tools
- Air sampling equipment
- Survey equipment

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned the tasks of opening containers of radioactive material are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training of personnel working with radioactive material. The RSO ensures personnel are qualified by training and experience to perform the requirements of this procedure.

4.3 Project Manager - The Project Manager is responsible for ensuring the conditions of this procedure are complied with during all project operations.

4.4 Health Physics Technicians - Health Physics Technicians are responsible for control of radioactive material.

5.0 Procedure

5.1 Review and Planning

5.1.1 The Project Manager shall review the shipping papers and receipt survey data to determine which RWP will be followed while opening the container.

5.1.2 If the container is of an unusual configuration, the Project Manager will generate a plan for moving and opening the container and conduct a pre-job briefing with the crew. Pre-job briefings will be documented.

5.2 Establish containment around the container in one of the following ways:

5.2.1 Move the containers into a controlled building or containment;

NOTE: The containment boot need only limit air flow around the container. The building atmospheres must be kept negative relative to the outside air, therefore inleakage around the container is normal and desired.

5.2.2 Place the container in one of the door openings in a controlled building and establish a boot between the building and the container.

5.2.3 Establish a temporary containment which incorporates the following requirements:

a. Wall, floor, ceiling membranes to control spread of contamination;

b. Ventilation blower drawing on the containment and exhausting through a HEPA filter with a minimum of 99.97% efficiency;

c. If it is believed gaseous activity is present, the blower shall be exhausted through a 99% efficient activated carbon filter in addition to HEPA filtration;

d. Discharge of the ventilation blower shall be sampled as needed to evaluate the air released.

5.3 Open the container as follows:

NOTE: If an unusual situation occurs, the operation shall stop and the Project Manager will be notified.

5.3.1 Notify the Radiation Protection Supervisor on site or the RSO that the container will be opened. Radiological conditions shall be monitored while opening containers.

5.3.2 Remove fasteners from container.

5.3.3 Open container as necessary to perform airborne contamination survey on interior volume of the container.

5.3.4 Perform airborne contamination survey.

5.3.5 Open container further to perform smear surveys for removable contamination.

5.3.6 If there is any indication of hazardous or dangerous material

a. If container can be easily and quickly secured, secure it.

b. Warn others of the material and keep others away.

c. Stop work and notify the RSO immediately.

5.3.7 Perform smear surveys and dose rate surveys in accordance with ARP-008.

5.3.8 If surveys indicate contamination levels and dose rates as expected, processing may proceed as planned.

5.3.9 If surveys indicate contamination levels or dose rates are greater than expected, the Operations Supervisor shall review processing plans to determine if changes are required prior to start of processing.

5.3.10 If the container will be closed and returned to storage, a copy of the survey results should be posted on the container.

5.4 Reopening Containers

5.4.1 Follow Sections 5.1 and 5.2.

5.4.2 If a container opening survey is on file, containers may be opened and off loaded without further survey as described in Section 5.3.

5.4.3 If container opening survey is not on file, all requirements of Section 5.3 shall be followed.

6.0 Attachments

None

consideration of air sampling?

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Decontamination of Equipment and Tools

ARP-024

Revision 0

Reviewed By: _____ 3/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 3/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 024
Decontamination of Equipment and Tools

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ARP-024
Decontamination of Equipment and Tools

1.0 Purpose and Scope

1.1 This procedure establishes the requirements for decontamination of equipment, material, and tools used on AEI field projects that become contaminated with radioactive material.

1.2 This procedure will be used to identify proper decontamination methods, provide instruction for the decontamination of equipment, material, and tools. Each decontamination operation is unique; thus, this procedure provides general, effective decontamination techniques and guidelines to be used by AEI field personnel. This document applies to all AEI personnel involved in the decontamination process.

2.0 General

2.1 Definitions

2.1.1 Decontamination - The processes whereby contamination can be safely and effectively removed from equipment, tools and materials, to levels required by Reg. Guide 1.86.

2.1.2 Herculite - A plastic or polyethylene floor covering and containment material used for decontamination operations. HERCULITE is a brand name.

2.1.3 MSDS. - Material Safety Data Sheet; Manufacturer directions, safety information and limitations for use of decontamination related solvents or cleaning solutions.

2.1.4 Radiation Work Permit (RWP) - A document generated by Health Physics to provide:

a. A description and scope of the work to be performed.

b. The existing radiological conditions in the work area.

c. The limitations placed upon the scope of work.

d. The maximum radiological limits allowed.

e. The measures to be employed to protect the worker(s).

f. The period of time the RWP is valid.

g. Special instructions to workers and HP personnel for the work.

2.1.5 Shall - The word "shall" as used in this procedure is to be understood as denoting a mandatory requirement.

2.1.6 Should - The word "should" as used in this procedure is to be understood as denoting a recommendation that is a sound safety practice; it does not denote a mandatory requirement, however, is normally done unless job conditions require other actions.

2.2 Precautions

2.2.1 All decontamination of contaminated tools or equipment shall be performed in accordance with the direction of the Health Physics Technician providing the job coverage in accordance with this Procedure, and the RWP requirements.

2.2.2 Decontamination activities shall be performed within a controlled area established in accordance with the provisions of procedure ARP-014.

2.2.3 Controls to contain the spread of loose contamination during the decontamination activity shall be planned and established prior to the decontamination of equipment, material, and tools.

2.3 Limitations

2.3.1 Protective clothing worn by the personnel involved in decontamination activities shall be determined according to the RWP.

2.3.2 Decontamination cleaning solvents/solutions shall only be used in accordance with the directions and limitations listed on the manufacturer supplied MSDS.

2.3.3 Decontamination solutions/solvents shall be approved by the Project Manager prior to use. Solvents/solutions requiring a pH adjustment shall be modified prior to use.

2.3.4 Respiratory protection devices required by the RWP for decontamination operations shall be selected and used in accordance with the provisions of ARP-032.

2.3.5 A pre-job briefing shall be held to instruct Decontamination Technicians of the conditions of the RWP. All personnel performing work in the decontamination area shall sign the RWP prior to work.

2.3.6 Every effort should be made by AEI personnel to avoid re-contamination of decontaminated materials. Contamination controls shall always be observed throughout a decontamination operation.

2.3.7 Radiation and contamination surveys shall be performed in accordance with the provisions of procedure ARP-008.

2.3.8 Release of equipment, materials, and tools from the decontamination area shall be performed in accordance with the provisions of procedure ARP-025.

2.4 Quality Control

Instrumentation used in the surveys will be checked with standards daily and verified to have current valid calibration.

Operations conducted using this procedure shall be reviewed for compliance at least annually.

3.0 References, Records and Equipment

3.1 References

Reg Guide 1.86	*Termination of Operating Licenses For Nuclear Reactors*
RSM	Radiation Safety Manual
ARP-001	Operation of Contamination Survey Meters
ARP-002	Alpha-Beta Sample Counting Instrumentation
ARP-003	Operation of Micro-R Survey Meters
ARP-006	Radiation Work Permits
ARP-008	Radiation and Contamination Surveys
ARP-014	Radiologically Restricted Areas
ARP-018	Classifying Radioactive Waste
ARP-022	Packaging Radioactive Material
ARP-025	Unconditional Release of Materials from Radiological Controls
ARP-032	Respiratory Protection

3.2 Records

The records generated by the use of this procedure are documented in accordance with the provisions of referenced AEI procedures. No new records are created.

3.3 Equipment

None required

4.0 Responsibilities

4.1 Program Manager - The Manager Director is responsible for ensuring that all personnel assigned the tasks of decontamination are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training of personnel in decontamination techniques and performing radiation surveys described in this procedure. The RSO ensures the decontamination technicians are qualified by training and experience to perform the requirements of this procedure.

4.3 Project Manager - The Project Manager is responsible for supervising the decontamination technician staff and for quality assurance of the decontamination effort.

4.4 Health Physics Technicians - Health Physics Technicians are responsible for performing the surveys of decontaminated items, and ensuring that radioactive material is not released to the public or the environment.

5.0 Procedure

5.1 Pre-Decontamination Preparation

5.1.1 The Project Manager shall initiate decontamination instructions.

5.1.2 A radiological survey shall be performed by a Health Physics Technician on any object which is to be removed from a controlled area.

5.1.3 If radiological survey results indicate that a RWP is required for decontamination, the Health Physics Supervisor shall write the RWP in accordance with the provisions of procedure ARP-006.

5.1.4 If a survey indicates that decontamination is required, the item should be bagged, wrapped, or contained under the direction of Health Physics Supervision. The Health Physics Technician shall label the item in accordance with the provisions of procedure ARP-019.

5.1.5 The Project Manager shall approve or disapprove the decontamination operation based on conditions of the RWP and the cost effectiveness of the operation versus disposal costs.

5.2 Establishment of the Decontamination Area

5.2.1 The Project Manager and the Health Physics Supervisor shall determine a location for set-up of the decontamination area.

5.2.2 Once a location has been established, the decontamination area shall be constructed by the Health Physics/ Decontamination Technicians under the direction of the Project Manager and Health Physics Supervisor.

5.2.3 The decontamination area should consist of:

a. Covered (or equivalent) floor surfaces. A double layer of Herculite (or equivalent) may be laid on the floor at the Health Physics Supervisor's direction.

b. Covered (Herculite or equivalent) wall surfaces, if applicable.

c. Engineering controls (HEPA ventilation, vacuum cleaners, containment tent walls, glove bags, etc.), if applicable. Engineering controls shall be determined on the basis of the ALARA considerations section of the RWP.

NOTE: All possible engineering controls shall be utilized when feasible to minimize the need for respiratory protection equipment.

d. Safe, sturdy work stations with contamination resistant surfaces. Tables that will support decontamination attempts on heavy pieces of equipment.

e. Adequate supply of overhead light, adequate electrical/compressed air supply for the operation of electrical/pneumatic driven decontamination equipment.

f. Overhead lifting equipment, if applicable.

g. Adequate supply of AEI approved cleaning solutions and solvents; adequate supply of decontamination equipment such as:

i. Light duty decontamination equipment such as paper wipes, paper towels, masslinn towels, etc.

ii. Medium to Heavy duty decontamination equipment such as scrub pads, wire brushes, steel wool, files, sandpaper, etc.

iii. Fully stocked hand tool kit for disassembly of contaminated equipment.

iv. Power tools, such as drills, saws, needle-guns, electric screwdrivers, etc.

v. Radioactive material storage bags, stickers, etc.

vi. Buckets, barrels or drums for the storage of contaminated liquids, sludges or slurries, if applicable.

vii. Blotter paper or sorbent, if applicable.

viii. Approved absorbent material such as oil dry, etc., if applicable.

h. Storage drums/bags for the storage of contaminated protective clothing under direction of Health Physics supervision.

i Proper surveillance instruments (air monitor/sampler, contamination monitor, friskers, dose rate meter, etc.) in accordance with the RWP.

j. Adequate supply of personal protective clothing, gloves, respiratory equipment, etc.

k. Step-Off Pad or Double Step-Off Pad in accordance with the provisions of the RWP.

l. A designated area within the decontamination area for the segregation of radioactive waste.

m. Fire extinguisher(s), if required.

5.2.4 Once the decontamination area has been established and stocked for operation, the bagged or wrapped contaminated or controlled equipment should be placed in the decontamination work area by Health Physics/Decontamination Technicians under the direction of the Project Manager and the Health Physics Technician. Contaminated or controlled items should always be escorted under the direction of a Health Physics Technician to the decontamination area.

5.3 Decontamination

5.3.1 After radiological posting of the decontamination area, all requirements of the RWP shall be observed.

5.3.2 The preparation for decontamination of a particular tool, material, or piece of equipment shall be performed as follows:

a. Position the wrapped item so that the written information on the wrapping is visible.

NOTE: Junior Health Physics/Decontamination Technicians may operate survey instruments for decontamination monitoring purposes. Health Physics Technicians shall oversee Health Physics/Decontamination Technicians when survey instruments are in use.

CAUTION: Survey instruments to be used in a known or suspected contaminated area should be protected (wrapped in plastic, poly, etc.) against possible contamination before use.

b. The Health Physics Technician shall direct the removal of the item from the wrapping in such a manner (rolling plastic wrapping inside out, etc.) to control the spread of contamination.

c. An item that is highly contaminated with smearable contamination should be misted with an approved liquid. The water vapor will wet down the particulate contamination and help prevent the possibility of airborne contamination.

d. Once the item has been removed from the wrapping and has been properly positioned, discard the wrapping as radioactive waste.

5.3.3 The following decontamination techniques should be considered for the decontamination of equipment, materials, and tools:

a. Any equipment with unaccessible areas shall be dismantled so that all surfaces are accessible for decontamination and for survey.

b. Decontamination shall be performed in a safe, effective manner.

c. The Health Physics Technician shall be notified IMMEDIATELY if the job conditions change (e.g. suspected asbestos found, presence of mercury in a switch or a light bulb, a fluid leak, or any other special circumstances).

d. A Health Physics/Decontamination Technician shall be assigned as a fire watch if any spark creating decontamination techniques (grinding, etc.) are used. There shall be a dedicated fire extinguisher located within the decontamination area.

e. In order to secure a safe cleaning surface, the item should be positioned on the work table (if size and weight allow) and locked into a vise or secured in another way if possible.

f. The decontamination area shall remain organized and free of debris. The Health Physics/ Decontamination Technicians shall "clean as they go."

g. A 'HEPA' vacuum cleaner may be used during the decontamination operation.

h. Smearable Contamination Removal

When item is properly positioned for decontamination and the pre-survey has been completed, perform the following:

i. Moisten the surface of the item with an approved liquid (e.g. demineralized water).

ii. Fold a paper or cloth wipe into sections, using one surface of the wipe, gently wipe contamination off in ONE direction AWAY from the user's body. This should reduce the possibility of personnel contamination.

iii. Re-fold the paper or cloth wipe so that a CLEAN surface is available (this should prevent cross-contamination) and continue until item is ready for survey.

iv. For some materials, duct tape will effectively remove smearable contamination. Wrap the duct tape loosely around the gloved hand, ADHESIVE side OUT. Roll the tape over the contaminated area. Re-survey.

i. Fixed Contamination Removal

i. There are many techniques that can be used to remove fixed contamination. The general idea is to remove the material which is fixing the activity to the surface, or remove a very thin layer of the surface material. The techniques selected for a particular decontamination operation is at the discretion of the Project Manager and the Health Physics Technician. The techniques can be divided into the following categories:

- Light hand decontamination
- Abrasive hand decontamination

- Power tool decontamination
- Machine decontamination (use of abrasive bead blasters, grit blasters, high pressure water wash systems, etc.) The specific implementation of these techniques is not included within the scope of this procedure.
- Cleaning solutions/solvents (use of ultrasonic cleaners, acid baths, electropolishing, etc.) The specific implementation of these techniques is not included within the scope of this procedure.

ii. Light hand decontamination consists of using many of the same techniques as 5.3.3 of this procedure.

iii. Abrasive hand decontamination shall be performed in the following manner:

- Remove as much smearable contamination as possible as indicated in Section 5.3.3 of this procedure.
- Moisten the surface of the item(s) to contain contamination.

CAUTION: Abrasive measures should only be applied to surfaces which are not critical for operation of devices which must be restored to working condition. Abrasion of machined surfaces should be minimized if the device is intended to provide it's designed operation.

- Use an abrasive cleaning tool (e.g. sandpaper, steel wool, steel brush, hand grinder, etc.) to loosen fixed contamination. Clean in one direction ONLY and clean AWAY from the body to prevent personnel contamination.
- Continue to moisten the surface of the item(s) to contain contamination.
- Remove as much smearable contamination as possible as per Section 5.3.3 of this procedure.
- Re-survey.

iv. Power tool decontamination shall be performed in the following manner only under the direction of the Health Physics Technician.

NOTE: When using power tools, always consider the potential of injury due to the hazards involved. Power tools shall be used cautiously and in accordance with the manufacturer's recommendations.

a. Some of the electric power tools that can be used in decontamination operations are:

- drills- used to drill out contaminated areas, to disassemble contaminated components and when used with grinding wheels or disks, may be used as an abrasive tool.
- saws- used to separate contaminated pieces from clean pieces
- grinders- used to grind fixed contamination from surfaces
- electric screwdrivers- used in the disassembly of component parts

b. Some of the air-powered tools that can be used in decontamination operations are:

- Needle gun - a pneumatic tool which can remove contamination from concrete and/or steel surfaces
- socket tools or impact hammer - used in disassembly of component parts
- jackhammer/rotohammer - a pneumatic tool which can remove contamination from concrete and/or steel surfaces

c. Power tool decontamination shall be performed in the following manner:

- Remove as much smearable contamination as possible as per Section 5.3.3 of this procedure.
- Moisten the surface of the item lightly to contain contamination. Use a spray bottle for moistening.

CAUTION: Do not use electric power tools on a wet working surface. Keep liquids away from electric power tools.

- Whenever feasible the use of containment devices (e.g. glove box, etc.) should be used to contain the spread of contamination when using power tools for decontamination operations.
- Use the power tool to remove fixed contamination. Clean in one direction ONLY and clean AWAY from the body to prevent personnel contamination.
- Re-survey.

5.4 Post Decontamination

5.4.1 If the decontamination was successful, the Health Physics/ Decontamination Technician shall notify the Health Physics Technician who shall perform a release survey in accordance with ARP-025.

a. If the item satisfies the criteria for release as in ARP-025, remove the item to a holding area for disposal and document results. When prepared for disposal, ensure compliance with the provisions of ARP-018 and 022.

b. If the item remains contaminated, attempt a second decontamination, then perform 5.4.1.

c. If the item remains contaminated, attempt a third decontamination ONLY by direction of the Project Manager.

5.4.2 If an item cannot be effectively or economically decontaminated, the Project Manager may direct the AEI work crew to volume-reduce (reduce to component parts) the equipment, material, or tools as much as possible. If the item is expendable, the individual parts may be surveyed and released in accordance with Section 6.4.1.

5.4.3 If an item is volume-reduced to its component parts and decontamination is not feasible, and the item is not needed, the item parts shall be considered radioactive waste. Radioactive waste is to be segregated into similar materials for shipment purposes by the direction of the Project Manager. The Health Physics Supervisor shall direct the segregation of radioactive waste into the following categories:

a. steels, hard metals

b. wood

c. transite, fiber products

d. paper

e. rubber

f. cloth (duct tape is considered a cloth)

g. aluminum, soft metals (brass)

h. glass

i. concrete

j. questionable items (e.g. light bulbs, pipe with lead solder, electronic component parts) which could be considered mixed or hazardous waste

k. other categories, if applicable

5.4.4 After all decontamination operations have been completed a Health Physics Technician shall perform a release survey of the decontamination area and de-post the area in accordance with procedures ARP-008 and ARP-014.

6.0 Attachments

None.

add a caution that customer/reg. body must approve release of matl for unrestricted use?

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Unconditional Release of Materials from Radiological Controls

ARP-025

Revision 0

Reviewed By: _____ 1/31/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 025
Unconditional Release of Materials from Radiological Controls

LIST OF EFFECTIVE PAGES
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ARP-025
Unconditional Release of Materials from Radiological Controls

1.0 Purpose and Scope

1.1 This procedure sets forth the specific requirements for release of materials from controlled areas applicable to AEI field projects.

1.2 The purpose of this procedure is to specify requirements for releasing material from controlled areas and to minimize the potential for unintentionally releasing contaminated items to uncontrolled areas in accordance with the provisions of references in section 3.

1.3 This procedure provides instructions for performing release surveys of items controlled as contaminated or potentially contaminated with radioactive materials.

1.4 This procedure will be used to ensure by survey that all materials released from contaminated or potentially contaminated areas will meet the release criteria applicable to the license conditions, facility requirements, or as specified in regulations or guidance provided by applicable regulatory agencies of the federal or state government.

2.0 General

2.1 Definitions

2.1.1 Activity - The rate of disintegration (transformation) or decay of radioactive material. The units of activity for the purpose of this procedure are disintegrations per minute (dpm), Becquerel (Bq), or micro-Curies.

2.1.2 Contamination - Deposition of radioactive material in any place where it is not desired, particularly where its presence may be harmful. The harm may be actual exposure to individuals or release of the material to the environment or general public. Contamination may be due to the presence of alpha particle, beta particle or gamma ray emitting radionuclides.

2.1.3 Restricted Area - Any area to which access is controlled in order to protect individuals from exposure to radiation and radioactive materials and/or to prevent the release of radioactive materials to the uncontrolled areas.

2.1.4 Fixed Contamination - Radioactive contamination that is not readily removed from a surface by applying light to moderate pressure when wiping with a paper or cloth disk smear,.or masslinn.

2.1.5 Minimum Detectable Activity (MDA) - For purposes of this procedure, MDA for removable radioactive contamination is defined as the smallest amount of sample activity that will yield a net count with a 95% confidence level based upon the background count rate of the counting instrument used.

2.1.6 Senior Health Physics Technician - An individual designated by the Radiation Safety Officer to evaluate materials or items in accordance with Sections 5.2 and 5.3.

2.1.7 Release for Unconditional Use - A level of radioactive material that is acceptable for use of property without restrictions. Under normal circumstances, authorized limits for residual radioactive material are set equal to, or below, the values specified in Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*, Table 1.

2.1.8 Survey Exempt Materials - The contents of sealed containers which remain unopened while in a controlled area are exempt, the outside surfaces are not exempt.

2.2 Precautions

2.2.1 Instruments used to perform release surveys shall be operated in accordance with the respective operating procedure, for example:

- Ludlum Model-2929 - ARP-002
- Ludlum Model-3 -ARP-001

2.2.2 MDA for the Ludlum Model-2929 shall be determined in accordance with ARP-002.

2.2.3 Large area smears may be used to augment (but not replace) the 100 cm^2 smear survey. Large area wipes may be counted with the Ludlum Model-3 or equivalent. Large area smears are used to obtain immediate information concerning loose contamination for the purpose of radiological protection and to minimize time spent performing disc smears on an item easily identified as contaminated.

2.2.4 A release document package, at a minimum, shall include the following forms:

a. The Health Physics daily log.

b. Material Release Log.

c. Radiation and Contamination Survey Report (ARP Forms 8-1,2, or 3) or an Unconditional Release of Equipment or Items Report (ARP Form 25-1) and/or Sample Calculation Worksheet (ARP Form 2-4).

d. ARP Form 1-1, Daily Instrument Calibration Log.

2.2.5 The release document shall include the following information:

a. The date of the release survey.

b. The number of the release survey.

c. A description or identification of the item.

d. The identity of the Health Physics Technician performing the release survey.

e. The evaluator of the material for release.

f. The release approval of the Health Physics Supervisor or designee.

2.2.6 All surveys performed for the release of material shall be documented on a Radiation and Contamination Survey Report (ARP Form 8-1, 2, or 3) and/or on a Unconditional Release of Equipment or Items Report (ARP Form 25-1).

2.2.7 Radiation/contamination surveys shall be performed in accordance with ARP-008.

2.2.8 Items identified as radioactive during the release survey shall be controlled in accordance with ARP-014.

2.2.9 Personnel performing release surveys shall be logged in on a Radiation Work Permit in accordance with ARP-006 (if applicable).

2.2.10 Audible response instruments must be used during direct scan surveys.

2.2.11 The instruments used for release surveys shall be within current calibration and shall have had a performance test check performed daily or prior to use in accordance with the instruments operating procedure.

2.2.12 Items presented for release shall be direct scanned in an area of low background.

2.3 Quality Control

Instrumentation used in the surveys will be checked with standards daily and verified to have current valid calibration.

When releasing large amounts of materials, a program shall be established to ensure by second check that no radioactive material has been released to the public or the environment.

2.4 Limitations

2.3.1 The maximum probe speed during direct scan surveys of surfaces shall be 3 cm/sec.

2.3.2 A response check shall be performed at the completion of the work day for instruments used for direct scan surveys in accordance with the instruments operating procedure.

2.3.3 The probe face shall be held within ¼ inch of the surface being surveyed for alpha radiation, and within ½ inch of the surface being surveyed for beta-gamma radiation.

2.3.4 If a instrument used to perform release surveys fails any operational check, it shall be removed from service. All data collected during the period of instrument failure must be evaluated by the Health Physics Supervisor.

2.3.5 Posting and access control of controlled areas shall be performed in accordance with ARP-014.

3.0 References, Records, and Equipment

3.1 References

10 CFR 20	*Standards for Protection Against Radiation*
Reg Guide 1.86	*Termination of Operating Licenses for Nuclear Reactors*
ANSI N3.1-1987	*Selection, Qualification and Training of Personnel for Nuclear Power Plants*
ARP-001	Operation of Contamination Survey Meters
ARP-002	Alpha-Beta Sample Counting Instrumentation
ARP-003	Operation of Micro-R Survey Meters
ARP-006	Radiation Work Permits
ARP-008	Radiation and Contamination Surveys
ARP-014	Radiological Restricted Areas
ARP-020	Use and Control of Radioactive Check Sources

3.2 Records

ARP Form 8-1	Radiological Survey Report
ARP Form 8-2	Radiation and Contamination Survey
ARP Form 8-3	Radiation and Contamination Survey Results

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned the tasks of surveying transportation vehicles are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training personnel performing radiation surveys described in this procedure. The RSO ensures the Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure.

4.3 Project Manager - The Project Manager is responsible for identifying items requiring surveys for release.

4.4 Health Physics Technicians - Health Physics Technicians are responsible for performing the surveys described in this procedure.

5.0 Procedure

5.1 Release Limits For Gross Activity (Unknown Isotopes)

EMISSION	REMOVABLE dpm/100 cm^2	TOTAL (Fixed and Removable) dpm/100 cm^2
Alpha	20	100
Beta-Gamma	200	1000

NOTE: If all of the constituents of the contamination are known and documented on the release documents, the release limits of Table 1 of Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors* apply.

5.2 Inaccessible Surfaces

5.2.1 Items with inaccessible surfaces should be disassembled as completely as possible to facilitate release surveys. Items with inaccessible surfaces will not be unconditionally released unless evaluated by a designated evaluator who authorizes and documents the release.

5.2.2 The following guidance will be used when performing evaluations:

- A history of the item should be reviewed.
- The actual release survey shall be reviewed.
- Determination of the radiological conditions in the area the item has been used or stored shall be reviewed.
- Use of gamma radiation sensitive detectors such as NaI(T1) or equivalent should be considered. (These detectors may indicate internal contamination that a beta sensitive detector may not detect due to the beta detector's lack of sensitivity to photon emissions).

5.3 Materials considered hazardous due to their physical or chemical nature and fragile items shall not be unconditionally released unless evaluated. For example, gases, pyrophoric materials, easily damaged electronic devices, or other easily damaged materials cannot be directly or indirectly surveyed. These materials will be evaluated on a case by case basis for release in a manner consistent with Section 5.2.2. Evaluation for release shall be performed by a designated evaluator only.

5.4 Survey Exempt Materials

5.4.1 Items such as briefcases, pens, papers, personal clothing, etc., are exempt from the Health Physics release survey requirements of this procedure if they are not causally used in the contaminated area..

5.4.2 Individuals shall survey the exempt items in the same manner as a whole body frisk when leaving a controlled area or have a Health Physics Technician perform the survey.

5.5 Survey Procedure

5.5.1 Upon receipt of an item presented for release, attempt to determine the history:

- Purpose of item.
- The current and past use of the item.
- The location(s) in which the item was used or stored.
- If the item was ever used for work with radioactive material or used in an area where radioactive material was used or stored.

NOTE: This knowledge of the item history should provide the surveyor with information helpful in performing the release survey.

5.5.2 Using protective clothing such as gloves, perform large area smears of 100% of the accessible surfaces of the item using large area wipes (e.g. masslinn).

a. Determine if transferrable (loose) radioactive material is present by measuring the amount of activity on the surface of the cloth.

b. If the presence of radioactive material is indicated by a count rate above background, the item shall be treated as contaminated until the results of the disc smear survey are obtained and determination is made concerning the actual 100 cm^2 loose contamination levels. The material shall be controlled in accordance with ARP-014.

5.5.3 Perform a direct scan of 100% of all accessible areas of the item, in accordance with the instrument's operating procedure, and ARP-008.

NOTE: Items presented for release shall be direct scanned in an area of low background. Preferably ≤ 100 CPM. The Health Physics Technician performing the release survey shall determine if the background is acceptable for direct scan of the item.

a. If the scan indicates radioactive material on the surface of the item is less than the limits for release for total activity, proceed to (c).

b. If the scan indicates radioactive material on the surface of the item is greater than regulatory limits for total activity, the item cannot be released.

c. During the direct scan of the accessible surfaces of the item, a static measurement shall be taken:

- If an increase in the audible count rate is detected.
- After each minute of scanning.
- When the Health Physics Technician determines that an indication of fixed activity in an area less than ten square centimeters may be present.

d. During the static measurement, the meter probe shall be held at the proper distance from the surface being surveyed for the proper response period to allow the meter reading to stabilize, in accordance with the instrument's operating procedure.

5.5.4 Perform disc smears which are representative of 100% of the effective surface area.

a. 100% of the effective accessible surface means performing a 100 cm^2 disc smear on all accessible areas of the item suspected of being contaminated.

5.5.5 Count the smears in accordance with reference ARP-008 and/or ARP-002 as appropriate.

a. Record smear data on the Radiation and Contamination Survey Report (ARP 8-2). If a Model-3 or equivalent was used, document the results on a Radiation and Contamination Survey Report (ARP 8-2).

b. If the smear results indicate transferrable activity below the release limits, proceed to Step 5.5.6.

c. If the smear results indicated transferrable activity above the release limits, the item cannot be released.

5.5.6 If the item has internal or inaccessible surfaces, AEI personnel will disassemble the item and repeat Steps 5.5.2 through 5.5.5 or have the item evaluated for release by a designated evaluator.

5.5.7 If the item meets the release limits or is evaluated as meeting the unconditional release criteria, complete forms ARP 25-1 and ARP 8-2. Health Physics Supervision must review the release documents and approve the release prior to allowing the item to leave the controlled area.

5.5.8 Items identified as radioactive during the release survey shall be controlled in accordance with ARP-014.

5.6 Action levels

5.6.1 If direct frisk beta-gamma instrument readings exceed 100 cpm above background (with background less than 200 cpm) or 25 cpm alpha, those areas shall be surveyed as follows:

a. Perform a smearable contamination survey using 100 cm^2 of affected areas, and count the smears for beta-gamma and alpha contamination to determine if contamination is "fixed" or "removable".

5.6.2 Any vehicle with removable contamination exceeding the site limits listed below shall be brought to the attention of the Project Manager and handled appropriately.

5.6.3 Any vehicle with removable contamination exceeding the DOT limits listed below shall be brought to the attention of the RSO for release or acceptance approval.

a. 2,200 dpm/100 cm^2 beta-gamma.

b. 220 dpm/100 cm^2 alpha.

5.6.4 Dose rate surveys which exceed 0.2 mR/hr shall be brought to the attention of the RSO for release or acceptance approval.

5.7 The results of the survey shall be documented on Radiation and Contamination forms (ARP 8-1 and ARP 8-2).

6.0 Attachments

ARP Form 25-1 Unconditional Release of Equipment or Items Report

Aguirre Engineers, Inc.

Unconditional Release of Equipment and Items Log

Project Name: _____ **Project #:** _____

Item or Equipment Released	Comments	Survey #	Date

Page ___ of ___

AGUIRRE ENGINEERS, INC.

High Hazard Services * Remediation * Environmental * Training

Volume 2

Radioactive Material License Application

Submitted to

The United States Nuclear Regulatory Commission

February 5, 1998

A/3

LIST OF PROCEDURES

ARP-001 Operation of Contamination Survey Meters
ARP-002 Alpha-Beta Sample Counting Instrumentation
ARP-003 Operation of Micro-R Meter Survey Meters
ARP-004 Operation of Ionization Chambers
ARP-005 Direct Reading Dosimeters (DRD)
ARP-006 Radiation Work Permits
ARP-007 Air Sampling and Sample Analysis
ARP-008 Radiation and Contamination Surveys
ARP-009 Routine Radiological Surveys
ARP-010 ALARA - As Low As Reasonably Achievable
ARP-011 Containment Devices
ARP-012 Portable HEPA Systems and Vacuum Cleaners
ARP-013 Step-Off Pads
ARP-014 Radiologically Restricted Areas
ARP-015 Personal Protective Equipment (PPE)
ARP-016 Radioactive Materials Brokering
ARP-017 Empty Transport Vehicle Radiological Surveys
ARP-018 Classifying Radioactive Waste
ARP-019 Radioactive Material Tracking
ARP-020 Use and Control of Radioactive Check Sources
ARP-021 Solidification of Radioactive Liquids/Sludges
ARP-022 Packaging Radioactive Material
ARP-023 Opening Radioactive Material Containers
ARP-024 Decontamination of Equipment and Tools
ARP-025 Unconditional Release of Materials from Radiological Controls
ARP-026 Soil and Sediment Sampling
ARP-027 Water Sampling
ARP-028 Material Sampling
ARP-029 Sample Chain of Custody
ARP-030 Document Control
ARP-031 Project Control
ARP-032 Respiratory Protection
ARP-033 Bioassay
ARP-034 Dosimetry
ARP-035 Emergency Response
ARP-036 Training
ARP-037 Radiological Compliance Audits
ARP-038 Procurement, Receipt, and Opening of Radioactive Material
ARP-039 Radiological Conditions Awareness Report
ARP-040 Leak Tests for Non-Exempt Sources of Radioactive Material

Attachment 2

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Soil and Sediment Sampling

ARP-026

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 026
Soil and Sediment Sampling

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
2	0	2/3/98						
3	0	2/3/98						

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ARP-026
Soil and Sediment Sampling

1.0 Purpose and Scope

1.1 The purpose of this procedure is to provide guidelines for collecting surface soil samples.

1.2 The scope of this procedure is limited to collecting samples of surface soil on AEI field projects. This procedure is applicable to all soil samples taken by AEI to fulfill a requirement for sampling. It is not intended for informal sampling, however, the techniques used should be followed even in the case of information only samples.

2.0 General

2.1 Quality Control

2.1.1 Instruments used for measurements required by this procedure shall be checked with standards and verified to have current calibration.

2.1.2 Surveillance of this procedure (in use) shall be performed at least annually to verify that operations are within the guidelines of this procedure. Any time this procedure is in effect, the project manager should ensure by personal observation that samples are collected and controlled appropriately.

3.0 References, Records and Equipment

3.1 References

SHSP	Site Health and Safety Plan
SDWP	Site Detailed Work Plan
NUREG/CR-5849	*Manual for Conducting Radiological Surveys in Support of License Termination*
NUREG/CR-5512	*Residual Radioactive Contamination From Decommissioning*
ARP - 029	Sample Chain of Custody
ARP - 027	Water Sampling
ARP - 028	Material Sampling

3.2 Records

ARP Form 26-1	Sample Status Log

3.3 Equipment and Supplies

- Digging implement: garden trowel, shovel, spoons, post-hole digger, etc.
- Special sampling apparatus (cup cutter, shelby tube, etc.) as required.
- Plastic bags, approximately 10 cm diameter x 30 cm long.
- Cardboard "ice cream" containers (1 quart size) or geology sample bags.
- Twist-ties.
- Masking or duct tape.
- Record forms.
- Labels and security seals.

- Indelible pen.
- Equipment cleaning supplies, as appropriate.

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned the tasks of control and tracking of samples taken for characterization data collection, are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training personnel working with radioactive material. The RSO ensures Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure or provide coverage to those workers who will collect the samples.

4.3 Project Manager - The Project Manager is responsible for ensuring the conditions of this procedure are complied with during all project operations. He/she shall ensure by personal observation that samples are collected appropriately and chain of custody is controlled as described in this procedure.

4.4 Health Physics Technicians - Health Physics Technicians are responsible for the control of radioactive material, coverage of radiation workers, and ensurance that personnel under their cognizance observe proper precautions.

4.5 Sample Collectors - are responsible to follow the instructions of the project manager and Health Physics technicians to ensure compliance with this procedure.

5.0 Procedure

Because standard surface soil contamination criteria for radionuclides are applicable to the average concentration in the upper 15 cm of soil, the usual sampling protocol described here is based on obtaining a sample of this upper 15 cm. Special situations, such as evaluating trends or airborne deposition, determining near surface contamination profiles, and measuring non-radiological contaminants, necessitate special sampling procedures. These special situations are evaluated and incorporated into site specific survey plans as the need arises.

Direct surface radiation measurements are to be performed at each location before initiating sampling. This may identify the presence of gross contamination, which msy require that samples and equipment be treated as radioactive and handled in accordance with appropriate procedures.

5.1 Loosen the soil at the selected sampling location to a depth of approximately 15 cm, using a trowel or other digging implement.

5.2 Remove large rocks, vegetation, and foreign objects (these items may also be collected as separate samples, if directed.)

5.3 Place approximately 2 kg of this soil into a plastic bag-lined cardboard container or geology sample bag.

5.4 Seal the bag using a twist-tie, cap, and tape the cap in place (or tie the sample bag strings). Tape plastic bags over the seal.

5.5 Label and secure the sample container.

NOTE: A box shall be lined with plastic and approved absorbent material prior to placing samples inside the box if the samples are to be shipped for analysis. A load rating stamped on the bottom of the box shall be noted. This rating shall not be exceeded to prevent degradation of the box during shipping.

5.6 The container should be placed in a cardboard box (also properly labeled) for storage or shipping.

> **CAUTION:** Samples must be contained within an outer protective cover (such as a second bag) to prevent (minimize) cross contamination of samples from one site to another.

5.7 Document all samples obtained on ARP Form 26-1, Sample Status Log and in the sample log book if applicable.

5.8 Sample Chain of Custody records shall be documented in accordance ARP 029.

> **CAUTION:** DO NOT proceed to the next sample site or leave the area with any equipment until you have completed Steps 5.9 AND 5.10.

5.9 Clean sampling tools before proceeding to the next sampling location.

5.10 Survey sampling equipment to ensure no removable contamination exists which could result in cross contamination of samples.

6.0 Attachments

ARP Form 26-1 Sample Status Log

Aguirre Engineers, Inc.

Sample Status Log

Project/Location: _____

Sample ID #	Sampling Location	Date and Time Sample Was Obtained	Requested Analysis	Technician Initials	Sample Status

Page ___ of ___

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Water Sampling

ARP-027

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 027
Water Sampling

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
2	0	2/3/98						
3	0	2/3/98						
4	0	2/3/98						

This table provides the most recent changes to pages in this document. A '0' means the original page is valid, a date in the revision level box indicates the date of the most recent change to the page indicated.

ARP-027
Water Sampling

1.0 Purpose and Scope

1.2 The purpose of this procedure is to provide guidelines for collecting water samples.

1.2 The scope of this procedure is limited to collecting samples of water on AEI field projects. This procedure is applicable to all water samples taken by AEI to fulfill a requirement for sampling. It is not intended for informal sampling, however, the techniques used should be followed even in the case of "information only" samples.

2.0 General

2.1 Quality Control

2.1.1 Instruments used for measurements required by this procedure shall be checked with standards and verified to have current calibration.

2.1.2 Surveillance of this procedure (in use) shall be performed at least annually to verify that operations are within the guidelines of this procedure. Any time this procedure is in effect, the project manager should ensure by personal observation that samples are collected and controlled appropriately.

3.0 References, Records and Equipment

3.1 References

SHSP	Site Health and Safety Plan
SDWP	Site Detailed Work Plan
NUREG/CR-5849	*Manual for Conducting Radiological Surveys in Support of License Termination*
NUREG/CR-5512	*Residual Radioactive Contamination From Decommissioning*
ARP - 029	Sample Chain of Custody
ARP - 026	Soil and Sediment Sampling
ARP - 028	Material Sampling

3.2 Records

The following records will be generated and retained in the permanent project file as a result of using this procedure.

ARP Form 26-1	Sample Status Log

3.3 Equipment and Supplies

- Bailing implement: cup, can. pail, etc.
- Borehole Bailer.
- Submersible pump, vacuum, or peristaltic pump with power source.
- Plastic sampling container.
- Funnel.

- Large Erlenmeyer Flask with two-hole stopper.
- Tygon tubing.
- Labels and security seals.
- Indelible pen.
- Record forms.

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned the tasks of sampling and control and tracking of samples taken for characterization data collection, are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training of personnel working with radioactive material. The RSO ensures Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure or provide coverage to those workers who will collect the samples.

4.3 Project Manager - The Project Manager is responsible for ensuring the conditions of this procedure are complied with during all project operations. He/she shall ensure by personal observation that samples are collected appropriately and chain of custody is controlled as described in this procedure.

4.4 Health Physics Technicians - Health Physics Technicians are responsible for the control of radioactive material, coverage of radiation workers, and insurance that personnel under their cognizance observe proper precautions.

4.5 Sample Collectors - are responsible to follow the instructions of the project manager and Health Physics technicians to ensure compliance with this procedure.

5.0 Procedure

5.1 Surface Sample

5.1.1 Scoop water with a clean dipper carefully from the selected location, being careful to avoid collection of bottom sediment or vegetation. Remember, this is a *water* sample!

5.1.2 Using a clean funnel, transfer the water into a container.

5.1.3 Collect a required volume of water for the analysis.

5.1.4 Cap the container tightly to prevent sample contamination and potential loss of sample material.

5.1.5 Label and secure the sample.

NOTE: Line the shipping box with plastic and approved absorbent material prior to placing samples inside the box if the samples are to be shipped for analysis. The project manager shall approve packaging material and method.

NOTE: A load rating is stamped on the bottom of the shipping box. Do not exceed this rating when shipping materials in this box to prevent degradation of the box during shipping.

5.1.6 The container should be placed in a cardboard box (also properly labeled) for storage or shipping.

> **CAUTION:** Samples must be contained within an outer protective cover to prevent cross contamination of samples..

5.1.7 Document Samples on ARP Form 26-1, Sample Collection Log.

5.1.8 Sample Chain of Custody records shall be documented.

5.1.9 Transfer the sample to the laboratory for analysis.

> **CAUTION:** DO NOT proceed to the next sample site or leave the area with any equipment until you have completed Steps 5.1.10 AND 5.1.11.

5.1.10 Clean all sampling tools before proceeding to the next sample location.

5.1.11 Survey sampling equipment to ensure no removable contamination exists which could result in cross contamination of samples.

5.2 Subsurface (well or borehole) Sample (Option 1)

5.2.1 Lower the bailer apparatus into the borehole or other below surface source of water.

5.2.2 Allow water to flow into the bailer (use care to avoid buildup of sediments on the bailer diaphragm, which could prevent the diaphragm from sealing).

5.2.3 Retrieve the bailer and empty contents through a funnel into a plastic sampling container.

5.2.3 Repeat procedure until a total volume of water has been collected.

5.2.4 Continue with steps 5.1.4 thru 5.1.11.

5.3 Subsurface Sample (Option 2)

5.3.1 Lower the pump (if submersible) until the inlet end of the tubing contacts the water surface.

5.3.2 Start pump and collect water in large flask.

5.3.3 Empty flask into a plastic sampling container as necessary.

5.3.4 Repeat procedure until a total volume of water has been collected.

5.3.5 Continue with steps 5.1.4 thru 5.1.11.

6.0 Attachments

None

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Material Sampling

ARP-028

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 028
Material Sampling

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
2	0	2/3/98						
3	0	2/3/98						
4	0	2/3/98						

This table provides the most recent changes to pages in this document. A '0' means the original page is valid, a date in the revision level box indicates the date of the most recent change to the page indicated.

ARP-028
Material Sampling

1.0 Purpose and Scope

1.1 The purpose of this procedure is to provide guidelines for collecting samples of material for analysis.

1.2 The scope of this procedure is limited to collecting samples of materials on AEI field projects. This procedure is applicable to all material samples taken by AEI to fulfill a requirement for sampling. It is not intended for soil or water sampling or for informal sampling, however, the techniques used should be followed even in the case of "information only" samples.

2.0 General

2.1 Quality Control

Instruments used for measurements required by this procedure shall be checked with standards and verified to have current calibration.

Surveillance shall be performed at least annually to verify that operations are within the guidelines of this procedure. Any time this procedure is in effect, the project manager should ensure by personal observation that samples are collected and controlled appropriately.

3.0 References, Records and Equipment

3.1 References

SHSP	Site Health and Safety Plan
SDWP	Site Detailed Work Plan
NUREG/CR-5849	*Manual for Conducting Radiological Surveys in Support of License Termination*
NUREG/CR-5512	*Residual Radioactive Contamination From Decommissioning*
ARP - 002	Alpha/Beta Sample Counting Instrumentation
ARP - 029	Sample Chain of Custody
ARP - 026	Soil and Sediment Sampling
ARP - 027	Water Sampling

3.2 Records

The following records will be generated and retained in the permanent project file as a result of using this procedure;

ARP Form 26-1, Sample Status Log

3.3 Equipment and Supplies

Equipment is chosen based on the type of material to be sampled. The following list represents some possibilities.

- Paint sampling: heat gun, paint stripper solution, hammer and chisel.
- Drains or pipes: plumber's snake, swabs.
- Residues: towels, scoops.
- Concrete or asphalt: core bores, hammer and chisel.
- Metals: Emery cloth or scraping tool.
- Dusts: Scraping tool and plastic bags.
- Record forms, Sample Chain of Custody forms, and sample log (Form 26-1)..

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned the tasks of sampling and control and tracking of samples taken for characterization data collection, are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training of personnel working with radioactive material. The RSO ensures Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure or provide coverage to those workers who will collect the samples.

4.3 Project Manager - The Project Manager is responsible for ensuring the conditions of this procedure are complied with during all project operations. He/she shall ensure by personal observation that samples are collected appropriately and chain of custody is controlled as described in this procedure.

4.4 Health Physics Technicians - Health Physics Technicians are responsible for the control of radioactive material, coverage of radiation workers, and ensurance that personnel under their cognizance observe proper precautions.

4.5 Sample Collectors - are responsible to follow the instructions of the project manager and Health Physics technicians to ensure compliance with this procedure.

5.0 Procedure

5.1 Methods for collecting miscellaneous samples should be determined based on the characteristics of the sample media. Care should be taken to limit the potential for spreading contamination during sample collection.

Sample quantities should be determined based on the following:

- Type of analyses required
- Number of analyses requested
- Detection sensitivity required of analytical result
- Estimated activity level of material

5.2 Remove material to be sampled by using the tools required and contamination control techniques to prevent loss of material from the area sampled. Label and secure all samples. Record pertinent information on Form ARP 26-1 and in the sample log book if used.

CAUTION: DO NOT proceed to the next sample site or leave the area with any equipment until you have completed Steps 5.2.1 AND 5.2.2.

5.2.1 Clean all sampling tools before proceeding to the next sampling location.

5.2.2 Survey sampling equipment to ensure no removable contamination exists which could result in cross contamination of samples.

5.3 Samples that require gamma, beta, or alpha spectroscopy or isotopic discrimination of any type shall be sent to an approved laboratory for analysis.

5.4 Samples that can fit into a 1/8" x 2" planchette that require gross alpha and/or beta/gamma results may be counted in a Ludlum 2929 or equivalent.

5.4.1 Ensure that minimum counting system sensitivity requirements are met by calculating MDA values for alpha and beta, as applicable. Increase sample count time and background count time, or use shielding to lower background count rate as necessary to reduce MDA. If minimum MDA requirements cannot be met by these methods, forward sample to off-site laboratory for analysis.

5.4.2 Place the sample into a planchette with the surface of measurement up.

5.4.3 Count sample for an appropriate length of time..

5.4.4 Record count and counting time data on Form ARP 2-4 and calculate activity estimates.

5.4.5 If the sample will be shipped to a laboratory for analysis, then complete steps 5.4.6 through 5.4.9. Chain of Custody records shall be documented, if applicable.

NOTE: Line the shipping box with plastic and approved absorbent material prior to placing samples inside the box if the samples are to be shipped for analysis. The project manager shall approve packaging material and method.

NOTE: A load rating is stamped on the bottom of the shipping box. Do not exceed this rating when shipping materials in this box to prevent degradation of the box during shipping.

5.4.6 The container should be placed in a cardboard box (also properly labeled) for storage or shipping.

CAUTION: Samples must be contained within an outer protective cover to prevent cross contamination of samples.

5.4.7 Document all samples taken on the ARP Form 26-1, Sample Status Log.

5.4.8 Sample Chain of Custody records shall be documented.

5.4.9 Transfer the sample(s) to the laboratory for analysis.

6.0 Attachments

None

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Sample Chain of Custody

ARP-029

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 029
Sample Chain of Custody

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
2	0	2/3/98						
3	0	2/3/98						
4	0	2/3/98						

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ARP-029
Sample Chain of Custody

1.0 Purpose and Scope

1.1 The purpose of this procedure is to establish administrative controls for transfer of samples collected for characterization to a subcontractor laboratory for analysis. Adherence to this procedure will provide reasonable assurance that there will not be a disassociation between the sample taken and the documented analysis of that sample.

1.2 This procedure will be used at all AEI work sites which require sample analysis to facilitate collection of data to be used in the official evaluation of the radionuclide or hazardous materials content of the sample.

2.0 General

2.1 Quality Control

2.1.1 Instruments used for measurements required by this procedure shall be checked with standards and verified to have current calibration.

2.1.2 Surveillance shall be performed at least annually to verify that operations are within the guidelines of this procedure. Any time this procedure is in effect, the project manager should ensure by personal observation that samples are collected and controlled appropriately.

3.0 References, Records and Equipment

3.1 References

RSM Radiation Safety Program Manual

3.2 Records

Records of the following shall be maintained for each sample collected:

ARP Form 29-1 Chain of Custody/Analysis Record
ARP Form 29-2 Chain of Custody and Sample Tracking Log

3.3 Equipment

As required for samples to be taken and analyzed.

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned the tasks of control and tracking of samples taken for characterization data collection, are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training of personnel working with radioactive material. The RSO ensures Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure or provide coverage to those workers who will collect the samples.

4.3 Project Manager - The Project Manager is responsible for ensuring the conditions of this procedure are complied with during all project operations. He/she shall ensure by personal observation that samples are collected appropriately and chain of custody is controlled as described in this procedure.

4.4 Health Physics Technicians - Health Physics Technicians are responsible for the control of radioactive material, coverage of radiation workers, and to ensure that personnel under their cognizance observe proper precautions.

4.5 Sample Collectors are responsible to follow the instructions of the project manager and Health Physics technicians and to ensure compliance with this procedure.

5.0 Procedure

5.1 The sample collector must initiate a chain of custody form by filling in the requested information. Identifying data for the sample must also be entered into the sample log in accordance with the sampling/work plan for the job.

5.1.1 The Chain of Custody/Analysis Record must be completed in its entirety as follows:

Project Number - A unique number which associates the project to specific records of analysis. This is as assigned by the Program Manager.

Project Name - Name of the facility and the type of project. For example: "LANL - Computer Program Development".

Required Report Date - The date which you expect to get sample results by. Be realistic, ASAP is not appropriate here.

Lab Contact and Lab Phone - The number you called and the person at the laboratory you spoke with.

Sample ID # - The unique number recorded on the status log (Form ARP 29-2), on the sample and on the chain of custody for a sample.

Sample Type - Air, Water, Soil, Oil, etc. as appropriate. Basically this answers the question, what is it a sample of?

Container - Describe the sample container such as; glass jar, Marinelli Beaker, Petri Dish, plastic bag, etc.

Volume - Record the volume and units of the volume such as; 1000 ml, 2.0 L, 5^{E6} cc, 1 gal., etc.

Preservative - Indicate the chemical name or brand name of preservative used in the sample.

Analysis Req'd - Indicate the desired type of analysis for the laboratory to conduct.

Date - The date the sample was taken.

Notes - Any other information for the laboratory. If there is need for a verbose note, place a circled number in this box and attach an addendum with the note written in detail prefaced with the circled number.

Lab ID# - A number assigned by the laboratory.

Sample TAT Req'd - The needed turnaround time for sample analysis. Be realistic, ASAP is not appropriate and short times may lead to increased (unnecessary) costs. Check with the Project Manager.

Check **all** sample characteristics that apply to this sample. For example; a sample may be Flammable, Hazardous, Liquid, and Radioactive.

5.1.2 Custody of samples must be maintained at all times to ensure appropriate assignment of the result to a sample. In custody tracking, the 1) Relinquished by is the person who took the sample or someone who was there when it was taken. The date and time and the person who took custody is recorded by signature along with the date and time received. These dates and times must match.

5.2 Proper chain of custody is maintained when the sample is controlled under the direct surveillance of an individual; in a controlled access facility, or the sample is in a tamper-proof container.

5.3 If the sample is to be transported by any means other than hand delivery by the custodial individual, security seals must be used. Log the seal number in the sample log and include a copy of the chain of custody form with the sample container.

5.4 Upon transfer of the samples to another individual, that individual shall sign as recipient. A copy of the chain of custody form will be maintained for record keeping purposes while the original will remain with the sample.

5.5 Upon arrival of the sample at the laboratory, the laboratory recipient shall inspect the sample for signs of tampering. If indication of tampering is noted, the laboratory shall notify site personnel who will collect another sample.

5.6 Once the sample is in the custody of the laboratory, it shall be maintained in accordance with the laboratory's chain of custody and quality assurance procedures.

5.7 Samples sent to an off site laboratory for analysis shall be returned to the site after processing for disposal if this is the condition of the laboratory contract. There may be occasions where the laboratory will hold and/or dispose of the samples.

6.0 *Attachments*

ARP Form 29-1 Chain of Custody/Analysis Record
ARP Form 29-2 Chain of Custody and Sample Tracking Log

AEI

Aguirre Engineers, Inc,

Chain of Custody / Analysis Record

Document No _____ .

Page ___ of ___

Project Number _____

Project Name _____

Project Manager _____

Project Phone _____

Project Fax _____

Req'd Report Date _____

Lab Contact _____

Lab Phone _____

SEND REPORT TO:

#	Sample ID #	TYPE .	CONTAINER	VOLUME	PRESERVATIVE	ANALYSIS REQ'D	COLLECTION DATE	NOTES	LAB ID#
1									
2									
3									
4									
5									
6									
7									
8									

Sample TAT Req'd: _____

Notes/Comments: _____

SAMPLE CHARACTERISTICS

Flammable ☐ Hazardous ☐ Gas ☐ Liquid ☐ BiPhase ☐ Sp. Grav _____ Color _____

Corrosive ☐ Radioactive ☐ Solid ☐ Sludge ☐ TriPhase ☐ Flash Pt. _____ Odor _____

CUSTODY TRACKING

1) Relinquished By:_____ Date: _____ Time: _____ Received By: _____ Date: _____ Time: _____

2) Relinquished By:_____ Date: _____ Time: _____ Received By: _____ Date: _____ Time: _____

3) Relinquished By:_____ Date: _____ Time: _____ Received By: _____ Date: _____ Time: _____

AEI

Aguirre Engineers, Inc,

Chain of Custody & Sample Tracking Log

Form ARP 29-2

Page ____ of ____

Sample ID #	Type	Project / Number	Project Manager	Sampler	Laboratory / Contact	Analysis Req'd	Collection Date	Send Date	Req'd Report Date	Report Received

Notes/Comment

Discuss proprietary issue pages 1+4

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Document Control

ARP-030

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 030
Document Control

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
2	0	2/3/98						
3	0	2/3/98						
4	0	2/3/98						
5	0	2/3/98						

This table provides the most recent changes to pages in this document. A '0' means the original page is valid, a date in the revision level box indicates the date of the most recent change to the page indicated.

1.0 Purpose and Scope

1.1 This procedure provides the methods AEI utilizes in control of documents associated with license requirements, projects, personnel, and equipment.

1.2 Adherence to this procedure will provide reasonable assurance that information will be retrievable.

1.3 AEI Procedures and official documentation are proprietary. This procedure is intended to ensure that only those persons authorized by a AEI manager to receive these documents will receive them. The AEI manager is responsible to use good judgement to ensure document recipients will respect the proprietary nature of these documents.

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1.4 This procedure will be used by AEI personnel to ensure proper control of information such as procedures, reports, dose records, medical records, training records, and any records which may be required to demonstrate compliance with NRC license conditions.

2.0 General

2.1 Types of Records which must be controlled

1. Instrument Calibration Records
2. Instrument Source Check Records
3. Radiation Survey Forms
4. Contamination Survey Forms
5. Medical Records)
6. Training Records
7. Dosimetry Records
8. Decontamination Documents
9. Project Logs
10. Project Reports (ARP-33)
11. Radioactive Material Transportation Records
12. Radioactive Material Disposal Records
13. Radioactive Source Transfer Receipts
14. Data Collection Forms (Work Procedures)

15. Sample Collection Forms

16. Sample Chain of Custody Records

17. Emergency Response Documentation

18. All other forms required by AEI procedures.

19. Document Distribution and Transmittal Forms

20. Respirator Issue Logs and History Records

21. Bioassay Records

22. Personnel Contamination Reports

23. Condition Adverse to Quality Reports

2.2 Definitions

1. Forms - Prepared documentation provided to ensure compliance with requirements. Forms have predefined fields for recording data.

2. Logs - Logs provide day to day documentation in a chronological fashion to identify what occurred during the execution of a project.

3. Reports - Reports provide a compilation of project data, the analysis of that data and the conclusions derived from the data analysis.

4. Quality Records - Quality Records (Records) shall be recognized as any compilation of forms, logs, or reports which pertain to a project or to regulatory compliance.

5. Receipts - Documentation of transfer of records from one individual or organization to another.

2.3 Quality Control

2.3.1 The project manager shall ensure by continuous supervision and surveillance that quality records are properly prepared, are accurate, neatly prepared, properly maintained during preparation, and are periodically reviewed during all project activities.

2.3.2 The project manager shall ensure that all records are present at the end of a project and that records are safely maintained during transfer or shipment to the location where they will be archived.

2.3.3 Records maintained at the project site, shall be reviewed periodically during a project by the project manager to ensure compliance with this procedure.

2.3.4 The Document Control Coordinator shall report the status of all controlled documents at least quarterly to the program manager.

3.0 Records, References and Equipment

3.1 Records

ARP Form 30-1 Document Distribution Log (DDL)
ARP Form 30-2 Document Distribution Record (DDR)
ARP Form 30-3 Document Transmittal Record (DTR)

3.2 References

All AEI Procedures
Code of Federal Regulations
License Conditions

3.3 Equipment

None required

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for providing equipment to enable compliance with this procedure and for ensuring that all personnel assigned the tasks of producing, validating, transferring, or controlling information subject to this procedure is familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Project Manager - The Project Manager (PM) shall ensure through continuous evaluation that all project documentation is collected and recorded in accordance with Procedures, Work Plans, Health and Safety Plans, and Quality Assurance Plans. The PM is responsible for document control of all project related quality information during a project and upon completion of the project.

4.3 Radiation Safety Officer - The RSO shall ensure all radiation safety information is recorded and evaluated to ensure adequate records exist to defend the Radiation Safety Program.

4.4 Document Control Coordinator - The Document Control Coordinator (DCC) shall ensure that documents are issued, maintained, stored, and transferred in accordance with this procedure. Any deviation from compliance will be reported immediately to the program manager.

4.5 Technicians - Technicians shall ensure documentation is recorded neatly and in accordance with procedures.

5.0 Procedure

5.1 Records Control

Each controlled document shall be stamped on the front page with the controlled document number as issued in the controlled document log.

5.2 Records Preparations

Records shall be prepared in dark ink and shall be neat and easily readable. Pre-prepared forms shall be used when available to collect information such as survey data or instrument analysis results. When a procedure has not defined a form for a specific purpose, the project manager may authorize creation of the method of documentation.

5.3 Record Transfer

Controlled records shall be transferred using the Document Distribution Log (DDL), the Document Distribution Record (DDR), and the Document Transmittal Record (DTR).

5.3.1 The DDL shall be maintained at the Records Management facility at the AEI Las Vegas office and shall be used to maintain a log of all transfers of Quality Records.

5.3.2 The DDR shall be used to provide documentation of record transmittals.

5.3.3 The DTR shall be used to ensure transfer of records by providing a receipt of record transfer.

- The DTR shall be returned to the Document Control Coordinator upon receipt of the document. If a DDR is not returned to the DCC, the DCC shall contact the issuee and request a letter of receipt stating that status.
- All controlled documents issued by AEI are the sole proprietary property of AEI and shall be returned to AEI upon request from issuees.

} revised

5.4 Record Review

All Controlled records shall be reviewed by Direct Supervisors of the record creator. This review shall be indicated by full signature on the record.

5.5 Record Correction

Incorrect information in records shall be corrected by the document creator if possible. In cases where the creator is not available, corrections may be made by the direct supervisor or the project manager.

5.5.1 Corrections are made by drawing a single line through the error and making the correction adjacent to the error. The line out shall be initialed and dated by the corrector.

5.4 Record Retention

Records shall be retained for the duration of the project at the project site by the project manager.

5.4.1 Upon return to the location of record management, the records shall be maintained i fashion such that they are protected from loss or damage. Record storage shall be ir accordance with federal regulations or NRC license conditions. This may be dual storage, one copy at both AEI facilities, or storage in a certified fireproof container.

5.4.2 Records shall be retained for a minimum of 10 years from the date of creation, for tl duration specified in the contract which caused creation of the project, or in accordance with Federal or State regulations where applicable.

6.0 Attachments

ARP Form 34-1 Document Distribution Log (DDL)
ARP Form 34-2 Document Distribution Record (DDR)
ARP Form 34-3 Document Transmittal Record (DTR)

Aguirre Engineers Inc

Document Distribution Log

Document	Version	Location	Sent to	Date Sent	Sent by	Received by	Date Received

Page _____ of _____

ARP Form 30-1 - Document Distribution Log (DDL) - 1/98

Aguirre Engineers Inc.

Document Distribution Record

NAME OF DOCUMENT: _____

DOCUMENT REVISION: _____ DOCUMENT DATE: _____

NAME AND TITLE OF RECIPIENT	DATE SENT

APPROVED BY: _____ / _____ / _____

Name Title Date

The approver signing this form has verified by personal observation that the information contained in the distribution package(s) has been properly labeled, and is controlled in accordance with procedure ARP-030.

Aguirre Engineers Inc.

Document Transmittal Record

NAME AND TITLE OF RECIPIENT:

QTY..	DOCUMENT TITLE	DOCUMENT NUMBER	REV NO.	DESCRIPTION	CONTROL NUMBER

DOCUMENT(s) SENT BY:

DOCUMENT(s) SENT TO:

NAME:

ADDRESS:

CITY/STATE/ZIP:

TELEPHONE:

PLEASE CHECK ONE OF THE FOLLOWING, SIGN AND RETURN TO SENDER:

- ☐ I ACKNOWLEDGE THAT I RECEIVED THE DOCUMENT(s) OR DOCUMENT(s) REVISION(s) AND THAT I HAVE UPDATED MY RECORDS.
- ☐ I AM RETURNING THE DOCUMENT(s) WITH THIS TRANSMITTAL RECORD
- ☐ I HAVE DESTROYED THE OLD DOCUMENT AND I AM RETURNING ONLY THE TRANSMITTAL RECORD.

SIGNATURE: DATE:

DOCUMENT TRANSMITTAL RECORD COMPLETE AND APPROVED

SIGNATURE:_____ DATE:_____

MANAGER

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Project Control

ARP-031

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 031
Project Control

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
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7	0	2/3/98						

This table provides the most recent changes to pages in this document. A '0' means the original page is valid, a date in the revision level box indicates the date of the most recent change to the page indicated.

1.0 Purpose and Scope

1.1 This procedure establishes the methods for the control and coordination of projects performed by and under the direct control of AEI personnel.

1.2 This document is designed to ensure compliance with the Occupational Safety and Health Administration (OSHA), Nuclear Regulatory Commission (NRC), Environmental Protection Agency (EPA), and AEI requirements associated with field projects.

1.3 This procedure applies to all Aguirre Engineers Inc. field remediation project job sites, and AEI waste management personnel.

2.0 General

2.1 Definitions

2.1.1 Organization - The organization for each project will be specified in the project plans.

2.1.2 Project - A job remote from AEI facilities at which AEI conducts work under NRC license, permit, or business license.

2.1.3 NRC License - Representations of AEI for performance of work involving radioactive materials to the Nuclear Regulatory Commission. AEI holds NRC Materials License Number

2.1.4 Work Plan - A planning tool for explanation of the techniques to be used to accomplish a project.

2.1.5 Health and Safety Plan - A description of the hazards expected to be present at a work site based on the Statement of Work, and the personnel and environmental protection methods to be used during the work.

2.1.6 Quality Assurance Plan - A description of the application of Quality Assurance methods which will be applied during execution of the project to ensure that the work is completed efficiently and completely.

2.1.7 ALARA (As Low As Reasonably Achievable) - The concept of ensuring that personnel exposure to radiation and other hazards such as exposure to chemicals is maintained well below limits and threshold limit values as is possible with the resources available.

2.2 Quality Control

2.2.1 Each project shall have a site specific quality assurance plan. The basic elements of the QA plan will typically be the same from site to site, however, each site may have a specific QA concern which will be addressed in the plan for the project.

2.2.2 Each day during operations at the site, the Health and Safety officer or a designee provided by the Project Manager shall review safety at the site using the Daily QC checklist, ARP 31-7.

3.0 References, Records and Equipment

3.1 References

RSM	Radiation Safety Manual
10 CFR	Code of Federal Regulations, Title 10, "Energy"
29 CFR	Code of Federal Regulations, Title 29, "Labor"
40 CFR	Code of Federal Regulations, Title 40, "Protection of Environment"

3.2 Records

ARP Form 31-1	Project Organization Form
ARP Form 31-2	Project Preparation and Completion Checklist
ARP Form 31-3	Regulatory Requirements Data Form for Field Projects
ARP Form 31-4	Work Plan Change Request
ARP Form 31-5	Project Personnel Information
ARP Form 31-6	Report of Injury
ARP Form 31-7	Daily QC Checklist

3.2.1 All of the necessary records, documents, procedures, etc., applicable to the project shall be available at the project site for use/reference and regulator review.

3.2.2 Completed forms ARP 31-1 through ARP 31-7 shall be stored in a project file and maintained by the Project Manager.

3.2.3 The Project Manager and Supervisor are responsible for maintaining Daily Operational Logs. All operational log books shall be bound and maintained as a master project log book. These logs shall be filed in the Project File at the completion of the project. Logs shall be retained indefinitely.

3.2.4 The RPS is responsible for maintaining the daily Radiological Controls Log, and Health & Safety Log, including associated Survey and Instrument Records. These documents shall be filed in the Project file at the completion of the project.

3.2.5 Upon completion of the project, the original copies of the project file shall be transmitted to AEI Denver Office for archiving.

3.2.6 The project manager shall verify completion of all project records by completion of ARP 31-2, the Project Preparation and Completion Checklist prior to it's filing with other project records.

3.3 Equipment

None required

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that this procedure is complied with for project control and coordination. The program manager is responsible for personnel assignment, and preparation of the management plan for the project.

4.2 Project Manager - The Project Manager is responsible for ensuring compliance with this procedure during all project activities. The project manager shall be responsible for preparing the Site Specific Health & Safety, Work, and Quality Assurance plans for the project.

4.3 Radiation Safety Officer (RSO) - The RSO shall be responsible for ensuring that activities are planned and executed in accordance with Federal, State and Local Regulations and NRC or State Radioactive Materials License(s).

4.4 Health and Safety Officer - The Project Health and Safety Officer is responsible for ensuring that on-site operations are conducted in accordance with the project Health and Safety Plan and Federal, State, and Local regulations regarding industrial safety.

4.5 Radiation Protection Supervisor (RPS) - The RPS shall be the RSO representative on-site and shall report to the RSO for issues regarding licensing or regulatory compliance on-site. The RSO will ensure that on-site operations are conducted in accordance with the project Health and Safety Plan, the NRC license, and Federal, State, and Local regulations regarding radiation safety.

4.6 Project Coordinator - The project coordinator is responsible for tracking expenses, assisting personnel in the preparation of forms for employment and separation, track project progress, and other administrative functions. This job function will only be used as needed.

5.0 Procedure

5.1 Project Organization and Administration

5.1.1 The Program Manager will assign an individual to be the Project Manager for each Field Project.

5.1.2 Together, the Program Manager and the assigned Project Manager will designate a Project Supervisor who will supervise work-related staff and activities. Also, the Project Manager, together with the Radiation Safety Officer (RSO) will assign a qualified individual to be the Radiation Protection Supervisor (RPS) for the Project should this be required.

5.1.3 The Project Manager is responsible for completing ARP Form 31-1, "Project Scope and Organization Outline Form".

5.1.4 The following topics should be discussed and approved by the project management personnel:

- Scope of Work for the Project,
- Operational techniques to be employed,
- Project schedule(s),
- Project manning requirements and organization,
- Operational equipment and supply needs,
- Availability and sources for required equipment/supplies, and
- Handling/packaging/shipping of Radioactive Materials, shipping broker requirements.

ARP Form 31-2, The Project Preparation and Completion Checklist shall be completed by the Project Manager to enable identification of procurement needs and ease preparation of the project plans. The checklist (in progress) should be passed to personnel who will work on these plans as needed.

5.1.5 The Project Manager is responsible for the development of the necessary operational procedures for the project and obtaining appropriate approvals from the AEI Program Manager and the Radiation Safety Committee for such procedures. The Project Supervisor is responsible for the implementation of all AEI Policies & Procedures and/or other instructions applicable to the project with the exception of those responsibilities assigned to the Radiation Protection Supervisor.

5.1.6 The Program Manager, together with the Comptroller, must initiate a Project Number authorizing the project manager to proceed with work.

5.1.7 The Project Manager shall ensure that all appropriate Notices to Employees (such as NRC Form 3, EPA and Department of Labor Postings) are posted as required by law and shall ensure that all employees are alerted to any hazards which may be present at the work site.

5.2 ALARA Requirements

5.2.1 "ALARA Requirements" are those requirements necessary to minimize personnel exposure to radiation and/or radioactive materials. These include the technical information, training, supporting equipment, and personnel needed to achieve this goal.

5.2.2 Field project operations and all Work Instructions, Temporary Procedures, and/or Procedures written for such operations, shall be in accordance with the applicable requirements set forth by law, Corporate policy and/or contract. Adherence to these controls will aid in limiting exposure(s) to a level that is "As Low As Reasonably Achievable" (ALARA).

5.2.3 The RPS and the Project Manager/Supervisor shall review and decide upon the necessary measures to satisfy the ALARA requirements for the project in concurrence with the RSO. Together with the RSO, the RPS and the Project Manager/Supervisor will prepare the radiation work permits (RWPs) for the job. The RWPs will be prepared in accordance with AEI procedures.

5.2.4 The proposed Radiological Controls Program for the Project shall be coordinated with the customer in order to include site-specific requirements necessary for approval.

5.2.5 The Project Manager/Supervisor and RSO/RPS shall decide upon and select the necessary Radiological staff to accommodate the proposed Radiological Controls Program.

5.2.6 The RPS and Project Manager/Supervisor shall determine training requirements for Project personnel (General Employee Training, Radiation Worker Training, OSHA, etc.) with the approval of the RSO.

5.2.7 The RPS will be responsible for selecting and acquiring the appropriate Radiological Controls equipment with concurrence of the RSO.

5.2.8 The RPS and Project Supervisor shall hold an ALARA briefing with the project crew upon project mobilization. The Project Supervisor shall document this briefing and the original briefing document shall be maintained on-site by the RPS.

5.2.9 The RPS is responsible for developing and obtaining, the necessary AEI procedures, to implement the Radiological Controls Program for the Project, and obtain appropriate approval for such procedures. The Project Manager and the Radiation Safety Officer will assist in these functions as needed.

5.3 Regulatory Requirements

5.3.1 The designated Project Manager/Supervisor is responsible for ensuring that the conditions specified in the governing Regulations and License(s) are followed throughout the Project.

5.3.2 The Project Manager and Supervisor shall together review the Regulatory requirements for the Project, conduct a Regulatory briefing with the project crew and complete Form ARP 31-3, "Regulatory Requirements Data Form."

5.4 Industrial Safety

5.4.1 The Project Supervisor and RPS shall conduct an Industrial Safety Briefing with the project crew and document this briefing. The RPS is responsible for the Health and Safety aspects of the project. The completed briefing document will be forwarded to the RSO or other designated manager for review.

5.4.2 Reportable injuries shall be identified to the project supervisor and project manager as soon as reasonable following the event. The legal (OSHA) log of these injuries shall be maintained by the AEI Health and Safety Officer.

5.5 Project Finances

5.5.1 The AEI finance department maintains the overall responsibility for accounting practices within the Company; however, it is field activities which expend resources in executing the contract. Therefore, it is the prime responsibility of the Project Manager, within the guidelines established by the Program Manager, to properly account for the project expenditures and activities under his or her control. This includes:

a. Make timely project financial reports to the finance department or management as directed.

b. Adhere to the AEI administration Policy and Procedure in the generation, control, distribution and maintenance of documentation for all field activities within his or her jurisdiction.

c. In the absence of a Project Coordinator assigned to the project, maintain a cost tracking system suitable to meet the needs of AEI and the customer for reporting all project costs to-date.

5.6 Work Plan Changes

5.6.1 Should a change to the work scope become necessary, ARP Form 31-4 shall be prepared and signed by the requestor. Justification for the change shall be provided on this form. The Project Manager or Health and Safety Officer shall review and approve or deny the change, and sign the request form.

5.6.2 The Program Manager will review the request and can approve or deny the change request. Prior to acceptance of the request, the program manager shall ensure that the addition to the work plan is within guidelines of the Scope of Work as prepared by the customer and that sufficient funding exists for the change to be completed under the contract.

5.7 Personnel

5.7.1 The training of personnel is covered in procedure ARP-036.

5.7.2 Project personnel shall complete ARP Form 31-5 prior to assignment.

5.8 Health and Safety

5.8.1 Each AEI project shall have a site specific Health and Safety plan which recognizes and provides all reasonable protection methods to ensure the safety and health of AEI workers, our clients, and members of the general public. In the case of injury, report the occurrence on ARP Form 33-6 and be sure of proper OSHA reporting of the injury.

5.8.2 Each project shall have one individual assigned the duties of the Health and Safety Officer who will ensure the implementation of the H&S plan.

5.8.3 At least one person at the work site will be trained in Cardiopulmonary Resuscitation (CPR).

6.0 Attachments

Form ARP 31-1 Project Organization
Form ARP 31-2 Project Preparation and Completion Checklist
Form ARP 31-3 Regulatory Requirements Data Form for Field Projects
Form ARP 31-4 Work Plan Change Request
Form ARP 31-5 Project Personnel Information
Form ARP 31-6 Report of Injury
Form ARP 31-7 Daily QC Checklist

Aguirre Engineers, Inc.

PROJECT ORGANIZATION FORM

This form provides the expected organization to accomplish the work on this project. If there are any changes to this form during a project, indicate that this has happened in the notes section and issue a new form with the revised organization. If personnel are assigned to functions other than those listed, then write in the title, selected individual, and date assigned.

Title	Selected Individual/Phone	Date Assigned/Replaced
Customer Technical Contact		
Program Manager		
Project Manager		
Project Coordinator		
Project Labor Supervisor		
Project RP Supervisor		
Project Health & Safety Officer		
Radiation Safety Officer		
Customer		
Customer Radiation Safety Officer		
Customer Health & Safety Officer		

NOTES

Aguirre Engineers, Inc.

AEI Project Preparation and Completion Checklist

Customer:_____ Contact:_____

Project Number:_____ Phone:_____

Initial Contact Date:_____ Fax:_____

Information needed

	Need	Complete
1. Hazard evaluation or site hazard evaluation upon arrival	☐	☐
2. Site address for deliveries	☐	☐

Address:_____

_____

Phone number:_____ Fax number:_____

3. Hospital name and address	☐	☐

Distance from job site: _____ miles.

Map of route to hospital attached	☐	☐

Address:_____

_____

_____

Phone number:_____ Fax number:_____

4. Emergency phone numbers	☐	☐

Contracting officer_____

5. Emergency contacts for site	☐	☐

Site contact_____

6. Availability of emergency equipment	Need	Complete
Fire extinguisher	[ ]	☐
Fire hoses	[ ]	☐
Fire pull boxes	[ ]	☐
Back boards	[ ]	☐
First aid kit	[ ]	☐
Bandages	[ ]	☐
Epicac	[ ]	☐
Antibiotic	[ ]	☐
Analgesic tablets	[ ]	☐
Bandaids	[ ]	☐
Burn kit	[ ]	☐
Emergency lights	[ ]	☐
Oxygen	[ ]	☐
Bull Horn	[ ]	☐
Emergency Training/CPR Training	[ ]	☐

Aguirre Engineers, Inc.

AEI Project Preparation and Completion Checklist

7. Laboratory address for bioassay analysis ..... ☐ . ☐

Address:_____

_____

_____

Phone number:_____ Fax number:_____

Equipment needed

1. Instrumentation appropriate for the job.....enter the number of items required in the...[ ]

Note: provide appropriate lead time when ordering to ensure arrival at site prior to start of job.

	Need	Complete
Ludlum model 3 with alpha and/or beta probes	[ ]	☐
Ludlum model 2929 counting system	[ ]	☐
Ludlum model 19 gamma detector	[ ]	☐
Ludlum model 9 ionization chamber	[ ]	☐
Calibration data forms for all instruments	☐ .	☐
Dosimeters (TLD)	[ ]	☐
Personal Ion Chambers (gamma)(neutron)	[ ]	☐
Air samplers (Grab)(Hi-Vol)	[ ]	☐
Air sampler heads	[ ]	☐
Air sample paper (particulate)(charcoal)(47 mm)	[ ]	☐
3"x3" Scintillation detector	[ ]	☐
2"x2" Scintillation detector	[ ]	☐
MCA/PHA	[ ]	☐
Other probe (type_____)	[ ]	☐
Neutron Instrument (REM Ball)	[ ]	☐

2. Gridding equipment

	Need	Complete
100' Tape measure	[ ]	☐
50' Tape measure	[ ]	☐
Markers	[ ]	☐
Chalk line	[ ]	☐
Ladders	[ ]	☐
Spray paint	[ ]	☐
Twine	[ ]	☐
Stakes	[ ]	☐
GPS system	[ ]	☐

3. Survey documentation equipment

Clip boards	[ ]	☐
Survey forms	[ ]	☐
Photo equipment	[ ]	☐
Pens, pencils, rulers, calculator	[ ]	☐

Specific photograph sites:

_____

_____

_____

Aguirre Engineers, Inc.

AEI Project Preparation and Completion Checklist

4. Miscellaneous
   - Bioassay sample bottles ..... [ ] ... ☐
   - Masslin cloths ..... [ ] ... ☐
   - Masslin mops ..... [ ] ... ☐
   - Cloth smears ..... [ ] ... ☐
   - Paper smears ..... [ ] ... ☐
   - Sample bottles ..... [ ] ... ☐
   - Sample bags, boxes ..... [ ] ... ☐
   - Sample auger (CA Hollow point)(Clamshell)(Other_____) ..... [ ] ... ☐
   - Tritium smears ..... [ ] ... ☐
   - Scintillation cocktail ..... [ ] ... ☐
   - Scintillation bottles ..... [ ] ... ☐
   - Insect repellent ..... [ ] ... ☐
   - Waste bags (RAD, HAZ, ASBESTOS, BIOHAZARD) ..... [ ] ... ☐

5. Ventilation
   - HEPA filters ..... [ ] ... ☐
   - HEPA blowers ..... [ ] ... ☐
   - Intake filters ..... [ ] ... ☐
   - Vent hose (trunk lines) ..... [ ] ... ☐
   - Length of vent hose_____ feet.

6. Personal Protective Equipment ..... Number Complete
   - Tyveks ..... [ ] ..... ☐
   - Booties ..... [ ] ..... ☐
   - Gloves (Nitrile) (Chemical resistant) (Latex) (Leather) (Cotton work) ..... [ ] ..... ☐
   - Cotton gloves ..... [ ] ..... ☐
   - Respirators (FF)(Small ____)(Medium ____)(Large ____) ..... [ ] ..... ☐
   - Respirator cartridges ..... [ ] ..... ☐
   - Type of cartridges [ ] ..... [ ] ..... ☐
   - SCBA ..... [ ] ..... ☐
   - extra air tanks ..... [ ] ..... ☐
   - Supplied air mask ..... [ ] ..... ☐
   - Supplied air lines and regulators ..... [ ] ..... ☐
   - Air Supply System ..... [ ] ..... ☐
   - Air Supply Cart ..... [ ] ..... ☐
   - Tarps ..... [ ] ..... ☐
   - Rubber shoe covers ..... [ ] ..... ☐
   - Welders helmet ..... [ ] ..... ☐
   - Welders respirators ..... [ ] ..... ☐
   - Hard hats ..... [ ] ..... ☐
   - Safety glasses ..... [ ] ..... ☐
   - Leather gloves ..... [ ] ..... ☐
   - Flashlights ..... [ ] ..... ☐
   - Cloth coveralls ..... [ ] ..... ☐

7. Tools Number Complete
   - Hammers ..... [ ] ..... ☐
   - Saws ..... [ ] ..... ☐
   - Cutters ..... [ ] ..... ☐
   - Screw drivers ..... [ ] ..... ☐
   - Tape measures ..... [ ] ..... ☐
   - Scabbler ..... [ ] ..... ☐
   - Air compressor {Grade (circle) C D } ..... [ ] ..... ☐
   - Extension cords ..... [ ] ..... ☐
   - Saws All ..... [ ] ..... ☐

AEI Project Preparation and Completion Checklist

Socket wrenches	[ ] ☐
Electric drills	[ ] ☐
Impact wrenches	[ ] ☐
Nail gun	[ ] ☐
Staple gun	[ ] ☐
Battery operated drill	[ ] ☐
Cutting torch, Welding torch and supplies	[ ] ☐
Bobcat, Forklift	[ ] ☐
Fire protective cloth	[ ] ☐
Shovel, (Pointed)(Snow)	[ ] ☐
Front loader	[ ] ☐
Compass	[ ] ☐
Transit	[ ] ☐
Masslin mops	[ ] ☐
Crescent wrenches	[ ] ☐
Plastic sleeve for equipment/tools/instruments	[ ] ☐
HEPA Vacuum cleaner	[ ] ☐
Vacuum Filter and Accessories	[ ] ☐

8. Required Documentation	Need	Complete
Forms	☐	☐
Procedures	☐	☐
Manuals	☐	☐
Specifications	☐	☐
Calculations	☐	☐
Shipping manifests	[ ]	☐
Shipping labels	[ ]	☐
Lock wires (security seals)	[ ]	☐
Lock wire pliers	[ ]	☐

Pre-Job Preparation

30 days prior to start: prepare Site Specific:

	Need	Complete
Work plan	☐	☐
Health and Safety plan	☐	☐
QA plan	☐	☐

15 days prior to project start: provide documents for review:

EPA	☐	☐
NRC	☐	☐
State EPA	☐	☐
State Radiological Protection	☐	☐
DOE	☐	☐
State Hazardous Materials Board	☐	☐
DOT	☐	☐

5 days prior to start.

Order instruments for delivery to site	☐	☐
Order dosimetry for delivery to site	☐	☐
Deliver any other equipment to site	☐	☐

Aguirre Engineers, Inc.

AEI Project Preparation and Completion Checklist

At the site.

- Conduct site specific training ☐
- Prepare work area ☐
  - Establish base office ☐
  - Establish communications ☐
  - Ensure toilet facilities ☐
  - Ensure proper lighting ☐
  - Prepare procedures ☐

Site Requirements

- Electric Power [ ] ☐
- Water ☐ ☐
- Telephone ☐ ☐
- Fax ☐ ☐
- Copy machine ☐ ☐
- Heavy Equipment ☐ ☐
- Laboratory Equipment ☐ ☐

Job Tasks

Preparations to accomplish work.

	Need	Complete
Safety walk down evaluation of the site	☐	☐
Collect pre-job bioassay samples from all workers	☐	☐
Conduct site specific training of all workers	☐	☐
Unpack instruments	☐	☐
Setup counting systems	☐	☐
Check all instruments for calibration and operability	☐	☐
Tour the facility (evaluate safety plans)	☐	☐
Write an RWP for the work based on a pre-job survey	☐	☐
Verify training of individual	☐	☐
Define work areas and establish methods to accomplish all work	☐	☐
Prepare for transportation of materials	☐	☐
Prepare for transportation of waste	☐	☐
Transportation company [ ]		☐

If gridding is required, begin gridding of facility rooms as directed by PM.

	Need	Complete
Grid the first four rooms in order to allow the gridding team a head start	☐	☐
After four rooms are gridded, begin survey of the gridded rooms	☐	☐
Continue to grid and survey until all rooms are complete.	☐	☐
Outline all job problems in project log	☐	☐
Job complete as outlined in the work plan	☐	☐

Project end Initials

Customer contact_____ ____

Verify all non-AEI project equipment is returned to it's owners ☐ ____

Equipment Vendors:_____

_____

Verify completion of all documentation ☐ ____

Pre-job and characterization survey forms ☐ ____

Aguirre Engineers, Inc.

AEI Project Preparation and Completion Checklist

Dosimetry forms	☐	____
Urinalysis information	☐	____
Pre-job training information	☐	____
Personnel contamination evaluations	☐	____
Counter calibration evaluations	☐	____
Personnel survey logs	☐	____
RWP acknowledgment log	☐	____
Prepare and ship all instruments to vendor	☐	____
Collect final bioassay samples from all workers	☐	____
Package and ship bioassay samples to lab	☐	____
Terminate RWP - collect all RWP information	☐	____
Collect dosimetry and send to Las Vegas office	☐	____
Conduct exit meeting with all personnel, compile lessons learned list	☐	____
Close out project log, including lessons learned	☐	____
Prepare Draft Final Report	☐	____
Review of Draft Final Report	☐	____

Review conducted by:_____

Prepare Final Report ..... ☐

Final Report review conducted by:_____

Project Closeout Review (files established and complete) ..... ☐

Filing completed by:_____

File number:_____

File copies distributed to:_____

Project Complete Closeout by:_____
Aguirre Engineers, Inc. Program Manager

Project Verified Closed by:_____

Aguirre Engineers, Inc.

REGULATORY REQUIREMENTS DATA FORM FOR FIELD PROJECTS

Regulation	Health and Safety Plan	Quality Assurance Plan	Work Plan
10 CFR Part 19			
10 CFR Part 20			
10 CFR Part 21			
10 CFR Part 30			
10 CFR Part 50			
10 CFR Part 71			
29 CFR Part 1910.120			
29 CFR Part 1910.1200			
40 CFR Part 260-270			

Aguirre Engineers, Inc.

WORK PLAN CHANGE REQUEST

CHANGE REQUESTED BY:_____ DATE:_____

REASON FOR CHANGE:_____

Change Requested:

REQUESTOR:_____ DATE:_____

WORK CHANGE REQUEST REVIEWED BY:_____
PROJECT MANAGER OR HEALTH AND SAFETY OFFICER

REMARKS:_____

_____

DISPOSITION OF WORK PLAN CHANGE REQUEST:_____

FINAL WORK CHANGE REQUEST: APPROVED ☐ DENIED ☐

_____
PROGRAM MANAGER

REMARKS:_____

_____

Aguirre Engineers, Inc.

PROJECT PERSONNEL INFORMATION

PROJECT NAME:
PROJECT LOCATION:
START DATE: ___ /___ /19___
PROJECT DESCRIPTION:
COMMITTED PERSONNEL NAME:
PHONE NUMBER:
OSHA 40 HOUR TRAINING? Yes [ ] No [ ] Last Refresher Date: ___ /___ /19___
ADDRESS: CITY: STATE: ZIPCODE:
POSITION:
WAGES:
NEAREST AIRPORT:
DATE OF BIRTH:
PLACE OF BIRTH:
SOCIAL SECURITY NUMBER:
TRAVEL REQUEST FORM COMPLETED: ☐
TRAVEL ARRANGEMENTS MADE: ☐
NRC FORM 4: ☐
EXPOSURE HISTORY: ☐
OSHA CERTIFICATION DATE: ___ /___ /19___
MEDICAL CERTIFICATION DATE: ___ /___ /19___
RESPIRATOR QUALIFICATION DATE: ___ /___ /19___
FORM I-9, FORM W-4, JOB ASSIGNMENT AGREEMENT: ☐
SITE INFORMATION SENT TO PROJECT CONTACT: ☐
NOTES:
Completed by:_____ Date:___ /___ /19___

Aguirre Engineers, Inc.

REPORT OF INJURY

EMPLOYER'S NAME: _____

EMPLOYEE'S PHONE: _____

EMPLOYEE'S Social Security Number: _____

EMPLOYER'S ADDRESS: _____

WORK LOCATION: _____

WORK LOCATION ADDRESS: _____

EMPLOYEE'S NAME: _____

EMPLOYEE'S ADDRESS: _____

DATE OF BIRTH: _____

MARITAL STATUS: _____

SINGLE ☐ MARRIED ☐ WIDOWED ☐ DIVORCED ☐

	Yes	No
IS THIS A WORK RELATED INJURY OR ILLNESS?	☐	☐

DATE AND TIME OF OCCURRENCE: _____

ACCIDENT OR ILLNESS DESCRIPTION: _____

_____

_____

_____

	Yes	No
IS THIS A LOST TIME ACCIDENT OR ILLNESS?	☐	☐
IS THIS AN OSHA RECORDABLE ACCIDENT OR ILLNESS?	☐	☐
WAS MEDICAL TREATMENT NECESSARY?	☐	☐

SUPERVISOR'S SIGNATURE: _____ DATE: _____

REVIEWED BY: _____ DATE: _____

Aguirre Engineers, Inc. Senior Management

Aguirre Engineers, Inc.

DAILY QUALITY CONTROL CHECKLIST

DATE:_____

		Satisfactory	Deficiency
1.	PERSONNEL MONITORING		
	DOSIMETRY	☐	☐
	RWP REQUIREMENTS MET	☐	☐
	RWP ACCESS LOG COMPLETE	☐	☐
2.	INDUSTRIAL SAFETY		
	HARD HATS AND SAFETY GLASSES WORN	☐	☐
	OTHER SAFETY EQUIPMENT USED	☐	☐
	WORK AREAS SECURED	☐	☐
	SAFETY RULE VIOLATIONS INVESTIGATED	☐	☐
3.	WORK PLAN REQUIREMENTS		
	WORK PLAN PROCEDURES FOLLOWED	☐	☐
	SCHEDULE COMMITMENTS MET	☐	☐
	WORK AREAS CLEANED AND SET UP FOR NEXT DAY	☐	☐
4.	RADIATION SURVEYS		
	ROUTINE SURVEYS COMPLETE	☐	☐
	AREA POSTINGS UPDATED	☐	☐
	BARRELS, CONTAINERS, BOXES ETC. LABELED	☐	☐
	SURVEY RESULTS ACCEPTABLE	☐	☐
5.	STOP WORK CONDITIONS		
	STOP WORK ORDERS INVESTIGATED	☐	☐
	CORRECTIVE ACTION IMPLEMENTED	☐	☐

SIGNATURE:_____ DATE:_____

HEALTH AND SAFETY OFFICER

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Respiratory Protection

ARP-032

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 032
Respiratory Protection

LIST OF EFFECTIVE PAGES
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This table provides the most recent changes to pages in this document. A '0' means the original page is valid, a date in the revision level box indicates the date of the most recent change to the page indicated.

1.0 Purpose and Scope

1.1 This procedure describes the requirements and AEI policies associated with respiratory protection at AEI job sites and during any work at customer facilities. Adherence to this procedure will provide reasonable assurance that personnel exposures to airborne radioactive material will be below specified limits, personnel will remain free of contamination and contamination will not be spread beyond the designated contaminated area.

1.2 This procedure will be used to ensure protection of personnel from internal exposure to radioactive materials.

2.0 General

2.1 AEI Respiratory Protection Policy

2.1.1 Engineering and process controls shall be used to the extent practicable to limit the concentrations of airborne radioactive materials to levels less than 10% of Derived Air Concentration (DAC) values listed in 10 CFR 20, Appendix B, Table 1, Column 1.

2.1.2 When it is impractical to use engineering and process controls, or while they are being implemented, other precautionary procedures such as limiting stay times, increased surveillance and/or the use of respiratory protective equipment will be used to limit the intake of airborne radioactive materials as far below 40 DAC hours, in seven (7) consecutive days, as possible, The 40 DAC-hour control measure of 10 CFR 20.1203 will be the internal exposure limit.

2.1.3 Respirators should not normally be used for routine repetitive tasks but may be used for non-routine tasks. No emergency situations involving potential respiratory hazards are expected under use of this program. Periods of respirator use and overall duration of use should be kept to a minimum. Respirator users shall be allowed adequate relief from use (breaks) at reasonable intervals. The variations in job assignments and in the physical and psychological capacities and attitudes of the user shall be considered. The user may leave the area at anytime for relief from respirator use in the event of equipment malfunction, physical or psychological distress, or any other condition which requires relief.

2.1.4 The attached procedures of the Respiratory Protection Program shall be followed as applicable for any work involving actual or potential exposure to airborne hazardous materials.

2.2 AEI Air Sampling Program

The air sampling program is established to provide adequate identification of all respiratory hazards present including radiological, oxygen deficient and toxic materials.

2.2.1 Air sample data will be used to select the proper respirator and provide estimates of worker exposure.

2.2.2 Air samples will be representative of the air being breathed by the worker(s).

2.3 AEI Bioassay Program

Measurements of radioactive materials in the body and/or excreted from the body will be performed as necessary for timely detection and assessment of individual intakes of radioactive materials. The techniques used, (e.g. whole body counts, urine samples, etc.) will be appropriate with respect to the material exposed.

2.3.1 Baseline bioassay data shall be obtained.

2.3.2 Periodic bioassay samples will be taken to determine the adequacy of the respiratory protection program and will be used to determine actual exposures, if any.

CAUTION: No personnel shall be allowed to wear a respirator without written permission from a medical doctor. This is required in order to protect workers from the physical harm which may be caused to a respiratory system which cannot handle the strain of breathing through a respirator.

2.4 Qualification of Workers

Personnel will complete baseline bioassay, physical examination, and fit test prior to initial use of respirators and at least every twelve (12) months thereafter (except fit test). Requalification/testing must occur within the twelve (12) month period.

2.4.1 Physical Examinations

Personnel will be certified by a licensed physician that the individual is physically able to use respiratory protection equipment. For radioactive materials and hazardous materials (except asbestos), this qualification is annual. For asbestos, this qualification is every six months, in accordance with 29 CFR 1910.

2.4.2 Training

Personnel shall be trained in respiratory protection. Training will be given to personnel who will wear respirators and to those personnel who will direct the work. The training will be based on the hazards to be encountered and the types of respirators to be worn. The training will include the following:

a. Discussion of the airborne contaminants against which the wearer is to be protected, including their physical properties, DAC's, physiological actions, toxicity and means of detection;

b. Discussion of the construction, operating principles, and the limitations of the respirator and the reasons the respirator is the proper type for the particular purpose;

c. Discussion of the reasons for using the respirator and an explanation of why engineering or process controls are not feasible;

d. Instruction on the proper use of the device, including performance of a pre-use inspection and negative pressure test;

e. Instruction in how to perform a qualitative fit test;

f. Instruction in the proper maintenance of the respirator;

g. Discussion of the application of available cartridges and canisters;

h. Instruction in emergency actions to be taken in the event of malfunction of the respirator;

i. Review of radiation and contamination hazards, including the use of other protective equipment that may be used with the respirator; and

j. Any other special training as needed.

k. The trainee will be required to properly perform a pre-use inspection, don, wear and remove the respirator. He/she will be given ample time to wear the device in an uncontaminated atmosphere so as to become familiar with its operation.

l. The training shall be given by personnel who have practical experience in the selection, use and maintenance of respiratory protection equipment.

2.4.3 Fit Test

A qualitative or quantitative respirator fitting test will be performed to determine the ability of each individual wearer to obtain a satisfactory fit with a negative pressure respirator. The results of the fit test will be used to select types, models and sizes of respirators for each individual user.

a. A quantitative fit test is preferred and, if performed, an overall fit factor of at least 100 shall be obtained with a full face negative pressure respirator.

b A qualitative fit test with a challenge atmosphere is acceptable and should be performed according to Attachment-A "Qualitative Fit Testing". If the wearer is unable to detect penetration of the challenge agent, the fit test is satisfactory.

2.5 Respirator Selection

Only respiratory protection equipment approved by NIOSH/MSHA shall be used. The respiratory protection equipment shall be selected for use based on the airborne hazard identified and DAC-hr limitations.

2.6 Respirator Maintenance

Respirators shall be maintained to retain their original shape, effectiveness and be in the same configuration as required by its' NIOSH/MSHA approval.

2.6.1 Respirators shall be cleaned, sanitized, and surveyed to ensure each worker is provided a clean respirator at all times.

2.6.2 Respirators shall be inspected immediately prior to each use, after cleaning, and at least monthly when available for use.

2.6.3 Replacement of parts or repairs shall be performed only by persons trained/experienced in proper respirator assembly. Replacement parts will be those designed for the particular respirator and designated by the manufacturer.

2.6.4 Respirators shall be stored to protect them against dust, sunlight, heat, extreme cold, damaging chemicals or excessive moisture. Respirators shall be stored to prevent distortion of rubber or elastomer parts.

2.6.5 All new respirators shall be cleaned, sanitized, inspected and tagged with an identification number prior to use.

2.7 Effectiveness of the Respiratory Protection Program

Workers shall be periodically observed working in respirators to ensure proper equipment functioning and to monitor worker stress while working.

3.0 References, Records and Equipment

3.1 References

RSM	Radiation Safety Manual
ARP-007	Air Sampling and Sample Analysis

3.2 Records

Records of the following shall be maintained for each individual who wears respiratory protection devices (other than dust masks) at any AEI work site:

3.2.1 Physical Qualifications

3.2.2 Fit Testing

3.2.3 Respirator Issue

3.2.4 Respirator Maintenance

3.2.5 Bioassay Data - Before and after exposure

3.2.6 Air Sample Results

3.3 Equipment

See individual appendices.

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel using respirators, are familiar with this procedure, adequately trained in the use of respirators, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training of personnel using respirators. The RSO ensures workers are qualified by training and experience to perform the requirements of this procedure.

4.3 Project Manager - The Project Manager is responsible for ensuring the conditions of this procedure are complied with during all project operations. He/she shall ensure by personal observation that respiratory protection operations are conducted as described in this procedure.

4.4 Health Physics Technicians - Health Physics Technicians are responsible for the control of radioactive material, coverage of radiation workers, and ensurance that personnel under their cognizance observe proper respiratory protection precautions.

4.5 All Personnel - Are responsible to ensure all respiratory protection equipment under their control is checked in accordance with the provisions of this procedure, are responsible to ensure they are currently qualified by medical examination and training before putting on a respirator, and shall ensure that all provisions of this procedure are complied with at all times.

5.0 Procedure

AEI personnel shall conduct all operations associated with respiratory protection in accordance with the following appendices to this procedure:

6.0 Appendices

A. QUALITATIVE FIT TEST
B. USE OF THE MSA ULTRA-VUE RESPIRATOR
C. RESPIRATOR ISSUE & DAC-HOUR TRACKING
D. RESPIRATOR MAINTENANCE
E. RESPIRATORY PROTECTION ISSUE/USE LOG
F. RESPIRATORY PROTECTION EQUIPMENT HISTORY RECORD

Appendix A

QUALITATIVE FIT TESTING

1.0 PURPOSE

This procedure provides instructions for performing qualitative fit testing of respirators.

2.0 EQUIPMENT

2.1 Qualitative Fit Test Materials

2.1.1 Irritant Smoke Test

a. Ventilation smoke tubes, stannic chloride (MSA Part# 5645 or equivalent)
b. Aspirator bulb
c. Tubing

2.1.2 Isoamyl Acetate Test

a. Isoamyl acetate
b. Tissue, cloth, swab, or brush

2.2 Respirator, full face piece, cartridge type, negative pressure, air purifying.

3.0 PRECAUTIONS AND LIMITATIONS

3.1. Verify that the individual has met the physical and training requirements and that the individual has no facial hair that may interfere with the proper operation of the respirator.

3.3 The individual administering the test should avoid breathing the test agent.

3.3 Exercise caution when handling irritant smoke tubes. Observe the precautions listed on the box and do not allow the crystals inside the tube to contact skin.

3.4 Verify that the respirator used for the fit test is in good working condition.

3.5 Disinfect each fit test respirator by wiping with a disinfectant cloth between each fit test.

3.6 Isoamyl acetate shall not be used when only HEPA cartridges are worn.

3.7 DO NOT direct the test material directly at filters or combination cartridges.

4.0 PROCEDURE

4.1 Test Method (perform one of the tests below)

4.1.1 Irritant smoke may be used when either HEPA or combination vapor and HEPA cartridges are worn.

4.1.2 Isoamyl acetate shall not be used when HEPA only cartridges are worn.

4.2 Irritant Smoke Test

4.2.1 The test subject will perform a pre-use inspection, don the respirator and perform a negative pressure test.

4.2.2 If NOT already done, break off the ends of the smoke tube so that a small hole results on each end.

4.2.3 Attach the smoke tube to the aspirator bulb and a piece of tubing to the end of the smoke tube to be directed at the respirator.

4.2.4 Aspirate a small amount of smoke to check that the assembly works.

4.2.5 Position test subject down wind of the tester.

4.2.6 Instruct the test subject to close their eyes.

4.2.7 Aspirate the smoke around the respirator sealing area slowly.

4.2.8 Instruct the test subject to perform the following exercises (each approximately 30 seconds) while continuing to aspirate smoke around the sealing surfaces:

a. Normal breathing
b. Deep breathing
c. Move head from side to side
d. Move head up and down
e. Talk
f. Frown
g. Normal breathing

4.2.9 If no odor or irritation is detected, the test is satisfactory.

4.2.10 If leakage is detected (odor or irritation), stop the test. The individual may adjust the fit or obtain another device and repeat the test.

4.3 Isoamyl Acetate

4.3.1 Perform step 4.2.1

4.3.2 The test should be conducted in an area with a minimum of air movement.

4.3.3 Saturate a tissue, brush or piece of cloth with isoamyl acetate.

4.3.4 Pass the material around the respirator sealing area slowly.

4.3.5 Have the individual perform the actions of B.8 above while continuing to pass the material around the respirator sealing areas.

4.3.6 If a banana odor is not detected, the test is satisfactorily completed.

4.3.7 If leakage is detected (banana odor) then go to step 4.2.10.

Appendix B

USE OF THE MSA ULTRA-VUE RESPIRATOR

1.0 PURPOSE

This procedure provides guidelines for the proper use of the MSA ULTRA-VUE air purifying respirator (or equivalent).

2.0 EQUIPMENT

2.1 MSA ULTRA-VUE RESPIRATOR (or equivalent)

2.2 Cartridges

2.2.1 Ultra-Vue HEPA filter cartridge (or equivalent) or;

2.2.2 Approved combination cartridge

3.0 PRECAUTIONS AND LIMITATIONS

3.1 When wearing this device, personnel are required, as soon as practical, to leave areas (removing the respirator, if necessary) in case of equipment malfunction, undue physical or psychological stress, procedural or communication failure, significant deterioration of operational conditions, or any other conditions that might require relief. Should such a condition occur, the individual will inform their supervisor.

3.2 Follow good work practices when using this device.

3.3 An individual may re-wear their assigned respirator during a shift provided that the interior of the face piece has no loose surface contamination above clean limits, is less than 0.1 mr/hr, and completes an additional pre-use inspection each time the device is donned.

3.4 DO NOT USE THIS DEVICE IN OXYGEN DEFICIENT OR IMMEDIATELY DANGEROUS TO LIFE OR HEALTH (IDLH) ATMOSPHERES. THIS DEVICE DOES NOT PROVIDE OXYGEN.

3.5 Observe any limitations on the cartridge used.

4.0 PREREQUISITES

4.1 Use of the respirator is required.

4.2 Documentation of issue has been performed.

5.0 PROCEDURE

5.1 Obtain the respirator.

5.2 Ensure the respirator has a current inspection.

5.3 Visually inspect the device.

5.3.1 Check that the filter cartridge is correctly installed.

5.3.2 Check the tightness of connections and the condition of the face piece and head harness. Special attention is to be given to rubber or elastomer parts to ensure that they are pliable and flexible and not deteriorating.

5.4 Don the respirator.

5.4.1 Check that all head band straps are extended.

CAUTION: IF A SURGEONS CAP OR HOOD IS USED, ENSURE IT DOES NOT PROTRUDE INTO ANY FACE PIECE SEALING AREA.

5.4.2 Insert chin into face piece and pull head harness back over the head. This may be accomplished by either pulling the harness over the head while inserting the face or initially placing the straps over the lens, inserting the face, then pulling the harness over the head.

5.5 Adjust the straps as follows:

5.5.1 Pull the two chin straps straight back.

5.5.2 Pull the two temple straps straight back.

5.5.3 Push the head band down on the back of the head, being careful not to place it on the neck.

5.5.4 Re-tighten the chin straps as necessary.

5.5.5 Re-tighten the temple straps as necessary.

5.5.6 Tighten the forehead strap if necessary.

5.6 Conduct a negative pressure test:

5.6.1 Place fingers over the filter inlet ports. If a combination cartridge is used, place palm over the inlet port.

5.6.2 Inhale gently so the mask collapses.

5.6.3 Hold breath for 5-10 seconds.

5.6.4 If any leakage is detected, readjust the head harness and face piece.

5.6.5 Repeat until no leakage is detected.

5.6.7 If a satisfactory seal cannot be obtained, the individual shall not wear the device and will notify their supervisor of the condition.

5.7 Note the time of work area entry and exit.

CAUTION: DO NOT GRASP THE RESPIRATOR BY THE FILTER CARTRIDGE WHEN REMOVING IT.

5.8 Removal

5.8.1 Remove the respirator by bending forward, grasping the snout area, and pulling the face piece out and away from the face.

5.8.2 Place the respirator into an appropriate container (bag).

5.8.3 Return the device to the storage area and complete the Respirator Issue/Use Log (ARP Form 32-1).

Appendix C

RESPIRATOR ISSUE AND DAC-HOUR TRACKING

1.0 PURPOSE

This procedure provides instruction for issuing respirators and tracking Derived Air Concentration-hours (DAC-HRS). DAC-HRS are a measure of exposure to airborne radioactive materials. One DAC-Hour is equal to a TEDE of 2.5 millirem. (stochastic)

1 DAC-hr (non-stochastic) = 25mrem

2.0 EQUIPMENT

MSA Ultra-Vue full face piece air purifying respirators equipped with the proper purifying filter (or equivalent).

3.0 PRECAUTIONS AND LIMITATIONS

3.1 Use of a respirator is required when airborne radioactivity concentrations cannot be maintained at less than 25% of DAC values (Table 1, Column 1, Appendix B, 10 CFR 20).

3.2 Personnel shall not exceed 40 DAC-hrs in any seven consecutive days.

3.3 Calculated DAC-hrs greater than or equal to two (2) in one day or ten (10) in any seven consecutive days shall be recorded. Exposures exceeding these guidelines will be evaluated by bioassay. If the bioassay results indicate;

3.3.1 a higher value, then the higher value shall be recorded.

3.3.2 a lower value, then the lower value MAY be recorded.

3.4 Periodic surveillance of individuals working in respirators will be performed to evaluate actual exposures and monitor workers stress and equipment performance. Any problems shall be reported to the job supervisor.

CAUTION: Contact lenses shall not be worn while wearing a respirator

4.0 PREREQUISITES

4.1 The individual has met the physical, training and fit test wearer requirements.

4.2 The individual has no facial hair which could interfere with the proper operation of the respirator.

5.0 PROCEDURE

5.1 Verify that the individual meets the prerequisites.

5.2 Verify that the respirator is required for the work the individual is to perform.

5.3 Issue the respirator and complete the applicable blocks of the Respirator Issue/Use Log (ARP Form 32-1).

5.4 Remind the individual to perform a pre-use inspection, negative pressure test, and to keep track of the actual time the respirator was worn.

5.5 At the end of each use period, or not later than the end of the shift, complete the remainder of the Respirator Issue/Use Log.

5.6 As soon as air sample data is available, calculate the DAC-hrs of exposure. See 5.3 above.

5.6.1 If the DAC-hrs meet the record requirement, then record the calculated DAC-hrs. If not, then N/A the DAC-hrs block.

5.6.2 $$\text{DAC-hrs} = \frac{\text{time in area (hrs.) X total DAC fraction}}{\text{respirator protection factor}}$$

5.6.3 Respirator protection factor for particulate filters (HEPA or combination). Reference 10 CFR 20, Appendix A for additional information.

5.7 Retain all Respirator Issue/Use Logs.

Appendix D

RESPIRATOR MAINTENANCE

1.0 PURPOSE

This procedure provides instruction for the inspection and maintenance of MSA Ultra-Vue (or equivalent) negative pressure air purifying respirators.

2.0 EQUIPMENT AND SUPPLIES

- disinfecting wipes
- plastic bags
- tape
- rags or sponges
- warm (approximately 120°F) water
- spare parts as required by the manufacturers instructions
- Clorox (or equivalent)
- MSA cleaner/sanitizer (or equivalent)
- soft bristle brush

3.0 PRECAUTIONS AND LIMITATIONS

3.1 Replace any questionable or faulty parts including rubber components that show wear or distortion. Replacement parts shall be those specified by the manufacturer.

3.2 Respirators will be assigned and tagged with a unique identification number. DO NOT tag the device in such a manner as to interfere with the proper operation.

3.3 Records will be maintained of all maintenance activities including cleaning/sanitizing, inspections and parts replacement.

3.4 HEPA cartridges shall not be re-used except as allowed in SOP #2 (by the same individual in the same shift after survey).

3.5 All respirators shall be cleaned and inspected when new, prior to initial issue and monthly at a minimum thereafter.

3.6 Respirator assigned to specific individuals shall be cleaned, surveyed and inspected at least at the end of each shift, prior to re-use, or more often as necessary.

4.0 PREREQUISITES

Personnel performing respirator inspections shall be trained in the use of this procedure. No attempt shall be made to conduct repairs beyond the scope of the manufacturer's instructions.

5.0 PROCEDURE

5.1 Cleaning

> **CAUTION:** Be sure to control wash water. Do not release the water to an uncontrolled drain without demonstrating by sample analysis that it meets release criteria. Do NOT soak or attempt to wash filters.

5.1.1 Remove the HEPA cartridge and properly dispose of as radioactive waste (if required).

5.1.2 Survey the respirator and cartridge to determine extent of contamination. Respirators with < 50,000 DPM/100 cm^2 shall be soaked prior to cleaning. (Do Not soak filters under any circumstances.)

5.1.3 Fill a container with warm water. Add one package of MSA cleaner/sanitizer, or 2 fluid ounces of chlorine bleach per gallon of water used.

5.1.4 Gently scrub the respirator with a soft bristle brush, sponge, or cloth for at least two (2) minutes.

5.1.5 Thoroughly rinse the respirator in warm water and allow it to air dry.

5.1.6 Survey the respirator after it is completely dry for loose and fixed contamination. Respirators which indicate <1000 DPM/100 cm^2 beta-gamma, 100 DPM/100 cm^2 alpha or <0.1 mr/hr fixed beta-gamma shall not be used. Repeat washing as above.

5.1.7 Document the survey results for each respirator.

5.2 After-use or New Inspections

5.2.1 Examine the face piece for dirt, cracks, tears or distortion.

5.2.2 Examine the head harness for breaks, tears, loss of elasticity or excessively worn serrations which might permit slippage. Check that the buckles are operational and free of defects.

5.2.3 Remove the exhalation valve cover and examine the valve for foreign material (dust, hair, dirt). Inspect the valve seat for cracks, tears, or distortion of the valve material. Check that the valve and seat are properly mounted and replace the valve covers.

5.2.4 Inspect the inhalation valve and seat for damage and foreign material. Inspect valve for cracks, tears or distortion. Check that the valve and seat are properly mounted and connection is tight. Check that the filter mounting coupling is not cracked and threads are in good working condition.

5.2.5 Examine clamps and connections and ensure they are tight and secure.

5.2.5 Examine clamps and connections and ensure they are tight and secure.

5.2.6 Check that there is a gasket in the inlet mounting assembly (coupling) and that it is not worn or deteriorated and is properly installed.

5.2.7 Inspect the speaking diaphragm for damage or deterioration.

5.2.8 Check that the lens is not cracked or badly scratched so as to impair visibility. Check that the lens position and frame are securely mounted and in good condition.

5.2.9 Install a NEW HEPA filter cartridge or other cartridge as directed by supervision. Be sure to check for gasket on the cartridge when it is installed (if required).

5.2.10 Check that the face piece is tagged with an identification number.

5.2.11 Lightly disinfect the interior of the face piece with a disinfectant wipe.

5.2.12 Place the respirator in a plastic bag and tape the bag closed.

5.2.13 Record on the bag the data the respirator was cleaned, inspected and surveyed and the signature of the person performing the above.

5.2.14 Record all maintenance, cleaning, inspections and repairs on the Respirator Equipment History Record, (AEI Form 32-2), Attachment B.

5.3 Monthly Inspections

5.3.1 Check that all connections are tight including that the filter cartridge is securely attached and the mounting assembly is secure.

5.3.2 Check that the filter cartridge is in good condition, no cracks and that the label is legible.

5.3.3 Check that the respirator is not hardening and that rubber and elastomer parts are pliable by massaging the respirator.

5.3.4 Check that the bag is securely closed and labeled including dates.

5.3.5 Record the inspection on the respirator bag and on the Respirator Equipment History Record, AEI Form 32-2.

5.4 Storage

5.4.1 Respirators will be stored with the head harness straps fully extended and on the inside of the face piece.

5.4.2 Respirators are to be stored so that they are not damaged by adjacent equipment, heat, cold or chemicals or twisted out of normal configurations.

5.4.3 Devices ready for use will be segregated from those not ready for use and clearly marked as such.

Aguirre Engineers, Inc.

RESPIRATOR ISSUE/USE LOG

NAME	SSN	RESP. TYPE/ID	DATE ISSUED	TIME ISSUED	USED IN: AREA/JOB	DATE RET'D	TIME RET'D	DAC-HRS/ CALCS BY	RECORDS UPDATED Y / N		BY	DATE COMP

Page ___ of ___

Aguirre Engineers, Inc.

RESPIRATOR EQUIPMENT HISTORY RECORD

DATE:_____ RESPIRATOR TYPE: _____ IDENTIFICATION NO. _____

INSPECTION: NEW ☐ INITIAL USE ☐ MONTHLY ☐

MAINTENANCE: (Check all that apply or are performed)

SURVEY	[ ]	RINSE	[ ]
INSPECT RESPIRATOR	[ ]	SANITIZE	[ ]
REMOVE HEPA CARTRIDGE	[ ]	AIR DRY/RESURVEY	[ ]
SCRUB	[ ]	NEW HEPA FILTER	[ ]

INSPECTION: (Check all that apply or are performed)

EXHALATION VALVE	[ ]	INHALATION VALVE	[ ]
CLAMPS/CONNECTIONS	[ ]	GASKET	[ ]
SPEAKING DIAPHRAGM	[ ]	LENS	[ ]
FACE PIECE	[ ]	HD HARNESS/BUCKLE	[ ]
FILTER CARTRIDGE	[ ]	RUBBER/ELASTOMER	[ ]

BAG RESPIRATOR /LABEL [ ]

RECORD MAINTENANCE DATA [ ]

LIST ALL REPLACED RESPIRATOR PARTS: _____

_____

_____

COMMENTS: _____

_____

_____

MAINTENANCE PERFORMED BY: _____ DATE: _____
Operator: Print/Sign

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Bioassay

ARP-033

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 033
Bioassay

LIST OF EFFECTIVE PAGES
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1.0 Purpose and Scope

1.1 To assess inhaled, ingested, or absorbed radioactive materials in order to determine internal dose to workers. To verify that radioactive material controls will maintain internal exposures As Low As Reasonably Achievable, ALARA.

1.2 This procedure will be used to evaluate the need for bioassay, and ensure that evaluation of radioactive materials in the bodies of workers is evaluated prior to and after jobs involving work with radioactive materials when required.

2.0 General

2.1 Definitions

2.1.1 Baseline Bioassay - An initial evaluation of the radioactive material in the body at the start of employment with AEI for personnel who will work with radioactive materials.

2.1.2 Bioassay - Any technique to determine a quantity of radioactive material within the human body or within organs of the body.

2.1.3 Multi-Channel Analyzer (MCA) - A composite of electronic equipment which can detect, identify and quantify gamma ray emitting radioactive material.

2.1.4 Contractor - A company under contract to AEI to conduct analysis of bioassay samples.

2.1.5 NRC - Nuclear Regulatory Commission

2.1.6 NRC Form 4 - The official record of previous exposure history which indicates deep dose, shallow dose, eye dose, the committed dose equivalent (CDE) due to internally deposited radionuclides, and total effective dose equivalent (TEDE).

2.1.7 Derived Air Concentration (DAC) - That concentration of an airborne radionuclide which, if inhaled for 40 hours per week for 50 weeks per year will cause a total effective dose equivalent (TEDE) of 5 rem or a committed dose equivalent (CDE) to an organ of 50 rem.

2.1.8 Gamma Radiation - One of the several kinds of ionizing radiation which is emitted from radioactive material. Gamma radiation is electromagnetic, a single packet of gamma energy is called a photon having no charge or mass. The quantification of gamma emitters in the body can be determined from body counting, urinalysis or fecal samples.

2.1.9 Beta Radiation - One of several kinds of ionizing radiation which is emitted from radioactive material. Beta particles are electrons having a + or - charge with the mass of an electron. The quantification of beta emitters in the body must be determined from urinalysis or fecal samples.

2.1.10 Alpha Radiation - One of several kinds of ionizing radiation which is emitted from radioactive material. Alpha particles are Helium nuclei and have a +2 charge. The quantification of alpha emitters in the body must be determined from urinalysis or fecal samples.

2.2 Bioassay Policy

Bioassay shall be conducted at the following times for workers who will be exposed to loose surface radioactive materials:

2.2.1 Upon Hire or at the start of a project

a. Determine whether the radiation worker has had previous radiation exposure history using the NRC Form 4 or equivalent.

b. If the worker has a previous history of radiation exposure and does not have documentation of internal exposure, obtain a urine analysis and/or whole body count, as necessary, as described in this procedure.

c. No bioassay or body count is necessary for individuals with no previous radiation exposure history.

NOTE: Baseline bioassay analysis documents previous radioactive material intake to establish a point of reference to the start of employment at AEI.

2.2.2 When airborne activity is found during Routine or Non-Routine Air Samples.

a. Air samples are to be taken and analyzed using facility procedures.

b. Air samples which identify activity concentrations above Radiation Survey Procedure, "Action Levels", may have additional analysis performed.

c. Radionuclide determination using historical information, a MCA or absorption methods and a Radiological Health Handbook, or other documentation of radionuclide emissions is needed to evaluate the intake.

d. Radionuclide quantification using a MCA or other quantification methods..

e. If air sample quantity is less than 0.10 times the DAC value listed in 10 CFR 20, no action is necessary.

f. If an air sample is taken before personnel entry and data is equal to or greater than 0.5 of the DAC value listed in 10 CFR 20, engineering controls or as a last resort, respiratory protection equipment as specified in the Radiation Work Permit (RWP) may be warranted.

g. If an air sample is taken during or after personnel entry into a radioactive airborne contamination area and the air sample data is equal to or greater than 0.5 of the DAC value listed in 10 CFR 20, and no respiratory protection equipment was used, a bioassay sample should be taken if it is likely that 4 DAC hours of exposure occurred. Four DAC hours will lead to a TEDE of (4 DAC-hours * 2.5 mrem/DAC-hour)= 10 mrem.

2.3 Quality Control

2.3.1 Instrumentation used in surveys required by this procedure will be checked with standards daily and verified to have current valid calibration.

2.3.2 This program shall be reviewed annually to verify compliance with license conditions.

2.3.3 Annually, 10% of AEI personnel available who wore respiratory protection shall be body counted to verify the adequacy of respiratory protection equipment and the respiratory protection program.

2.3.4 Annually, 10% of AEI personnel that may have been exposed to loose surface contamination shall be evaluated to verify the adequacy of AEI contamination control techniques. These should not be personnel who wore respiratory protection, if possible.

3.0 References, Records and Equipment

3.1 References

RSM	Radiation Safety Manual
ARP-002	Alpha-Beta Sample Counting Instrumentation
ARP-008	Radiation and Contamination Surveys

3.2 Records

3.2.1 Documentation initiated using this procedure will be maintained and controlled in accordance with the project work plan and AEI Document Control procedures.

3.2.2 All records of exposure, internal and external are legal and personal and must be controlled as such.

3.2.3 This procedure may cause the generation of reports which should be copied for each of the involved personnel. The reports should be maintained as a part of radiation exposure records for each individual.

3.2.4 All records generated by this procedure may be required to demonstrate compliance with state and federal requirements (10 CFR) and shall be maintained in accordance with these requirements.

3.3 Equipment

As required by testing

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned the task of working with radioactive materials are familiar with this procedure and have access to a copy of this procedure. The director shall ensure that personnel responsible for bioassay actions (scheduling, recording, etc.) are familiar with the requirements of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for quality audits of bioassay records, training of radiation workers, and technical assistants who have actions associated with bioassay. The RSO is responsible to notify personnel of the need for bioassay and the mechanism to get it done.

4.3 Project Manager - The project manager is responsible to ensure all personnel requiring bioassay sampling get their pre-job samples completed before allowing them to work at the site. In addition, the PM is responsible to ensure that personnel leave a bioassay sample upon exit from the site.

5.0 Procedure

5.1 Routine Bioassay Program

5.1.1 Routine whole body counts or urine analysis are conducted on personnel who will work with radioactive materials in order to verify that radiation protection program controls protect individuals working with radioactive materials from inhalation of airborne radioactive material and ingestion or absorption of radioactive materials on surfaces.

5.1.2 Urine analysis shall be required for all radiation workers entering areas controlled due to surface contamination in excess of prescribed limits.

a. Urine samples will normally consist of at least 500 milliliters, but may be changed dependent upon the needs of the testing lab. Samples for the purpose of this procedure shall be taken only for the determination of internal radioactive or hazardous materials.

b. Urine samples shall be labeled on the bottle with as a minimum:

- the name of the project or facility
- indicate an entry or exit sample
- the date of sampling
- the name of the individual providing the sample
- the social security number (SSN) of that person
- the date of birth of that person.

Attach the form to the bottle so that it will not easily become detached.

c. Using the Sample Chain of Custody procedure, ARP-029, record all information to ensure control of and proper analysis of the sample(s).

5.1.3 Body counts shall be required when working with gamma emitters for which urine analysis is a poor indicator of exposure.

a. Body counts will be conducted with particular concern to the gamma energy range of interest for radionuclides used on the job and at the project site.

b. Documentation of body count results shall include a written review by the AEI Radiation Safety Officer.

5.2 Emergency Bioassay Procedures

5.2.1 Immediate Evaluation

a. If there is radioactive material on or around the face, nose or mouth, take a nasal smear. Count the nasal smear on a portable survey instrument to determine if decontamination is needed.

b. Determine whether the radionuclides are beta, gamma, alpha, or combination emitters using procedures in ARP-008 and 002..

c. Documentation of bioassay data is critical to ensuring that a complete and proper dose analysis can be made. The information must be as accurate as possible.

i. Time and date of the contaminating event.

ii. A discussion of the events leading to the emergency, the results of initial and current surveys of the personnel involved.

iii. The initial levels of contamination, radiation dose, chemical exposure, and any information concerning decontamination that may be available.

d. If contamination is a pure alpha or beta particle emitter, a urine analysis is necessary. This is because these radiations will not penetrate the body for quantification.

i. Collect the required milliliters of urine, recording the individuals name, collection date, social security number, and collection time on the bottle.

ii. Collect one sample for each effective half-life duration for the radionuclides of interest, for three consecutive effective half-lives. This collection frequency determines radionuclide clearance rate.

iii. Forward urine samples to an analysis laboratory contractor. Forward all information as stipulated in the contract or as necessary for the analysis to be completed.

e. For contaminations involving transuranic compounds, a chest count in the first twelve hours following the event and a subsequent count 24 hours after the initial count will facilitate adequate determination of the intake.

f. If contamination is a gamma emitter, analyze the activity in the body by performing a whole body count. Arranging for a body count at a certified laboratory or contractor.

e. Receive bioassay results from contractor.

f. Include the analysis results, as provided by the laboratory, and the calculated committed dose equivalent and total effective dose equivalent in the worker's exposure file.

g. The project or facility Radiation Safety Officer shall review all documentation associated with the accidental exposure and develop a report for the individual's file to indicate internal and external dose equivalent.

6.0 Attachments

ARP Form 33-1 Bioassay Label

Aguirre Engineers, Inc.

Bioassay Label

The label affixed to a bioassay sample should be sized to fit the container in which the sample is stored and shipped. This is an example of an ~1.5" X 3" gummed label which could be used to identify a 100 ml urine sample.

Name: Sample Date:	
SSN/IDN	DOB
Type of Sample:	☐ Entry ☐ Exit ☐ Other* *
Project Name/#	Proj. Mgr. ..... Results To .....

Forms -
Must be
equiv. to NRC 4-5

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Dosimetry

ARP-034

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 034
Dosimetry

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

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1.0 Purpose and Scope

1.1 This procedure provides instructions for monitoring personnel for exposure to radiation in the workplace.

1.2 Radiation monitoring shall be conducted continuously when it is likely that any individual will exceed;

a. 10% of the annual limit of 5 rem, or 500 millirem.

1.3 Adherence to this procedure will provide assurance that exposures to radiation will be properly monitored enabling exposure to be controlled to As Low As Reasonably Achievable (ALARA).

1.4 This procedure will be used for monitoring of all personnel for exposure to radiation. Monitoring will be provided as described in the site specific work plan for the job to be accomplished.

2.0 General

2.1 Definitions

2.1.1 Monitoring - Measurement of radiation exposure to evaluate potential dose equivalent to the individual.

2.1.2 Dosimetry - Devices worn on the body (TLD or DRD) to measure the radiation dose received by the exposed individual.

2.1.3 *Dose* - The deposition of energy in matter. Dose applies to energy deposited in any material by any type of ionizing radiation.

2.1.4 Dose Equivalent - The deposition of energy in living tissue. Equivalent to the radiation dose times the quality factor for the type of radiation.

2.1.5 Quality Factor - The factor which is radiation dependent and identifies the relative biological effectiveness of a radiation type and energy. The quality factor is multiplied times the Dose to yield the Dose Equivalent.

2.1.6 TEDE - Total Effective Dose Equivalent - The sum of the Deep Dose Equivalent (external dose) and the Committed Effective Dose Equivalent (internal dose).

2.1.7 CDE - Committed Dose Equivalent - The dose equivalent to organs or tissues that will be received from an intake of radioactive material by an individual during the during the 50-year period following the intake.

2.1.8 CEDE - Committed Effective Dose Equivalent -The sum of the products of all organs or tissues with CDE and their respective weighting factors.

2.1.9 SDE - Shallow Dose Equivalent - Also termed Skin Dose, it is used for external radiations which cause their primary energy deposition in the first 0.007 cm of tissue.

2.1.10 EDE - Eye Dose Equivalent - The dose delivered to a thickness of tissue of 300 mg/cm^2 by external radiations.

2.1.11 DDE - Deep Dose Equivalent - The dose equivalent delivered by external radiations to tissues deeper than 1 centimeter.

2.1.12 TLD - Thermoluminescent Dosimeter - A device which provides passive radiation measurement of DDE, SDE, or EDE.

2.1.13 DRD - Pocket Ion Chamber - A self indicating, integrating radiation exposure measuring device.

2.2 Dosimetry Policy

2.2.1 Site Registration Form

All new personnel and visitors required to enter a radiologically controlled area must complete a Site Registration Form (ARP Form 34-1) prior to starting work at a facility.

Completed Site Registration Forms will be retained with the individual's personnel exposure file. Site Registration Forms for AEI personnel will be updated annually or earlier if existing information is known to be incorrect.

2.2.2 Occupational Radiation Exposure History

An NRC Form 4 or equivalent must be completed by each individual and reviewed by the Project Manager or designee prior to the individual being permitted to work in a radiologically controlled area where a dose of more than 25 mRem could be received.

2.2.3 Dosimetry Assignment

The TLD badge number, name, social security number, whether or not a worker has a completed NRC Form 4 or equivalent, the monitoring period (date from...to) and the individuals date of birth shall be recorded on ARP Form 34-1, for each individual monitored on a project. The original form will be maintained as a permanent record of the project monitoring. A copy will be maintained in the AEI Las Vegas office.

2.2.4 Occupational Exposure Limits & Administrative Control Levels

a. Nuclear Regulatory Commission limits per calendar year:

Whole Body (TEDE)	5 Rem
Eye Dose Equivalent (EDE)	15 Rem
Shallow Dose Equivalent (SDE)	50 Rem
Organ Dose (CDE)	50 Rem

b. Administrative Control Levels

i AEI Radiation Administrative Control Levels per calendar quarter:

Whole Body (TEDE)	1.25 Rem
Eye Dose Equivalent (EDE)	3.75 Rem
Shallow Dose Equivalent (SDE)	12.5 Rem
Organ Dose (CDE)	12.5 Rem

ii The AEI Radiation Safety Officer (RSO) shall approve exposure above the Quarterly Administrative Control Levels.

2.2.5 Radiologically Controlled Areas

a. A radiologically controlled area (RCA) is considered to be any portion of a facility, plant, vehicle or project for which restrictions apply for purposes of occupational radiation exposure control. Radiation exposures received within the boundary of a restricted area are occupational exposures. As described in the applicable Project Detail Work Procedure, radiologically controlled areas will be established to provide the specific radiological controls necessary for the completion of the work scope and the protection of all project personnel. The following guidelines apply:

b. RCA Location

An RCA is always located within a restricted area as defined by 10 CFR 20. Each radiation area, high radiation area, airborne radioactivity area, and contaminated area shall be contained within a radiologically controlled area.

c. RCA Personnel Monitoring

All personnel and casual visitors within an RCA will be provided with appropriate dosimetry and monitored for radiation exposure.

2.2.6 Radiation Work Permits

a. All personnel working in a radiologically controlled area must be assigned to a specific Radiation Work Permit (RWP), (ARP 6-1) applicable to the job being performed. A Radiation Work Permit Access Log, (ARP 6-2) will be attached to each RWP.

b. All personnel assigned to a job requiring an RWP shall sign the Access Log prior to starting work, indicating time in and starting DRD dose. Upon completion of the work or at the end of the shift, personnel shall sign out on the Access Log, indicating time out and the current DRD dose.

2.2.7 A weekly accumulated estimated exposure report will be maintained and posted for employee review at the start of each work week. This report will reflect a running total of exposure available for the current calendar quarter. The beginning quarterly available exposure will be 1250 mRem for those individuals with a completed and signed Occupational Exposure History Form.

2.2.8 Occupational Radiation Exposure History Request

a. An Occupational Radiation Exposure History Request, (ARP Form 34-5) will be completed for all personnel for whom permanent exposure results have been obtained. Copies of this letter will be sent to the individual, and maintained in the individual's personnel exposure file by the AEI Radiation Safety Office, Las Vegas. For current employees, this letter will be completed annually. For former employees, this letter will be completed and mailed within thirty working days after results have been obtained.

b. Any time AEI is required to report an individual's exposure to the Nuclear Regulatory Commission or other Regulatory Agency, a copy of the report will be sent to the individual.

2.2.9 Project Records/Documentation

Upon completion of the project, it will be the responsibility of the Project Manager or designee to forward all project records, logs, and communications regarding personnel exposure, exposure records, dosimetry records, and all other pertinent information about personnel dosimetry and individual radiation protection for RSO review, and filing in anticipation of NRC review.

2.3 Quality Control

Pocket Ion Chambers (DRD's) shall be calibrated by a certified laboratory or validated procedure every six months when in use.

3.0 References, Records and Equipment

3.1 References

RSM	Radiation Safety Manual
RSTM	Radiation Safety Training Manual
ARP-006	Radiation Work Permits
ARP-008	Radiation and Contamination Surveys
ARP-036	Training

3.2 Records

The following records are completed by this procedure and shall be maintained as specified in the project Quality Assurance Plan.

ARP Form 34-1	Site Registration Form
ARP Form 34-2	Lost, Damaged or Questionable Dosimetry Report
ARP Form 34-3	Dosimetry Issue Log
ARP Form 34-4	Radiation Exposure Record
ARP Form 34-5	Occupational Exposure History Request
ARP Form 6-1	Radiation Work Permits
NRC Form 4	
Weekly Available Exposure Report	

3.3 Equipment

None required

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned tasks using radioactive or hazardous materials are properly trained in their use and the necessity that they be monitored for exposure to radiations and hazardous materials as described in the site specific work plan.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training of personnel in the use of personal monitoring devices for radiation and for hazardous materials.

4.3 Project Manager - The Project Manager is responsible for ensuring that personnel at the work site understand the proper use of monitoring and recording exposure to radiations and hazardous materials.

4.4 Health Physics Technicians - Health Physics Technicians are responsible for performing the surveys described in the site specific work plan and ensuring the proper use of monitoring devices by workers.

4.5 Workers - All personnel are required to wear their dosimetry as required by the Radiation Work Permit and to maintain their exposure to radiation ALARA.

5.0 Procedure

5.1 Radiation Dosimetry - TLD

All personnel who could potentially receive 10% or more of the permissible legal limit for external radiation exposure are required by 10 CFR 20 to be furnished with personnel monitors. In the interests of ALARA, all personnel who work with radioactive material are required to wear appropriate radiation exposure monitors. Personnel working within a Radiologically Controlled Area will receive, at a minimum, a TLD. Personnel working in areas with dose rates above 5 mrem/hour, will wear a TLD and a low range Pocket Ion Chamber (DRD).

TLDs are the permanent record of an individual's occupational radiation exposure. Upon receipt of Project dosimetry, TLDs and TLD finger rings shall be stored in a low background area inside the project main office or in other designated storage locations when not in use. A (TLD) control badge shall be kept where the assigned badges are stored when they are not in use. All AEI personnel entering a Radiological Control Area (RCA) where 25 mRem could be received will be issued a TLD.

The individual's name, social security number, issue date, and date of return will be recorded on the Monthly Dosimetry Issue Log, (ARP Form 34-3).

5.1.1 At a minimum, personnel exposed to radiation in areas posted for protection of personnel, shall wear a thermoluminescent dosimeter (TLD) provided by a NVLAP certified vendor for the exposure period.

The TLD which monitors total body DDE shall be worn on the front torso in the region of the torso expected to receive the highest dose. In cases where other areas of the body may receive a higher dose, the HP technician shall evaluate and formally require (by specification on the RWP) that the total body dosimetry be worn at that body location.

5.1.2 Extremity monitoring shall be provided when necessary as described by the specific site work plan.

5.2 Direct Reading Dosimeters

All personnel working in a radiologically controlled area may be issued/monitored by a Pocket Ion Chamber (DRD) or other Direct Reading Dosimeter (DRD). DRD's may either be issued for an individual or group depending on the type and duration of work to be performed. The Project Manager or designee will determine if it will be necessary to issue individual or group DRD's. The DRDs used for general radiation work will have a range of response of 0 to 200 millirem. DRDs will be set to zero (0) at the start of each work shift.

5.3 Visitors/Group Monitoring

A casual visitor is any person touring or visiting the RCA on an infrequent basis, escorted while in the restricted area and not performing or supervising hands-on work.

Visitors will be issued a TLD on a case by case basis depending on the type and duration of the job. The Project Manager or designee shall determine if a TLD is to be issued to a visitor. TLDs will always be issued to occupational workers expected to exceed 25 mrem. A visitor expected to receive in excess of 25 mrem shall be trained as, and considered an occupational worker.

5.3.1 Visitor RCA Conditions

A visitor may be escorted into a RCA provided that:

- No entries into high radiation areas, surface contamination areas, or airborne contamination areas shall be allowed,
- External radiation exposure is limited to 50 mrem per year, or 10 mrem per entry.
- The visitor is furnished with a Direct Reading Dosimeter.

5.3.2 Visitor Dosimetry

Visitors within an RCA shall receive, as a minimum, a low range 0-200 mR Pocket Ionization Chamber (DRD).

Visitor TLD results are recorded on the Site Registration Form, ARP 34-1, which is maintained at the facility. When a visitor is issued a TLD, the individual's name, social security number, issue date, and date of return will also be recorded on the Monthly Dosimetry Issue Log.

5.4 Lost, Damaged or Questionable Dosimetry

In the event of a Lost, Damaged or Questionable TLD or DRD, the Project Manager or designee shall be notified immediately. A Lost, Damaged or Questionable Dosimetry Report, (ARP Form 34-2) will be completed and filed in the individual's exposure file. The dose estimated from all exposure received while the individual was in an exposure situation must be determined and recorded in the individuals' dose record.

In the event of multiple occurrences, the RSO shall be notified immediately.

5.5 Dropped or Off-Scale Personal Ion Chambers

If a DRD is dropped or if it's hairline is no longer visible (off-scale), the response of this device may no longer be valid and an estimate of the dose received by an individual must be made based on; dose rates and time in the work area, typical dose received on that type of job, or the dose received by another person doing the same type of work in the same area. A Lost, Damaged or Questionable Dosimetry Report, ARP 34-2, shall be used to document this type of situation. The dose determined shall be added to the dose record at the discretion of the Radiation Safety Officer. The Radiation Safety Officer shall review, approve, and maintain all completed dose estimates.

5.6 Project Dosimetry Issuance/Control

5.6.1 Prior to project commencement, the Project Manager and RSO will determine the appropriate radiation monitoring dosimetry required based on the radionuclides and activity present at the work area.. The Project Manager or designee will contact the AEI RSO provide the following information:

- AEI Project Name and Account Number
- Project start date and projected duration
- Appropriate dosimetry required for project
- Number of dosimetry requested
- Name, address, social security, birth date of project personnel to be monitored.
- Address dosimetry is to be shipped to.

5.6.2 Personnel assigned to projects will wear the appropriate dosimetry for no more than one month or the duration of the project, whichever is shortest.

It will be the responsibility of the Project Manager or designee to return dosimetry to the vendor for processing at the end of each monthly monitoring period.

If the original projected project duration is extended, the Project Manager or designee shall inform the RSO so that the proper arrangements can be made to supply additional dosimetry from the vendor.

The monthly issue period may be extended at the discretion of the RSO. Extensions shall be 'with cause' actions and documented by memo, at a minimum.

5.6.3 Dosimetry Processor (Vendor)

The dosimetry vendor must be NVLAP certified in accordance with the project Health and Safety Plan.

Upon receiving project dosimetry, the Project Manager or designee shall verify that the dosimetry received meets the requirements of the project. Any problems should be reported to the AEI RSO for immediate attention and resolution. All documentation received with dosimetry will be filled out completely. When all required preliminary training and documentation has been completed as described in the project Detail Work Procedure, dosimetry will be issued to project personnel.

It is the responsibility of the Project Manager or designee to ensure that ARP Form 34-3, Dosimetry Issue Log is completed at the time of dosimetry issuance and a copy is sent to the AEI Office, Las Vegas, Nevada.

6.0 Attachments

ARP Form 34-1 Site Registration Form
ARP Form 34-2 Lost, Damaged or Questionable Dosimetry Report
ARP Form 34-3 Dosimetry Issue Log
ARP Form 34-4 Radiation Exposure Record
ARP Form 34-5 Occupational Exposure History Request
NRC Form 4

Aguirre Enginners, Inc.
Las Vegas, Nevada

Site Registration Form

ADMINISTRATIVE INFORMATION	
NAME:	DATE:
SOCIAL SECURITY NUMBER:	DATE OF BIRTH:
PERMANENT ADDRESS:	
EMPLOYER'S NAME:	
EMPLOYER'S ADDRESS:	
AEI PROJECT NAME/NUMBER:	
PROJECT CONTACT:	
SIGNATURE:	**DATE:**
MEDICAL HISTORY	
LIST ANY CONDITION OR AILMENT THAT MAY AFFECT YOUR ABILITY TO PERFORM YOUR JOB:	
INDICATE IF YOU ARE EPILEPTIC OR DIABETIC:	
LIST ANY ALLERGIES YOU HAVE:	
LIST ANY MEDICATIONS YOU ARE NOW TAKING:	
LAST TETANUS SHOT DATE:	
DATE OF LAST PHYSICAL:	
SIGNATURE:	**DATE:**
DOSIMETRY USE ONLY	
PIC NO:	PIC READING:_____ MILLIREM.
TLD BADGE NO:	TLD BADGE RESULTS:_____ MILLIREM.
Radiation Safety Officer Approval	
This person has met the requirements for radiation work as specified in the AEI Radiation Safety Manual: Yes ☐ No ☐ This person has a medical or radiological condition which indicates they should not work with radiation: Yes ☐ No ☐ This person meets the requirements for radiation work with consideration of the notes below: Yes ☐ No ☐	
Notes:	
AEI RSO Signature:	

Aguirre Engineers, Inc.
Las Vegas, Nevada

Lost Damaged or Questionable Dosimetry Report

ADMINISTRATIVE
REPORT DATE/TIME:
PROJECT NAME/NUMBER:
PROJECT MANAGER/CONTACT:
INDIVIDUAL'S NAME/SSN:
BADGE NUMBER:
DATE/TIME OF INCIDENT:
LOCATION IF KNOWN:
APPLICABLE RWP NO.:
DATE BADGE WAS ISSUED:
DOSE CALCULATION
1. Dose from dosimeter readings (Total from date issued) thru _____ (Date) = ___ mrem
2. Current dosimeter reading: (If more than one dosimeter, use highest) = ___ mrem
3. If individual was not wearing a dosimeter, or lost his dosimeter, assign highest exposure received by workers in the same area. If none, use dose rate x time in area for the same period. Dose Rate_____ (mrem/hour) x Time _____ (hours) = ___ mrem
4. Total estimated exposure to be assigned: = ___ mrem
THE METHOD USED TO ESTIMATE MY EXPOSURE HAS BEEN EXPLAINED TO ME, AND THE ESTIMATED DOSE ASSIGNED TO MY RECORD IS ACCEPTABLE FOR THIS EVENT.   *EMPLOYEE'S SIGNATURE:* ..... *DATE:* ___/___/___
DOSE RECORD AUTHORIZATION
DOSE ESTIMATE CALCULATIONS BY: ..... DATE: ___/___/___
DOSE ESTIMATE REVIEWED BY: (RSO) ..... DATE: ___/___/___
DOSE ESTIMATE POSTED BY: ..... DATE: ___/___/___

Aguirre Engineers, Inc.
Las Vegas, Nevada

Radiation Dosimetry Issue Log

Project/Location: _____ Badge Series No: _____

TLD #	NAME	SSN	FORM 4 (Y/N)	DATES (FROM/TO)	DOB

Page ___ of ___

Aguirre Engineers, Inc.
Las Vegas, Nevada

Radiation Exposure Record

NAME: SOCIAL SECURITY NUMBER:

BIRTH DATE:

TLD BADGE NO: DRD No:

QUARTERLY WHOLE BODY DOSE: 1ST _____ 2ND _____ 3RD _____ 4TH _____

LIFETIME WHOLE BODY DOSE EQUIVALENT: _____ (REM) MONITORING YEAR: _____

Monitoring Period	Whole Body (DDE)	Shallow Dose (SDE)	Extremity Dose (SDE)	Eye Dose (EDE)	Organ Dose (CDE)	Internal Effective Dose (CEDE)	Total Effective Dose Equivalent - REM (DDE+CEDE) TEDE/CUMULATIVE	
January								
February								
March								
April								
May								
June								
July								
August								
September								
October								
November								
December								
Yearly Totals								

Notes

N/M = Not Monitored

Form ARP 34-4 - Radiation Exposure Record - 1/98

M, F

(Current Date)

OCCUPATIONAL RADIATION EXPOSURE HISTORY

NAME:	SSN:
ADDRESS:	
DATE OF BIRTH:	

THE ABOVE INDIVIDUAL WAS MONITORED BY: TLD: ☐ POCKET ION CHAMBER: ☐

THIS IS A/AN: RECORD: ☐ ESTIMATE: ☐

MONITORING BADGE NUMBER:_____

THE MONITORING PERIOD WAS:

FROM:_____ TO:_____

THE OCCUPATIONAL RADIATION EXPOSURE WAS RECEIVED DURING HIS/HER

ASSIGNMENT FOR: Aguirre Engineers, Inc.

ADDRESS: 6461 Plumcrest Road

CITY/STATE/ZIP: Las Vegas, NV 89106

TELEPHONE: 702-645-9292

License No. _____

RADIATION EXPOSURE RESULTS

LDE

DEEP DOSE EQUIVALENT FOR THE PERIOD STATED ABOVE: _____ REMS (DDE)

SHALLOW DOSE (Skin) FOR THE PERIOD STATED ABOVE: _____ REMS (SDE)

EXTREMITY DOSE FOR THE PERIOD STATED ABOVE: _____ REMS

EYE DOSE EQUIVALENT FOR THE PERIOD STATED ABOVE: _____ REMS (EDE)

COMMITTED EFFECTIVE DOSE EQUIVALENT (INTERNAL) : _____ REMS (CEDE)

TOTAL EFFECTIVE DOSE EQUIVALENT (DDE + CEDE): _____ REMS

THIS REPORT IS FURNISHED TO YOU UNDER THE PROVISIONS OF NUCLEAR REGULATORY COMMISSION REGULATION 10 CFR PART 20 TITLED "STANDARDS FOR PROTECTION AGAINST RADIATION". YOU SHOULD PRESERVE THIS REPORT FOR FURTHER REFERENCE.

RADIATION SAFETY OFFICER:_____ DATE:_____

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Emergency Response

ARP-035

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 035
Emergency Response

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
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5	0	2/3/98						

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ARP-035
Emergency Response

1.0 Purpose and Scope

1.1 This procedure provides instructions for internal AEI notification to emergency personnel.

1.2 This procedure will be used by all AEI personnel to ensure communication of emergency conditions and actions taken in the immediate phase of an emergency.

2.0 General

2.1 Policy

It is the policy of AEI, Inc to provide whatever response is necessary in order to protect the health of our workers and all others at or in the immediate area of a AEI work site. It is important for all AEI employees to recognize that response to emergency situations must be prompt and accurate in order to maximize our efficiency to deal with potential insults to the working population or members of the general public.

2.2 Quality Control

Periodic drills of emergency response actions will be held to ensure proper training of personnel. These drills may be held during training or on work sites as schedules permit.

3.0 References, Records and Equipment

3.1 References

RSM Radiation Safety Manual

3.2 Records

Results of emergency response and notification shall be kept to ensure recreation of the time and date of emergency actions and when personnel were notified.

3.3 Equipment

None required

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned the tasks at a AEI work site are familiar with this procedure, adequately trained in the use of this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for coordinating the response of the emergency response team. The RSO ensures that all members of the emergency response team are qualified by training and experience to perform the requirements of this procedure.

4.3 Project Manager - The Project Manager is responsible for all aspects of response to the emergency until relieved by the customer's emergency team or a representative of government.

4.4 ALL AEI Personnel at the work site shall be familiar with this plan so that participation in an emergency response would ensure minimal chance of expansion of the emergency conditions at the site.

5.0 Emergency Response/contingency Plan and Procedures

This section describes contingencies and emergency planning procedures, and personnel who must be notified. This procedure is to be implemented at each AEI work site. This plan is compatible with local, state and federal disaster and emergency management plans as appropriate.

5.1 Pre-Emergency Planning

During the site briefings held periodically, all employees will be trained in and reminded of provisions of the emergency response plan, communication plan, and evacuation routes.

5.2 Personnel Roles and Lines of Authority

The Project Manager has primary responsibility for responding to and correcting emergency situations. This includes taking appropriate measures to ensure the safety of site personnel and the public. Possible actions may involve evacuation of personnel from the site area. He/she is additionally responsible for ensuring that corrective measures have been implemented, appropriate authorities notified, and follow-up reports completed. The HSO/RCS may be called upon to act on behalf of the Project Manager, and will direct response to medical emergencies.

The Project Manager will notify AEI management personnel of emergencies involving chemicals or radioactive material as soon as practical after the occurrence or after the situation is stable.

5.3 Emergency Recognition/Prevention

The site Health and Safety plan provides a listing of the physical hazards on-site. Personnel will be familiar with techniques of hazard recognition from pre-assignment training and site specific briefings. The HSO/RCS is responsible for ensuring that prevention devices or equipment is available to personnel.

5.4 Evacuation Routes/Procedures

In the event of an emergency which necessitates an evacuation of the site, the following alarm procedures will be implemented: Three Horn Blasts.

Personnel will be expected to proceed to the closest exit with their buddy, and mobilize to the safe distance area associated with the evacuation route. Personnel will remain at that area until an authorized individual provides further instructions.

The Site Health and Safety Plan provides a map depicting evacuation routes for the site and immediate area.

5.5 Emergency Contact/Notification System

The Site Health and Safety Plan provides names and telephone numbers for common emergency contact personnel for the work site. In the event of a medical emergency, personnel will take direction from the HSO and notify the appropriate site emergency organization. In the event of a fire or spill, the Site Supervisor will notify the appropriate facility, local, state, and federal agencies.

5.6 Emergency Medical Treatment Procedures

Any person who becomes ill or injured in the Restricted Zone must be "frisked" to the maximum extent possible without causing further injury or causing delay of any medical function. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. If the patient's condition is serious (or may become serious), decontamination may be delayed, but emergency response personnel must be appraised of the situation. First aid should be administered while awaiting an ambulance or paramedics. All injuries must be immediately reported to the Project Manager.

revised ?

Any person being transported to a clinic or hospital for treatment should take with them information on the materials they may have been exposed to at the site. This information is included in Appendix A. The HSO/RCS or a senior AEI RCT will accompany an injured person to the clinic or hospital.

Any vehicle used to transport contaminated personnel will be treated and cleaned as necessary.

5.7 Fire or Explosion

In the event of a fire or explosion, the base fire department should be summoned immediately. Upon their arrival, the Project Manager or designated alternate will advise the Fire Marshall of the location, nature, and identification of the hazardous materials on site.

If it is safe to do so, site personnel may:

- Use fire fighting equipment available on site to extinguish incipient stage fires; and,
- Remove or isolate flammable or other hazardous materials which may contribute to the fire.

NOTE: Extinguishing media available on site: Class A, B, C extinguisher for all fires.

5.8 Spill or Leaks

In the event of a spill or a leak, site personnel will:

- Inform their supervisor immediately;
- Locate the source of the spill and stop the flow if it can be done safely; and,
- Begin recovery of the spilled materials and area decontamination.

TABLE 10.1

EMERGENCY RECOGNITION/CONTROL MEASURES		
Hazard	Specific Condition/Location	Prevention/Control
Fire/Explosion	Site	A, B, C, D, extinguishers
Spill	Processing Area	Berms
	All other areas	Absorbent materials
Air Release Radioactive Materials	Site	Enclosures, coverings, containment of water spray. Assess extent of contamination dispersal from fire.

TABLE 10.2

In the event of an injury, accident, fire, explosion, spill, release, or other non-routine event, immediately contact one of the following people for further instructions; starting with:

Name	Position	Business Phone	Home Phone	Other Numbers
Thomas O'Dou	Rad Program Manager	702-645-9292	[redacted]	Pager: [redacted]
Dixie Wells	Radiation Safety Officer	702-645-9292	[redacted]	Pager: [redacted]
Timothy Gotto	Explosives Specialist	702-645-9292	[redacted]	Pager:
William McKinnell	Vice President	800-403-7066 ext 1112	[redacted]	Pager: [redacted]

6.0 Attachments

None

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AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Training

ARP-036

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/4/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 036
Training

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
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4	0	2/3/98						
5	0	2/3/98						

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1.0 Purpose and Scope

1.1 This procedure provides AEI requirements for training of personnel to work at project sites involving radioactive materials.

1.2 Adherence to this procedure will provide reasonable assurance that personnel will be aware of their surroundings and the hazards associated with the type of materials in the work area, and the type of work conducted.

1.3 This procedure will be used for all AEI project work involving hazardous materials or radioactive materials.

2.0 General

2.1 Description of procedures

	Group
2.1 Contamination Survey Meters	A
2.2 Aphla-Beta Sample Counters	A
2.3 Micro-R Survey Meters	A
2.4 Ionization Chambers	A
2.5 Direct Self-Reading Pocket Dosimeters	A
2.6 Radiation Work Permits	B
2.7 Air Sampling and Sample Analysis	A
2.8 Radiation and Contamination Surveys	A
2.9 Routine Radiological Surveys	B
2.10 Containment Devices	B
2.11 Portable HEPA Systems and Vacuum Cleaners	C
2.12 Step-Off Pads	D
213 Radiological Restriced Areas	C
2.14 Personnel Protective Equipment (PPE)	D
2.15 Radioactive Materials Brokering	D
2.16 Empty Transport Vehicle Radiological Surveys	E

2.17 Classifying Radioactive Waste	E
2.18 Radioactive Material Tracking	E
2.19 Radioactive Check Source Use and Control	F
2.20 Solidification of Radioactive Liquids and Sludges	B
2.21 Packaging Radioactive Material	B
2.22 Opening Radioactive Material Containers	B
2.23 Decontamination of Equipment and Tools	A
2.24 Unrestricted Release of Materials from Radiological Controls	G
2.25 Soil and Sediment Sampling	G
2.26 Water Sampling	B
2.27 Material Sampling	H
2.28 Sample Chain of Custody	H
2.29 Document Control	H
230 Project Control	H
2.32 Respiratory Protection	B
2.33 Bioassay	B
2.34 Dosimetry	B
2.35 Emergency Response	B
2.36 Training	B
2.37 Radiological Compliance Audits	C
2.38 Procurement and Receipt of Radioactive Material	C

2.2 Definitions

2.2.1 Procedure - A logical, concise document describing the general requirements and methods to e used regarding a specific topic.

2.2.2 Training - The transfer of information by instruction to ensure knowledgeable personnel.

2.3 Quality Control

Personnel will be tested by examination for each instruction received. A grade of 75% shall indicate passing or at the discretion of the instructor, courses may be given pass/fail with no numeric grade assigned.

3.0 References, Records, and Equipment

3.1 References

AEI Safety and Radiation Safety Procedures
RSM Radiation Safety Manual
RSTM Radiation Safety Training Manual
10 CFR Part 20

3.2 Records

Results of instruction shall be maintained for all personnel assigned to work functions at AEI radiological material work sites. As a minimum, these records will contain the information requested on forms ARP 36-1 and ARP 36-2.

3.3 Equipment

None required

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel are trained in all aspects of radiation protection and safety associated with their job functions.

4.2 Radiation Safety Officer - The Radiation Safety Officer (RSO) is responsible for training of personnel in the aspects of radiation protection associated with their jobs. The RSO ensures Health Physics Technicians are qualified by training and experience to provide radiation protection at job sites.

4.3 Project Manager - The Project Manager is responsible for identifying training needs.

4.4 Health Physics Technicians - Health Physics Technicians are responsible for radiation and general safety protection and counseling workers in the right way to protect themselves.

4.5 All Other Personnel - All AEI personnel are responsible to ensure their training needs are met to ensure safe and efficient completion of projects

5.0 Procedure

5.1 Training shall be conducted for all personnel based on their assignment at a work site as indicated in Table 36-1.

5.2 Procedures for operation of instruments, methods of job completion, information important to emergency response, and methods of personnel protection shall be discussed with all personnel prior to their job assignments which involve these activities.

5.3 The Individual Training Record, Form ARP 36-1, shall be maintained for each individual assigned to work at AEI work sites.

5.4 The Course Attendance Record, Form ARP 36-2, shall be prepared by the instructor for each class given.

5.5 A Review of Personnel Qualifications, Form ARP 36-3, shall be completed by the individual and reviewed by the project manager for each individual hired to perform a specific job function at the project site.

5.6 On-The-Job training is as important as other types of training and should be documented when it occurs. An instructor shall validate on-the job training, using the course attendance record (Form ARP 36-2), as it occurs. The project manager may provide this validation in the absence of an instructor.

Table 36-1

Job Function	Job Specific Training			Procedure Training								
				Procedure Groups								
	QA Plan	H&S Plan	Work Plan	A	B	C	D	E	F	G	H	I
Decontamination Technician	✔	✔			✔				✔			
Equipment Operators	✔	✔	✔		✔				✔			
Health Physics Technician (Junior)	✔	✔	✔	✔	✔				✔		✔	
Health Physics Technician (Senior)	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	
Health Physicist	✔	✔	✔	✔	✔	✔	✔	✔	✔	*	✔	
Laborer	✔	✔	✔		✔				✔	*		
Project Supervisor	✔	✔	✔		✔	✔	✔		✔	✔		✔
Project Manager	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Project Director	✔	✔	✔		✔	✔	✔		✔	✔		✔
Radiation Safety Officer	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Radioactive Material Brokers	✔	✔	✔	✔	✔	✔	✔	✔	✔			
Sampling Technicians	✔	✔	✔		✔				✔	✔	✔	

* = As Required by Project Manager or Contract Specifications

6.0 Attachments

Form ARP 36-1	Individual Training Record
Form ARP 36-2	Course Attendance Record
Form ARP 36-3	Review of Personnel Qualifications

Aguirre Engineers Inc.

Individual Training Record

Name:
Address:
SSN:

Course Name	Date	Duration (# Days)	Job Function	Instructor	Grade

Page ___ of ___

Aguirre Engineers, Inc.

Course Attendance Record

TRAINING DATE:_____ INSTRUCTOR:_____

LOCATION:_____ TOTAL CLASS HOURS:_____

TRAINING COURSE TITLE:_____

SCOPE OF TRAINING: ☐ Classroom ☐ Laboratory ☐ On-The-Job

NAME OF STUDENT	SOCIAL SECURITY NO.	SIGNATURE*

*Verification of attendees may be performed by Trng Instructor &/or Project Mgr (with basis, such as project logs or notes)

Training Conducted by: _____
INSTRUCTOR DATE

Training Approved By: _____
PROJECT MANAGER or DIRECTOR DATE

Aguirre Engineers, Inc.

Review of Personnel Qualifications

NAME: _____

POSITION: _____

EDUCATION, TRAINING AND EXPERIENCE:

School	Name/Location (City and State)	Date Graduated	# of Years
High School			
College 1			
College 2			
College 3			
Technical 1			
Technical 2			

QUALIFICATIONS: ☐ ACCEPTED ☐ NOT ACCEPTED ☐ NOT FIT FOR DUTY

ADDITIONAL TRAINING REQUIRED: _____

_____

REVIEWED BY: _____ DATE: _____
PROJECT MANAGER or DIRECTOR

ADDITIONAL TRAINING ASSIGNMENT: _____

QUALIFICATIONS: ☐ ACCEPTED ☐ NOT ACCEPTED

REVIEWED BY: _____ DATE: _____
PROJECT MANAGER or DIRECTOR

NOTES: _____

_____

_____

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Radiological Compliance Audits

ARP-037

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/4/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 037
Radiological Compliance Audits

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
2	0	2/3/98						
3	0	2/3/98						
4	0	2/3/98						
5	0	2/3/98						
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ARP - 037
Radiological Compliance Audits

1.0 Purpose and Scope

1.1 The purpose of this procedure is to establish administrative controls and provisions relating to management review necessary to ensure safe operations under AEI's Nuclear Regulatory Commission Radioactive Materials License. This procedure establishes and defines the requirements for management audits of administrative practices and documentation, the radiological training program, technical operations, and compliance with program policy and procedures. In addition, it allows for surveillance on radiological safety equipment, job site work, and radiological area access controls.

1.2 This procedure will be used by AEI to verify by audit that it's radiological programs or any project, as part of those programs, is in compliance with applicable safety controls, and regulatory requirements and standards

2.0 General

This audit is to performed by the Corporate Health Physicist (CHP) or designee, or an independent Radiation Protection qualified auditor.

2.1 Definitions

2.1.1 Safety - A condition in which *you* are free from danger, risk or injury.

2.1.2 Quality Assurance - The entire suite of procedures, practices, documentation, and records required to provide confirmation of the accuracy of a measurement or of the degree of compliance of an activity with regulations and/or specifications.

2.13 Quality Control - Those actions that control the attributes of the analytical process, standards, reagents, measurement equipment, components, system or facility according to predetermined quality requirements.

2.1.4 Audit - A planned and documented activity performed to determine by investigation, examination, or evaluation of objective evidence, the adequacy of and compliance with established procedures, instructions, drawings, and other applicable documents, and the effectiveness of implementation. An audit should not be confused with surveillance or inspection activities performed for the sole purpose of process control or product acceptance.

2.1.5 Observation - A practice or event noticed that needs improvement.

2.1.6 Requirement - Identification of the guidance(s) that have been 'deviated from', as identified in the observation.

2.1.7 Severity - The problem level of the identified observation:

- Deficiency (lowest level): an action or situation that is incomplete or insufficient.
- Deviation (median level): an action or situation that minimally differs from guidance (license, procedure, etc.) given on the subject.

- Violation (highest level): an action or situation in which the guidance specification has been omitted or held without regard.

2.1.8 Reason - A description of or the rationale for the *Observation* and its' *Violation* assignment.

2.1.9 Recommendation - A suggestion by the auditor for a solution to the observation that may bring the action or situation into conformance with the *Requirement(s)* it is required to meet.

2.1.10 Response - A statement or statements given with regard to a particular audit observation. These statements should explain the action(s) or fix(es) being implemented to correct the observation, if required.

2.1.11 Good Practice - An instance in which an auditor notes and/or documents an action on the part of a auditee that exemplifies a standard or regulation or practice, i.e. an ALARA principle..

2.2 Precautions

2.2.1 The auditor must comply with all safety requirements of the facility or project being audited.

2.2.2 The auditor and the audit function should minimize interference of operations in the areas being audited.

2.3 Quality Control

The RSC will conduct a review of the audit reports during their regular meeting, to verify effectiveness of the audits and corrective actions taken.

3.0 Records, References and Equipment

3.1 Records

Records produced as a result of these audits will be filed in the permanent project files

3.1.1 Audit.Report: The original shall be forwarded to the Manager by the CHP with copies to the RSO, the Department Supervisor, and the Radiation Safety Committee.

3.1.2 Audit Responses: The original shall be forwarded to the CHP by the Manager with copies to the RSO, the Department Supervisor, and the Radiation Safety Committee.

3.1.3 Audit Close-Out and Related Correspondence: The original shall be forwarded to the Manager by the CHP with copies to the RSO, the Department Supervisor, and the Safety Committee.

3.1.4 All original audit records shall be maintained by the CHP and/or the Manager with copies maintained at appropriate location(s).

3.1.5 Copies of audit reports should be maintained at Las Vegas and Denver Operations for review by insurance carriers, federal and/or state regulators, and other parties with a need to have access to these audits. They will remain under the control of the Waste Management Division in both locations.

3.2 References

10 CFR 20	*Standards for Protection Against Radiation*
RSM	Radiation Safety Manual

3.3 Equipment

None Required

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel understand that they are subject to audit and have read and are familiar with this procedure, and have access to a copy of this procedure.

4.2 Radiation Safety Committee (RSC) - The Radiation Safety Committee is responsible for ensuring that these audits are conducted in a timely manner, reviews and evaluates, and may prescribe action on any issue concerning the audit.

4.3 Radiation Safety Officer (RSO) - The Radiation Safety Officer is responsible for training of personnel in this procedure, in addition to being the liaison/interpreter, if required, between the audit function and the license.

4.4 Corporate Health Physicist (CHP) - For the purposes of this procedure, the CHP or designee is auditor and performs the function of program examination.

4.5 Technicians - Technicians includes all personnel that are or may become subject to audit, and they are responsible to comply with the provisions of this procedure.

5.0 Procedure

NOTE: The steps of this procedure are written assuming that there is an auditor in addition to the CHP. In the event that the CHP is conducting the audit, he would assume responsibility for all actions, and in many cases, would combine steps. This is allowed as the CHP will still be held to the basic steps of radiological auditing.

5.1 Program and Project Audits

5.1.1 The audit program is controlled by the Corporate Health Physicist.

1. The CHP or designee must perform the audits.

2. Individuals designated by the CHP shall not be associated with the project that is being audited.

5.1.2 The CHP or designee shall schedule audits as described below:

1. An unannounced audit shall be performed at least semiannually.

2. An audit shall cover a minimum of two working days.

3. A minimum of four weeks shall have elapsed since conduct of the previous audit.

5.1.3 Each audit shall consist of an examination of selected aspects of license conditions, operational activities and applicable regulatory requirements using an audit checklist.

1. An audit checklist shall be prepared by the CRSO or designee.

2. Audits shall be conducted such that a comprehensive review and inspection of all activities are performed over a period of two (2) years.

3. Audit checklists shall be prepared using applicable federal and state regulations, licenses, and previous audit findings.

4. Audit checklists shall be paginated and dated as to the date of preparation.

5. Checklist items shall be answerable by SAT, UNSAT, or NA with explanations of UNSAT areas or why an item is NA, if necessary.

5.1.4 Conduct of Audit

1. A preaudit interview shall be conducted with the Manager, RSO, Department Supervision and/or designated staff representatives to describe purpose and scope of audit, and procedure to be followed.

2. The audit shall consist of items specified on the approved checklist and include, but be not limited to:

   - Review of records;
   - Observing operations;
   - Review of corrective actions;
   - Follow-up audit items; and
   - Interviews with personnel.

3. When necessary, the scope of the audit may be expanded by the auditor to fully evaluate a finding or observation.

   - This expansion may be in addition to, but not in place of checklist items required by the CRSO.

4. Findings must be recorded and be objective, factual and verifiable.

   - Copies of nonconforming documents should be made when possible.
   - Findings involving a specific procedure shall identify the procedure. Unless findings are willful violations of procedures or license, or a threat to employees, public, or environment, individuals will not be identified.

5. Those findings which present an imminent radiological control and safety threat or hazard shall be identified to the Manager, RSO, and staff immediately.

   - The CRSO shall be notified as soon as possible if audit is performed by designee.
   - Immediate corrective action shall be required to be taken by the Manager, RSO or appropriate staff.
   - If necessary, the auditor shall instruct the Manager to stop operations.

6. Upon completion of the audit, the auditor shall:

   - Conduct a brief summary of findings, observations and recommendations, and;
   - Hold a post-audit interview with the Manager, RSO, Department Supervision and/or designated staff.

5,1.4 Audit Report

1. The auditor shall, within 10 working days after completing the audit, prepare an audit report and forward to the CHP, if appropriate.

2. The audit report shall include:

   - A title page to include the project name, date of audit, auditor's name and signature and CHP's name and signature, if different;
   - An introduction listing the general categories included in the audit;
   - A findings section - each finding shall be sequentially numbered.

NOTE: Copies of documents supporting a finding shall be made a part of the audit report when possible; and

   - A recommendations section - each recommendation shall be listed numerically.

NOTE: Recommendations or comments by the auditor are; to enhance the project safety program, or to prevent potential violations of operations requirements of the license or regulations.

3. CHP shall review and approve the final report within five (5) days of receipt from the auditor.

4. The CHP shall forward the audit report to the following:

   - Original to affected Manager; and
   - Copies to the RSO, the appropriate Department Supervision, and the Radiation Safety Committee.

5.1.5 Audit Responses

The Manager or designee shall prepare a formal response to each audit finding and recommendation within 10 working days of receipt of the audit report. The responses shall correspond to the numerical system used in the audit report and shall include the following:

1. Date by which the corrective action was or shall be completed;

2. An explanation as to the cause of the deviation and the action(s) taken to prevent recurrence;

2. Action taken or to be taken regarding the recommendation; and

3. Date by which the action was or is to be completed on a recommendation.

4. The distribution shall be as listed in 5.2.4.4.

5.1.6 Response Review

1. The CHP and auditor shall review audit responses for appropriateness and completeness.

2. If audit responses are not satisfactory, additional information shall be requested in writing.

3. If audit responses are satisfactory, the CRSO shall issue a memo to the Manager closing the audit.

4. Records shall be closed out and forwarded for retention upon completion of all required corrective actions and closeout of the audit.

6.0 Attachments

ARP Form 37-1 Radiological Audit Checklist
ARP Form 37-2 Audit Report Format

Aguirre Engineers, Inc.

Radiological Audit Checklist

Reference: Radiation Safety Manual	Yes	No
This checklist is intended to be used as an aide in field observation of radiological work and radiologically controlled areas. It is organized to follow the order of the RSM. The RSM is AEI's implementation of and compliance with 10 CFR 20, and thus represents the minimum acceptable level of performance		
Is there a copy of the RSM onsite?		
Is the RSM accessible to all workers?		
Is there a copy of 10 CFR 20 onsite?		
Is there a copy of the Radiological Operations Procedures Manual onsite?		
ARP-006 Radiation Work Permits (RWP): **This procedure is intended to meet the 10 CFR 20 requirement that workers have proper dosimetry for the expected radiation levels, that proper personal protective equipment is prescribed, that the hazards associated with the task are known, that the worker is informed, that the area is monitored for changes during the work, and that any special instructions required are communicated to the workers.**		
Does the worker know what document (SOP, RWP, HASP, OP, Program Plan) covers this job?		
Does the worker have a copy available, or is one posted at the worksite?		
Is the document still current?		
Are the RWPs being tracked by the RSC and the RSO?		
Is the RWP properly issued with a radiation protection team leader or supervisor's approval?		
Are the radiation, contamination, and airborne activity levels that are identified in the RWP based on recent (<5 days old) surveys of the area?		
Is the survey that the RWP is based on attached to the RWP or posted at the worksite?		
If the work to be done will change the radiological conditions (i.e., cutting into contaminated systems, handling radioactive materials) does the RWP specify the changes expected and provide instructions for controlling the conditions and PPE/CPC needed?		
Have all the personnel involved in the task properly signed-in on the RWP or SOP sign-in sheet?		
If an ALARA review is specified, has it been completed, and was a pre-job briefing performed?		
Are the RPTs aware that the work is going on?		
Is RPT coverage provided in accordance with the RWP or SOP.		

Aguirre Engineers, Inc.

Audit Report Format

The following format is supplied as an example. The headings identified in Section 2.0 are shown with an italicized example shown after. An audit format should contain the elements listed in this example.

(Facility or Project Name) - (Required Date of Audit -*First Quarter 199?*) - (Type - *Radiation Protection Audit*)
(Auditor's Name(s)), (Date of Audit - *January, 1998*)

(Observation - *Facility Posting and Control - Inadequate Postings*)

1. Postings near the south side of the building were down making them partially unidentifiable. Also, these auditors found the signs on the postings to be unreadable due to fading of the printing on the signs.

2. Postings around the material on the west side of the yard are in poor condition, and are inconsistent. Three signs on the same rope did not appropriately describe the area.

3. Posting Condition...

(Requirement - *10 CFR Part 20*)

(Severity - *Violation*)

(Reason - *Although postings were present in some cases, not all of the postings sited met the intent of the requirement which is to provide proper control of the areas posted.*)
(Response - *Not Required - Action Complete - Areas posted correctly.*)

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Procurement, Receipt, and Opening of Radioactive Material

ARP-038

Revision 0

Reviewed By: _____ 2/2/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
P.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 038
Procurement, Receipt, and Opening of Radioactive Material

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
2	0	2/3/98						
3	0	2/3/98						
4	0	2/3/98						

This table provides the most recent changes to pages in this document. A '0' means the original page is valid, a date in the revision level box indicates the date of the most recent change to the page indicated.

ARP-038
Procurement, Receipt, and Opening of Radioactive Material

1.0 Purpose and Scope

1.1 This procedure provides the methods used to evaluate, order, and receive radioactive sources.

1.2 Adherence to this procedure will provide reasonable assurance that radioactive materials in the form of sources (licensed or unlicensed) meet an accountability standard for need, procurement and receipt.

1.3 This procedure will be used by AEI Radiation Safety personnel to determine the need for any radioactive material source, procedural guidance and accountability in ordering, and proper receipt of and incorporation of sources into a system of control.

2.0 General

2.1 Evaluation of Source Procurement

2.1.1 Establish the need for ordering a new radioactive source by filling out the Radioactive Source Procurement Document, Form 38-1.

2.1.2 All requests for procurement of sources must be evaluated by the Radiation Safety Officer and/or the Radiation Safety Committee.

2.1.3 In accordance with 10 CFR 20.1906, packages containing radioactive materials will be surveyed for radioactive contamination and radiation levels within three (3) hours after receiving the package during normal working hours, or not longer than three (3) working hours from the beginning of the next scheduled working day after receipt.

2.1.4 Equipment Used for Analysis of Received Sources

- Smears, remote smear handing assembly (in the case of any high level source), and liquid cleaner (if recommended by source manufacturer).
- Portable radiation detection equipment, radioactivity counting equipment, and calibration sources.

2.2 Definitions

2.2.1 Procurement Document - A purchase requisition, order, specification or instruction used to define requirements for purchase.

2.2.2 Restricted Area - An area containing radioactive materials to which access is controlled to protect individuals from exposure to ionizing radiation.

2.2.3 Receipt Survey - A systematic physical evaluation of the radiation and radioactive contamination in or on a received source of radioactive materials.

2.2.4 Leak Test - A survey technique to determine the removable activity from the surface of a sealed source of radioactive material.

2.3 Quality Control

The quality of radioactivity material purchases is dependent upon the manufacturer and communication with that manufacturer. Periodic evaluation of the process shall be conducted to ensure appropriate methods are used and this procedure is followed.

3.0 Records, References, and Equipment

3.1 Records

Source procurement information shall be recorded on Form 38-1, Radioactive Source Procurement Form. This form shall be used for all source purchases, and shall be signed by the requestor, approver, and the Radiation Safety Officer.

3.2 References

RSM	Radiation Safety Manual
ARP - 008	Radiation and Contamination Surveys
ARP - 020	Use and Control of Radioactive Check Sources

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel assigned the task of evaluating, procuring, or receiving any source of radioactive material are familiar with this procedure, adequately trained in the use of the procedure and associated equipment and instruments, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer is responsible for review and authorization for procurement of any radioactive source, and for training of personnel in the conduct of procurement of radioactive sources.

4.3 Technicians - Technicians conducting surveillance of sources are responsible for complying with provisions of this procedure.

5.0 Procedure

5.1 Initial Evaluations and Processes

5.1.1 Determine that a need has been established for a new radioactive source.

5.1.2 Evaluate the type (radionuclide), activity, and traceability requirements necessary to meet the established need.

5.1.3 Fill out Form 38-1 and route for signature.

5.2 Non-Exempt Source Procurement

5.2.1 Evaluation and approval of Form 38-1 indicates the need for ordering a non-exempt source.

5.2.2 Prior to ordering the source, the RSO shall process a license amendment submittal, if required.

5.2.3 Upon NRC approval of the license amendment, the source may be ordered.

5.3 Receipt of Any Radioactive Source

NOTE: Immediately notify the RSO should any deviation from this procedure be encountered.

5.3.1 Verify receipt paperwork with procurement paperwork to ensure the proper (ordered) source has been received.

5.3.2 Verify external dose rates are within the expected level.

5.3.3 Verify by survey that there is no external contamination.

NOTE: Ensure that appropriate precautions have been taken to protect the surveyor before beginning the contamination survey. Set up or control a specific area for control of any loose surface contamination that may be encountered; don protection gloves, etc. Examine the package for signs of any potential for contamination; such as, crushed, wet, or damaged externally.

5.3.4 If this is a non-exempt source, conduct a leak test of the source in accordance with ARP-020.

5.3.5 Perform a dose rate and contamination survey of the source container and source storage area.

5.3.6 For exempt sources, a surface smear shall be taken to ensure that the source is not leaking.

NOTE: If the activity estimation determines the leak test sample to be in excess of the leak test limit of 0.005 microcuries, then label the source as unusable to prevent further spread of activity. Conduct a detailed survey of the leak test work area to ensure that no activity from the source has escaped your control.

5.3.7 In the event a package containing radioactive material in excess of a Type A quantity as defined in 10 CFR 71.4 is received, these additional procedures will be enacted;

a. The package shall be received when delivered or have arrangements for immediate notification of the RSO that the material has arrived,

b. Verify it is properly labeled. Prior to disposal of packaging, verify that labels have been completely defaced.

5.3.8 Immediately notify the final delivery carrier and the NRC Region IV Administrator if;

- External radiation levels exceed the limits of 10 CFR 71.47 (200 mrem per hour at any point on the external surface of the package.

- Removable radioactive surface contamination exceeds the limits of 10 CFR 71.87, as specified in 49 CFR 173.443 [ten times (10x) the levels listed in Table 10 or β,γ=22 dpm/cm^2 (220), α=2.2 dpm/cm^2 (22)].

5.4 Inventory Control of Radioactive Sources

5.4.1 Place the source into inventory control system by use of ARP-20.

5.4.2 Enter the inventory control number on the procurement document to complete the 'traceability loop'.

5.4.3 Indicate the completion of the receipt survey and reference the results.

5.4.4 Indicate the due date of the next leak test and inventory check.

5.4.5 Complete all required paperwork and forward to the RSO for review and approval.

6.0 Attachments

ARP Form 38-1 Radioactive Source Procurement Form

Aguirre Engineers, Inc.

Radioactive Source Procurement Form

Applicability: This form shall be used for recording all information regarding procurement of sources of radioactive material.

Reason for Purchase:_____

_____

_____

Radionuclide requested:_____ Activity requested _____ Ci mCi uCi nCi dpm
(Circle units of activity)

Date of request ____/____/____ Date source needed ____/____/____

Is it necessary that the activity in this source be traceable to NIST ? Yes ☐ No ☐

Source Information (After Procurement)

Source Manufacturer:_____ Date of Source Assay: ___/___/____

Source Model Number:_____ Source Serial Number:_____

Activity of Source at Assay Date:_____ Ci

Radionuclide name_____ Half-life of radionuclide_____

Is the activity in this source traceable to NIST ? Yes ☐ No ☐

The source radionuclide and activity are: Exempt ☐ Non-exempt ☐

Source Purchase Requested

By:_____ Date: ___/___/____

Source Purchase Approval

By:_____ Date: ___/___/____

Radiation Safety Officer

Radioactive sources may not be purchased without authorization of the Radiation Safety Officer or RSC.

Approval:_____ Date: ___/___/____
Signature (Print/Sign / Title

Source Receipt Data

Receipt survey number:_____ Completed: ___/___/___ Inventory control number: _____

Due date of next survey of this source: ____/____/_____

Reviewed By: _____ Date: ___/___/____

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Radiological Conditions Awareness Report

ARP-039

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/4/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 039
Radiological Conditions Awareness Report

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
2	0	2/3/98						
3	0	2/3/98						
4	0	2/3/98						

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ARP-039
Radiological Conditions Awareness Report

1.0 Purpose and Scope

1.1 This procedure provides methods AEI utilizes to document a Radiological Conditions Awareness Report (RCAR), and provide a complete evaluation of all situations requiring management recognition.

1.2 This procedure will be used by AEI to alert management to any situation that may require them to take some action and provide a response/resolution for which they would be held responsible. The RCAR may be used within the AEI organizations, on project sites, on transport pickups, etc.

1.3 This procedure will provide reasonable assurance that AEI management will be made aware of situations, including positive notations, problem solving situations, ideas for improvement in any area of radiation health and safety, project progress, and so forth.

The following, although not all inclusive, are examples of what this document may be used for:

1.3.1 Industrial Safety

- Materials which may be needed to improve personnel and/or equipment safety.
- Procedural changes which may be needed to improve personnel and/or equipment safety.
- Awareness and/or operation training of personnel to improve personnel and/or equipment safety.
- Special work or situations which may need preplanning.

1.3.2 Radiation Safety

- Materials which may be needed to improve personnel and/or equipment safety.
- Procedural changes which may be needed to improve personnel and/or equipment safety.
- New techniques, equipment, or procedures which may increase efficiency and safety.
- New techniques, equipment, or procedures which enhance the ALARA principles.
- Training for situations and/or requirements to improve personnel and/or equipment efficiency and safety.
- Special work or situations which may need preplanning.

1.3.3 Product Improvement

- New techniques, equipment, or procedures which may increase efficiency.
- New ideas which may increase productivity or services available to clients.

1.3.4 Quality Assurance

- Items, equipment, etc. which are noted to be nonconforming to QA procedures or practices.

- New techniques, equipment, or procedures which may improve QA methods.

2.0 General

2.1 Definitions

2.1.1 Safety - A condition in which *you* are free from danger, risk or injury.

2.1.2 Quality Assurance - The entire suite of procedures, practices, documentation, and records required to provide confirmation of the accuracy of a measurement or of the degree of compliance of an activity with regulations and/or specifications.

2.1.3 Quality Control - Those actions that control the attributes of the analytical process, standards, reagents, measurement equipment, components, system or facility according to predetermined quality requirements.

2.1.4 Radiological Awareness Report - A document generated for the purpose of obtaining resolution for problem solving or providing information for improvement. A copy of the completed RCAR will be provided to the preparer of the RCAR upon request.

2.1.5 RCAR Log - A system maintained by the RSC which logs and tracks all RCARs from submittal through all reviews and discussions to completion.

2.2 Precautions and Prerequisites

2.2.1 The RCAR should be used for documentation of all situations requiring management recognition.

2.2.2 All RCARs must be logged into the RCAR logging system upon receipt, except events requiring immediate attention for personnel and/or equipment safety. In this instance, the RCAR will be filed after immediate actions have been implemented.

2.2.3 While on field projects, RCAR accountability will be maintained in the project log book. The designated project radiation safety person will perform the initial evaluation, handle or follow-up on immediate actions, and ensure submittal to the RSO and/or the RSC.

2.2.4 Periodic review of the RCAR log will be completed by the RSO to ensure timely completion of RCAR assignments.

2.2.5 Final disposition of the RCAR is to be reviewed and approved by the RSC for all RCARs completed.

2.2.6 Lessons learned through the RCAR program will be shared with all AEI team members.

2.3 Quality Control

The RSC will conduct a review of the "Active RCAR" files at least once per quarter. Completed RCARs may be included as an item in an annual audit of the Radiation Protection Program.

3.0 References, Records, and Equipment

3.1 References

RSM Radiation Safety Manual

3.2 Records

ARP Form 39-1 Radiological Conditions Awareness Report
ARP Form 39-2 RCAR Log

3.3 Equipment

None Required

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for ensuring that all personnel working in radiologically controlled areas are familiar with this procedure, adequately trained in the use of the procedure and have access to a copy of this procedure.

4.2 Radiation Safety Committee(RSC) - The Radiation Safety Committee is responsible for final review, evaluation and action on RCARs that affect the Radiation Safety Program.

4.3 Radiation Safety Officer(RSO) - The Radiation Safety Officer is responsible for training of personnel in the use of this procedure, in addition to providing initial evaluation of all RCARs for submittal to the proper management division. Field project initial evaluations will be performed by the designated project radiation safety person.

4.4 Technicians - Technicians includes all personnel that would have need or cause to generate a RCAR, and they are responsible to comply with the provisions of this procedure.

5.0 Procedure

5.1 When a situation has been identified which requires management attention, the individual noting such a situation shall obtain a blank RCAR (Form ARP 39-1)from the RSO or designed and fill in the 'Submitted By" section and mark the box appropriate to the situation.

5.2 The submitter should describe the situation in as much detail as possible, and submit it to the RSO or designee for logging and initial evaluation for assignment.

5.3 If the RCAR requires immediate action, those actions shall be performed as documented on the form.

5.4 The RCAR will be assigned by the RSO or RSO designee to the appropriate person or organization for investigation and resolution, or forwarded to the RSC for assignment and/or investigation.

5.5 A copy of the original RCAR will be retained by the RSO or designee after each action step is completed.

5.6 When a final resolution of the RCAR situation has been completed by the assigned individual, the completed RCAR and all documentation will be returned to the RSO, Designee, or RSC.

5.7 The RSC will evaluate the final resolution to the RCAR for completeness and acceptability.

6.0 Attachments

ARP Form 39-1 Radiological Conditions Awareness Report
ARP Form 39-2 RCAR Log

Aguirre Engineers, Inc.

Radiological Conditions Awareness Report

Reportable Condition:_____ Serial Number: _____

Submitted By:_____ Date:__/__/____

Assigned To:_____ Date:__/__/____

☐ Industrial Safety ☐ Radiation Safety ☐ Product Improvement ☐ Quality Assurance ☐ Other

*Description:

*Immediate Action Taken:

*Final Resolution:

*Attach additional pages as necessary. Identify additional pages using the assigned Serial Number.

Radiation Safety Officer: _____ Date:__/__/____

Radiation Safety Committee: _____ Date:__/__/____

Aguirre Engineers, Inc.

Radiological Conditions Awareness Log

Serial Number	Submitted By	Assigned To	Date	Category	Description (Include any immediate actions taken)	Completion Due	RSC Evaluation	Logged By:

Page ___ of ___

OE

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

for

Leak Testing for Non-Exempt Sources of Radioactive Material

ARP-040

Revision 0

Reviewed By: _____ 2/8/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/4/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

Aguirre Engineers, Inc.

Procedure ARP 040
Leak Testing for Non-Exempt Sources of Radioactive Material

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date	Page Number	Revision Level	Revision Date
1	0	2/3/98						
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ARP-040

Leak Testing for Non-Exempt Sources of Radioactive Material

1.0 Purpose and Scope

1.1 This procedure provides the methods AEI utilizes to evaluate sources for leakage of radioactive material.

1.2 This procedure will be used by AEI to determine the degree, if any, of leakage of radioactive materials from licensed radioactive sources.

2.0 General

2.1 Definitions

2.1.1 Restricted Area - An area containing radioactive materials to which access is controlled to protect individuals from exposure to ionizing radiation.

2.1.2 Leak Test - A survey technique to determine the removable activity from the surface of a sealed source of radioactive material.

2.2 Precautions and Prerequisites

2.2.1 Sealed sources of activity may exhibit very high dose rates, ensure that a thorough dose rate survey has been performed and documented prior to beginning any leak test evaluation.

2.2.2 Generate a Radiation Work Permit for leak testing of non-exempt sources.

2.3 Quality Control

The quality of leak test analyses is dependent upon the quality of the wipe, and the quality of the analysis. Periodic evaluation of the process and analysis methods shall be conducted to ensure appropriate methods are used and this procedure is followed.

3.0 References, Records, and Equipment

3.1 References

RSM	Radiation Safety Manual
ARP-001	Operation of Contamination Survey Meters
ARP-002	Alpha/Beta Sample Counting Instrumentation
ARP-008	Radiation and Contamination Surveys

3.2 Records

ARP Form 6-1	Radiation Work Permits
ARP Form 8-1	Radiological Survey Report
ARP Form 10-2	ALARA Pre-Job Review
ARP Form 40-1	Source Leak Test Data Sheet

3.3 Equipment

- Remote smear handing assembly
- Liquid cleaner (if recommended by source manufacturer)
- Smears
- Portable radiation detection equipment
- Radioactivity counting equipment
- Calibration sources.

4.0 Responsibilities

4.1 Program Manager - The Program Manager is responsible for insuring that all personnel assigned the tasks of leak testing sealed sources of radioactive material are familiar with this procedure, adequately trained in the use of the procedure and associated equipment and instruments, and have access to a copy of this procedure.

4.2 Radiation Safety Officer - The Radiation Safety Officer is responsible for training of personnel in the conduct of leak tests of sealed sources.

4.3 Technicians - Technicians conducting leak tests of sealed sources are responsible to comply with provisions of this procedure.

5.0 Procedure

5.1 Precautions and Initial Preparations

5.1.1 Select an area to conduct the leak test which is free of radioactive contamination.

5.1.2 Select instruments which are capable of measuring activity associated with the source of interest and capable of detecting at least 0.005 microcuries of the radionuclide of concern.

5.1.3 Prepare ethanol, propanol, or DI water in a nearby container as appropriate for the equipment being tested. Specific solutions may be mentioned in vendor documentation. If they are, use the solutions required by the vendor.

5.1.4 Inform the RSO of the source leak test to be done. The RSO will evaluate the test and provide precautionary measures to ensure protection of people and equipment in the work area.

5.1.5 Be aware of other counting equipment in the area of the source. Inform counting room personnel that they may experience increased count rates during source exposure for the leak test.

DANGER

Do not ever touch or get close to an exposed source of high activity. Sealed sources of activity may cause extremely high dose rates which may result in physical damage to your body.

5.1.6 Use remote means to cause a cloth or paper smear to contact the outside surface of the source. This smear will be the leak test sample which must be analyzed for activity associated with a potentially leaking source.

5.1.7 Be cautious when handling the leak test sample to prevent the spread of contamination should the sample have loose surface activity from a leaking source.

5.1.8 Ensure accountability and direct control of the source at all times when it is unlocked. Minimize the number of people in the area of the source during the leak test exposure of the source. High radiation area controls are necessary; ie; the source must be either locked or guarded.

5.1.9 Inform the senior radiation protection person on-site prior to the source exposure for leak testing.

5.1.10 Minimize the time period of the source exposure. In a well planned test, the source exposure time should be less than 10 seconds total.

5.1.11 If the source emits particulate radiation, the radioactive material will typically be covered by a very thin window for protection of the source surface. Take special precautions to prevent damage to the window during the leak test.

5.1.12 Be sure to wear rubber or latex gloves when handing equipment associated with the test or the leak test samples.

5.2 Monitoring Technique

CAUTION: The window area of a particle detector is covered with a thin window and can be easily punctured. Avoid surveying areas which have protruding fragments that might puncture the detector face. Upon removal of the leak test sample, monitor the sample away from the source. If the sample yields a high count rate compared to background, assume the source to be leaking and estimate the activity based on the reading of your portable instrument.

Beta Sources

Beta particles have a range in air of greater than a few inches to several feet. The detector must be held within ½ inch of the survey surface to ensure a reproducible geometry for activity estimation. However, touching the surface with the detector may contaminate the detector - avoid contact with the surface to be surveyed.

Alpha Sources

Alpha particles travel only a few centimeters in air. The detector must be held within ¼ inch of the survey surface to detect alpha particles. However, touching the surface with the detector may contaminate the detector - avoid contact with the surface to be surveyed.

NOTE

If the activity estimation determines the leak test sample to be in excess of the leak test limit of 0.005 microcuries, then label the source as unusable to prevent further spread of activity. Conduct a detailed survey of the leak test work are to ensure that no activity from the source has escaped your control.

5.4 Analysis

The leak test sample shall be analyzed by a method which will ensure detection of at least 0.005 microcuries of the radionuclide of interest in the source. AEI procedures shall be used as practical to ensure appropriate analysis and documentation of results.

5.5 Interpretation of Results

The results of leak test samples shall be less than 0.005 microcuries in order to comply with NRC requirements.

6.0 Attachments

ARP Form 40-1 Source Leak Test Data Sheet

Aguirre Engineers, Inc.

Source Leak Test Data Sheet

Applicability: This form shall be used for recording all information regarding the leak testing of sources of radioactive material.

Source Information

Source ID Number:_____

Source Manufacturer:_____ Date of Source Assay:__/__/____

Source Model Number:_____ Source Serial Number:_____

Activity of Source at Assay Date:_____ Ci

Radionuclide name_____ Half-life of radionuclide_____

Activity of Source Today:_____ Ci

Leak Test Sample Information

Location of Leak Test Work Area_____

Describe the method of leak testing:_____

_____

Sample Geometry:_____ Detector:_____

Detection Efficiency:_____ c/d Background count time:_____ minutes

Background count rate:_____ counts/minute MDA:_____ microcuries

Sample net count rate:_____ counts/minute Sample count time:_____ minutes

Leak test sample activity:_____ microcuries

Leak Test Result - Check all boxes that apply.

- ☐ The leak test sample is in excess of the 0.005 microcurie limit
- ☐ The leak test sample is below the 0.005 microcurie limit
- ☐ The source has been controlled to prevent spread of activity from the shield.
- ☐ The source has been released to the operators for continued use.

Source Leak Test Performed by:_____ Date:__/__/____

Leak Test Analysis Conducted by:_____ Date:__/__/____

Radiation Safety Officer:_____ Date:__/__/____

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

Site Specifc
Generic Detailed Work Plan

SDWP

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

CONTENTS

INTRODUCTION

This plan describes a generic method which would be accomplished in each specific work plan for facility characterization or remediation by Aguirre Engineering, Inc. This plan includes a description of radiation protection services which would be required for oversight on a typical project. Work will be conducted under the direction of AEI using the procedures and policies of the Nuclear Regulatory Commission Radioactive Materials License.

OBJECTIVE

AEI personnel, will perform the radiological surveys necessary to complete contract requirements in the work area and maintain exposure to radiological hazards As Low As Reasonably Achievable. AEI will utilize fully qualified radiological control technicians trained in the use of procedures of the AEI NRC license to survey and decontaminate personal and property identified as contaminated in accordance with current standards for unrestricted release acceptable to the NRC, DOE, DOD, or other regulatory authority.

SITE LOCATION AND DESCRIPTION

The work will be conducted within the United States of America. If the work location is within an agreement state, the regulatory authority for that state will be contacted and if required an arrangement for reciprocity will be completed with that authority. This section will typically provide a detailed description of the facility and it's geographic location.

SCOPE OF WORK

Under the terms of the contract to this work, AEI will perform radiological surveys, remove radioactive contamination from real property and personal property, remove personal property, and cleanup and release real property. AEI will also provide a final report of the radiological condition of the personal and real property sufficient to ensure to regulators that release criteria have been satisfied. All work completed under this contract will comply with the requirements for radiological protection stated in title 10 of the Code of Federal Regulations and radiological release criteria that are specified in the contact. AEI will perform radiological work on this contract under the Nuclear Regulatory Commission (NRC) License.

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PRELIMINARY ACTIVITIES

Prior to actual work at the site, plans will be prepared to ensure the Health and Safety of AEI, and other site workers and to ensure that the quality of the work does not permit activity above allowed levels to be released from the facility.

SUBMITTALS

Under the terms of the contract for this project all submittals must be approved by the AEI Radiation Safety Committee prior to the initiation of physical work. The AEI submittals of interest are (in most cases):

- Health and Safety Plan (HASP)
  - ◊ Elevated Work Surface Plan
  - ◊ Confined Space Entry Plan
  - ◊ Welding and Burning Plan
- Lock Out / Tag Out (LO/TO) Program
- Hoisting and Rigging Program
- Quality Assurance Plan
- Detailed Schedule
- Waste Management Plan
- NEPA Checklist

RADIATION PROTECTION

Radiation protection services for this project will be provided by Aguirre Engineering Inc. (AEI) under the direction given in their assigned Nuclear Regulatory License. In this regard, AEI will provide radiation protection services as follows:

1. Train personnel to the requirements of the Aguirre NRC license.
2. Evaluation of equipment and facilities for activity.
3. Coverage of personnel performing decontamination services
4. Coverage of personnel evaluating material for release.
5. Quality assurance that material released has been decontaminated as required.

Radiation protection on site will be continuously supported by AEI management as a representative of the AEI Radiation Safety Officer, Dixie Wells, and by direction of the AEI Radiation Safety Committee under the direction of Thomas J. O'Dou, CHP. All personnel will obey the directions provided by AEI personnel regarding radiation protection.

MANAGEMENT PERSONNEL

Overall project guidance for completion will be provided by:

Thomas J. O'Dou, CHP, RRPT
Aguirre Engineering, Inc.
6461 Plumcrest Road
Las Vegas, Nevada
Phone: 702-395-2814
Fax: 702-395-2824

Onsite activities will be controlled under the radiation protection guidance of:

Dixie J. Wells, RRPT
Radiation Safety Officer
Aguirre Engineering, Inc.
6461 Plumcrest Road
Las Vegas, Nevada
Phone: 702-395-2814
Fax: 702-395-2824

On site work activities will be conducted under the supervision of:

Thomas J. O'Dou, CHP, RRPT
Aguirre Engineering, Inc.
6461 Plumcrest Road
Las Vegas, Nevada
Phone: 702-395-2814
Fax: 702-395-2824

BASE CREW ON SITE

This section will typically indicate the number and job category of people who will be present for the majority of the job. This will typically include a project manager, a project supervisor, health physics technicians, a health and safety manager, and other personnel to complete the work task.

TRAINING AND QUALIFICATIONS

Any special training of personnel who will do the work on-site will be specified here. In general, people working to control radioactive material at the site will be trained in the use of the AEI procedures, Radiation Protection Manual, and Specific work plans.

CHARACTERIZATION

Prior to any work on the equipment or facilities, any equipment to be decontaminated will be characterized for radioactive and hazardous materials

AEI will review all existing data and documentation to identify the contaminants present on the equipment or facilities section of interest. Should there be questions regarding the reason for contamination or some abnormal situation be presented, existing conditions will be compared with past conditions so that any anomalies can be identified.

Surveys for fixed and removable radioactive materials will be conducted to identify levels of protection necessary for personnel and dose rate measurements will be made to identify areas requiring posting as radiation areas.

Hazardous materials will be identified and labeled. Personnel will be made aware of identified hazards as the information becomes available. Area boundaries will be defined based on the results of the characterization.

SAFETY AND HEALTH

Personnel from AEI will hold Pre-Job Briefings with all employees and observers to ensure personnel are aware of actual and potential hazards in the work area. Safety at the site shall be conducted in accordance with the guidelines of the AEI Site Health and Safety Plan.

SURVEYS

There will be three primary types of surveys performed during this project.

1) Radiological control surveys to determine measures for and ensure continued control. These surveys will be completed in order to initially assess the degree of contamination present in the work facility and will be performed periodically (daily as a minimum) to ensure control of contaminated material is maintained and to ensure personnel protection is adequate.

2) Pre-decontamination survey of equipment. These surveys will be done to identify the areas of equipment to be decontaminated and the degree of control needed to ensure proper protection of workers during decontamination.

3) Post-decontamination survey of equipment - release surveys. These surveys will be done in low background areas to ensure that adequate decontamination is accomplished prior to release of materials from control as radioactive. All contamination identified during this type of survey will be properly controlled to prevent release of the equipment from the facility.

Radiation surveys will be conducted daily throughout the work area and will consist of general area measurements of external radiation using a Ludlum Model 19 Micro-R meter or equivalent. All measurements of dose rate shall be recorded on survey forms which will be signature verified by a qualified senior technician.

Contamination surveys of the general work area will consist of surface evaluations for activity using 2 inch diameter cloth disks and large area cloths. A cloth disk survey of the general work area will be evaluated using a low background alpha-beta counting system at least weekly. Surveys of this type may be conducted as determined by the on-site radiation safety officer but shall not be done less than weekly. All measurements of surface contamination shall be recorded on survey forms which will be signature verified by a qualified senior technician.

Contamination surveys of specific work areas will be conducted immediately before the work and periodically during the disassembly process. These surveys will consist of contact and general area dose rate measurement and surface contamination evaluations using cloth disk smears. All cloth disk smears will be evaluated with portable instruments for this type of survey.

Evaluations of equipment and areas ready for release as clean will be conducted as the equipment and facility areas become available for survey. Release surveys will be completed by or under the direct supervision of a qualified senior radiation protection technician or the on-site AEI Radiation Safety Officer representative. All release surveys will be reviewed by the on-site AEI Radiation Safety Officer representative prior to release of the equipment from the controlled area. Loose surface activity will be evaluated on equipment using cloth smears which will be evaluated using a low background alpha/beta counting system (Ludlum 2929 or equivalent). The cloth smears shall be rubbed with even pressure over an area of 100 square centimeters. Fixed surface activity concentrations will be evaluated by direct measurements on the surface of the equipment within ½ inch from the surface for beta radiation evaluations and within ¼ inch for alpha emission evaluations. The response of portable alpha instruments (Ludlum Model 3 rate meter with a Model 43-5 or instrument with similar or better detection characteristics) should be similar to background to allow release with a background count rate less than 10 counts per minute. The response of beta detection instruments (Ludlum Model 3 rate meter with a Model 44-9 probe or instrument with similar or better detection characteristics) should be less than 100 counts per minute above background with the background count rate less than 200 counts per minute. For irregular surfaces and crevices where direct measurements may not be adequate, cotton swabs (dry or wetted with alcohol) may be used to ensure activity is not present above the release guidelines.

Using the criteria above, loose surface activity on surfaces shall not exceed 1000 dpm per 100 cm^2 for loose surface alpha or beta activity. Fixed activity shall not exceed 5000 dpm per 100 cm^2 for alpha or beta emissions. These are the criteria of the U.S. Nuclear Regulatory Commission as indicated in the U.S. NRC Policy Statement "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licensees for Byproduct, Source, or Special Nuclear Material", April 1993.

there are exception to this.

ok - revised

All instruments used for surveys shall be verified and approved by the AEI Radiation Safety Officer or her on-site representative. All instruments used for radiation measurements shall be calibrated to standards traceable to the National Institute of Standards and Technology at intervals not to exceed six (6) months.

DECONSTRUCTION

The facility will be laid out in a manner to promote ALARA in exposure of personnel and in control of radioactive materials. Exposure to safety hazards, construction work, radioactive and hazardous materials, and traffic will be minimized.

Specific areas of the facility will be established for the dis-assembly and decontamination of equipment. Physical barriers will be established around these areas to provide control of radiation exposure and contamination control. The floor of the disassembly area will be covered and walls or postings established around the area to prevent unauthorized personnel access and control of the spread of contamination. An access/egress control point area will be established to control entry and exit from the area. Staging areas for contaminated waste will be set up within the radioactive materials boundaries.

An area for survey of equipment will be set up near the disassembly and decontamination area. However, controls will be established to ensure that only clean materials are moved from the contaminated to the potentially contaminated area to minimize spread of activity to the area where surveys for release will be conducted.

The flow of the disassembly/decontamination area will be established in a manner that allows for omni-directional flow of material where there is no chance for cross contamination of equipment which is in the decontamination process.

SET BOUNDARIES

- Upon completion of area surveys AEI will establish, delineate, and post deconstruction area boundaries, hazardous material control boundaries, radiological boundaries and boundary control stations.
- Establish and post staging areas for clean trash, clean scrap, and contaminated waste.
- Establish inventory system for waste containers.

DECONTAMINATION

Decontamination will be accomplished utilizing the least obtrusive method. Non-aggressive cleaning will be applicable on the majority of equipment and facility surfaces. Loose surface contaminates will be removed using damp wipes or mild detergents. Fixed contamination will be removed from equipment surfaces using contained media blasting or mild chemical treatment. Mechanical and chemical methods will be accomplished in a controlled enclosure with HEPA ventilation and stack monitoring.

Fixed contaminates will be removed from floors and structural component using scabblers and/or blast units equipped with vacuum recovery units.

DOCUMENTATION

Documentation on the disposition of all equipment/materials will be provided to the customer on a weekly basis. Unique identifiers such as model and serial number of equipment will be specified on survey forms.

AEI will provide a final report of the project actions including the radiological condition of the personal and real property remaining in the project area.

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

Site Specifc
Generic Health & Safety Plan

HASP

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

SITE HEALTH AND SAFETY PLAN AND EMERGENCY OPERATIONS PLANS
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GENERIC - No Specific Work Site

SITE HEALTH AND SAFETY PLAN AND EMERGENCY OPERATIONS PLANS
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TABLES AND FIGURES

1.0 INTRODUCTION

This Site Health and Safety Plan (HASP) document defines the applicability and responsibilities with respect to compliance with AEI safety procedures and State and Federal Regulations.

1.1 Scope/Applicability of the Site Health and Safety Plan

The purpose of this Site Health and Safety Plan (HASP) is to define the requirements and designate protocols to be followed at the work area during the characterization of the area of concern and surrounding grounds and structures. Applicability extends to all Military, Civil Servants, contractors, subcontractors, and visitors.

All AEI and contractor personnel working on site shall be made aware of health, or safety hazards associated with the characterization or remediation operation. This HASP summarizes those hazards in Table 3.1, and defines protective measures planned for the site.

This plan must be reviewed, approved, and an agreement to comply with the requirements must be signed by all personnel prior to entering the restricted zone or contamination reduction zone. Documentation of the review, approval, and the agreement to comply; as well as certification(s) of 40 hour training (29 CFR 1910.120), all appropriate refresher training, radiation safety training, and fitness for duty shall be completed prior to the start of the project. This documentation is established and maintained by the AEI Health and Safety Officer (HSO)/Radiation Protection Supervisor (RPS).

During development of this plan, consideration was given to current safety and health standards, adverse health effects of known contaminants, and procedures designated to account for the potential exposure to unknown substances. Specifically, the following reference sources have been consulted:

- 10 CFR 20, "Standards for Protection Against Radiation"
- 10 CFR 71, "Packaging and Transportation of Radioactive Materials"
- 29 CFR 1910.120, "Labor/National Labor Relations Board"
- 29 CFR 1910.1000 series, "Labor/OSHA, Department of Labor"
- 29 CFR 1926, "Labor/OSHA, Department of Labor"
- 49 CFR, "Transportation"
- Occupational Safety and Health Guidelines for Hazardous Waste Site Activities
- EPA Publication "Air Surveillance for Hazardous Materials"
- U.S.Army Corps of Engineers "Safety Concepts and Basic Considerations for Unexploded Ordinance (UXO) Operations.

1.2 Visitors

All visitors entering the contamination reduction zone and restricted zone at the work area will be required to read and comply with the provisions of this HASP. In addition, visitors will be expected to comply with relevant OSHA requirements such as medical monitoring (Section 6.0), training (Section 4.0), respiratory protection and PPE (Personal Protective Equipment) (Section 5.0), and the included appendices. Visitors will also be expected to provide their own protective equipment. Dosimetry will not be required for visitors.

In the event that a visitor does not adhere to the provisions of the HASP, he/she will be required to leave the work area. All non-conformance incidents will be reported and documented in the site log.

2.0 KEY PERSONNEL/IDENTIFICATION OF HEALTH AND SAFETY PERSONNEL

2.1 Key Personnel

The following personnel and organizations are critical to the planned activities at DOD (US Army) work sites. The organizational structure will be reviewed and updated as appropriate by the site supervisor. In a site specific plan, this section would include key customer personnel. The example given is from the US Army Industrial Operations Command.

Name/Title	Organization/Branch	Address	Telephone
Kelly Crooks	US Army IOC	Rock Island, IL	309-782-0338 fax: 309-782-2988

2.2 Site Specific Health and Safety Personnel

The Project Manager (PM) in charge of this project is Thomas J. O'Dou. All on-site personnel will report to the Project Manager. If initial characterization involves only a few people, Mr. O'Dou will also serve as the Site Health and Safety Officer (HSO) and has total responsibility for ensuring that the radiological and non-radiological provisions of this HASP are adequate and implemented in the field.

The site Radiation Protection Supervisor (RPS) will provide on-site radiation protection and report to AEI RSO as needed for radiation protection instructions. The RPS will be assisted by a Radiation Control Technician (RCT) as required. The RPS will report (on-site) to the Project Manager, with the PM having ultimate responsibility for the site. Changing field conditions may require decisions to be made concerning the adequacy of programs. Therefore, it is vital that the individual assigned as the RPS be experienced and meet the additional training requirements specified by OSHA in 29 CFR 1910.120 (see Section 4.0 of this HASP). The RPS is also responsible for conducting site inspections on a regular basis in order to ensure the effectiveness of this plan.

The RPS will contact the PM prior to any downgrades in level of protection or monitoring frequency or for items identified in the site specific work plan. The downgrade will be entered in project records and approved by the RSO or on-site representative.

3.0 TASK/OPERATION SAFETY AND HEALTH RISK ANALYSIS

3.1 Historical Overview of Site

This Health and Safety Plan defines the known existing hazards and methods to protect personnel from hazards identified in the Scope of Work, background information, and on-site investigation.

For a review of available historical information concerning the building of concern, see the following documents:

3.1.1 Surveys of the work building.

3.1.2 Description of Work.

3.2 Task by Task Risk Analysis

The evaluation of hazards is based upon the knowledge of site background presented in Section 3.1, and anticipated risks posed by the specific operation.

The following subsections describe each task/operation in terms of the specific hazards associated with it. In addition, the protective measures to be implemented during the completion of those operations are also identified.

Tables 3.1 and 3.2 provide a summary of hazards and protective measures planned for each task at the work site.

TABLE 3.1

TASK ANALYSIS
CHEMICAL HAZARDS OF CONCERN / AIR HAZARDS

EXAMPLE

Unidentified Site

CHEMICAL	CONCENTRATION	LIMIT	NOTES
^{238}U	.1 DAC	10 DAC Hours/Week	1 DAC =
Concrete Dust	< 1 mg/m^3	5 mg/m^3	CAS# 1305-78-8 CaO, OSHA Unpublished limit is listed. Employee exposure must be minimized.
No other information given about chemical hazards in SOW.			

TABLE 3.2

TASK ANALYSIS
PHYSICAL HAZARDS OF CONCERN

EXAMPLE
Unspecified Work Site

Task	Hazard Description	Prevention/Monitoring Technique
Mobilization	Injury/Strain/Sprain	Ensure proper lifting in accordance with established Materials Handling Practices.
Site Work	Explosives	The site is a weapons testing facility and has been for many years. As a result, there may be unexploded ordinance in the ground or stored in areas at the facility. Trained personnel will be on-site during the initial phase to sweep all work areas to identify unexploded or unidentified ordinance. All personnel shall pay attention to orders given by the persons assigned to protect us from explosive hazards. This hazard and items found shall be discussed daily with personnel during characterization.
	Heat Stress	Implement heat stress control measures as necessary. It may be hot in the work area and in the early phase, when personnel are wearing outside protective clothing, and it may be necessary to break frequently to ensure that workers do not overheat. During continuation of the characterization phase, personnel working outside may need to protect exposed skin from potential radiant damage from the sun. A modified work/rest schedule will be implemented as needed to prevent heat stress.
	Fire	Ensure Class A, B, C fire extinguishers are on site for control of incipient stage fires.
	Radiation	Ensure all components of AEI Radiation Protection Plan spelled out in the AEI Radiation Safety Manual are implemented. Personnel disassembling and moving contaminated equipment will use radiation survey equipment and swipe surveys in accordance with AEI survey procedures. Personnel leaving the contamination reduction zone will be surveyed for ionizing radiation emitting contamination prior to leaving the zone.
	Strain/Sprain	Ensure proper lifting. Use mechanical assistance for any loads over, or expected to weigh over 50 pounds. Refer to the Work Plan for material handling specifics that may pertain to this site.

Dropping	Ensure personnel wear steel toed boots designed to prevent injury to feet and toes during handling of heavy items such as tools or pieces of concrete. In addition, head protection shall be mandatory in any area where it is possible for material to be dropped from cranes or other lifting devices (overhead) onto workers in the area.
Projectiles	When handing materials it is always possible to cause injury to eyes from chipped concrete, broken chipping bits, or dropped or shattered items. Ensure personnel take proper precautions to prevent eye injury at all times when working at the characterization site. Safety glasses shall be worn as practical to prevent injury.
Contamination	Prior to evaluation of the contamination hazards which may be present at the characterization site, and after they are identified, it is necessary that personnel take action to protect skin and clothing from radioactive and chemical contamination, by using PPE and/or engineering methods as needed.
Slivers/Protrusions	Ensure personnel take precautions to minimize cuts, slivers, and other damage to skin surfaces by covering the skin as practical to prevent injury.
Trips/Slips/Falls	When moving around in tight areas of the building, on the gazebo, outside in the field area, or near the brook, personnel will take precautions to prevent tripping, slipping, or falling. A lack of attention to the workers' situation here could cause very serious injury. This shall be a continuous safety reminder to personnel.
Noise	Ensure personnel take precautions to protect hearing from power tool operations and other actions which may not be associated with the characterization activities.
Power tools	Ensure precautions are taken to prevent injuries during the use of heavy equipment and power tools. Only personnel who are experienced in the use of power tools and heavy equipment shall be used for this type of work. Precautions shall be taken to minimize the possibility of injury to the equipment operator and to others in the area. Ensure control of electrical boxes to prevent electric shock.
Respiratory Protection	All personnel shall take precautions to prevent respiratory system injury when wearing respirators. Respirators on this job may be used to prevent entry of solids, both radioactive and non-radioactive dusts, particulates (ex. mists, vapors, fumes, and dust) into the breathing zone. Be sure to exit the area and remove your respirator should you feel weak or in case of rupture or plugging of a filter. Do not work under respiratory system distress.
Concrete Dust Exposure	Exposure to concrete dust may occur at low levels while inside building 611 B. For long term exposure to concrete dusts, skin surfaces may be protected with gloves. Personnel should wash residual concrete dust from their skin each day after the work shift.

Demobilization	Injury/Strain/Sprain	Ensure proper lifting in accordance with established Materials Handling Practices.

4.0 PERSONNEL TRAINING REQUIREMENTS

All site personnel are required to be trained in accordance with the OSHA (29 CFR 1910.120) regulation covering Hazardous Waste Operations and Emergency Response. 10 CFR Part 19 - "Notices, Instructions, and Reports to Workers: Inspections" - lists applicable posting and training requirements for workers exposed to radiation. This training will be provided by the HSO/RPS and is detailed in Attachment A to this plan. All personnel are required to be trained to recognize the hazards onsite, the provisions of this HASP, and the responsible personnel. Training shall be conducted and documented in accordance with procedure AEI-19, Training.

4.1 Pre-Assignment and Annual Refresher Training

Each employer will be responsible for certifying that his/her employees meet the training requirements. Consistent with 29 CFR 1910.120 paragraph (e)(3), each employee shall provide a document certifying 40 hours of (OSHA) training for general site workers. Personnel must receive 8 hours of annual refresher training, as required. In addition, hazard communication (29 CFR 1910.1200) training will be provided as it pertains to radioactive or hazardous materials onsite.

4.2 Site Supervisors Training

Consistent with 29 CFR 1910.120 paragraph (e)(8), individuals designated as site supervisors require an additional 8 hours of training. The following individuals are identified as site supervisors:

Name	Title/Responsibility
Thomas J. O'Dou, CHP	Program Manager
Dixie J. Wells	Radiation Safety Officer

4.3 Training and Briefing Topics

The following items will be discussed by a qualified individual at the site pre-entry briefing(s), as well as daily or periodic site briefings. This check list identifies site specific hazards and the frequency to refresh personnel in the necessary protective requirements.

Site Specific Training:

Initial	Daily	Periodic	Training Type
X	—	—	Site characterization and analysis, Sec. 3.0; [(29 CFR 1910.120 (I).)]
X	X	—	Physical hazards, Table 3.2
X	—	—	Chemical hazards (Concrete dust and Radiation)
X	—	—	Medical surveillance requirements, Sec. 6.0; [(29 CFR 1910.120 (f).)]
X	—	—	Symptoms of overexposure to hazards; [(29 CFR 1910.120 (e),(2),(vi).)]

X	—	—	Animal bites and stings
X	X	—	Site control, Sec. 8.0; [29 CFR 1910.120 (d).]
X	—	—	Training requirements Sec. 4.0; [29 CFR 1910.120 (e).]
X	—	—	Engineering controls and work practices, Sec. 8.5; [29 CFR 1910.120 (g).]
X	—	—	Heavy machinery
X	—	—	Forklift [29 CFR 1910.178 (e).]
X	—	—	Backhoe
X	—	—	Manlift [29 CFR 1910.66-.70]
X	—	—	Crane
X	—	—	Tools [29 CFR 1910.242-.247]
X	—	—	Overhead and underground utilities
X	—	—	Ladders [29 CFR 1910.25-.27 (a).]
X	—	—	Structural integrity
X	—	—	Pressurized air or gas cylinders [29 CFR 1910.101 (b).]
X	—	—	Personal protective equipment, Sec. 5.0; [29 CFR 1910.120 (g), 29 CFR 1910.134.]
X	—	—	Respiratory protection Sec. 5.8; [29 CFR 1910.120 (g) ANSI Z88.2-1980.] And [29 CFR 134]
X	—	—	Air Monitoring, Sec. 7.0; [29 CFR 1910.120 (h).]
X	—	—	Characterization, Sec. 9.0; [29 CFR 1910.120 (k).]
X	X	—	Emergency response plan, Sec. 10.0; [29 CFR 1910.120 (1).]
X	—	—	Handling drums and containers, [29 CFR 1910.120 (j).]
X	—	—	Radioactive waste
X	—	—	Confined space entry procedure, Sec. 11.0, [29 CFR 1910.146]
X	—	—	Sanitation, [29 CFR 1910.120 (n).]
X	—	—	Spill Containment, Sec. 12.0 [29 CFR 1910.120 (b)(4)(j).]

5.0 PERSONAL PROTECTIVE EQUIPMENT TO BE USED

This section describes the general requirements of the EPA designated Levels of Protection (A-D), and the specific levels of protection required for each task at the work site.

5.1 Levels of Protection

The level of protective equipment needed will depend on the following hazards:

Potential for radioactive airborne particulates in enclosed spaces (HEPA system and target room)

Potential for confined space controls behind the instrument room, and

Control of surface contamination inside the work enclosure.

Personnel shall wear protective equipment when response activities involve known or suspected atmospheric contamination, when vapors, gases, or particulates may be generated by site activities, or when direct contact with skin-affecting substances may occur. Full face piece respirators protect lungs, gastrointestinal tract, and eyes against airborne toxicants. Chemical-resistant clothing protects the skin from contact with skin-destructive and absorbable chemicals.

The specific levels of protection and necessary components for each have been divided into the two categories according to the degrees of protection afforded:

Level A: Should be worn when the highest level of respiratory, skin and eye protection is required.

Level B: Should be worn when the highest level of respiratory protection is needed, but a lesser level of skin protection is required.

Level C: Should be worn when the criteria for using air-purifying respirators are met, and a lesser level of skin protection is needed.

Level D: Should be worn only as a work uniform and not in any area with respiratory or skin hazards. It provides minimal protection against chemical hazards.

Modifications to these levels are permitted, and routinely employed during site work activities to maximize efficiency. For example, Level D respiratory protection and Level C skin protection may be required for a given task. Likewise the type of chemical protective ensemble (i.e., material, format) will depend upon contaminants and degrees of contact. If there is a potential for downgrading, HSO/RPS will ensure that all radiological and non-radiological concerns have been addressed.

The Level of Protection selected is based upon the following:

- Type and measured concentration of the chemical/radiological substance in the ambient atmosphere and the toxicity of that substance.
- Potential for exposure to substances in air, splashes of liquids, or other direct contact with material due to work being done.

- Knowledge of contaminants onsite along with properties such as toxicity, route of exposure, and contaminant matrix.

- Potential synergistic effects from multiple materials.

In situations where the type of radionuclide/chemical, concentration, and possibilities of contact are not known, the appropriate Level of Protection must be selected based on professional experience and judgement until the hazards can be better identified. Since there is minimal potential for airborne activity and there is no deficiency of oxygen, the maximum level of protection for this job is level C.

5.2 Level A Personal Protective Equipment (PPE):

The use of Level A PPE's are not anticipated and therefore not described.

5.3 Level B Personal Protective Equipment:

The use of Level B PPE's are not anticipated and therefore not described.

5.4 Level C Personal Protective Equipment:

- Air-purifying respirator (APR), full-face, cartridge-equipped (MSHA/NIOSH approved). AEI anticipated using full-face respirators with HEPA cartridges where APR use is appropriate. HEPA cartridges provide protection against: radionuclides, asbestos, dust and other materials as listed in manufacturers literature.

- Disposable one piece suit. Regular Tyvek "bag suits"

- Long-sleeved cotton shirts and pants

- Gloves (outer): latex, rubber, or nitrile

  Outer work gloves of cotton or leather may be worn to handle or move metal pieces

- Gloves (inner): cotton liners or latex

- Boots (outer): rubber overshoes

- Boots (middle): plastic, Tyvek or PVC 4 mil "bootie"

- Boots (inner): steel toes

- Hard hat (as required)

- Safety Glasses

5.5 Level D Personal Protective Equipment:

- As for Level C, but without respiratory protection.

- Long sleeve cotton shirts and pants

- Use of coveralls or Tyveks.
- Gloves; rubber, and leather or cotton
- Boots/shoes, leather or chemical-resistant, steel-toe
- Safety Glasses (as required)
- Hard hat (as required)

5.6 Reassessment of Protection Program

The Level of Protection provided by PPE selection shall be upgraded or downgraded based upon a change in site conditions or findings of investigations. The exact PPE requirements for any task will be specified in the Radiation Work Permit posted at the site. Downgrades will be made based on input from the personnel specified in section 2.0.

When a significant change in hazard potential occurs, the hazards will be reassessed. Some indicators of the need for reassessment are:

- Change in job tasks during a work phase.
- Change of weather.
- When temperatures or individual medical considerations limit the effectiveness of PPE.
- Contaminants other than those previously identified are encountered.
- Change in ambient levels of contaminants.
- Change in work scope which affects the degree of contact with contaminants.

5.7 Work Mission Duration

Before the workers actually begin work in their PPE, the anticipated duration of the work mission should be established. Several factors could limit mission length, including:

- Ambient temperature and weather conditions
- Capacity of personnel to work in PPE.

This is not anticipated to be a limiting condition at this work site, because the on-site job duration is a maximum of less than 30 work days, the maximum number of days in areas requiring PPE is less than 10 work days.

5.8 Chemical Resistance and Integrity of Protective Material

Tyvek suits were selected for the following reasons: Tyveks are effective against a broad range of potential radiological/chemical hazards. There are no anticipated liquids which would cause a spill hazard on-site. Based on information available to date concerning this characterization, Tyvek will be effective. Any materials splashed or spilled will need to be removed from outer clothing immediately.

Additionally, Tyvek will provide some protection from low energy beta particles.

Gloves have a higher potential for contact with radionuclides and chemicals. Based on information available and expected potential hazards, nitrile, latex or rubber gloves will be used for hand protection against contamination. The outer glove will be worn over cotton or latex inner gloves. The inner glove mainly provides for worker comfort, limited protection from contamination is obtained from inner gloves. If the type of work warrants, work gloves of sturdy materials (cotton, leather, etc.) may then be worn over the outer gloves. The work glove will tend to provide protection for the integrity of the outer glove. Also, gross contamination can be removed immediately by removing and discarding the work gloves. Personnel shall be aware that contaminated gloves require controlled disposal.

If a change of PPE is needed based on contaminant exposure, PPE will be doffed in accordance with Figure 9.1. In summary, if work gloves become contaminated, a new work glove will be placed over the outer glove, if the outer glove is not grossly contaminated. If the contamination is on the outer glove as well, then both the outer glove and the work glove will be replaced. If a suit becomes contaminated, the worker will take off the PPE following the order listed in Figure 9.1, and don with clean PPE in the reverse. For other contaminated PPE, don and doff in accordance with Figure 9.1.

5.9 Standard Operating Procedures for Respiratory Protection Devices

The following subsections define standard operating procedures for air-purifying respirators and self-contained breathing apparatus.

5.9.1 Cleaning and Disinfecting Respirators

Provided that respirators have not been radiologically contaminated, they shall be cleaned and disinfected at least daily with a MSA cleaner/sanitizer solution, or with a non-alcohol based cleaner/sanitizer wipe. If respirators have become radiologically contaminated, they shall be surveyed and "free-released", prior to cleaning. Respirators shall be washed in the cleaner/sanitizer solution at least weekly.

5.9.1.1 Daily Cleaning Procedure

The steps to be followed for cleaning and disinfecting daily are as follows:

- Respirator Disassembly. Respirators will be taken to a clean location where the filters, cartridges or canisters are removed, and damaged to prevent accidental reuse, and discarded (used respirator filters are considered potentially contaminated and should be packaged and treated the same as other soiled PPE). For thorough cleaning, the inhalation and exhalation valves, speaking diaphragm, and any hoses are removed and cleaned separately. The head straps should be fully extended.

- Cleaning. Usually, the cleaning and disinfecting solution provided by the manufacturer is used and is dissolved in warm water in an appropriate container. Using gloves, the respirator is placed in the container with the solution and swirled for a few moments. The removed parts may be cleaned in the same manner. A soft brush may be used to facilitate cleaning.

- Rinsing. The cleaned and disinfected respirator face pieces are rinsed thoroughly in warm water to remove all traces of detergent and disinfectant. This is very important for preventing contact dermatitis. All respirator pieces should be rinsed

in this manner, as the thorough removal of cleaners extends the life of the material.

- Drying. The respirator and its' parts may be allowed to dry in room air on a clean surface. The facepiece and hose may also be hung upside down (like drying clothes), but care must be taken not to damage or distort the facepiece. The preferred method of hanging the facepiece is to utilize the lower back head strap which inverts the facepiece for drying.

- Reassembly and Inspection. The clean, dry respirator should be reassembled and inspected in an area separate from the disassembly area to avoid any possible cross contamination. Special emphasis should be given to inspecting the respirator for detergent or soap residue left by inadequate rinsing. This appears most often under the seat of the exhalation valve, and can cause valve leakage or sticking. Should the exhalation valve flapper stick; attempt to free by reimmersion in clean rinse water. Pulling the flapper loose may cause distortion which renders the valve useless.

5.9.1.2 After Routine Use in Contaminated Areas

The steps to be followed for cleaning and disinfecting in the field are as follows:
Provided that the mask has been checked for radioactive material contamination and found to be non-contaminated;

- The mask must either be wiped with disinfectant wipes and allowed to air dry in a clean area or washed and rinsed with MSA Cleaner/Sanitizer solution, and allowed to air dry in a clean area, daily. Do not use alcohol wipes.

- The mask must be washed/rinsed with MSA Cleaner/Sanitizer at least weekly.

5.9.2 Respirator Inspection and Checkout

1. Visually inspect the entire unit for any obvious damages, defects, or deteriorated rubber.

2. Make sure that the facepiece harness is not damaged. The serrated portion of the harness can fragment which will prevent proper face seal adjustment.

3. Inspect lens for damage and proper seal in facepiece.

4. Exhalation Valve - pull off plastic cover and check valve for debris or for tears in the neoprene valve (which could cause leakage).

5. Inhalation Valves (two)(if applicable) - screw off cartridges/canisters and visually inspect neoprene valves for tears. Make sure that the inhalation valves and cartridge receptacle gaskets are in place.

6. Make sure a protective cover lens is attached.

7. Make sure the speaking diaphragm retainer ring is hand tight.

8. Make sure that you have the correct cartridge.

9. Don and perform negative and positive pressure test.

5.9.3 Storage of Respirators

OSHA requires that respirators be stored to protect against:

- Dust
- Sunlight
- Heat
- Extreme Cold
- Excessive Moisture
- Damaging Chemicals
- Mechanical Damage

Storage of respirators should be in a clean, secure area which minimizes the chance for contamination or unsanitary conditions, inside of plastic bags labeled "respirator".

5.10 Standard Operating Procedures for Personal Protective Clothing

5.10.1 Inspection

Proper inspection of PPE features several sequences of inspection depending upon specific articles of PPE and it's frequency of use. The different levels of inspection are as follows:

- Inspection and operational testing of equipment received from the factory or distributor.
- Inspection of equipment as it is issued to workers.
- Inspection after use or training and prior to maintenance.
- Periodic inspection of stored equipment.
- Periodic inspection when a question arises concerning the appropriateness of the selected equipment, or when problems with similar equipment arise.

The primary inspection of PPE in use for activities at the project will occur immediately prior to use and will be conducted by the user. This ensures that the specific device or article has been checked out by the user, and that the user is familiar with its use.

Table 5.1 Sample PPE Inspection Checklists

CLOTHING

Before use:

- Determine that the clothing material is correct for the specified task at hand (refer to the RWP for the task(s) to be performed).
- Visually inspect for:
  - imperfect seams
  - non-uniform coatings
  - tears
  - malfunctioning closures
- Hold up to light and check for pinholes.
- Flex product:
  - observe for cracks
  - observe for other signs of shelf deterioration
- If the product has been used previously, inspect inside and out for signs of chemical attack:
  - discoloration
  - swelling
  - stiffness

During the work task, periodically inspect for:

- Closure failure
- Tears
- Punctures
- Seam Discontinuities

GLOVES

Before use:

- Visually inspect for:
  - imperfect seams
  - tears, abrasions
  - non-uniform coating
  - pressurize rubber or latex gloves with air; listen for pin-hole leaks.

5.11 Specific Levels of Protection Planned for the Project Task Assignments

The following levels of protection will be utilized during activities at the work site.

_X_ Level C This section would identify the the levels of PPE expected for this job.

_X_ Level D _X_ Modified Level D

Table 5.2 presents the level of protection planned for the completion of individual task assignments and the specific components of each protective ensemble.

TABLE 5.2
SPECIFIC LEVELS OF PROTECTION PLANNED FOR THE TASK ASSIGNMENTS

- Level A Tasks: None.
- Level B Tasks: None.
- Level C Tasks: Survey of any controlled areas.

  Movement of contaminated materials inside of the controlled areas if there is no potential to generate or increase airborne radioactivity levels.

  Opening and surveys conducted in the HEPA ventilation system.
- Modified Level D Tasks:

  Mobilization/Demobilization

  Sampling and surveys of general site areas.

  Movement of potentially contaminated materials to storage/transport trailers.

6.0 MEDICAL SURVEILLANCE REQUIREMENTS

Medical monitoring programs are designed to track the physical condition of employees on a regular basis as well as survey pre-employment or baseline conditions prior to potential exposures. The medical surveillance program is a part of each employer's Health and Safety Program.

6.1 Baseline or Pre-Assignment Monitoring

Prior to being assigned to a hazardous or a potentially hazardous activity involving exposure to toxic materials, each employee must receive a pre-assignment or baseline physical. The contents of the physical are defined by OSHA. As suggested by NIOSH/OSHA/USCG/EPA's Occupational Safety & Health Guidance Manual for Hazardous Waste Site Activities, the minimum medical monitoring requirements for work are as follows:

- Complete medical and work histories.
- Physical examination.
- Pulmonary function tests (FVC and FEV1).
- Chest X-ray (every 2 years).
- EKG (as indicated by the AEI RSO or AEI Health and Safety Officer)
- Eye examination and visual acuity.
- Audiometry. - Urinalysis.
- Blood chemistry, including hematology, serum analyses.

The pre-assignment physical should categorize employees as fit-for-duty and able to wear respiratory protection.

6.2 Periodic Monitoring

In addition to a baseline physical, all employees require a periodic physical within the last 12 months unless the advising physician believes a shorter interval is appropriate. The extent of the periodic physical shall be similar to the pre-assignment physical unless determined otherwise by the physician.

All personnel working in contaminated or potentially contaminated areas will be verified current (within 12 months) with respect to medical monitoring.

6.3 Site Specific Medical Monitoring

The following specific tests will be required prior to individuals entering the Restricted Zone or Contamination Reduction Zone:

not the RSO on site RSO ?

Pre and post-project 24 hour urine bioassay for total gross gamma will be completed for individuals who will be working on this project, as directed by the project manager. In the case of accidental exposures of radiological importance, additional bioassay may be required.

revised to RSO

6.4 Exposure/Injury/Medical Support

As a follow-up to an injury or possible exposure above established exposure limits, all employees will seek medical attention and physical testing. Depending upon the type of exposure, it may be critical to perform follow-up testing within 24-48 hours. The AEI Corporate Health Physicist shall consult with the employer's medical consultant to ensure appropriate medical monitoring in such cases.

7.0 FREQUENCY AND TYPES OF PERSONNEL AIR MONITORING/SAMPLING

The primary hazard associated with the project is the potential for accidents associated with the physical condition of the facility and the potential for unexploded ordinance in or around the facility. The radiological hazard presented by Uranium 238 and its daughter products is the only radiological hazard. Personnel air monitoring/sampling will be in accordance with AEI procedures.

8.0 SITE CONTROL MEASURES

The following section defines measures and procedures for maintaining site control. Site control is an essential component in the implementation of the Site Health and Safety Program.

8.1 Buddy System

During all Level B activities, should any be needed, or when some conditions present a risk to personnel, the implementation of a buddy system is mandatory. A buddy system requires at least two people who work as a team; each looking out for the other.

8.2 Site Communications Plan

Successful communication between field teams and contact with personnel in the support zone is essential. The following communications systems will be available during all work activities:

_X_ Radios: Two way

_X_ Intrinsically safe - normal voice, visual contact, or yelling

_X_ Hand Signals:

Signal	Definition
Hands clutching throat	Out of air/can't breath
Hands on top of head	Need assistance
Thumbs up	OK/I'm alright/I understand
Thumbs down	No/Negative
Arms waving upright	Send backup support
Grip partner's wrist	Exit area immediately

8.3 Work Zone Definition

The three general work zones established at the work site are the Restricted Zone, Contamination Reduction Zone, and Support Zone. Figure 8.1 provides a site map of the work zones.

The Restricted Zone is defined as the area where contamination is either known or likely to be present, or because of activity, will provide a potential to cause harm to personnel. Entry into the Restricted Zone requires training and the use of personal protective equipment.

The Contamination Reduction Zone is the area where personnel conduct personal and equipment decontamination. It is essentially a buffer zone between contaminated areas and clean areas. Activities to be conducted in this zone will require personal protection as defined in the detailed work plan.

8.4 Nearest Medical Assistance

Figure 8.2 provides a map of the route to the nearest medical facility which can provide emergency care for individuals who may experience an injury or exposure on-site. The route to the medical facility shall be verified by the HSO, and should be familiar to all site personnel.

***** Phone Number: Site specific number listed here

8.5 Safe Work Practices

Table 8.1 provides a list of standing orders for the Restricted Zone.

Table 8.2 provides a list of standing orders for the Contamination Reduction Zone.

8.6 Emergency Alarm Procedures

The warning signals described in Section 10.4 "Evacuation Routes and Procedures", will be deployed in the event of an emergency. Communication signals will also be used according to Section 8.2.

FIGURE 8.1
SITE MAP DEPICTING WORK ZONE

INSERT

SITE

MAP

HERE

FIGURE 8.2
MAP DEPICTING ROUTE TO NEAREST MEDICAL FACILITIES

INSERT

MAP

TO MEDICAL

FACILITY

HERE

TABLE 8.1
STANDING ORDERS FOR RESTRICTED ZONE

- No smoking, eating, drinking or application of cosmetics in this zone.
- No horse play.
- No matches, lighters or tobacco products in this zone.
- Check-in on entrance to this zone (sign the APPROPRIATE RWP).
- Check-out on exit from this zone.
- Implement the communications system.
- Line of sight must be in position.
- Wear the appropriate level of protection as defined in the RWP.

TABLE 8.2
STANDING ORDERS FOR CONTAMINATION REDUCTION ZONE

- No smoking, eating, drinking or application of cosmetics in this zone.
- No horse play.
- No matches, lighters or tobacco products in this zone.
- Wear the appropriate level of protection as defined in the RWP.
- Perform whole body frisk prior to exiting area.

9.0 DECONTAMINATION PLAN

Table 5.2 lists the tasks and specific levels of protection required for each task. Consistent with the levels of protection required, Figure 9.1 provides a step by step representation of the personnel decontamination process for Levels B and C.

9.1 Standard Operating Procedures

Decontamination involves the orderly controlled removal of contaminants. Standard decontamination sequences are presented in Figure 9.1. All site personnel should minimize contact with contaminants in order to minimize the need for extensive decontamination. This is accomplished through the use of PPE, proper work practices, engineering controls, labels, and barriers.

9.2 Levels of Decontamination Protection Required for Personnel

The levels of protection required for personnel assisting with decontamination are modified Level D.

The HSO/RPS is responsible for monitoring decontamination procedures and determining their effectiveness.

9.3 Equipment Decontamination

All equipment will be decontaminated to the free release levels specified in the Work Plan.

FIGURE 9.1
LEVEL C & D DECONTAMINATION PROCESS

Step 1 Segregated equipment drop

Step 2 Tape removal

Step 3 Outer Boot removal

Step 4 Outer Glove removal

Step 5 Tyvek removal

Step 6 Respirator removal

---------- HOT LINE ----------

Step 7 Remove one bootie, step across line

Step 8 Remove next bootie, step across line

Step 9 Remove inner gloves

Step 10 Frisk

Step 11 Redress, if applicable

Step 12 Wash face and hands (Shower at end of the day at hotel)

10.0 EMERGENCY RESPONSE/CONTINGENCY PLAN

This section describes contingencies and emergency planning procedures to be implemented at the site. This plan is compatible with local, state and federal disaster and emergency management plans as appropriate.

10.1 Pre-Emergency Planning

During the site briefings, all employees will be trained in and reminded of provisions of the emergency response plan, communication plan, and evacuation routes. Table 10.1 identifies the hazardous conditions associated with specific site activities.

10.2 Personnel Roles and Lines of Authority

The Project Manager has primary responsibility for responding to and correcting emergency situations. This includes taking appropriate measures to ensure the safety of site personnel and the public. Possible actions may involve evacuation of personnel from the site area. He/she is additionally responsible for ensuring that corrective measures have been implemented, appropriate authorities notified, and follow-up reports completed. The HSO/RPS may be called upon to act on behalf of the Project Manager, and will direct responses to any medical emergency.

The Project Manager will notify AEI management personnel of accidents/incidents involving general safety, chemical exposure or radioactive material/radiation exposure. Table 10.2 identifies the AEI personnel that should be contacted in case of an emergency.

10.3 Emergency Recognition/Prevention

Table 3.1 provides a listing of physical hazards onsite. Potential additional hazards as a direct result of site activities are listed in Table 10.1. Personnel will be familiar with techniques of hazard recognition from pre-assignment training and site specific briefings. The HSO/RPS is responsible for ensuring that prevention devices or equipment is available to personnel.

10.4 Evacuation Routes/Procedures

In the event of an emergency which necessitates an evacuation of the site, the following alarm procedures will be implemented: Three Horn Blasts.

Personnel will be expected to proceed to the closest exit with their buddy, and mobilize to the posted, pre-designated meeting area. Personnel will remain at that area until an authorized individual provides further instructions.

Figure 10.1 provides a map depicting evacuation routes for the site and immediate area.

10.5 Emergency Contact/Notification System

The following list provides names and telephone numbers for emergency contact personnel. In the event of a medical emergency, personnel will take direction from the HSO and notify the appropriate emergency organization. In the event of a fire or spill, the Site Supervisor will notify the appropriate local, state, and federal agencies.

Local Organization	Contact	Telephone
Ambulance		
Police (Base)		
Police (Civil)		
Fire		
Hospital		
Poison Control Center		800-366-8888
Region X EPA		
National Response Center		Emergency 415-744-1305
Center for Disease Control	CDC	800-232-1311
State Environmental Protection Division		

10.6 Emergency Medical Treatment Procedures

Any person who becomes ill or injured in the Restricted Zone must be "frisked" to the maximum extent practical without delaying or affecting medical support or care. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. If the patient's condition is serious, decontamination may be delayed, but emergency response personnel must be appraised of the situation. First aid should be administered while awaiting an ambulance or paramedics. All injuries must be immediately reported to the Project Manager.

Any person being transported to a clinic or hospital for treatment should take with them information on the materials they may have been exposed to at the site. The HSO/RPS or a RCT will accompany an injured person to the clinic or hospital.

Any vehicle used to transport contaminated personnel will be treated and cleaned as necessary.

10.7 Fire or Explosion

In the event of a fire or explosion, the base fire department should be summoned immediately. Upon their arrival, the Project Manager or designated alternate will advise the Fire Marshall of the location, nature, and identification of the hazardous materials on site.

If it is safe to do so, qualified site personnel may:

- Use fire fighting equipment available on site to extinguish incipient stage fires; and,
- Remove or isolate flammable or other hazardous materials which may contribute to the fire.

NOTE: Extinguishing media available on site: Class A, B, C extinguisher for all fires.

10.8 Spill or Leaks

In the event of a spill or a leak, site personnel will:

- Inform their supervisor immediately;
- Locate the source of the spillage and stop the flow if it can be done safely; and,
- Begin decontamination and recovery of the spilled materials.

10.9 Emergency Equipment/Facilities

Figure 10.2 provides a map of the site and identifies the location of the following emergency equipment:

X	First Aid Kit	X	Eye Wash
X	Fire Extinguisher	X	Emergency Shower
X	Stretcher	X	Two-way Radio
X	Public Telephone	X	Off-site Telephone
X	Site Telephone	X	Drums or B-25 boxes
X	Mobile Telephone	X	Berm Material
X	Absorbent Material	X	Air Monitoring Station
X	Spill Kits	X	Emergency SCBAs
X	Decon basins	X	Other

TABLE 10.1
EMERGENCY RECOGNITION/CONTROL MEASURES

Hazard	Specific Condition/Location	Prevention/Control
Fire/Explosion	Site	A, B, C, D extinguishers
Spill	All areas	Absorbent Materials
Air Release	Site	Assess extent of contamination, from the site, notify the project manager immediately.

TABLE 10.2
AEI INTERNAL CALL LIST

In the event of an injury, accident, fire, explosion, spill, release, or other non-routine event, immediately contact one of the people starting with:

	Name	Business Phone No.	Home Phone No.	National Pager
1.	Thomas J. O'Dou	(702) 395-2814	[redacted]	[redacted]
2.	Dixie J. Wells (RSO)	(702) 395-2814	[redacted]	[redacted]
3.	William McKinnell	(800) -403-7066	[redacted]	
4.	Tim Gotto	(800) -403-7066	[redacted]	

FIGURE 10.1
EVACUATION ROUTES AND SAFE DISTANCES

INSERT SITE MAP WITH EVACUATION

ROUTES AND SAFE WORKING DISTANCES

FIGURE 10.2
SITE MAP WITH EMERGENCY EQUIPMENT LOCATED

A	First Aid Kit	D	Eye Wash
B	Fire Extinguisher	___	Emergency Shower
C	Site Telephone	E	Mobile Telephone

INSERT SITE MAP WITH

EMERGENCY EQUIPMENT LOCATIONS

11.0 SPILL CONTAINMENT PROGRAM

The procedures defined in this section comprise the spill containment program in place for project activities.

- All containers used shall meet the appropriate DOT, OSHA, and EPA regulations for the waste that they will contain.
- Containers shall be inspected and their integrity assured prior to being moved. Containers that cannot be inspected before being moved because of storage conditions, shall be positioned in an accessible location and inspected prior to further handling.
- Operations on site will be organized so as to minimize the amount of container movement.
- Employees involved in the container operations shall be warned of the hazards associated with the containers.
- Where spills, leaks, or ruptures may occur, adequate quantities of spill containment equipment (absorbent) will be stationed in the immediate area. The spill containment program must be sufficient to contain and isolate the entire volume of hazardous substances being transferred.
- Fire extinguishing equipment meeting 29 CFR Part 1910, Subpart 1 shall be on hand and ready for use to control incipient fires. This will consist of Class A, B, C fire extinguisher.
- Containers in poor condition will be overpacked.
- Containers shall have sufficient labels and markings to meet site requirements.

12.0 Unexploded Ordnance (UXO) Safety Precautions

DANGER

No AEI personnel or visitors will be allowed to sample in areas which are outside of the work area boundaries. All work areas must be checked for the presence of UXO prior to working in those areas.

All personnel working in these areas:

Shall be trained.
Shall comply with UXO safety procedures.
Shall work only in areas that have been checked for UXO.
Shall NOT touch or move suspect ordnance.

- All contractor personnel will receive training regarding working in the areas where the potential for UXO exists prior to any work at the work site. This training will be given by the UXO supervisor.
- UXO personnel will comply with all applicable provisions for safety as described in: The U.S. Army Engineering and Support Center's SAFETY CONCEPTS AND BASIC CONSIDERATIONS FOR UNEXPLODED ORDNANCE (UXO) OPERATIONS.
- All personnel will restrict their activities to the established boundaries of the work site that have been searched by the UXO team.
- If the need arises to characterize beyond the identified area, then the new area will be investigated by the contractor's UXO personnel prior to any work being conducted.
- No personnel will touch or move any suspect piece of ordnance.

ok

AGUIRRE ENGINEERS, INC.

Aguirre Radiation Safety Procedure

Site Specifc
Generic Quality Assurance Plan

SQAP

Revision 0

Reviewed By: _____ 2/3/98
D.J. Wells, KRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

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1.0 INTRODUCTION

1.1 Background

Aguirre Engineers, Inc. (AEI) has been contracted to provide for the characterization and or remediation of a radioactively contaminated facility.

As a supporting part of the overall work plan for the project, this Project Quality Assurance Plan has been prepared to augment the Project Detailed Work Procedure in order to provide the necessary controls to successfully complete the contract requirements.

1.2 Project Scope and Objectives

The on-site portion of this project is expected to be completed in less than 90 working days. The first task will consist of removal of non-contaminated items from the area to be characterized or remediated. Surveys will be conducted to determine the radiological status of components and rooms at the facility.

The Project Detailed Work Plan has been developed to meet the applicable regulations and requirements. This Project Quality Assurance Plan has been developed to provide assurance that the regulations and requirements are complied with The Project Health and Safety Plan will also be an integral part of the Project Detailed Work Procedure and Quality Assurance Plan.

No adverse impacts on personnel or the environment are expected in this characterization. The material will be handled and surveyed by trained personnel within the confines of the work area. The grounds contain no known accumulations of radioactive components, any items discovered to be contaminated will be segregated from the clean items, packaged, and stored for decontamination or disposal as desired by the Customer.

Working personnel will be supplied with protective clothing and monitoring equipment and will have detailed procedures to guide them during the characterization or remediation. Management and supervisory personnel will be on site to instruct and support working personnel.

2.0 QUALITY ASSURANCE PROGRAM

2.1 Project Quality Assurance Plan

The Project Quality Assurance Plan is to be implemented for the activities specified in the Project Detailed Work Procedure and the Project Health and Safety Plan. The Project Quality Assurance Plan highlights project specific aspects of the applicable quality assurance elements. The specific quality assurance tasks are defined in the Plan. Quality Assurance program control and records are specified in the Plan by the symbol ✍.

2.2 Quality Assurance Training

The Project Manager (PM) or designated alternate will perform the initial quality assurance training of project personnel at the start of the project.

If additional personnel are added to the project, they will receive quality assurance training prior to participation in the project activities. Quality assurance training will consist of a review and discussion of the Project Detailed Work Procedure and supporting documents. Special emphasis will be placed on documentation of work, quality control checks, equipment performance, identification and control of radioactive material and safety procedures.

Each participant shall acknowledge that he/she has received training and that he/she understands the quality assurance requirements relevant to the project by signing and dating the Course Attendance Record, Form AEI 36-2.

2.3 Technical Training and Personnel Qualifications

The PM will review written statements of qualification or resumes to establish personnel capabilities and qualification to perform the assigned task. If personnel qualification, including education, experience, and training do not meet project needs, appropriate training including "read and study" and "on-the-job" training will be performed or other appropriately qualified individuals will be assigned to perform the task.

Management review of personnel qualifications and acceptance that an individual is qualified to perform the work will be documented on the Review of Personnel Qualification, Form AEI 36-3. Personnel records shall be maintained in the quality assurance record file and shall include: a record of the initial qualifications,

documentation of review by the Project Manager or designee; acceptance of current qualifications or the need for additional training; and a record of the completion of training. Project management shall monitor the performance of individuals involved in activities affecting quality and shall determine if there is a need for retraining or replacement. Retraining or replacement of individuals will be initiated immediately upon identification of the need for such actions. The following guidelines shall be used to determine the proficiency and ability of the workers assigned to this project:

2.3.1 Qualification Requirements:

- Physically capable of performing the work tasks.
- Demonstrated capability to perform the specific function in accordance with approved procedures.
- Familiarity with technical aspects of the equipment and procedures, and capability to verify that the equipment is in proper working condition.

2.3.2 Capability Demonstration:

- The PM or designee shall determine the type of training or experience required to determine if personnel are qualified to perform the specific tasks.
- The individual workers shall review the approved Project Detailed Work Procedure.
- The individual workers shall demonstrate their understanding of the Project Detailed Work Procedure.

3.0 ORGANIZATION

The Project Quality Assurance Plan oversight will be performed by the Program Manager of Decontamination and Decommissioning and the Project Manager. Personnel performing work tasks will be responsible for individual quality items and will be audited by the PM or designee.

The Program Manager is responsible for assuring that the Project Quality Assurance Plan is implemented and is adhered to. All project records and documents will be submitted to the Program Manager for final approval.

The Project Manager will act as the on-site quality manager. The audit reports and records generated by the RSO, HSO, or other auditors, will be submitted to the Program Manager after discussion with the PM. Quality items that will impact the performance of the contract will be immediately submitted. Copies of all reports, records or correspondence will be maintained on site for review by the Customer's representative.

4.0 CONTROL OF DATA

4.1 Planning

The work tasks necessary to complete this contract will be performed in a planned, systematic manner. To assure adequate project planning, a Project Detailed Work Procedure will be approved prior to the start of work. The Project Detailed Work Procedure will specify the required data collection and records to verify that the contract commitments have been met.

4.2 Data Collection

Data collection will be performed by the individual performing the tasks or their supervisor. Data collection will be performed in accordance with the Project Detailed Work Procedure, Project Quality Assurance Plan and the Project Health and Safety Plan requirements.

4.3 Documentation

Data collection shall be fully documented on the appropriate data records and daily project logs. All records shall be complete and thorough as possible, hand written, legible, and in ink. Personnel making a change to a record shall cross out the old entry with one line, add the new information and initial and date the change. Under no circumstances shall the old entry be scratched out, whited out, erased or otherwise removed or made illegible. When applicable, an explanation should accompany the change or correction.

4.4 Quality Control Checks

All data shall be reviewed and checked by a technically qualified person such as the Corporate Health Physicist, the RCS, the RSO, or the Project Manager. These checks shall be made to assure that both the technical, operational and quality assurance requirements have been met. The following guidelines will be used to perform the quality control checks:

4.4.1 Verify that the record contains:

- The project name or task description
- Name and signature of the performer
- Date of performance
- Page number if pertinent.

4.4.2 And, if pertinent, that the record has:

- Conformed with the appropriate procedures,
- Instrument calibration data (instrument identification, calibration date, certificate of calibration, etc.) of survey instruments used is current,
- Completeness and adequacy of the performance and documentation, and
- Accuracy of the information documented.

If the material being checked conforms to the guidelines, the individual performing the quality control check shall sign and date the record. If the material is rejected, it shall be handled in one of two ways:

Discuss and correct minor deviations with responsible personnel resulting in subsequent acceptance of the record, or,

Initiate corrective action procedures in the form of a Non-Conformance Report.

4.5 Management Review

The Project Manager shall review all data records prior to submitting them to the Program Manager. The same steps shall be taken with the review that are taken with the quality control checks.

5.0 PROCUREMENT DOCUMENT CONTROL

Procurement or acquisition of barrels, plastic bags, protective clothing, safety equipment and radiological survey equipment, etc. will be needed to perform the work tasks. The procurement documents and packing lists will be reviewed upon receipt by the Project Manager or designee to verify that appropriate quality assurance and technical requirements have been met. These records will be maintained by the project manager with other project records.

* When in the field, quality control may be implemented by checking to ensure that items purchased are appropriate to complete the job for which they were purchased. This decision may be made by a field supervisor or the project manager.

6.0 PROJECT DETAILED WORK PROCEDURE

The Project Detailed Work Procedure and the associated supporting documents shall be reviewed and approved by management. The Project Detailed Work Procedure will have systematically numbered steps and pages, a cover page and an approval page.

Distribution of copies of records and reports will be sent to pertinent personnel in accordance with Section 7, Document Control.

If revisions to the Project Detailed Work Procedure are necessary during the performance of the project, the Project Manager shall document the need for the revision on the Project Work Plan Change Request Form, in procedure AEI-31. A draft of the revisions shall be prepared and submitted to the Program Manager.

Only after final approval may the revision be issued to project personnel for implementation. The Project Manager shall be responsible for verifying that only current copies of the work plan are in use by project personnel.

7.0 DOCUMENT CONTROL

The Project Detailed Work Procedure and associated supporting documents shall be issued as a controlled document to assure that the current approved revision is in use. Controlled copies of these documents will be issued to project personnel by the Program Manager. The Program Manager will maintain a distribution list of the controlled copies. Personnel assigned controlled documents will be required to acknowledge receipt of the document and all subsequent revisions to the document, in accordance with AEI-30, Document Control.

A Document Distribution Record, Form AEI 30-1, shall be maintained to assure that current documents are distributed. When issuing a current document or document revision, a Document Transmittal Record, Form AEI 30-2 shall be submitted to the recipient. This record will demonstrate that current documents have been issued and are in use. The transmittal record shall be acknowledged and returned to the Program Manager.

The recipient of the controlled document shall return the document to the Program Manager when the requirements for its use ends. Upon return of the controlled document, the Program Manager shall enter the date of return on the Document Distribution Record.

8.0 INSPECTIONS

All datum shall be reviewed and checked in accordance with Section 4.4, Quality Control Checks, to verify that they meet project requirements. For radiological measurements, quality control inspections will be performed by the Project Manager or designee. The quality control inspections will consist of randomly verifying survey techniques and survey meter results.

The Project Manager or designee will be responsible for completing the Daily Quality Control Checklist, Form AEI 31-3. The checklist is designed to account for Project Detailed Work Procedure activities that pertain to project tasks and radiation protection concerns. Unsatisfactory items will be immediately rectified to bring the item to a satisfactory condition. The checklist is to be completed at the end of each shift for that day's activities.

9.0 CONTROL OF MEASURING AND TEST EQUIPMENT

Measuring and test equipment shall be controlled and properly maintained to assure that the indicated results are accurate. Measuring and test equipment will not be used for any purpose other than the purpose the manufacturer intended. The equipment shall be stored, when not in use, in a controlled area so that environmental or physical damage does not occur. Only personnel qualified to use the equipment will be allowed to perform work with the equipment.

Measuring and test equipment that do not perform properly or do not provide good, reproducible results shall be taken out of service. The equipment shall be tagged with an "out of service" tag and removed from the normal equipment storage area.

The Project Manager is responsible for re-evaluating and documenting the validity and acceptability of all data or inspection results obtained using out-of-tolerance equipment.

9.1 Calibration

All survey and measuring equipment used in conjunction with work efforts on this project will be calibrated to the standard appropriate for the instrument use. All standards shall be traceable to the National Institute of Science and Technology (NIST). The Project Manager is responsible for ensuring that the method and interval of calibration for each item of equipment is defined, based on the type of equipment, stability characteristics, required accuracy, intended use, and other conditions affecting measurement control.

Copies of the primary calibration certificates will be sent with the meters to the job site. In addition, survey meters have an attached calibration sticker that indicates the calibration date and the calibration due date. Radiation survey meter performance testing and maintenance will be performed in accordance with the applicable Radiation Survey Procedures.

10.0 HANDLING, STORAGE AND SHIPPING

All radioactive material will be packaged, handled and stored according to the appropriate health and safety procedures. Packaging contaminated soil shall conform to the procedures detailed in the Project Detailed Work Procedure. Packages shall meet the Department of Transportation (DOT) regulations and burial site requirements. Shipping shall meet all applicable DOT, State and Low Level Radioactive Waste Compact Commission regulations.

Shipments will be manifested using the appropriate disposal site Waste Shipment Manifest and continuation pages. An AEI Senior Broker shall inspect and sign all shipping manifests if necessary.

11.0 CONTROL OF NON-CONFORMANCE ITEMS

Procedures have been established and documented to control equipment and activities that do not conform to work plan requirements or whose quality does not meet the intended use. Non-conforming items, including reviewed data, shall be identified, documented, segregated or disposed of as appropriate. Non-Conformance includes non-compliance with the technical procedures, contract documents or errors in documented analyses or results. Non-Conformance reports shall be prepared, including

a description of the non-conformance and the proposed corrective action or disposition such as accept, reject, repair or rework. Non-conforming items or data shall be marked as non-conforming and shall not be used in any further activity until corrective action has been satisfactorily completed or an acceptable disposition approved by the Program Manager.

Persons determining corrective action or disposition shall have demonstrated competence, have an adequate understanding of the requirement, and have access to pertinent background information. Proposed corrective action or disposition and completion of corrective action shall be reviewed and approved in accordance with Section 12.0, Corrective Action.

11.1 Identification and Reporting of Non-Conformances

A Non-Conformance exists if there is a deviation from or non-compliance with the Project Detailed Work Procedure or contract specifications. Non-conformances also include major errors in documented analysis, data or results and deficiencies in documentation or any other aspect of the project that affects quality. Personnel who identify a non-conformance shall report the condition by:

11.1.1 Completing Part A of the Non-Conformance Report, Form AEI-QA1;

11.1.2 Request a Non-Conformance number from the Project Radiological Controls Supervisor (RCS); and

11.1.3 Distribute the Non-Conformance report to the Project RCS and the Project Manager.

11.2 Evaluation of Non-Conformance Reports

The Project RCS and the Project Manager will review the Non-Conformance Report to determine if any of the following conditions exist and document the findings by completing Part B of the Non-Conformance Report.

11.2.1 The RCS may elect to evaluate the Non-Conformance item with the Customer's representative or the Customer's Radiation Safety Officer to determine if the Non-Conformance item could invalidate the results of ongoing work. If work is stopped, it shall be so noted on the Non-Conformance Report. All affected work shall be immediately stopped and the Program Manager notified. Work shall not be restarted until corrective action is approved and

work authorized to restart by the Program Manager and the Customer's representative.

11.2.2 If the Non-Conformance constitutes a significant condition adverse to quality, determine the cause of the condition. Examples of significant conditions adverse to quality include significant failures to implement the Project Detailed Work Procedure, major errors in data or analysis which had previously been approved or a condition that may significantly impact the cost or schedule of the contract.

11.2.3 If the Non-Conformance has any impact on previously obtained data or reports submitted to the Program Manager, Customer's representative or the Customer's Radiation Safety Officer, the Project Manager shall note the impact in the remarks section of the Non-Conformance report and notify in writing all individuals and organizations that may be affected by the non-conformance and resulting data.

11.3 Tracking Non-Conformance Reports

The Program Manager shall monitor Non-Conformance reports to determine if trends adverse to quality are developing. If such trends are developing, such as, repetitive reports related to a particular activity, a written report will be submitted to all project personnel identifying the particular problem. The Program Manager will evaluate the identified problem and propose and implement a written corrective action program to prevent recurrence of the non-conformance.

12.0 CORRECTIVE ACTION

Corrective action for conditions adverse to quality will be determined and implemented in a timely manner. Conditions adverse to quality are any of the following: failures, malfunctions, deficiencies, defective items and non-conformances. A significant condition adverse to quality is one which, if uncorrected, could have a serious effect on safety, operability or validity of data. The cause of the condition will be determined and action taken to preclude the recurrence of the non-conformance item. The Program Manager shall verify that the corrective action has been implemented and, if necessary, that the Project Detailed Work Procedure has been revised.

12.1 Recommendation of Corrective Action

The project personnel that recommend the corrective action will document the recommendation on Part C of the Non-Conformance Report. In the case of a non-conformance which is a significant condition adverse to quality, the corrective action shall be such as to preclude recurrence of the non-conformance. The recommended corrective action will be reviewed and approved by the Program Manager.

12.2 Corrective Action Implementation and Verification

The approved corrective action shall be implemented by the appropriate project personnel. When implementation is verified by the Program Manager and the Project Manager, Part D of the Non-Conformance Report will be completed. The completed Non-Conformance Report will be maintained on site with the Non-Conformance Record Log in the project file.

13.0 QUALITY ASSURANCE RECORDS

A quality assurance records system for the project will be implemented and maintained. Records shall be in ink, legible, identifiable, and retrievable. The quality assurance records will be sufficiently detailed to properly reflect all work activities in the performance of this contract.

These records may be in the form of data sheets, notes, graphs, comments, computations, and other graphic or written data generated in connection with the work activities. Records will be considered valid only if the individual completing the record has initialed or signed and dated the record. If revisions or changes to the quality assurance records are required, the changes will be made to the original records by crossing out the old entry with one line, adding the new information and initialing and dating the change.

The Project Manager will be responsible for maintaining and protecting the records. The records will be maintained on site with the project files. File access will be limited to project personnel and authorized contract personnel. At the completion of the project, the Project Manager will submit all project records to the Program Manager.

14.0 QUALITY ASSURANCE AUDITS

A quality assurance audit may be performed during the project if the Program Manager, Vice President of Waste Management Operations, the customer, or the Nuclear Regulatory Commission deems it necessary. Quality Assurance records will be evaluated and audited by the Program Manager at the end of the project.

During this project, it is anticipated that the RSO or her representative may audit records on-site during the project.

NONCONFORMANCE REPORT

NONCONFORMANCE REPORT NUMBER: _____

PART A

DESCRIPTION OF NONCONFORMANCE:

PERSON REPORTING NONCONFORMANCE: _____ DATE: _____

PART B

EVALUATION OF NONCONFORMANCE:

WORK STOPPAGE REQUIRED: Yes ☐ No ☐ IMPACTS PREVIOUS DATA: Yes ☐ No ☐

SIGNATURE: _____ DATE: _____

PART C

RECOMMENDED CORRECTIVE ACTION:

SIGNATURE: _____ DATE: _____

PART D

CORRECTIVE ACTION IMPLEMENTED:

CORRECTIVE ACTION TO NONCONFORMANCE APPROVED:

_____ _____

HEALTH AND SAFETY OFFICER DATE PROJECT MANAGER DATE

ACKNOWLEDGED/ACCEPTED: _____ /

PROGRAM MANAGER: PRINT/SIGNATURE

DATE

pages 20+35

Aguirre Engineers, INC.

Radiation Worker Training

Study Guide

Rev 01 (1/98)

"Knowledgeable people will bring us to the next level in Safety!"

Aguirre Engineers, Inc. 1998

INDEX

INTRODUCTION

Aguirre Engineers Inc. (AEI), is firmly committed to having a radiological control program of the highest quality. This program, as outlined in the AEI Radiation Safety Manual, requires managers and supervisors at all levels to be involved in the planning, scheduling and conduct of radiological work. **This directive also requires that adequate radiological safety shall not be compromised to achieve production or project objectives.**

Radiological Worker 1 Training (RW-1), is required for the worker whose annual whole body dose is likely to exceed 500 mrem or who needs unescorted entry into:

1. *Restricted Areas*
2. *Radiation Areas*
3. *Radioactive Materials Areas* (RMAs) containing sealed sources, activated material or properly packaged and labeled radioactive material.
4. *Contaminated Areas* containing dispersible radioactive material, or if work is in progress that could create dispersible radioactive material.
5. *Airborne Radioactivity Areas* containing radioactive materials dispersed in the air above the concentrations specified in the Radiation Safety Manual.

The RW-1 course is divided into ten units which provide workers with the information needed to work safely around radiological hazards. These units are:

1. Radiological Fundamentals
2. Biological Effects
3. Radiation Limits
4. ALARA Program
5. Personnel Monitoring Programs
6. Radioactive Material Control
7. Radiological Postings and Controls
8. Radiological Emergencies
9. Responsibilities of Individuals
10. Procedures for entry into contaminated areas

Completion of the course includes successfully completing a 25 question, multiple choice exam with a minimum passing grade of 80%. An alternative to attending the eight hour class, is passing a 50 question, multiple choice challenge exam with a minimum grade of 80%. This alternative is designed for an individual with prior experience, similar qualification at another facility or formal training in radiological controls or health physics. Once an individual has successfully completed the course (through either process), they are classified as a Radiological Worker 1 (RW-1) for a period of two years. A training certificate is issued to the individual and maintained in his/her personnel file to indicate successful completion of the course.

RADIOLOGICAL FUNDAMENTALS

The learning objectives in this lesson include:

1. Identify the three basic parts of an atom.
2. Define radioactive material, radioactivity and radioactive half life.
3. Identify the units used to measure radioactivity.
4. Define radiation.
5. Define ionization and ionizing radiation.
6. State the four basic types of ionizing radiation.
7. Distinguish between ionizing and non-ionizing radiation.
8. Identify the following for each of the four types of ionizing radiation:
   a. Physical characteristics
   b. Range/shielding
   c. Biological hazard(s)
9. Identify the units used to measure radiation.
10. Convert rem to millirem and millirem to rem.

History of Radiation

The discovery of radiation occurred in the late 1800's. Wilhelm Roentgen observed in 1895 that undeveloped photographic plates became exposed while he was working with high voltage arcs in gas tubes, similar to a fluorescent light. Unable to identify this energy, he called them "X" rays. Within a short time of the discovery of x-rays, physicians were using them to examine a buck-shot wound to the hand.

The following year, Henri Becquerel observed that while working with uranium salts and photographic plates, the uranium seemed to emit a penetrating radiation similar to Roentgen's x-rays. Madam Curie called this phenomenon "radioactivity". Further investigation by her and others showed that this property of emitting radiation is specific to a given element. It was also identified that atoms producing these radiations are unstable and emit radiation at characteristic rates to form new atoms.

Early researchers investigating the properties and uses of these energetic radiations, had yet to discover the harmful effects in living tissue. As research increased, effects were observed in individuals and controls were put into place to limit exposures. The first limit was based on preventing the skin from turning red. The long term effects of exposure to radiation were still not understood. As knowledge of the biological effects of radiation exposure increased, additional controls were established. During this same time, the ability of radiation to damage tissue was being put to beneficial uses in the medical treatment for cancers and other diseases.

Until the late 1930's, radioactive sources were limited in size and strength. They were made stronger by concentrating more radioactive material from natural ores. This was a difficult process, so large (high activity)

sources were not readily available. As technology advanced, x-ray machines improved and better high voltage generators were developed. Accelerators were also invented and used in high energy physics research which led to the ability to make stronger sources.

There were other major developments in atomic energy research during World War II. The discovery of atomic fission led to the development of the first "atomic pile" or nuclear reactor in Chicago. Within a few years, under the name Manhattan Project, the U.S. built and detonated three atomic bombs and ushered the world into the atomic age.

One of the more significant contributions from the Manhattan Project was radiation protection controls. These controls continued to develop and evolve under a new agency called the Atomic Energy Commission, where they were transferred to commercial, military and non-military uses. Today, even more rigorous controls are in place as we learn more about the risks and benefits of radiation.

The peaceful uses of atomic energy after the war led to research and development of power reactor technology, the production and use of many new forms of radioactive materials and advances in medicine and biology using radioactive materials developed at national lab facilities. With each new advancement in research at these laboratories, improved programs for radiation protection followed. The challenge remains to keep industry at the forefront of uses of radiation, and maintain high standards of radiation protection.

Atomic Structure

All of the materials we work with, whether they are gas, liquid, solid, plant, animal or mineral, are composed of atoms. Atoms are the smallest unit of matter that retain the properties of an element (such as carbon, lead, and helium). The atom is composed of three major parts: the neutron, proton, and electron. Neutrons and protons form the central core of the nucleus of an atom. These particles are approximately the same size. The particles differ in that protons have a positive electrical charge and neutrons have no electrical charge. The number of protons determines what the element is, for example, oxygen or iron. Surrounding the nucleus is an electron cloud composed of negatively charged electrons in orbit. The number of electrons depends on the element and generally equals the number of protons, so the atom is neutrally charged.

An element is a substance made up of atoms bearing an identical number of protons in each nucleus. Most of the atoms of an element also have the same number of neutrons in each nucleus, but not always. If atoms have the same number of protons, but a different number of neutrons, they are called isotopes of the element. They retain the same ***chemical properties*** of the element, but may exhibit different ***nuclear properties***, such as radioactivity.

Radioactivity

Radioactivity is the property of certain atoms to spontaneously emit particles or energy. The nuclei of some atoms are unstable, and eventually adjust to a more stable form by the emission of radiation. These unstable atoms are called radioactive atoms or radioactive isotopes. Radiation is the energy emitted from the radioactive atoms, either as electromagnetic waves or as particles. When radioactive (or unstable) atoms transform, it is called radioactive decay or disintegration. Material containing a large number of radioactive atoms is called either radioactive material or a radioactive source. Radioactivity is measured in units that are equivalent to the number of disintegrations per second (dps) or disintegrations per minute (dpm). The unit of measure is the curie (Ci) where one curie equals thirty seven billion disintegrations per second.

1 Ci = 37,000,000,000 dps or 3.7×10^{10} dps. 1 Ci = 2.22×10^{12} dpm.

A measurement program called System International (SI) uses the unit Becquerel (Bq) to measure radioactivity. The Becquerel is equal to one disintegration per second.

1 Bq = 1 dps 1 Ci = 3.7E10 Bq

This system is not currently used at AEI, but will be phased in over the next few years.

Each radioactive element decays or disintegrates at a characteristic rate that is measured as a radioactive half life. This is the time it takes for a radioactive substance to lose 50% of its activity by decay and is different for each element and each isotope of an element. After seven half lives of decay of a radioactive element, less than 1% of the original radioactivity remains.

NUMBER OF HALF-LIVES	*FRACTION REMAINING*	*PERCENT OF ACTIVITY REMAINING*
0	1	100%
1	1 X ½ = ½	50%
2	½ X ½ = 1/4	25%
3	1/4 X ½ = 1/8	12.5%
4	1/8 X ½ = 1/16	6.25%
5	1/16 X ½ = 1/32	3.125%
6	1/32 X ½ = 1/64	1.5625%
7	1/64 X ½ = 1/128	0.78125%

Radiation

Radiation is energy in the form of electromagnetic waves or sub atomic particles. Radiation is emitted from radioactive (unstable) atoms or from a radiation producing machine (such as an x-ray machine or accelerator). Radiation sometimes has enough energy to separate electrons from their atoms when the energy is absorbed in matter. The resultant, positively charged atom is called an ion and the process is ionization. When radiation has sufficient energy to create ions, it is called ionizing radiation. For the purposes of this course on radiation protection, ionizing radiation includes alpha particles, beta particles, gamma (and x rays) and neutrons. These will be discussed in further detail later.

Non-ionizing radiation has insufficient energy to form ions. Examples of non-ionizing radiation includes most visible light, infrared light, microwaves and radio waves. For the purposes of this course, the term "radiation" refers only to ionizing radiation.

Alpha particles

Alpha particles are charged particles containing two protons and two neutrons that are emitted from the nucleus of certain heavy atoms, such as uranium when they decay. Because of its size and charge, an alpha particle only travels a few centimeters in air. It can also be stopped or shielded using a sheet of paper. The alpha particle cannot penetrate the dead layer of human skin, but can be damaging if the source of alpha radiation is inside the body. There are only a few sources of alpha radiation normally encountered during work at AEI. These are primarily from uranium, thorium and plutonium wastes.

Beta particles

Beta particles are electrons emitted with high energy from many different radioactive atoms. The range of a 1 Mev beta particle is about 10 feet in air. Beta particles can easily be shielded by using ¼" of plastic or thin lightweight metals such as ⅛" of aluminum. Because beta particles can penetrate the dead layer of skin and affect the live skin tissue, in high doses they can cause serious injury to the skin or to the eyes. Some sources of beta radiation include tritium (^{3}H), phosphorous (^{32}P), strontium (^{90}Sr) and carbon (^{14}C).

Gamma and X-rays

Gamma and x-rays are electromagnetic radiation with no mass or charge. Gamma rays are emitted from the nucleus during radioactive decay, while x-rays are emitted from orbital electrons. Electromagnetic radiation may also be given off by a charged particle accelerating or decelerating in an electric field. Because they have no mass and no charge, gamma and x-rays are very penetrating forms of radiation. In air, high energy gamma or x-rays may travel several hundred feet. Dense materials such as lead are used for shielding. From a biological perspective, x-rays and gammas are considered external hazards, meaning that even with the source of radiation outside your body, the radiation can penetrate and affect internal organs.

Gamma radiation will probably be the major contributor to the total dose encountered by AEI employees during their work activities. Some of the major sources of gamma radiation anticipated include gamma emissions from radioactive sources and waste materials.

Neutrons

Neutrons are neutral particles emitted from the nucleus during radioactive decay or fission (splitting of an atom). Because they have no charge, neutrons can be a very penetrating form of radiation and can travel several hundred feet in air. At high energies, they transfer energy by collision with light atoms, especially hydrogen. At lower energies, neutrons can be absorbed and the absorbing material can become radioactive. Neutrons, like the x-rays and gammas, are considered an external hazard. Shielding that is most effective for neutrons includes water, paraffin, boron, cadmium and concrete.

Sources of neutrons are not anticipated in the normal AEI work activities. Neutron exposure could be encountered when handling, packaging or shipping neutron sources. If neutron exposure is likely, ensure proper precautions including assignment of neutron dosimetry have been taken.

TYPE	*PROPERTIES*	*RANGE*	*SHIELDING*	*HAZARDS*	*SOURCES*
Alpha	2 protons 2 neutrons +2 charge	1 - 2 inches in air	Paper, outer layer of skin	Internal only	Uranium, Thorium, Plutonium in radioactive waste and sources
Beta	1 electron -1 charge (+1 for a positron)	Up to 10 feet in air/Mev	Thin metal or plastic	External to the skin, eyes and internal	Tritium, Carbon and mixed fission products in radioactive wastes and sources
Gamma and X-rays	No mass, no charge	Several hundred feet in air	Lead, steel or concrete	External (whole body) and internal	Radioactive waste and radioactive sources
Neutron	Neutral particle	Several hundred feet in air	Water, paraffin or concrete	External (whole body)	Neutron sources and nuclear reactors during operation

Units of Dose and Dose Rate Measurement

Dose is a general term which will be used in this manual to refer to dose equivalent in the unit **rem**. Since the measurements of radiation fields we frequently encounter are small fractions of a rem, **millirem** or **mrem**, (the prefix, milli, meaning 1/1000), is the more commonly used term.

To convert rem to mrem, multiply the number of rem by 1,000 or move the decimal point three places to the right. For example, 1.3 rem would be 1,300 mrem.

The amount of radiation dose you receive from both external and internal sources is called the **total effective dose equivalent (TEDE)**. TEDE is usually expressed in mrem.

Dose rate is the amount of dose received in a specified period of time. Dose rate is usually expressed in units of mrem per hour (mrem/hr). Dose can be estimated by multiplying the dose rate and the time of exposure tot he radiation. For example, if you spend 4 hours in an area with 12 mrem/hr dose rate, your dose would be approximately 48 mrem.

BIOLOGICAL EFFECTS

The learning objectives in this lesson include:

1. Identify the major sources of natural background and man-made radiation
2. Identify the average annual dose to the general population from natural background and man-made sources.
3. State the methods by which radiation causes damage to cells.
4. Identify the possible effects of radiation on cells.
5. Define the terms "acute dose" and "chronic dose."
6. State examples of chronic radiation dose.
7. Define the terms "somatic effect" and "genetic effect."
8. State the potential effects associated with prenatal radiation doses.
9. Compare the biological risks from chronic radiation doses to health risks workers are subjected to in industry and daily life.

Introduction

Of the many environmental factors that cause cancer in man, we know more about the biological effects of ionizing radiation than most others. Our information is based on animal studies as well as a large body of information involving exposures to people. There are four groups of people that have been exposed to high doses of radiation, and studied to determine the effects of radiation on man.

The first group includes radiation workers from the early 1900's, early medical radiologists and radium workers who received large doses of radiation before the biological effects of radiation exposure were recognized. Since that time standards have been developed to protect workers.

The second group is the 77,000 survivors of Hiroshima and Nagasaki using atomic weapons during World War II. Some survivors received estimated doses in excess of 100,000 mrad.

The third group includes individuals who have been involved in radiation accidents. New studies of the Chernobyl accident continue to expand this knowledge.

The fourth group of individuals are patients who have undergone radiation therapy for a variety of diseases. Patients who receive radiation treatment for cancer are also being studied, but generally only short term effects can be observed.

Sources of Radiation

Exposure to radiation is generally discussed in two broad categories, radiation doses to the general public and occupational doses. Within the category of radiation doses to the general public, it is further divided into natural background and man-made sources.

Man has been exposed to natural background sources of radiation throughout his history. The major natural background sources include:

1. Radon gas; comes from the radioactive decay of uranium which is naturally present in the soil. The radon gas can migrate through the soil and into the air. The decay products of radon attach to dust particles and may be inhaled. The decay products of radon will then deliver a dose to the tissue of the lungs. On Long Island, the dose from radon is much lower than the national average because there is very little uranium in the soil. The average effective dose equivalent from radon in the United States is **200 mrem/year.**

2. Cosmic radiation; which comes from outer space and our own sun. The atmosphere shields us from most of the cosmic radiation, so your dose from cosmic radiation is determined by where you live. The dose is greater at higher altitudes than at sea level because there is less atmosphere to shield against cosmic radiation. For a comparison, the dose rate at sea level is about 24 mrem/year, the dose rate in Denver, Colorado (approximately 5,000 ft. above sea level) is 50 mrem/year, and in Leadville, Colorado (approximately 10,000 ft. above sea level) the annual dose rate is 125 mrem/year. The average dose from cosmic radiation in the U.S. is **28 mrem/year.**

3. Terrestrial sources; exist because a number of materials have remained radioactive since the formation of the earth. These natural radioactive materials are found in the ground, rocks and building materials. Some of the contributors to terrestrial sources are the natural radioactive elements radium, uranium and thorium. In fact, there are some areas in Brazil where the natural background radiation levels reach 3,000 mrem/year. The average dose from terrestrial sources in the United States is **28 mrem/year.**

4. Internal source; our bodies contain various, naturally occurring radioactive elements, and potassium (^{40}K) is one of the major contributors to your internal dose. The average dose from internal sources in the United States is about **40 mrem/year.**

The major man-made sources that contribute to the radiation dose to the general public include:

1. Medical/dental sources; this includes diagnostic (such as chest or dental x-ray) and therapeutic uses of radiation (such as radiation therapy for tumors). Because medical and dental doses are so individualized, your dose may vary from zero to several thousand mrem. The average dose from medical and dental sources in the United States is about **54 mrem/year.**

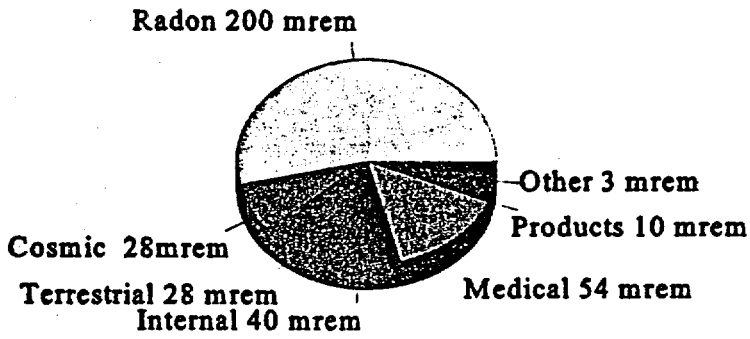
2. Consumer products; some consumer products contain small amounts of radioactive material. Examples include certain ceramic dishes (usually with an orange glaze), some luminous dial watches, and some smoke detectors. These consumer products account for a very minor contribution to the background dose. The average dose from consumer products in the United States is about **10 mrem/year.**

3. Other; this category includes radiation doses from fallout caused by bomb testing and accidents such as Chernobyl.

Overall, the average radiation dose to a member of the general population in the United States, from background and man-made sources is about 360 mrem/year, or about 25,000 mrem over the average lifetime.

The other broad category of radiation sources is occupational. Occupational sources for AEI employees will depend on the type of work undertaken. Always talk with the Radiation Safety Officer or health physics personnel to identify the actual sources and types of radiation you will encounter.

ANNUAL DOSE



Natural and man-made radiation sources

The dose you receive while working at AEI as a Radiological Worker, is called an occupational dose. This is in addition to any dose received from natural background and man-made sources identified above.

Biological Effects of Exposure to Radiation

A biological "effect" is a change in the body caused by cellular damage from radiation. This damage may be the result of the radiation directly interacting with a vital part of the cell or indirectly by the formation of toxic substances within the cell. Whenever a cell is exposed to radiation, one of the following will occur:

1. The cell may be undamaged by the radiation.
2. The cell may be injured, repair the damage and continue to function normally.
3. The cell may be injured, be unable to repair the damage and function abnormally.
4. The cell may sustain an injury so severe that it will die.

The extent of the damage done by the radiation is dependent on many factors. Some of these include how fast the dose was received, the magnitude of the dose and which part of the body was actually exposed. How soon these effects appear after the radiation dose, determines if they are classified as short term or long term effects. A short term effect usually appears a few days or weeks after the dose. A long term effect usually appears years after the dose.

Acute Doses

For the purposes of this course, an acute dose is defined as a large dose received over a short time period. An example of an acute dose is 100,000 mrads received in less than one week. The short term effects from this acute dose may include changes in the blood, nausea, diarrhea, fatigue, hair loss, sterility, easy bruising or other effects. Short term effects are detectable only when the acute dose exceeds about 10,000 mrad. Below this level, the effect or damage from the radiation is too small to detect with today's technology.

In addition to the short term effects, an individual may also experience a long term effect from an acute dose. This primarily develops as a form of radiation induced cancer several years after the acute dose. The probability of a long term effect occurring, increases with increased dose, but the severity of the cancer does not change as the dose increases.

It is important to note that acute exposures of radiation workers occur only in accident situations. Improper uses of, or violations of interlock protection for hot operations or radiation producing machines have the *potential* to cause acute doses.

Chronic Doses

In this course, a chronic dose is one received over a long period of time, usually in small increments. Examples of chronic doses include the dose received as a Radiological Worker (occupational dose) and the dose from background sources. Chronic doses may present an increased risk of a radiation induced cancer developing later in life. This is the possible long term effect associated with a chronic dose. ***There are no short term effects associated with a chronic low level radiation dose.*** Within the allowed dose limits, this increased risk of a radiation induced cancer is considered small, especially when compared to risks people accept in their everyday lives.

Prediction of long term effects occurring are based on studies of people exposed to large doses, and include the survivors of Hiroshima/Nagasaki, radium dial painters, Ankylosing Spondylitis (arthritis of the spine) patients, and uranium miners. The effects observed from these high doses are extrapolated to lower doses by assuming a direct, linear correlation. There has been some discussion about the appropriateness of these extrapolations from high dose to low dose, but scientific opinion generally concurs that these estimates are conservative.

Somatic Effects

Biological effects of radiation doses that appear in the individual exposed, are called somatic effects. These include the short term effects associated with an acute dose and the long term effects associated with either an acute or chronic dose.

Genetic Effects

Biological effects that appear in an offspring would be a somatic effect, if the mother was exposed after conception. If a biological effect appears in an offspring, or in a future generation, as the result of one of the parents being exposed prior to conception, it is called a genetic effect. These effects are the result of radiation injury to parent germ cells (egg and sperm cells). The prediction of genetic effects occurring is based mainly on plant and animal studies. **Genetic effects have not been observed in people, only calculated.**

Prenatal Exposure

Any harmful effect to the embryo/fetus (in utero) is called a teratogenic effect. As with many other physical factors that are known to cause a teratogenic effect, radiation at relatively high doses may cause low birth weight or retarded growth. Some of these other factors include the mother smoking, consuming alcohol during pregnancy and the use of caffeine. The rapidly developing and immature cells of the fetus are more sensitive to damage. The actual effects on the embryo/fetus are a function of the time during gestation that the dose is received, and the amount of dose received.

The prediction of these effects occurring are based on studies from Hiroshima/ Nagasaki and pregnant women receiving radiotherapy. When compared to the normal risks associated with a pregnancy, risk of teratogenic effects from exposure to radiation up to the DOE limits (500 mrem/gestation period) is considered negligible. Current knowledge indicates that only when radiation doses exceed 15,000 mrem is there a significant increase in the risk.

Because the embryo/fetus is more susceptible to injury from radiation (compared to mature, non-dividing cells) DOE, NRC and AEI have a policy restricting the dose allowed to a "declared" pregnant Radiological Worker. This policy is explained in detail in the section on Radiation Limits.

Risks Associated With Exposure To Ionizing Radiation

Based primarily on human studies, the National Academy of Science, National Council on Radiation Protection and Measurement, and the International Commission on Radiation Protection estimate the average risk (to an adult) of fatal cancer from radiation in his/her lifetime is 4 in 10,000 per rem, using linear extrapolation.

To illustrate this, in a population of 10,000 people, current statistics indicate that approximately 3,000 will contract cancer in their lifetime. Of the 3,000 that develop cancer, approximately 2,000 will die from their cancer. If all 10,000 people were to receive 1,000 mrem (in addition to the radiation dose from natural background and man-made sources), an additional 4 deaths may occur due to radiation induced cancers. This increases the total fatality from approximately 2,000 to 2,004. This small effect cannot be "seen" in the normal variation of the death rates, and therefore must be calculated.

Another way of stating this is that each member of the general population in the United States has roughly a 20% chance of dying from cancer (this is the natural cancer mortality rate). If this person were to receive an occupational dose of 1 rem (cumulative during his/her life), their risk of developing a fatal cancer would increase from 20 % to 20.04%.

Still, it is assumed, as a conservative approach to radiation protection, that there is some probability for effects occurring even at very low doses. This "no threshold" concept is the basis for our ALARA (As Low As Reasonably Achievable) policy. This requires us to justify the need to receive radiation dose in order to provide some value to life and ensure the benefit of completing the task outweighs the risk associated with the exposure received during the task.

The following chart may be used to gain perspective of the risk associated with exposure to radiation:

COMPARISON OF MORTALITY RATES

CAUSE	ANNUAL DEATHS/MILLION PERSONS
Cardiovascular disease	4780
Cancer	1700
Motor accidents	220
Home accidents	150
Homicides	100
Fire	30
Drowning	30
Poisoning	13
Radiation effects (per rem)	9
Aircraft crashes	8
Electrocution	6
Lightning	1
Animal and insect bites	1

The following charts provides a break down of occupational and work place hazards based on death rates:

RELATIVE OCCUPATIONAL DEATH RATES

OCCUPATION	RELATIVE VALUE	OCCUPATION	RELATIVE VALUE
Taxi cab/Chauffeur	15.1	Stocker/Bagger	3.1
Police Officer	9.3	Store Owner/Manager	2.8
Hotel Clerk	5.1	Bartender	2.1
Gas Station Worker	4.5	Radiation Worker (est.)	0.02
Security Guard	3.6		

RELATIVE WORKPLACE DEATH RATES

WORKPLACE	RELATIVE VALUE	WORK PLACE	RELATIVE VALUE
Taxi cab/Dispatch Office	26.9	Grocery Stores	3.2
Liquor Stores	8	Jewelry Store	3.2
Gas Stations	5.6	Hotels/Motels	1.5
Detective/Protective Agencies	5	Restaurants/Bars	1.5
Court/Prison/Police/Fire Dept	3.4		

As can be seen from these tables, the estimated or calculated risk of death from radiation exposure is quite low compared to many other actual or observed causes of death in our society.

Benefits of Radiation

Although the risks are low, some individuals are concerned about exposure to radiation, even at very low levels. These are personal value judgements that every individual must make for themselves. Everyone should keep in mind that many uses of radiation are very important in health care or in other applications by society. The potential benefits of such use should be carefully weighed in consideration of the small risks produced by them. Some beneficial uses of radiation include:

1. Medical/Dental x-rays
2. Cancer therapy
3. Radiography for structural integrity
4. Nuclear medicine scans (heart stress test, thyroid, liver, bone, kidney, brain, etc.)
5. Food preservation
6. Airport security
7. Biomedical research, such as DNA, cancer and immune system diseases
8. Electric power production from nuclear facilities

RADIATION DOSE LIMITS

The learning objectives in this lesson include:

1. State the purpose of radiation control limits.
2. State the occupational dose limits.
3. State AEI's administrative radiation dose level.
4. State the radiation dose limits for members of the general public.
5. Recognize the definition of PSE.
6 State the AEI policy concerning prenatal radiation dose.

Basis and Purpose for Radiation Dose Limits

Radiation dose limits have been established to minimize the potential risk of biological effects associated with radiation exposure. The dose limits established by DOE/NRC for occupational workers are based on guidance from the Environmental Protection Agency (EPA), National Council on Radiation Protection and Measurements (NCRP) and the International Commission on Radiological Protection (ICRP). These limits are also consistent with those of other state agencies and other countries. Limits are set by regulatory agencies (such as Department of Energy) and cannot be exceeded intentionally, except for approved planned special exposures discussed later in this section.

Occupational Dose Limits

The occupational dose standards are limits for dose received by workers assigned duties involving exposure to radiation and/or radioactive materials. Every effort will be made to maintain personnel radiation doses as far below the indicated radiation protection standards set forth in this section and consistent with the ALARA principle. Radiation dose received from natural background and medical exposures are not included in the radiation dose limits specified in this section.

The regulatory (NRC and DOE) occupational dose limits for radiation workers are:

Location	mrem Per Year
Whole Body: Head, Trunk (Including Male Gonads), Arms above the Elbow, and Legs above the Knee (TEDE)	5,000
Extremities: Hands, Forearms, Feet, Ankles	50,000
Internal Organs	50,000
Lens of the Eye	15,000
Skin: of Whole Body Region	50,000
Embryo - Fetus (per entire gestation)	500

The whole body dose limit combines both internal and external dose for an individual and is reported as TEDE.

Administrative Dose Level

At AEI, extensive controls are in place to keep dose well below regulatory limits. An administrative occupational dose control level of 1250 mrem TEDE per quarter is part of these controls. Keeping doses low requires a cooperative effort between radiation protection staff and individual radiation workers.

Public Dose Limits

Radiation doses tot he general public will be maintained below the following limits:

1) The dose in any unrestricted area will be maintained below 2.0 mrem in any one hour period.
2) The maximum exposed individual's total effective dose equivalent from occupancy in all unrestricted areas will not exceed 100 mrem per calendar year.

In addition, members of the general public are not allowed in AEI work areas where radioactive materials are being handled. If an individual requires entry in a AEI restricted work area for inspection or audit purposes, they will be required to provide information on their radiation worker training status. Appropriate supplemental training and dosimetry will be provided to these radiation workers commensurate with the hazard involved in the work.

Also, minors (anyone under 18 years old), will be considered as members of the public for radiation protection purposes and will not be assigned radiation worker duties.

Planned Special Exposure (PSE)

A planned special exposure is an authorized exposure that is separate from and in addition to annual dose received under the Federal limits previously specified. AEI does not anticipate that a PSE will be used in any of the work performed by the company or its workers. A PSE would only be considered: in the unlikely event that it was the ALARA solution to the serious conditions of an unusual situation, and all Federal requirements to perform the PSE had been met, and AEI senior management had provided written approval.

Prenatal Policy

Any Radiological Worker who becomes pregnant, is encouraged to voluntarily notify her supervisor in writing. Upon receipt of the written notification, she is classified as a "declared pregnant worker". Because of the woman's right to privacy, no action can be taken until the formal notification is received. The policy of AEI is to offer the option of a mutually agreeable assignment without loss of pay or promotional opportunity, such that further occupational radiation exposure is unlikely.

If the declared pregnant worker decides to continue working as a Radiological Worker, her dose limit for the gestation period is 500 mrem. AEI's goal is to control her exposure to no more than 50 mrem/month. To qualify as a Radiological Worker, you are required to sign a statement that this policy has been explained to you. The requirement states that all female Radiological Workers, their supervisors and co-workers must sign this statement.

AS LOW AS REASONABLY ACHIEVABLE

The learning objectives in this lesson include:

1. State the purpose of the ALARA concept.
2. State the AEI management policy for the ALARA program.
3. Identify both management and worker responsibilities regarding the ALARA program.
4. Identify the basic protective measures of time, distance and shielding.
5. Identify the worker's responsibilities concerning dose limits.
6. Describe the actions a worker should take if he or she suspects that dose limits are being approached or exceeded.
7. Identify methods for reducing radiation dose.

ALARA Concept

Every person working at AEI has a responsibility to themselves and their co-workers to work safely and maintain a safe working environment. Because there is a possibility, however small, of an effect occurring from any exposure to radiation, all doses are maintained As Low As Reasonably Achievable (ALARA).

Under the ALARA concept, AEI management policy includes:

1. Controlling radiation doses to workers and the public well below the regulatory limits.
2. Ensuring that no radiation exposure occurs without a corresponding benefit, and the benefit outweighs the risks associated with that dose.
3. Preventing unnecessary exposures to workers and the public.
4. Protecting the environment.

Individual Responsibilities

Some of the individual's responsibilities as a Radiological Worker at AEI include:

1. Assuming the ***primary responsibility*** for maintaining your radiation dose ALARA and below the dose limits.
2. Use time, distance, and shielding to maintain your radiation doses low.
3. Maintain radiation interlock systems in a fully operational condition.
4. Read and comply with all radiation barriers, signs, labels and postings.
5. Do not climb over barrier fences, or defeat any radiological protection systems.
6. If you suspect you are approaching or have exceeded a dose limit, stop work, leave the area and report your concern to your supervisor.
7. Comply with all regulations and orders establishing radiation dose limits.

As a Radiological Worker, and part of the AEI team, you have many resources at your disposal to aid in carrying out these responsibilities. Among these resources are the AEI Management, Radiation Safety Officer, Supervisors and Health Physics Technicians.

AEI's Management Responsibilities

Under the ALARA program, AEI management is responsible for the following:

1. Management must be involved in the planning, scheduling and approving the conduct of radiological work.
2. Must ensure that radiological safety is not compromised to achieve production or schedule objectives.
3. Must ensure the staff has completed the required training.
4. Must develop procedures to keep doses ALARA.
5. Providing overall health physics coverage for work activities.
6. Performing radiation and radioactive contamination surveys.
7. Providing coverage for Industrial Hygiene and Industrial Safety concerns.

Minimize Time of Exposure to Radiation

The main goal of the ALARA program is to reduce the radiation doses to a level that is As Low As Reasonably Achievable. Reducing the amount of time in a radiation area or field lowers the dose you receive. One of the keys in minimizing your time in a radiation area is to pre-plan the job or experiment. This may include:

1. Use of mock-ups to prove equipment or procedures, or to gain proficiency at the task to be done.
2. Taking the best route to the job site; the shortest route may not be the best - know where the higher and lower radiation level areas are.
3. Preparing the necessary tools and equipment prior to entering the area; verify any special calibration or tool preparation is done before entering the radiation area.
4. Never loiter in an area controlled for radiological purposes.
5. Working efficiently and quickly.
6. Eliminating rework by doing the job right the first time.
7. Performing preparatory work and parts assembly outside the area.

Maximize Distance from the Radiation Source

Use the protection offered by distance from the source of radiation whenever possible. For many sources, radiation levels decrease exponentially with increased distance. If the distance from a small (point) source is doubled, the radiation level decreases by a factor of 4.

Some methods to increase the distance from the radiation source include:

1. During work delays, move to lower dose rate areas.
2. Using long handled tools, mechanical arms, robotics, or remotely operated tools to avoid higher dose rate areas.
3. Knowing the radiological conditions of the area you are entering. If possible, move the item being worked on away from the source of radiation, or move the source of radiation away from the work area.
4. Use of mirrors or closed circuit TV to monitor the job site.

Use Shielding to Lower the Dose Rate

Shielding reduces the amount of radiation dose to the worker.

1. Select the proper materials to shield a worker from the different types of radiation.
2. Take advantage of permanent shielding such as equipment or existing structures.
3. Position yourself so that shielding is between you and the source.
4. Wear safety glasses/goggles to protect the eyes from beta radiation, when applicable.
5. Install temporary shielding when required by procedure or the Radiological Work Permit (RWP).

Interlocks and Shielding Design

Interlocks and Alarm systems are examples of engineering solutions that support the ALARA concept. Some of the basic interlock systems include:

1. Interlocks that prevent access.
2. Interlocks that turn off the source of radiation.
3. Interlocks that shield the source of radiation.

Alarm systems are also used in various ways to warn people of a hazardous condition or situation. Because there are so many different interlock systems in use, specific operating instructions and concerns will be discussed when you receive site specific training.

PERSONNEL MONITORING PROGRAMS

The learning objectives in this lesson include:

1. State the purpose of each of the personnel dosimeter devices used at AEI.
2. Identify the correct use of each of the personnel dosimeter devices used.
3. State the method for obtaining dose records.
4. Identify worker responsibilities for reporting radiation dose received from other sites and from medical applications.

Dosimeters

There are several devices used to monitor occupational dose. They include the thermoluminescent dosimeter (TLD), film badge, self reading dosimeter and finger ring TLDs.

Thermoluminescent Dosimeters

The TLD is issued to monitor your occupational dose while working for AEI. This dosimeter offers no protection from radiation, but monitors your exposure to beta, gamma and (if needed) neutron radiation. The TLDs are exchanged on a monthly basis and processed by an outside contractor. This processing usually takes a few weeks, unless there is a need for a quicker turn around in an individual case. There are many rules and requirements regarding the use of a TLD because the ***TLD is the basis for the legal record of your occupational dose.*** These requirements include:

1. TLDs are worn when required by AEI or work site-specific procedures.
2. TLDs must be worn on the front of the torso, between the waist and the neck. The best location is the center of the chest with the label side of the dosimeter facing away from the body.
3. When another type of dosimeter is required, it shall be worn adjacent to the TLD unless otherwise directed by Radiation Safety Officer or Health Physics technician.
4. The TLD user should place his/her TLD on the dosimeter board at the job site (if provided) at the close of business. If the work assignment requires the dosimeter be taken away from the job site, keep it in a cool, dry place and return it to the job site the next working day.
5. TLDs at AEI are usually exchanged the first Saturday of each month.
   a. If you leave AEI (employment is terminated or your contract has expired), turn your TLD in to the supervisor before you leave the site. The supervisor will notify the Radiation Safety Officer who will in turn cancel the TLD service.
   b. If you will not be here for the monthly exchange (e.g., business trip or vacation), leave your TLD on the dosimeter board or leave the TLD with your supervisor.
   c. Personnel that fail to return a TLD may be restricted from continued radiological work.

6. Radiological Workers shall never wear another worker's TLD, and never allow another to wear theirs. Because the TLD is issued to monitor an individual's monthly dose, either of these practices would invalidate the dose recorded on the TLD.
7. TLD wearers should notify their supervisor if the TLD has been misused or damaged in any way, (such as a trip through the laundry cycle or worn during a medical x-ray). A complete dose estimate will be documented and the dose assigned based on your work activities and radiological conditions of your work sites. A new TLD will be issued to accurately monitor your occupational dose for the remainder of the month. **Wearers should never open or tamper with the dosimeter.**
8. Individuals working in areas controlled for radiological purposes should take specific actions if their TLD is lost, damaged, or contaminated. These actions include placing your work activities in a safe condition, immediately exiting the area and notifying your supervisor or Health Physics Technician of the situation.
9. **TLD results are your legal records of dose.** Report any lost badge immediately, and if you find a dosimeter, turn it in to your supervisor. If you lose your dosimeter or fail to return it, an estimated dose is assigned to you based on your work activities and radiological conditions of your work sites.

Direct Reading Dosimeters

Direct Reading Dosimeters (DRDs) can be used to monitor an individuals exposure to gamma or x-ray radiation. The main benefit of the DRD is that it provides an immediate read out, and should be checked periodically by a worker during performance of a task. At AEI, the DRD is usually used only in High Radiation Areas, or when an individual is expected to receive a relatively high monthly dose to track their dose on a more frequent basis.

Finger Ring TLD

The Finger Ring TLD (Thermoluminescent Dosimeter) is used to monitor the dose to your hands under certain circumstances. If you are working with sources that will give your hands a much greater dose than that recorded by your film badge, notify the supervisor or Health Physics Technician. He or she will evaluate the situation and determine if the use of the Finger Ring TLD is warranted. Proper use of this TLD is explained prior to issue.

Dose Records

Every employee has a right to know their current dose levels. The records maintained by AEI are available to you and may be obtained from your supervisor. Additionally, a copy of your dose record is provided to you on an annual basis, and at the request of the individual (30 days post request or receipt of results, whichever is longer). If you are a visitor or guest and receive a detectable exposure, copies of your records are mailed to your parent organization when you leave AEI.

Differs from HASP Plan, p.1

Reporting Doses From Other Facilities

Occupational doses received from another facility (such as a DOE Laboratory or civilian nuclear power plant) or from employment (such as a part time job as an x-ray technician at a local hospital) shall be reported to your supervisor or Radiation Safety Officer. This is to ensure your dose records reflect your total occupational dose and reduce the possibility that you might receive excessive dose.

The dose from nuclear medicine studies and tests is not included in occupational doses, but may affect the dose registered by your TLD badge, or may inhibit your ability to detect radioactive material on your person when exiting certain areas. Because of this problem, AEI must be notified when you have been treated with radionuclides. You also have a right to privacy concerning any medical treatment you may be receiving. In order to preserve your right to privacy, this notification can be made to AEI through the Radiation Safety Officer. Otherwise you may notify your supervisor. Our concern is that we monitor your **occupational** dose only. This reporting requirement does not include the routine use of medical or dental x-rays. Do not wear your TLD or dosimeter during any dental or medical exam that uses radiation.

RADIOACTIVE MATERIAL CONTROLS

The learning objectives in this lesson include:

1. Define activated material, sealed sources, unsealed (dispersible) sources and radioactive contamination.
2. Define fixed, removable and airborne contamination.
3. State the pathways radioactive material can enter the body.
4. Identify the methods used to minimize internal radiation dose.
5. State the purpose of each type of internal monitoring method used.
6. Identify worker responsibilities concerning internal monitoring programs.
7. Describe the purpose and use of personnel contamination monitors.
8. State the appropriate response to personnel contamination monitor alarms.

Until now, all discussions have centered on external exposure to radiation. Because an individual qualified as RW-1 may enter and work in Radiation Areas, Radiological Contaminated Areas and Radioactive Material Areas, certain radioactive material controls must be discussed.

Activated Material

Activation is the process of making a material radioactive by bombardment with neutrons, protons or other high energy particles or radiations. Activated material is found at accelerators, reactors, neutron generators, neutron sources and around other sources of high energy particles or radiations. Controls for activated materials include:

1. Surveillance by a trained individual. If an item is determined to be radioactive, it must be labeled to ensure proper handling before being removed from the area.
2. Activated solid objects are normally considered non-dispersible radioactive material and should present only an external radiation hazard.
3. Activated materials must be controlled to prevent inadvertent release to uncontrolled areas.
4. Additional controls are required if solid activated material is machined, sanded, welded or processed in any manner that could create dispersible radioactive material.

Sealed Sources

Sealed sources are radioactive materials that have been encapsulated to prevent easy dispersion. They are manufactured to allow use as a source of radiation for instrument calibration sources, instrument check sources, irradiation of other materials and use in radiography. Controls for sealed sources include:

1. Labeling and conducting inventories for all sealed sources above a threshold quantity.
2. Leak testing to ensure integrity of the source capsule.

3. Proper shielding during storage and use.
4. Training in source control techniques, posting, area control, and emergency recovery. Never taste or touch a sealed source. These sources are usually of high activity and will cause high dose with only short exposure times.

Unsealed (Dispersible) Sources

Unsealed sources are radioactive materials intended for use in a dispersible manner, such as radioactive tracers, loose chemical compounds, gaseous materials, radiopharmaceuticals and certain alpha and beta check sources. Controls for unsealed (dispersible) sources include:

1. Labeling and conducting inventories.
2. Containment design to prevent unwanted dispersion.
3. The use of appropriate personal protective clothing.
4. Required training for handling dispersibles.

Contamination

Contamination is defined as a dispersible radioactive material in a location where it is not wanted. Contamination is found in three forms: removable (sometimes called loose), fixed and airborne. Some examples include dispersible radioactive material that is spilled, mixed with "clean" waste, found on a person's skin or spread by way of welding, machining, sanding, grinding, or similar process. Some of the controls for contamination include:

1. Using boundaries, containments and surveys to minimize the potential to spread contamination.
2. Procedures and techniques for working with dispersible radioactive material that are designed to prevent the spread of contamination.
3. The use of appropriate personal protective clothing.
4. Training for individuals whose work has the potential for creating or spreading contamination.

Methods to Reduce Internal Radiation Dose

An internal dose is the result of radioactive material being taken into the body through inhalation, ingestion, absorption through the skin or entry through a wound. Methods used to reduce the potential for contamination to enter the body include:

1. The use of appropriate personal protective clothing.
2. Proper containment of dispersible radioactive materials.
3. Careful handling when transferring dispersible radioactive materials.
4. Controlling access to certain areas for individuals with skin cuts or abrasions. As a general rule, you should notify the Health Physics Technician of an open skin wound before working with dispersibles.

5. Complying with all the requirements of the Radiological Work Permit or other work documents.
6. Restricting certain processes to designated areas.
7. Meticulous self monitoring (frisking) practices.

The routine bioassay methods for internal monitoring are urinalysis and whole body counts. The purpose of internal monitoring is to support AEI's program for contamination control. The results of this monitoring are used to determine the amount of radioactive material taken into the body. If you are suspected of getting contamination inside your body, you may be asked to provide a bioassay sample and/or have a whole body count. The results of internal monitoring (calculated dose) will be documented in your dose records.

Self Monitoring (Frisking) Procedure

Self monitoring or frisking refers to the process of carefully checking your person or work area for contamination. Frisking techniques or methods used to monitor for contamination on the body must be performed in a methodical manner. Actual frisking requirements and procedures are posted at the exit of the Radiological Buffer Area. Monitoring is generally performed in the following order:

1. Preoperational checks.
   a. Perform a visual check of the instrument for physical damage.
   b. Verify the calibration of the instrument is current.
   c. Perform a battery check.
   d. Perform a source check. Meter response must be within ± 20% of expected response listed on the side of the meter.
2. Determine background levels.
3. Survey hands before handling the probe or meter.
4. Hold the probe ¼" to ½" from the surface of the part of the body being surveyed.
5. Move the probe over the surface no faster than 2 inches per second.
6. ALWAYS listen for the audio response.
7. If you hear increases in the audio response, stop moving the probe and wait for the meter to respond, (up to 22 seconds in the slow mode). Note the meter reading.
8. Finally, survey the designated portions of your body, (hands and feet are minimum required to exit a Contaminated Area); a whole body frisk takes 2 - 3 minutes.

If contamination is found, either while frisking or by an alarming personnel contamination monitor, remain in the area, notify the Health Physics Technician or your supervisor and try to prevent further spread of contamination. **The Health Physics Technician or your supervisor will provide instructions and procedures used to decontaminate the affected area.**

RADIOLOGICAL POSTINGS AND CONTROLS

The learning objectives in this lesson include:

1. Identify the colors and symbols used on radiological postings, signs and labels.
2. Define Restricted, Radioactive Material, Very High Radiation, High Radiation, Radiation, Airborne Radioactivity, and Radiological Contaminated Areas.
3. State the entry, working in and exiting requirements for Restricted, Radioactive Material, Very High Radiation, High Radiation, Radiation, Airborne Radioactivity, and Radiological Contaminated Areas.
4. Identify the radiological areas that a Radiological Worker may enter, and the postings for each area.
5. State the purpose of and information found on Radiological Work Permits (RWPs).
6. Identify the individual's responsibility in using Radiological Work Permits.
7. State the radiological and administrative consequences of unauthorized removal or relocation of radiological postings, signs and labels.

Radiological Postings

Radiological postings are used to alert personnel to the presence of radiation and radioactive materials. All areas controlled for radiological purposes are posted with a sign containing a magenta (or black) three-bladed radiological warning symbol (trefoil) on a yellow background. Additionally, yellow and magenta ropes, tapes, chains, or other barriers may be used to denote the radiological boundaries. These barriers must be clearly visible to anyone approaching the area, and entrance points to those areas shall be posted with signs (or equivalent) listing the entry requirements.

Before entering an area controlled for radiological purposes, read and comply with all requirements on the signs. As radiological conditions change, the signs are updated to reflect the new conditions and requirements for entry.

Disregarding or unauthorized removal of radiological postings, signs, or labels may cause unnecessary dose, violates federal regulation, and AEI policy and may lead to disciplinary action.

Restricted Area

A Restricted Area is any area to which access is controlled to protect personnel from exposure to radiation or radioactive materials. A Restricted Area may exist any place where radiation levels are above background and where an individual may receive an occupational dose. A restricted area is posted with a sign bearing the words, CAUTION - Restricted Area. After successful completion of this course, you will be allowed unescorted access to Restricted Areas.

Radioactive Material Area

A Radioactive Material Area (RMA) is an area or structure where radioactive material is being used, handled or stored. Any area or room which uses or stores an amount of licensed material exceeding 10 times the quantity of such material specified in appendix C, Title 10 Part 20, Code of Federal Regulations, must be posted with a sign or signs "CAUTION, RADIOACTIVE MATERIALS AREA" OR "DANGER, RADIOACTIVE MATERIALS AREA".

Requirements to enter an RMA include:

1. Radiological Worker (RW-1) training as a minimum.
2. Applicable dosimetry.

The only general requirement to work in an RMA is to follow ALARA practices to keep your dose low and be conscious of the radiological conditions. Specific requirements to enter or exit the area will be posted.

Radiation Area

A Radiation Area is an area accessible to personnel, in which radiation levels could result in a person receiving a dose equivalent greater than 5 mrem, but less than 100 mrem in one hour. Any area accessible to personnel in which there exists ionizing radiation at dose-rate levels such that an individual could receive a deep dose equivalent in excess of 5 mrems in 1 hour at 30 centimeters from the radiation source, or from any surface that the radiation penetrates must be posted with a sign "CAUTION, RADIATION AREA". Sufficient indicators (such as radiation ribbon) shall be used to identify the boundary of the radiation area.

An exemption to this posting requirement is allowed in areas or rooms containing radioactive materials for periods of less than 8 hours, if each of the following conditions are met:

1) The materials are constantly attended during these periods by an individual who takes the precautions necessary to prevent the exposure to radiation or radioactive materials in excess of the limits specified in section 3.0 of the Radiation Safety Manual; and

2) The area or room is subject to the licensee's control.

For example, the area around a truck loading radioactive waste does not require posting if the above conditions are met.

After successful completion of this course, you will be allowed unescorted access to Radiation Areas.

Requirements to Enter a Radiation Area Include:

1. Radiological Worker (RW-1) training.
2. Worker's signature on the RWP (if applicable).
3. TLD and other appropriate dosimetry.
4. Site specific training (as appropriate).

Requirements for working in the area include:

1. Practice ALARA methods.
2. If unanticipated elevated radiation levels are indicated by an off-scale dosimeter, radiological alarms or other indicators; stop work, alert others, immediately exit the area and notify the Health Physics Technicians or your supervisor.

High Radiation Area

Any radiation area accessible to personnel in which there exists ionizing radiation at such levels that an individual could receive in excess of 100 mrems in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates must be posted with a sign "CAUTION, HIGH RADIATION AREA" or "DANGER, HIGH RADIATION AREA".

Radiation workers will only work in these areas under the control of a specific work permit and only under the direct observation of radiation protection personnel.

Very High Radiation Area

Any area accessible to personnel in which there exists ionizing radiation at such levels that and individual could receive in excess of 500 Rad in 1 hour at 1 meter from the radiation source or from any surface that the radiation penetrates must be posted with a sign "GRAVE DANGER, VERY HIGH RADIATION AREA".

Radiation workers will not enter a Very High Radiation Area without specific prior written approval of AEI Management.

Radiological Contaminated Area

A Radiological Contaminated Area (RCA) is a restricted area established to prevent the spread of radioactive contamination. A restricted area that has fixed and removable radioactive materials in the form of dusts, particulates, and sorbed contaminates which are above the limits specified in the following table is identified and posted with a "CONTAMINATED AREA" sign. Contamination control procedures and step off pads are used for entry and exiting the contaminated area to retain contamination within the designated area. Personal protective clothing are required for entry into a contaminated area to prevent contamination of workers and their personal clothing.

Requirements to enter a Radiological Contaminated Area:

1. Radiological Worker training.
2. TLD and other appropriate dosimetry.
3. Site specific training (if appropriate).
4. Protective clothing as required by an RWP.

Requirements for working in an RCA.

1. Always practice ALARA.
2. Follow the no eating, drinking, smoking or chewing policy for the area.
3. Obey all posted, written or oral requirements including "Evacuate" or "Stop work" orders from the Health Physics Technician or supervisor.
4. Use labels or tags to identify specific radiological hazards.
5. When storing radioactive material in drums, vials, flasks, boxes, etc., ensure containers are marked appropriately.
6. Report to a Health Physics Technician if you identify that radiological controls are not adequate or are not being followed.
7. Report to the Health Physics Technician if you see any unusual conditions such as leaks or spills, dust, hazy air or alarming radiological control instrumentation.
8. If a spill of radioactive material should occur, notify the Health Physics Technician or supervisor.
9. Be aware of changing radiological conditions.
10. Make certain that your activities do not create radiological problems for others and be alert that their activities may change the radiological conditions where you are. .

Requirements for Exiting an RCA:

1. Workers must monitor for contamination in accordance with procedures or posted instructions at the RCA exit. The minimum requirement for exiting an RCA includes a survey of the hands and feet.
2. All items being removed from the area must be monitored for contamination.
3. Personnel frisking must be completed before exiting.

Airborne Radioactivity Area

A room, enclosure or area must be posted with a "CAUTION, AIRBORNE RADIOACTIVITY AREA" or "DANGER, AIRBORNE RADIOACTIVITY AREA" if radioactive material is dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases and the concentration of the dispersed radioactive materials is in excess of:

a) The derived air concentrations (DAC's) specified in Table 1, column 3 of Appendix B, Title 10 Part 20 of the Code of Federal Regulations.

B) Concentrations such that an individual present in the area without respiratory protective equipment could exceed, during the hours the individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI).

Radiation workers may only work in these areas under the direction of a radiation work permit and the site supervisor or designee.

Escorts

Visitors with a demonstrated need to enter the following areas, may be allowed access if that access is controlled with a combination of training and the use of escorts trained for the specific area:

1. Radiological Contaminated Areas
2. Radiation and High Radiation Areas
3. Radioactive Material Areas

If you have any questions concerning the use of escorts, contact your Supervisor.

Radiological Work Permits (RWPs)

A Radiological Work Permit is an administrative mechanism used to establish radiological controls for intended work activities. As a RW-1 trained individual, you may be required to use an RWP. RWPs serve to:

1. Inform workers of area radiological conditions.
2. Inform workers of entry requirements into the areas.
3. Relate radiation doses received by workers to specific jobs or tasks.

Typical information found on Radiological Work Permits includes:

1. A description/location of work.
2. Radiological conditions of the work area. This information may be determined from radiological survey maps/diagrams or the radiological posting for that area.
3. Dosimeter requirements.
4. Required level of training for entry.
5. Radiological control support requirements.
6. Limiting radiological conditions that may void the permit.
7. Special dose reduction considerations.
8. Technical work documents and other unique identifying numbers.
9. Date of issue/expiration.
10. Authorizing signatures.

Responsibilities of the worker when using a RWP

When using a Radiological Work Permit, workers are responsible for reading the RWP, understanding the permit before entering the area and complying with all instructions on the RWP. Never make substitutions

for specific requirements. Sign in on the RWP (if applicable), or associated sign-in log, indicating:

1. You have read, understand, and will comply with the permit prior to entering the area.
2. If you think that the RWP is incorrect or you do not understand any of the information, do not start the job until your concerns are resolved. Contact your supervisor or Health Physics Technician.

Supervisor Responsibilities

1. Has front line responsibility for worker safety.
2. Ensures staff has completed required training.
3. Develops procedures to maintain dose ALARA.
4. Informs staff of Radiation Safety Manual, AEI Procedure, and RWP requirements .
5. Ensures all areas are properly posted.
6. Keeps Health Physics Technician informed of work scope and radiological condition changes.

Health Physics Technician Responsibilities

1. Reports to Radiation Safety Officer.
2. Has front line responsibilities for adherence to radiation protection policies and procedures..
3. Performs surveys and safety inspections.
4. Implements Radiation Safety Manual requirements.

Employee Responsibilities

1. ***Primary responsibility for your own radiation safety protection.***
2. Obligation to work safely.
3. Ensure you are trained before attempting new tasks.
4. When in doubt, consult with your supervisor or Health Physics Technician.
5. Comply with dose limits and administrative control levels.
6. Comply with monitoring requirements.

RADIOLOGICAL EMERGENCIES

The learning objectives in this lesson include:

1. State the purpose and types of emergency alarms.
2. Identify the correct responses to emergencies and/or alarms.
3. State the possible consequences for disregarding radiological alarms.

Emergency Alarms and Response

The purpose of emergency equipment that monitors radiation and alarms to warn personnel of unusual radiation or airborne contamination is to avoid unnecessary and unplanned dose to workers.

Equipment that monitors for unusual radiation levels and airborne contamination is placed in strategic locations. Your response to radiation alarms is as follows:

1. Immediately, place your equipment in a safe condition.
2. Warn others of the alarm and the need to leave the area.
3. Promptly leave the area and go to a safe location.
4. Prevent other workers from going into the area.
5. Notify radiation protection personnel of the alarming equipment.

It is essential that each worker be able to identify the equipment and respond appropriately to the alarms. Because of the variety of systems at various facilities, more detailed information will be provided during the initial job briefing at the work site.

Disregarding or deactivating emergency alarms without proper authorization can cause unnecessary dose to workers, violate federal regulations and AEI policy and may lead to disciplinary action.

If you witness any unusual situations, take appropriate actions for the situation, contact your Health Physics Technician or Supervisor for radiological concerns.

Spills

In general, immediate actions taken to control radioactive materials can be very important to minimize exposure during recovery operations. Should a spill of radioactive or hazardous materials occur, and there is no immediate danger to you or others in the area, then:

1. Stop the spill (upright the container, cover drums, etc.).
2. Warn others in the area of the spill.
3. Isolate the area to prevent entry of others.
4. Minimize your exposure and that of others.
5. Notify health physics personnel and your supervisor.

The emergency action required can be remembered by the acronym SWIMN.

RESPONSIBILITIES OF INDIVIDUALS

The AEI radiation safety program is administered by the Radiation Safety Officer who reports directly to the president of AEI. Responsibilities for the key functions of the radiation safety program are listed below.

Remediation Program Manager

The Program Manager has the following responsibilities on projects involving radioactive materials.

1. Ensure that operations comply with the provisions of the Radiation Safety Manual and other pertinent federal regulations.
2. Establish a radiation control program for projects involving radioactive materials.
3. Manage the preparation of operating procedures which ensure compliance with the Radiation Safety Manual, pertinent federal regulations, and customer requirements.
4. Ensure that employees working with radioactive materials have received the required training in operating procedures, rules, and special precautions prior to being occupationally exposed to ionizing radiation.
5. Keep the president of AEI informed of the status of the program and radiation safety objectives.

Radiation Safety Officer

The Radiation Safety Officer (RSO) has the following responsibilities.

1. Implement and maintain an effective Radiological Controls Program that complies with the provisions of the Radiation Safety Manual and pertinent federal regulations.
2. Provide advice and assistance to AEI management on all matters pertaining to radiation safety requirements, procedures, and policies.
3. Perform surveys and inspections as required to ensure compliance with the provisions of the Radiation Safety Manual and other pertinent AEI directives, federal regulations, and customer requirements.
4. Develop, coordinate and participate in training and orientation programs for occupationally exposed individuals, and other personnel as required by the Radiation Safety Manual.
5. Maintain current all applicable required licenses and amendments.
6. Maintain a current ionizing radiation source inventory under AEI control to ensure that sources are secure against loss or unauthorized use.
7. Stop any job or activity which in their opinion may lead to an out of compliance situation. Conduct a complete review and obtain Director approval prior to allowing job continuation.

Waste Broker

The Waste Broker has the following responsibilities.

1. Package and ship radioactive materials in accordance with the provisions of the Radiation Safety Manual and pertinent federal regulations.
2. Provide advice and assistance to AEI management on all matters pertaining to packaging, shipping and transportation of radioactive materials.
3. Assist the RSO in training and orientation programs for occupationally exposed individuals, and other personnel as required by the Radiation Safety Manual.
4. Stop any job or activity which in their opinion may lead to an out of compliance situation. Conduct a complete review and obtain Director or RSO approval prior to allowing job continuation.

Radiation Workers

Employees of AEI who are assigned to work activities involving radioactive materials have the following responsibilities:

1. Obey posted, verbal and written radiological control procedures.
2. Wear dosimetry devices when required by the Radiation Safety Manual and promptly report any lost or damaged devices to their supervisor.
3. Promptly report to their supervisor or RSO any incident, personnel injury, suspected overexposure, contamination, internal deposition, and any suspicious or questionable occurrence involving radioactive material.
4. Be thoroughly familiar with equipment, procedures and the requirement for and use of, any special devices prior to using or working with any source or device which produces radiation.
5. Avoid any unnecessary exposure and use the concept of time, distance and shielding when working in the presence of radiation sources to maintain your exposure As Low As Reasonably Achievable (ALARA).

CONVERSIONS

SI Prefixes

Factor	Prefix	Symbol
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10^{1}	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

SI UNITS

Radioactivity units, curie (Ci) and Becquerel (Bq)

1 Ci = 3.7 X 10^{10} dps = 3.7 X 10^{10} Bq
1 mCi = 3.7 X 10^{7} Bq
1 nCi = 37 Bq

1 Bq = 27pCi
1 kBq = 27 nCi
1 MBq = 27 μCi
100 MBq = 2.7 mCi

Absorbed dose units, rad and gray (Gy)

1 mrad = 0.00001 Gy = 10 μGy
1 rad = 0.01 Gy = 10 mGy
10 rad = 0.1 Gy = 100 mGy

100 rad = 1 Gy
1,000 rad = 10 Gy
10,000 rad = 100 Gy

Dose Equivalent units, rem and sievert (Sv)

1 mrem = 0.00001 Sv = 10 μSv
1 rem = 0.01 Sv = 10 mSv
10 rem = 0.1 Sv = 100 mSv

100 rem = 1 Sv
1,000 rem = 10 Sv
10,000 rem = 100 Sv

Airborne Activity units, DAC and ALI

1 ALI causes 5000 millirem TEDE or 50rem organ dose
2000 DAC hours causes 1 ALI
1 DAC hour causes 2.5 millirem (stochastic)
or 25 mrem (non-stochastic)

AGUIRRE ENGINEERS, INC.

Radiation Safety Manual

Revision 0

Reviewed By: _____ 3/31/98
D.J. Wells, RRPT, Radiation Safety Officer — Date

Approved By: _____ 2/3/98
T.J. O'Dou, CHP, AEI Health Physicist — Date

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GLOSSARY

Glossary of terms used in the text of this safety manual.

Airborne Radioactivity Area - A room, enclosure or area in which radioactive material is dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases and the concentration of the dispersed radioactive materials is in excess of:

a) The derived air concentrations (DAC's) specified in Table 1, Column 3 of Appendix B, Title 10 Part 20 of the Code of Federal Regulations (Also noted in Appendix B of this manual).
b) Concentrations such that an individual present in the area without respiratory protective equipment could exceed, during the hours the individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI).

Annual Limit on Intake (ALI) - The annual limit on intake (ALI) of radioactive materials is the smaller amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year (40 hours per week for 50 weeks) that would result in a committed effective dose equivalent of 5 rem to the whole body or a committed dose equivalent of 50 rems to any individual organ or tissue.

Byproduct Material - Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material.

Committed Dose Equivalent ($H_{T,50}$) - Committed dose equivalent is the dose equivalent to an organ or tissue that will be received from an intake of radioactive material by an individual during the 50 year period following the intake, i.e. fifty year organ dose (total dose for fifty years from internal contamination).

Committed Effective Dose Equivalent ($H_{E,50}$) - Committed effective dose equivalent is the sum of the products of the weighing factors applicable to each of the body organs of tissues that are irradiated and the committed dose equivalent to these organs or tissues.

Controlled Area - Controlled area is an area outside of a restricted area but inside the site boundary, access to which can be limited by the activity for any reason.
Curie (Ci) - The unit of activity, one Curie equals 3.7×10^{10} nuclear disintegrations per second.

Declared Pregnant Woman - A woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

Deep Dose Equivalent (H_d) - Deep dose equivalent, which applies to external whole-body exposure, is the dose equivalent at a tissue depth of 1 cm (1000 mg/cm^2). Deep dose equivalent establishes a standard depth for specifying the dose from whole body external exposure.

Derived Air Concentration (DAC) - Derived air concentration is the concentration of a given radionuclide in air which, if breathed by the "reference man" for a working year (40 hours per week for 50 weeks) under the conditions of light work (inhalation rate of 1.2 cubic meters of air per hour), results in an intake of one ALI.

Effective Dose Equivalent (H_E) - The probability of a stochastic effect, e.g., cancer induction or hereditary effect, in any tissue is proportional to the dose equivalent to that tissue. The value for the proportionality factors differs among the various tissues because of the differences in tissue sensitivity. If radiation dose is uniform throughout the body then the total risk factor is one. For nonuniform radiation, such as partial body exposure where the isotope concentrates to different degrees in the various tissues, weighing factors which are based on the relative susceptibility of the tissues to stochastic effects may be used to calculate an effective dose equivalent. The effective dose equivalent is the sum of the products of the weighing factors applicable to each of the body organs of tissues that are irradiated and the dose equivalent to these organs or tissues.

External Dose - Portion of the dose equivalent received from radiation sources outside the body.

Extremities - Extremities means hand, elbow, arm below elbow, foot, knee, or leg below the knee.

Eye Dose Equivalent - Eye Dose Equivalent applies to the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 centimeters.

High Radiation Area(HRA) - Any radiation area accessible to personnel in which there exists ionizing radiation at such levels that an individual could receive in excess of 100 mrem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

Internal Dose - That portion of the dose equivalent received from radioactive materials taken into the body.

Ionizing Radiation - Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly, in its passage through matter. Ionizing radiation includes the following: Gamma rays, x-rays, alpha particles, beta particles, neutrons, protons, and other particles and electromagnetic waves capable of producing ions.

Licensed Material - Licensed material means source material, special nuclear material, or byproduct material received, possessed, used, transferred, or disposed of under a general or specific license.

Members of the Public - Individuals who are not occupationally exposed to ionizing radiation.

RAD. - The unit of absorbed dose which is equal to the absorption of 100 ergs per gram in any substance.

Radiation Area (RA) - Any area accessible to personnel in which there exists ionizing radiation at dose-rate levels such that an individual could receive a deep dose equivalent in excess of 5 mrems in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

Radioactive Contamination - A radioactive substance dispersed in or on materials or in places where it's presence is undesirable

Radiological Control Program (RCP) - A company responsibility comprising all procedures and techniques which are used to control radiation sources and radioactive materials to minimize exposure to personnel and the environment. It includes control of all ionizing radiation sources during storage, handling, use, shipping and disposal.

Radiation Safety Committee (RSC) - A committee that consists of the RSO, at least one representative of management; and at least one user from each of the activities that will use radioactive materials under the license. The RSC is responsible for establishing appropriate policies and procedures to ensure control, overall development, and implementation of the Radiation Safety Program.

Radiation Safety Officer (RSO) - This individual is responsible for oversight of the day-to-day radiation protection program established by the RSC, communication with senior management and the RSC regarding program implementation and compliance status, and is available to provide advice and assistance on radiological safety matters.

Radiation Safety Staff - The staff of health physics professionals that support the RSO in the maintenance and control of the licensed program.

Rem - The unit of dose equivalent for any type of ionizing radiation absorbed by body tissue in terms of its estimated biological effect relative to an absorbed dose from exposure to one roentgen of high energy x or gamma rays.

Restricted Area - Restricted Area means any area, access to which is limited for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials.

Roentgen - A unit of exposure to electromagnetic ionizing radiation. It is that amount of x-ray or gamma radiation which will produce in air 2.58×10^{-4} coulombs of charge per kilogram of dry air at standard temperature and pressure.

Shallow Dose Equivalent (H_s) - Shallow dose equivalent, which applies to the external exposure of the skin or an extremity, is taken as the dose equivalent at a tissue depth of 0.007 centimeters (7 mg/cm^2) averaged over an area of at least 1 square centimeter.

Source Material - Uranium or thorium, or any combination thereof, in any physical or chemical form.

Stochastic Effects - Stochastic effects are health effects that occur randomly and for which the probability of the effect occurring, rather than its severity, is assumed to be a linear function of dose without threshold. Hereditary effects and cancer incidence are examples of stochastic effects.

Total Effective Dose Equivalent (TEDE) - Total effective dose equivalent is the sum of the deep dose equivalent (external dose) and the committed effective dose equivalent (internal dose)

Unrestricted Area - Any areas to which access is neither limited or controlled by the customer or by AEI for the purpose of radiation protection.

Very High Radiation Area - Any area accessible to personnel in which there exists ionizing radiation at such levels that an individual could receive in excess of 500 Rad in 1 hour at 1 meter from the radiation source or from any surface that the radiation penetrates.

Whole Body - Whole body means, for purposes of external exposure, head, trunk, arms above the elbow, and legs above the knee.

SECTION I - MANAGEMENT POLICY AND ORGANIZATION

1.0 PURPOSE AND PHILOSOPHY

1.1 Statement of Purpose

The purpose of this manual is to define program requirements and radiation protection standards for Aguirre Engineers, Incorporated (AEI) operations with respect to the health and safety of employees and workers, their protection from ionizing radiation, and the prevention of any release of radioactive contaminants that could adversely affect the environment. These requirements and standards will be implemented during AEI's performance of site surveys, remediation activities, decontamination activities, waste characterization, waste packaging, and waste shipment.

1.2 Statement of Philosophy

AEI's philosophy is to control the receipt, possession, use, transfer, and disposal of radioactive materials at a customers facility in such a manner that the total dose to any individual does not exceed standards for protection against radiation prescribed in regulations set forth by the Nuclear Regulatory Commission (NRC), Department of Energy (DOE), Environmental Protection Agency (EPA), state regulatory agencies and licenses or permits issued to AEI or our customers by NRC, EPA or state regulatory agencies. In addition to maintaining radiation exposure within regulatory standards, AEI is committed to maintaining radiation exposures As Low As Reasonably Achievable (ALARA) through the use of engineering controls, employee training, and administrative procedures. These exposure controls must be maintained for the sum of doses received by all exposed individuals as well as each individual. All personnel are responsible for making recommendations that would further reduce exposures.

Risk versus Benefit: Benefits from the use of ionizing radiation may require some risk of exposure to radiation. In these instances, it is necessary to determine a balance between risk and benefit. Though objective criteria cannot be identified to apply in all circumstances, objective guidelines and established regulations will be followed whenever possible. We will be able to demonstrate, if necessary, that improvements have been sought, modifications have been considered, and implemented when reasonable. If modifications have been recommended but not implemented, the reasons for not implementing them will be described.

1.3 Implementation of Policy

This policy will be implemented by a Radiation Safety Committee (RSC) and a Radiation Safety Officer (RSO). The RSC will be composed of members drawn from various company areas that would use, manage the use of, or train personnel in the use of sources ionizing radiation. The implementation of recommendations or decisions of the RSC is the responsibility of the Radiation Safety Officer, who will ensure implementation by the Radiation Safety Staff members.

2.0 RESPONSIBILITIES

2.1 Radiation Safety Committee

The Radiation Safety Committee reports directly to the president of AEI as shown in Figures 2a and 2b. The Radiation Safety Committee has the following duties and responsibilities:

1) Meet as often as necessary to conduct business but not less than quarterly,

2) Conduct periodic reviews and audits of the Radiation Safety Program, and along with the RSO and Staff, review records, reports from the RSO, results of NRC inspections, and written safety procedures. Observe audits performed by the RSO and Staff to ensure adequacy of the management control systems. These reviews may be conducted by an independent auditor, but this does not relieve the RSC of the responsibility to ensure that the reviews are conducted in accordance with regulations. Examples of review include, but are not limited to, the following:

- Review of letters of agreement or Basic Ordering Agreements (BOAs) with contract agencies, pertaining to activities that affect the radioactive materials license,
- Review of audit findings,
- Review of projects documents, such as the Specific Work Plan, Health and Safety Plan and QA Plan,
- Review of operating procedures to ensure compliance with this manual, pertinent federal regulations, license, and customer requirements,

3) Ensure that operations comply with the provisions of this manual and other pertinent federal and state regulations,

4) Establish a radiation control program for those projects involving radioactive materials and implement development of procedural guidance for the program and the projects. In accordance with guidance given in Regulatory Guidance 10.5, *Applications for Licenses of Broad Scope,* the RSC may authorize the following program changes without notifying the NRC:

- Changes dictated by NRC rule changes,
- Changes in internal management forms or specific dates,
- Changes in contractors for bioassay or waste disposal or for servicing and calibrating personnel dosimeters (providing the new contractor is NVLAP approved),
- Changes in contractors for other outsourcing services (labs, project personnel, equipment rental, etc.) Providing the new contractor presents equivalent or better credentials,
- Changes in a piece of referenced equipment providing the replacement is equivalent or better or the need has not been altered.

5) Ensure that employees working with radioactive materials have received the required training in operating procedures, rules, and special precautions prior to being occupationally exposed to ionizing radiation,

6) Evaluate AEIs overall efforts for maintaining doses ALARA on an annual basis, which will include the efforts of the RSO, authorized users, and workers as well as those of management,

7) Provide final approval of authorized users of radioactive materials on the license,

8) Inform the president of AEI on program status and radiation safety objectives, the quality of the radiation safety program in meeting customer needs, maintaining dose to personnel and members of the public ALARA, and assuring protection of the environment.

2.1.1. RSC Membership and Qualifications

The Committees is composed of members from the following activities or areas of responsibility:

1) Radiation Safety

2) Projects

3) Brokering

4) Training

The membership of the RSC may be changed as necessary to meet programmatic needs. The designated representative of each of these areas is valid as of the date shown on Attachment 1.

All members of the Radiation Safety Committee must have a college level degree and two (2) years of experience at a senior or management level in the area that they represent, or five (5) years of experience at a senior or management level in the area that they represent. All members must be familiar with AEI Radiation Safety procedures, applicable Federal and State regulations, and our license requirements.

A quorum of the Radiation Safety Committee is authorized to act on behalf of the committee for approval of necessary actions between regular meetings of the Committee. A quorum shall consist of the Chairman, the RSO, and at least one (1) other committee member or a minimum of 50% of the RSC.

The RSC is required to keep minutes of all quarterly meetings, any quorum meetings, and any ancillary actions of the Committee that affect or are affected by the Radiation Safety Program.

2.1.2 Minimum Qualifications of the Corporate Health Physicist and the Radiation Safety Officer:

The Corporate Health Physicist must have a B.S. or higher degree in Health Physics or a related field and at least five (5) years of practical health physics experience. Unless certified by the American Board of Health Physics, eight (8) or more years of practical experience is required.

The Radiation Safety Officer must have a college degree in Health Physics or a related science or engineering, and at least five (5) years of practical experience, of which at least two (2) years must be in a similar position and/or in equivalent training.

In the absence of the Radiation Safety Officer, the Corporate Health Physicist serves in that capacity. As designated by procedure and for a specified purpose; i.e.,required for two (2) or more projects at the same time, other qualified persons may act as or represent the office of the RSO for that function. These personnel may assume the duties of the RSO, however the responsibility for decisions of the RSO remain with license designated Radiation Safety Officer.

Minimum qualifications for an RSO designee (or a Program Manager designee) shall be similar to the qualifications required to hold the office. The designee should have a degree and at least five (5) years of practical experience, of which at least two (2) years must be in a similar position and/or in equivalent training, or at least eight (8) years of practical experience, of which at least three (3) years must be in a similar position and/or in equivalent training.

2.2 Radiation Safety Officer

The RSO is qualified in the field of health physics and radiation protection and heads the Radiation Safety Program. The RSO performs or supervises others to ensure that the duties required are performed in a timely manner. The person designated as the Corporate Health Physicist is available to the RSO for technical support and auditing purposes. The RSO reports to the Vice President of the Waste Management Services Division and has unrestricted access to the President of AEI on all matters pertaining to Radiation health and safety of AEI. The RSO is assisted by a Radiation Safety Staff to administer the AEI Radiation Program as set forth in this manual. The Radiation Safety Officer has the following minimum duties and responsibilities:

1) Responsible for oversight of the day-to-day radiation protection program established by the Radiation Safety Committee,

2) Communication with senior management and the RSC regarding program implementation and compliance status,

3) Be available to provide advice and assistance to the RSC and management on radiological safety matters,

4) Review and make recommendations to the RSC regarding the list of qualified users of radioactive materials in support of the license,

5) Report to the Radiation Safety Committee, at periods not exceeding one (1) year, on all findings and recommendations to reduce exposure to personnel,

6) Serve as the AEI liaison to the U.S. Nuclear Regulatory Commission on license and inspection matters.

2.3 The RSO and the Radiation Safety Staff have the following duties and responsibilities:

1) Implement and maintain an effective Radiological Controls Program that complies with the provisions and conditions of this manual, operating procedures, the radioactive materials license, and pertinent federal and state regulations,

2) Provide necessary information on all aspects of radiation protection to personnel at all levels of responsibility, pursuant to 10 CFR 19.12, and 10 CFR 20,

3) Maintain surveillance of overall activities involving radioactive material, including monitoring and surveys of all areas in which radioactive material is used or stored,

4) Maintain a current ionizing radiation source inventory under AEI control and a record of their location to ensure that sources are secure against loss or unauthorized use,

5) Perform or arrange for leak tests on all sealed sources and calibration of radiation survey instruments,

6) Develop, coordinate, and participate in training and orientation programs for occupationally exposed individuals at periodic intervals (refresher training), and other personnel as required by changes in procedures, equipment, regulations, etc.,

7) Maintain current all applicable required license amendments, and apply for amendments and renewals in a timely manner as approved by the RSC,

8) Distribute and process personnel radiation monitoring equipment, determine the need for and evaluate bioassays, monitor records for trends and unexpected exposures, notify individuals and their supervisors of radiation exposures approaching maximum permissible amounts, and recommend appropriate remedial action.

9) Formulate procedures for and in support of, revise, and maintain the Radiation Safety Manual,

10) Both the Corporate Health Physicist and the Radiation Safety Officer have individual authority to stop any job or activity which in their opinion could pose a hazard to the health and safety of the employees or the general public,

11) Investigate the cause of any incident, determine the appropriate actions to prevent recurrence, and complete documentation as required. (Use of an approved evaluation tool, such as the Institute of Nuclear Power Operations's, Human Performance Evaluation System (HPES), is advised.)

The Radiation Protection Staff has the responsibility of maintaining records associated with activities specifically designated above. For example, records on receipts, transfers, and surveys as required by 10 CFR 30.51, "Records", and subpart L, "Records", of 10 CFR Part 20. Other records include, but are not limited to;

- License amendments and applications,
- License inspection reports and responses,
- Radiation history, past and present, on all AEI personnel,

- All requests for sources of ionizing radiation,
- Surveys and recommendations,
- Calibration results,
- Surveys of all sealed sources.

All records will be maintained a minimum of five (5) years after the NRC terminates each pertinent license requiring the record.

2.4 Waste Broker

The Waste Broker reports to the Vice President of the Waste Management Services Division on all matters other than those specific to Radiation Protection. The Waste Broker has the following duties and responsibilities:

1) Package and ship radioactive materials in accordance with the provisions of this manual, the radioactive materials license, and pertinent state and federal regulations,

2) Provide technical advice and assistance to AEI management and personnel on all matters pertaining to packaging, marking, labeling, shipping and transportation of radioactive materials,

3) Assist the RSO and Training Coordinator in training and orientation programs, for occupationally exposed individuals, for handling and transportation of radioactive materials, and other personnel as required,

4) Stop any job or activity which in their opinion could pose a hazard to the health and safety of employees or the general public. Conduct a complete review of the noncompliance and obtain RSC approval prior to allowing the job or activity to continue.

2.5 Radiation Safety Training

The training program provides a commitment to initial training, retraining, and continuing education. The type and amount of instruction will be based on regulatory requirements, past documented experience, and will be commensurate with potential radiological health protection problems in the areas in which employees are expected to work. Performance-based training and continuing education, are considered important aspects of this training program.

In accordance with 10 CFR 19.12, all radiation workers will receive instruction prior to beginning work with licensed materials. The elements of this orientation will include, but are not limited to;

- Applicable regulations and license conditions,
- Areas where radioactive material is used and/or stored,
- Potential hazards associated with radioactive material,
- Appropriate radiation safety procedures,
- Individual's obligation to report unsafe conditions to the RSO or applicable authorities,
- Appropriate response to emergencies or unsafe conditions,
- Locations of pertinent procedures, regulations, licenses, and other material required by regulations,
- Radiation Work Permit (RWP).

In addition to basic classroom instruction, performance-based (on-the-job) training specific to the individual's duties may be conducted. This helps to ensures safe handling of radioactive materials in accordance with ALARA principles.

Since different radiation hazards will be encountered with different types of projects, site specific programs and/or job specific programs will be developed to instruct each different group with appropriate information in accordance with 10 CFR 19. This information may be incorporated into other training programs or may be presented separately. Specialized training such as; emergency procedures, OSHA, etc. are examples of training programs that would be presented as a separate training subject.

Records of training will be maintained for a minimum of three (3) years. Training records will include, but are not limited to;

- A list of topics presented,
- An approximation of the time spent on each topic,
- Names of instructors and students, including a manner of positive identification,
- Date(s) of training,
- A written assessment or test for each student that documents satisfactory completion of the training,
- The location of the training and a copy of materials involved in the training.

2.6 Radiation Workers

Employees of AEI who are assigned to work activities involving radioactive material have the following responsibilities, in accordance with 10 CFR 19 and this manual:

1) Obey posted, verbal and written radiological control procedures,

2) Wear dosimetry devices as instructed by procedure and when required by other specific instruction, of this manual, project health physics, etc. Promptly report any lost or damaged devices to their supervisor and/or the project health physicist,

3) Promptly report to their supervisor or RSO any incident, personnel injury, suspected overexposure, contamination, internal deposition, and any suspicious or questionable occurrence involving radioactive material,

4) Be thoroughly familiar with equipment, procedures and requirements for the use of any special devices, prior to using or working with any source or device which produces ionizing radiation,

5) Avoid any unnecessary exposure and use of the concept of time, distance and shielding when working in the presence of radiation sources to maintain their exposure As Low As Reasonably Achievable (AL:ARA).

SECTION II - PROGRAM IMPLEMENTATION

3.0 RADIATION PROTECTION STANDARDS

3.1 Introduction

Every effort will be made to maintain personnel radiation exposures below the indicated radiation protection standards as set forth in this section and consistent with the ALARA principle. The occupational exposure standards prescribed in this section are exposures received by an individual assigned duties involving exposure to radiation and to radioactive materials. Radiation exposures received from background radiation and medical exposures are not included in the radiation exposure limits specified in this section.

3.2 Occupational Exposures

Radioactive materials and sources of radiation will be controlled in such a manner that radiation exposures to workers do not exceed limits specified in 10 CFR 20, Subpart C.

Occupationally exposed workers who have received radiation exposure prior to employment with AEI are required to provide AEI with their radiation exposure history records or names and addresses of employers where they have received exposures. These previous exposures along with any exposure they may receive during employment with AEI will be recorded in the employee's file.

3.3 Embryo/Fetus

All reasonable efforts will be made to keep ionizing radiation exposure to the unborn child to the lowest practical level, as prescribed in 10 CFR 20.1208. Once a female employee determines she is pregnant, she is encouraged to notify AEI in writing of her pregnancy. AEI will then institute radiation control measures which will limit radiation exposure to the unborn fetus to less than 500 mrem for the term of the pregnancy and below 50 mrem per month in any month after the declaration.

3.4 Minors

No individual under 18 years of age will be assigned radiation worker duties.

3.5 Members of the Public

Members of the general public are not allowed in AEI work areas where radioactive materials are being handled. If an individual requires entry into a AEI work area for inspection or audit purposes, they will be required to provide information on their radiation worker training status. Appropriate supplemental training and dosimetry will be provided commensurate with the hazards involved in the work area. Radiation exposures to the general public will be maintained below the following limits as prescribed in 10 CFR

20.1301:

1) The dose in any unrestricted area will be maintained below 2.0 mrem in any one hour period,

2) The maximum exposed individual's total effective dose equivalent (TEDE) from occupancy in all unrestricted areas will not exceed 100 mrem per calendar year.

3.6 Contamination Standards

Radioactive material will be controlled in such a manner that the surface contamination does not exceed the levels specified in Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors,* and in the USNRC, Division of Industrial and Medical Nuclear Safety, August 1987 guideline document, *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material,* and as set forth in Table 1. Each of these sources cite the same levels.

The contamination levels in Table 1 represent the maximum allowable levels and every effort should be made to maintain contamination levels below these levels by implementing contamination control levels lower than the levels indicated. Contamination control levels for customer facilities where AEI works may, in fact, be lower than the levels indicated in the table. In those cases and in all cases of lower contamination levels, the more stringent contamination control levels will be used to maintain compliance with customer requirements.

Table 1. Contamination Limits.

RADIONUCLIDE	ALLOWABLE SURFACE CONTAMINATION (DPM/100 CM^2)	
	REMOVABLE	FIXED + REMOVABLE
Transuranics, Ra-226,Ra-228 Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20	100
Th-Natural, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200	1000
U-natural, U-235, U-238, and associated decay products	1000	5000
Beta-Gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	1000	5000

3.7 Airborne Radioactivity Standards

The amount of radioactive materials taken into a workers body will be limited to less than 10% of the ALI as specified in Table 1, Columns 1 and 2, of Appendix B of 10 CFR Part 20, providing the total effective dose to the individual is maintained ALARA.

4.0 CONTROL OF EXPOSURES

Exposure to radiation will be controlled by administrative procedures, employee training, and engineering controls. Only through the mutual cooperation and commitment of all employees can AEI meet its goal of maintaining personnel exposures As Low As Reasonably Achievable (ALARA).

4.1 · Training

. Effective training will be implemented to:

- Develop worker awareness of radiation safety procedures to encourage performance of tasks with greater efficiency and confidence.

- Make individuals aware that there is some risk associated with exposure to ionizing radiation. This promotes participants to become active in the decision to accept and, where possible, to reduce the risk as part of their job.

- Reduce or eliminate the number and seriousness of accidents and incidents.

Each radiation worker shall, prior to performing any radiation work, successfully complete radiation safety training including the following topics as a minimum. Successful completion of this training will be demonstrated by the individual attaining a minimum score of 75% on a written exam.

1) Types and sources of ionizing radiation contributing to personnel exposure.

2) Biological effects and risks associated with exposure to ionizing radiation.

3) Radiation exposure limits and control levels.

4) Specific procedures for using time, distance and shielding to maintain individual exposures ALARA.

5) Specific personnel dosimetry requirements.

6) Operating, maintenance, handling and accountability procedures for radioactive sources.

7) Facility or site survey requirements and procedures.

8) Responsibilities of individuals.

9) Emergency procedures.

10) Specific survey instrument requirements and operating procedures.

Initial training will be a minimum of eight hours and conducted by the RSO or a designated representative. Completion of the training course includes successfully completing a minimum 20 question exam with a minimum passing grade of 75%. An alternative to attending the eight hour class is passing a 50 question challenge exam with a minimum grade of 80%. This alternative is designed for an individual with prior experience, similar qualification at another facility, or formal training in radiological controls or health physics. Once an individual has successfully completed the course (through either process), they are classified as a Radiological Worker 1 (RW-1) for a period of two (2) years. The worker will be retrained or may challenge not later than the end of the month in which their two-year RW-1 classification expires. — Documentation of training?

4.2 Visitors

see procedure 3.6

Visitors who will receive occupational dose will be escorted during their entry into any controlled area. Training information commensurate with the hazard or risk involved will be provided and documented for retention in the visitors file. An attachment documenting the entry will be provided to the visitor upon completion of the entry/visit.

Escorted visitors will not normally be allowed to enter any contaminated or airborne areas. Any deviation from this will be presented to the RSO for consideration, on a case-by-case basis. Some level of formal documented training will be required in all cases.

4.3 Administrative Procedures

Administrative procedures define precise methods used to control radiation exposures, contamination, and airborne radioactivity.

4.3.1 Contamination Control

Contamination control is a method of keeping radioactive material within a confined or predetermined area or space. The contamination control also applies to

the prevention of individuals from ingesting or inhaling radioactive materials. The general requirements for contamination control are outlined below:

1) Areas which contain contamination above the limits specified in Table 1 will be isolated using a system of barrier ropes or entry doors which will be marked with "CONTAMINATED AREA" signs. Entry into these areas will be controlled through a buffer area which will provide an area for monitoring of personnel and equipment exiting the area.

2) Eating, drinking, chewing or smoking shall not be allowed in any radiologically controlled area or in areas where unsealed sources are used or stored.

3) Storage of food in contaminated areas shall not be allowed.

4) Eating, drinking, chewing or smoking while wearing potentially contaminated clothing shall not be allowed.

5) Radioactive liquids and powders shall be carried in containers with sealed closure devices.

6) A caution label shall be affixed to all containers actually containing or contaminated with radioactive material.

7) Protective clothing shall be removed or monitored for release before an individual leaves a contaminated area.

8) Tools and equipment used in a contaminated area shall be routinely monitored and decontaminated as necessary before release to unrestricted areas.

9) Any injury sustained in a contaminated area shall be reported to the RSO.

10) Contamination control shall not take priority over medical treatment of injuries sustained in a contaminated area.

4.3.2 Exposure Control

Exposure control is a concept of minimizing the amount of radiation exposure workers receive during the normal performance of their assigned duties. Exposure control guidelines used in the AEI radiation safety program include the following:

1) Radiation workers will receive training to make them aware of radiation

exposure sources and to utilize the concepts of time, distance and shielding to reduce radiation exposures.

2) Areas where an individual could receive a radiation exposure greater than 5 mrem in any one hour period will be posted with a "CAUTION, RADIATION AREA" sign to alert personnel of the elevated radiation levels in the area.

3) Areas where radiation sources are present will be routinely surveyed prior to work activities.

4.3.3 Airborne Activity Control

Airborne activity control is a concept of minimizing the amount of radioactive contamination that is present in the air which workers could inhale during their work activities. The control philosophy used in the AEI radiation safety program includes the following concepts:

1) Engineering controls and work procedures will be utilized to prevent the entrainment of contamination into the workers breathing zone. Engineering controls include ventilation systems and tent barriers to control airborne activity.

2) Procedural controls include misting surfaces to reduce entrainment of radioactive materials, minimizing the contamination levels in work areas, and enhancing the containment of contamination.

3) Airborne activity levels will routinely be maintained at less than 10% of the DAC listed in Appendix B of 10 CFR Part 20. Work performed in Airborne Radioactivity Areas or with potential airborne concentrations shall be evaluated so as to keep TEDE ALARA for all affected individuals.

4) Periodic air samples will be taken to verify that the airborne radioactivity concentration levels are maintained ALARA.

5) Limiting the concentration of activity in air also minimizes the possibility of releases of radioactivity to the work area and to the environment and subsequent deposition of activity on surfaces thus requiring decontamination.

5.0 SURVEYS AND MONITORING

5.1 Personnel Monitoring

Personnel likely to receive in one year from radiation sources external to the body, a dose in excess of 10% of the applicable limits will be monitored by personnel dosimetry. The personnel dosimetry devices will indicate the approximate amount of ionizing radiation to which the wearer was exposed. The personnel dosimeter will normally be worn on the upper torso. Personnel are responsible to wear dosimetry as directed by the RSO. If a personnel dosimeter is lost, misplaced, or indicates an offscale reading, the employee is required to notify their supervisor, Radiation Protection personnel and/or the RSO immediately.

5.2 Radiation Surveys

Radiation surveys are performed to determine radiation conditions in the work area and provide personnel awareness to implement the AEI ALARA commitment. Radiation surveys also identify radiation conditions which require special posting as required by regulations to alert personnel of elevated radiation levels in a particular work area. Worker exposures can be estimated and controlled by knowing exposure levels and working time.

Radiation surveys are also used to determine the levels of radioactive material on surfaces when characterizing sites and facilities. These surveys determine if residual activity is below "unrestricted" release criteria or identifies specific areas which must be decontaminated to meet the release criteria.

Radiation surveys are performed using AEI procedures listed in Appendix A.

5.3 Contamination Surveys

Contamination surveys are used to determine the levels of fixed and removable radioactive materials on surfaces and equipment. The survey technique uses filter paper swipes on surfaces to determine the amount of activity which can be removed from the surface. The swipes are then counted in a sample counter to determine alpha and beta activities which were removed in the test. The fixed plus removable contamination is determined by direct measurement on surfaces. If the fixed and removable contamination is below the limits specified in Table 1, the area or equipment can be further evaluated for release or disposal as "uncontaminated".

Contamination surveys also identify areas or items which must be placed under control to prevent the dispersion or release of radioactive materials. Once identified, the area or materials are confined using roped off areas and entry controlled to isolate the contamination until the levels are reduced by decontamination techniques below the

"*unrestricted*" release criteria.

Contamination surveys are performed using AEI procedures listed in Appendix A.

5.4 Air sampling

Periodic air samples are taken as required to verify air concentration routinely remains below 10% of the DAC, to maintain the TEDE ALARA. Air samples are taken using lapel air samplers or grab samplers which provide measurement of concentrations in the worker breathing zone. If the air concentration exceeds 10% of DAC values the RSO should be notified so appropriate corrective actions can be taken and exposures received by the workers evaluated and included in their exposure file.

Air sampling is performed using AEI procedures listed in Appendix A.

5.5 Calibration and Use of Instruments

Radiation detection instruments will be used only by personnel trained in their use and in accordance with AEI procedures. Instrumentation is calibrated on a 6 month schedule by the manufacturer or a certified calibration laboratory and a calibration sticker attached to the instrument to allow the operator to verify the instrument is within current calibration before use. If an instrument is found to have a past due calibration, the instrument shall not be used and shall be tagged with an "OUT OF CALIBRATION" sticker.

All radiation protection instruments shall be source checked before use.

6.0 STORAGE AND CONTROL OF RADIOACTIVE MATERIAL

6.1 Licensed Material

AEI's work with licensed materials will be performed within the requirements specified in a Radioactive Materials license issued by the NRC or an agreement state.

6.2 Exempt Materials

change 2

AEI can and does possess exempt quantities of radioactive materials in the form of check sources which are used to check instrument operation. Radioactive sources (which are exempt from licensing) are kept in a source storage locker located at 333 North Rancho Drive, Suite 580 in Las Vegas, NV. When these sources are used in field assignments, they are transferred by the RSO out of the storage locker by the individual user who is responsible for their control. Upon completion of the field assignment, the sources are returned to the storage locker and logged in by the RSO.

6.3 Contaminated Areas and Materials

All licensed materials at customer facilities shall be stored in secured areas when not in use or under surveillance by personnel to prevent unauthorized removal or access. Contaminated Areas which exceed the contamination limits in Table 1 shall be secured to prevent unauthorized entry or removal of contamination.

7.0 PRECAUTIONARY PROCEDURES

7.1 Posting Requirements

7.1.1 Radiation Areas

Any area accessible to personnel in which there exists ionizing radiation at dose-rate levels such that an individual could receive a deep dose equivalent in excess of 5 mrem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates shall be posted with a sign "CAUTION, RADIATION AREA". Sufficient indicators (such as radiation barrier tape or ribbon) shall be used to identify the boundary of the radiation area.

An exemption to this posting requirement is allowed in areas or rooms containing radioactive materials for periods of less than 8 hours, if each of the following conditions are met:

1) The materials are constantly attended during these periods by an individual who takes the precautions necessary to prevent the exposure to radiation or radioactive materials in excess of the limits specified in section 3.0 of this manual; and

2) The area or room are subject to the licensee's control.

For example, the area around a truck loading radioactive waste does not require posting if the above conditions are met

7.1.2 High Radiation Areas

Any radiation area accessible to personnel in which there exists ionizing radiation at such levels that an individual could receive in excess of 100 mrem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates shall be locked or continuously guarded and posted with a sign "CAUTION, HIGH RADIATION AREA" or "DANGER, HIGH RADIATION AREA".

7.1.3 Very High Radiation Areas

Any area accessible to personnel in which there exists ionizing radiation at such levels that and individual could receive in excess of 500 Rad in 1 hour at 1 meter from the radiation source or from any surface that the radiation penetrates shall be locked or continuously guarded when open and posted with a sign "GRAVE DANGER, VERY HIGH RADIATION AREA".

7.1.4 Airborne Radioactivity Area

Any room, enclosure, or area in which airborne radioactive materials exist in concentrations in excess of the derived air concentrations (DAC's) specified in Table 1, Column 3 of Appendix B, Title 10 Part 20 of the Code of Federal Regulations, or concentrations such that an individual present in the area without respiratory protective equipment could exceed, during the hours the individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI), i.e., 12 DAC-H for 40 Hour work week, shall be posted with a sign "CAUTION, AIRBORNE RADIOACTIVITY AREA" or "DANGER, AIRBORNE RADIOACTIVITY AREA".

7.1.5 Radioactive Materials Area

Any area or room in which there is used or stored an amount of licensed material exceeding 10 times the quantity of such material specified in Appendix C, Title 10 Part 20 of the Code of Federal Regulations shall be posted with sign or signs "CAUTION, RADIOACTIVE MATERIALS AREA" OR "DANGER, RADIOACTIVE MATERIALS AREA".

7.2 Labeling Containers

A container which contains licensed material shall have a durable clearly visible label bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL". The label shall also contain the following information which, will allow individuals working with or around the containers to take precautions to avoid or minimize exposures:

1) Radionuclide present,

2) Quantity of radioactivity and date of estimate,

3) Radiation levels,

4) Kinds of material and if appropriate, mass enrichment

Containers are exempt from the above labeling requirements if the following

conditions are met:

1) Containers holding licensed material in quantities less than the quantities listed in Appendix C Title 10 Part 20 of the Code of Federal Regulations.

2) Containers holding licensed material in concentrations less than those specified in Table 3 of Appendix B to Title 10 Part 20 of the Code of Federal Regulations.
3) Containers when they are in transport and packaged and labeled in accordance with the regulations of the Department of Transportation.

7.3 Receiving and Opening Packages

In accordance with 10 CFR 20.1906, packages containing radioactive materials will be surveyed for radioactive contamination and radiation levels within three (3) hours after receiving the transported package during normal working hours, or not longer than three (3) working hours from the beginning of the next scheduled working day after receipt, if delivered after work hours.

Procedures for the receipt, surveying and opening of packages are listed in Appendix A.

8.0 WASTE DISPOSAL

8.1 Disposal of Waste at Licensed Landfill

A licensee can dispose of licensed (radioactive) material by transferring the material to an authorized recipient, i.e., another licensee with a valid license to receive and store or receive and bury (provide final disposition) the material. In order to provide a disposal service in a land disposal facility licensed under 10 CFR Part 61, the authorized recipient must be specifically licensed to receive waste containing the specified or identified licensed material. The transfer of material between a licensee and an authorized receiver must be accompanied with a system of manifesting, a certification or characterization process and control/tracking system.

8.2 Disposal of Liquids in Sanitary Sewer

AEI employees shall not dispose of liquids containing radioactive or hazardous materials in a sanitary sewer.

8.3 Incineration of Waste

AEI employees shall not incinerate waste materials containing radioactive materials.

8.4 Disposal of Wastes From Contaminated Areas Following Surveys

Materials, items, and waste which have been decontaminated and a though survey indicates contamination levels are below those specified in Table 1 can be evaluated for disposal in a sanitary land fill. Note that more restrictive limits may apply at certain customer facilities where AEI works and the most restrictive contamination limits will prevail. Items from contaminated areas that are known not to have been contaminated and exhibit 'no detectable activity above background, as measured with an instrument appropriate for the material' may be released. If the waste consists of containers which have held contained radioactive materials, any radioactive materials signs shall be removed or defaced clearly indicating that the container no longer contains radioactive material.

SECTION III - DOCUMENTATION

9.0 RECORDS, REPORTS, AND NOTIFICATIONS

9.1 Personnel Records

A personnel file is maintained for each employee assigned work duties involving radioactive materials. The content of these files include:

1) A record of radiation exposure received by the individual during previous employment is maintained by requesting exposure information from previous employers where the individual worked with radioactive materials.

2) A record of personnel dosimeter measurements is recorded in the personnel file to provide a permanent record of radiation exposure received during AEI work assignments.

3) If a personnel dosimeter is lost or damaged an exposure investigation will be performed and an exposure will be assigned for the monitoring period. A report detailing the exposure estimate will be included in the personnel record.

4) If the air concentration in the work area exceeds 10% of DAC values, air samples and bioassay samples will be used to estimate internal exposures received by the worker and included in their exposure file.

5) If a worker finds contamination on their person above the limits specified in Table 1, a report of the incident will be placed in the personnel file to determine exposure from the incident.

The personnel records will be maintained indefinitely and personnel may review their file or request copies of information in their files. The licensee for which work is performed will be provided individual exposure information as required by their license or regulations.

9.2 Radiation and Contamination Records

Radiation and contamination survey records collected during site surveys, remediation/decontamination activities, and radiological characterization activities are stored in site specific files at the Las Vegas office. Duplicate copies of the records are also supplied to the licensee where the work was performed.

9.3 Records of Waste Disposal

Radiation survey records, contamination survey records, shipping manifests, and certifications generated for a licensee's shipment of radioactive materials to a licensed disposal site shall be stored in specific shipment files in the Las Vegas office. Duplicate copies of the records are supplied to the licensee for which the work was performed.

9.4 Notifications

AEI will immediately notify the NRC and the licensee for which work is being performed if any of the following conditions listed in 10 CFR 20, Subpart M exist.

MEMBERS OF THE RADIATION SAFETY COMMITTEE

William McKinnell, Vice President	High Hazard Services
Thomas J. O'Dou, CHP, Chairman	Corporate Health Physicist
Dixie J. Wells, RRPT	Radiation Safety Officer
Timothy Gotto	Projects
	Training/Hazardous Materials
Lester Splattstoesser, CWB	Brokering/Projects

NOTE: This table is subject to change without notification to Regulatory authorities.

Attachment 1

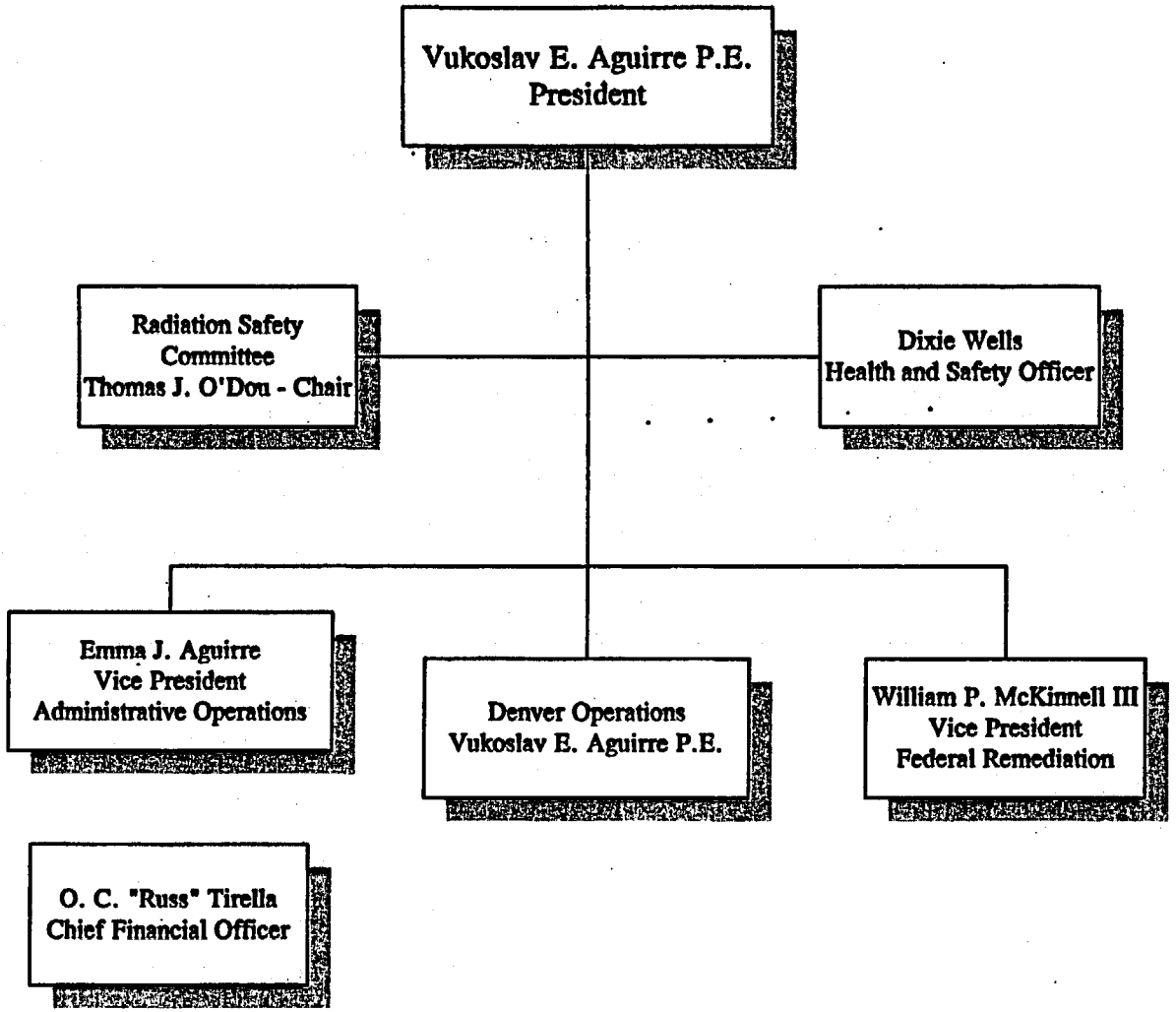
LIST OF PROCEDURES

ARP-001 Operation of Contamination Survey Meters
ARP-002 Alpha-Beta Sample Counting Instrumentation
ARP-003 Operation of Micro-R Meter Survey Meters
ARP-004 Operation of Ionization Chambers
ARP-005 Direct Reading Dosimeters (DRD)
ARP-006 Radiation Work Permits
ARP-007 Air Sampling and Sample Analysis
ARP-008 Radiation and Contamination Surveys
ARP-009 Routine Radiological Surveys
ARP-010 ALARA - As Low As Reasonably Achievable
ARP-011 Containment Devices
ARP-012 Portable HEPA Systems and Vacuum Cleaners
ARP-013 Step-Off Pads
ARP-014 Radiologically Restricted Areas
ARP-015 Personal Protective Equipment (PPE)
ARP-016 Radioactive Materials Brokering
ARP-017 Empty Transport Vehicle Radiological Surveys
ARP-018 Classifying Radioactive Waste
ARP-019 Radioactive Material Tracking
ARP-020 Use and Control of Radioactive Check Sources
ARP-021 Solidification of Radioactive Liquids/Sludges
ARP-022 Packaging Radioactive Material
ARP-023 Opening Radioactive Material Containers
ARP-024 Decontamination of Equipment and Tools
ARP-025 Unconditional Release of Materials from Radiological Controls
ARP-026 Soil and Sediment Sampling
ARP-027 Water Sampling
ARP-028 Material Sampling
ARP-029 Sample Chain of Custody
ARP-030 Document Control
ARP-031 Project Control
ARP-032 Respiratory Protection
ARP-033 Bioassay
ARP-034 Dosimetry
ARP-035 Emergency Response
ARP-036 Training
ARP-037 Radiological Compliance Audits
ARP-038 Procurement, Receipt, and Opening of Radioactive Material
ARP-039 Radiological Conditions Awareness Report
ARP-040 Leak Tests for Non-Exempt Sources of Radioactive Material

Attachment 2

Aguirre Engineers, Inc.

January 28, 1998

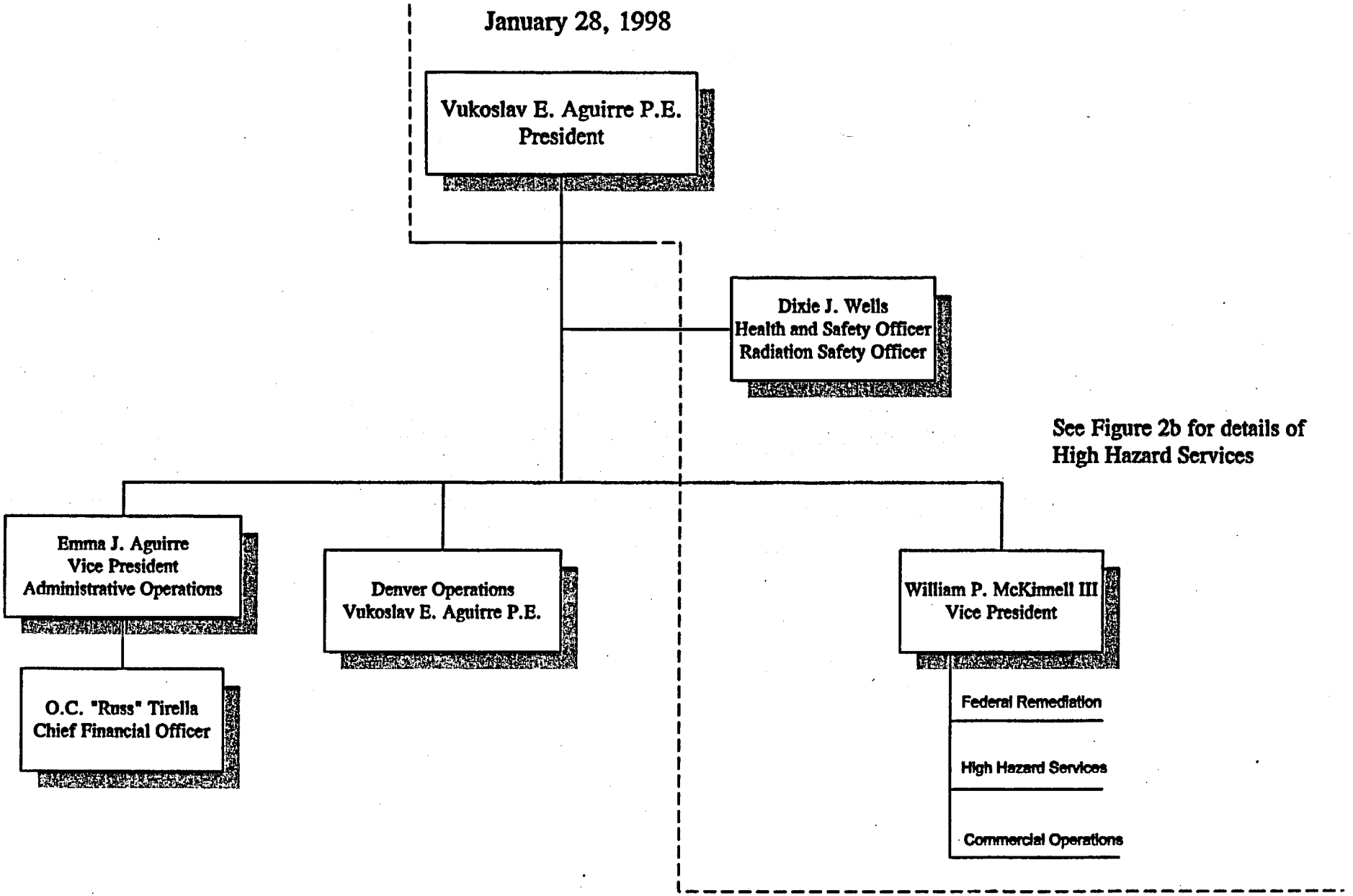


AEI Corporate Organization

Figure 1

Aguirre Engineers, Inc.

January 28, 1998



AEI Corporate Organization

Figure 2a

AEI High Hazard Services

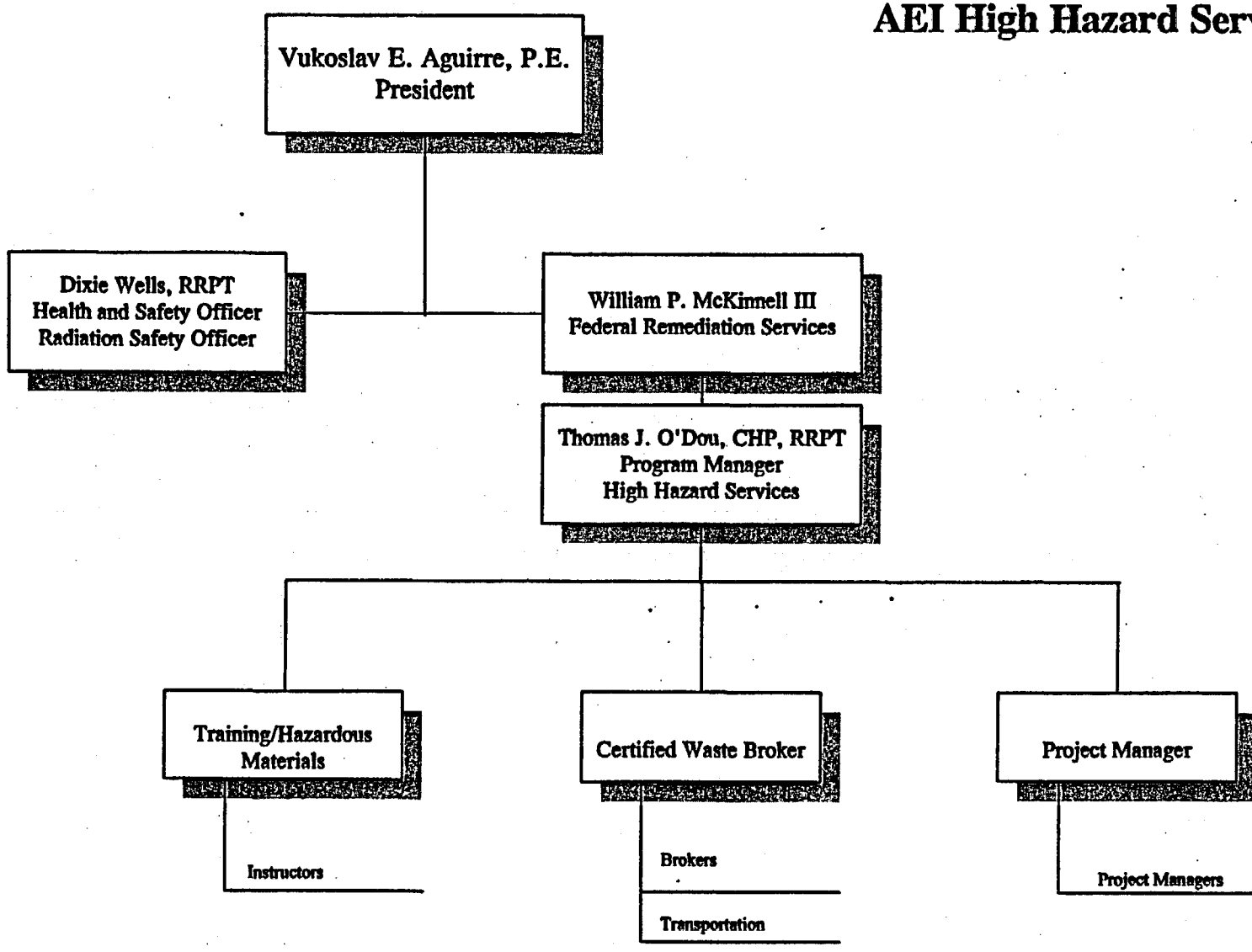


Figure 2b

Approved/Date: January 28, 1998

ok

RADIATION WORKER TRAINING EXAM
TEST BANK ANSWER KEY

1. Which of the following best describes an isotope of an element?
   a) Atoms which have the same number of electrons.
   b) Atoms which have the same number of neutrons but different number of protons.
   c) Atoms which have the same number of protons but different number of neutrons.
   d) Atoms which have the same number of neutrons and protons.

2. Which of the following is the unit of radioactivity?
   a) Curies (Ci)
   b) Disintegrations per minute (dpm)
   c) Becquerel (Bq)
   d) All of the above

3. A waste package contains 120 Curies of Chromium-51. Given that Chromium-51 has a half-life of 28 days, how many curies will remain following 56 days of decay?
   a) 30 Curies
   b) 60 Curies
   c) 15 Curies
   d) 28 Curies

4. Which of the following is an effective shielding material for 1 mev beta particles?
   a) Two sheets of paper
   b) The dead layer of the skin
   c) 1/8 inch of aluminum
   d) A few centimeters of air
   e) All of the above

5. Which of the following can cause the highest radiation dose to an occupational worker?
   a) A plated counting standard containing alpha emitting radionuclides.
   b) A piece of building rubble containing alpha contamination fixed with paint.
   c) A work area which has airborne alpha activity.
   d) All of the above

6. Which of the following would be the best shield for high energy gamma radiation?
   a) One foot of concrete
   b) One foot of lead
   c) One foot of water
   d) One foot of aluminum

7. How many disintegrations per minute (DPM) are equal to one curie?
   a) 2.22×10^{12}
   b) 3.7×10^{10}
   c) 1
   d) DPM is equal to the half life of the isotope in minutes.

8. Which of the following is the correct conversion of 12 rem /hr to mrem/hr?
   a) 0.012 mrem/hr
   b) 12000 mrem/hr
   c) 1.2 mrem/hr
   d) 1200 mrem/hr

9. What is the average annual radiation dose to a member of the general population in the United States from natural background and man-made sources?
   a) 28 mrem/yr
   b) 25000 mrem/hr
   c) 360 mrem/yr
   d) 54 mrem/yr

10. Which of the following is considered an acute exposure?
   a) A dose of 50 mrem per week for 20 years.
   b) A dose of 50 rem in one day
   c) An annual dental X-ray
   d) A single chest X-ray

11. Which of the following is considered a chronic exposure?
   a) A dose of 50 mrem per week for 20 years.
   b) Radiation dose from natural background
   c) An annual dental X-ray
   d) A dose of 50 Rem in one day

12. What is the annual TEDE limit for whole body dose to radiation workers?
   a) 5 rem/yr
   b) 50 rem/yr
   c) 15 rem/yr
   d) 500 mrem/yr

13. What is the annual limit for dose to the lens of the eye for radiation workers?
   a) 5 rem/yr
   b) 50 rem/yr
   c) 15 rem/yr
   d) 500 mrem/yr

14. What is the annual limit for dose to extremities for radiation workers?
   a) 5 rem/yr
   b) 50 rem/yr
   c) 15 rem/yr
   d) 500 mrem/yr

15. What is the annual limit for dose to the skin and any other organ except the lens of the eye for radiation workers?
   a) 5 rem/yr
   b) 50 rem/yr
   c) 15 rem/yr
   d) 500 mrem/yr

16. Which of the following ALARA concepts is included in AEI's management policy?
    a) Controlling radiation doses to workers and the public well below the regulatory limits.
    b) Ensuring that no radiation exposure occurs without a corresponding benefit, and the benefit outweighs the risks associated with that dose.
    c) Preventing unnecessary exposures to workers and the public.
    d) Protecting the environment.
    e) All of the above

17. A small cesium source has an exposure rate of 30 mr/hr at 2 feet. What is the exposure rate at 4 feet?
    a) 60 mr/hr
    b) 15 mr/hr
    c) 7.5 mr/hr
    d) 3 mr/hr

18. You have been assigned to work in an area where the dose rate is 40 mr/hr. Your supervisor wants you to limit your total dose to 100 mrems. How long can you work before you reach your limit?
    a) 150 minutes
    b) 8 hours
    c) 4 hours
    d) 200 minutes

19. You are part of a planning meeting to retrieve a source and place it in a lead pig. Which of the following ALARA concepts should be discussed in the planning meeting?
    a) Use of shielding to reduce exposure
    b) Use of long handled tongs to handle the source
    c) Use of a mock-up to gain proficiency at the task
    d) All of the above

20. Which of the following is the proper location for a whole body TLD dosimeter?
    a) Place the dosimeter in your pocket so you won't loss it.
    b) Wear the dosimeter on the front of the torso between the waist and neck.
    c) Leave it in a safe place so it won't get contaminated.
    d) Tape it to your wrist because your hand will be touching a waste drum.

21. You are transferring a cask with a cobalt-60 source using a fork lift. The cask tips over and the source falls out of the cask. Which of the following is the best action to take?
    a) Call over your fellow workers to survey the situation and form a recovery plan.
    b) Pick up the source and put it back in the cask to avoid delays in finishing the job.
    c) Immediately evacuate yourself and your fellow workers from the area.
    d) Use the fork lift to place the cask on top of the source to reduce the dose rates.

22. Which of the following areas would be posted with a "CAUTION, RADIATION AREA" sign?
    a) An area with a dose rate of 90 mr/hr.
    b) An area with a general dose rate of 6 mr/hr.
    c) An area which contains a Co-60 source in a lead pig and the surface of the pig reads 5 mr/hr.
    d) All of the above

23. Which of the following is the correct conversion of 0.3 mrems/hr to μrem/hr?
    a) 300 μrem/hr
    b) 30 μrem/hr
    c) 3 μrem/hr
    d) 3000 μrem/hr

24. How many disintegration per second (DPS) are equal to one Becquerel (Bq)?
    a) 2.22×10^{12}
    b) 3.7×10^{10}
    c) 1
    d) DPS is equal to the half life of the isotope in seconds.

25. Which of the following is an immediate action to control a spill?
    a) Stop the spill
    b) Warn others in the area
    c) Isolate the area to prevent entry
    d) Minimize your exposure and notify HP personnel
    e) All of the above

26. In accordance with the 1990 revised 10 CFR 20, a licensee may authorize an adult worker to receive doses in addition to and accounted for separately from doses received under the normal dose limits. These doses are allowed only for exceptional situations when alternatives to avoid higher exposures are unavailable or impractical. These exposures are termed:
    a) Emergency exposures
    b) Allowable doses in accordance with ALARA
    c) Committed ALARA doses
    d) Planned Special Exposures
    e) Authorized exposures

27. Which of the following are topics which should be discussed at prejob briefings?
    a) Complete description of the work tasks to be performed and method to minimize exposures to radiation and contamination while performing these work tasks.
    b) Discussions of the radiation, contamination, and air activities in the work area and situations which could result in increased levels of these components
    c) Safety concerns which could be encountered during work activities.
    d) Emergency procedures
    e) Discussions of the protective equipment requirements and the monitoring requirements of the RWP.
    f) All of the above

28. Each individual entering a RWP work area is required to do the following:
    a) Read, sign and comply with the provisions of the RWP
    b) Wipe their shoes so as not to track contamination into the area
    c) Stand outside the area and observe
    d) All of the above

29. Which of the following best describes the AEI policy for a 17 year old individual?
    a) Whole body exposure must be limited to less than 500 mrems
    b) This individual will not be assigned radiation worker duties
    c) All radiation exposures will be limited to 10% of the occupational exposure limits
    d) They may be trained as a radiation worker

30. An alpha particle is a charged particle containing:
    a) Two protons
    b) Two neutrons and two protons
    c) Two protons and two electrons
    d) Two electrons

31. Which of the following best describes a gamma ray?
    a) A neutral particle emitted from the nucleus
    b) Electromagnetic radiation with no mass or charge
    c) A beam of high energy electrons
    d) Non-ionizing radiation with no charge

32. A beta particle is best described as a charged particle containing:
    a) One proton
    b) One neutron and one proton
    c) One proton and one electron
    d) One electron

33. Which of the following are considered benefits of radiation?
    a) Airport security
    b) Cancer therapy
    c) Nuclear medicine scans
    d) Biomedical research
    e) All of the above

34. Which of the following best describes a radiation area?
    a) Any area accessible to personnel in which there exists ionizing radiation at dose-rates such that an individual could receive a deep dose equivalent in excess of 5 mrems in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
    b) A restricted area that has radioactive materials above the limits specified in the Radiation Safety manual in the form of dusts, particulates, and sorbed contaminants that could adhere to personnel clothing and skin while working in the area.
    c) A room, enclosure or area in which radioactive material is dispersed in the form of dusts, fumes, particulates, mists, vapors, or gases and the concentration of the

dispersed radioactive materials is in excess of:

1) The derived air concentrations (DAC's) specified in Table 1, column 3 of Appendix B, Title 10 Part 20 of the Code of Federal Regulations.
2) Concentrations such that an individual present in the area without respiratory protective equipment could exceed, during the hours the individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI).

35. Which of the following best describes a contaminated area?

a) Any area accessible to personnel in which there exists ionizing radiation at dose-rates such that an individual could receive a deep dose equivalent in excess of 5 mrems in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

b) A restricted area that has radioactive materials above the limits specified in the Radiation Safety manual in the form of dusts, particulates, and sorbed contaminants that could adhere to personnel clothing and skin while working in the area.

c) A room, enclosure or area in which radioactive material is dispersed in the form of dusts, fumes, particulates, mists, vapors, or gases and the concentration of the dispersed radioactive materials is in excess of:

1) The derived air concentrations (DAC's) specified in Table 1, column 3 of Appendix B, Title 10 Part 20 of the Code of Federal Regulations.
2) Concentrations such that an individual present in the area without respiratory protective equipment could exceed, during the hours the individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI).

36. Which of the following best describes an airborne radioactivity area?

a) Any area accessible to personnel in which there exists ionizing radiation at dose-rates such that an individual could receive a deep dose equivalent in excess of 5 mrems in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

b) A restricted area that has radioactive materials above the limits specified in the Radiation Safety manual in the form of dusts, particulates, and sorbed contaminants that could adhere to personnel clothing and skin while working in the area.

c) A room, enclosure or area in which radioactive material is dispersed in the form of dusts, fumes, particulates, mists, vapors, or gases and the concentration of the dispersed radioactive materials is in excess of:

1) The derived air concentrations (DAC's) specified in Table 1, column 3 of Appendix B, Title 10 Part 20 of the Code of Federal Regulations.
2) Concentrations such that an individual present in the area without respiratory protective equipment could exceed, during the hours the individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI).

37. The underlying radiation protection principle with respect to the exposure to ionizing radiation is:
   a) That the risk involved with exposure at the maximum permissible levels is acceptable risk taken by radiation workers.
   b) That any exposure is assumed to have some risk and that exposures should be maintained as low as practicable.
   c) That exposures maintained below the threshold for certain effects are not likely to produce other effects.
   d) That risk increases with dose rate.
   e) That risk decreases with dose rate.

38. Which of the following concepts is used by AEI to control radiation exposures?
   a) Radiation workers receive training to sensitize their awareness of radiation exposure sources and utilize the concepts of time, distance and shielding to minimize exposures.
   b) Areas where an individual could receive a radiation exposure greater than 5 mrems in any one hour period are posted with a "CAUTION, RADIATION AREA" sign to alert personnel of the elevated radiation levels in the area.
   c) Areas where radiation sources are present are always surveyed prior to work activities so workers can be briefed prior to starting their work activities.
   d) All of the above

39. What are the units used to report removable contamination?
   a) dpm/100cm^2
   b) mrem/hr
   c) µCi/cm^3
   d) rem

40. What are the unit(s) used to report radiation exposure rate to an individual?
   a) dpm/100cm^2
   b) mrem/hr
   c) µCi/cm^3
   d) rem

41. What are the units used to report airborne concentrations?
   a) dpm/100cm^2
   b) mrem/hr
   c) µCi/cm^3
   d) rem

42. What are the unit(s) used to report dose to an individual?
   a) dpm/100cm^2
   b) mrem/hr
   c) µCi/cm^3
   d) rem

43. When doing a self survey of clothing for alpha contamination, the alpha detector should be held:
   a) within one inch of the surface being surveyed
   b) within one quarter inch of the surface being surveyed
   c) within two inches of the surface being surveyed
   d) at contact with the surface

44. When doing a self survey of clothing for contamination, the detector should be moved:
   a) less than two detector widths per second
   b) less than one detector width per second
   c) as fast as possible
   d) 1 foot per second

45. Which of the following is considered a restricted area?
   a) Radiation area
   b) Airborne radioactivity area
   c) Contaminated area
   d) All of the above

46. Which of the following are responsibilities of a radiation worker?
   a) Obey posted, verbal and written radiological control procedures.
   b) Wear dosimetry devices as and when required by specific parts of this manual and promptly report any lost or damaged devices to their supervisor.
   c) Promptly report to their fellow workers and the NRC any incident, personnel injury, suspected overexposure, contamination, internal deposition, and any suspicious or questionable occurrence involving radioactive material.
   d) Avoid any unnecessary exposure and use the concept of time, distance and shielding when working in the presence of radiation sources to maintain their exposure As Low As Reasonably Achievable (ALARA).
   e) a, b, and d
   f) All of the above

47. Radioactivity is:
   a) The process by which the nucleus of stable isotopes disintegrates with the resulting emission of radiation.
   b) The property of certain atoms to spontaneously emit particles or energy.
   c) Described by the fission reaction.
   d) Described by the fusion reaction.
   e) None of the above.

48. Which of the following concepts are used to control contamination?
   a) Use of boundaries, containments and surveys to minimize the potential to spread contamination.
   b) Procedures and techniques for working with dispersible radioactive material that are designed to prevent the spread of contamination.
   c) The use of appropriate personal protective clothing.
   d) Training provided for individuals whose work has the potential for creating or spreading contamination.
   e) All of the above

49. A Thermoluminescent Dosimeter (TLD) is used to:
   a) Determine exposure rate after work is completed
   b) Measure dose received by radiation workers
   c) Determine contamination levels in the work area
   e) Determine airborne radioactivity concentrations

50. Which of the following concepts are used to reduce internal radiation exposures?
   a) Use of appropriate personal protective devices.
   b) Proper containment of dispersible radioactive materials.
   c) Careful handling when transferring dispersible radioactive materials.
   d) Meticulous self monitoring (frisking) practices.
   e) All of the above

51. The purpose of a Radiation Work Permit is to:
   a) Inform workers of area radiological conditions and entry requirements into the areas.
   b) Inform workers of the score of the Monday Nite Football game.
   c) Relate radiation doses received by workers in excess of AEI and federal limits.
   d) All of the above.
   e) None of the above.

52. Present radiation protection standards for occupational exposure are designed to:
   a) Protect individuals from undue risk from possible long-term effects.
   b) Protect individuals from the acute radiation syndrome.
   c) Decrease the risk from cancer to less than 1 in 10,000.
   d) All of the above
   e) None of the above.

53. In comparison with external radiation exposure, control of the period of exposure to an internally deposited radionuclide:
   a) Is difficult if not impossible in most cases once a radionuclide is taken into the body.
   b) Can be influenced to some degree in cases where diuretics are effective in the increase of the rate of biological elimination.
   c) Can be influenced by simply controlling the time of exposure to the concentration in cases where a radionuclide has a very short biological or radiological half-life.
   d) All of the above.
   e) None of the above.

54. If a person has been exposed to 450 rem:
   a) His chances for survival are approximately 50-50.
   b) No valid conclusions can be drawn, since the duration of exposure and the extent to which the body has been irradiated are not known.
   c) He will be violently ill and will have many undesirable after-effects.
   d) He has received a lethal exposure.

55. Different parts of the body have different dose equivalent limits for radiation protection because of:
   a) The relative importance of one part of the body regarding the overall well being and functioning of the exposed individual.
   b) Differences in the distribution of energy deposited.
   c) Differences in the quality factor as it relates to different parts of the body.
   d) All of the above.
   e) None of the above.

56. Radiation has a strong biological effect on:
   a) Young less mature organisms as compared to older more mature ones.
   b) Highly developed organisms as compared to organisms of simple structure.
   c) The embryo as compared to the fetus in the later stages of development.
   d) All of the above.
   e) None of the above.

57. A recommendation standard or concensus standard is a statement from a group such as the NCRP, or the ANSI. It is a statement of good practice and as such...
   a) Carries the force of law to regulatory bodies.
   b) Is usually promoted by experts as absolute necessity.
   c) Does not carry the force of law.
   d) Is internationally accepted as appropriate.
   e) May not be incorporated into license conditions which would make them legal requirements.

58. The present radiation protection standards for occupational exposure to ionizing radiation, for the whole body, limit doses to:
   a) An accumulated dose in rem not to exceed five times the age minus 18 and a quarterly dose not to exceed 3 rem.
   b) 170 mrem in a year from external sources.
   c) 5 rem in a year from internal and external sources.
   d) 100 mrem in a week from internal and external sources.
   e) 2.5 mrem in any one hour.

59. The ALI or Annual Limit on Intake for a radionuclide for occupational exposure is:
   a) Determined from the maximum permissible uptake rate by standard man for an occupational exposure of 50 years.
   b) Quantity which if taken into the body will cause a committed dose equivalent of 5 rem whole body or 50 rem to an organ.
   c) Only the annual amount in some organ of reference.
   d) That quantity in the total body such that the critical organ is irradiated at the maximum permissible dose equivalent rate.
   e) Is the same for a child as for the standard man.

60. The Derived Air Concentration, DAC, for a radionuclide ...
   a) Is the concentration of a radionuclide which, if taken into the body at standard rates, will result in the maximum permissible body burden.
   b) Is the concentration of a radionuclide which, if taken into the body at standard rates, will result in the ALI.
   c) Can be based upon 100 hours/week for occupational exposure.
   d) All of the above.
   e) None of the above.

61. Radiation initiates destruction of human tissue through the:
   a) Photoelectric effect.
   b) Ionization process.
   c) Multiple interaction of neutrons.
   d) Compton effect.
   e) All of the above.

62. Somatic effects refer to:
   a) Effects observed in the exposed individual including as possibilities erythema, leukemia, cancer, cataracts, and life shortening.
   b) Effects observed in the exposed individual's progeny.
   c) Only somatic mutations.
   d) Genetic mutations.
   e) All of the above.

63. Most of the genetic dose received by man from man-made sources of radiation is due to:
   a) Medical applications of radiation and radioactive materials.
   b) Industrial applications of radiation and radioactive materials.
   c) The operation of nuclear power reactors.
   d) Fallout from nuclear weapons testing.
   e) Ra-226

64. Present radiation protection standards for the population at large are designed primarily to:
   a) Protect the world wide population from undue risks from possible genetic effects and somatic effects.
   b) Protect the population from acute effects.
   c) Protect the population from cancer; prevent a doubling of the spontaneous mutation rate.
   d) Prevent the formation of cancer cells.
   e) Ensure that the hormesis significant dose is obtained.

65. If one million people in a population receive one rem each to the whole body, then the excess cancer deaths due to that exposure is estimated as:
   a) Significant compared to the natural cancer incidence and detected in the population.
   b) About 100 to 200 deaths.
   c) About 1000 deaths
   d) About 10000 deaths
   e) Insignificant so that radiation protection dose limits can be considerably

increased.

66. The occupational DAC for radionuclides is:
   a) That concentration when taken into the body of the reference man at standard rates for 40 hours per week 50 weeks, results in the Annual Limit on Intake (ALI).
   b) Determined for inert beta-gamma emitting radioactive gases as indicated in (a) above.
   c) Always that concentration in the given medium which delivers a spatial equilibrium dose equal to the annual permissible dose rate.
   d) Is a value which prevents internal dose at all costs.
   e) Ensures that respiratory protection is required.

67. For non-occupational exposure, the total effective dose equivalent (TEDE) limit for members of the general public from NRC licensed operations shall not exceed....
   a) 5000 millirem.
   b) 0.1 rem.
   c) 500 millirem.
   d) 50 millirem.
   e) 10 millirem.

68. For non-occupational exposure to radiation in unrestricted areas, the dose equivalent rate from external sources, according to the new 10 CFR 20 regulations, shall not exceed ...
   a) 0.01 Rem/hr.
   b) 5 mrem/hr.
   c) 0.1 mrem/hr.
   d) 2 mrem/hr.
   e) 1 mrem/hr.

69. In the event of fallout from atmospheric nuclear weapons testing.
   a) The amount of radioactivity deposited on the earths surface depends on the half lives of the fission products.
   b) Inhalation can sometimes be the most important route of entry for fission products into the body.
   c) With a constant wind speed the distance traveled downwind by fallout material depends on the particle size.
   d) I-131 is not important as stratospheric fallout.
   e) All of the above.

70. Monitoring exposures and doses due to internal radiation hazards
   a) May be difficult and not very accurate.
   b) May be accomplished by measuring concentrations of radionuclides in air, water and food with sampling or monitoring equipment.
   c) May be accomplished by estimating body burdens through whole body counting or bio-assay.
   d) All of the above.
   e) None of the above.

71. The basic physical methods applied to protection against internal radiation hazards are:
a) Film badges, dosimeters, ion chambers, survey meters.
b) Respirators, ventilation, air cleaning equipment, decontamination, time limitation, protective clothing, glove boxes.
c) Time, distance, shielding.
d) Bio-assay, whole body counting, nose wipes.
e) Standards, regulations, procedures.

72. If an abdominal X-ray examination is performed on a female patient who is later found to have been pregnant at the time of the X-ray.
a) There is normally little cause for concern.
b) The doctor requesting the exam should be admonished under all circumstances.
c) Pregnancy should be interrupted.
d) Experts should be consulted for advice on aborting the fetus regardless of the magnitude of the radiation dose delivered to the fetus.
e) The X-ray equipment operator should be dismissed.

73. With respect to gross mental retardation as a result of intrauterine irradiation, the bulk of available information derives from:
a) X-ray diagnostic procedures.
b) Japanese atomic bomb survivors where increased mental retardation, microencephaly, and a general diminution in stature were detected.
c) Doses between 1 and 25 rads.
d) X-ray therapeutic procedures.
e) Nuclear medicine applications.

74. The basic principles of protection against external radiation hazards are:
a) Film badge and dosimeters.
b) Anti-contamination clothing.
c) Time, distance, and shielding
d) Whole body counting and bioassay.
e) Cutie pie.

75. Persons receiving an acute whole body dose of 600 rads would exhibit the following:
a) No detectable symptoms.
b) Slight changes in blood cells.
c) Immediate loss of all hair.
d) Vomiting, fatigue, loss of appetite, hemorrhaging, infection, diarrhea, epilation, temporary sterility with a large possibility of death within thirty days.
e) A 50% chance of survival.

76. Which is the major factor in considering the milk-food chain as the predominant food chain when relating release of activity to the air and the dose to the population?
a) Short period of time between cow exposure and retail marketing of milk.
b) Large volume of air the cow breathes daily.
c) A large concentration factor between air & milk due to the large pasture area a cow traverses to obtain her food.
d) Large quantity of milk consumed by man.

e) None of the above.

77. Control of exposure to external sources of radiation in areas that are restricted for purposes of radiation protection is required by 10 CFR 20. In the control of access to high radiation areas...
a) Each access to such an area must have a guard.
b) Dose to personnel in these areas cannot exceed 100 mrem.
c) Each entry to such an area must be controlled to prevent unnecessary entry.
d) Control devices may be used to identify intruders.
e) The licensee is responsible for all dose.

78. The size of a reactor may be...
a) The size of a football.
b) The size of a car.
c) The size of a house.
d) All of the above.
e) None of the above.

79. The radius of the nucleus of an atom as compared to the atom as a whole is...
a) Some 10,000 times greater.
b) Some 1000 times greater.
c) Some 10,000 times smaller.
d) Some 100 times smaller.
e) Some 10 times smaller.

80. The 1990 revision to 10 CFR 20 has requirements for control of areas in which radiation levels could be encountered at 500 rads or more in an hour at a meter from a source or surface. The controls of such an area must...
a) Be the same as for a high radiation area.
b) Prevent entry under any circumstances.
c) Prevent unauthorized or inadvertent access in addition to high radiation area controls.
d) Are the same as for any contaminated area.
e) Must be completely shielded to reduce exposure.

81. A short term exposure of 600-700 roentgens of penetrating gamma radiation received over the whole body would result in the death of:
a) Nearly all exposed individuals within 30 days.
b) About three fourths of the individuals within thirty days.
c) About half of the individuals within 30 days.
d) About 25% of the individuals within 30 days.

82. The dose equivalent is:
a) The activity in curies in the organ of reference.
b) The dose in rads.
c) The energy deposited per gram times the quality factor.
d) The dose in rads times the quality factor times the distribution factor or other modifying factors.
e) The amount of X or gamma radiation interaction in air.

83. Regarding the biological risks to the embryo from ionizing radiation,
   a) The risk of abortion induced by radiation is highest for irradiations in the first two weeks after conception.
   b) The risk associated with the production of observable anomalies in the unborn child is greatest for irradiation during the second through sixth weeks following conception.
   c) Radiation exposure during all stages of pregnancy has been associated with an increased risk of leukemia and other childhood cancers.
   d) Risks are greatest during the first trimester of pregnancy.
   e) Risks have been identified with all of the above.

84. Absorbed dose:
   a) Is defined as the amount of ionization produced per unit mass.
   b) Is defined as the amount of energy deposited per unit mass and applies to any type of radiation in any medium.
   c) is measured in roentgens and applies only to X or gamma radiation.
   d) Is measures in ergs.
   e) None of the above.

85. If a large group of people received acute whole body doses of 800 rad, what fraction of the people would you expect to die within 2 months?
   a) < 25%
   b) 25 %
   c) 50 %
   d) 75 %
   e) 100 %

86. The critical organ for exposure to tritiated water vapor is:
   a) The lungs.
   b) The skin of the whole body.
   c) The Gi tract.
   d) The thyroid.
   e) None of the above.

87. The effect on an individual being exposed continuously to 100 R/hr for 7 hours relative to another exposed to 100 mR/hr for 7000 hours would be:
   a) Less.
   b) Greater.
   c) Same.

88. An important organ for exposure to elemental radioactive I-131 in air, because of bio-accumulation is:
   a) The whole body.
   b) The thyroid.
   c) The lungs.
   d) The skin of the whole body.
   e) None of the above.

89. During and after deposition, radioactive fallout exists as:
a) Particles in which all of the atoms are radioactive.
b) A radioactive gas.
c) Liquid droplets containing dissolved radioactive species.
d) Particles containing only radioactive fission products.
e) Particles containing mostly stable atoms and radioactive species whose radioactivity is comprised mainly of fission product atoms and lesser amounts of neutron activation products and atoms of fuel used in the weapon.

90. The Total Effective Dose Equivalent as applied in the 1990 revised 10 CFR part 20 means...
a) 5 rem per year.
b) The sum of the whole body dose and the skin dose.
c) The sum of the internal dose and the skin dose.
d) The sum of the whole body dose and the internal dose.
e) None of the above.

91. The maximum allowable dose rate on contact with a package shipped in other than sole use vehicles is:
a) 1 mrem/hr.
b) 2.5 mrem/hr.
c) 1000 mrem/hr.
d) 200 mrem/hr.
e) 100 mrem/hr.

92. Abdominal X-ray exams averaging 2 to 3 films each at any time during pregnancy in the U.S. population is:
a) Estimated to cause 280 cancer cases per year at equilibrium in children under 15 years of age.
b) Estimated to result in a cumulative cancer probability of 1 in 10,000 during the first 15 years of life.
c) Believed to relate to subtle mental, physiological, and genetic changes.
d) All of the above.
e) None of the above.

93. The ICRP, the International Commission on Radiological Protection, was established in 1928 and restructured in 1950. The purpose of this extremely important organization is...
a) Maintaining procedures for the safe handling of radioactive materials used in medicine.
b) To keep the world thinking about the dangers of radiation.
c) To protect man from ionizing radiation.
d) To make recommendations for the safe use of ionizing radiation.
e) To promote the use of radiation and radioactivity.

94. The simplest radionuclide is ..
a) Tritium.
b) A neutron.
c) An alpha particle.
d) A Be-8 atom.

e) A proton.

95. According to the Code of Federal Regulations, Title 10 Part 20, the maximum dose equivalent a radiation worker can receive in one quarter of a year to the whole body under any circumstances and not be considered a legal overexposure is... (remember, the new 10 CFR 20!)

a) 1.25 rem.
b) 3 rem.
c) 5 rem.
d) 500 DAC hours.
e) 1000 DAC hours.

96. A worker has no prior exposure and the licensee has met all of the requirements for determining prior dose and has received a completed and signed NRC form 4. The worker has been exposed to airborne radioactivity during the current quarter such that the total exposure to date is 250 DAC-hours, the dose equivalent that the worker may receive for the remainder of the quarter and not be legally overexposed is: (without consideration of planned special exposures)

a) 0 rem.
b) 0.625 rem (625 mrem).
c) 1.25 rem (1250 mrem).
d) 4.375 rem (4375 mrem).
e) 5 rem (5000 mrem).

97. When removing contaminated protective clothing without help, which article of clothing is usually removed last?

a) The toga.
b) Earrings.
c) Cumberbund.
d) Pierre Cardin briefs.
e) Inner pair of gloves.

98. The purpose of a step-off pad is to:

a) Identify the area where one should have a coffee break.
b) Provide absorbent material for sponging crud off of your sneakers.
c) Identify the area where on the job training is to take place.
d) Identify the boundary where, with hindsight, you would have liked the contamination to be confined within.
e) Slow people down to allow demonstrations of how not to remove contaminated clothing.

99. Chronic radiation exposures are those:

a) Involving continuous or repeated exposures over a relatively long time interval.
b) Involving a definite increase in risk of cancer.
c) Involving no significant genetic or somatic injury.
d) That are acceptable to the exposed individual.
e) That may have some small risk to the individual.

100. Acute radiation exposures are those:
   a) Occurring under critical conditions.
   b) Occurring as a result of an accident.
   c) Involving relatively large doses in a relatively short time.
   d) Requiring medical attention.
   e) Requiring notification of the NRC.

101. The sensitivity range from highest to lowest of cells or tissues in the body is given as follows:
   a) Epithelium, bone marrow, nerve, muscle, lymphocytes.
   b) Bone marrow, nerve, muscle, lymphocytes, epithelium.
   c) Nerve, muscle, lymphocytes, epithelium, bone marrow.
   d) Muscle, lymphocytes, epithelium, bone marrow, nerve.
   e) Lymphocytes, epithelium, bone marrow, nerve, muscle.

102. In the examination of women who are known to be pregnant,
   a) Examination of parts of the body other than the pelvis and lower abdomen are probably safe since no direct rays reach the fetus and scattered rays are minimal.
   b) The pelvic region should be shielded from accidental direct exposure if at all feasible.
   c) Examinations of the lower pelvic region should only be performed if there are very strong clinical indications to do so.
   d) Postponement of examinations involving the lower abdomen or pelvic region to the end of term or to the latter part of gestation should be considered by the referring physician.
   e) All of the above.

103. In the observation and estimation of certain biological effects and for the purpose of establishing radiation protection standards it is often assumed...
   a) That chronic radiation exposure has a cumulative effect resulting in irreparable injury that is additive.
   b) That all radiation exposure has some risk of injury.
   c) That the threshold for effects is zero dose.
   d) All of the above.
   e) None of the above.

104. The protection factor provided by a self-contained breathing apparatus operated in pressure demand mode...
   a) Is 10.
   b) Is 50.
   c) Is 500.
   d) Is 1000.
   e) Is 10,000.

105. A thirty year old radiation worker has accrued an integral dose of 5 rem as of his thirtieth birthday. What is the maximum dose he could receive legally in the next year prior to his thirty first birthday? (do not consider planned special exposures)

a) 5 rem.
b) 10 rem.
c) 12 rem.
d) 0 rem.
e) He has been overexposed.

106. Regarding the radiosensitivity of living organisms and cells,

a) The cells have their greatest sensitivity during meiosis and when they have not yet fully differentiated.
b) The simpler the organism, the greater its sensitivity.
c) Most radiation damage is due to the direct interaction of radiation with the genes.
d) Most radiation damage is due to direct interaction of radiation with important enzymes.
e) Most radiation damage results from the direct creation of holes in the cell wall.

107. The lens of the eyes receive the same absorbed dose from alpha particles, beta particles, gamma photons, X-rays, and neutrons. The radiation expected to produce the largest number of cataracts is:

a) Alpha.
b) Beta.
c) Gamma.
d) X-ray.
e) Neutrons.

108. Which of the following radiations presents the most severe external radiation hazard?

a) Alpha particles.
b) Gamma photons.
c) Fast neutrons.
d) Beta particles.
e) None of the above.

109. If a licensee is unable to obtain records for exposure of an individual from previous and current occupational dose, administrative controls must be established to reduce the individuals allowable dose by...

a) 2 rem for each year that records are not available.
b) 5 rem for each year that records are not available.
c) 1.25 rem for each quarter year that records are not available.
d) 2 millirem for each hour that he can't come up with them.
e) 500 millirem for each month.

110. Current recommendations of the NCRP relative to radiation exposure of pregnant women include which of the following?
   a) Integral doses during the first trimester of pregnancy should be less than 0.5 rem to the fetus.
   b) Integral doses during the entire period of gestation should be less than 0.5 rem to the fetus.
   c) Pregnant women should be granted a 3 month leave of absence during the first trimester of pregnancy and integral doses during the remainder of pregnancy should be less than 0.5 rem to the fetus.
   d) Quarterly doses should be less than 25% of the allowed quarterly limits for males or for pregnant females.

111. Radioactivity was discovered by:
   a) Marie Curie.
   b) Becquerel.
   c) Roentgen.
   d) Rutherford.
   e) Thompson.

112. The safe transportation of radioactive materials is enhanced most by:
   a) Labeling requirements.
   b) Use of special vehicles.
   c) The actions of persons with special training to handle and transport the materials.
   d) Using labeling, packaging, and transportation methods commensurate with the quantity, type, and hazard of radioactive material.
   e) Forbidding the transportation of highly hazardous radioactive materials over bridges, through tunnels, and through densely populated areas.

113. All but the following are true regarding an estimate of the dose equivalent in the body or in parts of the body:
   a) For external radiation, personnel dosimeters give sufficient information for the estimation of dose equivalent distribution.
   b) Current monitoring devices for external radiation can distinguish between dose equivalents caused by penetrating radiation and those essentially limited to the skin.
   c) A depth of 1 cm to separate "shallow" and "deep" dose equivalents is a useful compromise for distinguishing between the dose equivalent to the skin and to other tissues in the body.
   d) All of the above.
   e) None of the above.

114. The maximum allowable radiation level at three feet from the surface of a package shipped in other than a sole use vehicle is:
   a) 1 mrem/hr.
   b) 2.5 mrem/hr.
   c) 10 mrem/hr.
   d) 100 mrem/hr.
   e) 200 mrem/hr.

115. The ultimate dose equivalent received by an organ is proportional to
   a) The total quantity of the radionuclide taken up in the organ and the effective energy term for the radionuclide and organ of reference.
   b) The effective half-life.
   c) The inverse of the mass of the organ.
   d) All of the above.
   e) None of the above.

116. The maximum allowable radiation levels associated with the shipment of radioactive materials via sole use vehicles include all but the following:
   a) 1000 mr/hr. on contact with the external surface of any package.
   b) A maximum transport index of 50.
   c) 200 mr/hr. at the external surface of the vehicle.
   d) 10 mr/hr. at 6 feet from the external surface of the vehicle.
   e) 2 mr/hr. at any location of the vehicle occupied by a person.

117. What comparison is not correct regarding the greater radiation sensitivity for adverse biological effects?
   a) Young less mature organisms as compared to older more mature ones.
   b) Highly developed organisms as compared to organisms of simple structure.
   c) The embryo as compared to the fetus in later stages of development.
   d) Bacteria as compared to viruses.
   e) Nerve cells as compared to epithelial cells.

118. Regarding the dose consequences from inhalation of alpha emitting radioactivity, which of the following is not true?
   a) Extremely small particles (<0.1 micron) represent a dose threat primarily to the alveoli as opposed to the upper respiratory tract.
   b) Particulate activity in the 1 to 10 micron range and which are insoluble in body fluids represent a dose threat primarily to the G.I. tract
   c) No synergistic effects between smoking and lung deposition of alpha emitters (regarding lung damage) have been statistically demonstrated.
   d) The present concensus is that, for a given quantity of radioactivity the damage from a uniform distribution of insoluble particulates in the lung is greater than that from so-called "hot" particles at a specific site.

119. Absorbed dose is:
   a) Defined as the amount ionization produced per gram.
   b) Defined as the amount of energy deposited per unit mass and applies to any type of radiation in any medium.
   c) Is measured in roentgens and applies only to X-rays and gamma rays.
   d) Is measured in ergs.
   e) None of the above.

120. The number of mutations resulting from exposure of an organism to radiation...
   a) Decreases with total dose.
   b) Increases logarithmically with total dose.
   c) Depends on the total dose and the time period over which the dose was delivered.
   d) Is directly proportional to the total dose regardless of the dose rate.
   e) None of the above.

out the following are applicable to the lung cancer observed in uranium miners.

a) Miners who also smoke are observed to have a much higher incidence of lung cancer than non-smokers.
b) Cancer is observed primarily in the bronchial epithelium region.
c) Cancer is probably associated with the radiation dose from "hot particles".
d) Cancer is believed to be the result of the dose delivered by radiation emitted from radon daughter products deposited in the respiratory tract.
e) Cancer is observed primarily in workers who have worked a number of years in the industry.

122. Which one of the following is not true about shielding?

a) All heavy charged particles undergo similar interactions with matter, principally with electrons, and are shielded in the same manner.
b) The light charged particles, negatrons and positrons, present no special difficulties in shielding provided reasonable care is used.
c) The shielding of X and gamma rays is done most effectively by material with the highest electron density.
d) The best neutron shield for normal application (poly energetic neutrons) would be concrete.
e) The effectiveness of a shield comprised of layers of different materials is independent of the arrangement of the layers.

123. Which of the following radionuclides is most often used for thyroid uptake studies?

a) I-123.
b) I-125.
c) I-131.
d) Tc-99m.
e) Xe-133.

124. After a half-hour sampling interval, radon daughter particulates have an initial effective half-life of about...

a) 20 minutes.
b) 35 minutes.
c) 55 minutes.
d) 75 minutes.
e) 90 minutes.

125. The sensitivity of a given organ to microwave radiation depends primarily on...

a) The frequency of the microwave radiation.
b) The blood supply to the affected area.
c) The oxygen content of the tissue.
d) The hydrogen content of the tissue.
e) The degree of specialization of the irradiated cells.

U.S. NUCLEAR REGULATORY COMMISSION
REGION V

DATE ~~00/00/00~~ 3/18/98

TELEPHONE OR VERBAL CONVERSATION RECORD

TIME 4:15
00:00 am/(pm)

[ ] INCOMING CALL [X] OUTGOING CALL [ ] VISIT

PERSON CALLING:	OFFICE/ADDRESS:	PHONE NUMBER:
PERSON CALLED:	**OFFICE/ADDRESS:**	**PHONE NUMBER:**
Dixie Wells	Aguirre Engineers, Inc.	(702)645-9292

CONVERSATION

SUBJECT - License application, Control No. 572623

SUMMARY -

1) Are possession limits stipulated in the application?
No. The GPI license was referenced. Those limits would be appropriate.

2) Discussed new NRC release criteria in FR 39058, Vol. 62, No. 139, July 21, 1997. These will be fully effective in August 1998. Call Richard Turtil, Dr. McGuire, or Larry Bell for further information.

3) Discussed standard license condition and the fact that the customer is responsible for release of materials from the site. The regulatory authority for the customer-site must approve the release.

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	DATE:
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	DATE:

NRC FORM 218 REV-0 8/93 (ET/Ldc-RIV)

A/4

U.S. NUCLEAR [illegible]ATORY COMMISSION
REGION V

DATE 00/00/00

TIME 00:00 am/pm

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[ ] INCOMING CALL [ ] OUTGOING CALL [ ] VISIT

PERSON CALLING:	OFFICE/ADDRESS:	PHONE NUMBER:
PERSON CALLED:	OFFICE/ADDRESS:	PHONE NUMBER:

CONVERSATION

SUBJECT -

SUMMARY -

4.) As the ALARA program specifies that Project Mgrs. can train personnel, the minimum ~~training~~ training + experience for Project Managers should be specified.

5.) The organization chart labeled "AEI High Hazard Service" indicates that Tom O'Don reports to William McKinnell III and that he cannot report directly to Mr. Aguiso. This will be corrected. O'Don can go directly to the President. William McKinnell III is a business-manager type and is the company Vice President.

-B. Prange

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U.S. NUCLEAR ~~REGULATORY~~ COMMISSION
REGION V

DATE ~~00/00/00~~ 3/25/98

TELEPHONE OR VERBAL CONVERSATION RECORD MS-15

TIME ~~00:00~~ 2:25 am/(pm)

[ ] INCOMING CALL [ ] OUTGOING CALL [ ] VISIT

PERSON CALLING:	OFFICE/ADDRESS:	PHONE NUMBER:
PERSON CALLED:	**OFFICE/ADDRESS:**	**PHONE NUMBER:**
Dixie Wells	Aquire Engineers, Inc.	(702)645-9292

CONVERSATION FAX:(702)395-2824

SUBJECT - License application, Control No. 572623

SUMMARY -

1) Specify that possession limits should be as stated in License 27-29103-01, or specify appropriate changes.

2) Volume 3 will be returned. It was not needed for the review. It contained only QA program for contracted laboratories.

3) Questions regarding contractors:
   - GTS Duratek - current name, location?
   - Environmental Restoration Group - where located?
     12809 Arroyo De Vista NE
     Albuquerque, NM 87111
   - Yankee Atomic Labs - current name, location?

4) Organization chart must be revised to give RSC chair a direct path to the company president.

5) Training, experience, titles, needed for Gotto, Splattstesser — see p. 24 of manual.

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NRC FORM 218 REV-0 8/93 [NT/Ldc-RIV]

A/5

U.S. NUCLEAR [illegible]ATORY COMMISSION
REGION V

DATE 00/00/00

2

TELEPHONE OR VERBAL CONVERSATION RECORD

TIME 00:00 am/pm

[ ] INCOMING CALL [ ] OUTGOING CALL [ ] VISIT

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PERSON CALLED:	OFFICE/ADDRESS:	PHONE NUMBER:

CONVERSATION

SUBJECT -

SUMMARY -

you may wish to add minimum experience for project mgrs to p.5 of the manual.

6.) Are you a full-time RSO? yes. Will you have a staff? As needed, yes.

7.) Need commitment that emergency procedures will be posted at sites with appropriate contact names + phone numbers.

8.) Specify bioassay action levels and discuss consideration of follow-up bioassays.

9.) Will personnel operate waste compactors? No. However, they may contract this out.

10.) Procedure 2 - p.5 - CPM = counts / time in minutes typo.

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REGION V

DATE 00/00/00

3

TELEPHONE OR VERBAL CONVERSATION RECORD

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[ ] INCOMING CALL [ ] OUTGOING CALL [ ] VISIT

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PERSON CALLED:	OFFICE/ADDRESS:	PHONE NUMBER:

CONVERSATION

SUBJECT -

SUMMARY -

11.) Procedure 4 - p. 3 True β Exposure = (OW - CW) x BCF

12.) Procedure 9 - pages 2-5 reference ARP rather than RWP.

13.) Procedure 10 - pages 3, 5+6 reference attachments, but none were provided

14.) Procedure 16 - page 8 - Wipes should be taken over 300cm^2 see + 49CFR 173.443
Procedure 17, p. 3

15.) Procedure 19 - p. 3 - If there are less than 5 sources at a site, then the sources must be carried on the home office inventory. The required 6 mo. physical inventory is for all sources. Location must be indicated.

16.) Procedure 22 - Item 2.3.2 - Should reference safety measures for

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REGION V

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4

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TIME 00:00 am/pm

[ ] INCOMING CALL [ ] OUTGOING CALL [ ] VISIT

PERSON CALLING:	OFFICE/ADDRESS:	PHONE NUMBER:
PERSON CALLED:	OFFICE/ADDRESS:	PHONE NUMBER:

CONVERSATION

SUBJECT -

SUMMARY -

opening previously packaged material. May want to reference Procedure 23.

17.) Procedure 24- Consideration of air sampling should be discussed.

18.) Procedure 25 - Add a ~~cor~~ caution that customer/regulatory body must approve release of material for unrestricted use.

19.) Procedure 30 - page 1+4 - Proprietary issue. Applications are sent to the PDR. Reference to "proprietary" will be deleted.

20.) Procedure 32 - p.13 - The TEDE = 2.5mrem (stochastic)
1 DAC-hr (non-stochastic) = 25mrem

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	DATE:

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U.S. NUCLEAR REGULATORY COMMISSION
REGION V

DATE 00/00/00

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TIME 00:00 am/pm

[ ] INCOMING CALL [ ] OUTGOING CALL [ ] VISIT

PERSON CALLING:	OFFICE/ADDRESS:	PHONE NUMBER:
PERSON CALLED:	OFFICE/ADDRESS:	PHONE NUMBER:

CONVERSATION

SUBJECT -

SUMMARY -

21.) The forms in Procedure 34 are not equivalent to NRC Forms 4+5

22.) Procedure 35, p.3 references Appendix A, but there is none.

23.) The Final Status Survey Report structure will be included.

24.) Generic Detailed Work Plan

- pages 1+2 - release of material must be as approved by client/regulatory body.
- p.5 - The criteria as stated is not complete.

25.) Generic Health + Safety Plan

- References to Visitor dosimetry need to be consistent. See Rad. Safety Manual - p.13; ARP-34, p.6; Radworker Training Study Guide, p.20; and GHASP, p.1

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	DATE:
ACTION TAKEN:	INITIALS:
	DATE:

NRC FORM 218 REV-0 8/93 [KT/Ldc-RIV]

U.S. NUCLEAR [illegible]ATORY COMMISSION
REGION V

DATE 00/00/00

6

TELEPHONE OR VERBAL CONVERSATION RECORD

TIME 00:00 am/pm

[ ] INCOMING CALL [ ] OUTGOING CALL [ ] VISIT

PERSON CALLING:	OFFICE/ADDRESS:	PHONE NUMBER:
PERSON CALLED:	OFFICE/ADDRESS:	PHONE NUMBER:

CONVERSATION

SUBJECT -

SUMMARY -

26.) Study Guide

- p. 20 - Visitor dosimetry issue
- p. 35 - 1ALI = 5rem TEDE or 50rem organ dose
  1 DAC-hr is 2.5mrem (stochastic)
  25mrem (non-stochastic)

27.) Radiation Safety Manual

- pg 13 Where is 2-yr. Rad-worker training classification documented?
- p. 17 Change reference to storage location for exempt matls
- p. 24 Need titles for Gotto + Splatteldeeser, as previously discussed.

– B. Prange

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	DATE:
ACTION TAKEN:	INITIALS:
	DATE:

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV

Walnut Creek Field Office
1450 Maria Lane, Suite 300
Walnut Creek, California 94596-5368

MAR 26 1998

Aguirre Engineers, Inc.
ATTN: Dixie Wells
Radiation Safety Officer
6461 Plumcrest Rd. Ste.100
Las Vegas, Nevada 89108

SUBJECT: LICENSE APPLICATION

As was discussed in a telephone conversation with you on March 25, 1998, Volume 3 of the application, which included quality assurance plans provided by contractor laboratories, was not needed for this review. Therefore, both copies are enclosed for your use.

Sincerely,

Beth A. Prange

Beth A. Prange
Sr. Health Physicist (Licensing)
Materials Branch

Enclosures: As Stated

A/4

bcc:
LFARB, T-9 E-10
WCFO Inspection File
Docket File

DOCUMENT NAME: G:\beth\ AGI
To receive copy of document, indicate in box: "C" = Copy without enclosures "E" = Copy with enclosures "N" = No copy

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AGUIRRE ENGINEERS, INC.
High Hazard Services • Radiation Protection

March 31, 1998

Ms. Beth Prange
U. S. Nuclear Regulatory Commission, Region IV
Walnut Creek Field Office
1450 Maria Ln, Ste 300
Walnut Creek, CA 94596

Subject: Response to Questions with regard to AEI's Application for an NRC Specific License of Broad Scope for Byproduct Material

As per our discussions on March 18, 1998 and March 25, 1998, I have held all your comments and concerns to be answered in this one letter.

As to our request for possession limits, the possession limits as stated on NRC License Number 27-29103-01 are satisfactory for our needs with this license. Please use those limits.

The organization chart showing the Program Manager/Corporate Health Physicist as reporting to an AEI Vice President has been changed to reflect the reporting chain now leads to the President.

I have included copies of the radioactive materials licenses from Teledyne Engineering. Please use them to replace GTS Duratek, as I am having some of same difficulties that you encountered in getting information from them. Copies of the radioactive materials license that Duke Labs in Massachusetts held as Yankee Atomic and now hold as Duke Engineering Services is also enclosed.

I am forwarding the information that was faxed to me by Mr. Ken Baker of ERG in New Mexico (in the event that you were unable to reach them).

All other requests and discussions were with regard to procedures changes and those are the subject covered in Attachment 1 to this letter and the remainder of the package.

Finally, I looked for the best place to put the commitment to post the Emergency Call List and nothing seemed to lend itself. Since we had discussed that possibility and you indicated that my commitment in this format would be acceptable, this is AEI's commitment that the Emergency Call List will be immediately available to all personnel working on an AEI jobsite.

Thank you for your support and guidance in AEI's initial licensing effort. I always look forward to working with you on any project and this no exception. As you review these responses, please call me for immediate assistance with any questions, concerns, comments, or clarifications. I may be reached by phone at (702) 645-9292 or by fax at (702) 395-2824.

Sincerely,

Dixie J. Wells, RSO
Las Vegas Operations
AEI High Hazard Division

cc: Thomas J. O'Dou, Program Manager

572623

6461 Plumcrest Road • Las Vegas, NV 89108-5309 • PO Box 36441 • Las Vegas, NV 89133-6441 • USA 702-645-9292 • FAX 702-395-2824

A/7

The Radiation Safety Manual has been reformatted so that, in future, changes may be made to individual pages and/or sections without requiring that the document be completely reprinted to accommodate those changes. Since the Radiation Safety Manual (RSM) has been reformatted, I have included a complete copy of that document rather than just effected pages. Please replace this document.

However for ease of review, I have followed the outline that we discussed in annotating procedural changes. All changes that are listed in this cover letter may be located in each procedure by referencing the procedure's *Effective Pages* and turning to that page in the procedure, the change will be visually indicated by a vertical line in the right margin with the revision number (Rev. 1, 2, etc) and the date of the change.

The following changes were either previously discussed in the text in which they exist or are propagated by changes from other procedures.

Radiation Safety Manual

2.1.2 Requirements for a Program Manager have been separated from those of the Corporate Health Physicist and further delineated.

2.4 As discussed, the position of the Projects on our Radiation Safety Committee and Project Manager(s) are critical to our field operations. The requirements for and the responsibilities of the Project Manager have been added in order to allow for future consistency in that position.

2.5 The Waste Broker will report to the Program Manager rather than the Vice President. Since the Waste Broker will also be one of the AEI Project Managers, this change is prudent and avoids confusion later.

4.1 (Page II-5) The necessity for a tracking document to ensure that the two (2) year requalification period is not exceeded, has been added here. The training matrix that is normally part of personnel records is specified as the document of choice in this instance.

4.2 As discussed, there are four (4) different references that discuss the *fate* of visitors, and while they do not conflict with one another, they do not give a consistent treatment to the visitor. The manner of the handling of visitors is being established here first and will be followed through in the other references.

5.5 The basis for the bioassay program has been added at this point and specified with regard to the appropriate regulatory and procedural guidance.

6.2 The location of the source storage for exempt radioactive materials has been changed to reflect that they will be kept in a locker located at the AEI Las Vegas office facilities.

8.5 As discussed, the addition of statements regarding the fact that AEI does not have a waste compactor nor any inherent waste compaction capabilities has been added at this point. In addition, wording has been used that indicates that we will not operate such machinery except as a contractor and by contract, at the client facility, after receiving documented training.

The dimension not addressed specifically here is with regard to the fact that all work performed by this license is normally covered by the writing of a Work Package, which would contain any specification that AEI was being requested to operate this or any other type of client machinery.

Attachment 1 The titles and positions of the personnel currently on the Radiation Safety Committee have been better illustrated. The qualifications required to assume those positions have been previously documented.

To complete the changes to the RSM, the Table of Contents and the Effective Pages have been updated. A new cover page has been generated and signed by the principles.

Radiation Safety Training Manual

There was only one (1) requested/discussed change to this manual and that has been accomplished. On the last page of the manual, are the conversion units and the unit that dealt with conversion from DAC-Hr to mrem has been removed. After much discussion, internally, the Corporate Health Physicist and myself determined that the explanation of the difference in stochastic/non-stochastic and how it related to dose was far more involved than was necessary for 'everyday' in-use procedures. You will discover that this reference has been removed in another procedure in this revision package and for the same reason.

However, this document has also been reformatted and a complete copy is included. There are more pages in this manual than in the original, not because any information was added or changed. The additional pages are the product of reformatting to spread out the information, which gives the user more room for notes, both individually and in a classroom setting.

The cover page was redone, to match the cover on the Radiation Safety Manual, and a Forward page was added following the cover page. No *effective pages* was created for this document.

The remainder of this attachment constitutes the discussion with regard to the procedure changes that have been accomplished. Each is prefaced by its' procedure number and then an explanation of the change and why, when required.

AEI Procedures

ARP-002, Alpha-Beta Sample Counting Instrumentation, page 5; 5.4.7 contained the following typo:

CPM=Counts per minute or count time/ in minutes

and has been corrected to read:

CPM=Counts per minute or count time/minutes

ARP-004, Operation of Ionization Chambers, page 3; 5.3.3 - the formula was incorrect:

True β Exposure = (CW - OW) x BCF

and has been corrected to read:

True β Exposure = (OW - CW) x BCF

ARP-008, Radiation and Contamination Surveys, Form ARP 8-3 - Radiation and Contamination Survey Results -1/98 contained a confusing column sub-header. Under the heading *Removable*, the subheadings are *Alpha* in *dpm/100cm²* and *Beta/Gamma* in *cpm/probe*. The unit associated with the Beta/Gamma reading in this category is incorrect, it should be *Beta/Gamma* in *dpm/100cm²*. The survey form has been corrected to reflect the proper unit.

ARP-009, Routine Radiological Surveys, pgs. 2 and 5; 2.3, 3.3, and 5.3.1 - the use of the acronym ARP was not complete and did not reference the use of a Radiation Work Permit (RWP). The wording has been changed to reflect the use of both the RWP and the applicable procedure.

ARP-010, ALARA As Low As Reasonably Achievable, Section 6.0 Attachments references Attachment 10-1 and five (5) forms, 10-2 through 10-6. These forms were inadvertently omitted when the procedure was printed and copied. They have been included for review and addition to your AEI license submittal procedure data.

ARP-016, Radioactive Materials Brokering, page 4, 2.1.20 - typo: *soled* has been changed to *solid*; page 5, 2.1.21(b) - typo: *on* meter has been changed to *one* meter. In section 5.2 (pgs 7 & 8), the table and wording did not appear to properly reflect the survey technique or the limits, as specified in 49 CFR 173.443 (1996): subsections 5.2.4 & Table A have been revised to clarify and reflect the appropriate wording from the Code of Federal Regulations.

ARP-017, Empty Transport Vehicle Radiological Surveys, page 3, 5.3.3 references the limits discussed in Table A of ARP-016 and as set in 49 CFR 173.443. As in ARP-016, these numbers are not definitive with regard to technique of survey. Subsection 5.3.1 has been revised to clarify the survey technique and measurement analysis to be used.

ARP-019, Radioactive Material Tracking, - this procedure did not provide for tracking of smaller amounts of source material after it had been transported to a work site and may have resulted in those radioactive materials not being properly inventoried in accordance with license conditions. Section 5.3 has been revised to include statements regarding those sources (calibration, check, etc.) and section 5.4 has been added to ensure their inventory.

ARP-022, Packaging Radioactive Material, - no specific guidance had been prescribed for the opening of packages, although that guidance was resident in ARP-023. Subsection 2.3.2 has been revised to include the use of ARP-023 when opening packages and has been referenced in section 3.1.

ARP-024, Decontamination of Equipment and Tools, as we discussed, I revisited a previous writing with regard to the managing of potential airborne during fixed contamination removal operations. Those controls have been placed in subsection 5.3.3 (i)(i) on page 7 of this procedure.

ARP-025, Unconditional Release of Materials from Radiological Controls, page 5, Section 5.1 has a chart which contains a reference to Reg Guide 1.86. This is currently the operable guidance regarding decontamination release limits. However, due to impending changes within the NRC and the EPA, it seems prudent to upgrade such statements to encompass any future guidance.

ARP-030, Document Control, contained proprietary statements that were not appropriate for a procedure set that is part of a NRC radioactive materials license. Those statements, in 1.3 and 5.3.3, have been completed revised or removed.

ARP-032, Respiratory Protection, page 13, Section 1.0 referenced the value of one (1) DAC-Hour in millirem. Based on our discussions, that statement has been removed rather than create potential confusion on the part of the procedure user.

ARP-033, Bioassay, Subsection 2.3.5 has been added to give more completely delineate the bioassay actions levels referenced in Section 5.5 of the Radiation Safety Manual. Two (2) additional references have been placed in 3.1 to provide basis for the bioassay action level(s) assigned.

ARP-034, Dosimetry, - In subsection 2.2.8, the procedure refers to a NRC Form 4 equivalent and none was provided. Currently, all forms attached to this procedure are AEI forms and are not intended to replace any NRC form. AEI plans to use NRC Forms 4 and 5 as presented in Regulatory Guide 8.7. Subsection 2.2.8 has been revised to reflect that the AEI form will be accompanied by the appropriate NRC form and R.G. 8.7 has been added to Section 3.1 as a procedure reference.

Beginning in Section 5.2, the term Pocket Ion Chamber has been corrected to read Direct Reading Dosimeter. In all parts of Section 5.3, changes have been made to continue with consistency towards the AEI procedural handling of visitors.

ARP-035, Emergency Response, In Section 5.6 (second paragraph), there was a reference to an Appendix A, which did not exist nor was there any necessity to create such an appendix. That reference has been removed.

Although not required, Table 10.2 has been updated and included for your information.

ARP-036, Training, This procedure has been revised to provide consistency with regard to the issue of how to handle visitors. Section 5.7 on page 4 has been added to indicate that visitors are a part of the population and a potential training matrix for visitors has been added to the table on page 5.

SDWP, Generic Detailed Work Plan, This document is subjective indicating those topics that would normally be covered in a Site Specific Work Plan. In accordance with our discussions, I have shown potential revision to the development thought process involved in a Work Plan - by showing the changes we discussed on:

- Page 1 under Scope of Work
- Page 2 under Radiation Protection
- Page 5 under Surveys

Revision bars are shown with the appropriate change date. The complete document has been reproduced due to reformatting.

HASP, Generic Health & Safety Plan, As with the SDWP, this document is also subjective indicating those topics that would normally be covered in a Site Specific Health & Safety Plan. In accordance with our discussions, I have shown potential revision to the development thought process involved in a HASP - by showing the changes we discussed on:

- Page 1, 1.2 under Visitors (this continues the consistency revisions regarding visitors)
- Page 16 , 6.3 under Site Specific Medical Monitoring
- Page 28, the Call List has been undated with the current AEI personnel

Revision bars are shown with the appropriate change date. Only the change pages are included.

SFR, Sample Final Report, As requested, a sample of a Final Report has been included. This document is more difficult to create as a generic, because it depends completely on the job type, the actions taken, and the results received for its' creation. Therefore, we have taken the liberty of including one from an historical completed project. All personnel references other than the PM have been removed. Most of the job specifics remain, as well as the conclusions and recommendations that were made. Our handling of these topics are the actions that you seemed most interested in being able to review and ensure that we would be completing for the client and reporting to both the client and the NRC.

Please note that this is a real Final Report and was created in 1994, when some of the regulations were different. Any evaluations presented for current projects will be based on current regulations, and those will be referenced in the document.

Since most of the procedure changes affected either a major part of a page or the intent of the section, new Effective Pages have been generated for those procedures. Where no Effective Page was generated, the change was a typo and had no impact on the page.

All documents have been 3-holed punched for inclusion in the existing texts.

REGION V

~~00/00/00~~ 11/7/98

TELEPHONE OR VERBAL CONVERSATION RECORD

MS-15

TIME 11:00 ~~00:00~~ (am) pm

[ ] INCOMING CALL [ ] OUTGOING CALL [ ] VISIT

PERSON CALLING:	OFFICE/ADDRESS:	PHONE NUMBER:

PERSON CALLED:	OFFICE/ADDRESS:	PHONE NUMBER:
Dixie Wells	Aquire Engineers, Inc.	(702) 645-9292

CONVERSATION

SUBJECT - Letter dated March 31, 1998

SUMMARY -

1.) A license amendment would be needed prior to AEI operating a compactor under their license. If this is to be performed under a sub-contractor's license (yes), then change wording on p. II-14, Item 8.5 of Radiation Safety Manual. Revisions will be made.

2.) H-3 release criteria is DOE-approved. (See Attachment 10-1, #8) This will be deleted. Revise Procedure 10, p.3, Item 5.2.1(e) to reference Attachment 10-1.

3.) Release of material will be discussed in cover letter w/ license.

4.) The Final States Survey Report structure, as in RG 3.65 will be included.

5.) The "Training Office" is the same as the RSO office.

REFERRED TO:	[ ] ADVISE ME ON ACTION TAKEN
ACTION REQUESTED:	INITIALS:
	DATE:
ACTION TAKEN:	INITIALS:
	DATE:

NRC FORM 718 REV-0 8/93 [EP/Ldc-RIV]

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U.S. NUCLEAR ATORY COMMISSION
.ION V

.TE 00/00/00

TELEPHONE OR VERBAL CONVERSATION RECORD

TIME 00:00 am/pm

[ ] INCOMING CALL [ ] OUTGOING CALL [ ] VISIT

ERSON CALLING:	OFFICE/ADDRESS:	PHONE NUMBER:
PERSON CALLED:	OFFICE/ADDRESS:	PHONE NUMBER:

CONVERSATION

SUBJECT -

SUMMARY -

6.) Page II-9 of the Radiation Safety Manual, item 5.5, will be revised to reference Attachment 2 rather than "appendix A."

- Beth A. Prange

REFERRED TO:	[ ] ADVISE ME OF ACTION TAKEN
ACTION REQUESTED:	INITIALS:
	DATE:
ACTION TAKEN:	INITIALS:
	DATE:

AC FORM 218 REV-0 8/83 [RT/bdc-RIV]

AGUIRRE ENGINEERS, INC.
High Hazard Services • Radiation Protection

April 7, 1998

Ms. Beth Prange
U. S. Nuclear Regulatory Commission, Region IV
Walnut Creek Field Office
1450 Maria Ln, Ste 300
Walnut Creek, CA 94596

Subject: Response to Final Questions Regarding AEI's Application for an NRC License

As referenced in my letter of March 31, 1998, the final questions cover a range of discussion dates including March 18 and 25, 1998, and now our telecon of this AM. Hopefully, I will have held all your comments and concerns to these two (2) letters.

Since you had only 5 or 6 comment sections, I will address all issues within the body of this letter and will not include attachments to it.

Radiation Safety Manual (RSM):

- Page II-5, the Training Office is a subset of the Radiation Safety Office
- Page II-14, Section 8.5 - the provisions regarding the operation of a waste compactor were not as clearly defined as you wished. In accordance with those statements presented in the review guidelines which you sent me and our discussion, those statements now reflect the fact that AEI will not operate waste compacting equipment except under a subcontractor or client's license for such equipment and operations.
- On page II-9, you cited an erroneous reference to an Appendix A which had been changed to Attachment 2. In making that correction, I performed a "Find and replace" check and noted other instances where I had made the same mistake. I uniformly corrected that mistake on all pages in which it appeared.

ARP-10, ALARA:

- Page 3, Section 5.2.1(e) referenced Attachment 6-1 instead of 10-1. That reference has been corrected.
- Attachment 10-1, Surface Activity Guidelines, contained a Note 8 that discussed the treatment of Tritium and the DOE. That statement was not relevant to the use of this procedure or NRC guidelines regarding the treatment for and of Tritium. That statement has been removed and, in all cases, Tritium will be handled in accordance with the most current NRC guidelines.

Generic Final Report:

As per our discussion, I have completed an outline for a Final or Decommissioning Report.

As with the March 31 letter, I have included copies of all pages and or affected changes to procedures or other documents. Since I am faxing this information to you, I will put the originals in an overnite FEDEX this afternoon.

As always, your patience, guidance, and support in our licensing effort seem endless. Thank you. As you review these responses, please call me for immediate assistance with any questions, concerns, comments, or clarifications. I may be reached by phone at (702) 645-9292 or by fax at (702) 395-2824.

Sincerely,

Dixie J. Wells, RSO
Las Vegas Operations
AEI High Hazard Division

cc: Thomas J. O'Dou, Program Manager

572623

6461 Plumerest Road • Las Vegas, NV 89108-5309 • PO Box 36441 • Las Vegas, NV 89133-6441 • USA 702-645-9292 • FAX 702-395-2824

A/9

SECTION II - PROGRAM IMPLEMENTATION

5.0 SURVEYS AND MONITORING

5.1 Personnel Monitoring

Personnel likely to receive in one year from radiation sources external to the body, a dose in excess of 10% of the applicable limits will be monitored by personnel dosimetry. The personnel dosimetry devices will indicate the approximate amount of ionizing radiation to which the wearer was exposed. The personnel dosimeter will normally be worn on the upper torso. Personnel are responsible to wear dosimetry as directed by the RSO. If a personnel dosimeter is lost, misplaced, or indicates an offscale reading, the employee is required to notify their supervisor, Radiation Protection personnel and/or the RSO immediately.

5.2 Radiation Surveys

Radiation surveys are performed to determine radiation conditions in the work area and provide personnel awareness to implement the AEI ALARA commitment. Radiation surveys also identify radiation conditions which require special posting as required by regulations to alert personnel of elevated radiation levels in a particular work area. Worker exposures can be estimated and controlled by knowing exposure levels and working time.

Radiation surveys are also used to determine the levels of radioactive material on surfaces when characterizing sites and facilities. These surveys determine if residual activity is below "unrestricted" release criteria or identifies specific areas which must be decontaminated to meet the release criteria.

Radiation surveys are performed using AEI procedures listed in Attachment 2.

5.3 Contamination Surveys

Contamination surveys are used to determine the levels of fixed and removable radioactive materials on surfaces and equipment. The survey technique uses filter paper swipes on surfaces to determine the amount of activity which can be removed from the surface. The swipes are then counted in a sample counter to determine alpha and beta activities which were removed in the test. The fixed plus removable contamination is determined by direct measurement on surfaces. If the fixed and removable contamination is below the limits specified in Table 1, the area or equipment can be further evaluated for release or disposal as "uncontaminated".

Contamination surveys also identify areas or items which must be placed under control to prevent the dispersion or release of radioactive materials. Once identified, the area or materials are confined using roped off areas and entry controlled to isolate the contamination until the levels are reduced by decontamination techniques below the "*unrestricted*" release criteria.

Contamination surveys are performed using AEI procedures listed in Attachment 2.

5.4 Air sampling

Periodic air samples are taken as required to verify air concentration routinely remains below 10% of the DAC, to maintain the TEDE ALARA. Air samples are taken using lapel air samplers or grab samplers which provide measurement of concentrations in the worker breathing zone. If the air concentration exceeds 10% of DAC values the RSO should be notified so appropriate corrective actions can be taken and exposures received by the workers evaluated and included in their exposure file.

Air sampling is performed using AEI procedures listed in Attachment 2.

5.5 Bioassay

Bioassay is used to assess inhaled, ingested, or absorbed radioactive materials in order to determine internal and/or total dose to workers. The detection level for bioassay samples shall be 10% of the Annual Limit of Intake (ALI) or lower, if practical.

Bioassay sampling is performed using AEI procedures listed in Attachment 2 and all current regulatory guidance.

5.6 Calibration and Use of Instruments

Radiation detection instruments will be used only by personnel trained in their use and in accordance with AEI procedures. Instrumentation is calibrated on a 6 month schedule by the manufacturer or a certified calibration laboratory and a calibration sticker attached to the instrument to allow the operator to verify the instrument is within current calibration before use. If an instrument is found to have a past due calibration, the instrument shall not be used and shall be tagged with an "OUT OF CALIBRATION" sticker.

All radiation protection instruments shall be source checked before use.

3) Containers when they are in transport and packaged and labeled in accordance with the regulations of the Department of Transportation.

7.3 Receiving and Opening Packages

In accordance with 10 CFR 20.1906, packages containing radioactive materials will be surveyed for radioactive contamination and radiation levels within three (3) hours after receiving the transported package during normal working hours, or not longer than three (3) working hours from the beginning of the next scheduled working day after receipt, if delivered after work hours.

Procedures for the receipt, surveying and opening of packages are listed in Attachment 2.

8.0 WASTE DISPOSAL

8.1 Disposal of Waste at Licensed Landfill

A licensee can dispose of licensed (radioactive) material by transferring the material to an authorized recipient, i.e., another licensee with a valid license to receive and store or receive and bury (provide final disposition) the material. In order to provide a disposal service in a land disposal facility licensed under 10 CFR Part 61, the authorized recipient must be specifically licensed to receive waste containing the specified or identified licensed material. The transfer of material between a licensee and an authorized receiver must be accompanied with a system of manifesting, a certification or characterization process and control/tracking system.

8.2 Disposal of Liquids in Sanitary Sewer

AEI employees shall not dispose of liquids containing radioactive or hazardous materials in a sanitary sewer.

8.3 Incineration of Waste

AEI employees shall not incinerate waste materials containing radioactive materials.

8.4 Disposal of Wastes From Contaminated Areas Following Surveys

Materials, items, and waste which have been decontaminated and a though survey indicates contamination levels are below those specified in Table 1 can be evaluated for disposal in a sanitary land fill. Note that more restrictive limits may apply at certain customer facilities where AEI works and the most restrictive contamination limits will prevail. Items from contaminated areas that are known not to have been contaminated and exhibit 'no detectable activity above background, as measured with an instrument appropriate for the material' may be released. If the waste consists of containers which have held contained radioactive materials, any radioactive materials signs shall be removed or defaced clearly indicating that the container no longer contains radioactive material.

8.5 Operation of a Waste Compactor or Compaction Equipment

Pen 22 4/2/98

AEI employees shall not operate a waste compactor or compaction equipment unless performed under the provisions of a subcontractor's or client's license at a client site.

All personnel must comply with all conditions of the subcontractor's or client's license in performing any equipment operations. Personnel shall be trained in the proper operation and testing of such equipment prior to commencing any operations.

5.1.1 This procedure sets the minimum standards for performance of ALARA reviews and briefings and does not prohibit the performance of any reviews by the Client Radiation Protection Department that are in addition to those established in this procedure. In all cases, project radiation safety personnel:

a.. Are expected to consider and discuss with the Project Manager and site workers the dose reduction techniques pertinent to the work to be performed for those jobs not meeting the criteria for the performance of formal reviews.
b. Are expected to participate in and support the efforts of the project in performance of ALARA related activities.

5.2 Trigger Levels for Performance of Formal, Documented ALARA Reviews and Briefings

5.2.1 Formal, documented ALARA Pre-Job Reviews shall be conducted and documented, using the attached Pre-Job Review Form, if work is expected to result in:

a. An individual dose exceeding 100 millirem (mrem).
b. The collective dose for the job exceeding 0.5 person rem.
c. Airborne exposures exceeding 40 DAC-hrs per person.
d. General area dose rates exceeding 1 rem/hr.
e. Contamination levels exceeding 100 times the values in Attachment 10-1, Surface Activity Guidelines.
f. Use of supplemental engineering controls (portable high efficiency particulate air (HEPA) systems, gloves bags, tents, or other similar devices) or respiratory protection to reduce potential internal exposures.
g. Installation, removal, or modification of temporary shielding.

5.2.2 Formal, documented pre-job briefings shall be conducted for work involving conditions in 5.2.1 above.

a. Pre-job briefings shall be attended by all project personnel expected to work the job, the Task Manager, HPTs, and project radiation safety personnel supporting job performance, and the individual performing the pre-job review.
b. Pre-job briefings shall be performed and documented using the attached ALARA Briefing Record and the ALARA Briefing Attendance Record.

5.2.3 Pre-job reviews and briefings shall be conducted as indicated below. Briefings shall be conducted jointly by designated radiation safety personnel and the Project Manager.

Table 10-1
Pre-job Review Matrix

Conditions	Review Conducted By	Review Approved By	Briefing Conducted By
Conditions listed in 5.2.1	Lead HPT	RSO/PM	Lead HPT
5X Conditions in 5.2.1 a-e	RSO	RSO	RSO
10X Conditions in 4.2.1 a-e	RSO/Corporate CHP (CCHP)	Radiation Safety Committee	RSO/CCHP

Attachment 10-1
Surface Activity Guidelines

Allowable Total Residual Surface Activity (dpm/100cm²)[1]

Radionuclides[2]	Average[3][4]	Maximum[5][6]	Removable
Group 1 - Transuranics, I-125, I-129, Ac-227, Ra-226, Ra-228, Th-228, Th-230, Pa-231	100	300	20
Group 1 - Th-natural, Sr-90, I-126, I-131, Ra-223, Ra-224, U-232, Th-232	1,000	3,000	200
Group 3 - U-natural, U-235, U-238, and associated decay products, alpha emitters	5,000	15,000	1,000
Group 4 - Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous[7] fission) except Sr-90 and others noted above	5,000	15,000	1,000
Tritium (applicable to surface and subsurface)[8]	N/A	N/A	10,000

Notes:

(1) As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute measured by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

(2) Where surface contamination by both alpha and beta-gamma emitting radionuclides exits, the limits established for alpha and beta-gamma emitting radionuclides should apply independently.

(3) Measurements of average contamination should not be averaged over an area of more than one m^2. For objects of less surface area, the average should be derived for each such object.

(4) The average and maximum dose rates associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h, respectively, at 1 cm.

(5) The maximum contamination level applies to an area of not more than 100 cm^2.

(6) The amount of removable material per 100 cm^2 of surface area should be determined by wiping an area of that size with dry filter or absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wiping with an appropriate instrument of known efficiency. When removable contamination on objects of surface area of less than 100 cm^2 is determined, the activity per unit area should be based on the actual area, and the entire surface should be wiped. It is not necessary to sue wiping techniques to measure removable contamination levels if detect scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

(7) This category of radionuclides includes mixed fission products, including Sr-90, which has been separated from the other fission products, or mixtures where the Sr-90 has been enriched.

Aguirre Engineers, Inc.

Site Specific - Generic

Decommissioning Plan

Project Location

Revision 0

Project Date - 1998

NOTE

This plan is generic in nature and is not intended to be used 'as is' on any work site. Each site must have a site specific plan created for Decommissioning.

Use this template of the decommissioning plan as a tool to ensure that in the creation of your plan, you consider all aspects of decommissioning a site form control as radioactive. This [plan must take into account compliance with all AEI and License procedures, and must also meet applicable Federal, State, and Local requirements.

FINAL STATUS REPORT FOR DECOMMISSIONING

Facility Name

1.0 BACKGROUND

[Provide a discussion of the facility location, work that was done at this facility with radioactive and other hazardous materials, the radionuclides likely to be present at the facility and the magnitude of the cleanup.]

1.1 REASON FOR DECOMMISSIONING

[Identify the reason that the facility is to be returned to unrestricted use; for example, age of facility, relocation of process activity, geographic or environmental concerns, planned future uses, etc.]

1.2 MANAGEMENT APPROACH

[Provide very broad statements concerning conceptual designs, general considerations, a management philosophy, regulatory requirements, reasons for certain approaches, etc. Discuss assigned management responsibilities for QA/QC activities and for health and safety activities during the survey process. List any special training and/or qualifications that the management team may have. (Note: Information concerning cost estimates, funding, or scheduling may be included here)].

2.0 SITE DESCRIPTION

[Describe the physical characteristics of the building and provide enough information to distinctly identify which facility or portion of a facility is to be decommissioned.]

2.1 TYPE AND LOCATION OF FACILITY

[Discuss the type of facility, such as a research facility, light-water reactor, radiopharmaceutical facility, nuclear laboratory, etc. Include specific activities performed. Identify the location of the facility, including geographic location, state or local vicinity, building-specific information, etc.]

2.2 OWNERSHIP

[Identify who owns the facility and how the ownership is structure; that is, private corporation, parent company. If there have been multiple owners, provide a history of the ownership.]

2.3 FACILITY DESCRIPTION

[Include information on buildings, grounds, and any relevant topographical information that may have been a factor in the extent of contamination. Submit available drawings or photos that are relevant to the survey.]

2.4 BUILDINGS

[Include information on the size; construction materials; contents; roofs and release points; condition of surfaces after decontamination; and special considerations or problems such as inaccessible areas, expansion joints or floor penetrations, and piping. Include locations and use of any buildings that may have been razed or remodeled or whose use has been changed over the life of the facility.]

2.5 GROUNDS

[Discuss the size, topography, meteorology, demographics, vegetation, access routes, subsurface features buried waste, water courses, surface water runoff, etc. that may affect the area to be surveyed or the location or extent of contamination.]

3.0 OPERATING HISTORY

[Identify the types and dates of specific operations and/or uses of particular chemical or radiological processes that have evolved over the life of the facility, including uses of the site before licensed operations.]

3.1 LICENSING AND OPERATIONS

[Include the draft number and license number and issuance date for every license the facility has been issued. Indicate the type of work activity at every operating phase and the buildings and/or geographic locations wherein each licensed activity was performed.]

3.2 PROCESSES

[Specify every type (chemical and physical form) of radionuclide used and indicate the quantity required for each operation involved over the life of the facility. Be specific about the processes performed, the specific (and relevant) chemicals and/or radionuclides involved, the locations of each process performed over the life of the facility, related activities, etc. Also, discuss the containment practices for all radiation sources.]

3.3 WASTE-DISPOSAL PRACTICES

[Discuss any disposal practices that may have impacted the contamination status of the facility. Include any incident reports and significant spills.]

4.0 DECOMMISSIONING ACTIVITIES

[Discuss any relevant political, philosophical, or environmental considerations that may have influenced the method of decommissioning selected. Identify any agencies whose philosophy or methodologies (and/or procedures) where chosen for modeling and specify why those were selected.]

4.1 OBJECTIVES

[Broadly discuss what was to have been accomplished and why. Set the parameters (especially the limitations) within which the decommissioning activities were confined.]

4.2. RESULTS OF PREVIOUS SURVEYS

[Generalize the results of previous surveys in the chronological sequence in which they were performed. Discuss the activities of subsequent surveys as they address findings in earlier surveys. Include results of preliminary surveys, characterization surveys, etc.]

4.3 DECONTAMINATION PROCEDURES

[Discuss the specific procedures used to decontaminate the facility. Identify the organization who performed the decontamination and discuss their credentials and related expertise. Cover information on demolition and dismantling, including shipping, storage, and disposal of materials at a safe storage facility or landfill approved for radioactive waste. Discuss any security precautions and safeguards that may have been taken.]

5.0 FINAL SURVEY PROCEDURES

[Discuss general approach and list philosophy of (or reasons for selecting that approach. Refer to any unique conditions that may have been discovered in earlier surveys which relate to the written survey plan.]

5.1 SAMPLING PARAMETERS

[Summerize information concerning grid placement, specific areas scanned, accessibility restrictions, sampling criteria, defining parameters, types of samples taken (soil, water, etc.) and any special precautions taken to ensure readings are accurate. Include procedures used for determining sample analysis. Identify the areas that had low, medium, and high potential for contamination. Discuss how samples were taken at effluent systems (air handling systems, drains, sumps, and sewers).]

5.2 BACKGROUND/BASELINE LEVELS IDENTIFIED

[Discuss the background and baseline levels established for the site. Identify how these levels were determined.]

5.3 MAJOR CONTAMINANTS IDENTIFIED

[Discuss the major contaminants. Include the concentration levels and locations of each radionuclide of interest. Refer to the sources from the plant history, if known.]

5.4 GUIDELINES ESTABLISHED

[Discuss each agency whose guidelines had to be met before the facility could be released. Identify all procedures and regulations and define the release criteria that had to be met.]

5.5 EQUIPMENT AND PROCEDURES SELECTED

[Discuss the philosophy behind the selection of instruments and procedures. Cite any special conditions that may have required deviating from normal practices. Define which radionuclides were present and explain how instrumentation was selected to best detect their particle-emitting characteristics.]

5.5.1 INSTRUMENTS AND EQUIPMENT

[Specifically identify all equipment and instrumentation used in the survey procedures. If the criteria upon which each instrument was selected was not included in the previous subheading, elaborate on the radionuclides of interest and the associated detecting instrument chosen. Discuss calibration procedures used as well as instrument sensitivities and detection limits.]

5.5.2 INSTRUMENT USE TECHNIQUES

[Discus the procedures and techniques used in operating the instruments or equipment used in the survey.]

5.6 PROCEDURES FOLLOWED

[Discuss the procedures used in the survey process, including statistical methodologies used to determine the number of samples required, QA/QC procedures, field and laboratory techniques, and methods of sampling and disposing of contaminated materials used during the survey.]

5.7 SURVEYING ORGANIZATION

[Identify the survey organization and include expertise or credentials that establish their credibility.]

6.0 FINDINGS

[Discuss the general condition of the site as determined by the survey. Evaluate reasons for any significant differences found between the final status survey and any previous surveys Prepare and reference (1) tables of survey data and (2) graphic representation of findings to be included int hid section. Reference techniques for reducing and evaluating the data in the following subsections.]

6.1 TECHNIQUES FOR REDUCING/EVALUATING DATA

[Describe the computational methods used to convert raw data into conventional units and to evaluate average and/or "hot spot" activity levels. Include formulas and/or examples where appropriate.]

6.2 STATISTICAL EVALUATION

[Provide an explanation of the statistical methodology used to evaluate the survey findings. That is, show how the statistical method used provides a true representation of the data in relation to the applicable guideline values.]

6.3 COMPARISON OF FINDING WITH GUIDELINE VALUES AND CONDITIONS

[Provide a table and any supporting test that is needed to compare the findings with the release established by the regulatory agencies. Include criteria from any state, local, or other federal agencies who, in addition to NRC, may have jurisdiction. Reiterate how QA/QC procedures, survey procedures, documentation procedures, etc. comply with guidelines established by the NRV or other regulatory agency.]

7.0 SUMMARY

[Provide an overview of the entire program. One or two sentence summaries of each section and/or subsection should provide the information that should be included in the summary. The concluding paragraph should state that according to the findings of the final status survey, the release criteria have been met and the license is applying for license termination.]

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV

Walnut Creek Field Office
1450 Maria Lane, Suite 300
Walnut Creek, California 94596-5368

April 8, 1998

Aguirre Engineers, Inc.
ATTN: Dixie J. Wells
Radiation Safety Officer
6461 Plumcrest Rd. Ste. 100
Las Vegas, Nevada 89108

SUBJECT: NEW LICENSE

Please find enclosed License No. 27-29119-01. You should review this license carefully and be sure that you understand all conditions. If you have any questions, you may contact the reviewer who signed your license at (925) 975-0250.

The NRC is required to have your Taxpayer Identification Number in order to make payments (refunds). The self-addressed, stamped NRC Form 531, "Request for Taxpayer Identification Number" is enclosed.

As was discussed during the review process, this site remediation service contractor license does not authorize release (for unrestricted use) of previously contaminated equipment or facilities originating from a customer job site. Licensed material originating from the site must be transferred to an authorized recipient or be left at the site. Release of customer equipment or facilities remains a site-owner responsibility.

NRC expects licensees to conduct their programs with meticulous attention to detail and a high standard of compliance. Because of the serious consequences to employees and the public which can result from failure to comply with NRC requirements, you must conduct your program involving radioactive materials in accordance with the conditions of your NRC license, representations made in your license application, and NRC regulations. In particular, note that you must:

1. Operate in accordance with NRC regulations 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations," 10 CFR Part 20, "Standards for Protection Against Radiation," and other applicable regulations.

2. Possess radioactive material only in the quantity and form indicated in your license.

3. Use radioactive material only for the purpose(s) indicated in your license.

4. Notify NRC in writing of any change in mailing address (no fee required if the location of radioactive material remains the same).

5. Request and obtain written NRC consent before transferring your license or any right thereunder, either voluntarily or involuntarily, directly or indirectly, through transfer of control of your license to any person or entity. A transfer of control of your license

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includes not only a total change of ownership, but also a change in the controlling interest in your company whether it is a corporation, partnership, or other entity. In addition, appropriate license amendments must be requested and obtained for any other planned changes in your facility or program that are contrary to your license or contrary to representations made in your license application, as well as supplemental correspondence thereto, which are incorporated into your license. A license fee may be charged for the amendments if you are not in a fee-exempt category.

6. Maintain in a single document decommissioning records that have been certified for completeness and accuracy listing all the following items applicable to the license:

   - Onsite areas designated or formerly designated as restricted areas as defined in 10 CFR 20.3(a)(14) or 20.1003.

   - Onsite areas, other than restricted areas, where radioactive materials in quantities greater than amounts listed in Appendix C to 10 CFR 20.1001-20.2401 have been used, possessed, or stored.

   - Onsite areas, other than restricted areas, where spills or other unusual occurrences involving the spread of contamination in and around the facility, equipment, or site have occurred that required reporting pursuant to 10 CFR 30.50(b)(1) or (b)(4), including areas where subsequent cleanup procedures have removed the contamination.

   - Specific locations and radionuclide contents of previous and current burial areas within the site, excluding radioactive material with half-lives of 10 days or less, depleted uranium used only for shielding or as penetrators in unused munitions, or sealed sources authorized for use at temporary job sites.

   - Location and description of all contaminated equipment involved in licensed operations that is to remain onsite after license termination.

7. Submit a complete renewal application with proper fee, or termination request at least 30 days before the expiration date on your license. You will receive a reminder notice approximately 90 days before the expiration date. Possession of radioactive material after your license expires is a violation of NRC regulations.

8. Request termination of your license if you plan to permanently discontinue activities involving radioactive material.

You will be periodically inspected by NRC. Failure to conduct your program in accordance with NRC regulations, license conditions, and representations made in your license application and supplemental correspondence with NRC will result in enforcement action against you. This could include issuance of a notice of violation; imposition of a civil penalty; or an order suspending, modifying, or revoking your license as specified in the "General Statement of Policy and Procedure for NRC Enforcement Actions" (Enforcement Policy), NUREG 1600.

Also enclosed, please find the NRC letter dated July 12, 1995, to all materials licensees which transmits the NRC Policy on Communications Between the NRC and Licensees. It is the intent of this policy to foster greater openness and candid communications and to improve interactions with our licensees. We encourage you and your staff to become familiar with these principles so that we can maintain a high level of professional communication at all levels in our organizations.

Thank you for your cooperation.

Sincerely,

Beth A. Prange

Beth A. Prange
Sr. Health Physicist (Licensing)
Materials Branch

Docket: 030-34654
License: 27-29119-01
Control: 572623

Enclosures: As stated

cc: State of Nevada (License Only)

with copy of license:

Vukoslav E. Aguirre, P.E.
President
Aguirre Engineers, Inc.
P.O. Box 3814
Englewood, Co 80155-3814

bcc:

LFARB, T-9, E-10
WCFO Inspection File
Docket File

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4/8/98							

OFFICIAL RECORD COPY

TRAINING AND EXPERIENCE
AUTHORIZED USER OR RADIATION SAFETY OFFICER
(Use supplemental sheets if necessary)

1. NAME OF APPLICANT: Thomas J. O'Dou, CHP

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	FORMAL COURSE	ON THE JOB
a. Principles and practices of radiation protection	Lowell Technical Institute University of Lowell Portsmouth Naval Shipyard Davis-Besse Nuclear Power Station	4 Years 2 Years 10 Years 5 Years	B.S. RHP M.S. RSP	 10 Years 5 Years
b. Radioactivity measurement standardization and monitoring techniques and instruments	Lowell Technical Institute University of Lowell Portsmouth Naval Shipyard Davis-Besse Nuclear Power Station	4 Years 2 Years 10 Years 5 Years	B.S. RHP M.S. RSP	 10 Years 5 Years
c. Mathematics and calculations basic to the use and measurement of radioactivity	Lowell Technical Institute University of Lowell Portsmouth Naval Shipyard Davis-Besse Nuclear Power Station	4 Years 2 Years 10 Years 5 Years	B.S. RHP M.S. RSP	 10 Years 5 Years
d. Biological effects of radiation	Lowell Technical Institute University of Lowell Portsmouth Naval Shipyard Davis-Besse Nuclear Power Station	4 Years 2 Years 10 Years 5 Years	B.S. RHP M.S. RSP	 10 Years 5 Years

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE
MFP		Various Power Plants	15 Years	Radiation Protection
SNM	1500 Ci	ATG Richland & Yakima	3 Years	Corporate RSO
TRU	347 grams	ATG Richland	1 Year	Corporate RSO
Tritium	57 mCi	Department of Defense	6 mo	Instructor/Consultant
^{60}Co	200 Ci	Portsmouth Shipyard	10 Years	Radiation Protection
^{192}Ir	150 Ci 100 Ci	Portsmouth Shipyard	10 Years	Radiation Protection

4. RESUME WITH RADIATION WORK EXPERIENCE

DATES OF EMPLOYMENT	EMPLOYER / ADDRESS	JOB TITLE / DUTIES
February 1998 to Present	Aguirre Engineering, Inc. 6461 Plumcrest Road Las Vegas, NV	Program Manager/Corporate Health Physicist

4. RESUME WITH RADIATIC . WORK EXPERIENCE

DATES OF EMPLOYMENT	EMPLOYER / ADDRESS	JOB TITLE / DUTIES
March 1996 to February 1998	Gutierrez-Palmenberg, Inc 333 North Rancho Drive Ste 580 Las Vegas, NV	Program Manager/Health Physicist/Corporate Radiation Safety Officer
October 1992 to March 1996	Allied Technology Group, Inc 99A Midway Lane Oak Ridge, TN	Health Physicist/Radiation Safety Officer for Field Operations
June 1987 to August 1992	Davis-Besse Nuclear Power Station 5501 N. State Route 2 Oak Harbor, OH	Health Physicist / Radiological Assessor
February 1977 to June 1987	Portsmouth Naval Shipyard Portsmouth, New Hampshire	Health Physicist
June 1975 to October 1975	Temple University Health Science Center	Assistant Health Physicist
October 1974	Cambridge Nuclear Radiopharmaceutical Billerica, MA	Assistant Manager of Health Physics
June 1974 to August 1974	Yankee Atomic Electric Company Yankee Rowe	Health Physics Technical Assistant
June 1973 to August 1973	Virginia Electric Power Company Surry Power Station	Health Physics Technical Assistant

Brief resume of key persons, specialists and individual consultants for this project.	
a. **Name:** Thomas J. O'Dou	e. **Education:** **Degree(s)/Year/Specialization** MS [redacted] Radiological Sciences and Protection BS [redacted] Radiological Health Physics
b. **Project Assignment:** Program Manager	
c. **Name of firm with which associated:** Aguirre Engineering, Inc.	f. **Active Registration:** Certified Health Physicist. Registered Radiation Protection Technologist OSHA Hazardous Materials Training NQA-1 Auditor
d. **Years Experience:** With this Firm 1 mos With other Firms 23 yrs	

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g. Other experience and qualifications relevant to the proposed project:

Mr. O'Dou has extensive project field experience serving as Program Manager for government contracts that were completed 'ahead of time' and 'under budget' In coordination with his technical background, he has served as the project technical advisor and liaison.

Mr. O'Dou prepares work project characterizations, completes all work package definition (Health and Safety Plan, QA Plan and Detailed Work Plan), and writes all pertinent reports for a project. Some of the specific support he provides, includes:

- Project management of radioactive material characterization and decontamination/decommissioning projects
- Health Physics technical support for decontamination, decommissioning, radioactive waste volume reduction projects
- Health Physics program administrator for facilities doing radioactive waste brokering, radioactive waste volume reduction, and radioactive materials decontamination and decommissioning

Mr. O'Dou also provides expertise in several areas that augment and enhance radiological talents, such as:

- RESRAD (RESidual RADioactive) certified in accordance with the Radiological Health Risk Section Environmental Assessment Division of Argonne National Laboratory. RESRAD is a computer code developed at ANL for US DOE to calculate;
  - Site specific cleanup criteria,
  - Radiation dose and excess lifetime cancer risks to an on-site resident (a maximally exposed individual or a member of a critical population group)
- Development of unique instrumentation, build instrument systems, and calibration of instrumentation
- Develop and conduct training programs for customers as needed
- Assess company radiation protection programs and customer programs as required
- Project dosimetry, field operations procedures; preparation, review and approval

Mr. O'Dou has an extensive background in computers, computer programming and in writing training software. He maintains technical cognizance over software that he has written for use in a variety of health physics fields, such as:

- For use in education advancement;
  - HPEXAM for ABHP Certification
  - RPTEXAM for NRRPT Certification
- Operational Health Physics practice,
  - SOURCES for Radioactive source accountability and control

g. Other experience and qualifications (continued):

Brief resume of key persons, specialists and individual consultants for this project.	
a. **Name:** Thomas J. O'Dou	e. **Education:** **Degree(s)/Year/Specialization** MS [redacted] Radiological Sciences and Protection BS [redacted] Radiological Health Physics
b. **Project Assignment:** Program Manager	
c. **Name of firm with which associated:** Aguirre Engineering, Inc.	f. **Active Registration:** Certified Health Physicist Registered Radiation Protection Technologist OSHA Hazardous Materials Training NQA-1 Auditor
d. **Years Experience:** With this Firm 1 mos With other Firms 23 yrs	

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- RWP for radiation work permit creation and management
- RAD-STORE for accountability in radioactive material storage
- RAD-SPOTS for radiation hot-spot tracking
- RAD-AWARE for awareness report tracking

- Theoretical Health Physics operations,
  - SEARCH, a radionuclide database for emission identification
  - DK, a simple radioactive decay calculator

There are many more programs, either complete or in development. These programs and others that he has developed are currently assisting the radiation safety industry. He is providing technical support to in excess of 300 facilities around the world.

From his 20 years of continued success in the fields of nuclear power operations and health physics, Mr. O'Dou brings many skills to this arena. Among them are:

- Utilizing continuous assessment of a radiological control operation, he provides evaluation of program direction and makes recommendations for improvement
- Provides technical and administrative assistance to effect improvement of a Radiological Control Section
- He has served as a Radiological Control Ombudsman; Radiological Control Program advisor, as a member of the Radiological and Chemistry subcommittee of the Company Nuclear Review Board and Radiological Health advisory Board, Dose Assessment Coordinator for Emergency Control Center; and other similar technical positions
- He was responsible for the Davis-Besse Off-Site Dose Calculation Manual and Radiation Monitor Setpoint Manual, evaluating releases of radioactive gases and liquids and maintaining technical cognizance over radiation monitoring instrumentation and facility monitoring programs
- He managed a Health Physics Branch at a Naval Shipyard which consisted of eleven professional and technical personnel. This branch processed dosimetry for 2000 radiation workers at that facility, as well as maintaining control of dose records for radiation workers

Mr. O'Dou has been published in several professional publications; such as, *Radiation Protection Management, The Ohio Engineer,* and *HPS Journal.* In addition, he has written and/or presented papers at *Waste Management '95, Health Physics Society Meetings,* and *Ohio Engineer's Symposium.*

TRAINING AND EXPERIENCE
AUTHORIZED USER OR RADIATION SAFETY OFFICER
(Use supplemental sheets if necessary)

1. NAME OF APPLICANT: Dixie J. Wells

2. TRAINING RECEIVED IN BASIC RADIOISOTOPE HANDLING TECHNIQUES

TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	FORMAL COURSE	ON THE JOB
a. Principles and practices of radiation protection	Ingalls Shipbuilding (Naval Nuclear)	2 Years	Yes	Yes
b. Radioactivity measurement standardization and monitoring techniques and instruments	Ingalls Shipbuilding (Naval Nuclear)	2 Years	Yes	Yes
c. Mathematics and calculations basic to the use and measurement of radioactivity	Ingalls Shipbuilding (Naval Nuclear)	2 Years	Yes	Yes
d. Biological effects of radiation	Ingalls Shipbuilding (Naval Nuclear)	2 Years	Yes	Yes

3. EXPERIENCE WITH RADIATION (Actual use of radioisotopes)

*ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE
MFP		Naval Rxs/Various Power Plants	7 Years	Radiation Protection
SNM	2,000 Ci	ATG Richland & Yakima	2 Years	Radiation Protection/RSO
TRU	347 grams	ATG Richland	1 Year	Radiation Protection/RSO
^{192}Ir	57 mCi	Duane Arnold Energy Ctr	6 Months	Radiation Protection
^{90}Sr	75 Ci	ATG Richland - RCF	1 Year	Radiation Protection/RSO
	189,000 Ci			

4. RESUME OF RADIATION WORK EXPERIENCE

DATES OF EMPLOYMENT	EMPLOYER / ADDRESS	JOB TITLE / DUTIES
February 1998 to Present	Aguirre Engineering 6461 Plumcrest Road Las Vegas, NV 89108	Radiation Safety Officer
March 1996 to February 1998	Gutierrez-Palmenberg, Inc 333 North Rancho Drive Ste 580 Las Vegas, NV 89106	Radiation Safety Officer
April 1994 to March 1996	Allied Technology Group, Inc. Richland, WA 99352	Radiation Safety Officer

4. RESUME OF RADIATION ..ORK EXPERIENCE

DATES OF EMPLOYMENT	EMPLOYER / ADDRESS	JOB TITLE / DUTIES
April 1982 to September 1993	Detroit Edison Co. 6400 N. Dixie Highway Newport, MI	Radiological Assessor Internal Dosimetry Specialist Radiological Engineer
March 1980 to April 1982	NSSI Hershey, PA	Senior Technician Assistant Site Coordinator RP Instructor
January 1980 to March 1980	ARC @ DAEC Atlanta, GA	Senior Rad Pro Technician
1972 to January 1980	Ingalls Shipbuilding	Rad Con Monitor

Brief resume of key persons, specialists and individual consultants for this project.	
a. **Name:** Dixie J. Wells	e. **Education:** **Degree(s)/Year/Specialization** BS [redacted] Electrical Engineering BA [redacted] English E+6
b. **Project Assignment:** Radiation Safety Officer	
c. **Name of firm with which associated:** Aguirre Engineering, Inc,	f. **Active Registration:** Registered Radiation Protection Technologist OSHA Hazardous Materials Training INPO Qualified HPES Coordinator
d. **Years Experience:** With this Firm 1 mos With other Firms 25 yrs	

g. Other experience and qualifications relevant to the proposed project:

Ms. Wells has more than 20 years experience in the nuclear industry. Her function in the AEI organization is as Radiation Safety Officer (RSO), a position she has performed previously. The RSO is responsible for implementation of AEI's radiological controls and safety program, including the following:

- Order any operation suspended when it presents an imminent radiological or safety threat or hazard to employees, the general public, or to the environment
- Review, investigate, and document any abnormalities in the environmental monitoring data, personnel monitoring data, or bioassay data
- Establish standards and guidelines to comply with requirements and regulations
- Submit license application(s) and amendments to Federal and/or State regulatory agency(ies), including application and maintenance of any required permits
- Act as liaison with regulatory authorities; available for assistance in inspections and audits, and make required notifications to authorities
- Establish, review, and approve procedures for radiological protection and monitoring
- Perform as Health and Safety Officer for field projects as required
- Perform assigned project and field audits
- Ensure radiological controls documentation required by license is complete and accurate
- Investigate radiological incidents and assist in the development of corrective action plans in the areas of radiological controls and environmental protection
- Implement AEI's ALARA Plan
  - Ensure standards for protection of personnel, to maintain exposure to ionizing radiation and radioactive contamination ALARA
  - Review procedures and planned work in the developmental stage to ensure inclusion of ALARA principles
  - Provide selection criteria for equipment, supplies, and services for radiological controls and safety, and monitoring personnel for radiation exposure

In conjunction with this function, Ms. Wells has written, processed and received both NRC and Agreement State Radioactive Materials Licenses.

Ms. Wells prepares work project characterizations, completes all work package definition (Health and Safety Plan, QA Plan and Detailed Work Plan), and writes pertinent reports for a project. Some of the specific support she provides, includes:

- Project preparation of radioactive material characterizations and RSO/Health and Safety Officer for decontamination/decommissioning projects
- Health Physics technical support for decontamination, decommissioning, and radioactive waste volume reduction projects
- Health Physics Radiological Administrator for facilities doing radioactive waste brokering, radioactive waste volume reduction, and radioactive materials decontamination and decommissioning

Ms. Wells has field experience in several areas of radioactive waste, including processing and volume reduction, tracking and storage, packaging and shipping, decontamination/decommissioning, and preparation, submittal, and approval of work packages.

Brief resume of key persons, specialists and individual consultants for this project.	
a. **Name:** Dixie J. Wells	e. **Education:** **Degree(s)/Year/Specialization** BS [redacted] Electrical Engineering BA English E46
b. **Project Assignment:** Radiation Safety Officer	
c. **Name of firm with which associated:** Aguirre Engineering, Inc,	f. **Active Registration:** Registered Radiation Protection Technologist OSHA Hazardous Materials Training INPO Qualified HPES Coordinator
d. **Years Experience:** With this Firm 1 mos With other Firms 25 yrs	

g. Other experience and qualifications (continued):

Ms. Wells presents many skills from the field of nuclear power operations and health physics. Based on her many years of success in that arena, some of those skills are:

- Special Projects Engineer as Vice-Chairman for the NRC Region III 10CFR20 Working Group responsible for implementing the changes to 10CFR20 including; conducting training sessions for Region III inspectors
- Certified Human Performance (HPES) Evaluator and Coordinator
- Radiological assessor during the implementation of a QA Deviation Event Record system at Fermi 2 Nuclear Power Plant
- Contractor coordinator and administrator for refueling outage radiation control and decontamination personnel
- Internal dosimetry specialist, supervising personnel in routine and security in-processing operations
- Radiation Protection shift supervisor
- Established policy and procedures for Radiological Assessor

Ms. Wells has performed as a Human Performance Evaluator in accordance with standards set by the INPO. She has written and presented dozens of evaluations that were required by the NRC or an Agreement State to meet a response to finding(s) or concern(s). During the course fact-finding for an evaluation, all parameters are considered therefore these evaluations are used to address technical/mechanical, personnel, or environmental findings. In most cases, the results are used by the regulating authority to bring closure to an identified finding or failure.

Other primary operational skills include 10CFR50.59 qualifications. This training has prepared her to perform, review, and document Safety Analysis Reports (SAR) and/or Final Safety Analysis Reports (FSAR) in support of any Federal or State radioactive materials operation license. The specifics of "50.59" focus on review of design and construction documents and proceed to the end product operation. They document and authorize the manner in which an operation shall be performed in order to comply with the design of the system and the federal or state requirements regulating that operation. This also established the tolerances for personnel performance within that operation.

In addition to her extensive background in power plant operations, she received training from and worked with DoD (USN) for several years.

Ms. Wells has written papers and articles on waste processing and management. She has prepared brochures, flyers, and similar advertising media for radwaste volume reduction, processing, treatment, storage, transportation and burial. She has worked with the public in the form of lectures and presentations. In addition, she has written and published white papers dealing with the implementation of the changes to 10CFR20.