40-17

2020 Dow Center

The Dow Chemical Company
Midland, Michigan 48674

February 1, 2000

Mr. Sam Nalluswami
U.S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD 20852

Dear Mr. Nalluswami:

Subject: RESPONSE TO COMMENTS ON THE REVISED RADIOLOGICAL HEALTH AND SAFETY PLAN SUBMITTED FOR AN AMENDMENT ON LICENSE STB-527

Attached are Dow's Response to Comments of December 8, 1999 on the revised Radiological Health and Safety Plan and Standard Operating Procedures.

If you have additional questions regarding this information listed please let me know.

Sincerely,

Ben Baker

Ben Baker
Project Manager
The Dow Chemical Company
2020 Building
Midland MI 48674

Cc: Ed Kulzer, NRC Region III
Maria Sandow, Site RSO
Jerald Sgro, Radian Project Manager

NMSS01Public

RESPONSE TO COMMENTS OF DECEMBER 8, 1999 ON REVISED RADIOLOGICAL HEALTH AND SAFETY PLAN AND STANDARD OPERATING PROCEDURES

GENERAL COMMENTS

1. The September 1998 Dow Chemical Company's (Dow) THORAD Project Radiological Health and Safety Plan (RHSP) and Standard Operating Procedures (SOPs) include many key elements necessary in a Health and Safety Plan. However, as discussed the specific comments, additional information and clarification are requested.

   No Response Required

2. Sections in the RHSP (i.e., 8.0 Hazard Assessment) pertaining to non-radiological hazards (i.e. physical, biological, and chemical hazards, etc.) were not reviewed.

   No Response Required

3. The NRC Nuclear Facilities Decommissioning web site at "http://www.nrc.gov/NMSS/DWM/DECOM/decomm.htm" provides a draft Standard Review Plan (SRP) pertaining to decommissioning activities for license termination. This draft SRP, which is posted for public comment, describes regulatory guidance, regulatory and information requirements, and evaluation criteria used by the NRC staff for acceptance review/approval of various plans submitted by licensees in the decommissioning process. NRC's Standard Review Plan 10.0 Health and Safety Program During Decommissioning" is currently available on the NRC web site.

   No Response Required

4. Included for reference and application is "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material" (NRC, August 1987; Enclosure 3).

   No Response Required

5. Appendix D, RHSP: NRC For 3 (1-96) "Notice to Employees" which requires posting(s) in clearly visible location(s) has been recently updated. Enclosure 2 is a revised posting. Additional Notices may be requested, at no cost, by e-mail to "distribution@nrc.gov" or by fax at (301) 415-2289.

   No Response Required

6. *The September 1998 Dow RHSP did not incorporate many of Dow's March 1996 responses to NRC's comments dated February 5, 1996. Dow's responses and attachments, if still valid, should be included in the applicable sections in the RHSP.*

   We will incorporate those comments from the March 1996 responses that are still valid into the revised Radiation Health and Safety plan. We will provide a list of which responses have been incorporated into the Radiation Health and safety plan prior to re-commencement of onsite field activities.

SPECIFIC COMMENTS

Site Safety Management and Organization

Comment

1. *Provide the location and ownership of the Midland site.*

Response

The Midland thoriated material storage site was located within Dow's Midland, Michigan manufacturing facility. In a letter from the NRC dated June 4, 1997, NRC Report No. 040-00017/97001 (DNMS) this site was found to be effectively remediated.

Comment

2. *Identify the level of management that has the authority to commit funds and make license commitments for radiological health and safety for the project. Describe the mechanism for RHSP/SOP revision, periodic review/approval and documentation, implementation, and worker training of revised procedures.*

Response

Mr. Ben Baker, is the Dow Project Manager for the Midland and Bay City Thorium Decommissioning Project. He has the authority to sign contracts, commit project funds, and make license commitments for radiological health and safety for the project. Mr. Baker, who is a Remediation Leader in Environmental Operations Business has over 26 of years of experience in Dow, holding jobs of increasing responsibility in engineering, manufacturing, and project management.

If a change or revision to the RHSP/SOP is required, the change is presented to the RSO for initial approval. It is then presented to the ALARA committee for approval and implementation. The ALARA committee meets on a monthly basis. If a change is needed before the regularly scheduled meeting, a special meeting will be called. Documentation of approval will be in the minutes of the ALARA meeting.

The RHSP/SOPs are reviewed by the RSO annually for any changes in procedures that may be required. If a change has occurred, each employee is trained on the new procedure. That training is documented by signing the training attendance form provided

at the sessions. The employee is observed until it is judged that they are proficient at the new method or procedure.

Comment

3. *Specify who will be the next designated person with signature authority for health and safety issues in the event the Radiation Safety Officer (RSO) is available. Specify the person who can act as designee for the Assistant RSO.*

Response

The person designated as the Assistant RSO is Ms. Charlene Loar. Ms. Loar is an Environmental Engineer for Radian Remediation and Operating Services. She has approximately 4 years experience in Radiation Safety on the thorium decommissioning project. She will have the signature authority for all radiation health and safety issues in the absence of the RSO.

Comment

4. *a. Specify who reviews the Radian Work Permits (RWP's);*
   b. The current number of health physics (HP) technicians; and
   c. Whether approval of RWP is permitted verbally by the RSO or designee.

Response

a. The RSO initially reviews the RWPs. They are then submitted to the ALARA committee for final review and approval.
b. During the working season, there are up to 3 HP technicians on site.
c. No verbal approval is allowed. All RWPs require the signature of the RSO for final approval.

Comment

5. *The RHSP did not mention who (i.e. Dow staff or contractor) will be responsible for removing contaminated material from the site. Specify who will be conducting these activities.*

Response

Radian Remediation and Operating Services (formerly Radian International) is contracted by The Dow Chemical Company to remove the material from site. It is loaded into railcars and transported to Envirocare of Utah by Union Pacific Railroad.

Comment

6. *As described in the RHSP, 3.2.2 Radiation Safety Officer/Radiological Support Services, page 3-3 explain how authorization to restart work following a hazardous or potentially dangerous event will be approved in absence of the Health and Safety Officer (HSO).*

Response

Prior to the absence of the Health and Safety Officer a designee will be appointed as alternate HSO. This person will have the same authority of the HSO and will authorize the restart of any work following a hazardous or potentially dangerous event.

Worker Training

Comment

7. *Section 7.1 Worker Training, page 7-1: Describe how satisfactory completion of training is determined (i.e. examination, performance based). Specify the frequency of refresher training and content.*

Response

A written test is given upon completion of the initial training. The new employee is assigned to work with an experienced employee until it is judged that the new employee is proficient at the task.

Refresher training is conducted annually. It consists of a review of the topics listed in the RHSP, Table 7.1, page 7-2, Site Radiation Safety Training Outline.

Comment

8. *Section 3.2.5 Site Personnel, page 3-3: Since the responsibility of safety ultimately resides with an individual, the "stop work" policy should be included as part of a worker's indoctrination and emphasized during training (see 7.1 Worker Training).*

Response

We concur with the comment and will include this in the Worker Training program.

ALARA

Comment

9. *Describe how the As Low As Reasonably Achievable (ALARA) program will be used regarding reviews and approvals of administrative changes, and the establishment of administrative limits.*

Response

Any request for administrative changes or establishment of administrative limits is presented to the ALARA committee. The committee reviews all documentation pertinent to the request and moves according to their findings.

Comment

10. Section 4.0 ALARA, page 4-1: Describe what procedural measures are taken to follow up on corrective actions which may result from audits conducted quarterly, and indicate the principle staff members who participate in the management audit.

Response

When an audit indicates that a deficiency in the activities being performed the Dow Project Manager reviews the issue with the RSO and Radian Project Manager to determine whom is best qualified to address the issue. Once a response has been formulated to the issue it is brought to the ALARA committee for review to determine if

the response adequately addresses the issue. If the ALARA committee concurs the response is made part of the operating procedures.

Radiological Monitoring

Comment

11. *Section 10.3 Environmental Monitoring, page 10-4: In addition to air monitoring, describe a groundwater monitoring program as a means to monitor potential contamination from soil to ensure compliance with NRC guidelines, or provide the technical basis for not implementing such a program.*

Response

In 1978, a research project was completed to determine the potential for release of thorium or thorium daughters from the storage site into groundwater. This research project identified the leaching properties of the magnesium/thorium slag under laboratory conditions and was completed in 1978. It was determined that under these most severe laboratory-created conditions there was a potential for a slight amount of thorium and/or its daughters to leach into water. Because of this potential Dow has analyzed groundwater samples from nine wells immediately around the storage site. No thorium or thorium daughters were found at the detection limit of 2 pCi/L, based on Pb-212. Analysis of these samples by gross beta counting indicated a concentration of radioactivity ranging from 30 to 800 pCi/L in various samples. A careful crosscheck by gamma spectroscopy indicated that all of the gross beta activity could be accounted for by naturally occurring K-40.

In September 1979, the Michigan Department of Public Health, the Nuclear Regulatory Commission (Region III) and Dow sampled immediately adjacent to the thorium slag storage site. Identical soil, sediment, and groundwater samples were taken by each group and analyzed independently for Th-232. Again, the results indicated there was no significant migration of thorium from the storage site. The samples analyzed by Dow contained Th-232 at a concentration within the normal background for Th-232. Furthermore, the Nuclear Regulatory Commission report on the September 1979 survey concluded, "...no migration of thorium residues is indicated..." from the soil and sediment samples. The report also concluded that the groundwater samples indicated

"...thorium migration (if any) into ground or surface water was (and continues to be) extremely small".

However, in 1979 Dow began a semi-annual program of groundwater sampling from the nine wells surrounding the slag storage site. This program was continued until mid 1996 when it became necessary to remove the wells to implement the SDMP. The NRC Region III was informed of the need to remove the wells and a copy of the most recent monitoring data provided to them during a site visit in August, 1996. The sampling events conducted until the wells were removed indicated that the conclusion of the September 1979 NRC report was still valid.

Based upon this information and the removal of the majority of the Th-232, Dow does not believe the installation of new groundwater monitoring wells are justified.

Comment

12. *Section 7.2 Medical Requirements, page 7-4: Page 10-3 mentions that a bioassay (whole-body) program will be conducted to monitor potential airborne thorium at the beginning and end of decommissioning using facility SOP's. Describe the criteria for when non-routine bioassays are required. A description of the bioassay program and associated SOP(s) were not included in the submittal. Provide this information for review.*

Response

A non-routine bioassay is required when an individual is suspected of having received a large dose due to an unplanned event and when an employee leaves the project, unless the employee has not been in the controlled area since his/her last bioassay.

Thorad's bioassay program consists of an annual whole body count or urine analysis for thorium. The whole body count is performed at the Big Rock Nuclear Power Plant in Charlevoix, Michigan and consists of a 45-minute count on the employee's torso. Thermo NUtech in Albuquerque, New Mexico performs the analysis of an employee's 24-hour urine sample for thorium. Both companies provide a written analysis report that includes the thorium measured.

Comment

13. *Section 10.2 Personnel Monitoring and Protective Equipment, page 10-2: Specify the regulatory non-occupational/occupational dose limits, indicate administrative action levels (ALs) and describe the measures taken when ALs are exceeded. Provide the RSO review frequency of personnel radiation dosimetry processed by the NVLAP-accredited commercial vendor. State that internal/external does are used to report the Total Effective Dose Equivalent (TEDE).*

Response

The regulatory non-occupational/occupational dose limits for thorium-232 are 6E-15 μCi/mL and 1E-12 μCi/mL of the derived air concentration (DAC), respectively (10CFR20 Appendix B). The administrative action level (AL) is 100 percent of the DAC for non-occupational doses and 10 percent of the DAC for occupational doses. When the AL is exceeded the employee is required to notify the RSO or a radiation control technician (RCT) immediately. The RSO will determine the corrective action required. Corrective actions may include limiting or terminating work activities and/or requiring the employees to wear air-purifying respirators. The RSO will determine if an incident report is required.

The RSO receives the external dose analysis report from the NVLAP-accredited commercial vendor, in this case Landauer, Inc., every quarter. Annual dose reports (NRC Form 5) are prepared for every employee on the project that worked in the controlled area.

The results from the external dose reports (Landauer) and the internal bioassay results are both used to report the Total Effective Dose Equivalent (TEDE).

Comment

14. *Provide a current list of all field and laboratory instruments with the minimum detectable activities/concentrations (MDAs/MDCs) and the instrument's intended purpose (i.e., scanning, and static, analytical).*

Response

See attached Excel Spreadsheet

Comment

15. *Other radiation instruments (i.e., beta/gamma contamination, alpha scintillators, alpha spectroscopy) are mentioned in the RHSP and/or SOPs in addition to those listed in Table 7.1 "Site Radiation Safety Training Outline." These instrument/detector types should also be discussed in 6.0 Radiological Monitoring.*

Response

We concur with the comment and will include discussion of these instruments in Section 6.0 Radiological Monitoring.

Comment

16. *Section 10.1 Monitoring Equipment Calibration and Maintenance, page 10-1: Specify the National Institute of Standards and Technology (NIST)-traceable sources used (i.e., Am-241, Sr/Y-90, Cs-137) and source strengths used for calibrating all field instruments. Describe how instruments are calibrated in accordance with ANSI N323A (1997). Describe how performance testing is conducted to determine an instrument's acceptability prior to use. Describe how activities for all source types are appropriate for range of radiation detected considering the contamination/dose potential on site. Describe how results from performance checks will be documented and maintained.*

Response

See attached Excel Spreadsheet

Comment

17. Section 10.5 Sample Control Handling, Packaging and Shipping, page 10-6: Describe the onsite (Dow) and offsite (vendor) analytical laboratory Quality Assurance/Quality Control (QA/QC) programs for gamma spectroscopy to include the percentage of samples sent out for independent analyses. Describe how the system is calibrated using NIST-traceable standards (include sources(s)/activity concentration(s)), and performance checked prior to use. Describe how results from the Dow and vendor labs are compared. Provide the Dow staff responsible for performing the soil analyses, and their qualifications and training (describe in the appropriate section in the RHSP).

Response

The onsite program for gamma spectroscopy includes a background sample, a spike sample taken from the site, an NIST traceable multi-gamma source sample, and three multi-channel analyzers (MCAs). Each day prior to use, the MCAs are checked with each of the above samples for 15 minutes. A report is printed and the counts are converted to an activity and are then compared to the actual activity. If the relative percent difference between the actual activity is less than 10% for the NIST standard and less than 20% for the spike and background samples the unit is determined to be functioning properly. If the unit does not meet these criteria the sample is rerun (a maximum of 3 times) to balance statistical counting errors. If it still does not pass, the unit is re-calibrated.

One hundred percent of all verification samples and ten percent of the survey samples collected & analyzed at Bay City are sent to Dow's Freeport, Texas, laboratory for quality assurance/quality control (QA/QC). There the samples are analyzed in a similar manner as described above. Ten percent of all samples sent to Freeport are sent to an outside laboratory for QA/QC.

To calibrate, the NIST source and a spike are counted for one hour each. Peaks and regions of interest (ROI) are marked. Gammavision software is utilized at both laboratories, which allows the lab technicians to name each ROI and assign efficiencies for each peak (nuclide). The sources used are mentioned above. The NIST source contains seven different nuclides, which are listed in table 17.1. After the calibration, the unit is function checked as described above before being used.

Results from Freeport are compared to Bay City's results. If there is a discrepancy, the sample data and function checks are examined. If necessary, the sample is re-counted at both laboratories and the error is investigated internally. The same procedure is used for the QA/QC of the Freeport lab with the outside lab.

The Dow staff responsible for performing the soil analyses onsite have the training described in table 7.1 (page 7-2) and additional hands-on-training on the MCAs.

Dr. Keith Frank and Dr. Jaime Simon's of The Dow Chemical Company are responsible for performing the soil analyses. Their resume listing their qualifications was in the original Radiation Health and Safety Plan.

Table 17.1 Activities of NIST Source

Nuclide	Activity (microCuries)
Eu-155	0.078
Co-57	0.092
Sn-113	0.108
Cs-137	0.049
Mn-54	0.109
Zn-65	0.139
K-40	0.087

Decontamination

18. *Table 12.1 "Surface Contamination Limits," page 12-5. The unity formula given in the table is not clear. Provide the technical basis for the site-specific thorium (Th)-230 to Th-232 ratio of 3:1 and the site-specific alpha/beta surface contamination limits (dpm/100cm2).*

Response

The data base supporting the Th-230, Th-232, and Th-228 concentrations and isotopic ratios as determined from samples collected from the thorium slag, was provided in Dow's Response to Comments of February 5, 1996 on Health & Safety Plan (October, 1995), Decommissioning Work Plan (October, 1993) and Supplement to Decommissioning Work Plan (December, 1995) in a submittal dated March, 1996. This submittal indicated that the as measured, the isotopic ratio of Th-230 to Th-232 is approximately 3 to 1 based on the data base presented in Appendix H, Table H-1 of the March, 1996 response. However, the experience in remediation of the Madison, Illinois site containing the same type thorium slag, has shown that the Th-230 to Th-232 ratio tended to drop as a substantial data base was accumulated, resulting in a final average Th-230 to Th-232 ration of 1:34 at Madison based on 666 samples. Therefore, while we used the limiting concentrations determined in the analysis provided in Section 3.1, ("Release Criteria") of the 1995 Supplement, based on a 3:1 Th-230 to Th-232 ratio, we have chosen an administrative soil cleanup concentration that will provide a significant margin below the limiting value even if the ratio should ultimately be less than 3:1.

The NRC EA, July 19, 1996, stated that the radioactive contamination on the Dow sites is a mixture of three thorium isotopes: ^{232}Th, ^{228}Th, and ^{230}Th. By activity the ^{232}Th and

^{228}Th are in equal concentration and they are both part of the ^{232}Th decay chain. Thorium-230 is one of the natural decay products of ^{238}U decay chain; therefore its concentration is independent of the ^{232}Th or ^{228}Th concentration. In 1996, numerous soil samples from the Bay City site were analyzed for total thorium content and the average ratios of ^{232}Th: ^{230}Th ranged from 1:3 to 1:1. This information verified the Madison ratios for ^{232}Th to ^{230}Th.

The average Th-230 to Th-232 ratio is about 3:1 based on the 1996 database. The contamination limits in Table 12-1 have been adjusted to reflect this ratio. The limits are derived using the following relationships, appropriate for conditions where multiple radionuclides are present.

$$\sum_{I-1}^{n} \frac{Af_I}{g_I} \_ I$$

where:

f_i = fraction of the total activity on a surface due to the i_{th} radionuclides
A is the total activity on the surface
g_i = the applicable guideline for the i_{th} radionuclides

(Appendix A of NUREG/CR-5849)

Or

$$A = \frac{1}{\frac{f1}{g1} + \frac{f2}{g2}}$$

Where:

A = Surface Activity (Gross Activity Guidelines)
f1 = Relative fraction of Th-232
f2 = Relative fraction of Th-230

g1 = Reg. Guide 1.86 Guideline levels for Th-232
= 1000 dpm/100 cm2 (average);
= 3000 dpm/100 cm2 (max);
= 200 dpm/100 cm2 (removable)
g2 = Reg. Guide 1.86 levels for Th-230
= 100 dpm/100 cm2 (average);
= 300 dpm/100 cm2 (max);
= 20 dpm/100 cm2 (removable)

19. *Section 12.2.2 Monitoring of Scrap Material and Debris for On-Site Management or Disposal, page 12-3: Explain the basis for selecting 10 percent of objects for verifying that removable surface contamination limits are met.*

The decision of wipe sampling 10% of the material that exhibit background levels of radiation from a surface scan was a decision made by the ALARA Committee. The committee believe that if the surface scan conducted under SOP 1.2 *"Total Alpha Surface Contamination Measurements"* indicated only background levels it would still be prudent to have a certain number of the objects tested further to document that SOP 1.2 was valid. Since approximately 10 % of the soil samples are sent off site for analysis to verify the data generated by the on-site laboratory it was determined that 10 % of the objects should be wipe tested and checked as good part of our quality assurance program.

Contingency Plan

20. *Section 13.0 Contingency Plan, page 13-1: Describe the emergency response drills conducted, frequency, evaluation, and record keeping.*

Since the commencement of on-site activities in 1996 no activation of the emergency plan has been required. During the annual contractor training program required by Dow the emergency planning is one of the items covered. However, since 1998 there has been no on-site drills conducted.

21. *Section 13.2 Evacuation, page 13-2: Describe how evacuation drills are conducted and with what frequency, how drills are evaluated, and how records of conducted drills are maintained.*

Drills are not conducted at the site. The site is remote from other facilities, which could impact the project site. The work being conducted has a very low potential for creating a situation, which would require activation of the contingency plan.

Work Area Control

Comment

22. *Section 6.0 Site Access Control, page 6-1: State that site access training is required for visitors, and briefly describe the training content (see 7.1 Worker Training). Provide an explanation in Section 3.2.2: Field, of SOP 1.1: Access Control Procedures (Rev. 00, 07/21/98), on how a person (visitor), if wearing a respirator, can be escorted by the RSO or representative into a potentially contaminated zone without a prior medical exam, fit testing, and respirator training (as described for employees in 7.2 Medical Requirements).*

Response:

This was written prior to the changes in the OSHA rules regarding respiratory protection. A visitor will now have to comply with the respiratory requirements of 29CFR1910.134. This section will be rewritten to reflect the changes in the current OSHA regulations.

NRC Response To Comments - Question #14

Model Number	Serial Numbers	Intended Purpose	Probes	Serial Numbers	MDA
					µCi
Ludlum Model 1000	121249	Analytical	Ludlum 43-10	PR 127335	5.48E-08
Ludlum Model 1000	121256	Analytical	Ludlum 43-10	PR 127197	5.64E-08
Ludlum Model 1000	128285	Analytical	Ludlum 43-10	PR 132380	5.25E-07
Ludlum Model 1000	128300	Analytical	Ludlum 43-10-4	PR 132381	1.14E-06
Ludlum Model 1000	130040	Analytical	Ludlum 43-10	PR 131394	5.29E-07
Ludlum Model 1000	130041	Analytical	Ludlum 43-10	PR 135350	5.31E-08
Ludlum Model 12	125303	Scanning, Frisking	Ludlum 44-9	PR 128106	8.37E-05
Ludlum Model 12	128218	Scanning, Frisking	Ludlum 44-9	PR 132075	1.10E-04
Ludlum Model 12	128232	Scanning, Frisking	Ludlum 44-9	PR 130458	1.00E-04
Ludlum Model 177	124522	Scanning, Frisking	Ludlum 43-5	PR 131070	3.46E-05
Ludlum Model 177	128370	Scanning, Frisking	Ludlum 43-5	PR 131071	2.76E-05
Ludlum Model 177	128393	Scanning, Frisking	Ludlum 43-5	PR 127365	3.93E-05
Ludlum Model 177	128394	Scanning, Frisking	Ludlum 44-9	PR 132021	9.68E-05
Ludlum Model 19	123938	Static, Scanning			6.77E-01
Ludlum Model 19	127379	Static, Scanning			7.25E-01
Ludlum Model 2221	126502	Scanning	Ludlum 44-10	PR 128795	4.97E-03
Ludlum Model 2221	126518	Scanning, Static	Ludlum 43-90	PR 128800	1.10E-06
Ludlum Model 2221	126524	Scanning	Ludlum 44-10	PR 132143	5.12E-03
Ludlum Model 2221	126525	Scanning	Ludlum 44-10	PR 128794	6.06E-03
Ludlum Model 2221	127208	Scanning	Ludlum 44-10	PR 132150	5.98E-03
Ludlum Model 2221	127215	Scanning	Ludlum 44-10	PR 132151	5.68E-03
Ludlum Model 2221	127224	Scanning	Ludlum 44-10	PR 132152	5.48E-03
Ludlum Model 2221	127225	Scanning	Ludlum 44-10	PR 128453	5.42E-03
Ludlum Model 2221	127235	Scanning, Frisking	Ludlum 43-90	PR 132007	1.20E-06
Ludlum Model 2221	127250	Scanning, Frisking	Ludlum 43-90	PR 132353	1.07E-06
Ludlum Model 2221	127253	Analytical	Ludlum 43-10	PR 134281	4.22E-07
Ludlum Model 2221	127258	Scanning, Frisking	Ludlum 43-90	PR 128799	1.13E-06
Ludlum Model 500	121030	Equipment Function Check			na
MCA #1	----	Analytical	Sodium Iodide	----	not in use
MCA #2	----	Analytical	Sodium Iodide	----	5.50E-06
MCA #3	----	Analytical	Sodium Iodide	----	5.34E-06

MDA = (2.71 + 4.65 * sqrt(background counts / background count time^2) * (1 / Efficiency * Background Count Ti

Unpaired Probes

Ludlum 44-10	PR 128461		8 44-10 Shields	na
Ludlum 44-10	PR 131682		Ludlum 43-90	PR 131385
Ludlum 44-10	PR 132145		Ludlum 44-2	PR 130695
Ludlum 44-10	PR 132516	Used for Demonstration	Ludlum 44-2	PR 130741
Ludlum 44-10	PR 132151			

Returned to Freeport

Ludlum Model 12	125237	Ludlum 44-9	PR 131999
Ludlum Model 12	128251	Ludlum 44-9	PR 130457
Ludlum Model 12	128278	Ludlum 44-9	PR 132018
Ludlum Model 19	131244	Ludlum 44-9	021843
Ludlum Model 19	131292		
Ludlum Model 3	56541		
NRC Model ADM-300A	691033	NRC Model XP-100	690566
NRC Model ADM-300A	691034	NRC Model XP-100	690565
Ludlum Model 1000	128301	Ludlum 43-10	PR 131395

Sources and Source Strengths used to Function Check Field Instruments			
Facility	Dow Chemical, Bay City, Thorad Site		
	US NRC Source Material Lic. STB-527		
Source Type	Activity		**Source Used to Function Check:**
Cs-137, 0162	1	uCi	Ludlum Model 2221/44-10
Cs-137, 0209	1	uCi	Ludlum Model 19
Cs-137, 96CS2500062	4.9	uCi	
Th-230, 0398	17,190	dpm	Ludlum Model 2221/43-90
Th-230, 96th2200396	14970	dpm	Ludlum Model 177/44-9
Th-230, 96th2200397	12840	dpm	Ludlum Model 177/43-5
Th-230, 96TH4700061	21600	dpm	Ludlum Model 2221/43-10
			Ludlum Model 12/44-9
			Ludlum Model 1000/43-10
Tl-204, 98TL4702350	12700	dpm	Ludlum Model 1000/43-10-4

Calibration of field equipment is not done onsite. All of the field equipment is sent to Ludlum Measurements, Inc. annually to be factory calibrated. Performance testing is done each day before an instrument is used. In accordance with ANSI N323A (1997), each instrument undergoes a physical inspection, a general operations test, and a source check before use. An instrument is considered acceptable for use when it passes all of the these checks.

A periodic (usually monthly) statistical test is performed on each instrument. The statistical test will determine a range of source check and background values that are acceptable for that instrument and the daily checks are referred back to this range. If the daily check on the equipment falls within the range the instrument is ready for use.

The performance checks are documented and maintained according to SOPs 1.2, 1.5, and 1.7.

I can't answer the question "Describe how activities for all source types are appropriate for range of radiation detected considering the contamination/dose potential on site."