Attachment 3
December 7, 2007

**APPLICATION FOR RADIOACTIVE MATERIALS LICENSE 065-0317-3**

**(ITEMS 8 THROUGH 15)**

**FOR THE WILMINGTON FIELD SERVICE CENTER (WFSC)**

**(December 07, 2007)**

D/S

## WILMINGTON FIELD SERVICE CENTER

## RADIATION PROTECTION PROGRAM

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## 1.0 FACILITY DESCRIPTION

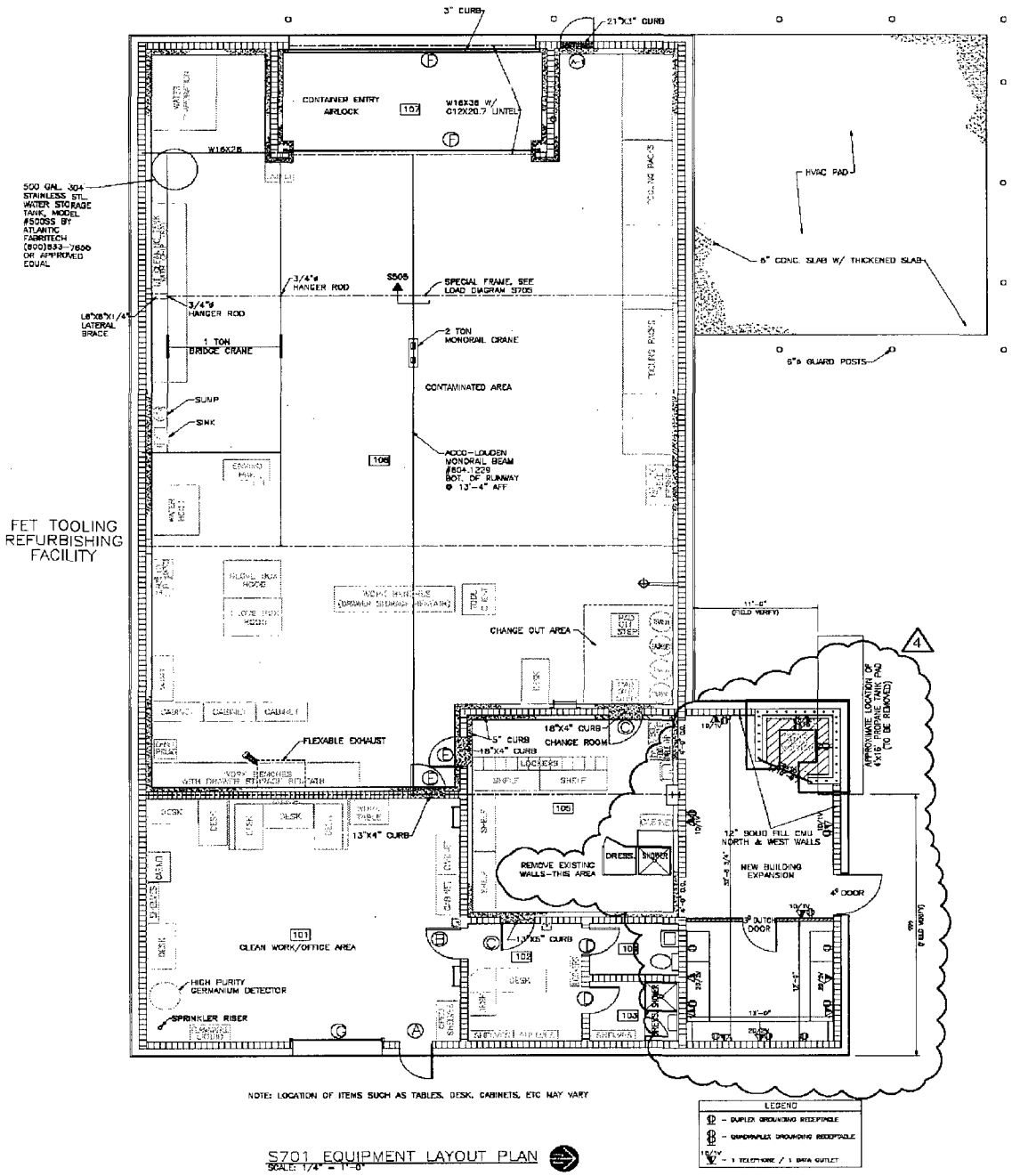
Two on-site buildings are used by the Fuel Examination Technology (FET) subgroup of the Wilmington Fuel Service Center (WFSC) at the Global Nuclear Fuel – Americas, L.L.C. (identified in this document as GNF-A) site. One, approximately 5,000 sq. ft. building (Figure 1) is designed with appropriate isolation and controls for a contaminated zone classification which occupies approximately 75% of the building space, with the remainder of the building used for uncontaminated storage, office space, and personnel access to the contaminated zone. The other building (Figure 2), approximately 7,500 sq. ft. is a warehouse to provide covered storage for the reusable containers when they are not in use. The containers in the warehouse provide storage for the equipment while not in the field or being serviced. Containers of tooling and equipment with removable loose contamination will remain closed and are not opened while in the warehouse. A general layout of the buildings relative to existing structures is shown in Figure 3. A fence (personnel barrier) is utilized to enclose both buildings, with the east end of the contaminated zone building forming one side of the enclosure. Paved roadway access to the buildings is provided for shipping access and exchanges between buildings as shown in Figure 3.

The Reactors and Field Services (R&FS) subgroup of the WFSC is housed in a building of approximately 42,000 sq. ft. The building is divided into work areas

designed to accommodate contaminated tooling, control rod drives (CRD), non-contaminated tooling and general warehouse storage (Figure 4). Portions of two adjacent warehouses of 42,000 sq. ft. each are also available for additional storage and maintenance of R&FS items. One of the warehouses is shared with the GNF-A fuel manufacturing operation, and is physically divided such that the two activities are segregated. The other additional warehouse houses the Dry Well Tooling (DWT) business. It is divided into work areas designed to accommodate non-contaminated storage, office space, and a radioactive materials area (RMA). The Dry Well Tooling RMA is designed to accommodate servicing and maintenance of items that have been released from a contaminated zone with minimal levels of fixed, non-removable contamination (less than or equal to 1 mrem/hr measured on contact with accessible surfaces). Servicing and maintenance activities are not permitted on items with removable loose contamination in this warehouse.

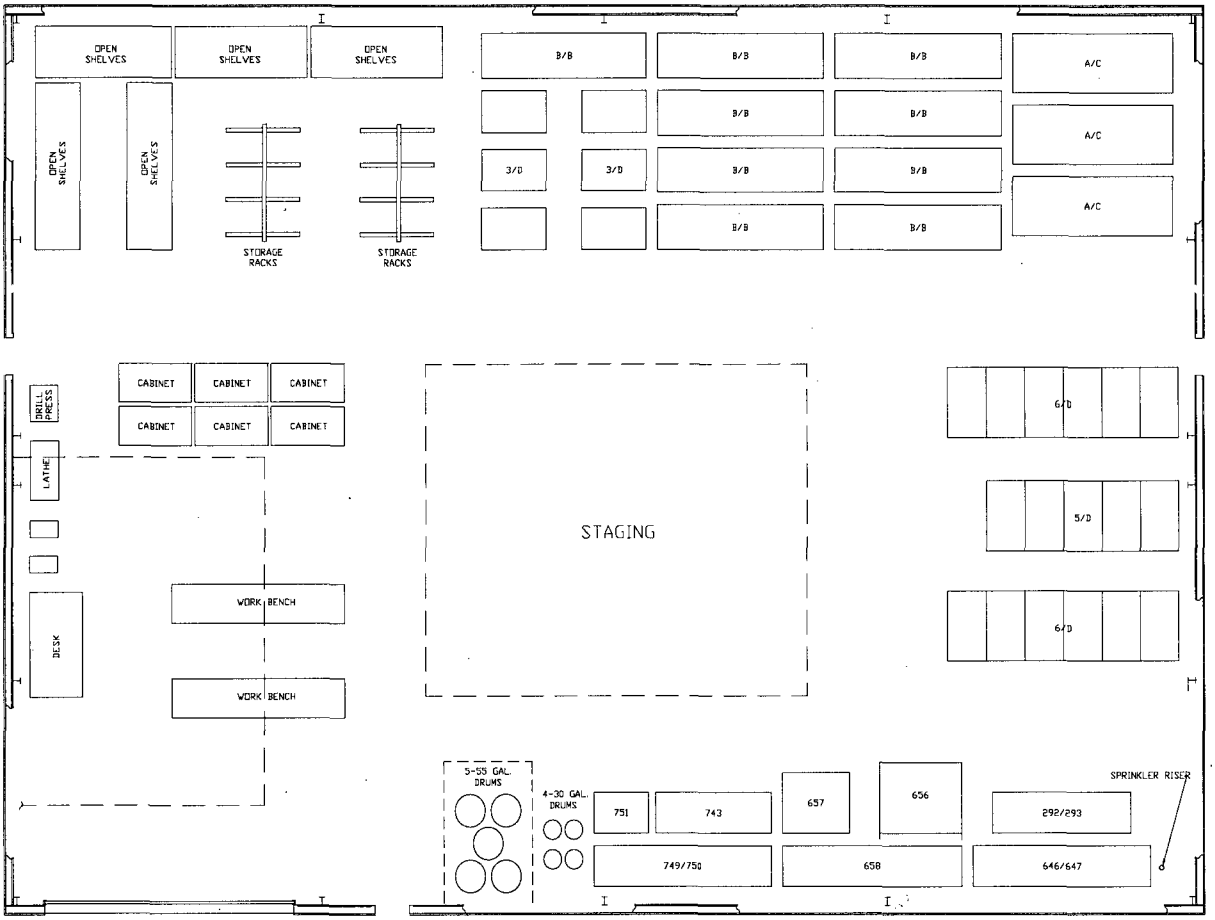
Appropriate isolation and controls are incorporated to limit the spread of contamination and maintain exposure to the workers and general public ALARA. The buildings are within the GNF-A site boundary fence. Paved roadway access to the buildings is provided (Figure 5).

# FIGURE 1
## FET TOOLING REFURBISHING FACILITY




Note: Locations of items such as tables, desks, cabinets, etc. may vary.

FIGURE 2
CONTAINER STORAGE WAREHOUSE




Note: Locations of items such as tables, desks, cabinets, etc. may vary.

FIGURE 3
FET FACILITY PLAN

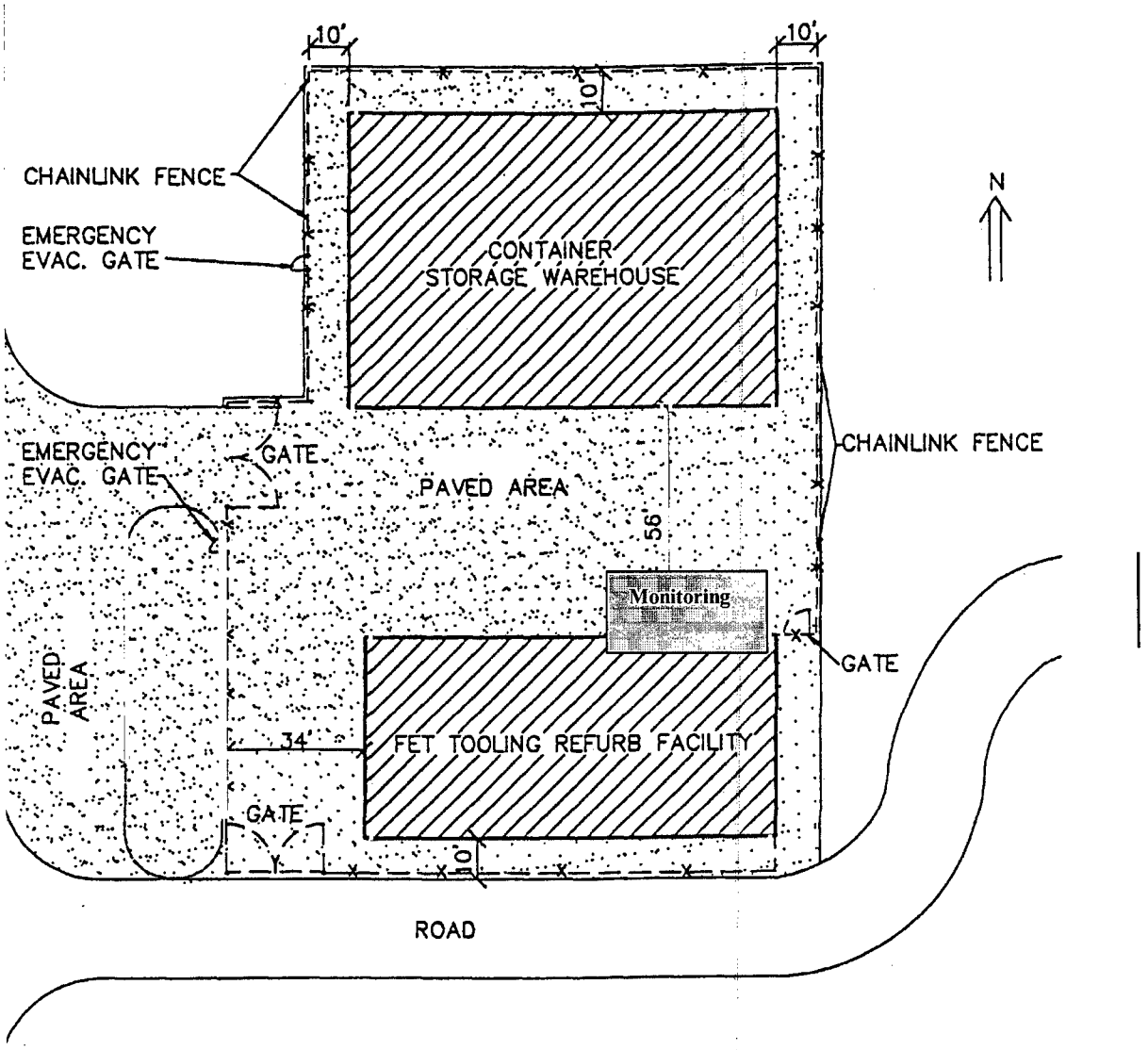
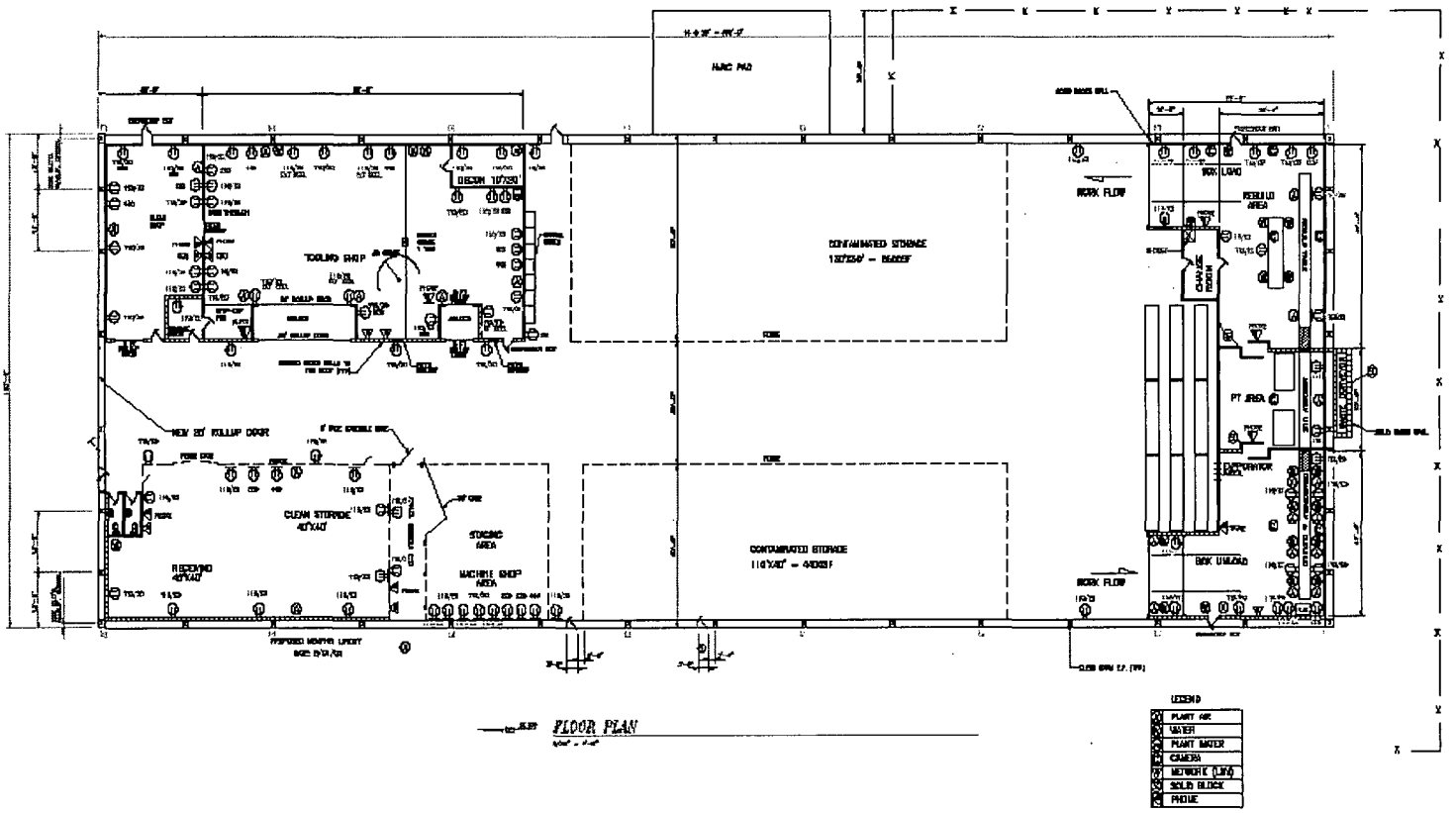
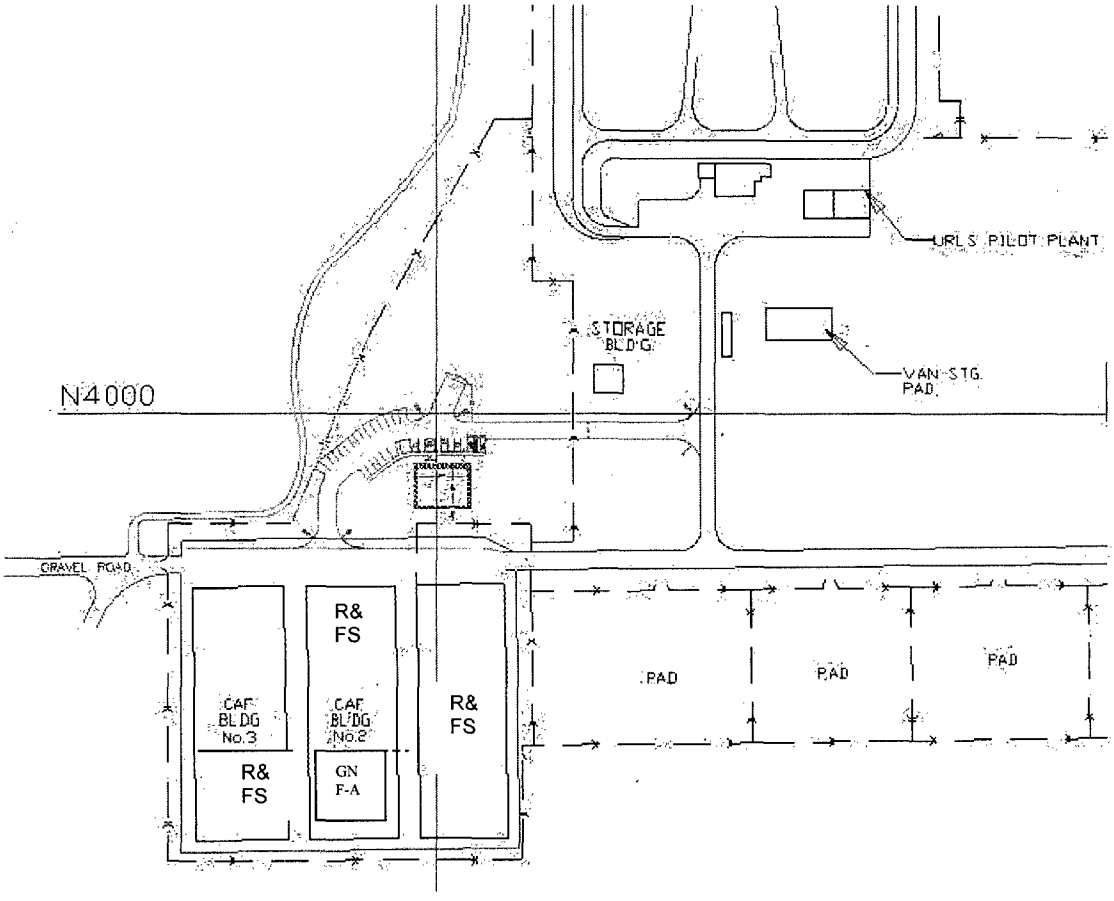


FIGURE 4
REACTOR & FIELD SERVICES FACILITY




Note: Locations of items such as tables, desks, cabinets, etc. may vary.

FIGURE 5
REACTOR & FIELD SERVICES SITE PLAN



The primary containment design for the contaminated zones of the working buildings is concrete floors with a cleanable epoxy coating, concrete block walls (also cleanable) and a minimum 3-inch curb at door openings.

The secondary containment design consists of interlocked (only one door open at a time) roll-up doors at each container entry airlock. Bypass of the interlock requires a Radiation Work Permit (Section 2.5.3). There is a 4-inch curb at the personnel change room entrance and a 3-inch curb at the container entry outer roll-up door location.

Within contaminated zones, negative pressure HVAC ventilation is maintained, which processes exhaust air through HEPA filter systems prior to discharge. Air from the decontamination hoods and welding effluents from repair work are processed through a dual HEPA filter system before discharge. Room air is continuously cleaned via circulation through HEPA filters. Room air and effluent from water evaporation exhaust through HEPA filter systems before discharge. All discharge is through monitored stacks (Section 4.1).

Equipment used in the facilities includes ultrasonic cleaning tanks, welders, drill presses, lathes and water evaporators. The ultrasonic cleaning medium is water, which is filtered through particulate filters.

## 2.0 GENERAL ORGANIZATIONAL & ADMINISTRATIVE REQUIREMENTS

### 2.1 POLICY

The GNF-A policy is to maintain a safe work place for its employees, to protect the environment and to assure operational compliance within the terms and conditions of radioactive materials licenses and applicable North Carolina regulations.

The GNF-A Facility Manager or their delegate, has the overall responsibility for safety and compliance to this policy.

In particular, GNF-A has established the principle of keeping radiation exposures to employees and the general public As Low As Reasonably Achievable (ALARA).

### 2.2 ORGANIZATIONAL RESPONSIBILITY & AUTHORITY

#### 2.2.1 Key Positions with Safety Related Responsibilities

##### 2.2.1.1 Facility Manager

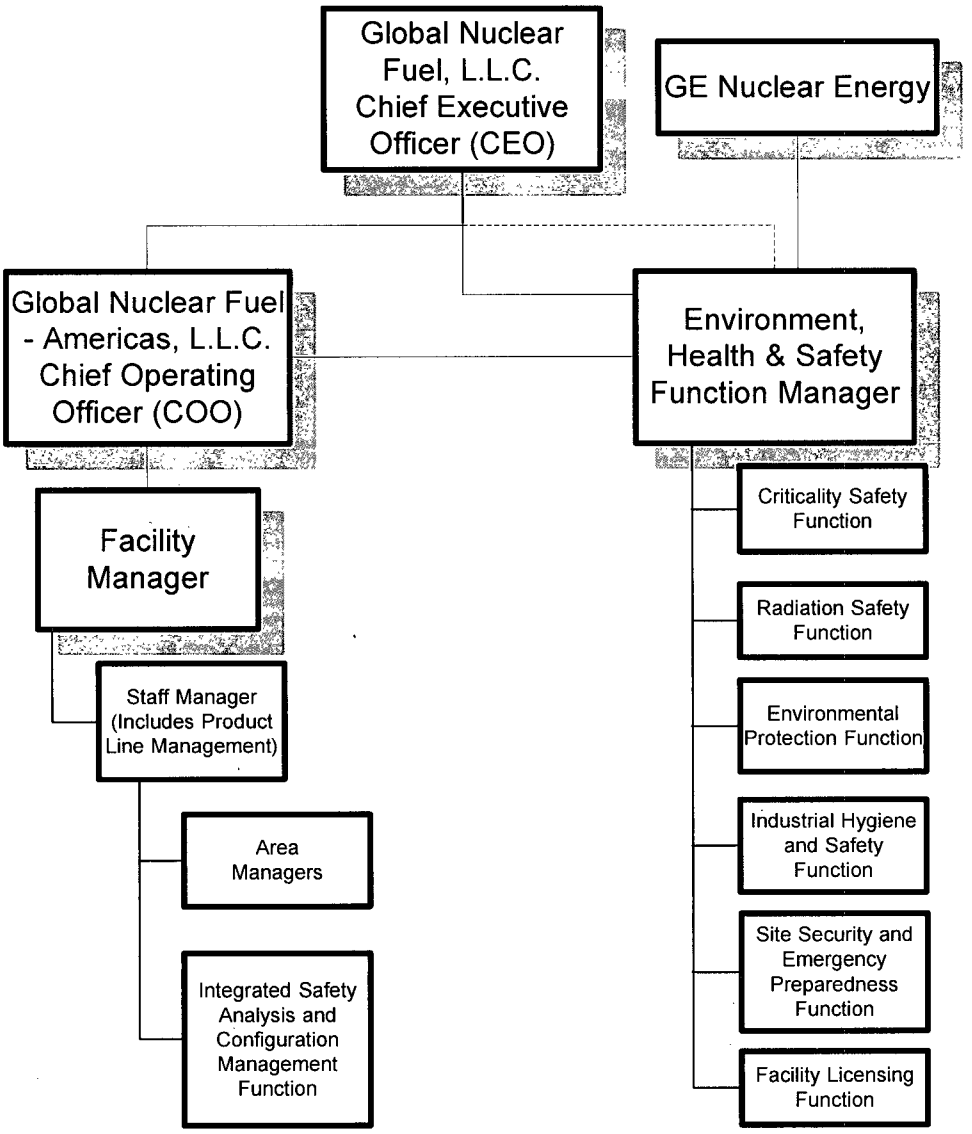
The Facility Manager is the individual who has overall responsibility for safety and activities conducted at the GNF-A site. The Facility Manager directs all operations personally, by procedure, or through other management personnel.

The Facility Manager's activities are performed in accordance with GNF-A policies, procedures, and management directives. The Facility Manager provides for safety and control of operations and protection of the environment by delegating and assigning responsibility to qualified Area Managers.

The GNF-A Facility Manager is knowledgeable of the safety program concepts as they apply to the overall safety of a nuclear facility, and has the authority to enforce the shutdown of any process or facility.

FIGURE 4

# The GNF-A Organization



2.2.1.2 Area Manager

The Area Manager is the designated individual who is responsible to ensure that all activities necessary for safe operations and protection of the environment are conducted properly within a designated facility. The responsibility of safe operation and control of activities in each facility and for the safety of the environs as influenced by the activities conducted therein is assigned to an Area Manager. The Area Manager shall assure approved written operating procedures are used which incorporate radiation safety controls and limits.

2.2.1.3 Radiation Safety Function

The radiation safety function has the responsibility of establishing and maintaining the radiation safety program necessary to ensure the protection of employees at the Wilmington site and the community. It is administratively independent of production responsibilities. The radiation safety function provides authoritative professional advice and counsel to Area Managers on matters of radiation safety and measures the effectiveness of the radiation safety program.

The manager of the radiation safety function shall review and approve the radiation safety program which shall include at least the following:

- Establish the radiation protection and radiation monitoring program,
- Establish the radiation protection criteria, procedures and training programs to control contamination and exposure to individuals,
- Evaluation of radiation exposures of employees and visitors and maintenance of related records,
- Emergency planning,
- Evaluate the integrity and reliability of radiation detection instruments,
- Analysis and approval of proposed changes in process conditions and processing equipment involving radiological safety.

2.2.1.4 Operational Radiation Protection Function

Within the radiation safety function is an operational radiation protection function. The operational radiation protection function is the function designated the responsibility to obtain data relative to radiation exposures of employees and visitors, and to provide operational support to functions requiring radiation monitoring services. It is administratively independent of production responsibilities and has the authority to shutdown an operation believed to threaten the health and safety of employees or the public.

Operational radiation protection function responsibilities shall include at least the following:

- Conduct of radiation monitoring programs,
- Administration of radiation work permit (RWP) covering radiation safety requirements,
- Measurements of airborne radioactivity concentration, contamination levels and external radiation levels,
- Evaluation of the operational integrity and reliability of radiation detection instruments.

Activities are conducted in accordance with approved written procedures.

2.2.1.5 Environmental Protection Function

The environmental protection function is administratively independent of production responsibilities. It is defined as that function at the Wilmington site with designated responsibility to include at least the following:

- Identification of environmental requirements of federal, state and local regulations governing the site's operation,
- Establishment of systems and methods to measure and document adherence to regulatory environmental requirements and license conditions,

- Evaluation and approval of new, existing or revised procedures involving environmental protection,
- Assurance of proper federal and state permits, licenses and registrations for non-radiological discharges from the facilities.

2.2.1.6 Environmental Health & Safety (EHS)

The EHS function is administratively independent of production responsibilities but has the authority to require the shutdown of any process or facility when the Area Manager has not assured or maintained controls for nuclear safety or environmental protection. It is the function designated to establish radiation safety, criticality safety and environmental protection programs to ensure compliance with federal, state and local regulations and laws governing operation of a nuclear facility. These programs are designed to ensure the health and safety of employees and the public as well as protection of the environment. The managers of the radiation safety and environmental protection functions report to the manager of the EHS function.

2.3 SAFETY REVIEW COMMITTEE

2.3.1 Wilmington Safety Review Committee (WSRC)

The functions of this safety review committee include responsibility for the

following:

- An annual ALARA review which considers the following:
  - Programs and projects undertaken by the radiation safety function and the operational radiation safety committee, and their contribution to ALARA.
  - Performance including, but not limited to, trends in personnel exposures and environmental monitoring results.
  - Programs for improving the effectiveness of equipment used for effluent and exposure control.
- Review of radiological and industrial safety practices applied to major changes made or proposed in authorized activities.
- Professional advice and counsel on radiation safety issues.

The committee shall consist of at least five senior members of the Wilmington site technical staff, appointed by the Facility Manager and shall include competence in the scientific and engineering disciplines. Senior members of management shall also serve on the committee upon the request of the Facility Manager.

The committee is responsible to the Facility Manager. Its proceedings, findings and recommendations shall be reported in writing to the Facility Manager and to

the staff level managers responsible for operations which have been reviewed by the committee. Such reports shall be retained for at least three years.

The committee shall hold at least three meetings each calendar year with a maximum interval of 180 days between any two consecutive meetings.

2.3.2 Operational Radiation Safety Committee

The Committee consists of engineering, shop operations, maintenance, radiation safety function, operational radiation protection function and quality control management or senior contributors.

The objective of the operational Radiation Safety Committee is to improve operations so as to affect improvements in employee radiological exposures and potential health/safety hazards.

The Committee meets monthly to maintain a continual awareness of the status of projects, performance measurements and trends, and the current shop operations radiation safety conditions. The maximum intervals between meetings shall not exceed 60 days.

A written report of each operational Radiation Safety Committee meeting shall

be forwarded to cognizant Area Managers. Records of the committee proceedings shall be maintained for three years.

2.4 TRAINING & EXPERIENCE REQUIREMENTS

Training policy requires that employees complete formal nuclear safety training prior to unescorted access in the controlled areas.

The objectives of nuclear safety training are as follows:

- To provide an overview of Wilmington site
- To understand the importance of compliance with nuclear industry regulations and standards and how compliance requirements are met
- To learn the nuclear industry worker's rights and responsibilities per 10CFR19
- To introduce the basics for radiological safety programs – 10CFR20, and occupational exposure limits
- To know general rules of nuclear safety requirements per internal procedures
- To be knowledgeable of ionizing radiation types, biological effects, and means of protection
- To learn how ionizing radiation is detected, quantified, and documented at the Wilmington site; ALARA applications
- To learn radiological and criticality safety postings used at the Wilmington

Site and the proper response to such postings

- To know the proper response to the site evacuation alarm
- To become familiar with comprehensive contamination control techniques, including proper use of anti-contamination clothing and exit personal surveys
- To learn basic identification, proper use, and proper handling of respiratory protection devices.

The method for evaluating the understanding of employees includes passing an initial examination covering formal training contents. Previously trained employees allowed unescorted access to the controlled area are retrained at a minimum of every two years.

Training is performed by instructors certified by the manager of the radiation safety function or by viewing training materials approved by the radiation safety function. Training program contents are reviewed at least every two years by the manager of the radiation safety function to ensure that training program contents are current and adequate.

FET and R&FS employees must also review and understand work procedures

specific to their work area, and work 40 hours with an experienced FET or R&FS employee prior to working alone in the controlled areas. The 40 hour requirement may be met by providing documented work experience of equivalent nature.

2.4.1 Facility Manager

The Facility Manager is an individual who is appointed by upper management as the overall manager of the Wilmington facility. This appointment reflects confidence of the Facility Manager's ability as an effective programs and business manager. The Facility Manager shall be knowledgeable of the radiation protection program concepts as they apply to the overall safety of the facility.

2.4.2 Area Manager

The minimum qualifications of an Area Manager are a BS or BA degree from a college or university in a technical field and two years experience in radiation related activities or a high school diploma with five years experience in radiation related activities.

Each manager shall be knowledgeable of the radiation safety program and procedures as they relate to their area of responsibility. Each Area Manager shall

be knowledgeable in the procedures applicable to the area under their management.

Each Area Manager shall have proficiency in the application of a radiation safety program as it relates to limitations and radiological controls for the kind of activities in their assigned radiation or radioactive materials area.

2.4.3 Radiation Safety Function Manager

The radiation safety function manager shall hold a BS or BA degree in science or engineering, have at least two years experience in assignments that include responsibility for radiation safety, and have experience in the understanding, application and direction of radiation safety programs.

Minimum qualifications for a senior member of the radiation safety function are a BS or BA degree in science or engineering with at least two years of nuclear industry experience in the assigned function. Alternate minimum experience qualification for a senior member of the radiation safety function is professional certification in health physics. A senior member shall have experience in the assigned safety function, and has authority and responsibility to conduct activities assigned to the radiation safety function.

2.4.4 Environmental Protection Manager

The qualification of the manager of the environmental protection function is a BS or BA degree in science or engineering and two years experience in assignments involving regulatory activities or equivalent.

2.4.5 EHS Manager

The manager of the EHS function must hold a BS or BA degree in science or engineering and have five years of management experience in assignments involving regulatory activities. The manager of the EHS function must have appropriate understanding of health physics, nuclear criticality safety, environmental protection, and chemical and fire safety programs.

2.5 OPERATING PROCEDURES - ADMINISTRATIVE CONTROLS

Licensed material work is conducted in accordance with properly issued procedures or instructions issued within a controlled document system.

2.5.1 Adopting & Issuing Procedures

Area Managers shall assure preparation of written operating procedures

incorporating radiation safety control limitations established by the radiation safety function. They shall assure that these operating procedures are made readily available to operators and other concerned personnel at designated locations within the work area, and through training programs and other appropriate written notifications. Subsequent to issuance, changes to operating procedures that may affect radiation safety are reviewed by the radiation safety function.

The radiation protection program is described in a comprehensive set of written instructions for radiation health and safety practices so as to maintain occupational radiation exposures at levels as low as reasonably achievable. Such instructions are reviewed by the radiation safety function prior to issuance and every two years (maximum interval not to exceed 26 months) thereafter.

2.5.2 Procedures for New or Changed Activities

A request for radiation safety analysis is prepared in writing by, or at the direction of, an Area Manager for proposed new activities or changes in activities which may require a proposed change in radiological safety controls.

The proposed changed activity will not be implemented until the radiological

safety analysis demonstrating safety of the activity has been completed, a pre-operational inspection has been conducted to verify that the installation is in accordance with the radiological safety analysis, and appropriate procedures and/or instructions are in place.

The results of these analyses are documented and maintained for a period of time they remain applicable.

2.5.3 Radiation Work Permit (RWP) Procedures

Routine and repetitive maintenance work performed in radiation controlled areas is administered by the use of standard procedures. Non-routine activities in these areas which generally are not covered by documented procedures, are administered by the RWP system. This includes facility construction, maintenance, and service work (e.g., equipment relocation, floor tile replacement, ventilation duct removal, etc.).

Radiation Work Permits are issued for non-routine operations which are not covered by an operating procedure. The RWP specifies the necessary radiation safety controls, as appropriate, including personnel monitoring devices, protective clothing, respiratory protection equipment, special air sampling, and

additional precautionary measures to be taken.

The manager or their delegate responsible for performance of the non-routine work is responsible for obtaining the RWP from the radiation protection function and for obtaining RWP approvals by the manager or a supervisor of the radiation protection function, the Area Manager or their delegate and by the requester. The Area Manager is also responsible for assuring that only personnel who have completed required radiation safety training (Section 2.4) are assigned to perform work under a RWP.

A copy of the RWP listing any specific radiation safety precautions is posted in a conspicuous location (hard copy or electronic) throughout the duration of the activity, and work is monitored by the radiation protection function, as required.

All RWPs have expiration dates and the status of issued RWPs is reviewed on an ongoing basis by the radiation protection function.

Upon completion of the work under the RWP, the requester is responsible to assure that the RWP is terminated and that the work area is returned to normal conditions.

Responsibilities and elements of the RWP system are documented in internal procedures.

## 2.6 ALARA PROGRAM

GNF-A has established a radiation protection program designed to ensure that occupational radiation exposures are maintained at levels as low as reasonably achievable. The approach consists of (1) a strong management commitment, (2) development and implementation of improved detection/ measurement capabilities, (3) development of advanced exposure-related management information systems, (4) provision in facilities for exposure reduction via implementation of well engineered systems, and (5) facility/equipment change evaluations and safety committee programs focused on ALARA.

### 2.6.1 Management Commitment

The GNF-A management commitment to the ALARA concept is emphasized in departmental level procedures and is evidenced in continued support of long range development programs and near-term improvement projects. In addition,

implementing instructions to the operating and engineering personnel stress the importance of continuous effective exposure control.

2.6.2 Detection and Measurement Systems

Health physics detection and measurement systems, some computer-based, provide the capability to determine airborne concentrations, internal exposures, extremity exposures, external exposures, and water concentrations.

2.6.3 Information Systems

A major program has been developed for an advanced, computer-based management system to calculate, monitor and record personnel radiological exposures. Relevant data are entered into the system and provide management with information on employee exposures. Data analysis capability built into the system provides accurate information for management planning of the continued employee exposure reductions.

2.6.4 Major Facility & Equipment Changes

Management attention is addressed to identifying operating conditions which require modification for reduced personnel exposure. Major facility changes and equipment process development programs meet criteria directed towards

exposure reduction and/or improved operating conditions. Project safety reviews are held to assure that ALARA has been addressed in proposed project designs.

2.6.5 The Wilmington Safety Review Committee and the Operational Radiation Safety Committee implement a significant part of the ALARA program. The Operational Radiation Safety Committee meets monthly to promote continued improvements in limiting employee radiological exposures and potential radiological hazards. The committee tracks personnel exposures, radiation survey results, air sampling results, audit findings, and unusual occurrences. This information is used to identify and prioritize nuclear safety concerns. Action plans with performance targets are established and implemented to address the high priority concerns.

An annual ALARA review is held by the Wilmington Safety Review Committee. This annual review considers programs and projects undertaken to reduce worker exposures and performance indicators such as trends in personnel exposures and monitoring results.

Current operating conditions are monitored to identify needed near-term upgrades in process equipment, equipment accessories and operating systems

which, when implemented, will result in reduced potential for occupational radiation exposures.

## 2.7 RECORDS

Records appropriate to radiation safety activities, occupational exposure of personnel to radiation, releases of radioactive materials to the environment, and other pertinent activities, are maintained in such a manner as to demonstrate compliance with license conditions and regulations.

Records associated with personnel radiation exposures are generated and retained in such a manner as to comply with the relevant requirements of 15A NCAC 11. The following additional radiation protection records will be maintained for at least two years:

- Records of safety review committee meetings,
- Survey of equipment for release to unrestricted areas,
- Instrument calibration,
- Safety audits,
- Training and retraining,
- Radiation work permits,
- Surface contamination surveys,

- Concentrations of airborne radioactive material in the facility,
- Radiological safety analyses.

## 2.8 RADIOACTIVE MATERIALS INVENTORY

Radioactivity values (activity) used for the purpose of inventory tracking are assigned based on radiation level measurements. The computation of activity is based on the "6CEn" equation found in the Radiological Health Handbook (Bureau of Radiological Health, p. 32, 1970 ed.). The computation incorporates a factor for shielding when necessary.

Records of the receipt, use, transfer and disposal of radioactive materials are maintained. An inventory record that indicates the current total activity possessed is maintained. The inventory record is updated each time an item is received and/or shipped. It also indicates the location and activity of each storage container, shipping container and waste container. The total activity held in each of the three controlled area shops is tracked as well. Once per year a physical verification of the inventory is performed.

## 3.0 RADIATION PROTECTION PROGRAM

### 3.1 ACCESS CONTROL

Access controls are in place to maintain exposure of workers and the public to radioactive materials ALARA. Only those individuals that have met nuclear safety training requirements (Section 2.4) and that have been authorized in accordance with site access requirements are allowed unescorted access to the controlled areas, i.e., contamination areas, radiation areas and high radiation areas. Access to high radiation areas is controlled by a combination of electronic badge readers and/or keyed locks. Entryways to high radiation areas are locked, except when access is required. Access to other controlled areas is controlled by either keyed locks, electronic badge readers or administratively.

### 3.2 PROTECTIVE CLOTHING

Individuals entering a contaminated zone must wear, at a minimum, coveralls, gloves, shoe covers and cap. Additional or alternate protective clothing may be specified by RWP. These items are available in change rooms adjacent to each contaminated zone. Protective clothing is not required for other areas.

## 3.3 RESPIRATORY PROTECTION

Respiratory protection devices with particulate filter are available to be utilized as a precautionary measure and to further reduce exposures during operations that produce airborne radioactivity. Prospective evaluations of the effect of respiratory protection on the total effective dose equivalent are performed for operations that may produce airborne radioactivity. Respirators specifically approved by the National Institute for Occupational Safety and Health (NIOSH) are utilized.

The respiratory protection program shall be conducted in accordance with 15 NCAC 11.1620, and shall be established in internal procedures to include at least the following elements:

- Air sampling measurements to evaluate airborne contamination and establish potential personnel exposure levels
- Surveys and bioassays to evaluate potential intakes
- Testing and inspection of respirators prior to each use
- Fit testing
- Approved protection factors as specified in Appendix A to 10CFR20
- Training
- Medical evaluations
- Proper use and selection of respiratory protection equipment

## 3.4 VENTILATION AND HOODS

Each contaminated zone is maintained at a negative pressure relative to adjacent areas at all times. Exhaust air is processed through a HEPA filter system prior to discharge. Hoods with adjustable sashes or spot ventilation are available for work on contaminated tools and equipment. Hood face velocities are verified at a minimum of every two months not to exceed 90 days and are required to meet internally established minimum and average air flows.

## 3.5 PACKAGE RECEIPT

Containers arrive accompanied by shipping documents that list the radioactive contents and dose rates. Containers are received and surveyed in accordance with 15A NCAC 11.1627. They are then either placed in storage or brought into a contamination zone. Containers with removable loose contamination are only opened inside a contamination zone. Surveys of radiation dose rates and contamination levels of the contents are made following opening of containers. As tools and equipment are unpacked, contamination smears are taken. Items with contamination levels greater than the action levels specified in section 3.8 require special handling which may include use of ultrasonic cleaning tanks, vented hoods, wash stations and/or additional administrative controls such as

additional PPE and segregated work areas.

Records of container inventories will be kept based upon surveys performed during container transfers.

## 3.6 PREPARING PACKAGES FOR TRANSPORT OR STORAGE

The containers are inspected for structural integrity and adequate seals prior to each use. Tools and equipment are secured in the containers. The containers are then bolted shut. Dose rates on contact and at 1 meter, contamination levels, curie content and isotopic distribution are determined prior to shipment or storage. Curie content is calculated based upon dose rate measurements and isotopic distribution is determined by historical information or gamma spectroscopy.

Containers are not released from the contaminated zone if the container exterior contamination level exceeds 220 dpm per 100 $cm^2$. Transportation labels, markings, and shipping papers are prepared in accordance with the requirements of the appropriate competent authority (USDOT, IAEA, IATA).

Records of shipments, including surveys and inspections; and records of the DOT 7A package certifications are maintained for two years.

## 3.7 POSTING AND LABELING

The facilities are posted in accordance with 15A NCAC 11.1624. The outermost boundaries of the facilities are posted as radioactive materials areas. The contaminated zones and the container storage areas are posted as radioactive materials areas and radiation areas or high radiation areas, as appropriate.

Containers are labeled in accordance with 15A NCAC 11.1626. A written record of the contents of each container is readily available to individuals authorized to access the contaminated zones or the storage facilities. The curie contents of containers are estimated based upon surveys performed during container transfers.

## 3.8 SURVEYS

The contaminated zones, change rooms and storage facilities are surveyed weekly by the radiation protection function. Surveys consist of measurements of removable contamination and radiation dose rates in areas frequented by individuals. Survey results in excess of limits specified in internal procedures are communicated to the Area Manager (or delegate), and corrective action is taken in accordance with internal procedures.

In addition to routine surveys, operational surveys can be performed by operations personnel before and during work in the contaminated zone. These surveys consist primarily of dose rate measurements of the immediate work area and wipes of potentially contaminated equipment.

Personnel contamination surveys for external contamination on clothing and the body are required by all personnel when leaving a contaminated zone. Frisker type survey instruments and portal monitors (Table 3.2) are available for personnel exit surveys.

Survey result action limits are as follows:

Action Limits for Radiation Dose Rates

| | mrem/hr | Action |
|---|---|---|
| Contaminated Zone (1 meter from source) | ≥ 50 | move to designated area |
| Storage Facility (1 foot from source) | ≥ 100 | move to designated High Radiation Area |
| DWT RMA (contact with accessible surface) | >1 | Move to contaminated zone |

Action Limits for Removable Surface Contamination

| | dpm/l00 $cm^2$ | Action |
|---|---|---|
| Contaminated Zone (equipment, exposed surfaces) | ≥ 50,000 | implement additional controls |
| Contaminated Zone – CRD Shop (equipment , exposed surfaces | ≥ 250,000 | implement additional controls |
| Contaminated Zone (floors & benches) | ≥ 10,000 | initiate clean-up within 24 hours after completion of job, resurvey |
| Contaminated Zone- CRD Shop (floors & benches) | ≥ 50,000 | initiate clean-up within 24 hours after completion of job, resurvey |

| | | |
|---|---|---|
| Change Room | ≥ 600 | initiate clean-up within 24 hours and resurvey |
| DWT RMA | ≥ 220 | initiate clean-up within 24 hours and resurvey |
| Storage Facility | ≥ 220 | initiate clean-up within 24 hours and resurvey |
| Offices, restrooms, etc. | ≥ 220 | initiate clean-up within 24 hours and resurvey |
| Skin | Non-detectable | clean immediately and resurvey |

Actions to mitigate or control dose rates in excess of these limits are taken immediately. Decontamination actions are taken as soon as is practical, and the delay to initiate actions shall not exceed 24 hours after completion of the affected work without the Area Manager's approval and a Radiation Work Permit. Equipment with dose rates above the action limit is placed in a designated work area or storage location depending upon the type of service work to be performed. A designated area means either a location specifically intended for storage or servicing of certain items, or a temporary location specified by an RWP or procedure. Additional controls to minimize personnel radiation exposure and to minimize the spread of contamination are incorporated when servicing or maintaining tooling and equipment above the action limits. Additional controls may include engineered features such as decontamination, shielding or ventilation, and/or administrative features such as segregation of the work area or additional PPE requirements.

## 3.9 COMPLIANCE WITH OCCUPATIONAL DOSE LIMITS

Occupational exposure to radiation is limited in accordance with the occupational dose limits specified in 15A NCAC 11.1604. Work activity restrictions will be imposed when an individual's annual exposure exceeds 80% of the applicable limit, i.e. 0.8 ALI, 4.0 rem CEDE, 4.0 rem TEDE, 4.0 rem DDE, 40 rem CDE or

40 rem SDE. Action guides, which include investigation levels and required actions, are established in internal procedures.

3.9.1 EXTERNAL DOSIMETRY

Dosimeter badges, supplied and processed by a National Voluntary Laboratory Accreditation Program accredited vendor, are worn by individuals routinely working in the FET or R&FS facility and are exchanged monthly, quarterly, or semi-annually. Personnel entering a contaminated zone or a designated storage area also wear alarming direct reading dosimeters (DRDs). Alarming dosimeters are employed to limit an individual's exposure to a predetermined amount based on the work to be performed and the individual's year to date exposure. The dosimeters are read and the results recorded daily, or more frequently when specified by the RWP. When a DRD alarms, the individual is required to exit the area, and an evaluation is performed by Radiation Protection. If a DRD is found to be off-scale, and a redundant DRD is not available or is also off-scale, then the individual is immediately restricted from areas requiring monitoring until their dosimetry is processed and evaluated. At a minimum, the DRDs are calibrated annually.

3.9.2 EXTREMITY MONITORING

Individuals routinely performing tasks with the potential to exceed 10% of the occupational dose limit for shallow dose equivalent to the extremities are monitored by the use of extremity dosimeters. Extremity dosimeters are exchanged monthly.

3.9.3 BIOASSAY

Internal exposures in excess of 10% of the Annual Limit on Intake are not likely due to the non-volatile nature of the material handled. Whole body counts of individuals working in the contaminated zone are performed semi-annually. The interval between counts will not normally exceed 210 days, except for individuals offsite for extended periods of time.

3.9.4 AIR SAMPLING

The contaminated zones are continuously monitored by stationary (fixed) air samplers positioned in the general work area, or adjacent to work locations such as benches and hoods. Air samplers operate continuously, and filters are

collected at intervals not to exceed 10 days and analyzed for gross beta activity. The minimum detectable concentration is 1 E-10 μCi/ml (based on counting efficiency for Tc-99).

3.10 COMPLIANCE WITH THE EMBRYO/FETUS DOSE LIMIT

The occupational exposure of a declared pregnant female is limited in accordance with the limit in 15A NCAC 11.1610 to ensure that the dose to the embryo/fetus during the entire pregnancy does not exceed 0.5 rem. Additionally, efforts are made to avoid substantial variation above a uniform monthly exposure rate. The process for declaring a pregnancy in writing is established in internal procedures, and is covered in nuclear safety training described in section 2.4.

3.11 COMPLIANCE WITH THE DOSE LIMIT FOR MEMBERS OF THE PUBLIC

In accordance with 15A NCAC 11.1611, operations are conducted such that the total effective dose equivalent to an individual member of the public resulting from licensed activities does not exceed 0.1 rem in a year. The external dose in any unrestricted area resulting from licensed activities is controlled such that it does not exceed 0.002 rem in any one hour.

## 3.12 INSTRUMENTATION

Radiation detection instruments (see Table 3.2) are available to ensure radiation surveillance can be accomplished. Selection criteria of equipment is based on the types of radiation detected, maintenance requirements, ruggedness, interchangeability and upper and lower limits of detection capabilities. The radiation safety function annually reviews the appropriateness of the types of instruments being used for each monitoring function.

Table 3.2 lists examples of the types and uses of available instrumentation.

Monitoring instruments utilized for radiation safety purposes are calibrated before initial use, after major maintenance, and on a routine basis not to exceed six months following the last calibration. Such calibration consists of (but is not limited to) a performance check on each range scale of the instrument with a radioactive source of known activity.

Prior to each use, operability checks are performed on monitoring and counting instruments utilized for radiation safety purposes.

The background and efficiency of counting instruments are checked on a daily basis during periods when the equipment is in use. Efficiency is determined using radioactive sources of known activity.

## TABLE 3.2

### TYPES & USES OF AVAILABLE INSTRUMENTATION

| Type | Typical Range or MDA | Routine Use |
|---|---|---|
| Dose Rate Meters | | |
| GM Low Range | 0.01 mR - 2000 mR | Area Dose Rate Survey, Shipment Survey, Personnel Survey |
| GM High Range | 0.1 mR - 1000 R | Emergency Monitoring, Shipment Survey, Equipment Survey |
| Ion Chamber - Low Range | 0.5 mR - 50 R | Area Dose Rate Survey, Shipment Survey |
| Ion Chamber -High Range | 1 mR - 1000 R | Emergency Monitoring, Area Dose Rate Survey |
| Personnel Monitoring Systems | | |
| Thin Window GM | 200 dpm (Cs-137) | Personnel Survey |
| Large Area Plastic Scintillator Portal Monitor | 0.4 μCi (Cs-137) | Personnel Survey/Whole Body Deposition Screening |
| In Vivo Whole Body Counter | 1 nCi (Cs-137) | Whole Body Deposition Measurements |
| Sampling Counting Systems | | |
| Sealed Gas Proportional | 0.1 nCi (Tc-99) | Air Sample Analysis |
| Fixed Geometry Thin Window GM | 200 dpm (Tc-99) | Smear Sample Analysis |
| HPGe & MCA | N/A | Nuclide Identification |

## 4.0 ENVIRONMENTAL PROTECTION

### 4.1 AIR EFFLUENT

Radioactive emissions in air effluent are unlikely due to the non-volatile nature of the material received and the HEPA filtration system. As an added precaution, the contaminated zone effluent stacks are continuously monitored by isokinetic stack air samplers, filters are collected at intervals not to exceed ten days and analyzed for gross beta activity. The minimum detectable concentration is 1E-14 μCi/ml (based on counting efficiency for Tc-99). Concentrations in excess of 10% of the allowable concentrations in 10CFR20 Appendix B, Table 2, Column 1 shall be investigated.

### 4.2 WATER EFFLUENT

Waste water produced in the contaminated zones and change rooms is quarantined and processed by evaporators which eliminate the water and collect the radioactivity as a residue. This process eliminates radioactive water effluent.

### 4.3 WASTE DISPOSAL

Liquid waste is stored in holding tanks that feed evaporators. The evaporators operate as necessary and can handle up to 200 gallons per day. The facilities generate approximately 4800 gallons of liquid waste per year from the ultrasonic

cleaning tanks, decontamination sinks and the showers. The evaporator process creates <5 cu. ft./yr. of residue. This material is isolated and stored until sufficient volume is created to warrant a shipment to a licensed waste disposal facility.

Solid waste is of three general types: (1) wash-water treatment residues (12 cu. ft./yr.), (2) unserviceable equipment, i.e. underwater tools, poles, replaced parts, etc. (1000 cu. ft./yr.) and (3) low level contamination and radiation (1000 cu. ft./yr.) from discarded plastic, tape, rags, paper suits, etc. Radioactive waste is dried, bagged (with appropriate absorbent as necessary), and placed in a container for shipment to a licensed waste disposal or processing facility as appropriate. Control rod drives and associated contaminated components are returned to the utility if no disposal option is available. The storage containers are designated as radioactive waste and located in the container storage area. The low level radioactive waste is collected in bags and stored in containers within a designated radioactive waste area.

The waste is prepared for shipment in accordance with the disposal facility's requirements. This may include solidification, incineration or other methods provided by either a licensed disposal facility or licensed waste processor.

The following practices within R&FS and FET will be used to keep radioactive waste volume to a minimum:

1. Compressible items are compacted to minimize radioactive waste volume as needed.
2. Unnecessary items are not taken into the contaminated zone.
3. Tools are decontaminated when practical so they can be reused rather than thrown away.