11.6 LOW LEVEL RADWASTE HOLDING FACILITY (LLRWHF)

11.6.1 Design Basis

The Low Level Radwaste Holding Facility (LLRWHF) has no safety related functions. It is designed to provide temporary on-site storage for low level radioactive waste (LLRW) and radioactive material produced at the Susquehanna Steam Electric Station (SSES). This storage capability is required whenever shipment off-site is temporarily restricted by unavailability of disposal site, unavailability of shipping casks, transportation problems, economic considerations, or other such problems that hamper LLRW disposal.

The original plant design provided very limited storage capacity based on the assumption that the waste would be continuously shipped off-site for disposal. The LLRWHF allows temporary shipping interruptions to occur without impacting plant operations.

This facility also aids in reducing the total man-rem exposure associated with the disposal process by providing the means to allow significant decay before off-site shipment and disposal activities occur.

Codes and standards applicable to the Low Level Radwaste Holding Facility are listed in Table 3.2-1.

11.6.2 LOW LEVEL RADWASTE HOLDING FACILITY DESCRIPTION

The Low Level Radwaste Holding Facility (LLRWHF) is a structural steel frame building with uninsulated metal siding and roofing to provide weather protection. The metal siding and roofing is designed for nominal wind loads and a snow load. The steel frame is designed for the wind and snow loads plus UBC Seismic Zone I loads, a 30 ton bridge crane, 4-10 ton monorails, and dead loads. See Dwg. B1P-005, Sh. 1 for the storage plan general arrangement in the LLRWHF. The building encloses a system of reinforced concrete waste storage vaults. For initial facility operation, two concrete vaults are provided for storage of waste liners (Liner Vault) and dry active waste (DAW) (Trash Vault) and are located in the western half of the building. The eastern half is referred to as the Open Area and is used for storage of radioactive material and shielded liner storage modules (LSMs). An additional concrete vault may be constructed over the eastern half of the building at a later date to accommodate additional storage.

The foundation consists of slab on grade with grade beams running around the perimeter of the building as well as underneath the vault walls. The slab is designed for a 250 psf floor load as well as the steel framing column loads, except in the truck bay which is designed for an AASHO H20-S16 load.

The reinforced concrete vaults consist of concrete walls. There is a wall which divides this area into two separate vaults. This entire area is covered by precast concrete panels with a total of 395 circular plugs which are individually removed while a waste liner is being placed in or retrieved from storage. These precast panels are supported by a structural steel framing system. Both the precast panels and framing system are designed for either a 100 psf uniform load or a 58 kip load from a waste liner and its shielding (shield bell) resting at individual locations, which ever is greater. The walls of this area are designed to withstand a total tornado pressure of 300 psf.

The shielded liner storage modules (LSMs) consist of a reinforced concrete right circular cylinder with removable lid. The concrete thickness on the module top and sides is used to provide radiation shielding for both transport and storage of solidified waste liners in the east open area. The LSMs are capable of being stacked a maximum of 2 modules high to maximize storage capacity in the open area.

For initial operation, waste liners may be stored in the west vault and within LSMs in the open area. DAW is stored in the adjacent east vault. An inspection area is provided in the west vault to allow appropriate waste liner inspections. In the adjacent vault, where DAW will be stored, a labyrinth is provided to allow access by a forklift truck. In addition, a stairway is placed up, over, and back down the vault wall in the south east corner for emergency egress while this vault is used for trash storage. At a later date, if the east vault is converted for use as a waste liner storage vault, an inspection station could be added and the emergency exit closed. High integrity containers containing dewatered waste will be stored in the east open area in LSMs. DAW and radioactive material may also be stored in the east open area.

DAW will be stored in the reinforced concrete Trash Vault or in the Open Area provided it is non-combustible and in accordance with the appropriate fire protection requirements. DAW and radioactive material will be packaged in a manner that will prevent the spread of contamination. Typically, containers that are ‘strong-tight’ or comply with the requirements of 49CFR173 will be used to minimize the need for repackaging prior to shipment. Solidified waste will be stored in reinforced concrete vaults or LSMs located within the LLRWHF. Dewatered waste may be stored in LSMs located in the Open Area. Solidified and dewatered wastes stored in the LLRWHF will typically be packaged in that meet disposal facility requirements in effect at the time of processing to minimize the need for repackaging prior to shipment.

If required, an additional concrete vault could be constructed in the eastern portion of the building to provide additional storage. This area could be enclosed by concrete walls.

A concrete wall is located along the north side of the truck bay. This wall provides shielding during waste liner storage or retrieval in the vaults.

A control room is located at the north east corner of the facility. It has concrete walls on the south and west sides and metal siding with insulated sheetrock walls on the north and east sides. The ceiling is insulated acoustical panels below the metal roofing.

A battery charging station and parking area is located adjacent to the west wall of the control room. It has concrete walls with a roll-up door into the truck bay. The roof is insulated metal roofing.

The Low Level Radwaste Holding Facility (LLRWHF) provides the following:

- interim storage of LLRW generated by five years of operation per unit (current waste generation rates are less than those projected as a result of successful volume reduction efforts)

- interim storage period not to exceed five years (extended storage afforded by reduced waste generation rates shall not be allowed until the LLRWHF has been evaluated with respect to the provisions of Information Notice 90-09)

- operation of the facility as necessary to hold the LLRW when licensed off-site disposal facilities are unavailable or not cost effective.

- the facility may be utilized for temporary projects which have been evaluated on a case by case basis and approved by supervision.

11.6.3 LLRWHF WASTE DESCRIPTION AND CAPACITY

The LLRWHF is designed to store low level DAW, dewatered waste, and solidified waste generated by the Susquehanna SES. The facility may also be used to temporarily store pieces of contaminated plant equipment and radioactive material. The LLRWHF will not be used to store gaseous wastes nor wastes containing free liquids.

The LLRWHF may be used for temporary projected related to the storage of and processing of radioactive material. When used for such projects temporary enclosures, supplemental HEPA ventilation and other containment control practices will be utilized as necessary to control the release and spread of contamination and airborne radioactivity. Each temporary project will be evaluated separately to assure conformance to the FSAR including Section 12.5, Health Physics Program, and design base requirements.

Dry active waste is defined as contaminated material containing sources of radioactivity dispersed in small concentrations throughout large volumes of inert substances, and has no free liquid. It generally consists of paper, high efficiency particulate air (HEPA) and cartridge filters, rags, clothing, small equipment, and other dry materials.

Solidified waste is defined as wet, dewatered waste in the form of resins and sludges which is solidified in a media, meets the free liquid criteria of NUREG 0800, SRP 11.4, BTP ETSB 11-3, and satisfies applicable transportation and disposal site requirements. Dewatered resins and sludges meeting the free liquid criteria of NUREG 0800, SRP 11.4, BTP ETSB 11-3, and satisfies applicable transportation and disposal site requirements are classified as solidified waste.

This definition is intended whenever solidified waste is referenced.

Original LLRWHF storage configuration design estimates of the annual waste generation rates range from 1100 to 1800 m^3 (39,000 to 63,000 ft^3) based on operation of both units. A nominal figure of about 1700 m^3 (60,000 ft^3) was chosen. Table below gives a breakdown of the low-level waste volume by source and waste type. After four years of operation the two Susquehanna SES units will have generated approximately 6800 m^3 (240,000 ft^3) of LLRW that will have required storage; the capacity of the LLRWHF will be about 6800 m^3 (240,000 ft^3).

Original Design Estimated Annual Low-Level Waste
Generation Rate For Operation of Both Units

Source-Waste Type	m^3/yr	ft^3/yr
DAW--compacted	500	18,000
DAW--non-compactible	150	5,300
Evaporator bottoms (25 wt%)	510	18,000
Resins	90	3,200
Waste sludges	450	16,000
TOTAL	1,700	60,500

Current estimated waste generation is described in Section 11.4.

11.6.4 LLRWHF SOURCE TERM

Source term calculations for the LLRWHF were performed for eight (8) radwaste/container combinations: LRW/HIC, Condensate Demin Bead/HIC, Condensate Demin Bead/Steel, Sump Sludge/steel, RWCU/HIC, Cartridge Filter/HIC, Compactible DAW/ strong tight and Non-Compactible DAW/strong tight. Actual radwaste generation volumes for 1990 and 1991, rather than design basis quantities, were used to determine generation rates for the source term calculation. Isotope inventory was determined for each waste type based on information submitted in SSES Semiannual Effluent and Waste Disposal (SAE & WD), Reports from 1990 and 1991. The maximum isotope activity for each period was used to develop shine and release source terms. Shine source terms contain only gamma-emitting isotopes; release source terms contain all isotopes. The total period of generation is five years. Total radwaste generation by type was determined by dividing the average actual generation rate in two years by nominal container volumes supplied. The accumulation rate (number of containers produced in five years) was used to determine whether accumulation is monthly, quarterly or annually. Decay calculations were performed for each type of waste based on the accumulation rate. The following generation rates and container volumes were used as inputs to the calculations:

GENERATION RATE (ft^3/yr) OF WASTE

RADWASTE TYPE	1990	1991
C/D Bead, steel liner	1050	1500
C/D Bead, HIC	5940	5610
Sump sludge, carbon steel	65.6	143.1
LRW HIC	745.6	1739.4
RWCU HIC	55	330
Cartridge Filter, HIC	78	78
Compactible DAW, strong-tight	3457.9	2549.3
Non-compact DAW, strong-tight	207.6	456.74

VOLUME (ft^3) OF CONTAINERS

RADWASTE TYPE	VOLUME
C/D Bead, steel liner	150
CD Bead, HIC	165
Sump sludge, carbon steel	70
LRW HIC	150
RWCU HIC	51
Cartridge Filter, HIC	39
Compactible DAW, strong-tight	64
Non-compact DAW, strong-tight	64

Results of the LLRWHF Source Term Calculation are shown in Reference 11.6-2, Attachment B.

Radioactive material other than that described above (for example contaminated equipment such as scaffolding and large components such as turbine blades) have not been explicitly modeled. Dose profiles based on storage of “maximum activity vans” 8 feet wide by 20 feet long by 8 feet high (10 mR/hr @ 2 meters) and “typical activity vans” (20 mR/hr @ 1 cm) assuming a Co-60 gamma spectrum have been developed to bound offsite dose consequences.

11.6.5 CONTAINERS

The radwaste containers which will be stored in the LLRWHF are designed to preclude or reduce the occurrence of uncontrolled release of radioactive materials due to handling, transportation or storage.

DAW and radioactive material will be packaged in a manner that will prevent the spread of contamination. Typically, containers that are ‘strong-tight’ or comply with the requirements of 49CFR173 will be used to minimize the need for re-packaging prior to shipment. Solidified waste will typically be packaged in containers that meet disposal facility requirements in effect at the time of processing.

At the present time, and for the foreseeable future, there is a wide profusion in sizes and shapes of disposal containers in use in the nuclear industry. Each has its own advantages and applications. It is expected that during the life of the facility it will be required to accommodate several of these different container types manufactured from steel or polyethylene material as deemed acceptable in the nuclear industry.

11.6.6 CONTAINER SHIELDING FOR TRANSPORT AND STORAGE

Transport and storage of high integrity containers (HICs) from the Radwaste Processing Facility to the LLRWHF will utilize LSMs. They serve as a shield for radwaste containers while being transported, moved and stored to minimize radiation exposure to personnel (Reference 11.6-9). LSMs are presently in use throughout the nuclear industry for onsite storage.

Steel liners are typically transported to the LLRWHF in a concrete shielded transfer cask. A shield bell may be used to move liners from the transfer cask to their storage location to minimize radiation exposure to operating personnel. See Figure 11.6-3.

The shield bell incorporates an electrically operated grapple for securing the liner within the shield bell for liner transport. The grapple is operated by an electric motor driven hoist which raises or lowers the grapple into position to engage a waste liner. The shield bell is supported by the bridge crane and receives necessary power and control signals via the crane bridge from a control panel located in the LLRWHF control room.

11.6.7 CRANE LOADING AND UNLOADING SYSTEM

The LLRWHF 30-ton crane with the 10-ton girder mounted monorail hoist is provided with a closed circuit television system for use in operating the crane to handle radwaste liners and vault shield covers plugs remotely. Both loads are imposed on the crane bridge simultaneously. The crane bridge is provided with closed circuit television cameras along with bridge mounted lighting fixtures to optimize visibility of crane loads-liners, shield covers, shield bell--and the path of crane motion. In addition, the crane is provided with a control pendant to facilitate local operation.

Provision is made for crane retrieval from the liner storage vault area back to the truck bay by releasing the crane brakes manually should there be a loss of power.

Provision has also been made to facilitate relocating the crane from the west vault to the east vault. Lifting eyes are provided to facilitate lifting the crane from the runway rails, over the truck bay, using hoist/trolleys provided on monorails over the truck bay. In this manner, the crane may be moved from the west vault to the east vault or vice-versa.

11.6.7.1 LLRWHF 30-Ton Crane Operation

The crane motion speed controls operate in accordance with the following requirements:

The main hoist operates through 5 speed steps and provides a maximum hook speed of 15 feet/minute (fpm). The hoist drive is equipped with a completely independent and separate microdrive system. The microdrive system drives the hoist at 6 inches/minute (maximum) to obviate impact loads and achieve the required load positioning accuracy of ±1/2 inch. An electrical interlock permits lowering the load over the storage vault using the microdrive system only.

The crane main hoist is interlocked with the shield bell grappling device. It may be energized for lifting or lowering the shield bell when the liner is attached to the shield bell, or when the liner is not attached to the shield bell and the liner grapple is withdrawn into the shield bell.

The drive for the trolley operates through 5 speed steps and provides maximum trolley speed of 50 feet per minute. The trolley is also equipped with a completely independent and separate microdrive system. The microdrive system drives the trolley at 6 inches/minute.

The main drive for the crane bridge operates through 5 speed steps and provides a maximum bridge speed 70 feet per minute. The drive is also equipped with a separate and independent microdrive system. The microdrive system drives the crane bridge at 6 inches/minute so as to provide no impact.

The motor-driven monorail hoist operates at a maximum speed at 15 fpm. The hoist is provided with a microdrive for a speed of 6 inches/minute. An electrical interlock permits lowering the load over the storage vault using the microdrive system only. The monorail hoist is provided with an alarm signal at the control panel for loads exceeding 7 tons.

The controls for operating the shield bell hoist motor are located on the shield bell control unit on the crane control panel and interlocked with the crane main hoist.

The crane positioning system accuracy meets the requirements for locating concrete vault shield plugs.

11.6.7.2 Liner Storage in Vault

The 30-ton capacity crane main hoist is used to lift radwaste liners from the transportation vehicle parked in the east end of the Truck Bay of the LLRWHF. The radwaste liner may be contained inside a shield. The assembly--shield bell and liner--is lifted by the crane main hoist and transported into the vault area.

The 10-ton monorail hoist supports the shield plug grapple which is used to engage and lift the vault shield plug. The crane bridge is then moved to position the liner and shield bell, if used, directly over the vault opening from which the shield plug has been removed. The liner is lowered into the vault and released.

When used, the shield bell hoist raises the empty liner grapple up into the shield bell and the crane main hoist lifts the shield bell from the vault roof recess.

The crane bridge is moved to realign the vault shield plug over the opening where the liner was placed and the vault shield plug is lowered into place.

11.6.7.3 Liner Retrieval in Vault

The 30-ton capacity crane is used to remove the liners from the vault. The 10-ton monorail hoist supports the shield plug grapple which is used to lift the vault shield plug.

When the shield bell is used, the crane bridge is then moved to position the shield bell directly over the vault opening from which the shield plug has been removed. The liner grapple is then lowered via the shield bell hoist, into the vault and the grapple is attached to the liner to be removed from storage. The shield bell hoist raises the liner into the shield bell. The crane main hoist lifts the shield bell from the vault opening and the crane bridge is moved to position the vault shield plug directly over the vault opening. The vault shield plug is lowered into place and the grapple is removed from the vault shield plug.

The liner and shield bell, if used, are moved by the crane to the appropriate position required by the next operation, which will be either the inspection station, another vault location or the truck bay for shipping.

11.6.7.4 Mobile Crane Operation

Mobile crane(s) with sufficient load capacity is used in the eastern half open area. This crane is used to lift LSMs containing waste in containers to/from the transportation vehicle parked in the LLRWHF. The entire assembly---LSM and container---is lifted by the crane from the transportation vehicle and placed into the storage area. This sequence is reversed for loading the entire assembly from the storage area to the transportation vehicle. Mobile cranes may also be used to lift radioactive materials and waste packages in the open area.

11.6.8 HEALTH AND SAFETY REQUIREMENTS

The LLRWHF is designed to limit off-site doses from the onsite storage of LLRW to a fraction of the 40CFR190 limits for the Susquehanna SES site, and on-site radiation exposure within the guidelines of 10 CFR 20. In both instances, the facility is designed to maintain dose rates ALARA as outlined in Regulatory Guides 8.8 (NRC 1979, Information Relevant to Ensuring that Occupational Exposures at Nuclear Power Stations will be As Low As is Reasonably Achievable) and 8.10 (NRC 1977, Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As is Reasonably Achievable). Exposure of on-site workers will be minimized by the use of concrete shielding around the stored material, shielded loading equipment, and controlled access to the facility. Since no radioactive materials would be released off-site, dose rates would be minimized through the use of shielding, distance, the self-shielding properties of the storage containers, and temporary shielding.

11.6.9 FLOOR DRAIN SYSTEM

Under normal conditions there will be no free liquids inside the building. Therefore, any free liquids entering the facility would come from sources such as: fire protection water; minute amounts of liquid from a breached container; rainwater or snow melt from roof leakage; cooling system or fuel leakage from equipment inside the facility; and snow brought in on vehicles. All such liquids will be considered contaminated until verified otherwise.

The floor drain and curb system will collect any liquids spilled on the floor of the facility. The system will route all drains to the collection sump located along the periphery of the building. The sump is equipped with liquid-detection devices that signal the facility control room whenever liquid enters the sump.

Sampling of the liquid in the sump is performed from inside the building. These liquids may be pumped to portable containers from inside the building and transferred to the main plant for processing. However, no permanent pumping equipment or piping is connected to the main plant.

11.6.10 LLRWHF HVAC SYSTEM

11.6.10.1 General Functions and Controls

The HVAC systems are designed to provide adequate air flow to remove heat and fumes, and maintain area design temperatures in the facility.

In the event of fire, the Storage Area Ventilating System, the Battery Charging Station Heating and Ventilating System, and the Truck Bay Vehicle Fume Exhaust System are automatically shutdown completely upon a signal from fire detection system. An override switch is provided in the control room to override the fire detection signal and purge smoke after a fire has been suppressed. To prevent outside air infiltration, backdraft dampers are provided for the fans exhausting room air directly to outside of the building and arranged to close automatically when fans are not operated.

11.6.10.2 Storage Area Ventilating System

The system has three separate subsystems and is designed to remove heat and fumes from the storage area and maintain the room design temperature of 100°F using outside air introduced through outside air inlets.

The subsystem equipment consists of five roof mounted exhaust fans for the area above vaults and open area ceiling, and ceiling mounted exhaust fan for the Trash Vault.

The system sequence of operation and controls are as follows:

1. The selected exhaust fans are started manually by individual hand switches located in the control room.
2. With the hand switches in the automatic position, exhaust fans are started automatically by room temperature switches when the temperature exceeds the set point of 100°F.
3. The Trash Vault ceiling fan is interlocked with the roof mounted exhaust fans, so that roof mounted exhaust fans are operated whenever ceiling fans are in operation unless the signals are overridden by the control room switches.

11.6.10.3 Control Room HVAC System

The control room HVAC system is designed to maintain room design temperatures during occupied periods as well as unoccupied periods and maintain positive room pressure to minimize air infiltration from the storage area.

The equipment consists of an air cooled cooling unit which consists of a low efficiency filter band, a supply fan, direct expansion cooling coil, and a multi-step electrical duct heater, with associated ductwork and controls.

The system sequence of operation and controls are as follows:

1. The supply fan on the cooling unit is started manually by a hand switch mounted on unit.
2. The supply fan may also be started automatically by room temperature switches when the hand switch is in the automatic position.
3. The set points of room temperature switches are 78°F and 90°F for summer, 70°F and 45°F for winter, during occupied and unoccupied periods respectively. The supply fan is started with either the cooling coil or the electric duct heater, as required.
4. When the system is started and the cooling or the heating mode is determined by room temperature switches, the system capacity will be adjusted automatically in response to room loads modulating the expansion valve on the cooling coil for cooling mode operation or adjusting the operating step on the electric duct heater for heating mode operation.
5. The supply fan continuously recirculates conditioned air with a fixed quantity of outside air for space pressurization.

11.6.10.4 Battery Charging Station Heating and Ventilating System

The system is designed to remove hydrogen gas produced during battery charging operation and maintain summer and winter room design temperatures. The exhaust fan operates continuous whenever the battery charging operation is required and maintains room pressure slightly below atmospheric to prevent the spread of hydrogen gas.

The equipment consists of a roof mounted exhaust fan, an electric unit heater and associated controls.

The system sequence of operation and controls are as follows:

1. The exhaust fan and electric unit heater are started manually by individual hand switches located on the local control panels.

2. With the hand switch in the automatic position, the exhaust fan is started when room temperature exceeds the set point of 100°F.

3. With the hand switch in the automatic position, room temperature is maintained above 40°F automatically by room temperature switch which starts heater.

11.6.10.5 Sprinkler Valve House Heating Systems

The systems are designed to maintain a minimum room temperature of 40°F for freeze protection. The equipment consists of two 50% capacity electric base board heaters and associated controls for each system.

The system sequence of operation and controls are as follows:

1. Heaters are started manually by individual local hand switches located in the valve houses.

2. The heaters can be started automatically by room temperature switches mounted inside of the valve houses. The set points for room temperature switches is 45°F for the primary heater and 40°F for the secondary heater.

3. If the room temperature drops below 35°F, low temperature switches activate audible low temperature alarms installed near the valve houses and also annunciate to the control room.

4. Normally, room temperature is maintained by the hand switch in the automatic position. The manual controls are required for operating tests.

11.6.10.6 Truck Bay Vehicle Fume Exhaust System

The system is designed to remove vehicle fumes produced during loading and unloading operations. The equipment consists of a wall mounted exhaust fan, with associated ductwork and manual controls.

11.6.10.7 Inspection Station Ventilation

One wall mounted exhaust fan is provided for heat removal from high intensity lighting in the inspection station. The fan exhausts to the area above the vaults and is manually controlled by hand switches on the local panel.

11.6.10.8 Air Inlets

Air inlets are placed to evenly distribute air entering the facility even when it is closed. Air inlets are located such that the accumulation of snow or other substances are prevented from restricting the flow of air and to prevent these substances from being drawn into the facility.

11.6.11 Effluent Monitoring

The LLRWHF was evaluated for potential unmonitored effluent pathways in accordance with the Offsite Dose Calculation Manual (ODCM). The LLRWHF will be used primarily to store solidified wastes and radioactive material. Gases and free liquids will not be stored. The solidified waste, along with radioactive material, will be properly confined and contained to prevent inadvertent airborne release. The LLRWHF has been categorized as an 80-10 System. All material stored in the LLRWHF will contain low levels of fixed or removable contamination. Materials with removable contamination will not be stored in open containers. Contamination on the external surfaces of the containers will be maintained below conditional release limits per Health Physics procedures. Containers which cannot be decontaminated to conditional release standards due to ALARA concerns will be decontaminated to <50,000 dpm/100 cm^2 and stored in LSMs or Vaults. Thus, airborne radioactivity in the LLRWHF would occur only in the event of breach of one or more barriers. LLRWHF general area and local air will be periodically sampled for airborne radioactivity. Any radioactivity detected will be included in determining compliance with site dose limits. Any such occurrences will be reported in the Annual Effluent and Waste Disposal Report. The LLRWHF would be decontaminated or additional safety evaluation would be performed for continued operation of the facility.

The LLRWHF may also be used for temporary projects related to the storage of and processing of radioactive material. When used for such projects temporary enclosures, supplemental HEPA ventilation and other contamination control practices will be utilized as necessary to control the release and spread of contamination and airborne radioactivity. In addition, the general area and local air in the vicinity of the work will be periodically or continuously sampled as necessary to ensure that any radioactivity detected is included in determining compliance with site dose limits.

11.6.12 ELECTRICAL SYSTEMS

11.6.12.1 480 Volt Distribution System

The 480 volt distribution system is a non Class IE, seismic category II design system rated for operation at 277/480 volt, 3 phase, 4 wire, 60 Hz with neutral solidly grounded. Source power for the LLRW holding facility is supplied by PPL Electric Utilities through a 300 KVA, 3 phase transformer. Underground service entrance conductors connect the transformer to the 480 volt motor control center located in the LLRWHF control room. Ground fault protection and overload protection is provided on the main incoming line breaker of the motor control center. All power for the LLRWHF is distributed at appropriate voltage levels from the control room. The motor control center is the main source of power for all LLRWHF loads. The exceptions are: battery packs, for emergency exit lighting; batteries used in the transponder for the fire alarm system; and batteries used for the annunciator system. Batteries are also provided to power the annunciators in the event of loss of power. There is no diesel backup or 125 volt DC station battery power for this facility. Metering, controls, and alarm relaying are provided in the LLRWHF control room. The motor control center has a spare section to allow for additional future loads.

11.6.12.2 Grounding System

The grounding system includes a grounding grid of 250 MCM cables to which every other building column is connected. The grounding grid is connected to the site main grounding grid. The structural steel for liner vaults is bolted together and connected directly to the building ground grid. Electrical and mechanical equipment, stairways, handrails and grating are connected to the building ground grid, either directly, or indirectly through the grounded structural steel. The 480 volt motor control center is connected to the building ground grid to provide a low resistance fault current return path. The system neutral in the MCC, and the lighting transformer neutral are connected to the facility grounding grid by individual grounding conductors.

11.6.12.3 Lighting System

Control of the lighting system is maintained in the LLRWHF control room. Lights on the outside of the LLRWHF over each personnel exit door are controlled by photocell. Roll-up doors have switches at the doors and small rooms are also switched locally.

Long life lamps are installed in low level radiation areas to minimize time spent by maintenance personnel in replacing lamps. General illumination has been provided above the vaults to assist the supplementary high intensity incandescent lights installed on the crane for the closed circuit television operation. High levels of illumination have been provided in the inspection station(s).

Outside area lighting for security purposes is integrated into the total plant system as described in Section 9.5.3 and is not a part of this lighting system description.

Lighting is obtained from the LLRWHF main service via the motor control center and lighting panels. In the event of loss of power, battery operated emergency exit lights have been strategically located to facilitate egress from the LLRWHF. Convenience receptacles are located throughout the LLRWHF.

Provision has been made for future expansion and the addition of extra lights anywhere in the LLRWHF to the extent of 25% of the existing lighting system. This provision is in the form of spare capacity.

11.6.12.4 Communication System

A telephone with a main plant extension is located in the LLRWHF control room. The control room and storage areas are furnished with an extension of the main plant intercommunication system with paging station and speakers. Public address handset stations for conversation and paging are located in the control room, off loading area, and the inspection station. PA speakers are located in the control room, truck bay and storage areas such that paging or alarm can be heard when the facility is at full capacity. The various communication systems are described in Section 9.5.2.

Provision is made to add additional PA speakers within the LLRWHF.

11.6.12.5 Cable and Raceway System

Systems that are an extension of the main plant are: telephone, intercommunications, and alarm. Spare conduits are provided for four systems: telephone, instrumentation, control and low voltage power.

Underground conduits are run in a duct bank between the PP&L 300 KVA transformer, located outside of the LLRWHF battery charging room and the 480 V motor control center in the LLRWHF control room.

11.6.13 CONTROL PANELS

Three control panels are located in the LLRWHF control room that consolidate all functions for the operation of the facility. The panels include; 1) HVAC and Radiation Monitoring, 2) Crane Control and Shield Bell Control and, 3) Fire Protection Panels.

The HVAC and Radiation Monitoring includes the switches that control the roof exhaust fans, the fume exhaust fan and the smoke override. Radiation indicators and annunciation of high radiation reading and high liquid level in the sump for the DAW and vault area are also included in the panel. A common trouble annunciator is also transmitted to the main plant power plant control room.

The crane control panel has all the controls necessary for remote operation of the LLRWHF 30-ton crane and TV monitors for viewing the operation. The shield bell control panel is a part of the crane control panel.

The fire protection panel includes all smoke and fire detection signals, fire alarm signals and the fire sprinkler system for the entire facility. Lighted zone annunciation and alarm bells are provided in the panel to locate trouble areas. All signals received by the panels are retransmitted to the main power plant fire control system as described in Section 9.5.1.

11.6.14 RADIATION ZONING

The facility is divided into radiation zones as described in Section 12.3.1.3.
Dwg. B1N-100, Sh. 1 shows the radiation zones for the proposed storage arrangement.

11.6.15 RADIATION MONITORING SYSTEM

The radiation monitoring system is designed to monitor the general area radiation levels at various locations-inside the DAW vault, the off-loading area, and the LLRWHF control room. The radiation monitor to be used is a gamma measuring device that has a sensor, an indicator, and power supply. The monitors' sensors are strategically located on the walls of the DAW storage areas, control room, and truck bay. There are area radiation monitors in the truck bay; one near the inspection station and one near the catch basin, and one in the control room. In the east vault used to store DAW, an area radiation monitor is near the north entrance and another near the emergency stairs at the south end.

Radiation levels detected by the sensors are sent to indicators located on the LLRWHF control room panel. Channels for additional monitors are provided.

11.6.16 SHIELDING

The LLRWHF contains four types of shielding; 1) fixed shielding for the in-place stored material, 2) transient shielding for waste containers for transport to the facility and for loading and unloading in the waste storage area, 3) Liner Storage Modules (LSMs) for the storage of higher activity items in the Open Area, and 4) temporary shielding that may be used for the radioactive material in the Open Area. Shielding design objectives are described in Section 12.3.2.1.

The fixed shielding consists of concrete storage vaults and modules for the solidified and DAW waste, concrete walls in the truck bay areas and concrete walls for the control room. The storage vault and module walls are reinforced concrete. The storage vaults and modules have precast concrete covers with removable plugs. Reinforced concrete walls are provided for shielding on the north and west sides of the truck bay areas. The control room has reinforced concrete along the south and west walls.

The transient shielding for the solidified wastes consists of portable shielding on the transport vehicle and a portable shield bell.

The shielded liner storage modules (LSMs) consist of a reinforced concrete right circular cylinder with removable lid. These are typically used for storage of the High Integrity Containers, but may also be used for other higher activity radioactive material and radioactive waste.

Temporary shielding such as lead blankets may be used in accordance with the radiation protection program to limit actual dose rate profiles to less than the bounding profiles to meet offsite dose criteria.

Further segregation of the waste containers within the vaults and modules will also be used to take maximum advantage of the self shielding properties of the waste material and to minimize exposure. To the maximal extent practicable, waste stored in the DAW storage vault will be arranged with containers having lower contact dose rates on the top layer of the storage areas and containers with higher contact dose rates stored underneath. Similarly, to the maximal extent practicable, solidified waste stored within the solidified waste storage vaults and modules will be arranged with lower contact dose rate containers stored on the outer perimeter and on the top layer. Containers with higher contact dose rates will be stored inside this perimeter.

11.6.17 SECURITY

The entire LLRWHF is within the restricted area security fence that encloses the Susquehanna SES and is under routine surveillance by plant security patrols. Access to the LLRWHF is administratively controlled through the use of a locked door(s).

11.6.18 FIRE PROTECTION SYSTEM OPERATING DESCRIPTION

11.6.18.1 Dry Pipe Sprinkler Systems

The dry pipe sprinkler systems are hydraulically designed to discharge at a density of 0.25 gpm/sf over the most remote 3000 sf. The design complies with NFPA #13 and provides protection to areas containing combustibles. Sprinkler heads in the storage area are equipped with fusible links rated at 286°F. When the links fuse upon high heat, the air in the piping system is released allowing it to fill with water and discharge at the design rate. A single AC powered air compressor supplies air to the dry pipe systems through the automatic filling system at each valve. Air pressure is maintained in the sprinkler system piping at approximately 50 PSI to maintain the water inlet valve in a closed position and prevent freezing of the protection system.

All radioactive material and radioactive waste shall be stored in an area which is approved in accordance with the fire protection program for the type of material and packaging used. The areas currently approved for storage of “combustible” containers are the DAW vault and the extreme northern section of the east open area, which are protected by the dry pipe sprinkler systems. Temporary projects may use the east open area without dry pipe sprinkler systems for the storage of and processing of radioactive material provided the requirements of the SSES Fire Protection Program are met.

11.6.18.2 Infra Red Smoke Detection Systems

Initially, smoke detectors are provided in the East Vault. Later, if required, additional detectors maybe added where required to assure an adequate detection system. The smoke detection system is comprised of units which project an infra-red beam the length of the vault. Each unit includes a transmitter and a receiver mounted below the vault roof. A smoke emitting fire causes attenuation of the beam at the receiver which generates a smoke alarm when 50% obscuration occurs. Total blockage of the beam is discriminated by the receiver, so that inadvertent blockage (during maintenance) does not result in a smoke alarm.

11.6.18.3 Photo Electric Smoke Detection System

The photo electric system is comprised of three (3) spot type ceiling mounted detectors of the conventional type operating on the light scattering, photodiode principle. They are located in the LLRWHF control room and will alarm at a smoke density of 1.5% light obscuration per foot.

11.6.18.4 Truck Bay Smoke Detection System

The smoke detection system in the Truck Bay consists of ionization detectors powered, operated, and controlled as a separate sub-system. Alarm transmission is delayed for a pre-determined time-out period to minimize false alarms.

11.6.18.5 Fire Alarm System

The fire alarm system is an extension of the existing plant system as described in Section 9.5.1. The LLRWHF incorporates the use of the Simplex Time Recorder Company basic transponder as the control panel for the local facility. It provides both normal and emergency back up power to the system from its own internal power supply.

All external fire alarm circuits from the transponder are electrically supervised against open and short circuits. In addition, the power supplied for the operation of the infra-red smoke detection system and the spot type smoke detectors is also supervised. Any malfunction is alarmed locally and the signal retransmitted to the plant central control room over supervised multiplex circuits from the Central Processing Unit (CPU).

The fire alarm system incorporates the use of separate alarm zones as follows:

A. The water flow switch of each of the sprinkler systems is connected to a common zone so that the operation of any system provides a common alarm.

B. The alarm contacts of each infra-red beam receiver are connected to a common zone so that the operation of any system provides a common alarm.

C. The alarm contacts of each photo electric smoke -detector are connected to a common zone so that the operation of any detector provides a common alarm.

D. The alarm contacts of the Truck Bay smoke detectors are connected to a common zone so that the operation of any detector provides a common alarm.

E. Several supervisory features for external devices are provided and the operation of any of these units provides a common alarm. Those supervisory features provided are as follows:

1. Low air pressure in a sprinkler system
2. Low air temperature in a valve house
3. Off normal position of any sprinkler system water supply valve.
4. Low air pressure or low temperature are also alarmed on a panel in the valve house and at an external horn (rated 100 DB) near the enclosure.

The control panel (transponder) is located in the LLRWHF control room and is provided with lighted zone annunciation and alarm bell. In addition, a slow whoop horn (rated at 100 DB) is located in the storage area.

11.6.19 EXPOSURE TO OPERATING PERSONNEL

The LLRWHF is designed to and will be operated to minimize the exposure to operating personnel while providing sufficient facility access. This will be accomplished by providing the necessary radiation shielding, by using current design technology and by using appropriate administrative controls to ensure that radiation levels are below applicable limits (10 CFR 20) for all phases of operation. Exposure of on-site workers will be minimized through the use of concrete shielding and shielded loading equipment. The number of operating personnel will be minimized and access to the LLRWHF will be controlled to further eliminate unnecessary radiation exposures.

The technical design and operating procedures of the LLRWHF maintain occupational doses ALARA, in accordance with current plant radiological zoning and control described in Section 12.3.

11.6.20 ENVIRONMENTAL CONSEQUENCES OF OPERATION OF THE LOW-LEVEL RADIOACTIVE WASTE HOLDING FACILITY

During routine operation, and during temporary projects that use the LLRWHF, no significant environmental consequences should occur related to the facility. No gases or liquids will be stored in the facility. Therefore, no releases of radioactive gaseous or liquid effluents should occur during routine operation. Small amounts of solid radioactive waste material could be released but would remain within the confines of the facility until the required decontamination and/or repackaging was completed.

The only expected radiation exposure pathway from operation of the LLRWHF is exposure from penetrating radiation originating within the facility either as direct radiation or as skyshine. Administrative and/or engineering controls assure annual dose remain below the 10CFR20 and 40CFR190 limits consistent with U.S. Nuclear Regulatory Commission (NRC) Branch Technical

Position 81-38 (Reference 11.6-8). The dose equivalent from naturally occurring external sources in this geographical area is about 100 mrem per year to which operation of the LLRWHF would make no significant contribution.

11.6.21 LINER INSPECTIONS

The facility is equipped with provisions for liner inspections as required by Generic Letter 81-38 and 49CFR173. Inspections include the following:

1) Visual inspection of the container for deterioration, leakage, or other conditions which might preclude shipment, disposal, or require repackaging.

2) A contact radiation dose reading on the container surface.

3) A radiation dose reading at three feet from the outer surface.

4) An outer surface contamination smear.

5) Weighing of a liner.

The inspection method provides shielding for the person performing the inspections and remote operating capability for these functions to minimize the radiation exposure per ALARA principles (Reference 11.6-10). Inspection method is compatible with the loading system of the facility and is provided in one solidified storage vault bay with the provisions for installing another in the Trash Vault in the future.

The inspection method is equipped with the appropriate lighting to allow inspections. Provisions are made in the facility for electrical power for the system at the location it will occupy. Pre-shipment inspections may also be performed in the Radwaste Building.

In addition to pre-shipment inspections, a container storage inspection and monitoring program shall be implemented on at least a periodic basis. Use of high integrity containers would permit an inspection program of reduced scope. This program shall include the following:

1) Ensure container integrity and detect failures.

2) Capability for remote operation of inspection equipment.

3) Minimize radiation exposure per ALARA principles

In the unlikely event that radioactive contamination is discovered, the container would be transported back to the main plant for decontamination.

11.6.22 SAFETY ANALYSIS

Due to the facility design, the possibility of an equipment failure or serious malfunction is remote. Because strict administrative controls will be exercised during waste transfer operations the possibility of an accident caused by human error is also minimized.

However, an accident analysis has been performed to demonstrate the facility's capability to control or mitigate the consequences of postulated failures or accidents. These accidents are divided into two categories: 1) handling and storage accidents and 2) other accidents.

Radiological consequences for postulated accidents are evaluated at the site boundary and at the western perimeter of the site security fence. The minimum distance from the LLRWHF to the site boundary is provided for each specific accident location. The western perimeter fence is located 75 ft. west of the facility.

11.6.22.1 HANDLING AND STORAGE ACCIDENTS

Handling and storage accidents analyzed include drops, collisions and system failures such as loss of electrical power.

The probability of occurrence or the consequences of an accident or malfunction as a result of storing solidified-dewatered waste, as described in Section 11.6.3, in high integrity containers placed in LSMs were evaluated. Principal concern is from exposure to radiation due to loss of shielding. Radioactivity releases are minimized due to waste in the solidified form and container integrity. These accidents would not create airborne radiation hazards and cause significant releases to the environment.

Airborne radiation hazards are mitigated by the design of the containers used for packaging DAW, radioactive material, dewatered wastes, and solidified wastes, as described in Section 11.6.3. High integrity containers (HICs) are designed, manufactured, tested, and certified to meet disposal facility criteria. LSMs are tested to the applicable standards of 49CFR which include missile penetration and drops as specified in procurement orders. Tests performed ensure container integrity during handling, transportation and storage accidents. LSMs will absorb impacts with minimal damage but the integrity of the High Integrity Container will remain intact.

DAW and radioactive material will be packaged in a manner that will prevent the spread of contamination. Typically, containers that are 'strong-tight' or comply with the requirements of 49CFR173 will be used. Solidified waste will typically be packaged in containers that meet disposal facility requirements in effect at the time of processing. These actions minimize the consequences of potential handling and storage accidents.

The potential for drop accidents is minimal due to the operating and design features which are incorporated in the crane(s). Lifting lugs and cables are designed with a minimum factor of safety of 2. Container lifting devices remain engaged until an electrical or mechanical force is applied to release them. Lifting heights, travel speeds and distances are minimized to further reduce the possibility or consequences of a drop accident.

Collisions with transport vehicle, storage vaults and modules are possible. Vehicle speed and facility design minimizes impact on structural integrity and shielding capabilities. Dose rates from unshielded containers due to handling and storage accidents are bounded by Container Drop from a Transport Vehicle (Reference 11.6-7).

System failures such as loss of electrical power are analyzed in Loss of Offsite Power Accident (Reference 11.6-5).

11.6.22.1.1 CONTAINER DROP FROM A TRANSPORT VEHICLE

LLRW storage containers are transferred from the waste processing facility to the LLRWHF on a truck. A container drop from the transport vehicle is assumed to occur during transport as the result of a postulated vehicle collision or vehicle upset and the radiological consequences off site evaluated. Since waste materials inside the containers are in the form of DAW, radioactive material, and solidified wastes, a waste container damaged in a fall to the ground during transport would not create an airborne radiation hazard. However, direct radiation doses as a result of loss of shielding could result.

Solidified waste, as described in Section 11.6.3, containers will have the highest container radiation levels and are shielded with a portable shield while being transferred to the LLRWHF. A container drop accident could cause damage to or loss of the portable shielding resulting in direct radiation doses from the container. It is assumed for this accident that a solidified waste container with a design radiation level of 988 rads/hr is dropped with total loss of container shielding. The worst case drop location for the LLRWHF is immediately outside the southeast truck bay area and is also assumed. The resulting off site doses for this accident are 221 mrem TEDE at the western perimeter fence and 0.274 mrem TEDE at the site boundary. These doses are well within the dose criteria of 10CFR 50.67. The radiation sources and assumptions used for this calculation are given in Table 11.6-1.

11.6.22.1.2 HANDLING AND STORAGE ACCIDENTS INSIDE THE DAW STORAGE VAULT AND OPEN AREA

Handling and storage accidents inside the DAW storage vault and east open area such as container drops or a transport vehicle collision could result in damage to the containers. Since waste materials inside the containers are in the form of DAW, a breached container would not create an airborne radiation hazard. No waste material would leave the facility's confines until the required decontamination and/or repackaging was complete. Also, these accidents would have no impact on the structural integrity or the radiation shielding capabilities of the Trash Vault or the Open Area.

Therefore, there would be no off site radiological consequences due to these accidents.

11.6.22.1.3 DROPPING A HEAVY COMPONENT ONTO THE SOLIDIFIED WASTE STORAGE VAULT

The shield panels covering the solidified waste storage vaults are not designed to withstand the drop impact of a cell plug cover, LLRW container or another shield panel. However, the storage vaults are designed such that the supporting steel frame members are not affected by damage to, or failure of, one or more of the vaults shield panels. Therefore, although the panel and stored waste containers could be damaged by a heavy component drop, the structural integrity of the cell and the remaining facility would not be compromised. Since the waste is solidified, this postulated accident would not create an airborne radiation hazard off site. However, damage to the shield panels could cause a skyshine radiation dose off site.

Assuming two fully loaded storage vaults and no shielding provided by the damaged panels, the skyshine radiation dose rates are 1.9E-1 mrem/hr at the western perimeter fence and 4.8-4 mrem/hr at the site boundary. The sources and assumptions used in this evaluation are given in Table 11.6-2.

If this accident were to occur, the damaged containers would be covered by a spare shield panel and remain in the storage vault until the required decontamination, repair and/or repackaging could be completed. The total dose for the accident duration would be well within the dose criteria of 10CFR 50.67.

11.6.22.1.4 DROPPING A LLRW CONTAINER INTO SOLIDIFIED WASTE STORAGE CELL

During storage cell loading operations, it is possible that a waste container could be dropped into a partially loaded cell and damage the container and the storage cell contents. Since all waste stored in the cells is solidified, there would be no airborne radiation hazard to unrestricted areas. The damaged waste containers would remain shielded in the cell until the required decontamination, repair and/or repackaging could be accomplished. Therefore, no off site radiological consequences would result from this accident.

11.6.22.1.5 COLLISIONS - SOLIDIFIED WASTE CONTAINER HANDLING

Collisions which could occur inside the LLRWHF during handling of solidified waste storage containers would be collisions involving the container transport vehicle, overhead crane or both. Inside the LLRWHF, the transport vehicle moves no faster than 10 miles per hour and the overhead crane no faster than 50 feet per minute.

Collisions occurring at these slow travel speeds would have no impact on the structural integrity or the shielding capabilities of the storage vault and truck bay walls. Also, a collision with a storage container would only result in abrasive damage to the container or shield. The off site radiological consequences of collisions resulting in container drops are bounded by the container drop accident consequences.

11.6.22.1.6 SHIELDED LINER STORAGE MODULE ACCIDENTS

The storage plan requires the use of LSMs for container storage. Loss of shielding would result in radiation dose rates off-site. No radioactivity would be released off-site because container integrity would be maintained. The LSMs are designed, fabricated and tested to 49CFR specifications. The LSMs are fabricated from reinforced concrete which provides sufficient structural integrity. Design includes provisions for safe handling and storage. Testing provisions in 49CFR cover incidents normal to transportation which include penetration, drops and collisions.

Worst case accident would be failure of concrete shielding. Radiological consequences from LSM accidents are bounded by Container Drop from a Transport Vehicle.

If a lid from a LSM became dislodged during an accident, the skyshine radiation doses are 30 mrem TEDE at the western perimeter fence and 0.02 mrem TEDE at the site boundary for an accident duration of 8 hours. The sources and assumptions used in this evaluation are given in Table 11.6-5.

The total dose for the accident duration would be well within the dose criteria of 10CFR50.67.

11.6.22.2 OTHER ACCIDENTS

Other accidents include fires, freezes, tornadoes, floods, earthquakes and sabotage.

11.6.22.2.1 FIRES

A fire in the LLRWHF is extremely unlikely because all combustible materials will be stored inside the concrete Trash Vault or the Open Area in accordance with the fire protection program. Also, the facility is equipped with a fire detection/protection system described in Technical Facility Description. Therefore, a fire inside the facility would not result in significant damage to the LLRWHF or its contents.

The total curie content of DAW to be stored in the LLRWHF is given in Reference 11.6-2. In order to demonstrate that there would be no adverse radiological consequences for a fire in the Trash Vault because of the low activity levels of the DAW, an accidental release due to an unspecified incendiary event involving 100% of the stored DAW was evaluated. No credit was taken for the mitigating effects of the fire protection system. The resulting doses and the radiation sources and assumptions used for this calculation are given in Table 11.6-3. Since a fire in the Trash Vault would result in significantly less damage to the DAW than was assumed for the above analysis, the radiological consequence off site would also be significantly lower and well within the dose criteria of 10CFR 50.67.

11.6.22.2.2 FREEZES

The breech of a container due to water crystallization expansion of its contents is not possible because all stored waste will be solidified and contain less than 1.0 percent free liquid by waste volume in a container.

11.6.22.2.3 TORNADOES

In order to estimate the consequences of a tornado strike on the LLRWHF, a damage analysis was performed for a tornado with a wind velocity of 300 mph. The forces resulting from a tornado wind velocity of 300 mph considered in the analysis were:

Pressure on the windward side	185 psf
Suction on the leeward side	115 psf
Total force on the building	300 psf
Uplift on the roof	140 psf

In addition an atmospheric pressure drop of 3 psi over 3 seconds, remaining at 3 psi for 2 seconds, and then returning to 0 psi in another 3 seconds was considered.

Results of this analysis shows that the damage that would probably result to the LLRWHF from these forces is as follows:

1. Most of the metal roofing and siding will be blown away.

2. The structural steel framings, girts, and purlins will probably deform, however, the connection strength is sufficient to hold the structure together and prevent steel missiles from occurring.

3. Although deformations may result, the concrete walls around the vaults are sufficiently strong to withstand the tornado forces. Any missiles generated by the tornado may cause local damage, but will not affect the structural integrity of the walls.

4. When the 3 psi pressure drop occurs, the equivalent of 2 to 3 plugs will be raised off the Liner and Trash Vaults. This results in an immediate decrease in the pressure differential between the inside and outside of the vaults and as a result no additional damage should occur to the vault roof. If the plugs come off only partially or are tilted, additional plugs may be raised.

5. The walls along column 11 in the east open area are not designed to withstand tornado loads and will probably collapse. Minimal damage would result to LSMs if located in this area.

6. The wall at the north side of the truck bay is not designed to withstand the tornado loads and will probably collapse. However, since it is approximately 23 feet from the vault walls, the truck wall debris should cause no damage to the waste storage vaults.

LSMs would not sustain damage from the consequences of a tornado strike. Results include the following:

1. Although deformations of the LSM may result, the concrete construction is sufficiently strong to withstand the tornado forces. Missiles generated may cause local damage but will not affect the structural integrity.

2. If a lid would become dislodged during this event, the radiological consequences are bounded by Container Drop (LSM) from a Transport Vehicle (Reference 11.6-7) and evaluated by accident dose analysis for RWCU Resin in LSM Without Lid (Reference 11.6-6).

The use of the east open area for the storage of and processing of radioactive materials during temporary projects results in the same consequences from a tornado strike as analyzed above. Missiles which may be generated by the equipment and materials being processed or stored, are bounded by those potential missiles analyzed above. The structural integrity of the LSM's and existing concrete vaults remains intact. Each temporary project will be reviewed separately to assure conformance to these design base tornado requirements.

11.6.22.2.4 FLOODS AND SEISMIC EVENTS

The LLRWHF is designed for the maximum plant design rainfall intensity of 6 inches per hour. The facility does not have other special flood provisions because it is well above the Susquehanna River flood stage for the probable maximum flood. The grade elevation of the LLRWHF is approximately 215 m (700 ft) msl. This elevation exceeds both the probable maximum flood elevation of 167 m (548 ft) msl and the maximum historical flood elevation of 158 m (517 ft) msl.

The LLRWHF is a Non-Category I structure. Failure of this structure during a seismic event would not result in the release of significant radioactivity nor affect safe reactor shutdown.

11.6.22.2.5 Sabotage

Damage to the LLRWHF and its contents due to sabotage is highly improbably because of the inherently safe design. Also, the stored wastes are inert and low in radioactivity making them an unlikely sabotage target. Since the facility is within the site's secured area, is under routine surveillance by plant security patrols, and has access administratively controlled by a locked door, no accidents beyond those already considered are evaluated specifically for sabotage.

11.6.22.2.6 Loss of Off-Site Power

Electric power is provided to the LLRWHF from two sources. The normal power source is Salem 69-12kV substation via West Building tap and LLRW tap no. 2 (two). The alternate source is the Salem 69-12kV substation via Salem 46-01 line and LLRW tap no. 1 (one). The emergency source is the Berwick 66-12 kV substation overhead distribution line. Power is extended to the LLRWHF transformer via an underground duct bank from a point where manual transfer capability between the two power sources is provided.

Loss of off-site power to the LLRWHF could occur as the result of primary source failure, transformer failure or cable failure. Estimated outage duration for these failures are as follows:

Outage	Duration
Primary source failure personnel (transfer to alternate) available	1 Hr - Trained site
Transformer failure (replace transformer)	2 Hrs - Call-out of division trouble man
	12 Hrs - Occurs during normal work hours
	16 Hrs - Occurs off-hours
Cable failure	8 Hrs - Occurs during normal work hours
	12 Hrs - Occurs off-hours

The longest estimated outage duration is 16 hours for a failure of the LLRWHF transformer during off-working hours and is assumed for this accident.

Loss of off-site power to the LLRWHF would not affect the safe storage of waste in the facility. However, if an outage were to occur when a solidified waste container is in the process of being loaded into a vault storage cell with the overhead crane, off site doses could result. Since the overhead crane and auxiliary hoist are equipped with holding brakes to prevent dropping loads if electric power is lost, the shield bell and shield plug would remain suspended above the vault. Sources of radiation exposure would be a direct dose from the shield bell (depending on the location of the storage cell) and a skyshine dose from the waste in the uncovered storage cell. This would result in integrated doses off-site above those that would normally occur from solidified waste handling because of continued exposure from these sources during the outage. It is assumed for this accident that a solidified waste container with a design radiation dose rate of 2.32 rads/hr is in the process of being loaded into a vault storage cell when the power outage occurs. The resulting off-site doses for this accident are 1.78 TEDE mrem at the western perimeter fence and .00026 mrem TEDE at the site boundary. These doses are well within the siting criteria of 10CFR 50.67. The radiation sources and assumptions used for this calculation are given in Table 11.6-4.

It should be noted that it is possible to manually position the shield plug directly over the open cell by using winches and cables to move the overhead crane. This would provide an effective shield against skyshine from the open cell since the cover is only 8 inches above the vault. Also, once the shield plug is positioned above the cell opening, it could be replaced by manually controlling the holding brakes on the auxiliary hoist. However, for this analysis, continuous exposure from the shield bell and the open cell for the duration of the outage is assumed.

Handling LSMs during loss of off-site power would not result in a loss of shielding and subsequent doses as described above. The waste container is within the LSM during handling. It is assumed for this accident that a solidified waste container with a design radiation dose rate of 988 rads/hr is in process of being inspected when an 8 hour power outage occurs. The resulting off-site doses for this accident are 30 mrem TEDE at the western perimeter fence and 0.020 mrem TEDE at the site boundary. The radiation sources and assumptions used in this evaluation are given in Table 11.6-5. These doses are well within the siting criteria of 10CFR 50.67.

In the event that power is lost while the Facility is being used for temporary projects related to the storage and process of radioactive material, activities requiring the use of equipment to prevent spread or minimize the release of radioactivity will be stopped until power can be restored.

11.6.22.3 SUMMARY

The LLRWHF, and its associated storage containers, equipment and operating procedures provide a satisfactory interim storage facility which is capable of controlling and mitigating the radiological consequences of potential accidents and unplanned events. The radiological consequences for all accidents postulated for he LLRWHF are well within a small fraction of the dose guidelines specified in 10CFR 50.67.

11.6.23 REFERENCES

11.6-1 "Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants," WASH-1238, December, 1972.

11.6-2 PP&L Calculation, EC-012-3149, "LLRWHF Source Terms, Verification and Validation of SOURCE.WK1 Program".

11.6-3 PP&L Calculation, EC-012-3150, “Exposure Rate Profiles for LLRWHF Sources in Liner Storage Modules”.

11.6-4 PP&L Calculation, EC-012-3151 "Exposure Rate Profiles for Maximum (Unshielded) Sources".

11.6-5 PP&L Calculation, EC-012-3152, “Exposure Rate Profiles for Compacted and Non-compacted Dry Active Waste (DAW)”.

11.6-6 PP&L Calculation, EC-012-3153, "Accident Dose Analysis for LLRWHF Dry Active Waste (DAW) Fire".

11.6-7 PP&L Calculation, EC-RADN-0516, "Offsite Dose Consequences Due to Container (LSM) Drop from Transport Vehicle”.

11.6-8 PP&L Calculation, EC-RADN-0517, "Accident Dose Analysis for LLRWHF RWCU Resin in LSM Without Lid".

11.6-9 PP&L Calculation, EC-RADN-0518, “SSES Offsite Dose Analysis for Transporting Radwaste from Radwaste Building to LLRWHF.”

11.6-10 PP&L Calculation, EC-RADN-0519, "Offsite Dose Analysis for Loss of Power Accident at LLRWHF".

11.6-11 PP&L Calculation EC-RADN-0520, "Annual Dose Analysis From Quarterly Inspections".

11.6-12 PP&L Calculation EC-RADN-0521, "Analysis for Normal Loading and Unloading Radwaste at the LLRWHF".

11.6-13 PP&L Calculation, EC-RADN-0522, "Offsite Dose Analysis for Heavy Component Drop on LLRWHF Vault Shield Panels".

11.6-14 PP&L Calculation, EC-RADN-0523, "Annual Dose and Exposure Rates to Walls for Operations at LLRWHF".

11.6-15 PP&L Calculation, EC-RADN-0524, “LLRWHF Calculation of Direct and Skyshine Dose Rates”.

11.6-16 PP&L Calculation, EC-RADN-1033, “SSES Doses Resulting from Storage of Miscellaneous Radioactive Material at the LLRWHF”.

11.6-17 PP&L Calculation, EC-ENVR-1025, “SSES Fuel Cycle 40CFR190 Dose Calculation”.

11.6-18 PP&L Safety Evaluation NL-92-007, Operation of the LLRWHF at SSES.

TABLE 11.6-1

DESIGN BASIS SOURCES AND ASSUMPTIONS USED TO CALCULATE THE OFF-SITE RADIOLOGICAL CONSEQUENCES DUE TO A CONTAINER DROP FROM A TRANSPORT VEHICLE (REFERENCE 11.6-7)

A. Radiation Source

A design radiation level of 988 rad/hr contact is assumed for the solidified waste container and is based on a solidified-dewatered reactor water clean-up spent resin activity distribution. The source term for the reactor water clean-up spent resin is given in Reference 5.3.

B. Geometry of the Dropped Container

The geometry of the dropped container is based on SEG Radlok-200 Container

Diameter - 51.8"

Height - 60.3"

Volume - 51 cu. ft.

C. Distance from the Source to Receiver Point

The drop point is assumed to be at the south truck bay entrance to the LLRWHF on the southeast side of the building. This is the closest point to the dose receptor locations that the drop could occur. The source to receiver distances are as follows:

Drop point to western perimeter fence	= 287.5 ft.
Drop point to site boundary	= 2026 ft.

D. Duration of Accident

Total time the container is assumed to remain unshielded - 8 hrs.

E. Off-Site Radiological Consequences

Direct Dose Rate at Western Perimeter Fence	= 2.76+1 mrem/hr
Total Integrated Dose at Western Perimeter Fence	= 2.21+2 mrem TEDE
Site Boundary Direct Dose Rate	= 3.42-2 mrem/hr
Total Integrated Site Boundary Dose	= 2.74-1 mrem TEDE

TABLE 11.6-2

DESIGN BASIS SOURCES AND ASSUMPTIONS USED TO CALCULATE THE OFF-SITE RADIOLOGICAL CONSEQUENCES DUE TO DROPPING A HEAVY COMPONENT ONTO THE SOLIDIFIED WASTE STORAGE VAULT (REFERENCE 11.6-1)

A. Skyshine Radiation Source

To maximize accident source term, the following distribution was used:

2 - exposed undecayed solidified sump sludge liners

2 - exposed decayed solidified sump sludge liners

3 - peripheral decayed solidified sump sludge liners

9 - peripheral undecayed condensate demineralizer liners

Source term is given in Reference 5.2.

B. Skyshine Source Geometry

The total activity contained by two vaults assuming maximum capacity is used to determine an equivalent point source. No credit is taken for shielding provided by the damaged panels.

C. Distance from the Source to the Receiver Point

Distance from the facility to the western perimeter fence	= 75 ft.
Distance from the facility to the site boundary	= 1699 ft.

D. Off-Site Radiological Consequences

Direct Dose Rate at Western Perimeter Fence	= 1.9-1 mrem/hr
Site Boundary Direct Dose Rate	= 4.81-4 mrem/hr

TABLE 11.6-3

DESIGN BASIS SOURCES AND ASSUMPTIONS USED TO CALCULATE THE OFF-SITE RADIOLOGICAL CONSEQUENCES DUE TO AN UNSPECIFIED INCENDIARY EVENT INVOLVING 100% OF DAW (REFERENCE 11.6-6)

A. Source Term

The activity source term for this event is based on five years accumulation of DAW. The isotopic inventories are listed as follows.

Isotope	Inventory (Ci)	Isotope	Inventory (Ci)
Am-241	7.18E-03	H-3	6.32E-03
C-14	7.05E-03	I-129	2.77E-02
Cm-242	1.10E-03	Mn-54	1.18E+00
Cm-244	3.96E-03	Ni-63	1.83E-01
Co-58	8.62E-03	Pu-238	1.46E-04
Co-60	7.01E+00	Pu-239	6.04E-05
Cr-51	4.18E-03	Pu-241	1.06E-02
Cs-137	8.68E-05	Sr-89	6.01E-06
Fe-55	2.97E+01	Tc-99	6.13E-02
Fe-59	1.30E-02	Zn-65	1.46E-01

B. Meteorology

Western Perimeter Fence (EAB)	7.3E-03 sec/m^3
Low Population Zone (LPZ)	9.6E-05 sec/m^3
Control Room Habitability Envelope (CRHE)	3.8E-05 sec/m^3

C. Airborne Radiation

Percent of Particulate Assumed Released to Environment	1%

D. Distance from Source to Receiver Point

West Perimeter Fence	23 meters
Low Population Zone (LPZ)	4758 meters
CRHE	504 meters

E. Calculated Radiological Consequences

West Perimeter Fence	1.53E-01 Rem TEDE
Low Population Zone (LPZ)	2.02E-03 Rem TEDE
CRHE	8.03E-04 Rem TEDE

TABLE 11.6-4

DESIGN BASIS SOURCES AND ASSUMPTIONS USED TO CALCULATE THE OFF-SITE RADIOLOGICAL CONSEQUENCES DUE TO LOSS OF OFF-SITE POWER TO THE LLRWHF (REFERENCE 11.6-5)

A. Radiation Sources

A design radiation level of 2.32 rads/hr contact is assumed for the unshielded solidified waste container inside the shield bell and is based on a solidified sump sludge activity distribution. This source is also assumed for the waste inside the open storage cell. The source term is given in Reference 5.3.

The solidified waste container is a SEG LVM-100 and has the following dimensions:

Diameter - 73"
Height - 70.25"
Volume - 170 cu. ft.

B. Waste Handling Assumptions

It is assumed for this accident that a solidified waste container is in the process of being loaded into an open cell in the solidified waste storage vault when loss of off site power to the LLRWHF occurs. As a result, the following conditions based on waste handling procedures for solidified waste exist at the open storage cell, and are assumed for the duration of the accident:

- A solidified waste container is inside the shield bell and is suspended eight inches above the vault by the overhead crane.
- The shield plug from the open storage cell is suspended eight inches above the vault by the auxiliary hoist.
- The shield bell and plug are in a position that results in maximum skyshine exposure from waste in the open cell. In this position, approximately two thirds of the cell opening is shielded from skyshine by the shield bell and plug. Credit is taken for the shielding effects of the shield bell and plug.
- The cell is located in the outer row of the vault at the west end of the building which minimizes distances off site from the sources and provides a direct exposure path from the shield bell.

C. Distances from the Sources to the Receiver Point

Distance from the facility to the western perimeter fence = 75 ft.

Distance from the facility to the site boundary = 1699 ft.

TABLE 11.6-4 (CONTINUED)

DESIGN BASIS SOURCES AND ASSUMPTIONS USED TO CALCULATE THE OFF-SITE RADIOLOGICAL CONSEQUENCES DUE TO LOSS OF OFF-SITE POWER TO THE LLRWHF (REFERENCE 11.6-5)

D. Duration of Accident

The duration of the accident is assumed to be 16 hours. This is based on the longest estimated power outage which occurs for a failure of the LLRWHF transformer during off working hours. Continuous exposure from the shield bell and open storage cell is assumed for the duration of the accident.

E. Off-Site Radiological Consequences

Western Perimeter Fence

Direct Dose Rate from Shield Bell	= 1.09-E-01 mrem/hr
Skyshine Dose Rate from Open Storage Cell	= 2.19-E-03 mrem/hr
Total Dose Rate at Western Perimeter Fence	= 1.11-E-01 mrem/hr
Total Integrated Dose at Western Perimeter Fence	= 1.78 mrem TEDE

Site Boundary

Direct Dose Rate from Shield Bell	= 1.12-E-05 mrem/hr
Skyshine Dose Rate from Open Storage Cell	= 5.43-E-06 mrem/hr
Total Dose Rate at Site Boundary	= 1.66-E-05 mrem/hr
Total Integrated Dose at Site Boundary	= 2.66-E-04mrem TEDE

TABLE 11.6-5

DESIGN BASIS SOURCES AND ASSUMPTIONS USED TO CALCULATE THE OFF-SITE RADIOLOGICAL CONSEQUENCES DUE TO MOBILE SHIELDED STORAGE MODULE WITHOUT LID (REFERENCE 11.6-6)

A. Skyshine Radiation Source

An undecayed reactor water cleanup resin waste container is located within a storage module with lid removed. The source term for the reactor water cleanup resin is given in Reference 5.2.

B. Skyshine Source Geometry

The effects of objects in the line of sight providing additional shielding, such as other LSMs and the vaults, will not be considered.

C. Distance from the source to the receiver point distance from facility to the western perimeter fence = 75 ft.

Distance from facility to the site boundary = 1960 ft.

D. Duration of Accident

Total time the container is assumed to remain unshielded -8 hrs.

E. Off-Site Radiological Consequences

Skyshine Dose Rate at Western Perimeter Fence	3.7 mrem/hr
Total Integrated Dose at Western Perimeter Fence	30 mrem TEDE
Site Boundary Skyshine Dose Rate	1.90-3 mrem/hr
Total Integrated Site Boundary Dose	2.0-2 mrem TEDE

THIS FIGURE HAS BEEN
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Figure 11.6-1 replaced by dwg.
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FIGURE 11.6-1, Rev. 49

AutoCAD Figure 11_6_1.doc

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Figure 11.6-2 replaced by dwg.
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FIGURE 11.6-2, Rev. 49

AutoCAD Figure 11_6_2.doc

Security-Related Information
Figure Withheld Under 10 CFR 2.390

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SHIELD BELL ASSEMBLY FIGURE 11.6-3