ATTACHMENT 2

ENVIRONMENTAL ASSESSMENT OF THE OPERATION OF AN ON-SITE LOW-LEVEL RADIOACTIVE WASTE HOLDING FACILITY (INTERIM STORAGE) AT THE SUSQUEHANNA STEAM ELECTRIC STATION

September, 1982
Revision 1

Pennsylvania Power and Light Company
Allentown, PA 18101

SUSQUEHANNA STEAM ELECTRIC STATION
UNITS 1 & 2

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GLOSSARY AND ABBREVIATIONS

ALARA - as low as reasonably achievable

Applicant - Pennsylvania Power and Light Company and Allegheny Electric Cooperative, Inc.

BWR - boiling water reactor

CFR - Code of Federal Regulations

cfs - cubic feet per second

CST - condensate storage tank

DAW - dry active waste

DER - Department of Environmental Resources (Pennsylvania)

DOLI - Department of Labor and Industry

ha - hectare

HEPA - high efficiency particulate air (filters)

Hz - hertz (cycles per second)

Liner - a steel inner container that is designed to fit in an NRC certified shipping cask

LLRW - low-level radioactive waste

LLRWHF - Low-Level Radioactive Waste Holding Facility

MW - megawatt (1 million watts)

mrem - millirem (one thousandth of a rem)

msl - mean sea level

NRC - Nuclear Regulatory Commission

NUREG - Nuclear Regulatory Commission Publication

pH - measure of alkalinity-acidity

rad - unit of absorbed dose

rem - special unit of dose equivalent

SES - Steam Electric Station

1.0 EXECUTIVE SUMMARY

This is an environmental assessment report on the proposed action to store waste in an on-site low-level radioactive waste holding facility (LLRWHF) at Susquehanna Steam Electric Station (SES) Units 1 and 2. This facility is intended to be used for contingency storage in the event that off-site disposal facilities are not available. The analyses and conclusions in this report are based on data provided by the Applicant (Pennsylvania Power and Light Company and Allegheny Electric Cooperative, Inc.). Units 1 and 2 are each designed to generate 1050 MW of electricity; the first unit is anticipated to be in operation within the next two years. The proposed action, described in detail in Chapter 3.0 of this report, involves the operation of a facility sized to temporarily store about 1700 m^3/yr (60,000 ft^3/yr) of low-level radioactive waste (LLRW) generated from both units. This waste will be packaged in steel liners or in 55 gallon steel drums, and stored for up to four years per unit or until the waste can be shipped to off-site disposal sites. The holding facility was not planned at the commencement of construction of Unit 1 and 2 because at that time, off-site disposal sites were available. In recent months, however, waste quantities that will be accepted at off-site disposal sites have been restricted. Developing circumstances suggest that adequate off-site disposal may not be available when required for Susquehanna SES.

The LLRWHF will measure about 88 m x 73 m (290 ft x 240 ft) and occupy a land area of about one hectare (ha) (2.5 acres). The Applicant shall comply with all applicable existing laws, regulations and permit requirements for the operation of the facility to protect public and occupational health and safety. The estimated cost of the facility will be $23 million with an annual estimated cost of $350,000 for operation and maintenance. If off-site storage were not available, and in the absence of this facility, the operation of Susquehanna SES Units 1 and 2 might have to be suspended until adequate storage became available. The estimated economic impacts from suspending operations would include: 1) cost of replacement power at $600 million per year for both units, and 2) loss of revenue needed for payment of the fixed annual cost of $475 million for carrying the investment. Other impacts would include temporary loss of regional employment and possible interruption of power supply with consequent impacts on the regional socioeconomics.

Impacts from facility operation to the general public would be substantially less than applicable limits and significantly smaller than the natural background radiation dose. The occupational doses will be maintained as low as reasonably achievable (ALARA) within applicable limits (10 CFR 20). The radiation dose at the Susquehanna SES restricted area fence will be limited to an annual dose of 0.5 rem within applicable limits (10 CFR 20). The dose to any member of the general public from the LLRWHF will be a small fraction of the Susquehanna SES limits given in 10CFR190 (Environmental Protection Standards for Nuclear Operation), in accordance with the U.S. Nuclear Regulatory Commission (NRC) Branch Technical Position (81-38, Storage of Low Level Radioactive Waste at Power Reactor Sites). The Applicant plans on postponing construction of the trash waste vaults within the LLRWHF until the storage capacity of the cemented waste vaults is depleted. This interim operation of the facility will have minor radiological impact and is addressed in this assessment report.

It is concluded from this assessment that the potential environmental impacts of operating the LLRWHF would be well within applicable limits.

2.0 PURPOSE AND NEED

The Susquehanna SES is located about 8 km (5.0 mi) northeast of Berwick, Pennsylvania, and consits of two 1050-MW boiling water reactors (BWR). The need for the power that will be generated at this facility has already been addressed in a Final Environmental Impact Statement (NRC 1981 NUREG 0564) relating to issuance of an operating license for operation of the Susquehanna SES.

Routine operation and maintenance of the plant would result in the generation of LLRW. It consists of a variety of radioactively contaminated material such as paper, rags, protective clothing, etc., which are collectively described as dry active waste (DAW). Low-level waste also includes process wastes such as filter-treatment sludges, spent-filter cartridges, and spent ion-exchange resins. Based on the experience at other BWR operating plants, the Susquehanna SES is expected to produce about 1700 m^3 (60,000 ft^3) of LLRW per operating year for two units (assuming no allowance for volume reduction other than trash compaction).

At the time the Susquehanna SES was planned, LLRW from operating power reactors in the eastern U.S. was packaged and shipped to a low-level waste disposal facility operated by Chem-Nuclear Systems, Inc. at Barnwell, South Carolina. However, in recent months, significant restrictions have been placed on the amount of packaged LLRW that will be accepted at the Barnwell site. The long-term availability of alternative disposal sites in Beatty, Nevada and Hanford, Washington has also become less certain. Although deliberations are being held across the country for establishing state and regional disposal sites, operation of additional LLRW sites is uncertain.

In view of these uncertainties, the Applicant proposes to establish an on-site LLRWHF with the capacity to temporarily store LLRW generated for up to four reactor-years of operation per unit. The use of this facility would only be necessary if off-site disposal were not available. Permanent retention of these wastes in the propsed facility is not planned. The only wastes to be temporarily stored are those low-level solid wastes that are incidental to the production of power by the Susquehanna SES; acceptance of any off-site generated wastes for storage in this facility is not contemplated.

3.0 PROPOSED ACTION

This chapter describes the proposed action for interim storage of LLRW generated by Units 1 and 2 of the Susquehanna SES. Additional information is available in the Susquehanna SES LLRWHF Technical Facility Description.

3.1 GENERAL DESCRIPTION AND LOCATION OF THE FACILITY

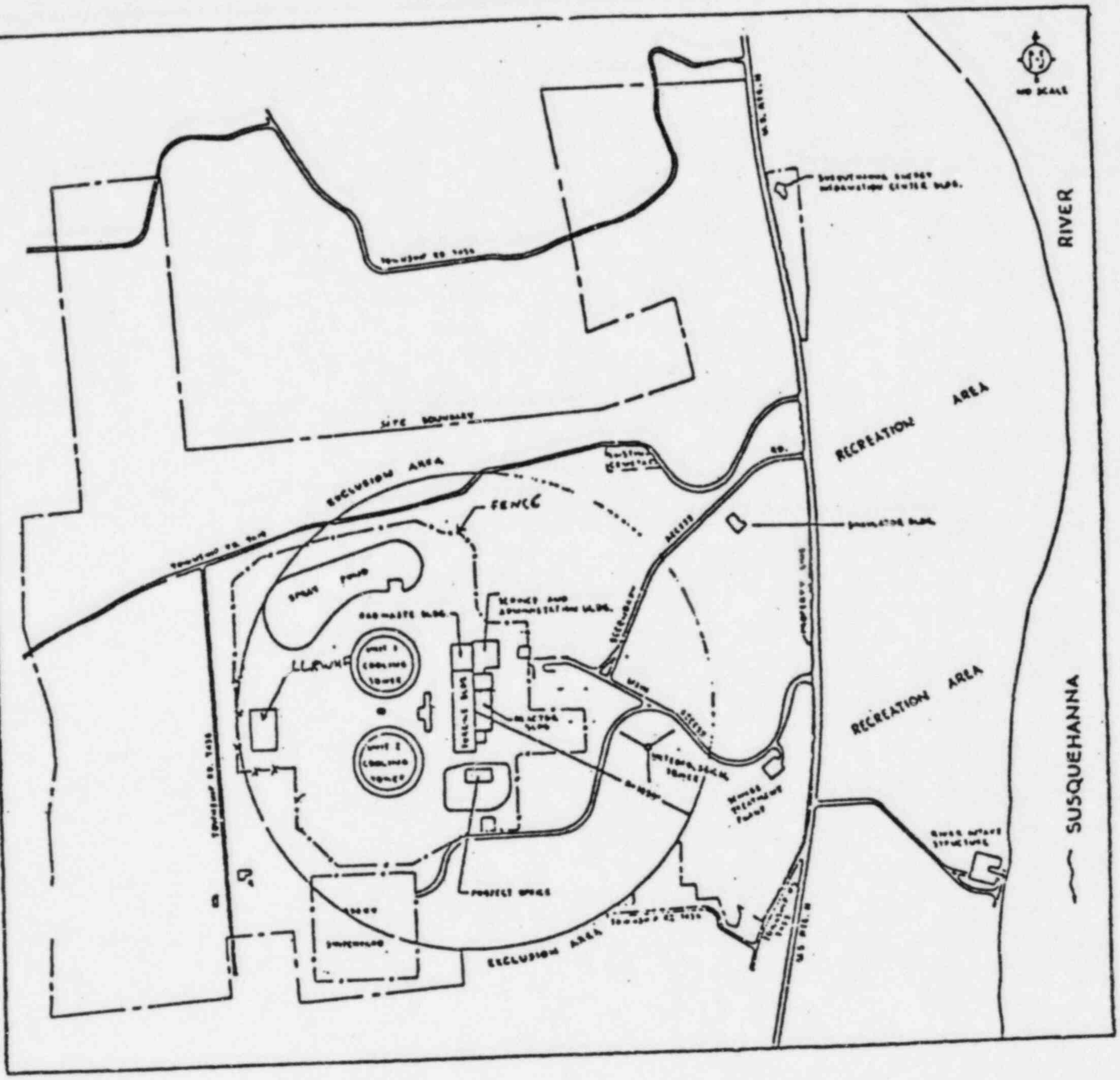
The proposed action is defined to include the following:

- interim storage of LLRW generated by four reactor-years of operation per unit
- interim storage period not to exceed four years per unit
- operation of the facility as necessary to hold the LLRW when licensed off-site disposal facilities are unavailable

The LLRWHF is a structural steel frame building with uninsulated metal siding and roofing. The building encloses a system of concrete waste storage vaults. The primary function of this metal building will be to provide weather protection for the stored wastes and to provide all-weather loading and off-loading capability. The primary function of the concrete vaults will be to provide radiation shielding.

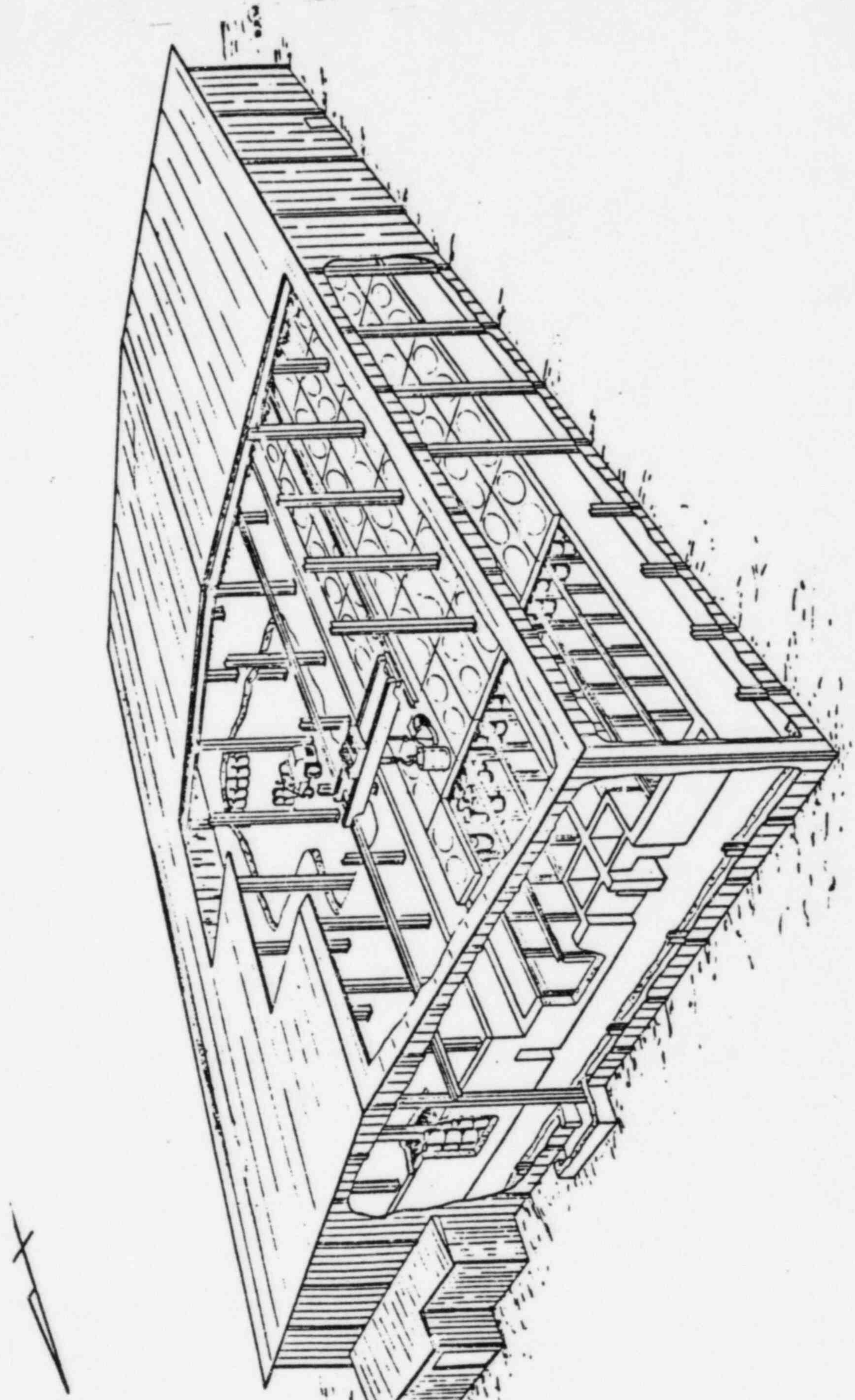
The LLRWHF will be located approximately 300 m (1000 ft) due west of the cooling towers for Units 1 and 2 (see Figure 1). The grade elevation of the LLRWHF is approximately 215 m (700 ft) msl. This elevation exceeds both the probable maximum flood elevation of 167 m (548 ft) msl and the maximum historical flood elevation of 158 m (518 ft) msl (NRC 1980).

The overall dimensions of the facility will be 73 m (240 ft) by 88 m (290 ft) with a centerline elevation of 13 m (42 ft). In addition, a control and equipment room 6 m x 9 m (20 ft x 30 ft) will be located adjacent to the north wall of the facility approximately 5 m (16 ft) from the northeast corner of the structure (see Figure 2).



<u>FIGURE 1.</u> Plan View of Susquehanna SES

FIGURE 2. Artist's Rendering of Low-Level Radioactive Waste Holding Facility



3.2 WASTE DESCRIPTION

The LLRWHF is designed to store low level dry active waste (DAW) and solidified (cement) waste generated by the Susquehanna SES. The facility may also be used to temporarily store pieces of contaminated plant eqiupment. The LLRWHF will not be used to store gaseous wastes nor wastes containing free-standing liquids.

Dry active waste is defined as contaminated material containing sources of radioactivity dispersed in small conentrations throughout large volumes of inert substances, and has no free-standing water. 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 evaporator bottoms, resins, and sludges that have been immobilized in cement and contain less than 0.5 percent free-standing water by waste container volume or 3.8 liters (1.0 gal) of liquid in the waste container.

Estimates of the annual waste generation rates for the two units range from 1100 to 1800 m^3 (39,000 to 63,000 ft^3)based on operation of both units. For this report a nominal figure of about 1700 m^3 (60,000 ft^3) was chosen, Table 1 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).

TABLE 1. 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—noncompactible	150	5,300
Evaporator bottoms (25 wt%)	510	18,000
Resins	90	3,200
Waste sludges	450	16,000
TOTAL	1,700	60,000

3.3 DESIGN FEATURES

The following section presents the designed features of the LLRWHF which are based on the Technical Facility Description.

General Design Considerations

The LLRWHF will be sized to store wastes generated by four years each of the Susquehanna SES Units 1 and 2. The design life of this facility will be 40 years.

The LLRWHF will be a Non-Seismic Category I structure (i.e., one whose failure would not release significant amounts of radioactivity and would not require reactor shut down). The facility is not designed for the effects of a flood since the elevation exceeds the maximum probable flood level. However, it is designed for a maximum rain fall intensity of 4.2×10^{-5} m/s (6 in/hr) and consequent surface run-off.

Architecture

The LLRWHF is a structural steel frame building with uninsulated metal siding and roofing to provide weather protection. The building encloses a system of three concrete waste storage vaults. A trash storage vault consisting of reinforced concrete walls and a poured-in-place concrete roof is provided for the storage of DAW. A labyrinth allows access by a forklift truck to store and retrieve the DAW containers. Two waste storage vaults are provided for storing solidified waste containers. The walls of these vaults are reinforced concrete. These vaults are covered with precast concrete panels supported by a structural steel framing system. The precast panels have removable plugs, which permit loading and retrieval of solidified waste containers by means of a remote controlled crane. Inspection stations are provided in each of the solidified waste storage vaults.

A shielded truck bay area is provided on the north side of the building. The facility control room is located at the northeast corner of the building. A battery charging station and parking area for a forklift truck is located adjacent to and to the west of the control room.

A curb around the perimeter of the building will contain any liquid such as rainwater or fire sprinkler water that may be introduced into the building. The curb will be designed to retain the volume of fire protection water that would be released if all the sprinklers were actuated for one-half hour. A system of floor drains and sumps will ensure drainage of additional flow. This system will route such water to a sump in the off-loading area so that it can be sampled and collected for disposal. Ramps will be provided for vehicular traffic over the curb. The floor, curbing, sumps, and shield walls of the facility will be coated to a height equal to the height of the curbing with a material that can be decontaminated.

Health and Safety Requirements

The LLRWHF is designed to limit off-site doses from the on-site storage of LLRW to a small 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 will be 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, and the self-shielding properties of the storage containers.

Provisions for the removal of equipment exhaust fumes are included in the facility design. The building ventilation system will be structured so that the flow of air draws exhaust fumes away from operators working on the floor of the facility.

Containers

The containers to be stored in the LLRWHF will be designed to preclude or reduce uncontrolled releases of radioactive materials during handling, transportation, or storage. All material stored in the facility will be packaged in a form that allows for eventual off-site shipment and permanent disposal. All containers will be decontaminated for shipping to the standards of 49 CFR 173.397 (Contamination Control) and/or other applicable burial site criteria before leaving the Rad Waste building and transported to the LLRWHF.

At the present time, and for the foreseeable future, there is a wide profusion in size and shape 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 the LLRWHF will be required to accommodate several of these different container types. The most likely containers which will be stored in the facility are steel liners for the cemented wastes and 55 gallon steel drums and steel boxes for the trash.

Loading and Off-Loading Systems

The loading system (e.g., forklifts for DAW, a remote controlled crane for cemented waste), will be capable of placing, retrieving and reloading the cemented waste and DAW within the facility. This system will also have the capacity to lift, transport, and replace all movable shield bells and individual cell or vault covers.

The loading system for cemented wastes will allow the transfer of the crane from one vault bay to the other as the vaults are filled.

Floor Drains System

Under normal conditions there will be no free-standing liquids inside the building. Therefore, any free-standing liquids entering the facility would come from sources such as: fire protection water; minute amounts of liquid from a breached cement 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 one or more collection sumps located along the periphery of the building. Each sump will be equipped with liquid-detection devices that signal the main plant and facility control rooms whenever any liquid enters the sumps.

Sampling of the liquids in the sumps may be performed from either inside or outside the building. These liquids may be pumped to portable tanks from either inside or outside the building. However, no permanent pumping equipment or piping is connected to the main plant.

Ventilation System

The basic functions of the ventilation system will be: 1) to remove noxious or irritating exhaust fumes when internal combustion engine-powered machinery operates inside the facility, and 2) to prevent excessive heat buildup from the roof in the summer. The system will move air generally in an upward direction away from operators. Air inlets will be designed to evenly distribute air entering the facility even when it is closed. Inlets will be placed to prevent accumulation of snow and other substances from restricting the flow of air and to prevent these substances from being drawn into the facility. The system will exhaust through a damper that opens when the fans are in operation and closes when the fans are shut down.

Electrical System

A power system will supply AC power to all the electrical loads in the facility at the appropriate voltage. These loads will include the lighting system, the ventilation system, the overhead crane, the power operated door, the fire detection system, and the fire protection system. The AC power system equipment will be located in an enclosed space outside the facility storage area. Convenience outlets for 120-VAC, 60-Hz service and 480-VAC power and welding receptacles will be installed in the control room, the electrical equipment room, and the loading area. All electrical equipment including cable contained within the storage area will be designed to function normally under the range of environmental conditions expected to exist inside and outside the LLRWHF.

The grounding system will establish a building ground grid to connect electrical and mechanical equipment and structures, raceways, duct banks, and other required grounds to the existing exterior station grounding system.

Lighting

It is anticipated that the facility lighting will be in service only during loading or off-loading to conserve energy. The system will be designed to provide adequate lighting for safe, efficient handling of the waste containers in the off-loading area, and for safe and efficient handling of the shielded vault covers.

3.4 FACILITY OPERATION

The facility's function will be to temporarily store LLRW on-site until it can be shipped to an off-site location. The facility will be occupied only during periods of loading and off-loading activities. Storage of the low-level DAW and cemented waste will be segregated (see Figure 3). DAW is stored in the trash storage vault and cemented waste in the solidified waste storage vaults. Further segregation of the waste containers within the vaults will also be used to take maximum advantage of the self shielding properties of the waste material and to minimize exposure. To the maximum extent practicable, waste stored in the trash storage vault will be arranged with containers having contact dose rates of less than or equal to 30 mrads/hr on the top layer of the storage area and containers wilh higher contact dose rates stored underneath. Similarly, to the maximum extent practicable, cemented waste stored within the solidified waste storage vaults will be arranged with containers having contact dose rates of less than or equal to 3 rads/hr stored next to the vault walls and on the top layer. Containers with a contact dose rate greater than 3 rads/hr will be stored inside this perimeter.

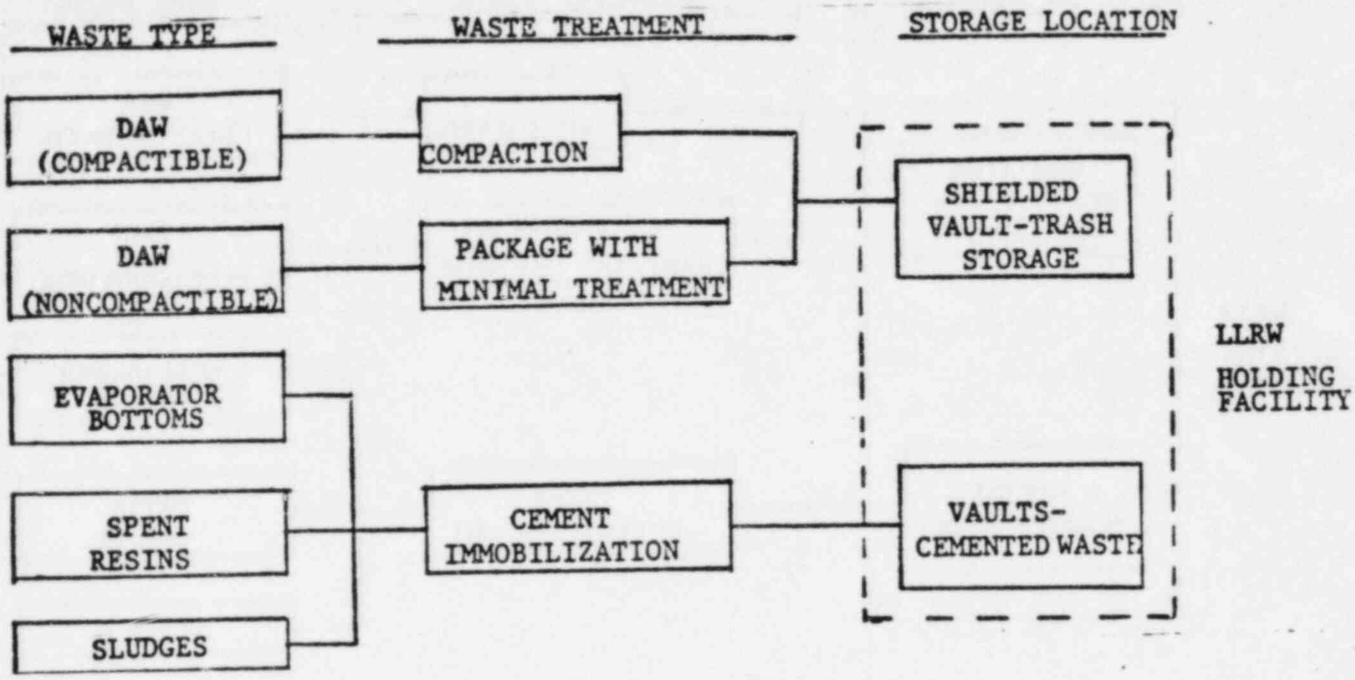


FIGURE 3. Proposed Action for Storing Low-Level Radioactive Waste at Susquehanna SES

In the event of a fire in which water or other fire fighting materials are introduced into the facility, these items will be considered contaminated until proven otherwise.

Prior to off-site shipment of the containers, all containers will be inspected for damage and surveyed for residual surface contamination. In the unlikely event that radioactive contamination is discovered, the container would be transported back to the main plant for decontamination.

3.5 SAFETY AND SECURITY

The discussion of safety and security will be addressed in the context of five separate topics:

- security
- radiation monitoring system
- shielding
- fire detection/protection system
- communications system.

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 will be administratively controlled through the use of a locked door.

Radiation Monitoring Sytsem

The radiation monitoring system will be designed to monitor the general area radiation levels at various locations inside the trash 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 will be strategically located on the walls of the trash storage areas, control room, and truck bay. There will be two area radiation monitors in the truck bay (one near the inspection station and one near the catch basin), and one in the control room. During the interim when the solidified shielded vault is used to store trash, an area radiation monitor will be near the north entrance and another near the emergency stairs at the south end. Thus five radiation monitors will be in use initially. When the future dry trash storage area is in use, four additional area radiation monitors will be installed. One area radiation monitor will be near each of the four entrances. When all the trash is removed from vault No. 1, the two monitors may be removed.

Radiation levels detected by the sensors will be sent to indicators located in the facility control panel. Nine radiation monitors may be necessary when both trash vaults are in use, but channels for twelve monitors will be provided.

Shielding

The LLRWHF will contain two types of shielding and 1) fixed shielding for the in-place stored material and 2) transient shielding for waste containers for transport to the facility and for loading and unloading in the waste/storage area.

The fixed shielding consists of concrete storage vaults for the cemented and DAW waste, concrete walls in the truck bay area and concrete walls for the control room. The storage vault walls are reinforced concrete. The trash storage vault has a poured-in-place concrete roof and the solidified waste storage vaults pre-cast concrete covers with removable plugs. Reinforced concrete walls are provided for shielding on the north and west sides of the truck bay area. The control room will have reinforced concrete along the south and west walls.

The transient shielding for the cemented wastes will consist of portable concrete shielding on the transport vehicle and a portable shielding device (shield bell).

Fire Detection/Protection System

The fire protection design will be based on a combustible loading of 1790 kb/m² (1200 lbs/ft²). The facility will be equipped with a fire detection system. The entire structure will be equipped with a dry pipe sprinkler designed to deliver 1.0×10^{-2} m³ of water per m² of floor surface (0.25 gpm/ft²). The sprinkler heads will be rated at 141°C (286°F) which is in accordance with standard practices.

Water will be supplied from the existing fire protection system by a 0.25m (10 in) mortar-lined, ductileiron fire protection line. The water supply will be capable of supplying a minimum of 0.1 m³/s (1500 gpm) at 6.8 atm (100 psi). Fire hydrants will be provided and equally spaced at 91 m (300 ft) intervals around the building perimeter.

Smoke detectors will be placed at various locations in the facility. If smoke is detected, the ventilation system will automatically shut down and an annuciator will be actuated in the control rooms of the main plant and the LLRWHF.

Communication Systems

The communications system will allow two-way conversation and paging between the main plant and the facility. It will have at least one station for paging and conversation in the off-loading area. It will have enough speakers inside the storage area to insure that paging or alarms can be heard when the facility is at full capacity. It will also have one station for paging and conversation in the facility control room. One telephone with a plant extension will also be provided in the control room. All communication cables will be in rigid steel conduit.

3.6 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 (see previous section), 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 controlled to further eliminate unncessary radiation exposures.

The technical design and operating procedures of the LLRWHF maintain occupational doses ALARA, in accordance with current plant radiological zoning and control (Susqehanna

SES FSAR, Section 12.3). The radiation zoning for the LLRWHF is given in Section III of the Susquehanna SES LLRWHF Technical Facility Description.

An assessment of the increased occupational exposures to on-site personnel from the interim storage of low level radwaste in the LLRWHF has been made and is presented in the following subsections. Only those operations associated with the LLRWHF and interim storage of waste containers are considered. Normal waste handling operations that are independent of interim storage are not included. The estimated results are summarized in Table 2.

3.6.1 Man-Rem Estimates to Operating Personnel for the Interim Storage of Low Level Radwaste in the LLRWHF

Interim storage of low level radwaste in the LLRWHF will result in occupational exposures to operators from the following LLRWHF waste handling operations:

1) Transporting waste containers to the LLRWHF

2) Solidified waste container loading into vaults

3) Inspection of stored solidified waste containers

4) Solidified waste container off-loading

5) Handling and stacking of trash (DAW) containers using a forklift truck.

The following describes the man-rem estimated exposures for the above LLRWHF operations:

Exposure from Transporting Waste Containers to the LLRWHF

Waste storage containers are transported from the solidification facility to the LLRWHF on a truck. During transport, the driver in the cab will receive some radiation exposure from the waste containers on the truck. It is estimated that it will take the driver 10 minutes to transport a load of waste from the solidification facility to the truck bay of the LLRWHF.

Trash (DAW) containers are transported to the LLRWHF unshielded. The maximum dose rate in the cab of the truck will be 2 mrem/hr. For the 1000 pallets expected to be transported annually and assuming that each truckload consists of 12 pallets, the annual exposure to the driver is calculated to be 30 mrem. This corresponds to .03 man-rem per year.

Two occupational exposures result from transporting solidified waste containers to the LLRWHF. Since the containers are inside of the shield bell during transport, a manual power disconnect between the bell and the radwaste building crane must be made before the truck can be moved. In addition, the driver in the cab will receive some radiation exposure from the waste containers on the truck. The maximum estimated dose rate at the surface of the shield bell is estimated to be 40 mrem/hr when a CD container is inside and 110 mrem/hr when an RWCU container is inside. Approximately 180 CD containers and 40 RWCU containers are expected to be transported to the LLRWHF each year. Assuming that the manual power disconnect operation requires 2.5 minutes, an operator will receive 480 mrem per year for this operation for 220 containers. The truck driver in the cab will be exposed to a maximum dose rate of 2 mrem/hr. For transporting 220 containers each year, the annual exposure to the driver is calculated to be 70 mrem per year. Therefore, for both operations, the exposure for transporting solidified waste containers is 550 mrem annually or .550 man-rem per year.

The total exposure for transporting all waste containers to the LLRWHF is estimated to be about 0.6 man-rem per year.

Exposure from Loading Solidified Waste Containers in the Vaults

Solidified waste container loading procedures in the LLRWHF require a manual connect-disconnect of the crane to the shield bell. This is an electric power connection for the shield bell and is required prior to moving the shield bell and container to the storage vault area with the crane. Since all other container loading operations are remote controlled, this is the only container loading operation resulting in operator exposures.

The maximum dose rate at the surface of the shield bell is estimated to be 40 mrem/hr when a CD container is inside and 110 mrem/hr when an RWCU container is inside. Approximately 180 CD containers and 40 RWCU containers are expected to be stored each year. Assuming that the manual connect operation requires 2.5 minutes and there are 220 annual operations an individual at the surface is estimated to receive 480 mrem per year, or approximately 0.5 man-rem.

Exposures from Inspection of Stored Solidified Waste Containers

Since the handling of solidified watse containers will be by remote control, no personnel exposures will result when containers are loaded into or removed from the inspection station. However, some occupational exposure from the inspection itself will be incurred outside of the inspection station. The estimated dose rate just outside the inspection station from an RWCU container is 9 mrem/hr. The corresponding dose rate for a CD container is 0.03 mrem/hr.

Assuming a one-hour inspection of a container results in 0.009 man-rem per inspection of an RWCU container and 0.00003 man-rem per inspection of a CD container.

Inspection of stored solidified waste containers will be required as part of the container integrity surveillance program. The surveillance program requires 1 percent of those solidified waste containers in storage over one year to be inspected quarterly; however, the number of containers inspected quarterly is not to exceed 10. Based on these requirements, it is estimated that over a four year period of waste accumulation in the LLRWHF, an average of 2 RWCU containers and 9 CD containers will be inspected for container integrity each year. The occupational exposure resulting from the inspection of these containers will be approximately 0.02 man-rem per year.

Exposures from Solidified Waste Container Off-Loading

The handling of solidified waste containers in the LLRWHF for off-loading will be done with the remote controlled crane. The only off-loading operation that results in occupational exposures will be inspection of the containers in the inspection station and occurs prior to cask loading. The estimated operator exposure for a one-hour inspection of a solidified waste container is approximately 0.009 man-rem per inspection of an RWCU container and 0.00003 man-rem per inspection of a CD container. Assuming that off-loading is required for the same number of containers as loaded, approximately 40 RWCU containers and 180 CD containers are shipped off-site each year. The occupational exposure resulting from the inspection of these containers is estimated to be 0.4 man-rem per year.

Trash (DAW) Handling Exposures

Trash (DAW) container handling and stacking will be accomplished in the LLRWHF with a forklift truck. The forklift operator will receive radiation exposure from trash as it is unloaded from the transport vehicle, from the trash carried by the forklift, and from trash already stored in the facility.

During initial operation, the trash will be loaded into the interim trash storage vault. The radiation exposure to the forklift operator for each load of trash placed within the interim vault is calculated to be approximately 1.4 mrem. For the 1000 pallets expected to be loaded annually, this corresponds to 1.4 man-rem.

When the future trash storage area is completed, newly arrived trash will be stored in this new storage vault. The forklift operator will be exposed to a dose of 1.3 mrem for each load of trash placed within this vault and an annual accumulation of 1.3 man-rem for the 1000 pallets expected to be loaded annually. The trash originally stored in the interim vault will be transferred to the new storage vault. The radiation exposure per load of trash transferred is calculated as 2.6 mrem to the forklift operator with a one-time accumulation of 4.1 man-rem for the 1595 pallets transferred.

The trash handling man-rem for unloading the trash storage vault will be the same as those for loading the vault since the steps for both operations will be the same except in reverse order. Thus, 1.3 man-rem annually is expected for unloading 1000 pallets from the trash storage vault.

3.6.2 Man-Rem Estimate for Construction of the Trash Storage Vault

The LLRWHF will be in operation during the construction of the trash storage vault. As a result, construction workers will receive some radiation exposure from the interim storage of waste in the facility. Radiation exposure to construction workers during construction of the trash storage vault is calculated with the following information and assumptions:

- Total construction man hours is 75,000 hours.
- Construction man hours above the 17 ft. level of the vault is 5000 hours. The 17 ft. level is the top of the solidified waste storage vaults.
- The interim trash storage vault during construction of the future trash storage vault is 50 percent filled with trash pallets.
- During construction of the trash storage vault, all waste is loaded into the LLRWHF during off construction hours.

The total man-rem exposure to the construction workers is calculated to be 1.0 man-rem of which 0.8 man-rem is from construction above the 17 ft. level of the vault.

TABLE 2

SUMMARY OF THE INCREASED OCCUPATIONAL EXPOSURES TO ON-SITE PERSONNEL FROM THE INTERIM STORAGE OF LOW LEVEL RADWASTE IN THE LLRWHF

Category	Annual Estimated Man-Rem
OPERATION OF LLRWHF	
Transporting waste containers to LLRWHF	0.6
Solidified waste container loading into vaults	0.5
Inspection of stored solidified waste containers	0.02
Solidified waste container off-loading	0.4
Trash (DAW) handling exposures-Interim Storage Vault	
Trash container loading	1.4
Trash container off-loading	1.4
Trash (DAW) handling exposures-New Storage Vault	
Trash container loading	1.3
Trash container off-loading	1.3
Total (includes interim storage vault for trash)	4.3
Total (includes new storage vault for trash)	4.1
CONSTRUCTION OF TRASH STORAGE VAULT	
Total man-rem exposure to the construction workers for construction of trash storage vault	1.0
TRASH (DAW) CONTAINER TRANSFER	
One-time accumulation for transfer of trash from interim to new trash storage vault	4.1

4.0 ALTERNATIVES TO THE PROPOSED ACTION

This chapter discusses three alternatives to the proposed action: 1) the no action alternative, 2) off-site operation of a LLRWHF and 3) on-site interim storage.

4.1 THE NO ACTION ALTERNATIVE (OFF-SITE DISPOSAL)

The no action alternative is defined as the use of the Susquehanna SES design-basis, on-site storage capacity for interim storage of LLRW (one-month storage). (NUREG 0776, NRC 1981c). Under this alternative no other alternatives, including the proposed action, would be considered. The success of this alternative would depend on the continued availability of off-site commercial LLRW disposal sites. The Susquehanna SES plant design provided very limited storage capacity based on this assumption. Any interruption in shipment of LLRW could potentially shut the plant down.

The positive aspects of the no action alternative would include a savings of approximately $23 million in LLRWHF construction costs and $350,000 annual operating and maintenance costs. An additional benefit may include minimizing SES occupational exposures through prompt off-site shipment of LLRW.

In recent years, LLRW disposal has been hampered by the unavailability of shipping casks, transportation problems, and restrictive disposal quotas (McArthur 1979). Space for waste disposal is expected to become increasingly scarce in the next few years as restrictions continue to be placed or are placed on the amount and type of LLRW the three disposal sites (Barnwell, South Carolina; Beatty, Nevada; Hanford, Washington) are willing to accept. Finally, development of new disposal facilities is not expected to begin until 1986 (NWPA 1980). As a consequence, interruptions in off-site shipments of radioactive wastes are possible, and operation of the station could be severely limited. Even if the plant were shut down it would continue to generate some amount of radioactive waste requiring storage and ultimate disposal. Therefore, the no action alternative would limit the electric power generating capability of Susquehanna SES and would not resolve the problem of LLRW storage.

4.2 OFF-SITE OPERATION OF A LOW-LEVEL RADIOACTIVE WASTE HOLDING FACILITY

Off-site storage facilities would consist of the same facilities and would require the purchase of property for a site and also require obtaining additional permits. The land-use impact from such a site would have to be evaluated and problems resolved prior to construction. Radiological and other monitoring programs independent of the Susquehanna SES would have to be established. The increased waste handling and transportation requirements for off-site storage of the waste would add extra costs (in terms of both dollars and radiation exposure) above those for on-site storage. Off-site interim storage of the LLRW is concluded to be a less desirable alternative to the proposed action because all impacts of the proposed action would result in addition to those that would be specific to a new construction site including additional waste handling and transportation.

4.3 ON-SITE INTERIM STORAGE IN EXISTING FACILITIES

The use of existing structures on-site for interim storage of the LLRW is a third alternative to the proposed action. This option would potentially save the estimated $23 million dollars required for construction of an on-site LLRWHF. Several areas were considered as potential sites for interim storage of the waste.

Most areas identified as prospective storage locations would already be in use as equipment laydown, washdown, access, or storage areas. In addition, extensive handling of the LLRW containers and special lifting devices would be required so that some locations could be used. Other prospective sites would demand removal of hatches, and evacuation of transfer areas. Some locations, in particular the refueling floor, would require outside transfer of containers. In the event of a forced outage, storage of LLRW on the refueling floor would hamper work by requiring additional shielding or removal of waste to permit worker access. These requirements could extend the duration of the outage. Multiple storage locations would make accountability of the LLRW inventory difficult.

Storage of the LLRW in-station would increase the radiation exposure of plant personnel. The overall background radiation levels in the plant would increase. Multiple storage locations dictate expanded radiation surveillance which means greater human contact and increased dose. Nonradiation zones could be changed to radiation zones to accommodate the waste. The overall impact of interim in-station storage of LLRW would be to increase the radiation dose to employees. This would not be consistent with the policy of maintaining radiation exposures ALARA.

5.0 DESCRIPTION OF AFFECTED ENVIRONMENT

The Susquehanna SES site is located (NUREG 0564, NRC 1981b) on a 435-ha (1075 acres) tract of land on the west bank of the Susquehanna River in Salem Township, Luzerne County, Pennsylvania (Figure 4). It is about 8 km (5 mi) northeast of Berwick and 32 km (20 mi) southwest of the city of Wilkes-Barre. The topography near the site is characterized by moderate-to-steep slopes directed toward the river on both banks. Elevations range from 151 m (496 ft) above msl at the river to 213 m (700 ft) msl at the propsed LLRWHF to over 275 m (900 ft) msl in the northern section of the site. The LLRWHF site will be approximately 61 m (200 ft) msl above the river level. The area typically has hot humid summers and cold winters with considerable amounts of snow. The average annual air temperature is 9°C (48°F) with average temperatures ranging from -3°C to 22°C (0° to 72°F). Annual average precipitation is about 88 cm (35 in) distributed fairly evenly throughout the year. Prevailing winds are from the West and Southwest, but during some years this may be reversed (Dames & Moore 1980). Wind direction is influenced by the generally Northeaat-Southwest oriented valley near the site. The average wind speed is about 7.3 km/h (4.5 mph). The calculated tornado frequency at the site is 4.6×10^{-4}/yr. Between 1953 and 1974, 35 tornados were reported in the 160-km² (62-sq mi) area containing the Susquehanna SES; between 1971 and 1977 ten hurricanes passed within 30 km (50 mi) of the site (NRC 1979).

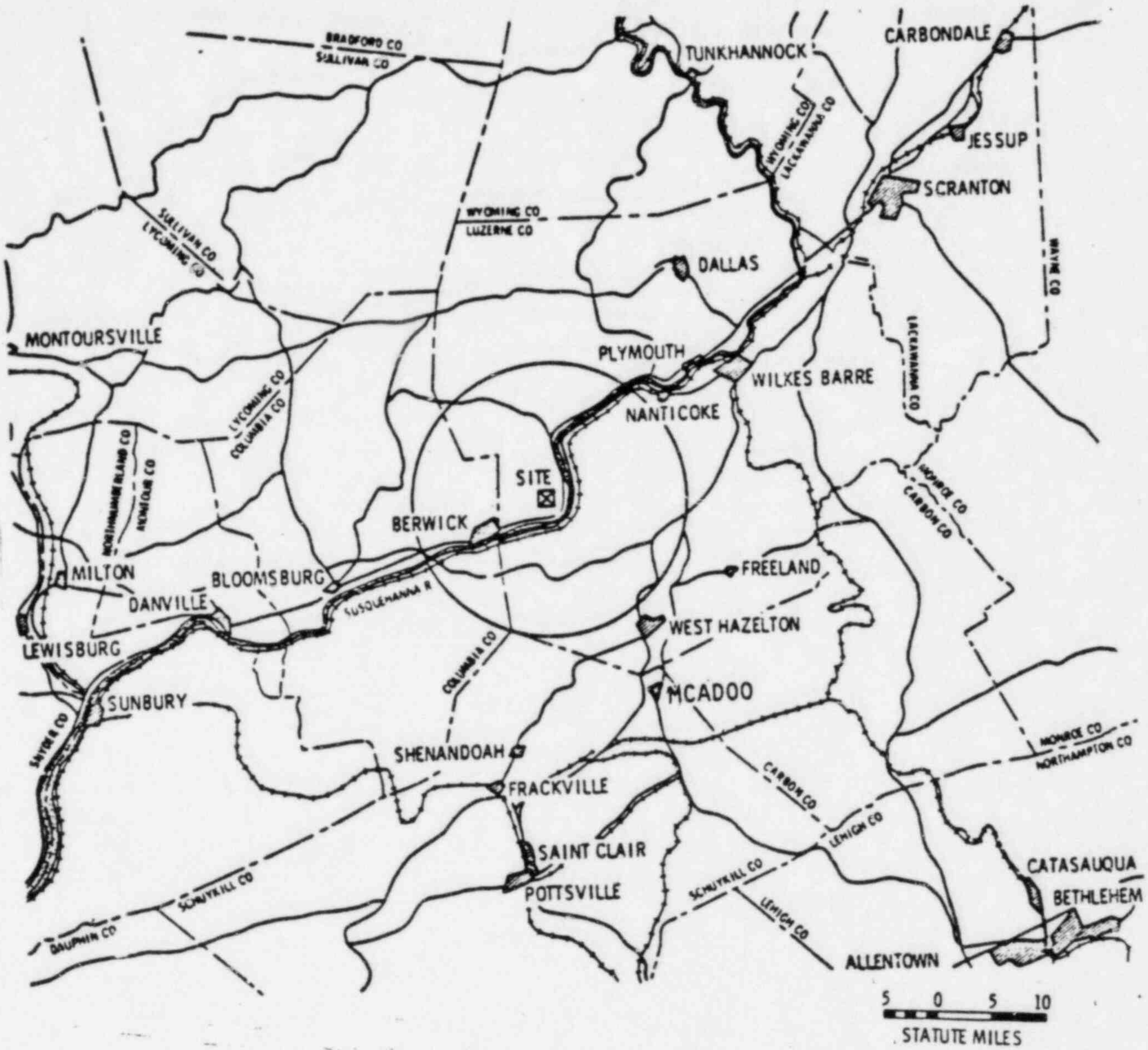


FIGURE 4. Susquehanna Site and Its Immediate Surroundings

The Susquehanna River the principal source of station cooling water is located about 1220 m (4000 ft) east of the LLRWHF. The river flows 68 km (42 mi) through Luzerne County with an average gradient of 0.18 m per km (0.95 ft per mi). Average annual flow is 387 m^3/s (13,650 cfs). Maximum flows of 9880 m^3/s (349,000 cfs) have been measured at the site and minimum flows of less than 15.6 m^3/s (550 cfs) have been observed at Wilkes-Barre. River elevations during historic floods at the Susquehanna SES range from 155 to 157 m (510 to 517 ft) above msl. This is below the 213 m (700 ft) elevation of the LLRWHF.

Susquehanna River water quality near the Susquehanna SES site is generally acceptable. Acid mine drainage, much of which reaches the Susquehanna by way of the Lackawanna River, tends to produce high concentrations of iron and at times low pH. Iron concentrations in the river near the site exceed state water quality standards (1.5 mg/l). The generally high acid mine runoff tends to impair the river ecosystem. The high iron levels are not acutely toxic to most river organisms but they increase turbidity and the precipitation of iron compounds which in turn reduces light penetration and alters the bottom substrate. These changes generally reduce the production of aquatic plants and bottom-dwelling animals. The pH of the Susquehanna River varies from 6.0 to 8.5. Annual river temperatures range from 0°C (32°F) to 29.4°C (85°F) and dissolved oxygen concentration ranges from 5.6 to 15 mg/l.

Little use is made of surface water, except for that used by the Susquehanna SES, within 3.2 km (2 mi) of the site. The first municipal water user downstream from the station is located approximately 50 km (31 mi) away at Danville, Pennsylvania.

Fish in the Susquehanna River do not seem to be directly affected by the high iron concentrations. The most abundant species are the white sucker, spotfin shiner, bluegill, white crappie and spottail shiner. None of the fish are on the U.S. Fish and Wildlife Service's Rare and Endangered list, but two ciscos, a species classified as rare by the Pennsylvania Fish Commission have been caught during recent sampling in the river. These fish probably entered the river near Nanticoke by way of Harvey's Creek, the outlet of Harvey's Lake. The Pennsylvania Fish Commission introduced the cisco into Harvey's Lake from 1969 to 1972. Because cisco prefer deeper lake waters, there is little likelihood that a population of cisco has been or will be established in the river as a result of movement from Harvey's Lake.

Groundwater is generally of acceptable quality at the site but may be rather hard (up to 545 mg/l total dissolved solids) in some areas near the station. Estimated groundwater travel time to the Susquehanna River is 8.8 years. Depth to the water table is 2.1 to 7.9 m (7 to 26 ft) at the Susquehanna SES and there are 185 wells within 3.2 km (2 mi) of the site. Estimated withdrawal of ground water is 212 m^3 (7485 ft^3) per day within 3.2 km (2 mi) of the station.

Twenty-three species of amphibians and reptiles are found in the region. No threatened or endangered species are found near the site.

One-hundred and twenty-eight species of birds have been recorded near the Susquehanna SES. Most of these are songbirds. The major migratory birds flyway is located to the east, nearer the Atlantic Ocean.

Twenty-six species of mammals live near the site and none are considered threatened or endangered. Rodents are the most abundant group. Larger game and fur-bearers include opossum, cottontail, woodchuck, raccoon, muskrat, and gray squirrel. Muskrats are trapped extensively in the area. Whitetail deer are the most important large game species in the area.

The region is relatively free from earthquake activity and seismic hazard. No capable faults exist within 8 km (5 mi) of the station. The maximum expected earthquake intensity would be VI to VII on the Modified Mercali Scale. The site is within Zone I seismic risk.

Soils in the vicinity of the Susquehanna SES are mainly of glacial origin and are used more for grazing and timber production than for farming. The dominant vegetation on the land near the site is made up of maple, birch, cherry and oaks with an understory of spicebrush, blackberries, viburnum, witch hazel, laurel, dogwood and rhodedendron. None of the plant species in the area are classified as threatened or endangered.

Land use near the site is varied. About 228,000 ha (570,000 acres) or 11 percent of the land in Luzerne County is used for agriculture on about 500 farms. Farming occupied about 0.8 percent of the county's workforce in 1975. Approximately 40 ha (100 acres) of Susquehanna SES floodplain land is farmed by a tenant farmer. Much of the surrounding area that is not cultivated is covered with woodlands and scrub brush.

A number of small industries are located within 8 km (5 mi) of the site. These include textile and clothing manufacturing, meat and animal products, concrete products, manufacturing, and lumber production. The nearest industry is about 2.4 km (1.5 mi) North-Northeast of the site and employs approximately 490 persons.

Outdoor recreation facilities at the Susquehanna SES includes a small lake for fishing and boating, native trails and a picnicing area. Also a number of recreational facilities are near the site. The Applicant maintains the Riverland's Park near the Susquehanna SES. Within a 16 km (10 mi) radius there is one county park, two Girl Scout camps and three privately owned camps. Recreational fishing is popular in the Susquehanna River along the east bank of the river near the site. The nearest boat launching facility is about 3.2 km (2 mi) south of the site. No commercial fishing exists within 80 km (50 mi) of the Susquehanna SES. In Luzerne County, hunting harvest for both small game mammals (squirrels and rabbits) and deer make up about eight percent of the state total. Waterfowl are not abundant near the site and are of minor value to local hunting.

The Susquehanna River has no commercial navigation; transportation routes are mainly by highway, railroad and air. Three Salem Township roads and U.S. Route 11 pass within 790 m (2600 ft) of the center of the Susqhehanna SES exclusion area. The Delaware and Hudson Railroad line passes approximately 2 km (1.3 mi) east of the station and the Conrail line is located about 0.8 km (1/2 mi) east of the center of the site. The nearest operating airports are the Hazleton Municipal Airport and the Wilkes-Barre Scranton Airport located 19 and 45 km (12 and 28 mi), respectively, from the station.

The population in the vicinity of Susquehanna SES is low. The steep sloping terrain and the present land use limits human habitation. In 1976 about 2420 persons were living within the low population zone (within 3 mi). This is projected to increase to 4670 by the year 2020, the expected end of operation of Units 1 and 2 of the Susquehanna SES. In 1970 the population within 80 km (50 mi) of the SES was about 1,420,000. The year 2020 population estimate in this area is 1,582,000. Berwick is the largest borough (1970 population of 12,274) within 16 km (10 mi) of the site. Hazleton, about 24 km (15 mi) from the Susquehanna SES had a 1970 population of about 30,000. No schools, hospitals, and state or municipal parks are located within the low population zone.

6.0 ENVIRONMENTAL CONSEQUENCES

Environmental consequences of the operation of the Susquehanna SES LLRWHF are presented and contrasted with the consequences from several alternatives to the proposed action.

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

During routine operation, 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 shyshine. The facility has been designed to limit the radiation dose at the station restricted area fence to an annual dose of 0.5 rem. The dose to any member of the general public from operation of the LLRWHF is estimated to be 1.2 mrem per year which is a small fraction of the limit given in 40 CFR 190 for the Susquehanna SES. 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.

No known endangered or threatened species as listed by the Department of Interior's list of endangered, threatened wildlife and plants (U.S. Dept. of Interior 1979) are on the LLRWHF site. The plant has no interaction with the wetlands aspect of the Susquehanna River floodplain.

Irreversible or Irretrievable Commitment of Resources for Operation of the Facility

The only irreversible or irretrievable commitment of resources for operation of this facility would be fuel, electricity, and manpower. These would constitute an insignificant addition to those already committed for the operation of the station proper.

6.2 ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES TO THE LLRWHF

Although none of the previously discussed alternatives to the proposed action are believed to be viable, a brief comparative discussion is provided.

The No Action Alternative

While the no action alternative would eliminate the minor operational impacts and further reduce the already trivial doses to the hypothetical resident at the site boundary from the LLRWHF, the dose to in-plant workers would be increased because of the need to store in-plant until space was fully occupied. If off-site disposal facilities were available, occupational doses resulting from placement of wastes in an on-site LLRW facility would be eliminated for the Applicants (however, similar doses would be incurred by the disposing contractor staff). Assuming that the LLRW will eventually be sent to a waste disposal site, direct off-site shipment would result in less handling and also reduce its attendent potential for accidents. This alternative is, however, not viable since the plant could not operate more than one month without some additional storage capability in the event that off-site storage were not available and adequate off-site disposal facilities are not expected to be available when needed for LLRW from the Susquehanna SES.

Operation of an Off-Site LLRWHF

The environmental consequences of an Applicant owned and operated LLRWHF off-site would be the same as those for the on-site facility plus the following:

- Additional public exposure (however trivial) would be incurred as a result of shipment of wastes to the off-site location; the additional exposure would be proportional to the distance traveled.
- Because of the time needed to obtain the required permits, an off-site facility would probably not be ready in time to receive wastes as generated, thus increasing in-plant worker exposure because of the need to store waste in-plant.
- Lack of storage space could lead to a station shutdown.

On-Site Storage in Existing In-Plant Facilities

The alternative of on-site storage in existing in-plant facilities would merely postpone construction of the LLRWHF given the present uncertainty in off-site disposal. The alternative would result in reduction of the already small doses from the proposed action to the public. This dose reduction, however, would be more than offset by an increase in dose to the station workforce. Because in-plant storage, if feasible, would not permit station operation beyond a few months, a more detailed discussion of environmental consequences is believed unwarranted.

7.0 COST-BENEFIT DISCUSSION

No anticipated significant environmental impacts and costs are associated with the operation of a LLRWHF; also, there are no significant direct environmental benefits derived from its operation.

The estimated capital cost of the LLRWHF at the Susquehanna SES site is approximately $23 million (1982 dollars). The annual levelized facility cost (e.g., interest, taxes, and depreciation) at an assumed 15.85% annual rate, is estimated to be $3.6 million, and operating and maintenance costs are estimated at approximately $350,000. Total annual cost is thus estimated to approximate $4.0 million.

If an off-site disposal facility were available at which all waste could be disposed (currently, no candidate sites have been identified), the estimated annual cost to dispose of the low-level wastes would be about $3.0 million (1982 dollars). Since LLRW storage defers but does not eliminate this cost, direct disposal would be the preferred alternative, if it were available.

The principal benefit of providing a LLRWHF at Susquehanna SES is to insure against a possible forced shutdown of the station. Without off-site disposal, in the absence of the LLRWHF, shutdown would result after approximately one month of continuous operation of Units 1 and 2 unless on-site space in existing facilities could be converted to waste storage.

This benefit (i.e., avoided cost) can be quantified in dollar terms. The cost to replace the station power with power generated with higher cost fuel (ultimately borne by the Applicant's customers) would be about $50 million per month. The fixed cost to the Applicant of carrying a non-productive Susquehanna SES investment is estimated to approximate $50 million per month.

Also, the non-productive wages of $1.5 - 2.0 million per month (1982 dollars) are an added cost in the event of a shutdown. Another benefit to the regional society would be the uninterruption of local, state, and federal taxes estimated to exceed $95 million annually.

The environmental impacts, detailed in Chapter 6, are insignificant in keeping with the passive character of the LLRWHF. A 73 m x 88 m (240 ft x 288 ft) tract of land (already dedicated to activities associated with the generation of electricity) will be required for the storage building.

No significant ecological impacts or costs have been identified. Radiation dose to the limited number of LLRWHF workers (estimated as 1 full-time worker equivalent) will be well below the applicable limits (10CFR20). Radiation dose to the general population from LLRWHF operations is estimated to be 1.2 mrem/yr which is a small fraction of the Susquehanna SES limit given in 40 CFR 190.

8.0 COMPLIANCE WITH APPLICABLE LAWS AND REGULATIONS

The proposed action, operation of a LLRWHF would be implemented to ensure compliance with all applicable federal, state and local licenses, standards, and permits. The facility design and operation will conform to all applicable codes. See Technical Facility Description for details of applicable codes.

At present the only permit or license required for the operation of the LLRWHF is an occupancy permit from the Pennsylvania Department of Labor and Industry.

9.0 REFERENCES

Dames & Moore. 1980. Susquehanna Steam Electric Station 1979 Meteorological Summary. Prepared for Pennsylvania Power and Light Company by Dames & Moore. Washington, D.C.

McArthur, W. C. 1979. "The Status of Low-Level Radioactive Waste Disposal—How to Plan a Disaster," in Low-Level Radioactive Waste Management. Proceedings of Health Physics Society Twelfth Mid-Year Topical Symposium, February 11-15, 1979, Williamsburg, Virginia.

Pennsylvania Power and Light Company. 1978. Susquehanna Steam Electric Station Units 1 and 2 Environmental Report Operating License Stage. Allentown, PA.

Pennsylvania Power and Light Company. 1981. Susquehanna Steam Electric Station Low-Level Radioactive Waste Holding Facility Technical Facility Description, Rev. 3, Allentown, Pennsylvania.

State Planning Council on Radioactive Waste Management. 1980. Nuclear Waste Policy Act.

U.S. Code of Federal Regulations. Title 10, Part 20.

U.S. Code of Federal Regulations. Title 10, Part 50.

U.S. Code of Federal Regulations. Title 40, Part 190.

U.S. Code of Federal Regulations. Title 49, Part 173.397.

U.S. Department of the Interior. 1979. "Endangered and Threatened Wildlife and Plants." Federal Register, Vol. 44, pp. 3636-3654. Washington, D.C.

U.S. Nuclear Regulatory Commission. 1981b. Final Environmental Statement Related to Operation of Susquehanna Steam Electric Station, Units 1 and 2 Pennsylvania Power and Light Company Allegheny Electric Cooperati[illegible], Inc., NUREG-0564. Washington, D.C.

U.S. Nuclear Regulatory Commission. 1977. Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable, Regulatory Guide 8.10, Revision 1-R. Washington, D.C.

U.S. Nuclear Regulatory Commission. 1979. Information Relevant to Ensuring that Occupational Exposures at Nuclear Power Stations Will be As Low As Is Reasonably Achievable, Regulatory Guide 8.8, Rev. 4. Washington, D.C.

U.S. Nuclear Regulatory Commission. 1981c. Safety Evaluation Report by the Office of Nuclear Report Regulation in the Matter of Pennsylvania Power and Light Company and Allegheny Electric Cooperative, Inc., Susquehanna Steam Electric Station Units Number 1 and 2, NUREG-0776. Washington, D.C.

U.S. Nuclear Regulatory Commission. 1981a. Storage of Low Level Radioactive Waste at Power Reactor Sites, Brach Technical Position, 81-38. Washington, D.C.