NUCLEAR REGULATORY COMMISSION STAFF'S
ENVIRONMENTAL IMPACT APPRAISAL
OF
LOW-LEVEL RADIOACTIVE WASTE STORAGE
AT
TENNESSEE VALLEY AUTHRITY
SEQUOYAH NUCLEAR PLANT

DOCKET NO 30-19101
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1.0 PURPOSE OF REPORT AND NEED FOR THE PROPOSED ACTION

1.1 The Environmental Assessment

This report has been prepared in accordance with the general requirements of the Code of Federal Regulations, Title 10 Part 30 (10 CFR 30) for the purpose of evaluating the environmental effects of the Tennessee Valley Authority's (TVA) proposal to store low-level radioactive waste (LLRW) at its Sequoyah Nuclear Plant (SNP) for a period of five years. Additionally, it is to provide a basis for the Nuclear Regulatory Commission (NRC) staff decision to require preparation of an Environmental Impact Statement (EIS) or to issue a negative declaration.

The scope of the assessment considered three logically separable periods of time. The first period involves the activities performed during the five-year term of a license. The second period addresses the options available at the end of the five-year period. The third period encompasses those activities at the end of the life of the facility (i.e., activities generally considered as decommissioning).

The above scope of review was selected by the NRC staff, in part, upon the following observations:

1. The ongoing operation of the SNP will result in the continued generation of waste and the LLRW Storage Fcility has a useful life well beyond the five-year term of the initial license; thus, the provision for storage of LLRW onsite after the initial term of the license shuld be considered in assessing total foreseeable impact associated with the LLRW Storage Facility.

2. The capacity of the facility would accommodate at least five years production of waste and thus the removal of the waste after the initial license term or storage of the waste for the life of the plant should also

Operation of SNP results in planned and controlled generation of LLRW. This waste consists of ion exchange and condensate demineralizer resins and miscellaneous trash which has, since start-up, been regularly packaged and shipped to the Chem-Nuclear Systems, Inc.'s (CNSI) waste disposal site at Barnwell, South Carolina (hereafter referred to as the Barnwell site).

TVA, on November 24, 1980, forwarded a request to NRC for approval of LLRW onsite storage for a five-year term in new structures that were being built at the site.[2] The November 24, 1980 application was revised and submitted to NRC on March 18, 1982. Environmental evaluation of this request is the focus of this EIA.

Since 1979 the total annual volume of LLRW buried at the Barnwell site has been reduced from 2,400,000 ft^3 to 1,200,000 ft^3, a 50 percent reduction.[4] Volume allotments at the Barnwell site are assigned by utility rather than by individual plant and until 1980 TVA's total allotment at the Barnwell site was approximately 100,000 ft^3 per year. Table 1.1 presents historical data of the TVA allocations and total volumes shipped. Although TVA has cancelled or significantly revised the schedule for completing construction of some nuclear plants, TVA is in the process of bringing additional nuclear power electric generating plants into operation.[5] Current schedules provide for construction of the first unit at Watts Bar Nuclear Plant to be completed in 1984 and at in Bellefonte 1985[6]. The design basis values for generation of LLRW from these three new plants are approximately 56,000 ft^3 per year per plant. This number assumes periodic steam generator tube leakage and annual refueling outages for each unit. As a result, the LLRW production rate during initial years of operation at these plants could be lower. Therefore the estimated total volume of LLRW to be disposed over the next five years (1982-1986) is estimated to be approximately one million ft^3. Assuming that allotments at the Barnwell site remain constant, there may be about a 500,000 ft^3 shortfall at the Barnwell site for TVA.

1.2.2 The Need for the Proposed Action

The need to develop alternatives for managing SNP LLRW which is in excess of TVA disposal allocations at CNSI's Barnwell site is immediate. The intent of

Table 1.1 Historical Data - TVA Allocations and Total Volumes Shipped (ft^3)

Month	Allocation	First-Come First-Served Pool	Total Shipped BFNP	Total Shipped SNP
October 1979	-	-	7,506	-
November 1979	-	-	5,936	-
December 1979	-	-	4,434	-
January 1980	4,102	-	4,095	-
February 1980	3,293	-	3,286	-
March 1980	3,293	924	4,217	-
April 1980	2,828	15,839	18,667	-
May 1980	2,827	2,732	5,559	-
June 1980	2,827	4,967	7,794	-
July 1980	6,607	-	5,294	240
August 1980	5,948	3,310	8,858	400
September 1980	5,948	-	5,606	-
October 1980	5,463	5,914	11,377	-
November 1980	5,463	1,707	7,170	-
December 1980	5,463	1,076	6,539	-
January 1981	4,999	1,055	6,054	-
February 1981	4,999	921	5,920	-
March 1981	4,999	1,480	6,479	-
April 1981	4,535	3,266	7,481	320
May 1981	4,535	2,272	5,430	1,377
June 1981	4,535	962	5,497	-
July 1981	4,050	3,580	5,510	2,120
August 1981	4,050	1,615	5,665	-

the proposed action is to ensure that the uncertain availability of commercial disposal space will not adversely affect future electric power generation at Sequoyah. SNP is a significant contributor to the TVA electric power system and adds significantly to the reliability of the system. Implementation of the proposed action will make TVA's operations at SNP essentially immune to outside restrictions on disposal of LLRW for the immediate future.

The need for immediate action requires an LLRW management plan that can be initiated promptly. The continuing nature of the problem requires a solution that will extend into the foreseeable future. However, as discussed below in Section 3, the solution must also consider the probable impact of recent legislation regarding low-level waste management. The solution to TVA's LLRW disposal problem requires a plan that is flexible, that meets the immediate waste management problems, and that is also compatible with the developing low-level waste management compacts.

TVA's future use of the volume allocation at the Barnwell site is under continuing review by TVA. Because of uncertainty of TVA being able to obtain sufficient disposal allocations at the Barnwell site, the proposed plan is to store LLRW material onsite when the LLRW Storage Facility is licensed. TVA wants to begin using the onsite storage modules immediately upon receipt of authorization, because of the limited allocations for offsite disposal and rate of production of waste in all TVA plants.

In its updated amended application[3] TVA indicated that the storage modules can be con tructed as needed. Recently, TVA has announced in a press release* that it ' tends to participate in the compact among southeastern states to dispose of LLRW at a regional disposal facility. TVA further stated that because of the new compact among southeastern states it will use a smaller number of onsite storage modules for emergency use only. However, since restrictions are still being placed on the amount of waste that TVA can dispose of at the Barnwell site and it is expected that restrictions will continue until the regional compact is implemented, TVA's recent announcement does not alter the need for

*Enclosed in letter, L. M. Mills, TVA to H. R. Denton, NRC, July 26, 1982 the proposed action. It does, however, indicate that if under this TVA policy the full five-year storage capacity is not used, the impacts will be considerably less than those assessed here.

2.0 DESCRIPTION OF THE PROPOSED ACTION*

The proposed action is the construction and operation of a LLRW Storage Facility. The area selected for location of the LLRW Storage Facility is on the east central edge of the SNP site. It is bordered to the east by Lake Chickamauga, to the north by the plant water intake channel, to the west by the discharge flume and to the south by the plant cooling towers. Prior to construction the area was a north-south lying ridge known as Locust Hill (Figure 2.1) that was mostly open and grass covered except for a stand of hardwood trees, about 100 ft in width, along the lake shore and the intake channel. The ridge peaked at an elevation of about 780 ft above mean sea level (msl.).

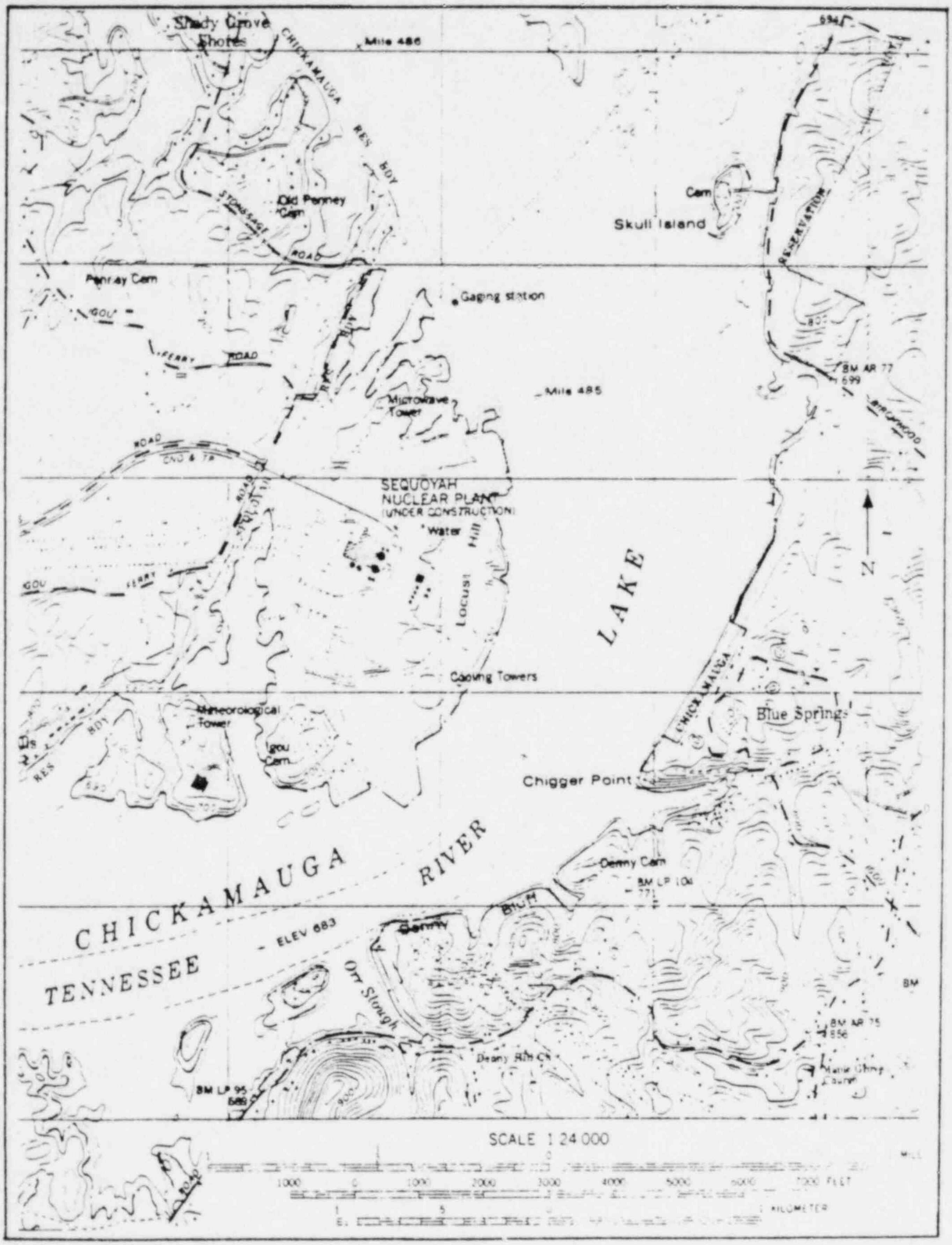
The construction of the facility involves site preparation and the building of up to 13 LLRW storage modules. The modules are above ground structures constructed of reinforced concrete.

2.1 Description of the LLRW Storage Site

2.1.1 Description of LLRW Site Preparation

The area was cleared of vegetation (principally grasses but including a few trees) and grubbed to remove remaining roots. This was followed by grading to achieve a uniform site elevation of 750 msl. During this process approximately 1,300,000 yd^3 of earth was removed and deposited in onsite spoil areas. Runoff water was controlled by rock filter dams, coffer dams, straw, etc. in accordance with best management practices developed by the U.S. Environmental Protection Agency (EPA). Discharge of runoff was via approved NPDES permit discharge locations. The cleared area was then suitable for in-situ placement of LLRW storage module base slabs. To date, four storage modules (1 for trash and 3 for resin and evaporator concentrates) have been constructed at SNP.

*The descriptions presented in sections 2.1, 2.2, and 2.3 are based upon references 1, 2, 3, and 7.



Locust Hill
Figure 2.1

2.1.2 Description of Modules

Provisions for the storage of LLRW comprises independent buildings (storage modules) for trash and resin storage. Four modules have been constructed and additional modules can be built as needed. The maximum number of storage modules to be constructed at the SNP site is 13; eight resin and five trash storage modules. Each module is made up of four compartments each of which is made up of five cells. Each resin storage module cell can accommodate six large-volume (186 ft^3) liners. Each trash storage module cell will hold 156 55-gallon drums.

The resin and trash storage modules are above-ground structures constructed of reinforced concrete. The two types of modules are nearly the same size (resin storage modules are three ft. longer) with floor slabs 39-1/2 in thick, outside width of 34 ft, compartment cell caps and cap support beams of 24 in. thickness. The cell caps have been so designed that an additional 18 in. of concrete can be added to their present thickness if required for additional shielding. The height from the base of the floor slab to the top of the module is 19 ft 6 in. The walls of the resin storage modules are 42 in. thick while those of the trash storage modules are a minimum of 24 in. thick. The following Figures 2.2 through 2.4, show isometric, plan and elevation drawings of module compartments and storage cells for both trash and resin storage modules. Figures 2.5 and 2.6 show cell caps. Curbed (8 in.) concrete runways are provided at the sides of each module, the entire length of the module, for crane operation. The interiors of the modules, except the cell caps, have a decontaminable coating.

In addition to severe and extreme environmental loading conditions the modules have been designed to withstand the following design basis events: earthquake, flood, wind, precipitation and tornado. These design basis events are the same as those used for the design of the SNP.

The modules are so designed that if any liquid collects in them, either from environmental or other outside sources or from failure of a container, the liquids can be safely handled. Provisions have been made for removal of any liquids and decontamination of the modules. Each compartment of a module is

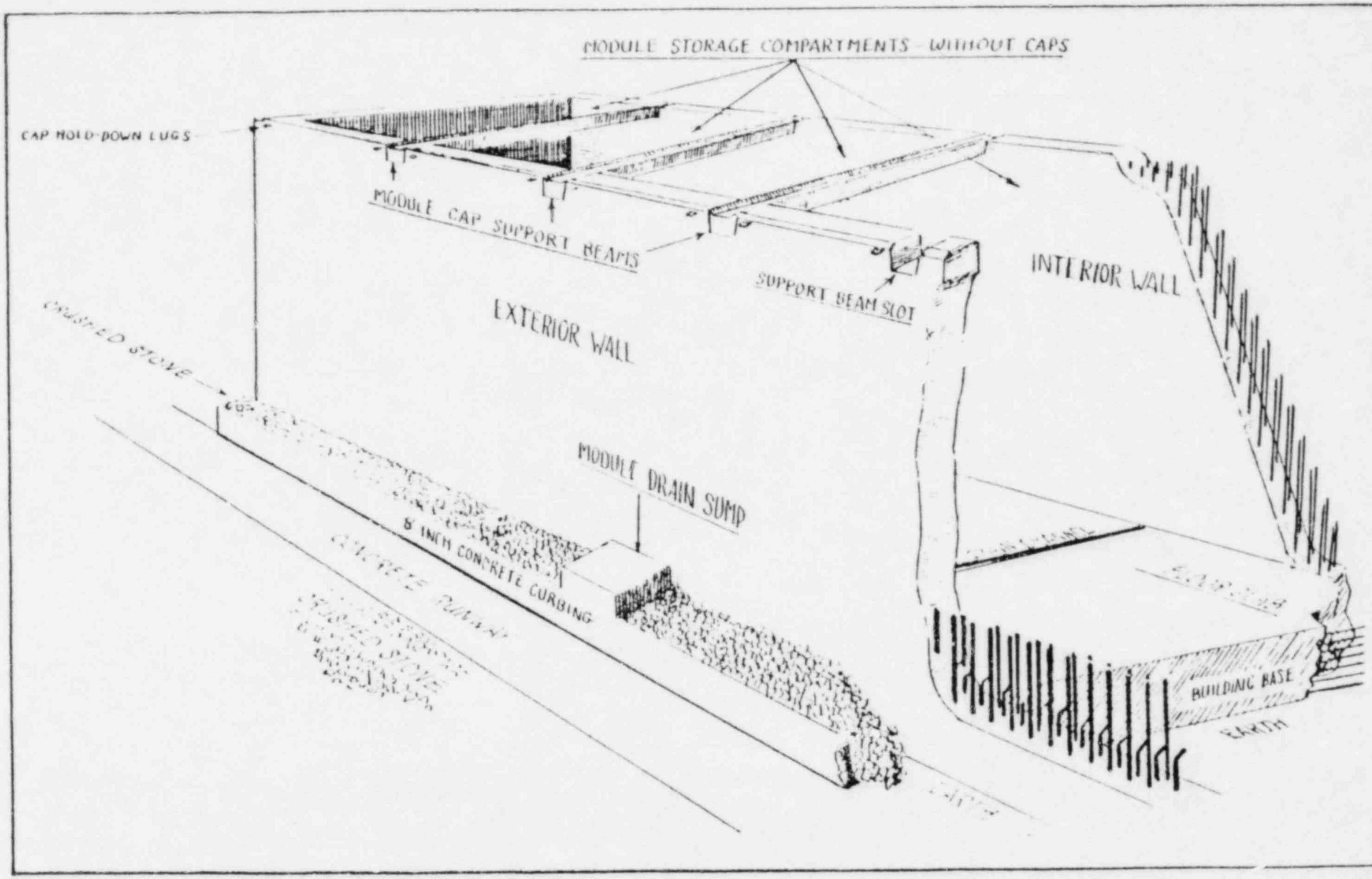
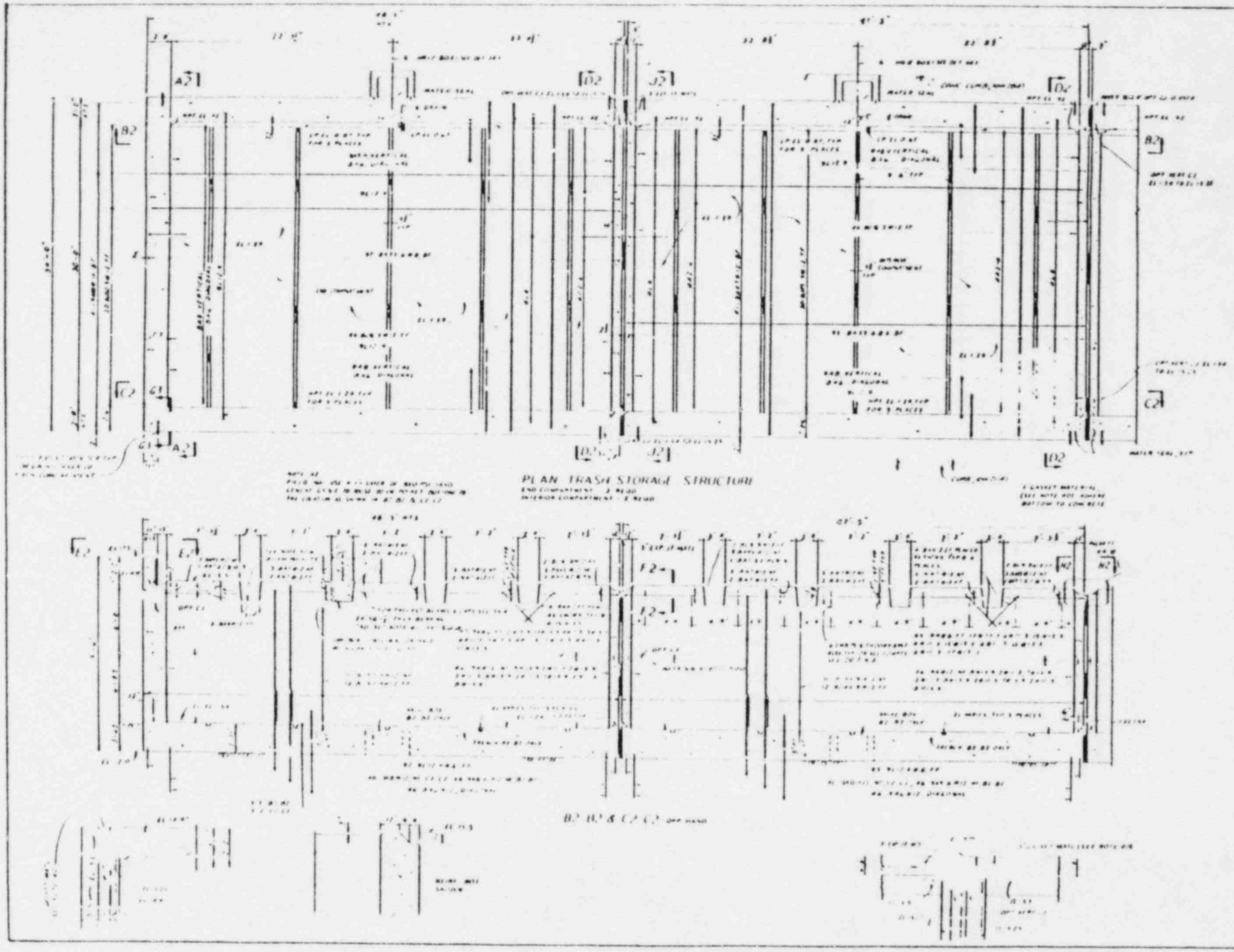
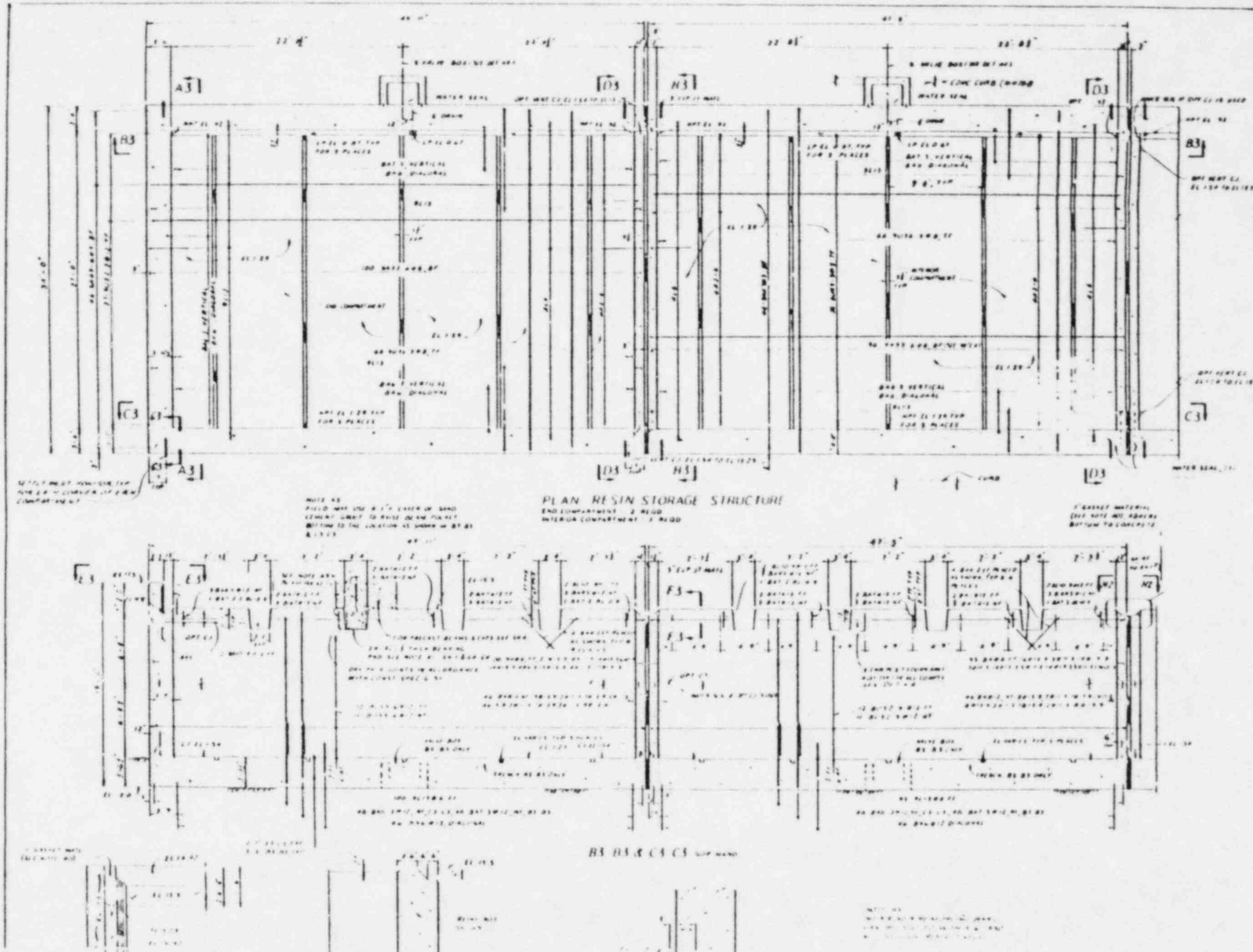


Figure 2.2 Isometric Cutaway of a Portion of a Storage Module



Trash Module Figure 2.3



Resin Storage Module Figure 2.4

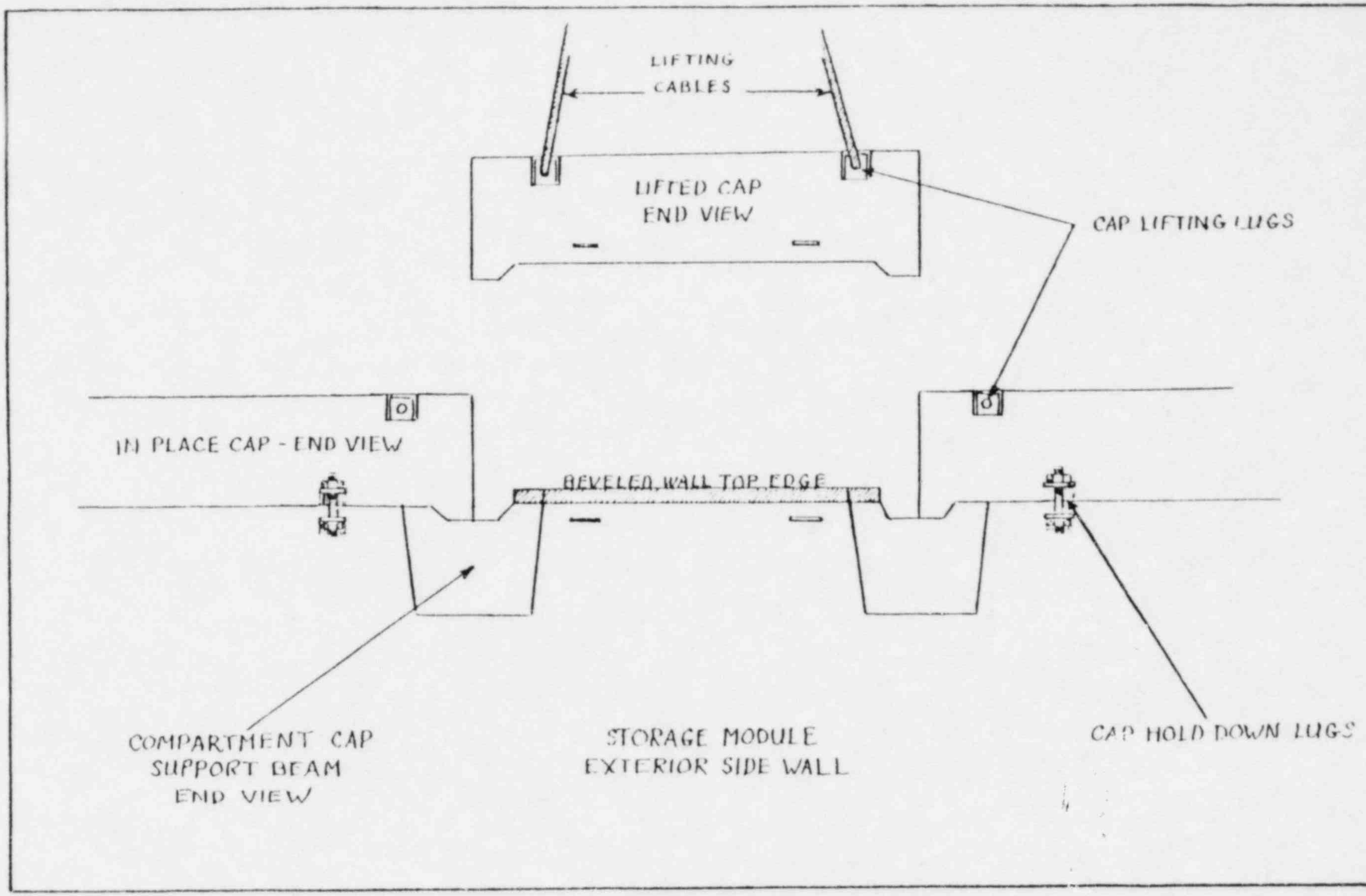


Figure 2.5 End View of Storage Cell Caps, In Place and Lifted

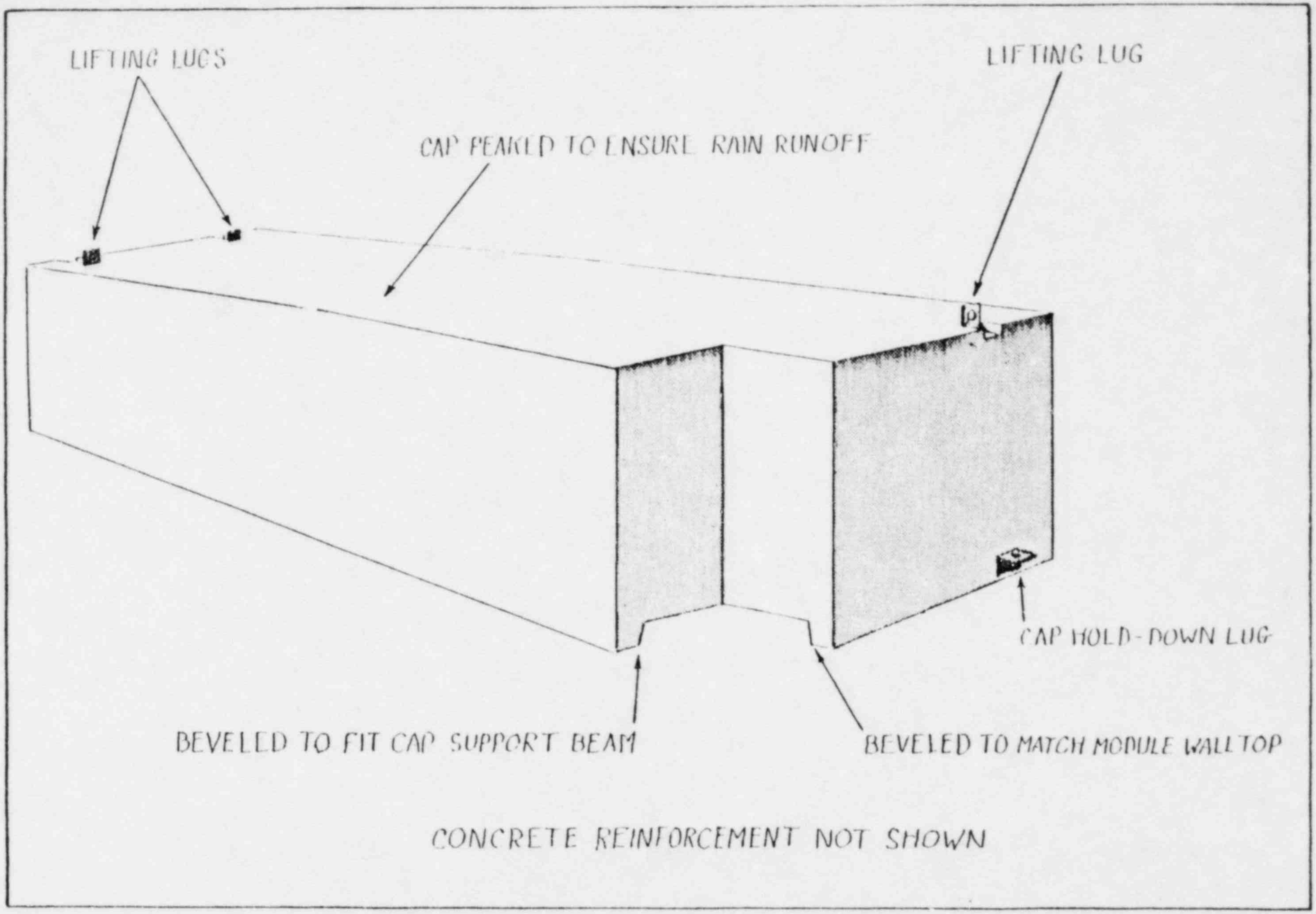


Figure 2.6 Cutaway of a Cell Cap Showing Beveled Inside Edges

provided with an internal liquid collection and drainage system which is routed to an external sampling point in the sumps shown in Figures 2.3 and 2.4. All LLRW storage and operating equipment is designed, procured, constructed and inspected in accordance with the industrial codes and standards listed in Table 2.1. These codes and standards are supplemented by TVA construction codes and standards.

2.1.3 Storage Site Support and Utilities

The LLRW Storage Facility is surrounded by a 20-ft wide perimeter road which will pass no closer than 50 ft from any module. A fabric wire fence, topped by three strands of barbed wire and totaling 8 ft in height, will enclose the entire storage area at a distance of 30 ft from the centerline of the perimeter road. Access to the facility consists of a personnel and vehicular gate (vehicular gates are sized to accommodate fire-fighting vehicles and large trucks) at the gatehouse. The gatehouse is located at the southeast corner of the LLRW Storage Facility with its centerline 143 ft away from the centerline of the nearest storage module. A second vehicular gate is located at the southwest corner of storage facility area. Both vehicular gates are provided with high-security, key-operated locks. Gates will remain locked at all times except when facility operations require the entry and exit of authorized vehicles and personnel. Communications systems consist of telephones as well as fixed and portable radios. Presently there are four completed storage modules located at the south end of the LLRW Storage Facility. Since TVA has stated in its application that the modules can be built as needed, an interim fence has been erected approximately 26 ft north of the nearest completed modules and separates them from modules under construction. As modules are finished and before they are used, the interim fence will be progressively moved to encompass completed storage modules.

Electrical power requirements for the LLRW Storage Facility will be modest, e.g., gatehouse and area lighting, gatehouse-HVAC and a limited number of convenience outlets mounted on the exterior of the storage modules. Electrical power will be furnished from the nonsafety-related portion of the SNP Auxiliary Power System.

Table 2.1 Applicable Industrial Codes and Standards

EQUIPMENT CODES				
Component	Design and Fabrication	Materials	Welding	Inspection and Testing
PIPING AND VALVES				
a. Storage Module Drains	ANSI B31.1 (QA shall be in accordance with attachment RW of MEB E.P.23.5.5)	304-L or 316-L	ANSI B31.1	ANSI B31.1
b. Storm Drains	AASHTO	AASHTO	-	-
c. Potable Water and Sewers	National Plumbing Code	National Plumbing Code	National Plumbing Code	National Plumbing Code
d. Fire Protection	NFPA Code Standard 24	NFPA Code Standard 24	NFPA Code Standard 24	NFPA Code Standard 24
CRANE	Joint Industrial Council and AISC	ASTM	AWS	AISC, ASTM, and AWS
Decontaminable Coatings	TVA Spec. G-14	ANSI N512	-	TVA Spec. G-55
Electrical, Security, and Radiation Monitoring Equipment	IPCEA Standards Industry Standards NEMA Standards RDT Standards RDTC1-1T	ASTM Industry Standards	AWS Industry Standards	Industry Standards ANSI-N13.1-1969 ANSI-N13.10-1974
FIRE PROTECTION				
a. Extinguishers	NFPA Code Standard 10	NFPA Code Standard 10	-	NFPA Code Standard 10
b. Hydrants, Houses, Hoses, etc.	NFPA Code Standard 24	NFPA Code Standard 24	NFPA Code Standard 24	NFPA Code Standard 24

Water for use in the gatehouse will come from the SNP potable water supply system and wastewater from the gatehouse will be piped to the SNP sanitary wastewater treatment facility.

LLRW module loading/unloading will be accomplished through the use of a crane. The crane to be used at the LLRW Storage Facility is a rubber-tired, diesel-powered, mobile gantry crane. It has two cross beams, a 15-ton capacity trolley on the front beam and two 30-ton capacity trolleys on the rear beam. The 15-ton hoist will be used to handle the LLRW containers (Resin liners and 55 gal. drums) and the 30-ton hoists will be used to handle the storage module caps. In order to facilitate movement from one module to another, the crane is driven and steered by the same wheels and these wheels are capable of turning 90° in either direction. In addition to its standard features, the crane is equipped with an AC generator, an air compressor, eight 500-watt lights, a cable reel and a hose reel to provide air and electric power to the 15-ton hook, and a CCTV monitoring system. The CCTV monitoring system is designed to allow remote handling of the LLRW containers beyond the line of sight of the operator. The CCTV monitors, the CCTV controls, and all crane controls are mounted in a cab on the lower frame of the crane.

The CCTV system consists of two monitors and four cameras, all completely independent of each other except for their power source. Each monitor is equipped with manual control capabilities to select display from any of the four cameras. The cameras are equipped with individual pan and tilt controls.

2.2 Waste and Waste Container Descriptions

2.2.1 Waste Description

The LLRW generated by operation of the two units of SNP consists of two categories of waste: trash and resins. Table 2.2 provides the composition of LLRW trash.

Table 2.2 Low-Level Trash

Scintillation Liquids	Scintillation Vials
Oil/Water mix from lubrication and diesel oil	PVCs
Rubber Shoe Covers	Polyethylene Boots
Rubber Hose	Ion Exchange Resins
Cotton Gloves, Inserts, Coveralls, and Surgical Masks	Plastic Hose (Nalgene)
Plywood Crates	Paper Coveralls
Copper Wire	Pine Crates
Chains	Oak Crates
Mops	Scrap Iron and Steel
Wood used for scaffolding and ladders	Small Hand Tools
HEPA Filters	Cables
Other wood and small metal objects	Brooms
	Cable Insulation
	Laboratory Equipment (vials, glassware, plastic bottles)

High-activity chemical and volume control system (CVCS) resin and others ion-exchange wastes will be stored in steel liners. The CVCS resins will be solidified with cement. The material consists of the following: anion and cation resin in bead form, cellulose filtration material, radioactive material, and water contained within the other materials. The radioactive material (consisting mostly of activated corrosion products) is removed from water within the nuclear plant. The resin waste will conform to the free-standing water requirements of the Barnwell disposal site. The resin consists of a plastic material (copolymerized styrene crosslinked with divinyl benzene) with strong acid cation (hydrogen form) capacity. It should be noted that the resins will be fully or partially exhausted after being used in plant systems.

A fibrous filtering material may be used in cleanup systems on the secondary side of the plant if leaks occur in the steam generator. These materials will be used only if required and then only limited quantities are expected to be generated.

The pH values of typical resin mixtures will range from 4.2 to 10.5. The conductivity of water which has collected in areas of the liner could be as high as 100 umhos. The above conditions could be corrosive to carbon steel, and internal coating of the liner will be required. The protective coating will allow storage of waste with a pH range of 2 to 13 during the five-year storage period. Free-standing water content ranges from nondetectable levels to less than 0.5 percent of the container volume.

The activity of ion-exchange resin varies depending on plant operating conditions and the source of the water that is demineralized by the resin. In TVA's application the resins are described as having an activity from about 0.005 to 1.07 uCi/cc with liner contact dose rates from 20 mrads/hr to 300 mrads/hr. The CVCS resins would be higher with contact dose rates from 50 rads/hr to several hundred rads/hrs.

The isotopic composition of waste depends upon the plant operating conditions. Data of the isotopic composition from the SNP are limited. Isotopic composition data were collected from the NRC PDR on plants of a similar design and vendor as SNP. These data are summarized in Table 2.3. These data and the information provided in the application were considered in the selection of the isotopic composition for use in doing the radiological assessment presented in Section 5.

2.2.2 Waste Container Descriptions

2.2.2.1 Miscellaneous Dry Trash Containers

All miscellaneous dry trash is stored in steel drums. In general, these containers meet the Department of Transportation (DOT) specification 17H (or equivalent), and have a capacity of 55 gallons. As an alternative, metal boxes meeting DOT specifications may be used for storage. These containers are constructed of at least 18-gauge steel and externally coated to reduce container corrosion. No wooden or cardboard packages will be stored in the LLRW storage facility.

Most of the radioactive waste stored in these containers will be dry and chemically inactive. On occasion, moist material (with no free-standing water) may be packaged for storage. All moist material will be packaged in a sealed

Table 2.3 Composition of Resin Waste from Two Plants of Design Similar to Sequoyah Design

Plant		MN-54	CO-58	CO-60	CS-134	CS-137
D.C. Cook	2/2 1981		45	10	15	30
	1/2 1980		35	25	15	25
	2/2 1980		45	10	20	25
	1/2 1979		2	2	39	57
Salem	1/2 1980	17	9	74	-	-
	2/2 1980	3.3	80.4	16.3	-	-
Composition used in Radiological Assessment		3	37	10	20	30

NOTE: 1/2 indicates the first half of the calendar year
2/2 indicates the second half of the calendar year

polyethylene bag before it is placed in the steel container. Double bags will be used when necessary.

2.2.2.2 Resin Waste Containers

TVA's resin liner is constructed of 0.25 inch A-36 carbon steel in the snape of a cylinder. These liners are constructed for TVA by the TVA Power Operations Service Shops in Muscle Shoals, Alabama, in accordance with TVA drawings. All welding is performed utilizing welders and procedures qualified to the requirements of TVA Division Procedure Manual, No. N73M2 (construction procedure G29M). During and following construction of the liners, a number of tests and inspections are performed to ensure that the liner is properly built. These include a hydrostatic or pneumatic pressure test to ensure container integrity, visual inspection of interior and exterior welds in accordance with written procedures, visual inspection of internal dewatering elements and pipe fittings, and a final inspection check to ensure that the liner meets all tolerances. Upon receipt at SNP the liner will be inspected to ensure that exterior coatings are properly applied, that the liner and the coating have not been damaged during transportation, and that there are no obvious defects in fabrication.

Liners currently used for offsite disposal are coated on the exterior surfaces with one coat of primer and two coats of alkyd gloss enamel. Liners to be used for onsite storage are coated on the exterior surfaces with one coat of primer and two coats of alkyd gloss enamel and on the interior surfaces with one coat of a 2-part epoxy coating to a minimum thickness of 8 mils. This coating is applied with sufficient quality control to ensure that uniformity and minimum thickness requirements are met and, when possible, is checked for pin hole defects. The coatings are applied to prevent chemical attack on the liner material during waste storage.

The coatings protect the interior of the liner from chemical attack by the liner contents and preclude corrosion of the exterior surface from high humidity, rain, temperature extremes, and other expected corrosion-producing mechanisms. The coatings are selected to provide corrosion protection for periods exceeding the five-year license term. Closure of liner penetrations (countersunk pipe plugs) is accomplished using a thread sealant (such as Teflon tape or Loctite) before storage of the waste.

Because of changes in the criteria for acceptability of certain resin wastes at the Barnwell site, TVA may want to use alternate types of containers not described in its application. Before any such container is used in the LLRW Storage Facility, TVA will evaluate the container to determine its adequacy for storage purposes. The purpose of TVA's evaluation plan is to ensure that any new type container used for storage of LLRW will perform at least as well as the containers described in its application.

2.3 Description of Operations

Preparation/packaging of LLRW for shipment, either for onsite or offsite disposition, is accomplished at the main plant radwaste facility. The waste containers are loaded onto transport vehicle for shipment to the LLRW Storage Facility. This activity is authorized under the TVA's operating licenses.

Resin liners may be lifted using either a permanently attached sling or an air-actuated remote lifting device. All lifting devices and closures are visually inspected to ensure proper fabrication and installation before liner use.

Fifty-five gallon drums containing trash, or resins contained in steel liners or in steel liners in shielded casks, will be transported to the LLRW Storage Facility main access gates by the appropriate type truck. The transfer of LLRW to the facility will be in accordance with applicable DOT and NRC regulations. The shipping containers will be NRC certificated or DOT specification shipping containers. The transporting vehicle will be directed to the appropriate storage module. Each module will be designated as to the type of waste, i.e., trash or resin, that will be stored therein. The previously described gantry crane will then be positioned over the module compartment cell to be loaded, the cap hold-down bolts removed, the lifting cables from the crane trolleys attached to the lifting lugs on the cap, the cell cap removed, and set aside. Normally the cap will be removed and set on cribbing laid on top of an adjacent cell cap. The crane will have to be moved forward or backward to accomplish this cap placement. The crane will then be indexed over the module cell to be loaded. If the transporting vehicle has a removable top, or no top, the containers may be lifted directly from the truck. If van-type trucks are used, a portable ramp and forklift will be used to place the containers on the ground where they will be individually picked up by the crane and loaded into the storage cell.

Three special lifting devices will be furnished. Handling of the resin liners will be accomplished using a rigid frame with air-actuated lifting device. The 55-gallon drums will be handled using a standard gravity-actuated barrel grapple. A magnetic lifting system will be provided to handle the support grating that is to be used for stability between levels of drums or liners and placed on the floor of each module before beginning compartment loading. Once in proper position in the cells, on support grating, the containers' lifting mechanisms are detached from the container via the crane operator's controls.

If a shipping cask is used, the bolts on the cover of the cask will be removed by an air wrench and the cask top fastened to a crane hook. The cover will then be lifted and set aside by the crane and disconnected. The crane will then be indexed over the cell to be loaded, its hook connected to the liner and the liner lifted from the cask, moved over and lowered into the designated storage cell. These procedures will continue until the scheduled shipment, drums or liners, has been stored. The crane will then be moved to a position to pick up the "set aside" cell cap. Once hooked up, the crane will move the cap to the proper position and lower it into position to close the module cell. The crane lifting cables will be disconnected from the lifting lugs on the cap, the cap hold-down bolts replaced and the crane moved to some other appropri e location. Basically the same procedures will be used when removing conta ers from storage.

Drawings of the general appearance of the crane and the planned cell cap removal and loading operations are presented in Figures 2.7 and 2.8.

A container monitoring program will be established. The objective of the program is to ensure that the container's integrity is maintained while in storage thereby preventing any release of the waste to the module or the outside environment. The monitoring program consists of quarterly visual

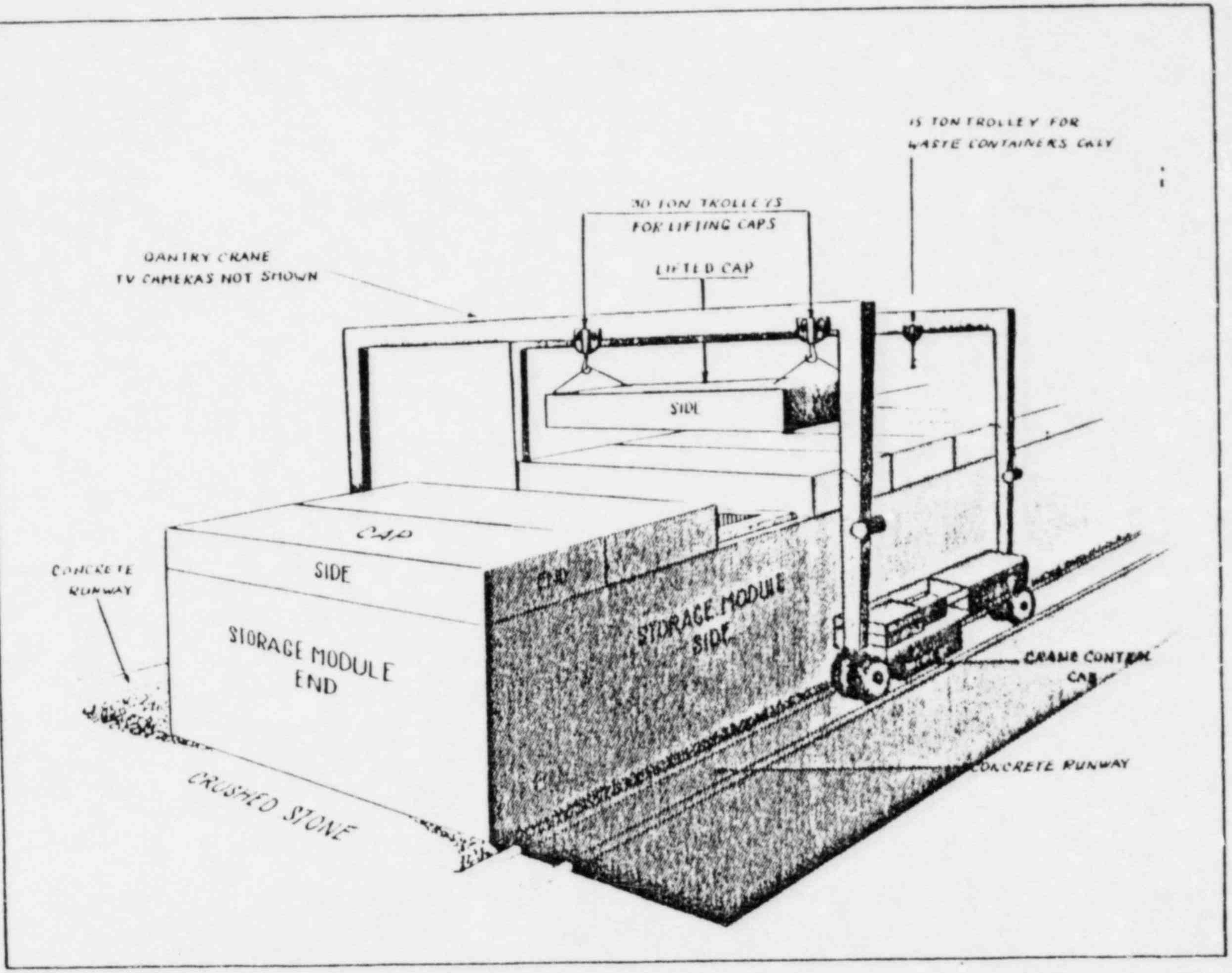


Figure 2.7

Crane With Lifted Cell Cap

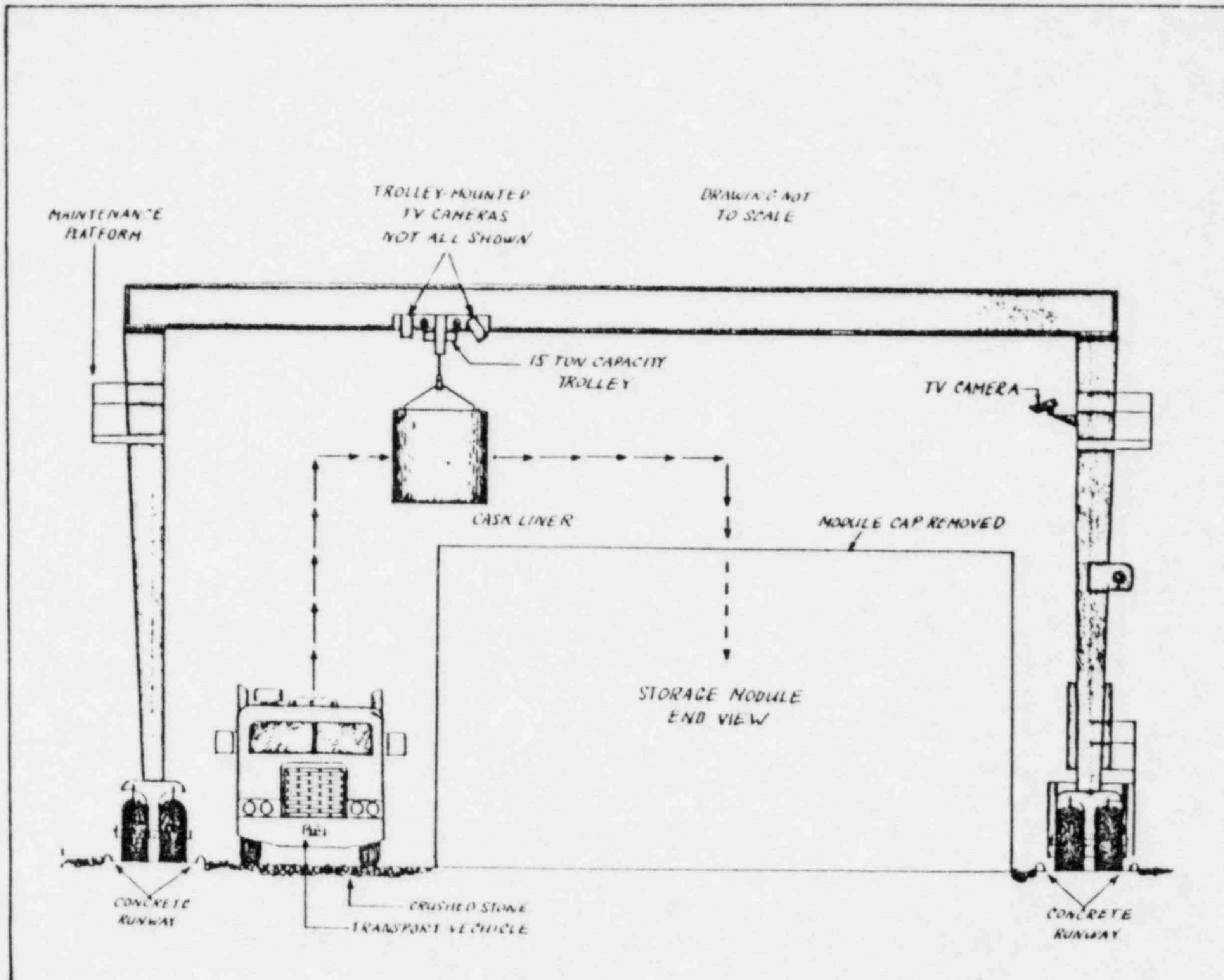


Figure 2.8
Module Cell Loading

inspections of those resin module cells filled with dewatered resin[3]. The visual inspection uses remote CCTV. The attributes inspected include swelling, external corrosion, and failure of the resin liners. The container monitoring program also includes monitoring of control containers at the Browns Ferry Nuclear Plant. The control containers are monitored for internal pressurization, gas evolution, ph, free water and for evidence of resin degradation. In view of the nature of the materials stored in drums, the dry trash drums will not be included in the inspection program.

All laborers, crane operators, and truck drivers will be TVA employees. All operations at the LLRW Storage Facility will be monitored by plant health physics employees as part of the Special Work Permit procedure. Monitoring activities include vehicle and container surveys during shipment and module loading and unloading.

Because of the dose rate resulting from direct unshielded exposure to the waste being placed into storage (see Section 5.1.2), all loading/unloading of containers into/out of the module will be done remotely utilizing the crane mounted closed-circuit television monitor to observe the placement/position of the container in the module. The monitor will be used to ensure that a container is placed in the correct storage cell without damaging either the container, the storage module, or other containers in storage.

2.4 Description of Safety Systems

2.4.1 Fire Protection

The storage modules have not been equipped with any internal fire suppression/fighting systems due to the extremely low potential for combustion within a closed module. The possibility of the contents of a module igniting due to module exposure to an external fire is also very small due to the noncombustible nature of the modules and the fact that the thickness of the walls is such that it provides a three-hour fire resistance rating from external exposure fires. An external fire would be detected by periodic security patrols or by workers in the area of the LLRW Storage Facility. In the unlikely event that fire did occur in a storage module, it would be fought from outside.

The LLRW Storage Facility fire-fighting water supply is taken from the nuclear plant yard fire main. Hydrants and hydrant houses are provided around the perimeter of the LLRW Storage Facility in accordance with NFPA Standard No. 24. Two points of entry are provided through the security fence to accommodate a standard fire department pumper.

Each storage module compartment has been sized to collect and contain that quantity of water used for manual fire fighting from two 2-1/2-inch hose streams simultaneously for a duration of at least one hour. The LLW Storage Facility will also be provided with multipurpose dry chemical fire extinguishers in accordance with NFPA Standard No. 10. All fires will be fought by specially assigned personnel of the SNP fire brigade.

2.4.2 Occupational Monitoring and Radiation Protection

Workers involved in LLRW Storage Facility operations will be subjected to the same radiation protection and monitoring requirements that govern all SNP operations. Waste loading operations will be performed under the coverage of Special Work Permits* (SWP), on which all necessary protection and monitoring requirements are specified.

In general, the occupational monitoring will employ health physics surveys, use of self-reading pocket dosimeters, and use of thermoluminescent (TLD) badges. Health physics surveys will be performed as required by SNP Health Physics Technicians using portable survey instruments. All surveys will be performed according to appropriate SNP Radiological Control Instructions (RCI), which contain specific instructions necessary for the Health Physics staff to properly carry out their functions. Self-reading pocket dosimeters will be used by the workers to continuously keep close track of their accumulated exposures, while

*The SWP procedure is used by TVA at the SNP site to control all work having potential for significant radiological exposure.

the TLD badges will be used as the official means of dose accounting. The issuance and use of self-reading dosimeters and TLDs are also governed by RCIs.

The administration of the radiation protection program at the plant is the responsibility of the Radiological Hygiene Branch, which develops and applies radiation protection standards and procedures. The plant Health Physicist is the onsite supervisor who represents the Radiological Hygiene Branch and is responsible for the direction of an adequate radiation protection and monitoring program for all plant operations involving potential radiation hazards, including waste handling and storage operations at the LLRW Storage Facility.

2.5 Environmental Monitoring Program

The SNP environmental monitoring program is discussed in the SNP FEIS. The monitoring program includes atmospheric, terrestrial, and reservoir monitoring programs. In addition to the radiological monitoring program at SNP, if conditions warrant, TVA has the capability to monitor water in the underlying aquifer at the LLRW Storage Facility through clusters of monitoring wells drilled outside the security fence.

3.0 OPTIONS AND ALTERNATIVES

In the following sections, possible waste management options available to TVA, involving the LLRW Storage Facility following the five-year license term, are presented. Each option would have some environmental impacts that may be a result of the proposed action and therefore are being considered in this Environmental Impact Appraisal. Additionally, since each action would require some NRC licensing action, we are considering whether or not granting a license for the proposed action would unjustifiably restrict the NRC's decisional alternatives or limit its ability to withhold approval of subsequent related applications.

Alternatives to the proposed action are also presented.

3.1 Options Beyond the Five-Year License Term

Options available to TVA following the five-year license term are presented so that the proposed action can be evaluated for possible environmental impacts at the end of the license term and at the end of the life of the LLRW Storage Facility.

3.1.1 Options at the End of License Term

At the end of the five-year license term, several options involving the LLRW Storage Facility, for managing LLRW at the SNP, may be available to TVA. Briefly they are:

1. Renew license for continued operation until the five-year design capacity is used, or

2. Renew license for possession only; no new LLRW stored, or

3. Renew license for further operation; remove old LLRW and store newly generated LLRW, or

4. Renew license for storage of volume reduced LLRW, or

5. Ship stored LLRW for disposal and terminate license, or

6. Volume reduce stored LLRW, ship it for disposal and terminate the license.

The first option could occur if, at the end of the five-year license term, the total five-year design capacity of the storage modules had not been used. This would involve the same activities as the proposed action, described in Section 2.

The second option, to renew the license for possession only with no new storage of LLRW, would involve considerably less activity than the proposed action. Until ultimate disposition of the LLRW, the activities associated with this option would be those of the container integrity, module, safety and environmental monitoring programs.

The third option of renewing the license for further operation could occur if the modules were full. LLRW that had been in storage the longest would be removed for disposal and its place taken by newly generated LLRW. This option would involve activities similar to the proposed action but with the additional operational step of removing older LLRW before storing new waste.

The fourth option of renewing the license to allow storage of volume reduced LLRW would, in addition to similar activities for the proposed action, involve the construction and operation of a facility to reduce the volume of stored and newly generated LLRW.

The fifth option would essentially be renewing the license for possession only while the LLRW was removed for disposal. The activities would be similar to the proposed action except no new LLRW would be placed in the modules. When all the LLRW was removed and appropriate decontamination or decommissioning accomplished, the license would be terminated.

The sixth option would require the renewal of the license until all the LLRW could be shipped for disposal. The activities involved in this option would be the same as that described for the fifth option with the additional activities associated with construction and operation of a LLRW volume reduction facility.

The particular option TVA may select will depend upon many factors which are presently uncertain. Such factors include:

1. Construction schedule,
2. Module usage (i.e., TVA stores all LLRW or only stores on an as-needed basis),
3. Container integrity,
4. Formation of Regional Compacts for LLRW disposal,
5. Availability of LLRW disposal, and
6. Volume reduction methods, licensing, and economics.

Based on present considerations, TVA has stated that its intention is to remove the LLRW and ship for disposal if space is available.[3]

The evaluation of these options may be found under Environmental Assessment, Section 5.2.

3.1.2 Options at the End-of-Life Plant

The life span of the LLRW Storage Facility cannot be definitely stated at this time. The storage modules are of substantial construction and could function for several decades. However, the useful life of the modules for storage of LLRW may only have to be until provisions for near-surface disposal are adequate. On the other hand, the LLRW Storage Facility could be used by TVA as a contingency storage facility after near-surface disposal provides space for TVA's waste.

TVA anticipates that near the end of SNP life, a final decision will be made as to the method for decommissioning the LLRW Storage Facility. TVA has identified three methods for decommissioning of the LLRW Storage Facility. They are:

1. Placing the LLRW Storage Facility in an inactive state (i.e., possession only with no planned operations) and providing for the security and environmental monitoring for an indefinite time;

2. Sealing all radioactive material inside the LLRW Storage Facility (utilizing a material such as concrete) in a technique known as entombment; and

3. Retrieving all radioactive waste and transporting all of this material to a disposal facility then decontaminating as necessary, leaving the area in as close to its original state as possible.

The specific method has not been selected at this time since actual decommissioning for the LLRW Storage Facility will not be necessary for some time. Other methods, which are more advantageous than the above, may be developed before the decommissioning is necessary.

It is TVA's intention at this time to retrieve all stored radioactive waste for shipment to another site for ultimate disposal.[3] Environmental monitoring precautions would be continued until either the material is disposed of offsite or the LLRW Storage Facility is released for unrestricted use. It should be noted that design features, such as, the decontaminable coating to the interior of the modules, were incorporated to facilitate the decommissioning of the storage modules.

An evaluation of TVA's intended option may be found under Environmental Assessment, Section 5.2.

3.2 Alternatives to the Proposed Action

In this section, alternatives to the proposed action are presented along with a discussion of their viability. Four alternatives were selected for consideration. They are: no action, interim storage at another TVA site, near-surface disposal at a TVA site, and volume reduction. These alternatives were evaluated against the need discussed in Section 1.

The Low-Level Waste Policy Act, enacted by Congress in December 1980,[10] allows and encourages states to form regional compacts for the purpose of establishing regional disposal plans and sites for the management and ultimate disposal of low-level radioactive waste. Many states are currently in the process of forming regional compacts. Once established these compacts can rely on NRC or Agreement State programs for licensing of new disposal sites. One provision of the Act would allow regional disposal sites to exclude waste from non-member states after 1986. Congress must approve the provisions of the individual compacts after the compacts have been ratified by the state legislatures of the member states.

Some compacts have already been formed. The southeastern states are considering the formation of the Southeast Interstate Low-Level Radioactive Waste Management Compact. As of July 15, 1982 Alabama, Florida, Georgia, Mississippi, South Carolina, Tennessee and Virginia have radified the compact and become members of the Southeast Interstate Low-Level Radioactive Waste Management Compact.[11] Presently the State of South Carolina has agreed to host the disposal site and the Barnwell site is the likely host site. The staff believes that once regional compacts and disposal sites are operational, TVA will have access to a disposal site which, will be able to fulfill SNP and TVA's long-range disposal requirements. It is therefore the ability to fulfill TVA's need in the interim which we evaluated to determine the viability of an alternative.

The staff further believes that the Southeastern Interstate Low-Level Radioactive Waste Management Compact will have such a disposal site available for TVA's use prior to the expiration of the requested five-year license term for the SNP LLRW Storage Facility and that such a disposal site will be able to accommodate the amount of LLRW which may be stored in the SNP LLRW Storage Facility under the requested five-year authorization.

3.2.1 No Action

The "No Action" alternative is a continuation of the present arrangements for disposal of low-level waste by TVA's SNP. This alternative consists of preparation and shipment to the low-level waste burial site at Barnwell, South Carolina. This alternative, considering TVA SNP as a single, isolated unit, would be a viable alternative; however, TVA does have an additional 3 reactors on-line and more coming on line during the next 5 years. With this number of reactors on line the current and projected allotments for near surface disposal at the Barnwell site are insufficient to dispose of the projected volume of waste. Taking no action does nothing to alleviate TVA's uncertainty about disposal allocations and therefore is considered not viable.

A variation on the no action alternative would be for TVA to ship the SNP LLRW to one or both of the other licensed disposal sites. This would involve transportation of the waste to either Beatty, Nevada or Richland, Washington. However, because of the Low-Level Waste Policy Act of 1980 and the formation of compacts in those regions, these sites may soon be closed to SNP wastes. Because the availability of these sites over the next five years is uncertain, this variation of the "No Action" alternative does nothing to alleviate TVA's uncertainty and therefore is also considered not viable.

3.2.2 Interim Storage at Another TVA Site

This alternative considers the building of the low-level waste storage modules at a separate TVA non-reactor site. The activities associated with this action would be similar to those activities required of the proposed action, that is, the construction and operation of low-level waste storage modules. In addition to the construction and operation of the modules, additional requirements over the proposed action are:

1. need to establish separate environmental monitoring program for the operation of the site.
2. need to have operationally dedicated staff at the other site.
3. need for TVA to locate and purchase, or evaluate presently owned land for use as a storage site.
4. need for additional shipments of LLRW.

Because of the time required to locate and purchase new land or evaluate presently owned land, this alternative is not considered viable because it lacks immediate utility.

3.2.3 Near-Surface Disposal at a TVA Site

Near-surface disposal of low-level radiological waste is a proven technology. Several sites are or have been licensed by NRC (or its predecesor agency the AEC) and Agreement States. The requirements for a near surface disposal facility site are discussed in the draft 10 CFR 61 rulemaking documents.

Near-surface disposal as an alternative to the proposed action would consist of siting of the facility, obtaining permits and licenses for the construction and operation of the facility. The facility may be a commercial site, such as the presently licensed sites, or, conceivably, a site for dedicated TVA use. The time required to locate, license, and construct a site is estimated to be 3 years as a minimum. Because of the time required to implement this alternative, it lacks immediate utility and therefore is considered not viable.

3.2.4 Volume Reduction

Another alternative to the proposed action would be for TVA to reduce the volume of LLRW generated at SNP, for example by incineration before shipping it offsite, thus more effectively using TVA's allotment at the offsite disposal facility. The NRC encouraged licensees to reduce volumes of LLRW for disposal through its Policy Statement on Low-Level Waste Volume Reduction issued in the FEDERAL REGISTER on October 16, 1981 (46 FR 51100). A number of volume reduction techniques are in varying stages of development. Depending on the method selected, the time required for implementation would be lengthy because of requirements for testing and evaluation, construction, installation and licensing. For example, we estimate that an incineration system could take from three to five years to become operational. For this reason this alternative lacks immediate utility and therefore is not considered viable.

4.0 SITE CHARACTERISTICS

The SNP is located in Hamilton County in southeastern Tennessee approximately 18 miles northeast of Chattanooga and six miles east of the town of Soddy-Daisy. The plant site occupies a 525-acre tract of land on a peninsula on the western shore of Chickamauga Lake, a reservoir formed by the Chickamauga Dam on the Tennessee River. The penninsula site extends 2,000 ft north and 3,000 ft south of Tennessee River miles 485 and 484, respectively. Figures 4.1 and 4.2 show the site location. The LLRW Storage Facility is located along the eastern edge of the plant site bordered by Chickamauga Lake (Figure 4.3) and occupies approximately 20 acres. The plot plan for the LLRW Storage Facility is shown in Figure 4.4. A detailed description of the physical and environmental characteristics of the plant site and the surrounding areas is presented in the SNP EIS[1]. The following subsections are to provide additional data in areas where new or supplemental information is relevant.

4.1 Demography

The area in immediate proximity to the SNP and the LLRW Storage Facility is sparcely populated. There are three residences within one mile to the west-northwest and west. The nearest residence is approximately 4,275 ft west-northwest of the LLRW Storage Facility. There are also about 25 more residences within a mile of the LLRW Storage Facility which are located along the eastern shore of Lake Chickamauga. There is a total population of 9203 persons living within five miles of the LLRW Storage Facility. Table 4.1 shows the population density from zero to five miles, five to ten miles, then, in ten-mile increments, out to 50 miles from the LLRW Storage Facility, for each of 16 compass directions. The total population within a 50 mile radius of the LLRW Storage Facility is calculated to be 796,497. Chattanooga and immediate environs comprise about 25% of the total population within the 50 mile radius.

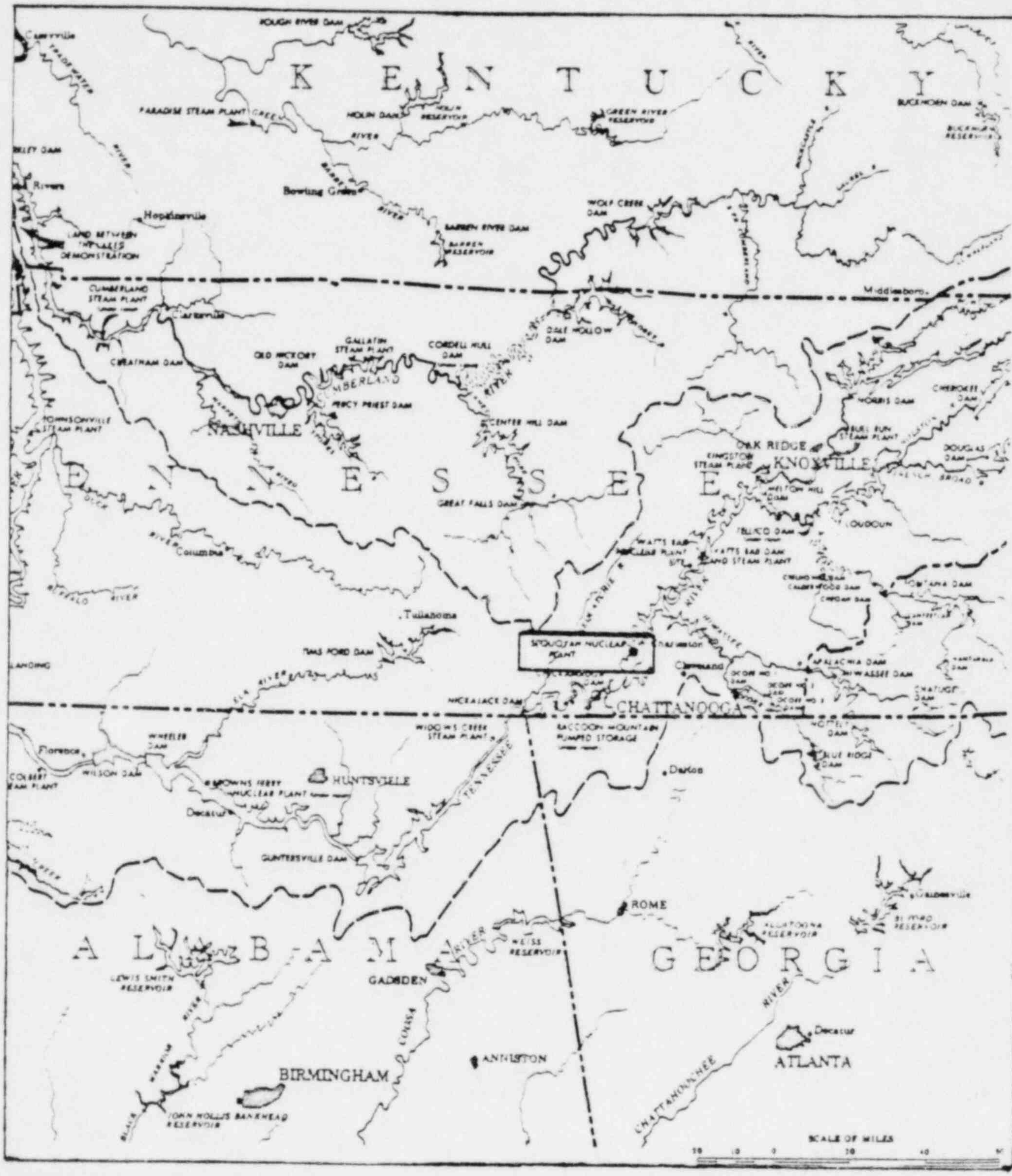


Figure 4.1 General Plant Location

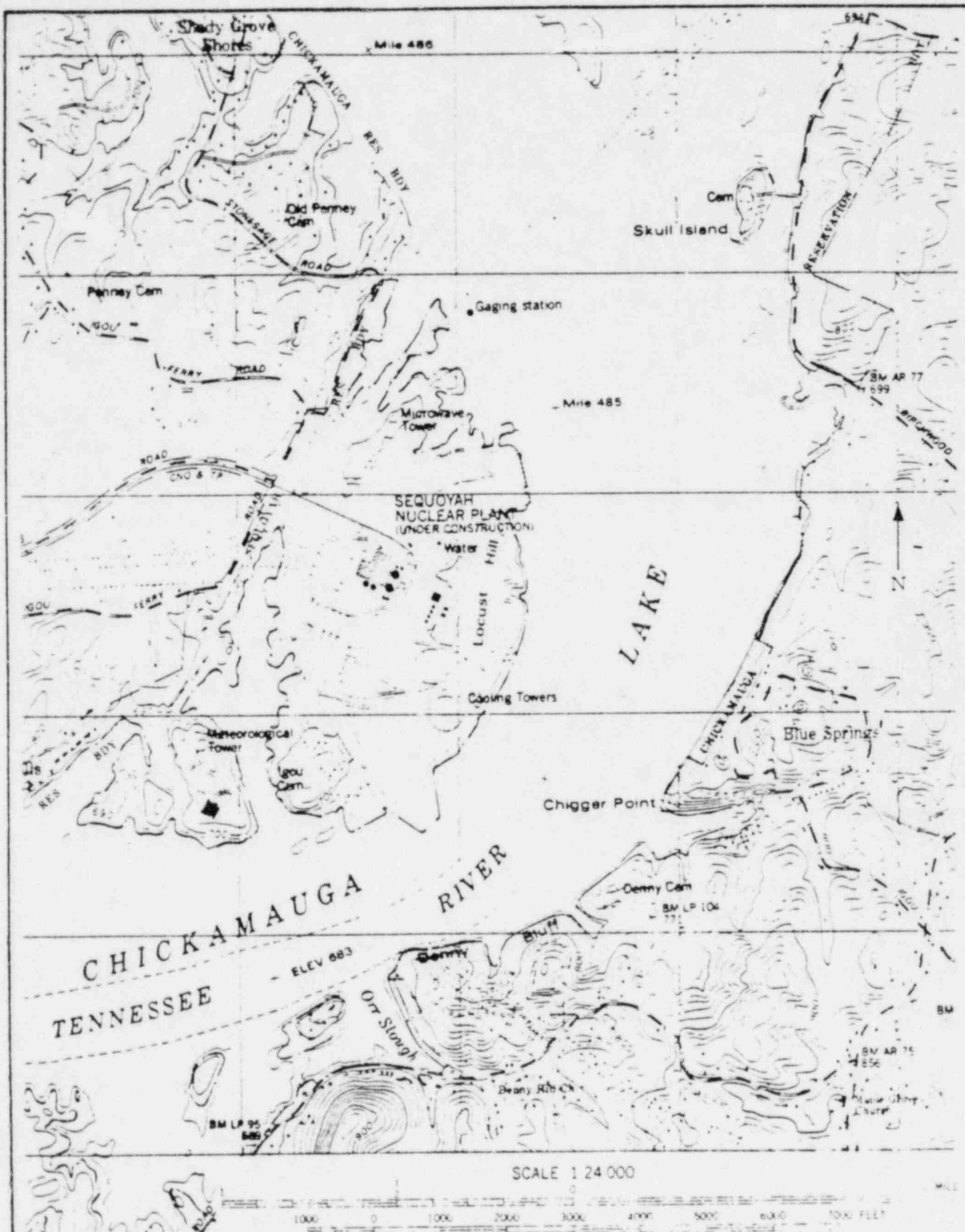


Figure 4.2 Plant Location Detail

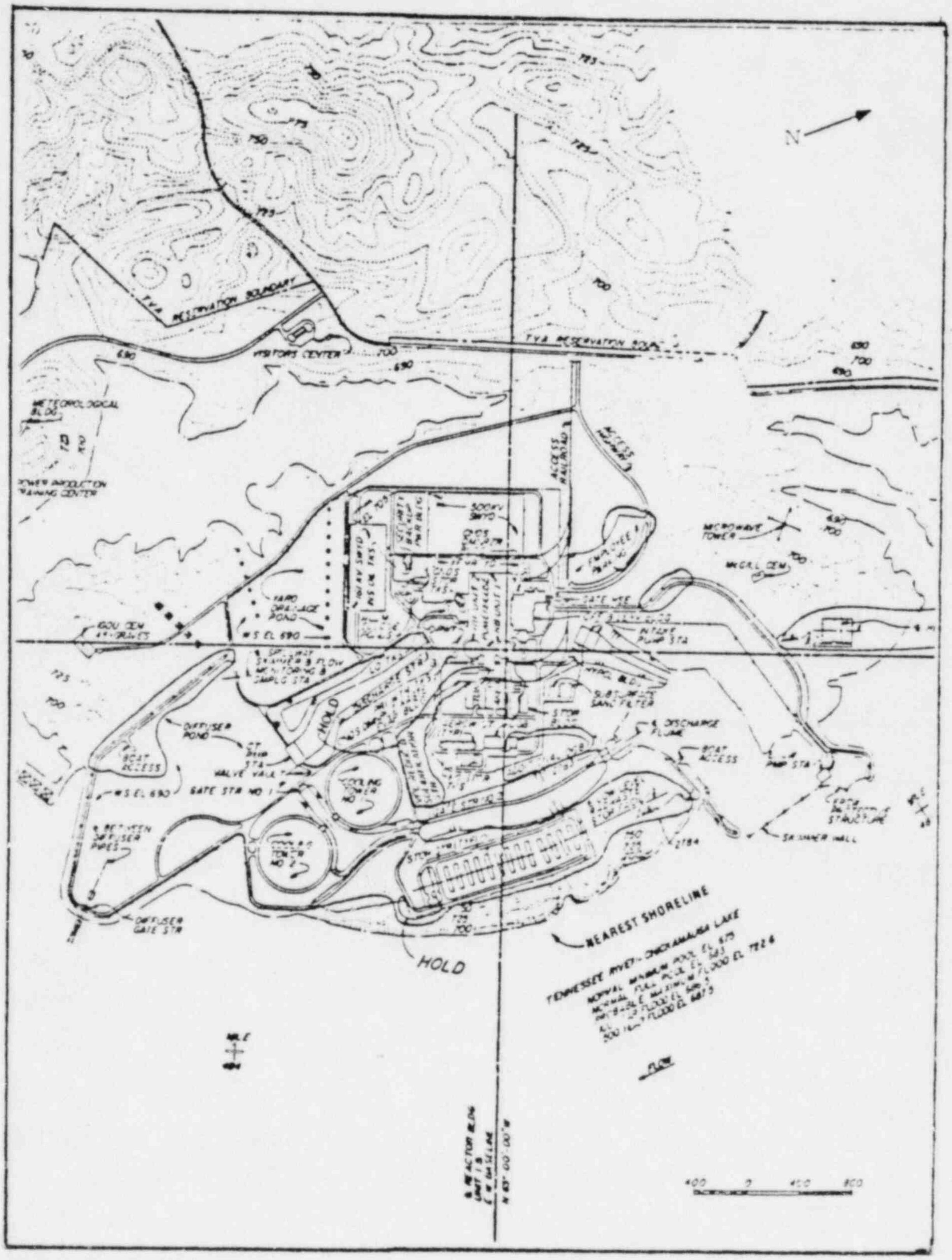
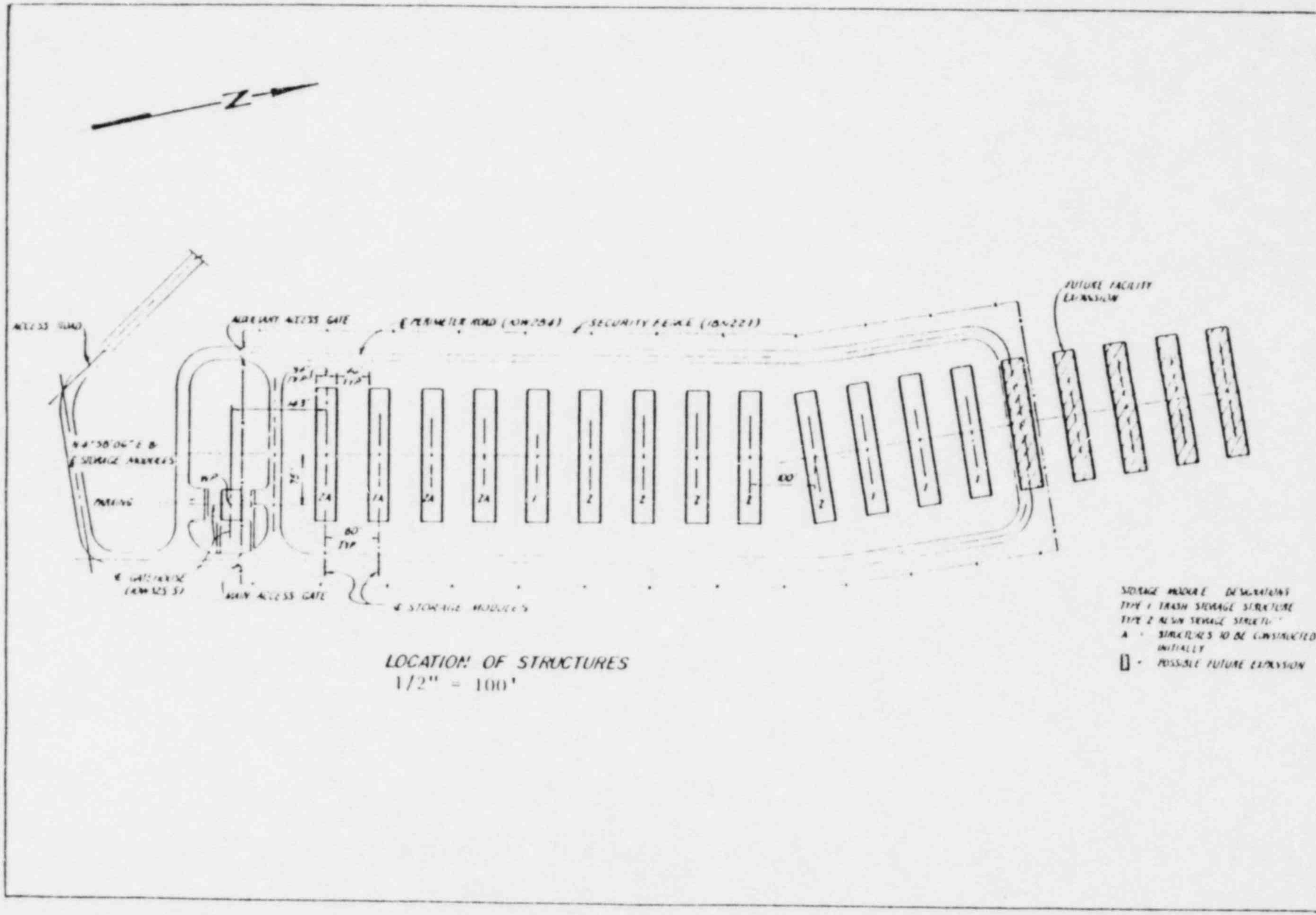


Figure 4.3 LLRW Storage Facility Location



LLRW Storage Facility Plot Plan

Figure 4.4

Table 4.1

Population Density Around SNP to 50 Miles by Compass Headings*

Miles / Direction	0 - 5	5 - 10	10 - 20	20 - 30	30 - 40	40 - 50
N	101	814	3987	3158	3276	5352
NNE	226	348	4378	4971	5054	13159
NE	94	306	1922	4495	5841	14888
ENE	292	436	6740	5088	24495	6735
E	234	423	7591	4653	4347	2879
ESE	416	1121	31159	2368	5274	8667
SE	468	713	7049	7775	4931	4205
SSE	694	700	5439	22131	21163	10928
S	644	1030	10082	19631	18303	16783
SSW	490	2998	197495	25339	21054	15278
SW	314	3265	5784	10233	10422	3658
WSW	1976	6704	23889	1418	15208	7675
W	775	12481	2385	2943	5855	6398
WNW	1229	3141	4339	3542	6477	6814
NW	848	5371	2471	1344	3169	17079
NNW	402	1059	5620	2163	2652	6283
Totals	9203	40910	320830	121252	157521	146781

*Population Estimates Based on U.S. Bureau of Census 1980 Figures.

4.2 Ecology

Areas adjacent to SNP are considered "nonfarm rural" and consist of a mixture of open and wooded land that have, and continue to support, terrestrial, avian, aquatic and vegetation species as described in the SNP FEIS.

Construction of the power plant commenced in 1970 and has continued with varying degrees of intensity since that time. The impacts to flora and fauna that did occur due to industrialization of the site have long since stabilized. The portion of the site used for construction of the LLRW Storage Facility is an open, grass covered hill bisected by a north-south oriented road. A stand of hardwood trees bordered the shoreline and these have essentially been undisturbed by the construction activity. Small ground and tree dwelling rodents and passerine birds probably continue to inhabit the wooded area. Threatened or endangered species (avian) may occasionally be observed, but the area is used neither for feeding nor nesting by these species.

4.3 Geology

The regional and local geologic features of southeastern Tennessee have been described in the SNP FEIS. These basic features have remained unchanged with the exception Locust Hill which was leveled from a peak elevation of 780 ft msl. to an average elevation of 750 ft msl. to accommodate construction of the LLRW Storage Facility.

The Seismic Risk Map of the United States (Figure 4.5)[12] shows the SNP location within seismic risk Zone 2 where earthquake intensity may reach VII on the Modified Mercalli (M.M.) scale. Figure 4.6[12] shows the locations of earthquake epicenters in the general area and within 60 mi. of SNP. The triangles in the figure indicate the location of quake epicenters; the Roman numerals indicate the intensity, M.M. scale, of the most recent activity; the arabic numbers indicate the number of times activity has occurred at that location; the date below the triangle is that of the most recent activity. The nearest earthquake epicenter to SNP was ten miles east-southeast, had an M.M. intensity of V, was the second recorded in that location with the last activity in 1945. A detailed

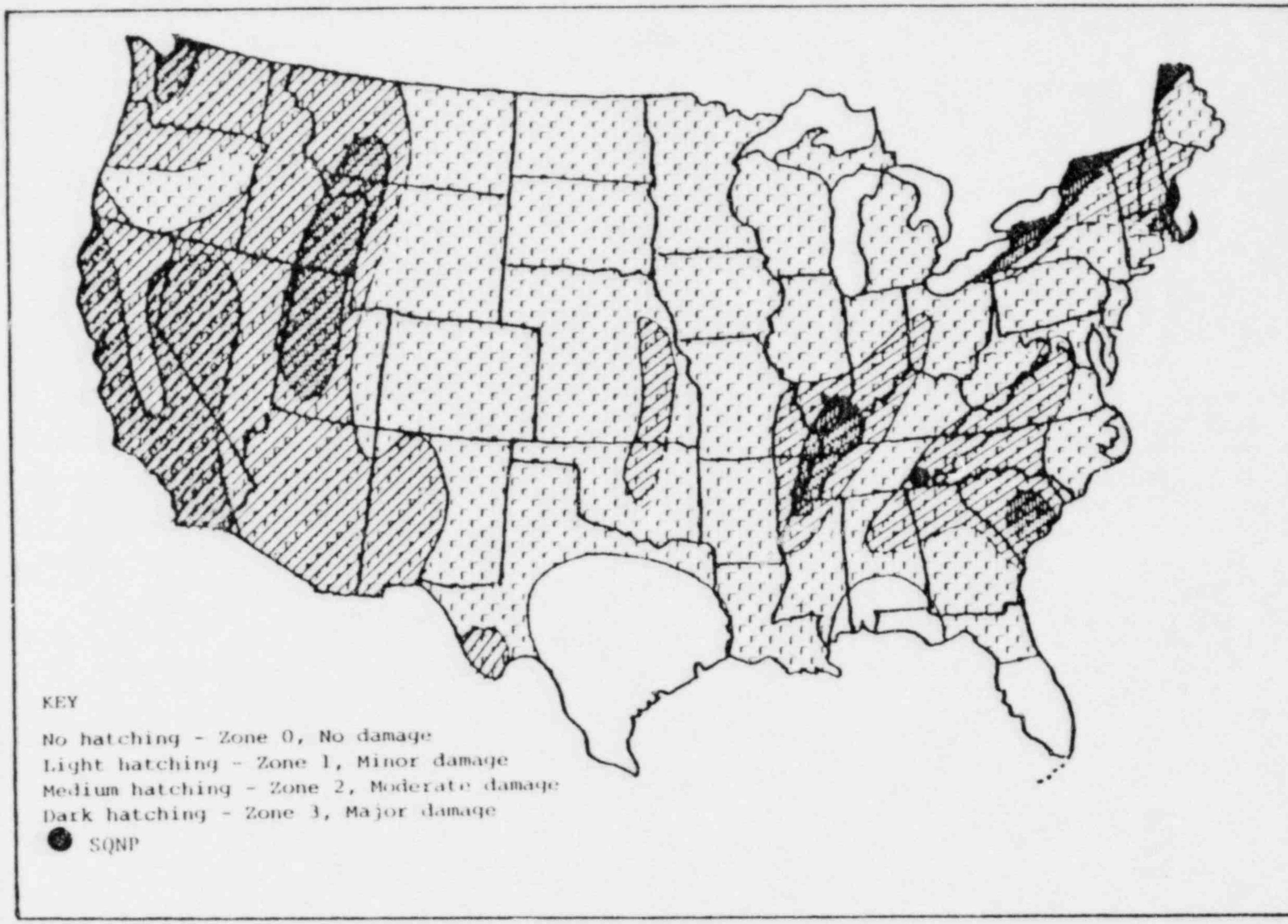


Figure 4.5 Seismic Risk Map of the United States.

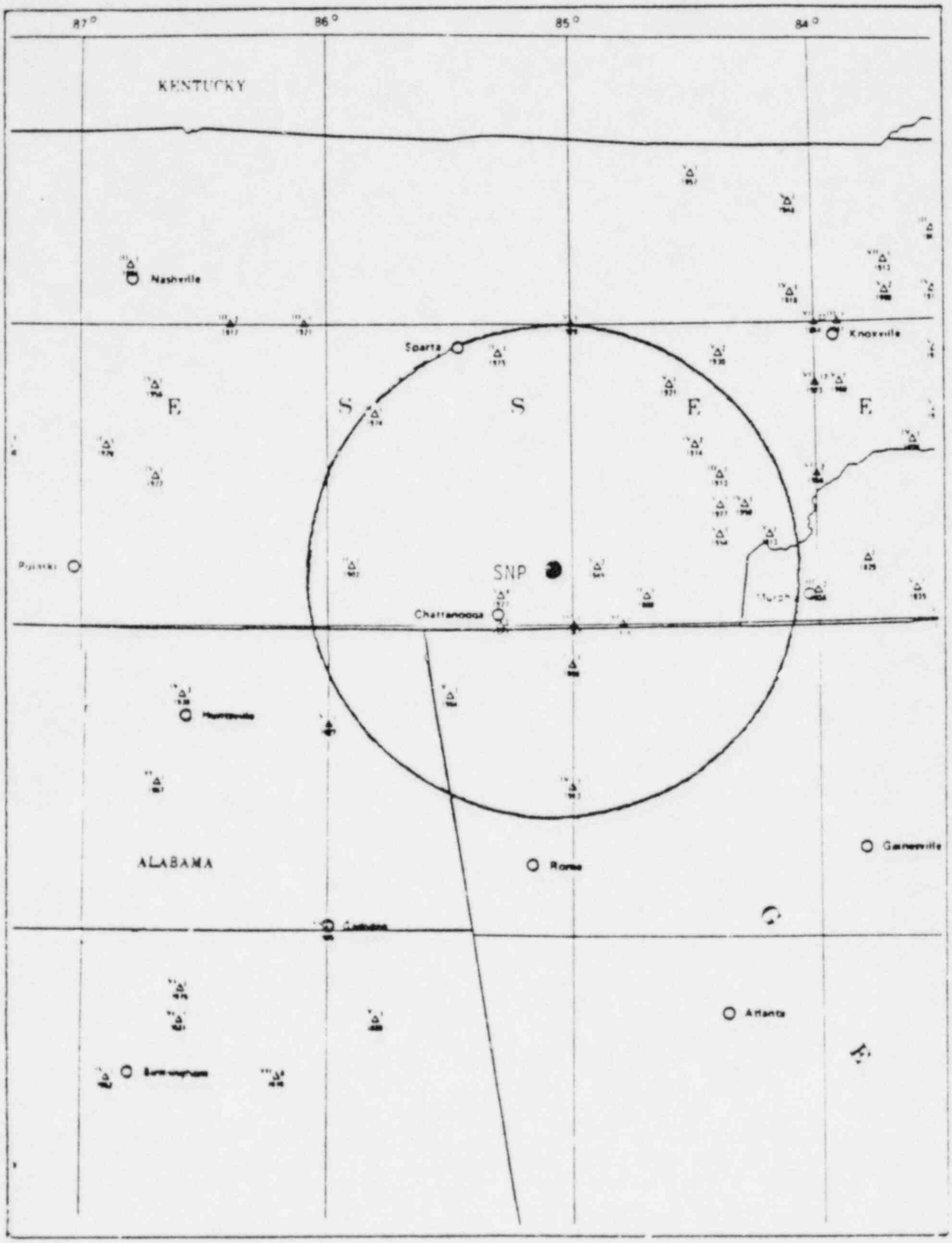


Figure 4.6 Earthquake Epicenter (Within 60 Miles of SNP).

analysis and explanation of the seismic characteristics of the local area is provided in SNP Safety Evaluation Report of March 1979.[14]

4.4 Hydrology

The Tennessee River - Chickamauga Lake is the principal hydrologic feature in the SNP area. The water level varies due to flow control activities at the Watts Bar Dam (upstream) and the Chickamauga Dam (downstream). The normal minimum pool elevation pool is 683 ft msl.; the 100 year flood elevation has been estimated by TVA to reach 686.5 ft msl. (i.e., a flood of this magnitude might occur with a frequency of once in 100 years); the 500 year flood 687.5 ft msl. Based on TVA's estimates and considering the fact that the average elevation of the LLRW Storage Facility is 750 ft msl no threat is posed by flooding.

Ground water in the area is derived from precipitation which has averaged 58 in./yr. over the past 20 years of record. There is no distinct aquifer in the SNP area and ground water moves through the terrace material overlying the bedrock. Test holes have shown that the water table stands about 20 ft above the bedrock, i.e., at an elevation of about 675 ft msl. with the distance below the surface varying with the variance in surface elevations.

4.5 Land Use

Land use remains basically as described in the SNP EIS with some increasing urbanization five to ten mi. southwest of the plant site. As the LLRW Storage Facility is entirely within the original site boundary there has been no additional land occupation by SNP.

4.6 Meteorology

Meteorological data recorded since the publishing of the SNP (through 1980) indicate there has been no significant changes in the meteorological characteristics of the area as described in the SNP FEIS.

5.0 ENVIRONMENTAL ASSESSMENT

5.1 Assessment of The Proposed Action

5.1.1 Construction

The site of the LLRW Storage Facility has been prepared and some of the LLRW modules have already been built. No unexpected consequences or problems have been encountered.

The construction activities associated with the radwaste storage modules resulted in some temporary degradation of local air quality. Air pollutants generated from this activity primarily include: (1) fugitive particulate emissions from various activities, including cleaning of steel and concrete, drilling, and painting; (2) fugitive dust from earth excavation and grading; (3) particulate emissions from the open burning of small amounts of wood scraps; and (4) small amounts of particulates, hydrocarbons, nitrous oxides and carbon monoxide emissions from fossil-fueled construction and construction employee vehicles.

The construction site mitigation program consisted of: fugitive dust suppression, by methods such as water sprinkling, which substantially reduces this problem; periodic inspections to ensure proper maintenance of construction and control equipment to minimize exhaust emissions; open burning in accordance with all applicable Federal, State, and local regulatory requirement.

Concrete production during construction of the LLRW Storage Facility was approximately 50 yds^3 per hour at an at an onsite batch plant. Fugitive dust from the concrete batch plant was controlled through the use of filters.

The construction of the entire LLRW Storage Facility as currently conceived may require up to approximately 20 acres of land, all within the SNP reservation boundary. Construction involves no offsite land use conflicts. The LLRW

Storage Facility is compatible with the land use plans within the SNP reservation for the nuclear plant and its support facilities.

Approximately 1,300,000 yds^3 of soil has been moved for the construction of the LLRW Storage Facility. During construction of this facility storm water runoff was controlled to prevent erosion and all runoff discharged to local waters was in conformance with NPDES permits. The methods used were in accordance with the best management practices developed by the Environmental Protection Agency (EPA) pursuant to the Federal Water Pollution Control Act. Guidelines for Erosion and Sediment Control Planning and Implementation, EPA, Environmental Protection Technological Series--EPA-R2-72-015, August 1972.

The usual sources of noise associated with construction activity were present. However, these noise impacts were temporary, intermittent and limited to the site area.

There were small amounts of solid waste generated due to the construction. Solid wastes generated were handled in accordance with State and Federal regulations.

During the construction period, portable chemical toilets were provided for use by construction personnel. There was no on-site effluent from these facilities. TVA obtained the services of a contractor who disposed of the waste in State-approved treatment facilities.

Since the construction activity will be accomplished within to a previously disturbed area on the SNP reservation, no effect on any known archaeological or cultural resources is expected.

No known population of endangered, threatened, or otherwise sensitive species are adversely affected by the development of the proposed project.

The site for the proposed action is not located in a floodplain nor is it expected to directly or indirectly support or encourage floodplain development. There are no wetlands which were affected by the project.

The proposed action required a significant construction effort in view of the urgency of the situation. There is now and will continue to be significant ongoing renovations and additions to SNP and there are manpower, housing, and services available in the area to fill the construction and labor skill requirements for the LLRW Storage Facility. As a result of an adequate supply of manpower, no overall population increase is expected as a result of this construction activity, and because this plant is near an urban areas (Chattanooga, Tennessee), there were no significant socioeconomic impacts.

5.1.2 Radiological Assessment of the Proposed Action

There are three principal pathways by which members of the public may be exposed as a result of facility operation: direct radiation, exposure to radioactivity released in gaseous effluents and exposure to liquid effluents. These pathways, and the associated modes of exposure, are illustrated in a generalized manner in Figure 5.1. This section provides an assessment of the radiological impact of the proposed operation via all important pathways. Both normal facility operation and unplanned radioactive releases are assessed, as are the expected incremental increases in occupational radiation exposures.

The general assumptions used in these assessments are presented in Table 5.1. Additional assumptions and methods are presented below as they pertain to the subject under discussion. In each case, care has been taken to use assumed values which are conservative, yet realistic.

5.1.2.1 Direct Radiation

The primary exposure pathway associated with normal facility operation is direct irradiation of nearby residents and site workers as a result of waste loading and storage operations. Four separate components to this exposure are assessed:

(1) Direct exposure to waste containers during their lifting and placement into the storage modules;

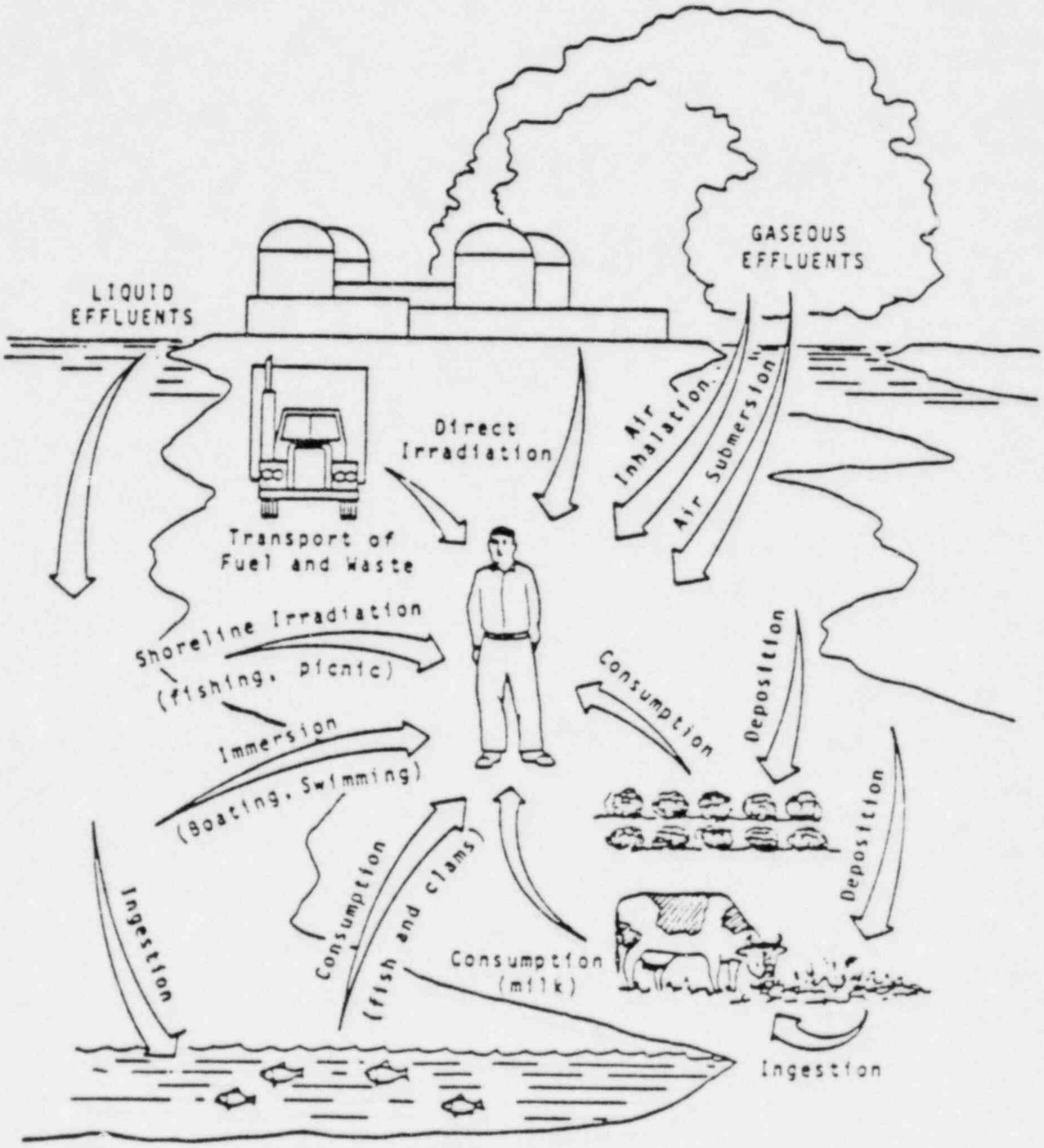


Figure 5.1. Generalized Radiation Exposure Pathways to Man.

Table 5.1 General Assumptions Underlying the Assessment of TVA Sequoyah Onsite LLRW Storage Facility

	Trash Waste	Resins	Liquid Concentrates	Regenerates
Drums or cask liners per module cell (1)	120	.13	1.28	4.59
Drums or cask liners stored per year	1632 (compacted) 1716 (noncompacted)	3.8	38	136
Initial activity per container (Ci)	.015	1,300	311	7
Exposure rate at 10 ft. (R/hr)	.00083 (compacted) .0013 (noncompacted)	17	5.2	.091
Activity stored per year Ci/yr	44	4,940	11,800	900

(1) Six cask liners stored per module cell. These values are the average number of each type of waste stored in cask liners.

Initial Isotopic Composition

37% Co-58
30% Cs-137
20% Cs-134
10% Co-60
3% Mn-54

(2) Exposure to "skyshine" radiation (i.e., radiation which is emitted from the source in an upward direction and is subsequently scattered earthward) when the cell cap is removed for waste placement;

(3) Exposure to skyshine radiation through the cell cap; and

(4) Exposure to direct radiation through the storage module wall.

Skyshine doses have been calculated using the data of Roseberry and Shultis[15] and American National Standard ANSI/ANS-6.6.1-1979[16], while direct exposures were calculated assuming line or point source geometries. Table 5.2 presents the estimated annual dose that would result from nonvolume-reduced waste placement and storage for the fifth year of operation. These values should be considered as upper level estimates since conservative assumptions were used. For example, no credit was taken for either self-attenuation in the waste material or attenuation in container walls.

The NRC has established radiation protection requirements in 10 CFR 20. They address, among other aspects, occupational dose, exposure to concentrations of radionuclides in air and water, and permissible levels of radiation in unrestricted areas.

The Environmental Protection Agency (EPA) has established an annual dose equivalent limit of 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ for any member of the public from uranium fuel cycle operations. These limits are given in 40 CFR 190.

The estimated annual dose from LLRW Storage Facility operations at the location of the nearest resident is given in Table 5.2. When added to the estimated 6 mrem maximum dose to any individual,[1] the total (~7mrem) is within the 40 CFR 190 standard. Future TVA reports assessing the radiological impacts at the SNP will include those from the LLRW Storage Facility. The combined effects are expected to be mostly from the SNP reactor operations.

The maximum annual dose to the population residing within ten miles of the LLRW Storage Facility resulting from five years of accumulated waste storage is presented in Table 5.3. As can be seen, the annual collective dose impact from waste storage activities are minimal. It should again be noted that

Table 5.2 Estimated Annual Dose in mrem Resulting from Onsite Waste Storage

Location	Direct Exposure During Placement(1)	Skyshine Exposure Cell Cap Removed(2)	Skyshine Exposure Cell Cap in Place(3)	Direct Exposure Through the Wall	Total
91 m (Near Shore)	16	68	260	73	417
26 m (Construction Area)	194	1290	304	203	1991
610 m (Plant)	.4	.15	.0018	.3	.85
1000 m (Nearest Resident)	.1	.0007	.0017	.6	.7

(1) Based on 3 minutes per container airborne. Assumes line of sight conditions.

(2) Source terms: Trash - 2 Ci; Resins - 298 Ci (3 weighted average containers). Exposure time: Trash - 500 hours/year; Resins - 235 hours/year

(3) Based on 2000 hours/year for Construction Area and Plant Locations

Table 5.3 Annual Population Dose Resulting From Onsite LLRW Storage Facility During Fifth Year of Operation(1).

Distance	Population	Exposure Rate (R/yr)	Person-Rem
0-2 miles	630	2.3E-4	1.5E-1
2-3 miles	1,005	5.9E-5	5.9E-2
3-4 miles	2,455	2.6E-5	6.4E-2
4-5 miles	2,230	1.5E-5	3.3E-2
5-10 miles	26,340	6.5E-6	1.7E-1

(1) Annual exposure based on 1.78E-7 Ci-days source term.

these are conservative figures taking no credit for attenuation within the waste material.

Since waste containers will be suspended for short periods of time in an unshielded configuration during placement, it is necessary to consider the exposures that might result in unrestricted areas. Assuming a minimum distance of 300 ft to the nearest shoreline, the following dose rates are the maximimum estimated to result:

	Shoreline mrem in one hr
Resins	2.87
Liquid Concentrates	2.21
Regenerates	1.95
Compacted Trash	.0034
Non-Compacted Trash	.01

During the handling of certain waste containers, the maximum level of radiation at the near shore location may exceed the permissible level of 2 mrem in any one hour (10 CFR 20.105(b)(1)). The accordance with 10 CFR 20.105(a), TVA has proposed the limit of 10 mrem in any one hour. To ensure that no individual is present to receive such a dose, TVA will post the area to indicate no trespassing and will check the near shoreline and immediate lake area for occupancy before liner handling operations begin. To ensure that all other requirements of 10 CFR 20.105 are satisfied, two TLD stations will be used to measure actual doses at the nearest shoreline. Table 5.2 shows that the estimated maximum annual dose resulting from LLRW storage will not exceed 500 mrem/yr to a hypothetical individual who is continuously at the near shoreline site boundary.

5.1.2.2 Accidental Fire

TVA's application discussed several postulated accidents. The estimate radiological impacts of the accidents were all small. The postulated accidental fire in an LLRW Storage Facility trash module had the greatest potential for offsite effects and in discussed below.

The postulated accident is a fire involving a compartment in which 600 drums of trash waste containing a total of 8.8 Ci of activity are stored. In trash or rubbish fires involving non-volatile radionuclides, entrainment of these nuclides would be roughly in proportion to the amount of fly ash produced. An upper limit to the production of fly ash from incinerator experience is estimated to be about 30 lb/T of refuse, or about 1.5 percent[17]. If airflows are very high (e.g., in forced draft situations), this percentage could increase substantially. However, such high airflows would not be expected in the case of a compartment fire, and 1.5 percent can appropriately be used as the maximum fraction of activity released.

This assessment is based on the following set of assumed conditions:

Activity released - 0.13 Ci in 1 hour
Isotopic composition - see Table 5.1
Wind speed - 2 m/s
Atmospheric stability category - G
Atmospheric dispersion factor (from Ref. 18)
- 91 m - 6.6E-3 s/m^3
- 610 m - 2.1E-4 s/m^3
- 1000 m - 8.8E-5 s/m^3

Breathing rate - 1.2 m^3/hr for one hour
Dose conversion factors - see Table 5.4

The Environmental Protection Agency has established protective action guidelines for individuals exposed to radiation as the result of an accident. These guidelines are 1 rem to the whole body and 5 rem to the most severely affected organ. The 50-year dose commitments calculated for the postulated fire are presented in Table 5.5. As can be seen, these doses are well within the EPA guidelines.

5.1.2.3 Waterborne Radioactive Releases

It is conceivable that radioactivity could be leached from the stored waste materials, enter the ground water, and eventually be discharged into the

Table 5.4 Fifty-Year Inhalation Dose Conversion Factors (mrem/pCi)[1]

Radionuclide	f	Total Body	Lung	Thyroid	Bone	Liver	GI Tract
Mn54	.03	7.87E-7	1.80E-6	7.87E-7[2]	7.87E-7[2]	4.95E-6	9.67E-6
Co60	.1	1.83E-6	7.46E-4	1.83E-6[2]	1.83E-6[2]	1.44E-6	3.56E-5
Cs134	.2	9.10E-5	1.22E-5	9.10E-5[2]	4.66E-5	1.06E-4	1.30E-6
Cs137	.3	5.35E-5	9.40E-6	5.35E-5[2]	5.98E-5	7.76E-5	1.05E-6
CO52	.37	2.59E-7	1.16E-4	2.59E-7[2]	2.59E-7[2]	1.98E-7	1.33E-5
$f_i DCF_i$	-	3.46E-5	1.23E-4	3.46E-5	3.46E-5	2.73E-5	9.35E-6

(1) Source: NUREG-0172 (Ref. 20)

(2) DCF data not available; assumed to be equal to DCF for total body.

Table 5.5 Estimated Fifty-year Dose Commitments from Activity Released in Accidental Fire

Location	Activity Inhaled (pCi)	Dose Commitment (mrem/50 yr) Total Body	Lung	Thyroid(1)	Bone	Liver	GI Tract
91 m (Near Shore)	2.87E+5	9.93	35.3	9.93	7.84	12.86	2.68
610 m (Plant)	9.10E+3	0.31	1.12	0.31	0.25	0.41	0.09
1000 m (Nearest Resident)	3.83E+3	0.13	0.47	0.13	0.10	0.17	0.04

(1) Assumed to be equivalent to Total Body Dose Commitment.

Tennessee River. The following assessment shows, however, that such a scenario would be extremely unlikely, and if it did occur, of little consequence.

In order for ground water to become contaminated, leached fluids must be produced, the contaminant of interest must be capable of being transported by the leachate, and this leachate must be capable of entering the ground water system. Even though waste placement operations will not be initiated during times of precipitation, it is still possible that some water may enter the storage modules. This moisture, which could contain radioactivity, will be pumped from the module compartment, collected and disposed of as radioactive liquid waste. It is very unlikely, therefore, that a significant amount of contaminated water will be released and enter the ground water.

The rate at which contaminants migrate through soil is dependent on a number of factors, the most important of which include particle size distribution, pore size distribution (i.e., the void fraction), pH, chemical composition and ion exchange capacity of the soil, and climate. Since many contaminant attenuation mechanisms involve physical and chemical reactions on soil particle surfaces, the potential for attenuation is greatest in soils containing smaller particles. Finer soil materials, such as silts, clays, and colloids, have greater surface area per unit weight and, in general, can be considered as having greater attenuating characteristics than coarser materials such as sands or gravels. The clay material underlying the onsite storage facility is a very efficient attenuating medium.

If it is conservatively assumed that all of the radioactivity present in the storage modules consists of 99.978% Cs-137 and 0.022% Sr-90, and that one percent of the maximum amount of stored activity is released and enters the ground water, the radiological impact would still be minimal. This is due primarily to the fact it would take an extremely long time for the leached material to reach the river.

Distribution coefficients for cesium and strontium in silty clay are assumed to be 750 ml/g and 50 ml/g, respectively. If a bulk density of 1.7 g/cm^3, an effective porosity of 0.4, and a ground water velocity of 1 m/day[21] are assumed, the time required for the leached cesium and strontium to migrate to the river would be about 598 years and 42.6 years, respectively. Any radioactivity which would reach the river will be diluted by one-tenth (1%) of the river flow (about 3.1×10^{16} cm^3/yr) before reaching withdrawal points. Based on the above assumptions, for Cs-137, the calculated whole body 50-year dose commitment is 1.0E-5 mrem and 2.2E-5 mrem to the bone. For Sr-90, the whole body 50-year dose commitment is 3.7E-2 mrem, and 1.2E-1 mrem to the bone. Thus, it can be concluded that the waterborne pathway is not an important means of exposure in this case.

5.1.2.4 Occupation Exposures

Waste handling operations associated with the LLRW Storage Facility will result in a small increase in the total occupational dose of the SNP workforce. The application of engineered safeguards and administrative controls will ensure that all exposures are maintained at levels which are as low as reasonably achievable (ALARA). Specifically, remote handling and lifting devices will be monitored on closed-circuit television to further reduce employee exposures. All vehicles will be monitored for both contamination and dose rates before being allowed to return to the plant.

Table 5.6 contains an estimation of the maximum expected annual collective occupational dose. The total of about 25 person-rem occupational exposure is a very small part of the total occupational exposure expected at a PWR facility. For example, in 1979 the average occupational exposure for PWR is 510 person-rem per reactor[20]. Individual doses are controlled to be within the limits of 10 CFR 20.

There is the possibility that, for short periods of time, during certain waste storage operation, a radiation area (as defined in 10 CFR 20.202(b)(2)) could exist which extends beyond the LLRW Storage Facility security fence. When such a situation occurs, the licensee shall take appropriate measures in accordance with the provisions of 10 CFR 20 in order to protect workers constructing adjacent modules and other individuals not associated with waste storage operations thay may be located in the vicinity of the LLRW Storage Facility. For this reason construction activities may present special problems in the area of Health Physics administration. An intensive effort will have to be

Table 5.6 Maximum Expected Annual Occupational Doses From Onsite Storage of Radioactive Waste[1]

Category	Dose (person-rem/yr)
Truck Driver	.1
Crane Operators	14.64
Waste Handlers and Technicians	8.55
Reactor Plant Employees(2)	2.
TOTAL	25.29

(1) Based on TVA calculations, Reference 3.

(2) 2500 employees exposed, no credit taken for shielding by buildings.

made to assure ALARA policies are adhered to during periods of construction. The possibility of scheduling construction activities around waste loading and inspection activities will significantly reduce occupational doses to construction workers. Because of the unknown extent of construction, no attempt has been made to calculate an occupational dose to construction workers.

5.1.3 Other Operational Impacts

The operation of the LLRW Storage Facility will slightly increase the transportation activities on the SNP site. Since approximately the same number of shipments of resin and trash waste will be made under the proposed action as would be made normally, there would be essentially no change in the average frequency of travel for transfer of LLRW from the radwaste building to the LLRW Storage Facility.

5.2 Evaluation of Options Beyond the Five-Year Term

The options presented in Section 3.1 are being evaluated in order to address environmental impacts that may be a result of the proposed action.

5.2.1 Options at the End of License Term

To reiterate, the options considered in Section 3.1 are:

1. Renew license for continued operation until the five-year design capacity is used, or
2. Renew license for possession only; no new LLRW stored, or
3. Renew license for further operation; remove old LLRW and store only newly generated LLRW, or
4. Renew license for storage of volume reduced LLRW, or
5. Ship stored LLRW for disposal and terminate license, or
6. Volume reduce stored LLRW, ship it for disposal and terminate the license.

The environmental impact of the first two options are expected to be less than the impacts of the proposed action. Option one is based on the assumption that the storage modules are not filled to their five-year total design capacity and, therefore, less LLRW stored than assumed for the proposed action. Since the remaining capacity of the modules and the annual rate of LLRW storage for option one is expected to be less than the maximum utilization assessed for the proposed action, the annual environmental impacts are expected to be less than those presented in Section 5.1. Under the second option, no new waste would be stored. This means no waste handling operations and fewer storage module cap removals. The result would be lower environmental and occupational doses than those assessed for the proposed action. Also, because of decay the total radioactivity in the modules would be less than that assumed for the proposed action. Therefore, the radiological impacts of option two are also expected to be less than that assessed in Section 5.1 for the proposed action.

The impacts of option three may be slightly more than those of the proposed action since this option will require the additional operational step of removing older LLRW before storing newly generated LLRW. This additional step would mean possible additional waste handling by workers and additional time the module cells would be open. This could result in slight increases in occupational and environmental doses over those assessed for the proposed action. Although the impacts for this option could be slightly more than those for the proposed action it is expected that option three would be conducted within appropriate regulatory limits and therefore accomplished in an environmentally acceptable manner.

Option four consists of two operations; LLRW storage and LLRW volume reduction. The impacts from storage of volume reduced LLRW will be similar to those discussed in Section 5.1.2. Without knowing details of the volume reduction method, it is impossible to determine impacts from such operations. However, installation and operation of volume reduction equipment for licensed material would be accomplished within the appropriate regulatory requirements. Under 10 CFR 20.305 treatment or disposal of licensed material by incineration would require NRC approval.

Option five involves simply a reversal of the procedures of the proposed action and therefore because of radioactive decay the impacts are expected to be similar if not less that those assessed for the proposed action.

The impacts of option six would be those of option five plus any impact from volume reduction activities. As previously stated, volume reduction would be accomplished within appropriate regulatory requirements.

5.2.2 Options at End of Life-of-Plant (Decommissioning)

TVA has designed and constructed the LLRW Storage Facility recognizing that decommissioning will be required eventually. Whether or not decommissioning is done at the end of the five-year license term or at a later time is immaterial -- the impacts are similar.

Although TVA has proposed three possibilities for decommissioning the Facility, it has selected none at this time. This is consistent with the NRC's regulations which contemplate detailed consideration of decommission ing near the end of a facility's life by reviewing the licensee's proposed plan at that time.

Decommissioning of the LLRW Storage Facility is not an imminent health and safety problem, nor is it expected to be in the future. The potential for contamination of module walls is low and their coating permits easy cleaning. The lack of equipment and systems, piping and instrumentation within the modules precludes the entrapment of radioactivity in inaccessible locations. NRC previously evaluated TVA's financial capability for decommissioning the SNP reactors[13]. Decommissioning the LLRW Storage Facility would cost a very minor fraction of the cost for decommissioning the reactors. If TVA decides to retain the modules for another use after their use for LLRW storage, the cost for decommissioning would be inconsequential. If the modules are to be razed, up to 95,000 yd^3 of concrete and reinforcing bar would have to be disposed of at a local site. Although the cost of such razing, both economic and environmental, would not be inconsequential, it would still be relatively small in comparison to that for decommissioning the SNP.

5.3 Assessment of Alternatives to the Proposed Action

Since none of the alternatives were found to be viable in fulfilling TVA's needs, no assessment of their environmental impacts is presented. However, because the impacts of the proposed actions are small, it is anticipated that none of the alternatives, regardless of viability, would be found to be significantly environmentally preferable.

6.0 SUMMARY AND CONCLUSION

The action proposed by TVA for the storage of SNP LLRW has been evaluated. Alternatives to the proposed action were also evaluated and found not to be viable because they fail to provide an immediate solution to reduce the uncertainty associated with the availability of disposal space for LLRW at near-surface disposal facilities and thereby provide TVA with the capability for reliable and responsible management of LLRW generated at SNP. The proposed action provides TVA with a means to responsibly manage SNP LLRW in the near term and does not foreclose options (of Tennessee, the region, TVA or NRC) regarding the long-term management of SNP LLRW.

The proposed action involves approximately 20 acres which is within the SNP site boundary. The land used at SNP had already been disturbed during construction of the nuclear plants and possible societal impacts were considered at that time.

The LLRW Storage Facility is designed so that operations will be conducted in accordance with all applicable regulations concerning radiological protection of the general public and work force. Furthermore, activities involving radiation exposures will be subject to the TVA SNP ALARA program. The radiological doses associated with the proposed action are small and within the limits of 10 CFR Part 20. Also, when combined with the doses of the SNP, the dose to the nearest resident is within the requirements of 40 CFR Part 190. The radiological impact to the work force is expected to be only a small fraction of that existing at SNP.

In regard to compatibility with waste management policies, TVA options, and possible future NRC licensing actions for the SNP, the proposed action has no large impacts. The proposed action is compatible with the development of a regional low-level waste management compact. The proposed action would simply fill a gap until the Southeast Interstate Low-Level Radioactive Waste Management Compact is formed and assures capacity for the disposal of the wastes while providing LLRW management flexibility. The proposed action does not irrevocably commit TVA to any one option for the long-term management of SNP waste. Other options may require a licensing action by the NRC. The proposed action does not force, nor does it preclude, any future NRC licensing action.

Given the present status concerning the formulation of waste management compacts, particularly in regard to the Southeastern Region including the State of Tennessee, we have reasonable assurance that, near the end of the license term, there will likely be adequate space available for offsite disposal. Should space for disposal not be available for the stored LLRW at the end of the license term, continued storage can be accomplished in an environmentally acceptable manner, for no expected conditions are known that would cause degradation of container integrity that could not be identified in a timely manner by the container and module monitoring programs. Should preventive actions be necessary, TVA has the capability to repackage the LLRW at the SNP.

Lastly, the proposed action would serve an immediate useful function. It provides TVA an environmentally acceptable alternative to shutting down the SNP if space is not available for disposa' of LLRW from the facility.

On the basis of this Environmental Impact Appraisal, the Staff concludes that the proposed action will not significantly affect the quality of the human environment and that there will be no significant environmental impact from the proposed action. Therefore, the staff has found that an environmental impact statement need not be prepared, and that pursuant to 10 CFR 51.5(c) the issuance of a negative declaration to this effect would be appropriate.

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