UPDATED SAFETY ANALYSIS REPORT
FOR
DECOMMISSIONING THE SNEC FACILITY
REVISION 1

August, 1997

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1.3. SAFSTOR / PRE-DECOMMISSIONING

1.3.1 HISTORICAL INFORMATION

The facility was placed in a condition equivalent to a status later defined by the NRC as SAFSTOR after it was shutdown in 1972. Since then, it has been maintained in a monitored condition. All fuel was removed from the CV in 1972 and shipped to the Atomic Energy Commission (AEC) facility at Savannah River, S.C., which remained owner of the fuel. As a result, neither SNEC nor GPU Nuclear have any responsibility relative to the spent fuel from the SNEC facility. In addition, the control rod blades and the majority of the superheated steam test loop were shipped offsite and disposed of at Savannah River, S.C. Following fuel removal, equipment, tanks, and piping located outside the CV were removed. The buildings and structures that supported reactor operations were partially decontaminated in 1972 through 1974.

After the formation of the GPU Nuclear Corporation in 1980, SNEC formed an agreement with GPU Nuclear to use GPU Nuclear and its resources to maintain, repair, modify, or dismantle SNEC facilities as might be required. Both SNEC and GPU Nuclear are subsidiaries of the same parent company, General Public Utilities Corporation, (GPU). While SNEC remains the owner of the facility, a license amendment issued in 1996 designated GPU Nuclear as a co-license holder. It has direct responsibility for management-related activities and compliance with the license and technical specifications. GPU Nuclear will carry out the SNEC facility decommissioning on behalf of the site owner SNEC.

Decontamination/removal of reactor support structures/buildings was performed in 1987, 1988, and 1989, in preparation for demolition of these structures. This included the decontamination of the Control and Auxiliary Building, the Radioactive Waste Disposal Facility, Yard Pipe Tunnel, and the Filled Drum Storage Bunker, and the removal of the Refueling Water Storage Tank. Upon acceptance of the final release survey by the Nuclear Regulatory Commission (NRC), these structures were demolished in 1992.

In November 1994, the Saxton Soil Remediation Project was completed. This was a comprehensive project involving monitoring, sampling, excavation, packaging and shipment of contaminated site soil. This program successfully reduced radioactive contamination levels outside the exclusion area below the NRC current and presently proposed levels required to meet site cleanup criteria for unrestricted use.

1.3.2 SAXTON NUCLEAR EXPERIMENTAL CORPORATION FACILITY DESCRIPTION

1. GENERAL FEATURES

A. Saxton Nuclear Experimental Corporation Facility Site Layout

The Saxton Nuclear Experimental Corporation (SNEC) Facility Site is shown on Fig. 1-1. The site is located about 100 miles east of Pittsburgh and 90 miles west of Harrisburg in the Allegheny Mountains three fourths of a mile north of the Borough of Saxton in Liberty Township, Bedford County, Pennsylvania. The site is on the north side of Pennsylvania Route 913.

The SNEC Facility was built on the east side of the Saxton Steam Generating Station (previously demolished) owned by the Pennsylvania Electric Company (Penelec), (one of the three SNEC owners). The SNEC Facility site is entirely contained within the Penelec site which comprises approximately 150 acres along the Juniata River. See Fig. 1-2.

The SNEC Facility site consists of the 1.148 acre tract deeded to SNEC from Penelec on which is located all of the structures, systems and components described below. In addition, on Penelec property immediately adjacent to the SNEC site are temporary facilities to support the decommissioning of the site. These include work crew, restroom, tool and office trailers, material staging and laydown areas, vehicle parking, etc.

The major permanent structures, systems and components are described in the following sections.

B. Containment Vessel Arrangement

The Containment Vessel (CV) encloses that part of the nuclear facility that contains the reactor vessel, main coolant and certain other radioactive auxiliary systems. The CV was designed to prevent the escape of vapor and fission products to the atmosphere in the unlikely event of a break in the high-pressure equipment. It is the only remaining prominent, original plant structure on the site.

The vessel is a self-supporting, vertical, cylindrical steel vessel with a hemispherical head at the top and an elliptical head at the bottom. It is 50 ft. in diameter and has an overall height of 109 ft. 6 in. The bottom of the vessel is located 50 ft. 4 in. below grade with the bottom head embedded in concrete.

The CV is divided into five general areas. These are the general operating area, the reactor compartment, the primary compartment, the auxiliary compartment, and the control rod compartment. These areas are formed by concrete walls which provide shielding between the various compartments. All areas except the general operating area are located in the below grade portion of the vessel. The general arrangement of the compartments and the equipment within them is shown on Figures 1-3 & 1-4.

The major portion of the operating floor is located at an elevation of 812 ft., one foot above the grade elevation of 811 ft. The portion of the operating floor that covers the primary compartment is located at an elevation of 818 ft., normal access to the containment vessel is made at this elevation. Access to the reactor compartment and associated storage well is provided at the operating floor level of 812 ft. by means of removable concrete shield slabs. A movable bridge is provided over the reactor compartment. The equipment access opening and emergency exit opening are also located at elevation 812 ft. These openings were disabled following final plant shutdown.

All permanent plant equipment described is shutdown and disabled with the exception of the personnel access hatch and the 20-ton rotary bridge crane. All permanent electrical systems have been deenergized and removed. All liquid systems have been drained, vented and in most cases opened for characterization. All of the systems and components described are scheduled to be removed and disposed of as part of the facility decommissioning. All of the structures described are scheduled to be removed and disposed of as part of the facility decommissioning except for the portions which are greater than three feet below grade and are permitted to be released under the applicable radiological release criteria.

The reactor compartment houses the reactor vessel, spent fuel rack, and demineralizer vessels. All new and spent reactor fuel was removed from the facility following plant shutdown in 1972.

The primary compartment houses the steam generator, main coolant pump and pressurizer. The regenerative and non-regenerative heat exchangers are also located in this compartment.

The auxiliary compartment, which is divided into three levels, houses various auxiliary system equipment such as heat exchangers, pumps, and tanks. The shutdown cooling heat exchanger and pumps, discharge tank and pumps, and sump pumps are located in the bottom section of the auxiliary compartment.

The control rod compartment is a small room located below the reactor vessel which houses the control rod drive mechanisms and air-handling unit.

2. MAIN COOLANT SYSTEM

A. Function

The main coolant system including all components is deactivated, disabled and drained and performs no function. It is not needed for any safety related purpose.

The system and all components are scheduled to be removed and disposed of as part of the plant decommissioning.

B. General Description

The main coolant system consists of a single closed loop containing the reactor vessel; a steam generator; a canned-motor type circulating pump; loop piping; and temperature, pressure, and flow instrumentation. A surge line connects the loop to the system pressurizer vessel. Auxiliary system piping connections into the main coolant system are described later under the appropriate auxiliary system. This system has been drained and vented. The system is located entirely inside the Containment Vessel.

C. Reactor Vessel

The vessel, which contained the reactor core, is a right circular cylindrical container with a hemispherical bottom head and a flanged and gasketed removable top head. The flanged head has a monitored leak-off connection and provision for seal welding. The vessel has a 58-inch ID and an overall height of 18 feet. The top and bottom heads are 5½ inches and 4½ inches thick respectively. The main cylindrical shell course, like the shell of the SPERT III reactor vessel, is made up of relatively thin plates, individually formed into barrels which are wrapped and welded one to another to the required total thickness of 5 inches. This type of construction known as "multi-layer" construction is shown in Figure 1-5 and described in WCAP-1391, MULTI-LAYER CONSTRUCTION FOR THE SAXTON REACTOR VESSEL. This report describes the background and history of multi-layer construction and the reasons for its use in the Saxton vessel including economy, operating safety and flexibility of design.

Westinghouse Report WCAP-1620, SUPPLEMENTARY TECHNICAL INFORMATION ON THE SAXTON REACTOR VESSEL summarizes additional technical information requested by the Atomic Energy Commission, Reactor Hazards Evaluation Branch. This report gives additional information in the areas of multi-layer vessel history, fabrication, quality control, service stresses, and operating limitations.

The inside surfaces of the vessel are clad with stainless steel.

The cylindrical thermal shield is made of stainless steel and is concentric with the core; it rests on support lugs attached to the vessel wall. The core barrel also served as a thermal shield and had a water annulus between its outside diameter and the inside diameter of the thermal shield. The support plates are attached to large thin-walled stainless steel cylinders provided with mounting flanges at the top, which supported the assembled core from a ledge just below the vessel closure.

The six control rod mechanism thimbles are welded to adapter parts in the bottom of the vessel. The top head has eleven openings for the insertion of test elements, instrument leads, and a superheater test loop assembly.

A summary of the reactor vessel characteristics is given in Table 1.3-1.

D. Steam Generator

The single steam generator, shown in Figure 1-6 is of the vertical shell and U-tube type with integral steam drum and three stages of moisture separation. All surfaces, which were in contact with the main coolant water, are either stainless steel or Inconel.

The main coolant flowed into the inlet channel at the bottom through a 12-inch (nominal) inlet nozzle. From the inlet channel, the coolant flowed up through the U-tubes and back down to the outlet channel and left through a 14-inch (nominal) outlet nozzle. A welded Inconel partition plate separates the inlet and outlet channels. Access to the underside of the tube sheet is provided by a manway in the bottom of each channel. These manways were sealed with bolted double gasketed covers. The steam generator is suspended from the operating deck above by adjustable solid rods.

The characteristics of the steam generator are shown in Table 1.3-2.

E. Main Coolant Pump

The main coolant pump is a single stage centrifugal pump of the canned motor type. The pump consists of a sealed motor and centrifugal pump impeller mounted on a single shaft, self-contained heat exchanger, volute and high-pressure motor terminals.

The suction and discharge nozzles and pump casing are permanently welded into the main coolant piping. The motor end plate and motor to impeller casing closures are bolted and double gasketed.

The rotor and stator cans of the pump motor are Inconel, thrust and journal bearings are Stellite-graphitar and all other parts which were in contact with the main coolant are stainless steel. The main coolant pump is suspended from the operating deck above by adjustable solid rods.

F. Coolant Piping and Fittings

The main coolant piping is fabricated of stainless steel was designed in accordance with Section I of the ASME Boiler and Pressure Vessel Code. Centrifugally cast pipe and cast fittings are utilized. The lines connecting the reactor vessel to the steam generator and the main coolant pump to the reactor vessel are of nominal 12-inch pipe. The line connecting the steam generator to the main coolant pump is a nominal 14-inch pipe.

The flow-measuring element located in the line between the steam generator and main coolant pump is a venturi-type insert. This insert is of 316 stainless steel and is welded to the inside of the main coolant pipe.

3. PRESSURE CONTROL AND RELIEF SYSTEM

A. Function

The pressure control and relief system is deactivated, disabled and drained and performs no function. It is not needed for any safety related purpose. The system and all components are scheduled to be removed and disposed of as part of the plant decommissioning.

B. Description

The pressure control and relief system consists of a pressurizer vessel equipped with replaceable electric heaters, safety valves, a relief valve, and spray system; a discharge tank equipped with a spray system and rupture discs; two discharge tank pumps; and interconnecting piping, valves, and instrumentation. The system is located entirely inside the Containment Vessel.

The pressurizer and its associated components are shown on Figure 1-7.

Volume surges were transmitted to and from the pressurizer by a 3-inch pipe that runs from a point near the steam generator outlet nozzle into the side of the pressurizer.

A 1-inch spray line enters the vessel at the top and terminates in a spray nozzle inside the unit. This line is connected to the main coolant system at the discharge of the main coolant pump. The pressurizer is suspended from the operating deck above by adjustable solid rods.

A nozzle is provided on the pressurizer for connection to a power-operated relief valve. The valve was provided to prevent or reduce the possibility of operation of the self-actuated safety valves. The safety valves were provided to accommodate large volume insurges which were beyond the pressure limiting capacity of the pressurizer, its spray system, and the relief valve.

The discharge tank received steam from the pressurizer relief valve or safety valves and provided temporary storage of liquids and gases from various vents and drains inside the containment vessel until these wastes could be pumped to the radioactive waste disposal facility (previously removed) for treatment.

C. Components

1. Pressurizer

The pressurizer is a cylindrical pressure vessel, which is installed with its longitudinal axis in a vertical position. The pressurizer is equipped with a bundle of electric heaters composed of 18 stainless steel sheathed immersion heaters individually welded to a stainless steel diaphragm which is backed up by a heavy carbon steel blind flange. The heater rods thus extend vertically up into the vessel body. The pressurizer shell and heads are fabricated from ASTM A-212 Grade B carbon steel clad with austenitic stainless steel. All internals which were exposed to primary water or steam are constructed of austenitic stainless steel. The pressurizer is shown on Figure 1-7.

The pertinent characteristics of the pressurizer are listed on Table 1.3-3.

2. Discharge Tank

This tank is a right circular cylinder with both ends closed by standard ASME spherically dished heads. A corrosion resistant lining adequately protected all wetted surfaces. The tank is equipped with a 16-inch circular manhole with bolted and gasketed cover plate.

The discharge tank was designed in accordance with Section VIII of the ASME Code for Unfired Pressure Vessels, Nuclear Code Cases 1270N and 1273N and all applicable sections of the Pennsylvania Department of Labor and Industry Regulations. A sparger is installed inside this tank which properly distributed the flow of steam at a minimum pressure drop and to provide the most rapid rate of steam condensation. Two rupture discs were installed on this tank to relieve excessive pressure to the containment vessel interior.

The pertinent characteristics of the discharge tank are listed in Table 1.3-4.

3. Discharge Tank Drain Pumps

Two discharge tank drain pumps are provided. Each is a single stage centrifugal pump.

4. PURIFICATION SYSTEM

A. Function

The purification system is deactivated, disabled and drained and performs no function. It is not needed for any safety related purpose. The system and all components are scheduled to be removed and disposed of as part of the plant decommissioning.

B. Description

The purification system consists of a regenerative heat exchanger, let-down flow control valve, non-regenerative heat exchanger, purification demineralizer, boric acid demineralizer, filter, and the necessary valves, piping, controls, and instrumentation. The system is located entirely inside the Containment Vessel.

C. Components

1. Regenerative Heat Exchanger

This unit is a horizontally mounted U-tube and shell type heat exchanger. The tubes are welded to the tube sheet and the end closure is of a welded cap design. The tubes and all other material in contact with the main coolant water are Type 304 stainless steel. The regenerative heat exchanger was designed for 2750 psig pressure.

2. Nonregenerative Heat Exchanger

This heat exchanger is a flanged head, horizontal, U-tube, and shell type unit. The tubes and all other surfaces which were in contact with the main coolant are Type 304 stainless steel. The shell and tube sides of this unit were designed for 150 psig at 300°F.

3. Demineralizers

Both demineralizer vessels are constructed of Type 304 stainless steel and contained 6 cubic feet of resin each. The design pressure for the vessel shells was 150 psig at 366°F.

The purification demineralizer contained a mixture of cation and anion resins. The boric acid demineralizer contains an anion resin, which was in the OH^- form. All resins were discharged and disposed of following final plant shutdown. Some resin, which could not be flushed, remains in the vessel.

4. Filter

Two filter units are provided; a nine-element disposable cartridge type unit followed by a single-element unit. The bodies of both filter housings are 300 Series stainless steel capable of withstanding 150 psig and 200°F. The filter elements were removed and disposed of following final plant shutdown.

5. COMPONENT COOLING SYSTEM

A. Function

The component cooling system is deactivated, disabled and drained and performs no function. It is not needed for any safety related purpose. The system and all components are scheduled to be removed and disposed of as part of the plant decommissioning.

B. Description

The component cooling system is located entirely inside the containment vessel and consists of two centrifugal circulating pumps, two heat exchangers, and the necessary piping, valving, and instrumentation. The system is located entirely inside the Containment Vessel.

C. Components

1. Component Cooling Heat Exchangers

These heat exchangers are flanged head, horizontal, U-tube, and shell type units. They are constructed of carbon steel with admiralty tubes. The shell sides and tube sides were designed for 150 psig and 200°F.

2. Component Cooling Pumps

Two single speed, and suction, vertically split casing, centrifugal pumps are provided for circulating the component cooling water. Each pump is provided with a single mechanical seal to minimize leakage. The design pressure is 150 psig at 200°F. The pumps are of cast iron construction with bronze trim.

6. SAMPLING AND LEAK DETECTION SYSTEM

A. Function

The sampling and leak detection system is deactivated, disabled and drained and performs no function. It is not needed for any safety related purpose. The system and all components are scheduled to be removed and disposed of as part of the plant decommissioning. The system is located entirely inside the Containment Vessel.

B. Description

1. General

The system consists of piping and equipment located completely inside the containment vessel. The sampling portion of the system is composed of piping, valving and instrumentation necessary for transporting the samples from the source to the sampling station. Two sample coolers were provided to cool the high temperature, high-pressure sample bomb effluent. The leak detection portion of the system is composed of piping, valves, and instrumentation located entirely within the containment vessel.

2. Main Coolant Sample

This sample line is connected to the main coolant loop on the pressurizer spray line takeoff and provided a source of high pressure, high temperature main coolant for analysis. The line is constructed of ¼-inch stainless steel tubing and was designed for 2500 psig at 650°F.

3. Pressurizer Vessel Sample

This sample line is connected to the pressurizer vessel below the low water level line and provided a source of high pressure, high temperature pressurizer vessel water for analysis. The sample line is similar to the main coolant sample line above.

4. Purification Demineralizer and Boric Acid Demineralizer Inlet Sample

This sample line is connected to the purification system piping upstream of the demineralizers and provided a source of demineralizer influent water for analysis. This line was designed for 150 psig at 400°F and is constructed of ½-inch stainless steel tubing.

5. Purification Demineralizer and Boric Acid Demineralizer Outlet Sample

This sample line is connected to the purification system piping downstream of the demineralizers and provided a source of demineralizer effluent water for analysis. This line was designed for 150 psig at 400°F and is constructed of ½-inch stainless steel tubing.

6. Storage Well Demineralizer Samples

These sample lines are connected to the storage well piping upstream and downstream of the demineralizer and provided a source of storage well inlet and outlet water for analysis. These lines were designed for 150 psig at 400°F and are constructed of ½-inch stainless steel tubing.

7. Reactor Vessel Shell Leak

This sample line is connected to a pipe nipple protruding from the reactor vessel shell and provided indication of leakage past the inner shell of the reactor vessel. This line is constructed of ½-inch carbon steel tubing with a design pressure of 50 psig.

8. Reactor Vessel Gasket Leak

This line is connected to a pipe nipple leading from the space between the inner and outer gaskets at the reactor vessel head closure. This line is constructed of stainless and carbon steel tubing designed for 2500 psig at 650°F.

9. Gasketed Closure Leakoffs

Various gasketed closures are provided with a leakoff line which is connected to relief valve and common header. These lines are constructed of ½-inch carbon steel tubing designed for 150 psig at 400°F.

10. Valve Stem Leakoffs

Various valves are provided with valve stem leakoff lines. These lines are constructed of ½-inch carbon steel tubing designed for 150 psig at 400°F. These lines form a common header which is connected to the gasketed closure leakoff header.

11. Reactor Vessel Seal Weld Leak

This line is connected to the reactor vessel between the outer gasket and the seal weld to provide indication of leakage past the outer gasket at the reactor vessel head closure if a seal weld is required. This line is constructed of stainless and carbon steel tubing designed for 2500 psig at 650°F.

C. Components

1. Sample Coolers

The sample coolers are tube in shell type coolers. The shell is constructed of stainless steel and the tubes are of Inconel. The design conditions for this cooler were 2500 psig at 650°F.

7. SHUTDOWN COOLING SYSTEM

A. Function

The shutdown cooling system is deactivated, disabled and drained and performs no function. It is not needed for any safety related purpose. The system and all components are scheduled to be removed and disposed of as part of the plant decommissioning. The system is located entirely inside the Containment Vessel.

B. Description

The system is located entirely within the containment vessel and consists of a heat exchanger, two circulating pumps, piping, valves, fittings, instrumentation and control.

The inlet line to the shutdown cooling system is connected through the safety injection system piping to the outlet nozzle of the reactor vessel. After passing through the shutdown cooling heat exchanger, or the non-regenerative heat exchanger which serves as a spare, water was returned to the main coolant system by the shutdown cooling pumps.

C. Components

1. Shutdown Cooling Heat Exchanger

This heat exchanger is a flanged head horizontal U-tube and shell type unit and is a duplicate of the purification system non-regenerative heat exchanger.

2. Shutdown Cooling Pumps

These pumps are the end suction centrifugal type with vertically split casing and back head cradle. Wetted pump surfaces are stainless steel and the pump shaft is provided with a double mechanical seal to minimize leakage to the atmosphere.

8. SAFETY INJECTION SYSTEM

A. Function

The safety injection system is deactivated, disabled and drained and performs no function. It is not needed for any safety related purpose. The system and all components are scheduled to be removed and disposed of as part of the plant decommissioning.

B. Description

This system was principally located outside the CV. Those components were previously removed. The only remaining portions of the system are the piping runs and the associated valves inside the CV.

C. Components

Three inch injection piping and motor operated, check and miscellaneous valves.

9. STORAGE WELL SYSTEM

A. Function

The storage well system is deactivated, disabled and drained and performs no function. It is not needed for any safety related purpose. The system and all components are scheduled to be removed and disposed of as part of the plant decommissioning. The system is located entirely inside the Containment Vessel.

B. Description

The storage well system consists of two circulating pumps, a heat exchanger, demineralizer, filters, and the necessary piping, valving, and fittings. All components are located inside the Containment Vessel.

C. Components

1. Storage Well Heat Exchanger

The storage well heat exchanger is a horizontal shell and U-tube type. It contains Type 304 stainless steel tubes which are seal welded to a stainless clad tube sheet. The tube side design pressure was 125 psig at 150°F and the shell side design pressure was 150 psig at 150°F.

2. Demineralizer

The storage well demineralizer vessel is a 15-inch diameter by 54-inch high mixed bed demineralizer constructed of Type 304 stainless steel. It contained 5 cu. ft. of resin. All resins were discharged and disposed of following final plant shutdown. Some resin, which could not be flushed, remains in the vessel.

3. Prefilter

The demineralizer prefilter is a 120-gpm-cartridge type filter of Type 304 stainless steel construction. The filter element was removed and disposed of following final plant shutdown.

4. Post-Filter

The demineralizer post filter is a 15-gpm cartridge type filter of Type 304 stainless steel construction. The filter element was removed and disposed of following final plant shutdown.

5. Storage Well Pumps

The storage well pumps are horizontal, centrifugal pumps with mechanical seals.

10. ORIGINAL COOLING, HEATING, AND VENTILATING SYSTEMS

A. Function

The original cooling, heating and ventilating system is deactivated and disabled and performs no function. It is not needed for any safety related purpose. The system and all components are scheduled to be removed and disposed of as part of the plant decommissioning.

B. General Description

Each of the four major containment vessel compartments was conditioned by a separate air-handling unit. Units for the operating and auxiliary compartments contain a cooling coil which was supplied with river water and a heating coil which was supplied with steam. Units for the control rod and primary compartments contain a cooling coil only. All remaining portions of the system are located inside the Containment Vessel.

C. Components

The pertinent characteristics of the system components are listed in Table 1.3-5.

11. VENTS AND DRAINS SYSTEM

A. Function

The vents and drains system is deactivated, disabled and drained and performs no function. It is not needed for any safety related purpose. The system is scheduled to be removed and disposed of as part of the plant decommissioning.

B. Description

Three main headers are provided in the containment vessel. These are a vent and drain header for radioactive gases and liquids, a drain header for non-radioactive liquids, and a flushing header. The vent and drain header for radioactive gases and liquids collected vented gases; relief valve discharges, liquids, and valve leakoffs from radioactive systems and discharged them to the pressure relief system discharge tank. The drain header for nonradioactive liquids collected such liquids and discharged them to the containment vessel sump. The flushing header collected flushing effluents from the purification system filter and demineralizers. All components are located inside the Containment Vessel.

12. SHIELDING

A. Function

The radiation shielding no longer performs its original primary function of permitting CV entry shortly after reactor shutdown and to provide sufficient shielding to allow routine maintenance and refueling operations. The shielding does assist in keeping doses to the work force as low as reasonably achievable (ALARA). The shielding which is above three feet below grade will be removed as part of the decommissioning process. Shielding below this level which can meet the applicable release criteria will remain.

B. General

The radiation shielding was designed to provide biological protection wherever a potential health hazard from radiation existed. The shielding is divided arbitrarily into two categories according to function. These are (1) primary shield, and (2) secondary shield. Figures 1-3 and 1-4 show the general shielding layout.

C. Primary Shield

This consists of a reinforced ordinary concrete ($\rho = 2.3$) structure, immediately adjacent to the exterior of the neutron shield which served to attenuate radiation from the reactor to the same level as the radiation emanating from the main coolant system. The bottom portion of the shield is an integral part of the main structural concrete support for the reactor vessel.

The radial shield consists of a 5-foot thick concrete wall separating the reactor area from the primary equipment area, and a 1.5-foot thick concrete annular wall extending from the main structural concrete to the operating deck above the reactor.

D. Secondary Shield

The secondary shield consists of reinforced ordinary concrete ($\rho = 2.3$) and utilizes the earth surrounding the containment vessel below grade elevation. The vertical portion of the shield, inside the containment vessel, consists of an ordinary concrete wall, separating the primary from the auxiliary compartment. This wall is 3.5 feet thick from the operating deck to Elevation 800′ - 0″, below which it tapers to 2.5 feet. In addition, a 1.5-foot thick annular concrete wall surrounds the entire plant below grade within the containment vessel.

Supplementary secondary shielding is provided external to the containment vessel. The reactor compartment is surrounded by a 3-foot thick concrete wall extending from 5 feet below grade to a point 3 feet above grade. The pipe tunnels outside the reactor and primary compartments are shielded by 3 foot and 2 foot thick concrete slabs respectively.

The operating floor over the primary compartment consists of a 3.5-foot thick concrete shield.

The control rod room, which houses the control rod drive mechanisms, is shielded by an iron-shot filled tank.

13. CONTAINMENT VESSEL

A. General

The containment vessel is a vertical cylindrical steel vessel with a hemispherical head at the top and an elliptical head at the bottom. It is 50 feet in diameter and has an overall height of 109 ft. 6 in. The bottom of the vessel is located 50 ft. 4 in. below grade with the bottom head embedded in concrete.

The portion of the containment vessel wall that is below grade is provided with an inner wall of reinforced concrete that is 1 ft. 6 in. thick. The primary purpose of this wall is to reinforce the below grade cylindrical portion of the containment vessel shell against external pressure due to ground water and backfill and to contribute to the support of the concrete operating floor. One-half inch thick, premolded, expansion material is provided between the steel shell and the inner concrete wall to a depth 6 feet below grade to provide for differential expansion between the steel shell and the inner concrete wall.

The general arrangement of the containment vessel is shown on Figures 1-3 & 1-4.

B. Function

1. Containment Isolation

The containment vessel is no longer needed to perform its original function of containment isolation. Containment isolation is no longer required to protect against possible overpressure as all fuel has been removed from the facility and all liquid systems are drained and vented. All original energy sources have been removed.

2. Containment Integrity

Containment integrity is maintained to serve as a barrier to prevent the inadvertent release of airborne and loose surface radioactive materials and to prevent unauthorized intrusion. The CV is equipped with intrusion alarms to prevent and detect unauthorized entry. The requirement to maintain containment integrity is limited to those features of the Containment Vessel liner required to serve as contamination and intrusion barriers.

C. Design Features and Fabrication

The design and fabrication of the vessel was in accordance with the ASME Code and the latest applicable code cases. Steel plate and all other pressure parts of the vessel conform to ASTM Specifications A-201 Grade B Firebox Quality and in addition are heat-treated to ASTM A-300 Specifications for plates and A-350 Specifications for forgings as covered in Code Case 1272N. All welding, stress relief, radiographing, and other inspection and test procedures used, conformed to the requirements of Section VIII of the ASME Boiler and Pressure Vessel Code as modified by Code Case 1272N. Shell welds were fully radiographed, double welded butt joints. All welds, such as those around nozzles and opening frames were examined for cracks by magnetic particle or fluid penetrant methods of inspection. All doors, nozzles, and opening frames were preassembled into shell plates and stress relieved as complete assemblies before they were butt-welded into the shell. Openings were designed and reinforced so that all parts are at least as strong as the shell itself. The portion of the containment vessel, which is above grade, is not insulated. A refined coal tar enamel (Bitumastic) is applied to the outside surface of the below grade portion of the vessel that is not embedded in concrete.

The pertinent characteristics of the containment vessel are listed in Table 1.3-6.

The vessel will withstand an 80 mph wind load (20 psf) applied to the vertical projection of the above grade portion of the vessel and a snow load of 25 psf applied to all portions of the hemispherical head with a slope within the range of 0 to 50%.

D. Components

1. Personnel Access Air Locks

Two personnel double door assemblies are mounted in the vessel shell, slightly above grade level. One assembly is for normal personnel access to and from the vessel and the second provided an emergency exit from the vessel. The emergency exit air lock was disabled following final plant shutdown. Each door assembly consists of two pressure-tight latched doors mounted in a cylindrical section. Each door was designed to withstand the design pressure or vacuum within the vessel without leakage, and opens toward the inside of the vessel so that the vessels design pressure will help to form a seal. The doors for normal access are 2 ft. 6 in. by 6 ft. 8 in. and the doors for emergency escape are 2 ft. 6 in. in diameter.

2. Equipment Access Openings

One flanged and bolted access opening for the removal of reactor plant components is mounted in the vessel shell slightly above grade level. The opening was designed to withstand the design pressure or vacuum within the vessel and will utilize any internal vessel pressure to help effect a leak-proof seal. The opening is 6 feet in diameter.

3. Piping and Ventilating Penetrations

All piping and ventilating penetrations are below grade except for those penetrations for ventilating air. The penetrations for lines which operated at a temperature below 250°F consist of a section of the carbon steel or stainless steel pipe system welded to the vessel plate and stress relieved in the fabrication shop. The penetrations for 3 inch safety injection lines and lines which operated at a temperature greater than 250°F utilize thermal sleeves that are sealed to the pipe system by means of an expansion joint or a solid metal end connection.

14. MISCELLANEOUS STRUCTURES, SYSTEMS & COMPONENTS

A. Reactor Compartment and Storage Well

A rectangular opening approximately 27 feet 6 inches by 13 feet can be provided in the operating floor above the reactor compartment and associated storage well by the removal of the seven precast 20-ton concrete slabs. The reactor is located in the west end of this compartment. The east end of the compartment forms a spent fuel storage area.

The concrete surfaces of the reactor compartment and storage well are lined with a Series 300, four-coat catalized phenolic protective lining made by the Carboline Corporation. Materials which were in contact with the storage well water are made of either aluminum or stainless steel.

B. Equipment, Tools, and Structures

1. Rotary Bridge Crane

A 20-ton rotary bridge crane with a single two-speed hoist having a 60-foot lift is mounted on the containment vessel shell. The hoisting speeds are 5 and 15 fpm. The low speed permitted safe handling of the reactor vessel head and core components. The higher speed was for raising or lowering tools and equipment into shielded compartments and is the normal operating speed. The traverse speed of the trolley is 25 fpm. The bridge will rotate up to 370° at a traverse speed at the rail of 25 fpm.

C. Make-up and River Water Cooling

1. Function

The make-up and river water cooling systems are deactivated, disabled and drained and performs no function. They are not needed for any safety related purpose. The systems and all components are scheduled to be removed and disposed of as part of the plant decommissioning.

2. Description

The make-up and river water cooling systems were principally located outside the Containment Vessel and those portions of the system and all major components have been previously removed. Minor piping runs and valves remain in the Containment Vessel.

15. DECOMMISSIONING SUPPORT STRUCTURES, SYSTEMS AND COMPONENTS

A. Decommissioning Support Facility

This pre-engineered facility was constructed to support decommissioning operations at the site. It consists of a steel "Butler" type building approximately 40' x 60', on slab construction which is located against the Containment Vessel (CV) on the south side. The building consists of three structures; the main Decommissioning Support Building (DSB), the Material Handling Bay (MHB), and the Personnel Access Facility (PAF). Various doors are provided and it is planned to cut an access from the MHB into the CV to facilitate removal of components to be packaged and prepared for shipment. A 10 ton hoist is planned to be installed between the CV and MHB once this access is cut, to aid in the removal of these components.

This facility does not perform any function needed for the safe operation of the plant. It may serve as the Exclusion Area boundary when the CV access is cut open. The DSF is equipped with intrusion alarms to prevent and detect unauthorized entry.

B. Containment Vessel Decommissioning Ventilation System Design

Since the original, permanent plant ventilation systems are no longer functional, a temporary ventilation system has been installed.

1. Function
   a. Provide for worker comfort by minimizing CV temperature extremes.
   b. Minimize potential for confined space restrictions by providing sufficient air volume changes.
   c. Reduce CV interior Radon concentrations.
   d. Provide sufficient face velocity at the CV/DSB opening to meet the Containment Integrity requirements as given in Section 13.B.2.
   e. Provide for filtration and quantification of radioactive airborne effluent releases.

2. General Description

   The system consists of ductwork installed inside the CV to provide suction from above and below the operating floor (818' elev.); outside the CV, a high efficiency particulate air (HEPA) filter and housing, a 6500 CFM nominal flow fan unit, an effluent radiation monitor, and associated ductwork, controls, instrumentation and alarms are installed. Refer to Figure 1-8.

3. Components

   a. 6500 - CFM nominal flow fan, 230V/480V/3ph/60Hz, 10BHP motor.
   b. 6500 - CFM pre-filter/HEPA filter housing with six 24" x 24" pre-filters and six 24" x 24" Nuclear Grade HEPA filters rated for >99.97% removal efficiency.
   c. Effluent radiation monitor, Eberline Model AMS-3 provided with isokinetic sampling of the air stream.
   d. Smoke detectors, one installed in each CV suction duct.
   e. HEPA filter differential pressure instrumentation.

f. Alarms and indication for:
   (1.) Low HEPA Filter Differential Pressure
   (2.) Smoke/Fire
   (3.) Radiation Monitor Alarm
   (4.) Low Shed Temperature
   (5.) Radiation Monitor Failure
   (*Note:* Alarms 2, 3 and 5 provide for automatic trip of the ventilation fan.)

4. Design

The ventilation system consists of one exhaust fan drawing air from the upper and lower portion of the CV. The exhaust fan is a centrifugal unit that is provided with pre-filters and HEPA filters for the removal of airborne particulates in the exhaust air. There are no radioactive gases remaining at the facility. To provide indication and monitoring of radioactive releases, a radiation monitor, with isokinetic sampling, is installed downstream of the HEPA filter unit. The filtration unit was designed and constructed in accordance with ANSI N509 and tested per ANSI N510. The exhaust fan and filtration units are located outside the CV on the north side and are ducted to the CV using the existing 17- inch CV ventilation penetration. The duct penetration is thoroughly sealed to prevent exfiltration of airborne radioactive materials. The make-up air for the exhaust comes from the Decommissioning Support Building (DSB) through the roll-up doors or gravity type (counter-balanced) wall louvers. The approximate face velocity at the planned opening between the DSB and the CV is 45 feet per minute (fpm). This flow arrangement provides for ventilation of the DSB and CV from low to high contamination areas and provides sufficient face velocity at the planned DSB/CV opening to meet the containment integrity goals i.e. prevent the inadvertent release of radioactive contamination or airborne radioactivity.

The flow path of the air is from the DSB wall louvers (or roll-up doors), through the DSB, through the planned CV/DSB opening and across the CV operating floor. From the operating floor, the air will sweep across the CV storage well/spent fuel pool opening to be exhausted through exhaust registers attached to a plenum, which runs from elevation 832' to 811'- 6". A duct connection is provided inside the CV on the inlet plenum to allow connection of a flexible duct hose for local ventilation needs. The plenum then connects to the existing 17 inch CV ventilation penetration. Outside the CV, the 17 inch penetration is provided with an isolation damper and is connected to the filtration unit. Air flows from the filtration unit to the fan and is exhausted via a short stack. The stack height and arrangement was selected based on industrial safety considerations and to prevent the intrusion of debris. The stack height is not relevant to radioactive release criteria for this situation.

The system capacity was sized to provide sufficient face velocity at the planned CV/DSB opening to ensure airflow into the CV and to provide adequate turnover of the CV air volume per industry standards. The face velocity of approximately 45 fpm and CV air volume change rate of approximately three per hour meet these goals.

The alarms provide indication locally and at the GPU Energy Dispatch Facility, which is manned 24 hours a day. Administrative controls are provided to ensure proper notification and actions are taken in the event of an alarm.

5. Surveillances

The following surveillances/tests are required when the system is operational:

a. Annual verification of HEPA filter efficiency in accordance with ANSI N510.
b. Semi-Annual calibration of the radiation monitor in accordance with established procedures.
c. Annual calibration of HEPA filter differential pressure instrumentation with established procedures.
d. Quarterly functional checks of all alarms in accordance with procedures.
e. Weekly functional check of the effluent radiation monitor in accordance with procedures.

16. TABLES

TABLE 1.3-1

REACTOR VESSEL CHARACTERISTICS

Vessel inside Diameter, inches	58
Wall Thickness, inches	5
Hemispherical Bottom Thickness, inches	4½
Hemispherical Top Head Thickness, inches	5¼
Overall Height, feet	18
Original Design Pressure, psia	2500
Original Cold Hydrostatic Test Pressure, psia	3750
Weights (lbs):	
Reactor vessel	63,790
Head Assembly	19,194
Thermal shield	10,491
Vessel head studs, nuts & washers	6,372
Shot Shield Assembly	15,712
Vessel Canning Assembly	1,756
Internal Support Assembly	7,090

TABLE 1.3-2

STEAM GENERATOR CHARACTERISTICS

Number of U-tubes	736
Tube Material	304 ss
Shell Material	carbon steel (ASTM-A-212 Gr. B)
Tube Outside Diameter, inches	0.625
Tube Wall Thickness, inches	0.058
Shell Outside Diameter, inches	52.25
Tube Sheet Thickness, inches	9.5
Inlet Nozzle Size (Nominal), inches	12
Outlet Nozzle Size (Nominal), inches	14
Overall Length, feet	20
Original Shell Side Design Pressure, psia	1800
Weight (lbs)	52,000

TABLE 1.3-3

PRESSURIZER CHARACTERISTICS

Original Maximum Working Pressure, psia	2500
Original Maximum Working Temperature, °F	668
Original Normal Operating Pressure, psia	2000
Original Normal Operating Temperature, °F	636
Free Internal Volume, cu. Ft.	100
Weight (lbs)	25,000

TABLE 1.3-4

DISCHARGE TANK CHARACTERISTICS

Construction material	Carbon steel
Design pressure, psia	75
Design temperature, °F	300
Design vacuum, inches of water	10
Tangent length, ft.	6.75
Diameter, ft.	5
Weight, lbs	3,500

TABLE 1.3-5

CHARACTERISTICS OF ORIGINAL CONTAINMENT VESSEL VENTILATING EQUIPMENT

Unit	Original Flow Rate, cfm	Original Outlet Velocity (fpm)	Inlet Filters (since removed)
Operating Area Air Handler	8,000	1920	High Efficiency
Primary Compartment Air Handler	5,750	1680	High Efficiency
Auxiliary Compartment Air Handler	940	1130	High Efficiency
Control Rod Compartment Air Handler	2,710	1750	High Efficiency
Operating Area Air Mixing Fan	20,050	--	None
Control Rod Compartment Ventilating Fan	420	--	None

TABLE 1 3-6

CHARACTERISTICS OF CONTAINMENT VESSEL

Vessel Diameter, feet	50
Tangent Length, feet	72
Original Internal Design Pressure, psig	30
Original Internal Design Temperature, °F	250
Maxiinum Wheel Load From Rotary Crane, lb.	50,000
Number of Crane Wheels ,qty	4
Uniform External Pressure Due To Vacuum within the Vessel, psig	0.5
Gross Volume, ft^3	190,200
Net Volume (Approximate), ft^3	141,500

17. LIST OF FIGURES

1.4 CURRENT RADIOLOGICAL CONDITIONS

Site-specific radiological and environmental data was obtained in 1995 as part of the Saxton Site Characterization Plan (Reference 1) in order to support the development of the SNEC Facility Decommissioning Plan. The scope of the characterization plan extended over areas of the facility that may have become internally or externally contaminated or activated during the facility's operating history. Results of the characterization have been used to determine the current radiological status of the facility.

Figure 1-1

SNEC FACILITY SITE LAYOUT

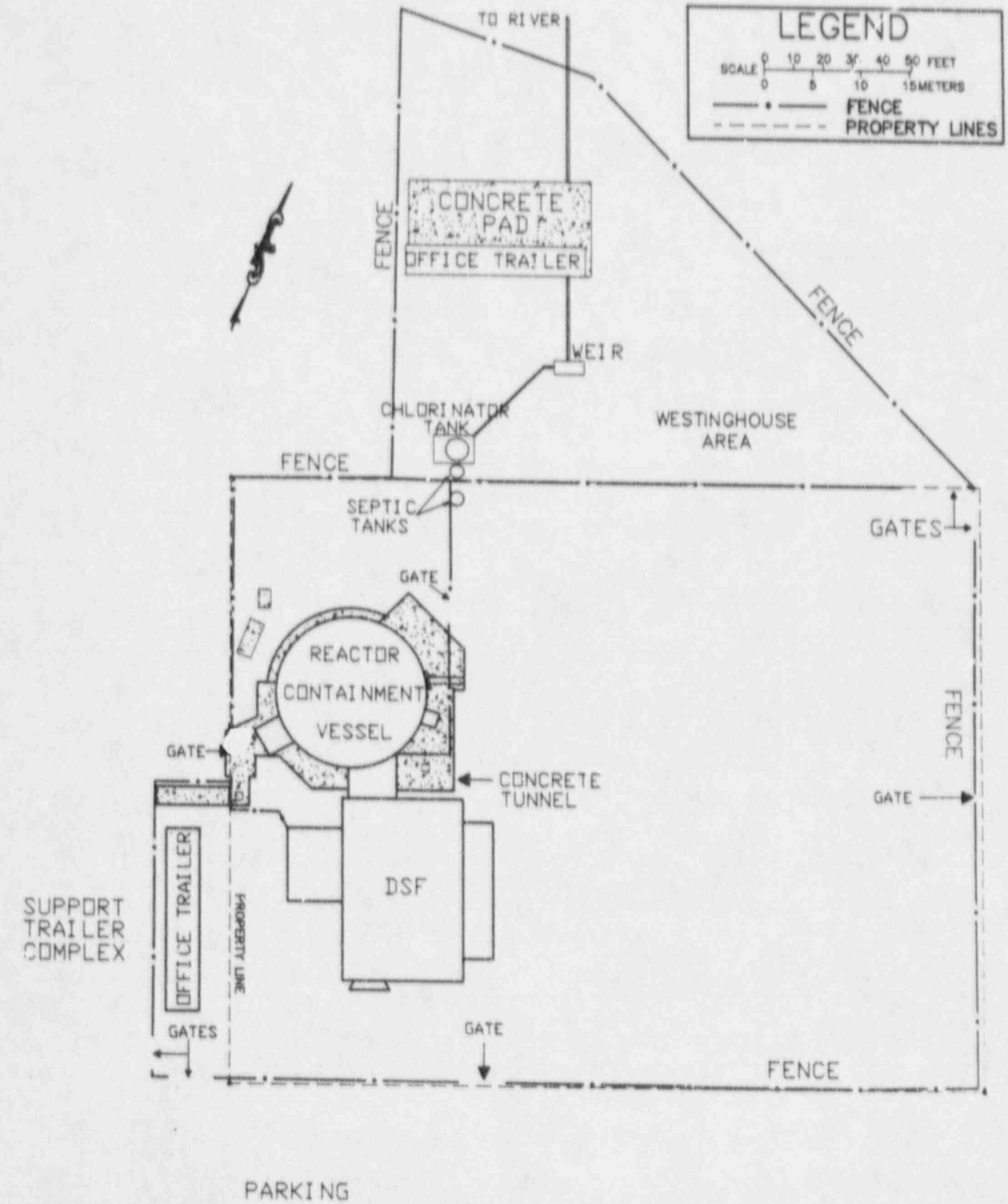


Figure 1-2
PROPERTY MAP - SAXTON SITE

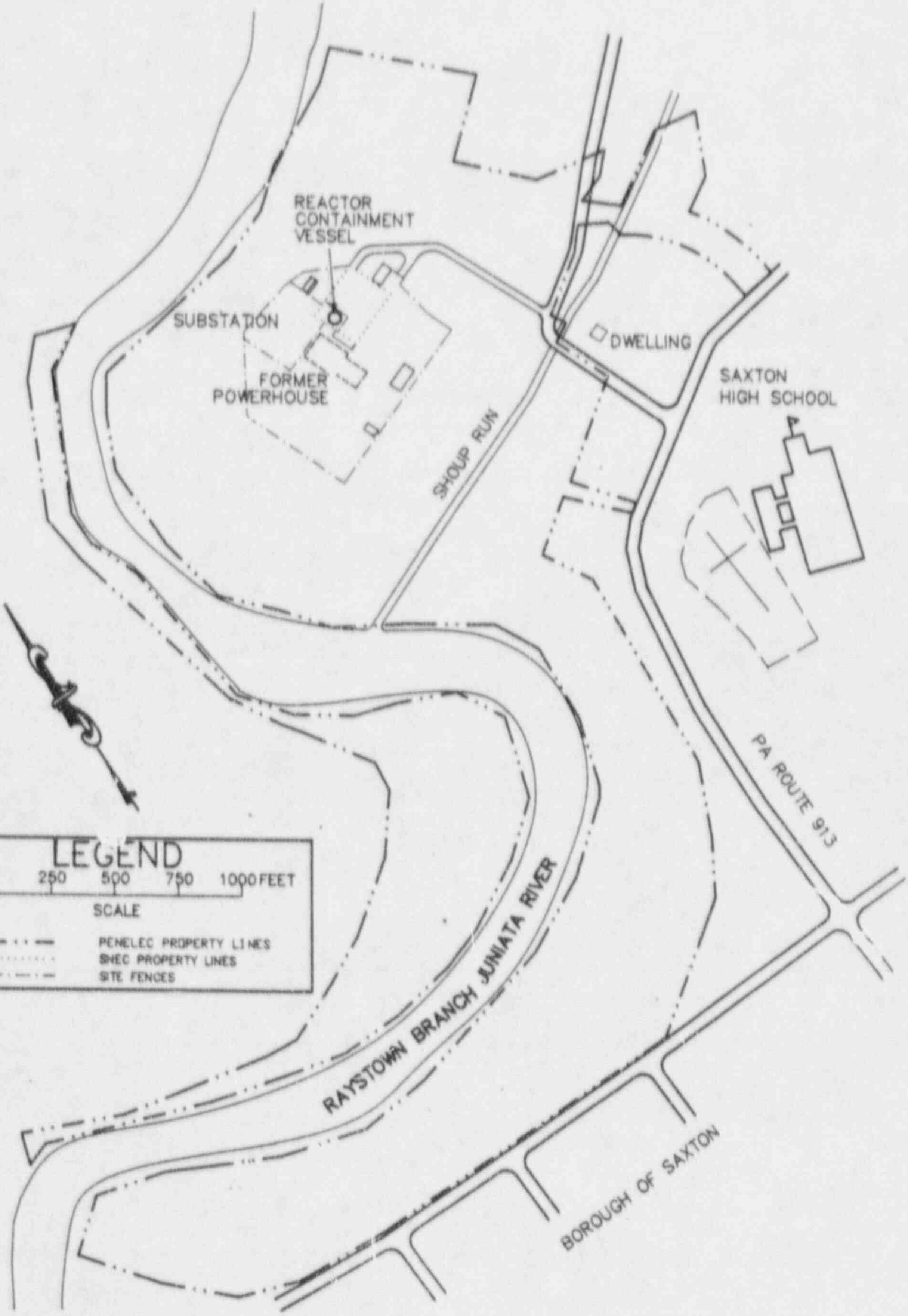
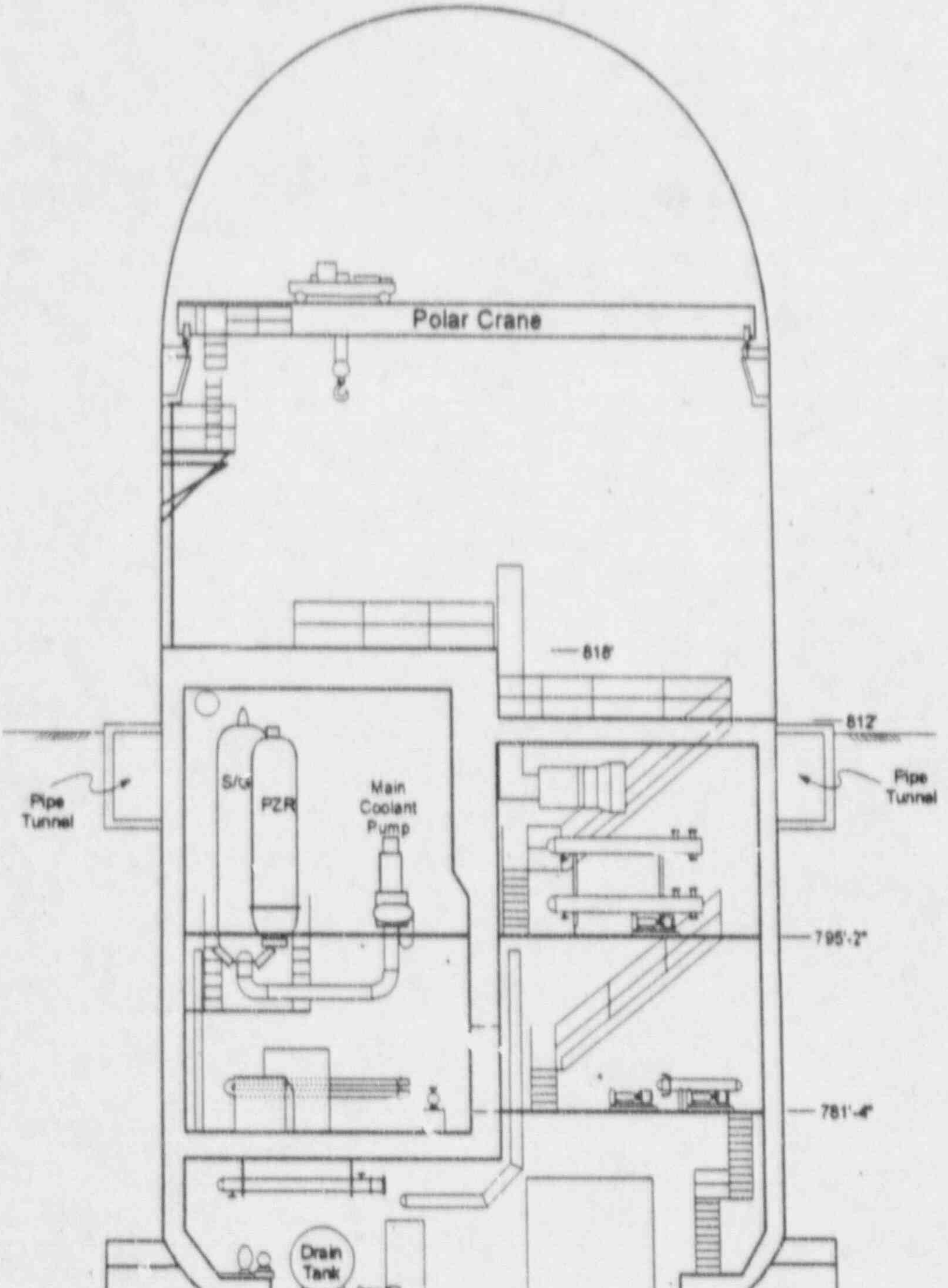


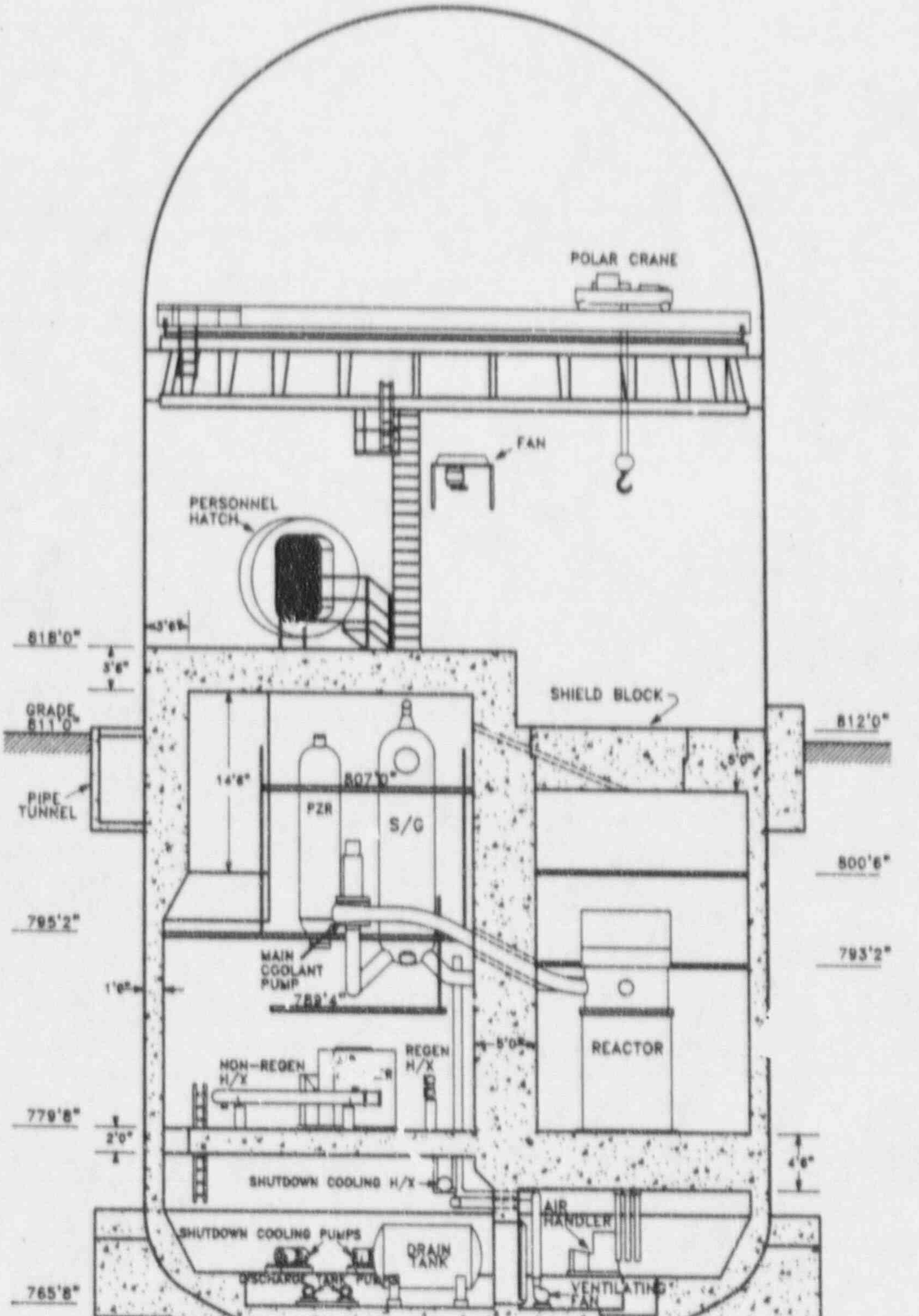
Figure 1-3



Containment Vessel, Sectional View (Looking North)

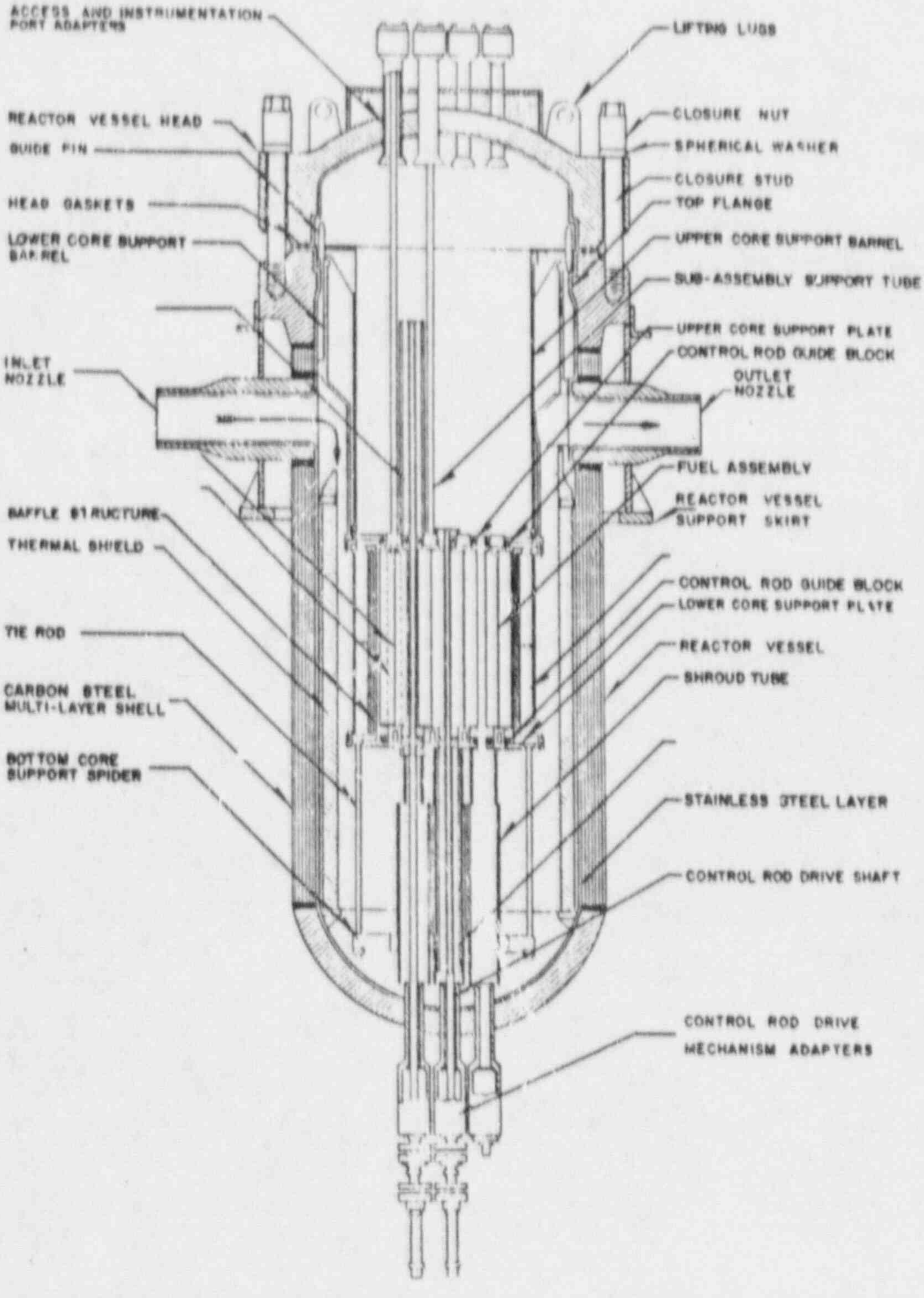
No Scale

Figure 1-4



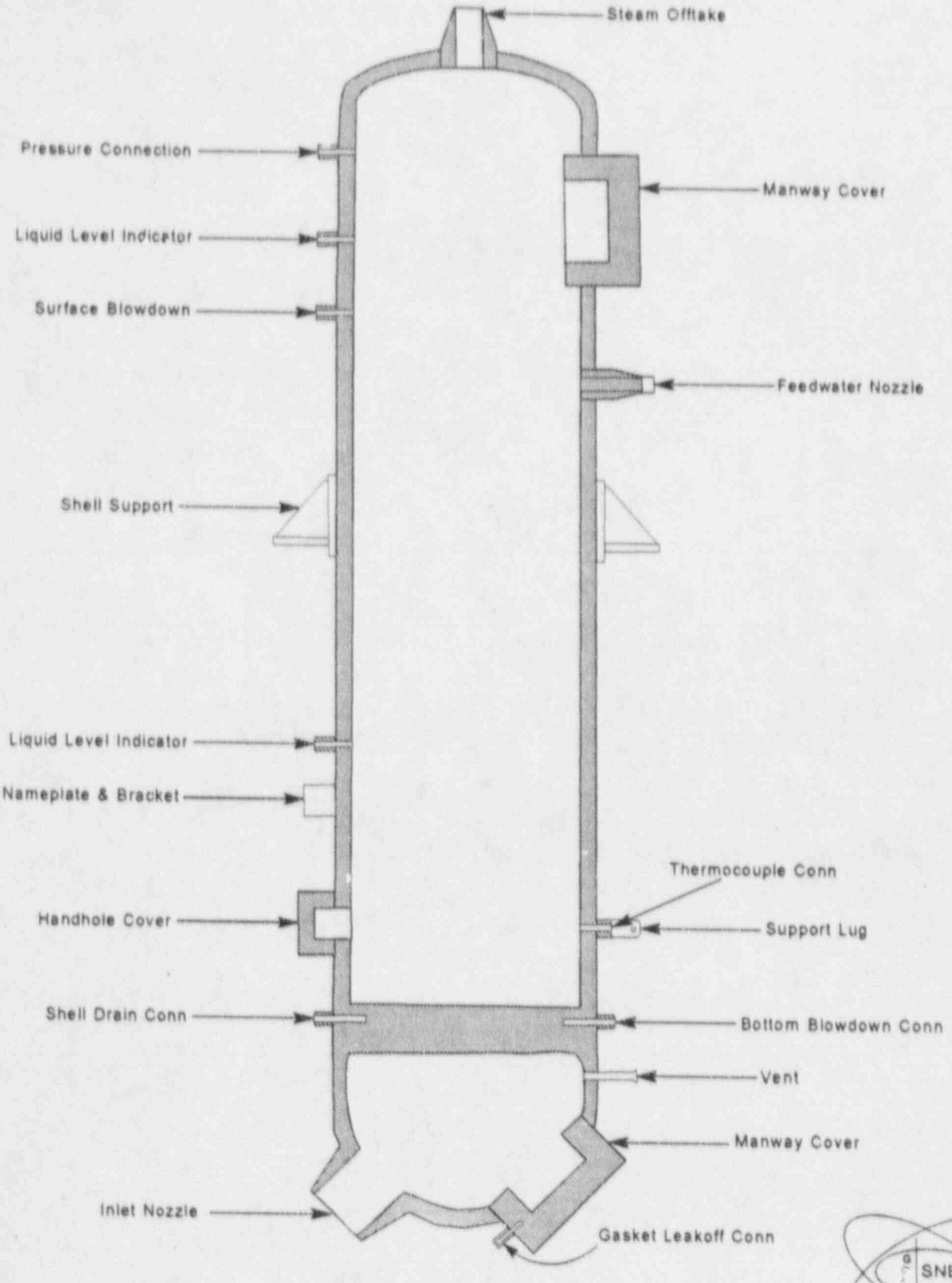
Containment Vessel, Sectional View
(looking West)

Figure 1-5



Reactor Vessel Cross Section

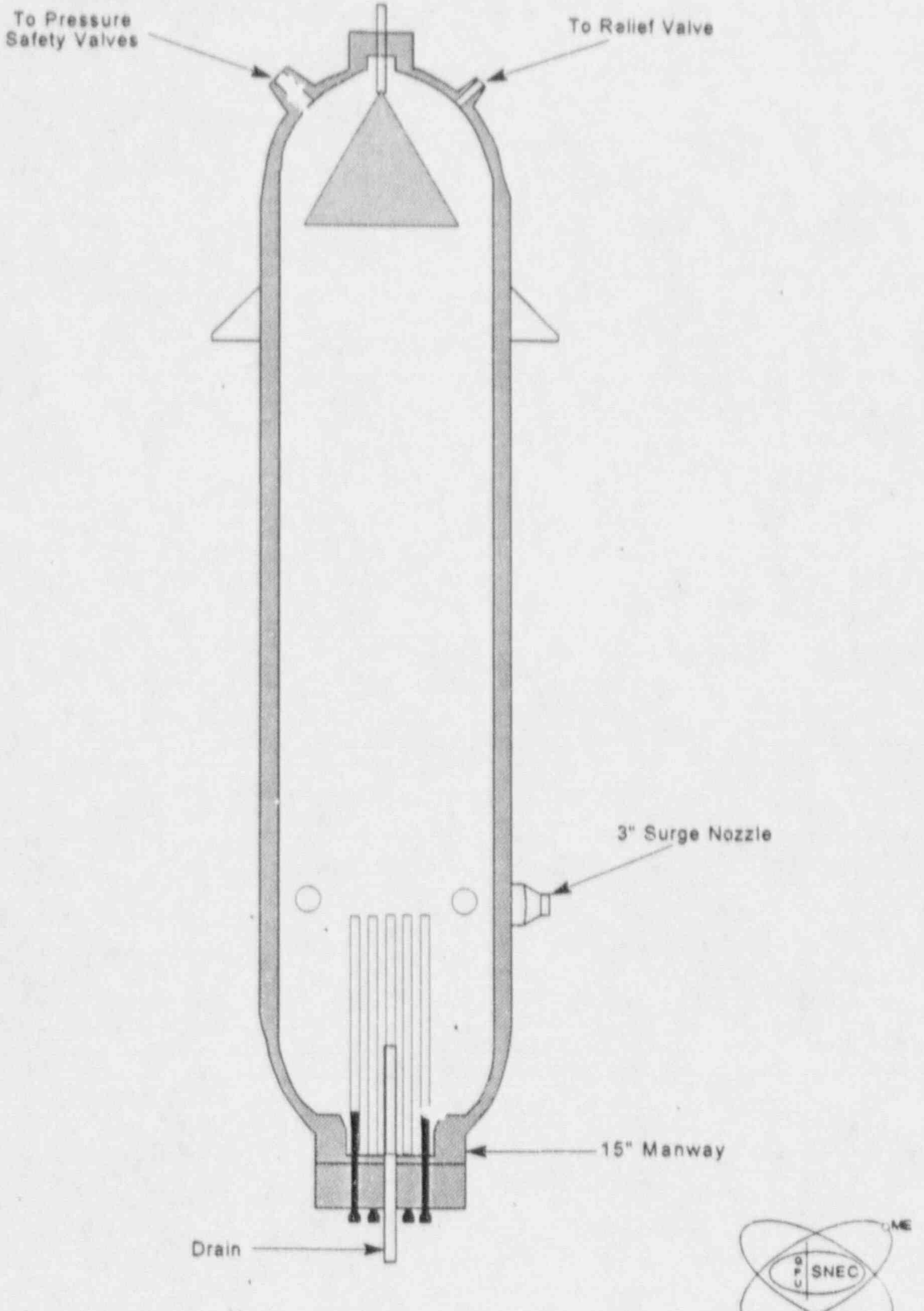
Figure 1-6



Steam Generator

NO SCALE

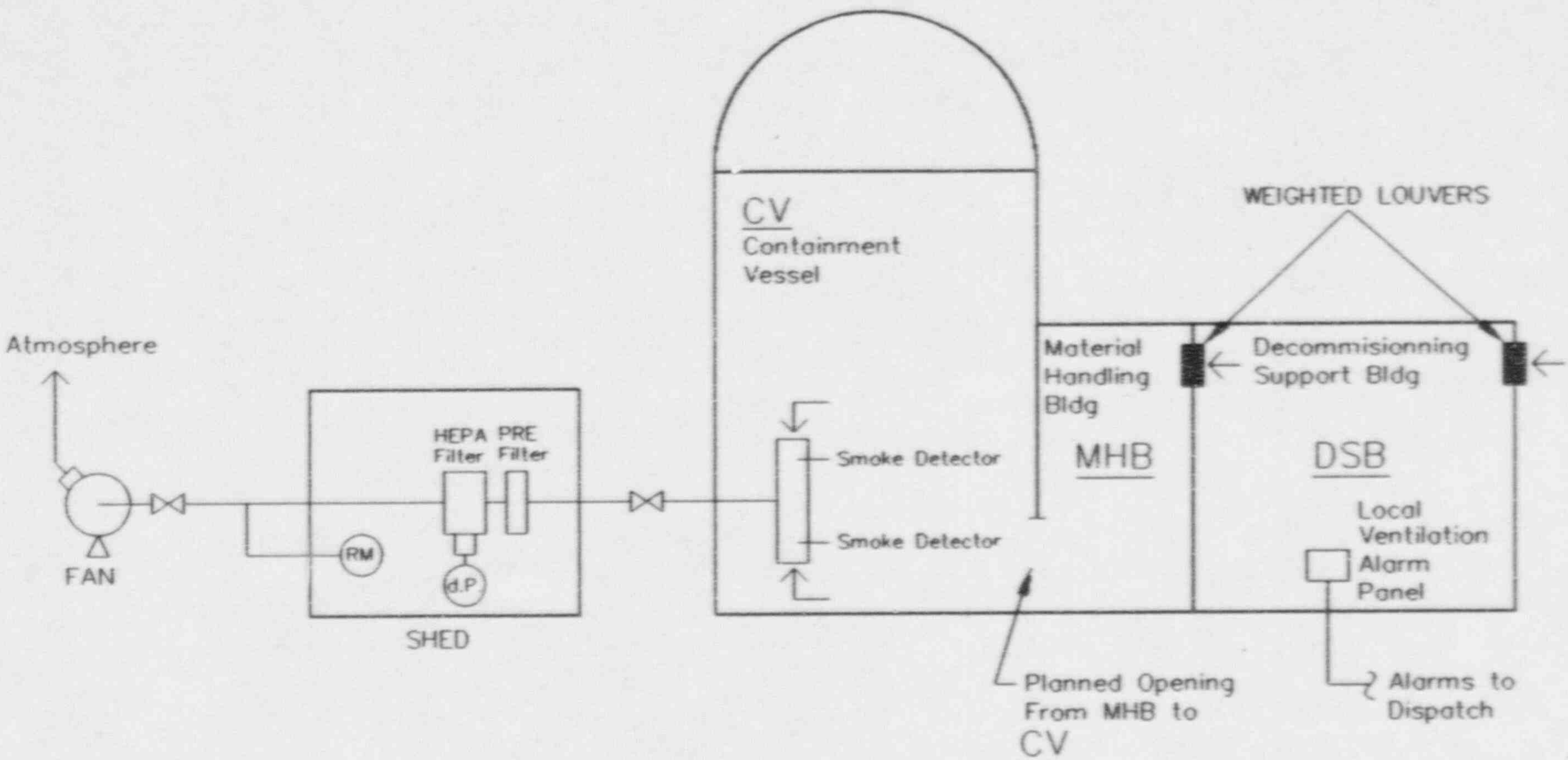
Figure 1-7



Pressurizer

NO SCALE

SNEC FACILITY VENTILATION SYSTEM



(d.P) DIFFERENTIAL PRESSURE – USED FOR LOW FLOW ALARM
SYSTEM FLOW – NOMINAL 6500 CFM
HEPA – 99.97% EFFICIENT – TESTING IN ODCM
(RM) RAD MONITOR – SURVEILLANCE/SETPOINT IN ODCM

Figure 1-8