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SUBJECT: Forwards revised draft FSAR pages for solid radwaste sys.
Pages will be incorporated into FSAR Amend 18,dtd Sept 1981.

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Docket No. 50-397

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Director, Nuclear Reactor
Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

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U.S. NUCLEAR REGULATORY COMMISSION

Attention: Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing

Subject: SUPPLY SYSTEM NUCLEAR PROJECT NO. 2
SOLID RADWASTE SYSTEM

Gentlemen:

Attached are two (2) copies of the revised WNP-2 FSAR pages for the Solid Radwaste System. These copies are being submitted in draft form to assist NRC reviewers. These pages will be incorporated into Amendment 18, dated September 1981.

Figure 11.4-1 will be changed to Figures 11.4-1a and 11.4-1b. These figures will be available and will be transmitted to the NRC by October 1, 1981.

Very truly yours,

G. D. Bouchey

G. D. BOUCHEY
Director, Nuclear Safety

GDB:CDT:nm

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1.2.2.8 Radioactive Waste Systems

1.2.2.8.1 Liquid Radwaste System

This system collects, treats, stores, and disposes of all radioactive liquid wastes. These wastes are accumulated directly in radwaste tanks or in sumps at various locations throughout the plant for subsequent transfer to collection tanks in the radwaste facility. Wastes are processed on a batch basis with each batch being processed by such method or methods appropriate for the quality and quantity of materials determined to be present. Processed liquid wastes may be returned to the condensate system or discharged to the circulating water blowdown line to the river. The liquid wastes in the discharge piping are diluted with circulating water blowdown to achieve a concentration at the site boundary which is below the limits of 10 CFR Part 20.

Batches of waste which have excessive chemical concentrations are processed through the radwaste concentrator. The distillate is condensed and can be demineralized before discharged or reused as required. The concentrate is sent to the solid radwaste system.

Equipment is selected, arranged, and shielded to permit operation, inspection, and maintenance with minimum personnel exposure. For example, tanks and processing equipment which contain significant radiation sources are located behind shielding, and sumps, pumps, instruments, and valves are located in controlled access rooms or spaces. Processing equipment is selected and designed to require a minimum of maintenance.

Protection against accidental discharge of liquid radioactive waste is provided by design redundancy, instrumentation for detection and alarm of abnormal conditions, and procedural controls.

1.2.2.8.2 Solid Radwaste System

Solid radioactive wastes are collected, processed, and packaged for storage and ultimate burial. These wastes are generally stored on the site until the short half-lived isotopes have decayed. Wet solid wastes are collected, dewatered, and ~~packaged~~ solidified in steel containers. Examples of

TABLE 1.3-8 (Continued)

ITEM	CHANGE	REASON FOR CHANGE	FSAR PORTION IN WHICH CHANGE IS DISCUSSED
Off-Gas System Charcoal Vault Refrigeration System	Added a refrigeration system to the vault in which the off-gas system charcoal adsorber filters are housed	To maintain charcoal adsorbers at a temperature of 0°F	9.4.5; 11.3.2.1
Makeup Water Pumps Transformer Vault Ventilation	Added a ventilation system to makeup water pump transformer rooms powered from the emergency buses	To insure suitable ambient temperatures for transformers in the event of a loss of off-site power caused by a tornado	9.4.6
Radwaste Solid Waste Processing Pump and Hopper Discharge Valves	Pump from Section III Class 3 to manufacturer's Standard; Valves from Section III Class 3 to ANSI B31.1.0	"Moyno" pumps are best suited for this type of service and are not manufactured with an "N" stamp. Knife edge gate valves are required due to the consistency of the hopper discharge fluid. These valves are not manufactured with a "N" stamp	
Air Ejector	Three stage air ejector to two stage air ejector	Manufacturer offered a two stage unit that meets the same operating conditions.	10.4.2
Sealing Steam Supply	The gland steam evaporator will produce sealing steam using main steam on its tube side during start-up and shutdown modes. PSAR stated auxiliary boiler would be used.	Adequate sealing steam can be produced with main steam pressure down to 125 psig.	10.4.3
Containment Instrument Air System	Safety classification of the compressors has been changed from 3 to G and compressors use building air suction rather then suction from containment vessel. Redundant bottled gas supply utilized for supplying ADS valve accumulators for accident conditions.	System will function irrespective of drywell isolation due to overpressure. Assures continuous supply of air to the valve operators irrespective of containment isolation. Change eliminates the problem of leakage of containment atmosphere into the reactor building. Also a 150 psig compressor manufactured to Seismic I requirements could not be procured.	9.3.1.1.2
Off-Gas Holdup Line	Radiography of circumferential welds was not done.	Line was buried before radiography was done. Welds were magnetic partial tested and line will be hydro-tested at 1200 psig and then helium pressure decay leak tested with a sensitivity of 10^{-2} cc/sec.	-
Radioactive Waste Solidification Process	Cement-sodium silicate solidification process to be used in lieu of urea-formaldehyde process.	To eliminate the generation of free water in solidified containers, a problem inherent to the urea formaldehyde process.	11.4

TABLE 3.2-1 (Continued)

Principal Component (1)	Scope of Supply (2)	Safety Class (3)	Location (4)	Quality Group Classification (5)	Quality Class (6)	Seismic Category (7)	Comments
17. Refueling Equipment							
.1 Refueling equipment platform assembly	GE	3	C	N/A	I	I	
.2 Refueling Bellows	P	O	C,R	D	II	I	(33)
18. Storage Equipment							
.1 Fuel storage racks	GE/P	3	R	N/A	I	I	
.2 Defective fuel storage container	GE	3	R	N/A	I	I	
19. Radwaste System (Figure 11.2-2, 3.2-9, 3.2-10, 11.2-3, 11.2-4a,b,c, 11.4-1a,b)							
.1 Tanks, Atmospheric	GE/P	O	W	C	II	II	~~(16 & 24)~~ (16, 24 + 38)
.2 Heat exchangers	GE/P	O	W	C	II	II	(16 & 24)
.3 Piping and valves forming part of containment boundary	P	2	C,R	B	I	I	
.4 Piping; other	P	O	W	C	II	II	~~(16)~~ (16 + 38)
.5 Pumps	GE/P	O	W	C	II	II	~~(16 & 24)~~ (16, 24 + 38)
.6 Valves, flow control and filter system	GE/P	O	W	C	II	II	~~(16 & 24)~~ (16, 24 + 38)
.7 Valves, other	P	O	W	C	II	II	~~(12, 16 & 24)~~ (12, 16, 24 + 38)
.8 Mechanical modules	GE/P	O	W	C	II	II	(16 & 24)
.9 Radioactive Equipment & Floor Drains and other radwaste piping and valves upstream of collector tanks	P	O	R,T,W	D	II	II	(32)
.10 Instrumentation and control boards	GE/P	O	W	N/A	II	II	
.11 Concentrator	GE	O	W	C	II	II	
.12 Plant discharge line	GE/P	O	W	D	II	II	(37)
20. Reactor Water Cleanup System (Figure 3.2-11)							
.1 Vessels, filter/demineralizer	GE	O	W	C	II	II	
.2 Heat exchangers	GE	O	W	C	II	II	
.3 Piping, within outermost isolation valves	P	1	C	A	I	I	(12)
.4 Piping, beyond outermost containment isolation valves	P	O	R,W	C	II	II	(12 & 10)
.5 Pumps	GE	O	R	C	II	II	(12 & 10)
.6 Valves, isolation valves Reactor Coolant Pressure Boundary	P/GE	1	C,R	A	I	I	(12)

TABLE 3.2-1 (Continued)

Notes (Continued)

systems will not cause significant loss or inventory. In addition, a Seismic Category I makeup source which can be used as makeup as well as evaporative cooling is supplied by the standby service water system.

19. The main steam line extending from the outermost containment isolation valve up to but not including the turbine main steam stop valve, and connected piping of 2-1/2 inches or larger nominal pipe size up to and including the first isolation valve is designed by use of an appropriate seismic-system analysis for the SSE and OBE. The power conversion system structures are constructed in accordance with applicable codes for steam power plants. The turbine building, interacting with main steam lines and branch lines, is designed as a modified non-Category I Seismic structures as described in 3.8.4.1.3.

20. The condensate storage tanks are designed, fabricated, and tested to meet ASME Code, Section III, subsection ND-3800. In addition, the specification for this tank requires 100 percent surface examination of the side wall to bottom joint, and 100 percent volumetric examination of the side wall weld joints.

21. Not Used.

22. These lines meet the requirements of Quality Group B except that hydrostatic testing of the containment spray piping is not required.

23. The RCIC turbine exhaust line from the isolation valve to the suppression pool meets all the requirements of Quality Group B except that hydrostatic testing of this portion of piping is not required.

24. Equipment, piping and valves which are part of the radwaste system but not used for processing radioactive fluids are designed to Quality Group D standards.

The solid waste processing pump is a "Moyno" pump manufactured by Robbins and Meyers. This type of pump is best suited for handling sludges and is not manufactured with an "N" stamp. The hopper discharge valves are knife edge gate valves which are required due to the consistency of the hopper discharge fluid and are not manufactured with an "N" stamp.

TABLE 3.2-1 (Continued)

Notes (Continued)

33. Although the refueling bellows are designed to withstand an SSE without rupture, they may be plastically deformed.

34. All inspection records shall be maintained for the life of the plant.

35. This piping has been voluntarily upgraded from Safety Class 3 to Safety Class 2 and from Quality Group Classification C to Quality Group Classification B.

36. The following qualification is met with respect to the certification requirements:

   a. The manufacturer of the turbine stop valves, turbine governor valves, turbine bypass valves and main-steam leads from turbine control valve to turbine casting utilized quality control procedures.

   b. A certification has been obtained from the manufacturer of these valves and steam leads that the quality control program so defined has been accomplished.

37. Up to and including the last stop valve this line meets requirements of Quality Group C.

38. Equipment, piping and valves which are part of the Radwaste Solids Handling System are designed to Quality Group D standards.

LIST OF TABLES (Continued)

LIST OF FIGURES

In keeping with ALARA and Appendix I to 10 CFR Part 50 the solid waste management system's contribution to off-site doses is minimized by venting the process equipment to a filtered ventilation exhaust system and by directing the ventilation air flow from areas of low airborne contamination to areas of higher airborne contamination. The filtered ventilation radioactive releases are discussed in 11.3.

The solid waste management system operations and procedures are designed to limit the dose to off-site persons from station operations to significantly less than the limits specified in 10 CFR Part 20. Water separated in processing is returned to the liquid waste management system for treatment as described in 11.2.2.1.5 and shown in Figure 11.4-1.

The system can accommodate a variety of shipping container sizes and shapes with and without shields. Provisions are made for the remote detection and removal of loose surface contamination on the waste containers. The radiation level of the ~~hopper~~ waste mixing tank contents is monitored so that provisions can be made to ensure that shipping regulation radiation levels are not exceeded. Compliance with applicable regulations, e.g. 10 CFR Part 71 and 49 CFR Part 173 is discussed in 11.4.2.10.

The solid waste management system upstream of and including the ~~phase separators~~ centrifuges is designed to Quality Group C as defined in 3.2. The solid waste management system downstream of the centrifuges is designed to Quality Group Table 11.4-1 lists capacities, design pressure and design temperature of the equipment.

The solid waste management system is not designed to Seismic Category I. It is located in the Seismic Category I portion of the radwaste building. The seismic classification of the radwaste building is discussed in 3.8.4.1.2.

General Design Criteria 63

Area radiation monitors and ~~hopper~~ waste mixing tank radiation monitors ensure that excessive radiation levels associated with the solid waste management system are detected and alarmed.

11.4.2 SYSTEM DESCRIPTION

11.4.2.1 General

The sources of the various radioactive solid waste inputs to the system are shown on Figure 11.2-1. Table 11.2-6 shows the expected frequency of input, the quantities of solids generated, the radioactivity level of the solids after accumulation, and the volume of liquid utilized in sluicing accumulated solids to the solidification equipment. The excess liquid is subsequently returned to the liquid waste management system. These values are based on experience from operational BWR nuclear power stations. Figure 11.4-1 shows the waste packaging portion of the solid waste management system. The phase separation and concentration portions of the system are shown on Figures 3.2-11, 10.4-4, 11.2-2, 11.2-3 and 11.2-4. Tanks containing radioactive waste are provided with overflow connections which direct any overflow to drain sumps.

The solid waste processing areas are located in the radwaste building. Both wet and dry solid wastes are processed. Wet solid wastes include backwash sludge from the reactor water cleanup system, the condensate filter demineralizer system, the fuel pool filter demineralizers, the floor drain filter and the waste collector filter; spent resin from the floor drain demineralizer, the waste demineralizer, the distillate polishing demineralizer; and concentrated bottoms from the decontamination solution concentrators. Dry solid wastes include items such as rags, paper, small equipment parts and laboratory wastes.

11.4.2.2 Radwaste Disposal System for Reactor Water Cleanup Sludge

The backwash discharge from the cleanup filter demineralizers is collected and concentrated in two 4500 gallon cleanup phase separators which are located below the cleanup demineralizers in the radwaste building. After several backwashes are accumulated, the concentrated waste is transferred to either the centrifuges or waste mixing tanks for dewatering.

The cleanup phase separators are designed to concentrate the sludge from 0.5% by weight solids to 5% by weight solids by sedimentation and decantation of the slurry. While the working separator is filling, the other previously filled tank is held isolated to allow additional decay of sludge activity.

After each backwash batch is received by the working separator, the batch is allowed to settle for a period of time and the decantate is then transferred by pumping to the waste collector tank. When sufficient sludge has accumulated, the working separator is isolated and allowed to stand for a period to permit radioactive decay. At the end of this decay period (1 to 2 months) the sludge is fluidized to the 5% weight slurry and transferred by pumping to either the centrifuges or waste mixing tanks for dewatering.

11.4.2.3 Radwaste Disposal System for Condensate Demineralizer Sludge

The backwash discharge from the condensate filter demineralizers is collected in the condensate backwash receiving tank which is located below the condensate filter demineralizers in the radwaste building. After collection, the waste is transferred by pumping to one of the two condensate phase separators for processing.

Operation of the condensate phase separators is similar to that for the cleanup phase separators. Backwash sludge is received at 0.5% by weight solids and concentrated to 5% by weight solids, allowed to stand for a period of radioactive decay and then decanted and transferred by pumping to either the centrifuges or waste mixing tanks for dewatering.

11.4.2.4 Radwaste Disposal System for Fuel Pool, Floor Drain and Waste Collector Filter Sludge

Backwash sludge wastes from the fuel pool filter demineralizers, floor drain filter, and waste collector filter are backwashed to the waste sludge phase separator tank which is located in the radwaste building. The waste sludge phase separator is designed to concentrate the sludge from 0.5% by weight solids to 5% by weight solids by sedimentation and decantation.

After each backwash batch is received by the separator it is allowed to settle for a period of time and the decantate is then transferred by pumping to the floor drain collector tank.

When a predetermined quantity of waste sludge has been accumulated, the sludge is fluidized to a 5% by weight slurry and transferred by pumping to either the centrifuges or waste mixing tanks for dewatering.

11.4.2.5 Radwaste Disposal System for Spent Resin

Spent resins from the floor drain, waste collector and distillate polishing demineralizers are hydropneumatically transferred to the spent resin tank.

The spent resin tank is designed to retain one batch of resins from any of the above demineralizers plus resin transfer water plus freeboard.

The decay time of any single batch is governed by the need to make the spent resin tank available to receive a subsequent batch from an alternate demineralizer. The frequency of spent resin discharge from the floor drain, waste collector and polishing demineralizers is estimated to be about 2 months, 2 months and 3½ months respectively. Each batch of the spent resin is transferred in a 5% by weight solution to either the centrifuges or waste mixing tanks for subsequent processing.

11.4.2.6 Radwaste Disposal System for Concentrated Solutions

The concentrated waste solution from the decontamination solution concentrators is blown down with steam to one of two decontamination solution concentrated waste tanks. Each concentrated waste tank is sized to handle one batch of concentrated waste solution processed by one concentrator plus freeboard.

From the concentrated waste tank the concentrated solution is pumped to the decontamination solution concentrated waste measuring tank by means of the decontamination solution concentrated waste pump. From this concentrated waste measuring tank the solution is discharged into ~~disposable containers and solidified.~~ the waste mixing tank.

11.4.2.7 Radwaste Solids Handling System

The purpose of this system is to process the waste sludge slurries from the cleanup phase separators, the condensate phase separators, the waste sludge phase separator, the spent resin tank and the ~~concentrated~~ solutions from the decontamination solution concentrates waste measuring tank on a batch basis. ~~The system dewaters the bulk volume of the solid waste slurries by one of two centrifuges. Water effluent from the centrifuges is transferred to the waste sludge phase separator tank for decanting, reprocessing and recycling. The dewatered solid wastes are discharged from the centrifuges by gravity into their respective hoppers which are used for filling 50 cubic foot containers for ultimate disposal. For concentrated waste solutions the system solidifies the~~

Insert "A" →

Insert "A"

Resin slurries and filter sludges are dewaterd in ~~the pur-chaser's~~ centrifuges and are delivered to the waste mixing tank through an interconnecting chute.

The ~~tank is~~ waste mixing tanks are also equipped with a decanting filter system, which may be used to decant the supernate fluid from settled filter sludges or bead resins. The filter float is held up out of the tank during normal processing by an air cylinder operator. An in-line centrifuged pump, ~~P-7,~~ is supplied for the decanting process and ~~T~~the discharge from the pump is routed back to the liquid ~~Purchaser's waste~~ radwaste system.

The waste mixing tank ~~has a capacity of 80 cu. ft. The tank~~ is equipped with a mixer ~~powered by a 5 hp motor~~, a spray-flush header, vent and overlow connections and an ultrasonic level indicator to provide continuous waste level indication at the control panel. A high level probe provides redundant protection against overfilling the waste mixing tank.

The concentrated liquid waste or dewatered waste slurry is transferred from the waste mixing tank by a Moyno progressive cavity waste feed pump and is mixed with portland cement in ~~the~~ an in-line cement-waste mixer ~~This single skid mounted subsystem~~ consists of an open throat Moyno pump with an AC motor drive, and the necessary valves and instruments. ~~Initial mixing of the radwaste and portland cement occurs in the throat of the Moyno pump and complete mixing is achieved as the mixture passes through the Static Mixer.~~ The throat of the Moyno pump is equipped with special spray nozzles and a manual drive unit to permit clearing the pump on loss of electrical power. ~~The UMC~~ in-line cement waste mixing ~~subsystem~~ assures complete mixing of the portland cement and radwaste while maintaining a small internal volume ~~of less than 1 cuft~~ for ease of flushing and to minimize the quantity of flushing waste.

The Moyno waste feed pump and the waste mixing pumps are manufactured to food industry standards to eliminate crevices and rough surfaces to assure complete flushing, thus reducing the potential for personnel exposure during mainteance.

Insert "A" (continued):

The mixture of dewatered slurry or concentrated liquid waste and cement is injected into a disposable 50 cubic foot container through the fill nozzle.

~~the fill nozzle.~~ The sodium silicate injection line is located inside the fill nozzle in a concentric tube arrangement. [The] provides thorough mixing of the ~~concentrated~~ waste-cement ~~solidification agent~~ stream with the sodium silicate stream ~~as the two streams enter~~ [upon entrance into] the ~~disposable~~ [50 cubic foot] container.

An ultrasonic level indicator is mounted on the fillport seal plate to provide continuous readout at the control panel (X) so the level of waste in the container. A high level probe provides redundant protection against overfilling the container.

no ¶

~~A vent nozzle is located on the seal plate.~~ The fillport and waste mixing tank vents are connected to the plant exhaust system. ~~through a flexible hose system.~~

The portland cement [bulk storage] silo is equipped with an aeration system to fluidize the cement for ease of handling. The cement is fed into an air transporter ~~"blow" tank,~~ which feeds the cement day tank on a batch basis. A vibrating screw feeder from the cement day tank provides a regulated uniform flow of cement to the waste mixing pump. The cement system is completely sealed and all air is exhausted through a high efficiency bag filter to eliminate cement dust.

The sodium silicate day tank is connected to a Moyno pump and SCR drive unit which are used to meter the rate of feed of sodium [silicate] into the [50 cubic foot] container. Sodium silicate is transferred as required from the ~~purchaser's six~~ [sodium silicate bulk] storage tanks to the day tank.

Table 11.4-2 presents the quantities of waste, cement, and sodium silicate required for proper solidification of the waste mixture.

Insert "A" (continued):

The mixing and filling operations are fully automated. Preparation of the dewatered wastes in the waste mixing tank is performed manually. ~~Once prepared, the operator need only turn the process selector switch to the proper waste and press the Master Start switch. Selection of the appropriate feed rates and valve settings is automatic.~~ At the end of each fill cycle, the portion of the system, starting with the waste feed pump and the portion that contained portland cement, is flushed automatically. ~~If 55 gallon drums are processed~~

Other parts of the system may be flushed manually.

The equipment is designed for a service life of 40 years and, where appropriate, for a total radiation exposure of up to 10^7 rads.

~~solutions in disposable containers for off-site shipment.~~
The system has the capability for solidifying all dewatered solid wastes if necessary for off-site shipment.

Two processing trains are provided for processing the solid waste slurries. Each processing train consists of a centrifuge, hopper, controls and piping to dewater and concentrate the solid waste slurries. In addition, one processing train contains equipment for solidifying the waste using the urea-formaldehyde process. This equipment consists of a waste processing pump, static mixers and associated polymer storage tanks, polymer day tank, catalyst mixing tanks, and pumps to deliver predetermined amounts of polymer and catalyst during solidification.

If solidification is required for sludge and resin wastes by the burial site, the solidification processing train is used. The hopper is filled with dewatered solids to a predetermined level from the centrifuge, and the required amount of water is added to each hopper. An empty 50 cubic foot container is placed on the transfer dolly. The transfer dolly and container are moved to the filling station underneath the hopper. The hopper discharge valve is opened permitting flow of the wastes to the waste processing pump. The hopper augers force the wastes into the discharge bin and the conveyor transports the waste to the throat of the pump. The speed of the waste processing pump, polymer processing pump and catalyst processing pump are set to achieve the proper ratio of waste, polymer and catalyst required for proper solidification of the mixture. Table 11.4-2 presents the quantities of waste, polymer and catalyst required for proper solidification of the mixture. The processing pumps transport the waste, the polymer and the catalyst to the static mixers. The waste and polymer are first mixed together in a static mixer and then the waste-polymer mixture is mixed with catalyst in a second static mixer. This mixture is then discharged into the disposable container via a flexible loading sleeve extending into the disposable container.

An identical process to the above is used to solidify decontamination solution concentrator wastes. The concentrator waste measuring tank discharges to the waste processing pump. The speed of the waste processing pump, polymer processing pump and catalyst processing pump are set to achieve the proper ratio of concentrate, polymer and catalyst required for solidification of the mixture. The processing pumps supply static mixers where mixing of the concentrate, polymer and catalyst occurs as described above. The mixture is discharged into the disposal container via a flexible loading ~~sleeve extending into the disposable container.~~

To limit radiation exposure to operating personnel, solid radwaste system operations are performed remotely from the radwaste control room and from local panels located in shielded areas.

Each hopper is provided with two augers and a conveyor for mixing and assuring free flow of materials from the hopper. The augers are of the motor driven ribbon blender type and serve to mix the hopper contents as well as force the contents into the hopper discharge bin. The conveyor is of the reversible, motor driven type designed to convey the waste to the hopper discharge chute which leads directly to the container or to the hopper outlet which directs the wastes to the solidification equipment depending on rotation direction. Each of the hopper outlets is fitted with an air-operated shutoff valve. A third air-operated hopper outlet valve is provided to drain hopper rinse water to the solids area sump.

Filled containers are transported on a track riding dolly to the container capping station consisting of a container capper and viewing equipment to permit remote capping. The next dolly station has provisions for remote handling and viewing, permitting smear wiping and decontamination of the external surfaces of the capped containers.

Following external decontamination the containers may be positioned at the truck loading area station or the storage area station. The truck loading area station is used for loading containers onto a truck for off-site disposal. For shielded containers, the dolly is positioned at this station to allow a shipping cask to be placed upon it by the truck area crane. After a waste filled container is placed inside the shipping cask at the storage area station, the dolly is moved back to this station and the cask cover is installed. The truck area crane lifts and positions the cask on a truck for shipment to the burial site.

The storage area station is utilized for loading and unloading containers to and from the storage area. The storage area crane can remove containers from the storage area and place them on the dolly for moving to the truck area station for shipping. Equipment locations and arrangements are shown in 1.2.

Table 11.4-4, excluding dry and compacted waste, shows the expected annual container production of solid wastes based upon the process diagram data inputs. No decay after container filling operations has been considered. The annual production of solid waste, excluding dry and compacted waste, is comparable to WASH-1258, Volume 1, Table 2-47, when considering differences in processing. Table 2-47 also lists 500 to 700 drums of dry and compacted waste as the estimated annual production for a comparably sized plant.

11.4.2.10 Packaging

~~Dewatered solid~~ Radioactive wastes are ~~packaged~~ solidified in 50 cubic foot containers that meet the requirements established in Title 49 CFR Part 173 for the Department of Transportation. ~~and Title 10 CFR Part 71 for the Nuclear Regulatory Commission.~~

The processing of all solid wastes is based on the remote handling of containers behind shield walls. Containers are brought into the processing area and loaded on the dolly. The dolly is moved to the filling station where waste is added. The quanity of wastes packaged in the container is measured by a level indicator.

The filled container is moved to the container capping station where it is remotely capped by the operator. The capped container is moved to the smear and washdown station where it is sampled for surface contamination and decontaminated if necessary prior to being sent to the storage area station.

The container filling and capping area is shielded from the storage areas so that personnel involved in maintenance in the operating area are isolated from the storage area.

11.4.2.11 Storage Facilities

The general arrangement drawings in 1.2 show the layout of the solid radwaste handling areas in the radwaste building.

The storage area can accommodate seventy-two 50 cubic foot containers. High activity containers are stored to allow for decay prior to shipment.

From the storage area station the capped, decontaminated containers are moved into the storage area by the storage area crane.

11.4.2.12 Shipment

Containers filled with solid wastes will be shipped off-site on a regular basis in accordance with Department of Transportation Regulations for radioactive materials.

High activity wastes are shipped in shielded casks meeting Title 10 CFR Part 71 requirements for the Nuclear Regulatory Commission. A truck containing the cask is moved into the truck loading area. The cask is placed on the transport dolly by the truck loading crane. The dolly is moved to the storage area loading station and a capped container of wastes is placed inside the cask by the storage area crane. The dolly is moved back to the truck loading area where the cask cover is placed on the cask. The cask is decontaminated if necessary and placed on the truck for shipment. Similar operations are performed when loading unshielded containers onto the truck.

Any unshielded containers found to have external contamination exceeding 49CFR173 limits are decontaminated by passing them through a spray cleaning operation. Further smear tests and cleaning are carried out as required until the activity on the containers is within acceptable limits.

Spills and radwaste shipping cask drop incidents are discussed in 15.A.6.5.3 (Event 48) and 15.A.6.6.3 (Event 50), respectively.

11.4.2.13 Process Monitoring

The solid waste management system is fully equipped with remote readout instrumentation to allow system operation from the radwaste control room and the solid waste control panel. ~~Tanks containing wet solid wastes are equipped with remote reading level indication and with level alarms.~~ The ~~hoppers~~ waste mixing tanks are monitored by radiation detectors that read, record and alarm at the solid waste control panel. ~~The waste container loading sleeves are instrumented with ultrasonic level detectors to indicate the container waste level.~~ The waste container location is indicated by lights on the control panel mimic board, and the entire waste container filling and handling operation can be monitored through a lead glass window or by the use of closed circuit television.

11.4.2.13.1 Reactor Water Cleanup Phase Separator Instrumentation

Each cleanup phase separator is equipped with two level indicating devices, one for total liquid level and one for the sludge level. The total liquid level indicator utilizes an air bubbler and a pressure sensing level transmitter which drives a 0-100% level gage and a high level alarm in the

Insert "B"

~~later in this proposal.~~ Ultrasonic level indicators are used to provide a continuous indication at the control panel of the level of portland cement and sodium silicate in the day tanks, waste in the waste mixing tank and the cement-waste mixture in the disposable container. Indicating lights on the control panel alert the operator if the temperature of the system is not within the normal operating range. Pressure switches downstream from each pump provide positive flow indication at key points in the process. The magnetic flow meters provide a permanent record of the quantity of waste and solidification agents in each container and a digital readout at the control panel of the ratio of the volume of waste to ~~be~~ the volume of solidification agents.

radwaste control room. This level transmitter also drives a level indicator on the local control panel and provides control functions for the decant pump, the sludge discharge pump, and the phase separator inlet selector valve. Sludge level indication is accomplished by a pair of ultrasonic probes positioned in the phase separator.

11.4.2.13.2 Condensate Phase Separator Instrumentation

The condensate phase separators level instrumentation is the same as that described for the reactor water cleanup phase separators.

11.4.2.13.3 Waste Sludge Phase Separator Instrumentation

The waste sludge phase separator has total liquid level indication. It uses an air bubbler and a pressure sensing level transmitter. In addition to the level gage and high level alarm in the radwaste control room, the level transmitter provides control inputs to the decant pump, the stop and flush circuit on the sludge discharge pump and the discharge valves from the waste collector and floor drain collector tanks to the waste sludge phase separator.

11.4.2.14 Spent Resin Tank Instrumentation

Level indication for the spent resin tank is essentially the same as that described for the cleanup phase separators utilizing an air bubbler and level transmitter for total liquid level and ultrasonic probes for resin level.

11.4.2.15 Concentrated Waste Measuring Tank Instrumentation

This tank is equipped with a level transmitter that drives a level indicator in the radwaste control room.

11.4.2.16 Waste Mixing Tank ~~Hopper~~ Instrumentation

The waste mixing tanks ~~hoppers~~ are equipped with ultrasonic level detectors that drive indicators, a recorder and high level alarms on ~~in~~ the solid waste ~~radwaste~~ control panel ~~room~~. They also provide control signals to stop the centrifuges on high level. ~~and to operate the hopper rinse valves.~~ The waste mixing tanks ~~hoppers~~ are also provided with radiation detectors. These monitors which have a range of 10 mR/hr to 100 R/hr drive a recorder and alarms on the solid waste control panel.

SOLID WASTE MANAGEMENT SYSTEM MAJOR EQUIPMENT ITEMS

Cleanup Phase Separators - 2 Required

Construction: Stainless steel shell and internals. Atmospheric design pressure. 250°F design temperature. Capacity - 4,500 gallons/ea.

Cleanup Sludge Discharge Mixing Pump - 1 Required

Construction: Stainless steel. Design pressure - 150 psig. Design temperature - 150°F. Capacity - 210 gpm at 170 feet TDH.

Cleanup Decant Pump - 1 Required

Construction: Stainless steel. Design pressure - 150 psig. Design temperature - 150°F. Capacity - 53 gpm at 50 feet TDH.

Condensate Backwash Receiving Tank - 1 Required

Construction: Stainless steel shell and internals. Atmospheric design pressure. 150°F design temperature. Capacity - 19,000 gallons.

Condensate Backwash Transfer Pump - 1 Required

Construction: Stainless steel. Design pressure - 150 psig. Design temperature - 150°F. Capacity - 450 gpm at 50 feet TDH.

Condensate Phase Separator - 2 Required

Construction: Epoxy-coated carbon steel shell, stainless steel internals. Atmospheric design pressure. 250°F design temperature. Capacity - 23,500 gallons/ea.

Condensate Sludge Discharge Mixing Pump - 1 Required

Construction: Stainless steel. Design pressure - 150 psig. Design temperature - 150°F. Capacity - 420 gpm at 160 feet TDH.

Condensate Decant Pump - 1 Required

Construction: Stainless steel. Design pressure - 150 psig. Design temperature - 150°F. Capacity - 450 gpm at 50 feet TDH.

Waste Sludge Phase Separator Tank - 1 Required

Construction: Epoxy-coated carbon steel, stainless steel internals. Atmospheric design pressure. 150°F design temperature. Capacity - 13,000 gallons.

Waste Decant Pump - 1 Required

Construction: Stainless steel. Design pressure - 150 psig. Design temperature - 150°F. Capacity - 53 gpm at 50 feet TDH.

Waste Sludge Discharge Mixing Pump - 1 Required

Construction: Stainless steel. Design pressure - 150 psig. Design temperature - 150°F. Capacity - 210 gpm at 105 feet TDH.

Spent Resin Tank - 1 Required

Construction: Stainless steel shell and internals. Atmospheric design pressure. 150°F design temperature. Capacity - 1,200 gallons.

Spent Resin Pump - 1 Required

Construction: Stainless steel. Design pressure - 150 psig. Design temperature - 150°F. Capacity 21 gpm at 105 feet TDH.

Decontamination Solution Concentrated Waste Tank - 2 Required

Construction: Stainless steel shell and internals. Atmospheric design pressure. 150°F design temperature. Capacity - 700 gallons/ea.

Decontamination Solution Concentrate Waste Pump - 1 Required

Construction: Stainless steel. Design pressure - 150 psig. Design temperature - 150°F. Capacity - 30 gpm at 70 feet TDH.

Concentrated Waste Measuring Tank - 1 Required

Construction: Stainless steel. Atmospheric design pressure. 150°F design temperature. Capacity - 400 gallons.

Centrifuge - 2 Required

Type- Solid bowl, horizontal, continuous feed. Removal efficiency of solids - 98%
Solids discharge - 40% to 60% by weight.

Waste Mixing Tank
~~Hopper Mixer~~ - 2 Required

Construction: Stainless steel. Capacity - ~~60~~ 80 cubic feet. Equipped with ~~two augers and motor driven mixing conveyor.~~ a mixer and spray header.

sert C" →

Sodium Silicate
~~Polymer~~ Storage Tank - 6 Required

Construction: Aluminum. Capacity - 550 gallons/ea.

Sodium Silicate
~~Polymer~~ Day Tank - 1 Required

Construction: Carbon steel. Capacity - 250 gallons.

Chemical Addition
~~Catalyst Mixing~~ Tank - 2 required

Construction: Polypropylene. Capacity - 100 gallons/ea.

Sodium Silicate
~~Polymer~~ Transfer Pump - 1 Required

Construction: Carbon steel. Capacity - ~~7.5~~ 8 gpm at ~~50~~ 20 psig.

Sodium Silicate Feed
~~Polymer Processing~~ Pump - 1 Required

Construction: Stainless steel. Capacity - ~~0.5~~ 1 to ~~5~~ 2 gpm at ~~40~~ 20 psig.

Chemical Addition
~~Catalyst Processing~~ Pump - 2 Required

Construction: Stainless steel. Capacity - 0.05 to ~~1.0~~ 2.0 gpm at 50 psig.

Waste ~~Processing~~ Mixing Pump - 1 Required

Construction: Stainless steel. Capacity - ~~5 to 15~~ 30 gpm at ~~50~~ 10 psig.

sert D" →

Transfer Dolly - 1 Required

Track riding dolly for transfer of 50 cubic foot containers between processing stations.

Insert C:

Waste Feed Pump - 2 Required

Construction: Stainless steel. Capacity - 10 to 18.7 gpm at 20 psig.

Dewatering Pump - 2 Required

Construction: Stainless steel. Capacity - 40 gpm at 15 psig.

Sample Pump - 2 Required

Construction: Stainless steel. Capacity - 7.5 gpm at 25 psig.

Insert "D":

Bulk Cement Storage Silo - 1 Required

Construction: Carbon steel. Capacity - 1000 cubic feet. Equipped with pneumatic transporter system to convey cement from storage silo to cement day tank.

Cement Day Tank - 1 Required

Construction: Carbon steel. Capacity - 50 cubic feet. Equipped with vibrating screw feeder to waste mixing pump.

TABLE 11.4-2

SOLIDIFICATION MIXTURE FOR 30 FT³

DISPOSABLE CONTAINERS

Waste Description	Waste Quanity ~~gallons~~ cubic feet	Cement cubic feet ~~Polymer gallons~~	Sodium Silicate cubic feet ~~Catalyst gallons~~
Powdered Resin a. Condensate Filter Demineralizer b. Cleanup Filter Demineralizer c. Floor Drain Filter d. Waste Collector Filter e. Fuel Pool Filter Demineralizer	~~199~~ 37.5 *	~~160~~ 8.5	~~11~~ 4.0
Dead Resin a. Waste Demineralizer b. Floor Drain Demineralizer c. Distillate Demineralizer	~~183~~ 37.5 *	~~156~~ 8.5	~~31~~ 4.0
Concentrate Waste Solution	~~160~~ 35	~~164~~ 12.5	~~38~~ 2.5

* Slurried with water or concentrated waste, resin volume is 30 cubic feet.

TABLE 11.4-3

SIGNIFICANT ISOTOPE ACTIVITY IN ~~WET SOLIDS AFTER PROCESSING~~ SOLIDIFIED WASTE

STREAM	CLEAN UP SLUDGE	WASTE SLUDGE	DISTILLATE RESIN	EQUIP. DR. RESIN	FLOOR DRAIN RESIN	CONDENSATE SLUDGE	CONCENTRATE WASTE
Batch Solid Production	524 lbs/ 60 days	220 lbs/ 3.4 days	1539 lbs/ 165 days	1539 lbs/ 66 days	1539 lbs/ 67 days	3300 lbs/ 10.5 days	581 lbs/ 8 days
ISOTOPES			Ci/50 CUBIC FOOT CONTAINER				
Sr-89	~~50.13~~ 30.07	-----	~~1.35~~ 8.10 x 10^{-6}	~~0.71~~ 0.43	~~5.14~~ 3.08 x 10^{-3}	~~0.39~~ 0.23	~~6.04~~ 9.56 x 10^{-4}
Sr-90	~~12.73~~ 7.64	-----	~~1.00~~ 6.48 x 10^{-7}	~~0.00~~ 0.05	~~5.71~~ 3.44 x 10^{-4}	~~0.06~~ 0.04	~~1.29~~ 6.79 x 10^{-5}
Sr-91	---	-----	-----	~~0.41~~ 0.25	~~2.00~~ 1.73 x 10^{-3}	----	-----
Sr-92	---	-----	-----	~~0.09~~ 0.05	~~1.66~~ 1.60 x 10^{-3}	----	-----
Y-90	~~12.71~~ 7.64	-----	-----	~~0.00~~ 0.05	-----	~~0.00~~ 0.64	-----
Y-91	~~1.85~~ 1.11	-----	-----	~~0.19~~ 0.11	-----	~~0.13~~ 0.08	-----
Y-91M	---	-----	-----	~~0.20~~ 0.17	-----	----	-----
Y-92	---	-----	-----	~~0.09~~ 0.05	-----	----	-----
Zr-95	~~0.83~~ 0.50	-----	-----	----	-----	~~0.04~~ 0.02	-----
Nb-95	~~2.11~~ 1.27	~~4.66~~ 2.80 x 10^{-4}	-----	~~0.00~~ 0.04	-----	~~0.05~~ 0.03	-----
Mo-99	---	~~1.59~~ 9.57 x 10^{-2}	~~2.09~~ 1.25 x 10^{-5}	~~0.23~~ 0.14	~~1.00~~ 1.13 x 10^{-3}	~~0.01~~ 0.006	~~4.29~~ 6.77 x 10^{-3}
Tc-99M	---	~~1.03~~ 6.18 x 10^{-2}	-----	~~0.76~~ 0.46	~~9.17~~ 5.50 x 10^{-3}	~~0.01~~ 0.006	-----
Ru-103	---	-----	-----	----	-----	~~0.02~~ 0.01	-----
Te-129M	~~2.99~~ 1.79	-----	-----	~~0.01~~ 0.006	~~5.53~~ 3.32 x 10^{-5}	----	-----
Te-129	~~1.91~~ 1.15	-----	-----	----	-----	----	-----
Te-132	---	-----	~~5.39~~ 3.23 x 10^{-5}	~~1.21~~ 0.73	~~9.69~~ 5.81 x 10^{-3}	~~0.01~~ 0.006	~~9.54~~ 1.51 x 10^{-2}
Br-83	---	-----	-----	~~0.01~~ 0.006	~~3.61~~ 2.17 x 10^{-4}	----	-----
I-131	~~1.46~~ 0.88	-----	~~2.90~~ 1.74 x 10^{-5}	~~0.00~~ 0.48	~~5.92~~ 3.55 x 10^{-3}	~~1.06~~ 1.12	~~3.42~~ 3.83 x 10^{-3}
I-132	---	-----	-----	~~1.30~~ 0.78	~~2.77~~ 1.66 x 10^{-3}	~~0.01~~ 0.006	-----
I-133	---	-----	-----	~~0.59~~ 0.35	~~6.12~~ 3.67 x 10^{-3}	----	-----
I-134	---	-----	-----	~~0.07~~ 0.04	~~3.71~~ 2.23 x 10^{-3}	----	-----
I-135	---	-----	-----	~~0.20~~ 0.17	~~4.50~~ 2.70 x 10^{-3}	----	-----

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TABLE 11.4-3 (Continued)

STREAM	CLEAN UP SLUDGE	WASTE SLUDGE	DISTILLATE RESIN	EQUIP. DR. RESIN	FLOOR DRAIN RESIN	CONDENSATE SLUDGE	CONCENTRATE WASTE
ISOTOPES			Ci/50 CUBIC FOOT CONTAINER				
Cs-134	~~8.10~~ 4.86	----	~~7.78~~ 4.67 x 10^{-7}	~~0.05~~ 0.03	~~3.88~~ 2.33 x 10^{-4}	~~0.04~~ 0.02	~~2.63~~ 4.16 x 10^{-5}
Cs-136	----	----	----	~~0.01~~ 0.006	----	----	----
Cs-137	~~13.90~~ 8.34	----	~~1.18~~ 7.08 x 10^{-6}	~~0.08~~ 0.05	~~5.99~~ 3.59 x 10^{-4}	~~0.06~~ 0.04	~~4.69~~ 7.43 x 10^{-5}
Cs-138	----	----	----	~~0.02~~ 0.01	----	----	----
Ba-137M	~~12.99~~ 7.79	----	----	~~0.08~~ 0.05	----	~~0.05~~ 0.03	----
Ba-139	----	----	----	~~0.07~~ 0.04	~~3.11~~ 1.87 x 10^{-3}	----	----
Ba-140	~~6.01~~ 3.61	----	~~2.59~~ 1.55 x 10^{-5}	~~0.86~~ 0.51	~~6.22~~ 3.73 x 10^{-3}	~~0.21~~ 0.13	~~1.76~~ 2.79 x 10^{-3}
Ce-141	----	----	----	~~0.01~~ 0.006	----	~~0.03~~ 0.02	----
Ce-144	~~1.51~~ 0.91	----	----	~~0.01~~ 0.006	~~3.76~~ 2.26 x 10^{-4}	~~0.05~~ 0.03	----
La-140	~~6.89~~ 4.13	----	----	~~0.86~~ 0.51	----	~~0.24~~ 0.14	----
La-141	----	----	----	~~0.02~~ 0.01	----	----	----
La-142	----	----	----	~~0.01~~ 0.006	----	----	----
Pr-143	~~1.78~~ 1.07	----	----	~~0.01~~ 0.006	----	~~0.06~~ 0.04	----
Pr-144	~~1.51~~ 0.91	----	----	~~0.01~~ 0.006	----	~~0.05~~ 0.03	----
Np-239	----	----	~~1.99~~ 1.19 x 10^{-4}	~~4.24~~ 2.54	~~3.58~~ 2.15 x 10^{-2}	----	~~4.69~~ 7.43 x 10^{-2}
Cr-51	~~3.57~~ 2.14	~~5.30~~ 3.18 x 10^{-3}	~~1.87~~ 1.12 x 10^{-6}	~~0.04~~ 0.02	~~3.05~~ 1.83 x 10^{-4}	~~0.23~~ 0.14	~~9.73~~ 1.54 x 10^{-4}
Mn-54	~~2.11~~ 1.27	----	----	~~0.01~~ 0.006	----	~~0.05~~ 0.03	----
Mn-56	----	~~1.79~~ 1.07 x 10^{-2}	----	~~0.02~~ 0.01	~~5.90~~ 3.54 x 10^{-4}	----	----
Co-58	~~129.60~~ 77.76	~~5.46~~ 3.28 x 10^{-2}	~~2.19~~ 1.31 x 10^{-5}	~~0.63~~ 0.38	~~4.57~~ 2.74 x 10^{-3}	~~4.64~~ 2.78	~~9.73~~ 1.54 x 10^{-3}
Co-60	~~31.58~~ 18.95	~~5.56~~ 3.34 x 10^{-3}	~~2.42~~ 1.45 x 10^{-6}	~~0.09~~ 0.05	~~6.10~~ 3.66 x 10^{-4}	~~0.73~~ 0.44	~~9.73~~ 1.54 x 10^{-4}
Fe-59	~~1.36~~ 0.82	~~8.65~~ 5.19 x 10^{-4}	----	~~0.01~~ 0.006	~~6.23~~ 3.74 x 10^{-5}	~~0.06~~ 0.04	----
Ag-110M	~~3.17~~ 1.90	~~6.64~~ 3.98 x 10^{-4}	----	~~0.01~~ 0.006	~~6.80~~ 4.08 x 10^{-4}	~~0.08~~ 0.05	----
W-187	----	~~1.15~~ 6.90 x 10^{-3}	----	~~0.01~~ 0.006	~~1.12~~ 6.72 x 10^{-5}	----	----
TOTAL	~~310.86~~ 186.52	~~3.59~~ 2.15 x 10^{-1}	~~3.71~~ 2.22 x 10^{-4}	~~14.41~~ 8.63	~~1.09~~ 6.53 x 10^{-2}	~~9.25~~ 5.55	~~6.60~~ 1.06 x 10^{-1}

~~A Without solidification except for concentrated waste~~

~~AA Solidified~~

TABLE 11.4-4

EXPECTED ANNUAL PRODUCTION OF SOLIDS

	50 FT^3 CONTAINERS/YR ~~NOT SOLIDIFIED*~~	SOLIDIFIED	NORMAL ACTIVITY μCi/CONTAINER	MAXIMUM ACTIVITY μCi/CONTAINER
Cleanup Filter Demineralizer Sludge	~~3~~	5	1.37 ~~1.29~~ x 10^8	2.19 ~~3.65~~ x 10^8
Condensate Filter Demineralizer Sludge	~~50~~	~~91~~ 83	2.82 ~~4.70~~ x 10^6	6.30 ~~1.05~~ x ~~10^7~~ 10^6
Waste, Floor Drain & Fuel Pool Filter Demineralizer Sludge	~~18~~	~~33~~ 30	1.66 ~~2.77~~ x 10^5	2.62 ~~4.37~~ x 10^6
Distillate Demineralizer Resin	~~2~~	~~4~~ 3	7.38 ~~1.23~~ x ~~10^2~~ 10^1	8.34 ~~1.39~~ x ~~10^2~~ 10^1
Waste Demineralizer Resin	~~4~~	~~11~~ 7	1.81 ~~3.35~~ x 10^6	2.27 ~~3.79~~ x 10^7
Floor Drain Demineralizer Resin	~~4~~	~~11~~ 7	4.77 ~~7.90~~ x 10^3	1.91 ~~3.19~~ x 10^5
Concentrated Waste Solution	~~19~~**	~~19~~ 12	1.03 ~~6.5~~ x ~~10^4~~ 10^5	1.06 ~~6.7~~ x ~~10^4~~ 10^5
Total Containers	~~100~~	~~174~~ 147		
Total Volume (Ft^3)	~~5000~~	~~8700~~ 7350		

~~*Without solidification except for concentrated waste.~~

~~**Solidified~~

a. Purpose

To verify that the radioactive waste system will perform its design functions of processing liquid and solid radioactive wastes.

b. Prerequisites

The system lineup tests have been completed. TWG has reviewed and the Startup Superintendent has approved the test procedure and the initiation of testing.

c. General Test Methods and Acceptance Criteria

Testing will demonstrate that the pumps, tanks, controls and valves including automatic isolation, diversion and protective features and instrumentation and alarms will operate and function in accordance with design requirements.

Figure Number	Title	Engineering Dwg. No.
11.2-2	Equipment Drain Subsystem Flow Diagram	M532
11.2-3	Floor Drain Subsystem Flow Diagram	M531
11.2-4a	Flow Diagram Chemical Waste Processing	M533 Sht. 1
11.2-4b	Flow Diagram Chemical Waste Processing	M533 Sht. 2
11.2-4c	Flow Diagram Chemical Waste Processing	M533 Sht. 3
11.4-1a	Radioactive Waste Disposal Solids Handling System	M536 Sht. 1
11.4-1b	Radioactive Waste Disposal Solids Handling System	M536 Sht. 2

(a) Radwaste Control Room (RCR)

(b) Main Control Room (MCR).

(c) ~~Hopper mixers~~ Waste Mixing Tanks are interlocked to stop the centrifuges and shift valve lineups on local high level alarms, refer to FSAR Figure 11.4-1.

(d) Overflow of the centrifuges is routed to the waste sludge phase separator.