OCONEE NUCLEAR STATION

DESCRIPTION OF PROPOSED MODIFICATION

TO

RADIOLOGICAL EFFLUENT TREATMENT FACILITY

SEPTEMBER, 1979

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1.0 INTRODUCTION AND GENERAL DESCRIPTION

1.1 INTRODUCTION

The initial Duke Power Co. design for Oconee Nuclear Station included a system for processing liquid radioactive wastes at a rate of approximately 10 gpm. Early in 1973, in light of increasing regulatory requirements and operating experience, it was recognized that the capacity of this system would be insufficient to accomodate the volume of low-level radioactive waste to be generated by the three Oconee units. Therefore, an interim facility was constructed to provide additional capacity until a permanent facility could be designed and built. Initial operation of the interim facility coincided with that of Oconee Unit 3. When it was observed that the interim radwaste facility was capable of processing the wastes actually generated, plans for the permanent facility were postponed. In June of 1975, Duke Power Company submitted a Waste Management Facility Safety Analysis Report which described the operation of the interim facility systems and their ability to satisfy the waste processing demands experienced.

Since that time, more stringent regulatory requirements relating to the release of radioactive effluents and the volume of low-level radioactive waste generated as a result of operating transients have indicated a need for additional liquid waste processing capabilities. The Liquid Waste Processing, Reactor Coolant Recycle, Powdered Resin Recovery, and Waste Solidification Systems described in this report comprise an addition to the existing radwaste processing capability.

1.2 GENERAL DESCRIPTION

1.2.1 SITE CHARACTERISTICS

A detailed description of the Oconee Nuclear Station site can be found in Chapter 2 of the Oconee Final Safety Analysis Report (FSAR). Additional subsurface investigations are being made to assure that the location intended for the Radiological Effluent Treatment Building (RETB), which will house the additional radwaste treatment systems, is suitable.

1.2.2 PRINCIPAL DESIGN CRITERIA

A principal design criterion is that no single administrative error or operational failure will result in an offsite release in excess of the limits established in 10 CFR20.

In order to assure that any radioactive effluent releases are kept "as low as reasonably achievable," there will be sufficient operational flexibility to treat properly wastes from all anticipated sources. In addition, all system operation and maintenance will be conducted in accordance with 10CFR20 to assure that "as low as reasonably achievable" objectives are also met for occupational exposure.

The standards for the design and fabrication of the components to be used meet or exceed the Quality Group D Standards listed in Table 1 of Regulatory Guide 1.26, Revision 3. The components are classified as non-nuclear-safety-related.

2.0 LIQUID PROCESSING SYSTEMS

The purpose of the Liquid Waste Processing (LW) Systems is to treat liquid radwastes to yield water, to be recycled or released to the environment, and a relatively small volume of concentrated waste, which is transferred to the Waste Solidification (VR) System. The Reactor Coolant Recycle (LR) System, which is similar to the LW Systems, will be dedicated to processing reactor coolant to produce reactor grade water and concentrated boric acid. The description which follows applies to any of the three liquid processing systems. The effectiveness of the separation processes will be consistent with the "as low as reasonably achievable" (ALARA) guidelines of 10CFR20 in order to protect the public and the environment without significantly affecting unit availability.

2.1 DESIGN BASES

2.1.1 HOLDUP AND SAMPLING OF LIQUID WASTES

2.1.1.1 Holdup of Contaminated Liquids

All liquid waste transferred to the LW Systems is received from either the miscellaneous waste header or the laundry and hot showers header. Holdup capability is provided by four 10,000 gallon waste feed tanks (WFT's). Each header is equipped with redundant strainers and oil absorbing agents to prevent debris or oil from entering the waste feed tanks. The laundry and hot shower header is equipped with a carbon filter for removal of organic material. Four tanks are provided in order to provide for the following functions:

1) Receipt of liquid wastes from waste headers.
2) Isolation for sampling and chemical adjustments, if required, prior to processing.
3) Discharge to processing equipment.
4) Extra tank for processing by another independent flow path or for holdup due to delays in sampling or chemical adjustment.

2.1.1.2 Mixing and Sampling

Mechanical mixers for each tank ensure that a uniform mixture is available for sampling. Mixers are used instead of recirculation pumps to (1) provide for more effective mixing, (2) limit the area requiring shielding, and (3) reduce the possibility for leakage of contaminated liquids.

Sampling of all four WFT's is done in a centralized area. Sample lines are flushed in closed loops, and a sample is drawn through a three-way valve.

Flush water is returned to the WFT by means of a small capacity WFT sample pump. If the sample pump is inoperable, the flush water can be diverted to the equipment drain.

2.1.2 SEPARATION OF LIQUID RADWASTES

Depending on the source of liquid wastes, water from a WFT may be treated by one or more of the following components: (1) the waste filter, (2) the carbon filter, (3) the waste evaporator or (4) the waste demineralizer. Redundant filters, demineralizers, and pumps are provided as backups for equipment that may be removed from service or for simultaneous operation of independent trains.

2.1.2.1 Waste Filters

Two backflushable waste filters are provided for separation of suspended particulates from the fluid. Since most liquid wastes contain such solids, it is anticipated that virtually all liquid wastes will require treatment by the waste filters. The objective of the waste filters is to remove 95% of all particulates greater than 5 microns in size.

Backflushable filters are used instead of replaceable cartridge filters in order to minimize handling of radioactive materials, in accordance with ALARA considerations, and to reduce operating and maintenance costs.

2.1.2.2 Carbon Filter

One of the LW Systems is equipped with a carbon filter for the removal of organic wastes, particularly detergents, typically found in laundry and hot shower effluents. Only one carbon filter is provided, since the existing plant system will continue to be the principal means for treating the laundry wastes.

2.1.2.3 Waste Evaporator

A single waste evaporator (WE) provides for the separation and concentration of a variety of liquid radwastes, especially those with high ionic concentrations. The waste evaporator has sufficient capacity to process the volume of a waste feed tank during an operating shift.

2.1.2.4 Waste Demineralizers

Two mixed-bed waste demineralizers remove potentially radioactive ionic wastes from the liquid effluents. The demineralizers will normally be used to polish the evaporator distillate when floor drains are being processed, and will be used to treat reactor quality water prior to treatment by the evaporator.

2.1.2.5 Waste Fines Filters

Two disposable-cartridge waste fines filters will be located between the waste demineralizers and the three waste monitor tanks. The waste fines filters serve to retain resin fines from the waste demineralizers. In addition, the waste fines filters can act as final filters to limit further the concentration of suspended solids released. Since the waste fines filters will be exposed only to a relatively high quality effluent, minimal shielding will be required, and the spent cartridges should be easily handled. Disposable filters offer the flexibility to vary filter sizes when desired.

2.1.3 MONITORING OF EFFLUENTS

The effluent from the separation stages is transferred to one of three 10,000 gallon waste monitor tanks (WMT's). The waste monitor tanks provide holdup capability while the contents are sampled and tested. Mixing and sampling is done with similar equipment and in the same manner as for the waste feed tanks.

2.1.4 TRANSFER OF EFFLUENTS AND BY-PRODUCTS

2.1.4.1 Effluents

The processing system effluent which meets chemistry and radioactivity specifications is transferred to the Effluent Release (ER) System for dilution and discharge to the environment. Transfer of effluents to the ER System assures that releases do not exceed instantaneous concentration limits.

Effluent which fails to meet chemistry or radioactivity specifications is returned, by means of the miscellaneous waste header, to the waste feed tank for reprocessing. If there is a need for additional Reactor Coolant System makeup water, the LW System effluent can be returned to the recycle feed tank in the LR System for further processing or to the recycle water holdup tank.

2.1.4.2 By-Products

Radioactive by-products from the separation processes are transferred to the VR System. Evaporator concentrates may be stored in the waste evaporator concentrates holdup tank (WECHT) prior to transfer to the VR System's solidification batching tank (SBT). Transfer of LR System by-products can be made in the same manner, except that bottoms containing high quality concentrated boric acid may be stored in the boric acid holding tank (BAHT) prior to return to the concentrated boric acid storage tank (CBAST).

2.2 DESIGN DESCRIPTION

2.2.1 COMPONENT DESIGN PARAMETERS

2.2.1.1 Tanks

All tanks are vented to the building exhaust through carbon and absolute filters. The tank design parameters are presented in Table 2.2-1.

2.2.1.2 Pumps

All pump wetted surfaces are stainless steel. The pump design parameters are presented in Table 2.2-2.

2.2.1.3 Filters, Strainers, and Demineralizers

Design parameters for filters, strainers, and demineralizers are presented in Table 2.2-3.

2.2.1.4 Waste Evaporator Equipment

(Not currently available)

TABLE 2.2-1
TANK DESIGN PARAMETERS

	Number	Type	Material	Volume (gal)	Pressure	Temperature
Waste Feed Tanks	4	Lined Concrete Pool	Stainless Steel	10,000	4 psig	200°F
Waste Monitor Tanks	3	Lined Concrete Pool	Stainless Steel	10,000	4 psig	200°F
WECHT	1	*	Stainless Steel	5,000	50 psig	250°F
WFT Chemical Addition Tanks	3	*	*	100	0 psig	200°F
WE Antifoam Addition Tank	1	*	Stainless Steel	100	0 psig	200°F

* Not currently available.

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TABLE 2.2-2
PUMP DESIGN PARAMETERS

	Number	Type	Material	Temperature	Flowrate	Developed Head
Waste Feed Pumps	2	Centrifugal	Stainless Steel	200°F	50 gpm	300 ft
WMT Transfer Pump	2	Centrifugal	Stainless Steel	200°F	150 gpm	150 ft
WFT and WMT Sample Pumps	7	*	Stainless Steel	200°F	2 gpm	20 ft

* Not currently available.

TABLE 2.2-3
DESIGN PARAMETERS FOR
FILTERS, STRAINERS, AND DEMINERALIZERS

	Number	Type	Material	Pressure (psig)	Temp. (°F)	Flow rate (gpm)	ΔP Clean (psi)	ΔP Fouled (psi)	Comments
Waste Filters	2	Flushable	Stainless Steel	150	200	50	5	25	(1)
Carbon Filter	1	Flushable	Stainless Steel	150	200	50	5	20	(2)
Waste Fines Filters	2	Disposable Cartridge	Stainless Steel	150	200	100	5	20	(3)
WFT Inlet Strainers	4	Flushable	Stainless Steel	150	200	150	1	25	(3)
Waste Demineralizers	2	Non-regenerable	Stainless Steel	150	200	50	-	-	(4)

(1) Retain 95% of particulates greater than 5 microns in size.

(2) Activated carbon volume: 20 ft^3.

(3) Retention data will be provided at a later date.

(4) Resins: 30 ft^3 of Duolite.

2.3 SYSTEM OPERATION

The liquid processing systems are non-nuclear safety related, and their operation cannot adversely affect station safety. The systems are designed to be operated from the RCR with a minimum of manual action. Adequate control equipment and instrumentation and alarms are provided in the RCR to ensure safe and proper system operation.

2.3.1 MULTIPLE SYSTEM OPERATION

The liquid processing systems are designed to be operated independently, with sufficient redundancy incorporated to assure that processing capacity is available at all times. In the event that the plant generates liquid waste in excess of the capacity of one LW System, or if a critical component is out of service, a second system is available. Two of the LW Systems are designated 1LW and 2LW for the purpose of equipment and instrumentation nomenclature. The third is the LR System. System 1LW is illustrated by Figure 2.3-1, System 2LW is illustrated by Figure 2.3-2, and the LR System is illustrated by Figure 2.3-3. The primary difference between Systems 1LW and 2LW is that System 1LW is equipped with a carbon filter to supplement the current capability for processing laundry and hot shower tank effluent.

2.3.2 NORMAL OPERATION

2.3.2.1 Holdup and Sampling of Liquid Radwastes

Potentially radioactive wastes received by the liquid processing systems are diverted to one of the four waste feed tanks of one of the systems. Contents of the tank are mixed thoroughly prior to sampling. Based on the results of the chemical and radiological analyses of the influent sample and the required quality of the effluents, the appropriate processing path is selected. Should components in the system selected be unavailable, the waste feed tank contents can be transferred to one of the other LW Systems by way of the miscellaneous waste header.

Prior to further processing, the contents of the waste feed tank should meet the specifications listed in Table 2.3-1. Wastes which do not meet those specifications can be diluted and the pH can be controlled by the addition of acid or basic solutions. In addition, a miscellaneous chemical addition tank allows treatment with flocculents or other chemical agents, as required.

2.3.2.2 Processing Liquid Wastes

Table 2.3-2 lists typical process flow paths which may be selected depending on the influent chemistry. Normal processing includes the filter (plus the carbon filter in the case of laundry wastes), the evaporator, and the demineralizer. For most wastes, this sequence should yield an effluent of relatively high quality. From a waste feed tank, the waste can be transferred to any one of the process components or to a waste monitor tank. Bypass loops are provided for each component. Process flow can be returned to a bypassed component only by being transferred to a waste monitor tank and then back to a waste feed tank. The waste monitor tanks cannot be bypassed completely; all process flow is eventually transferred to one.

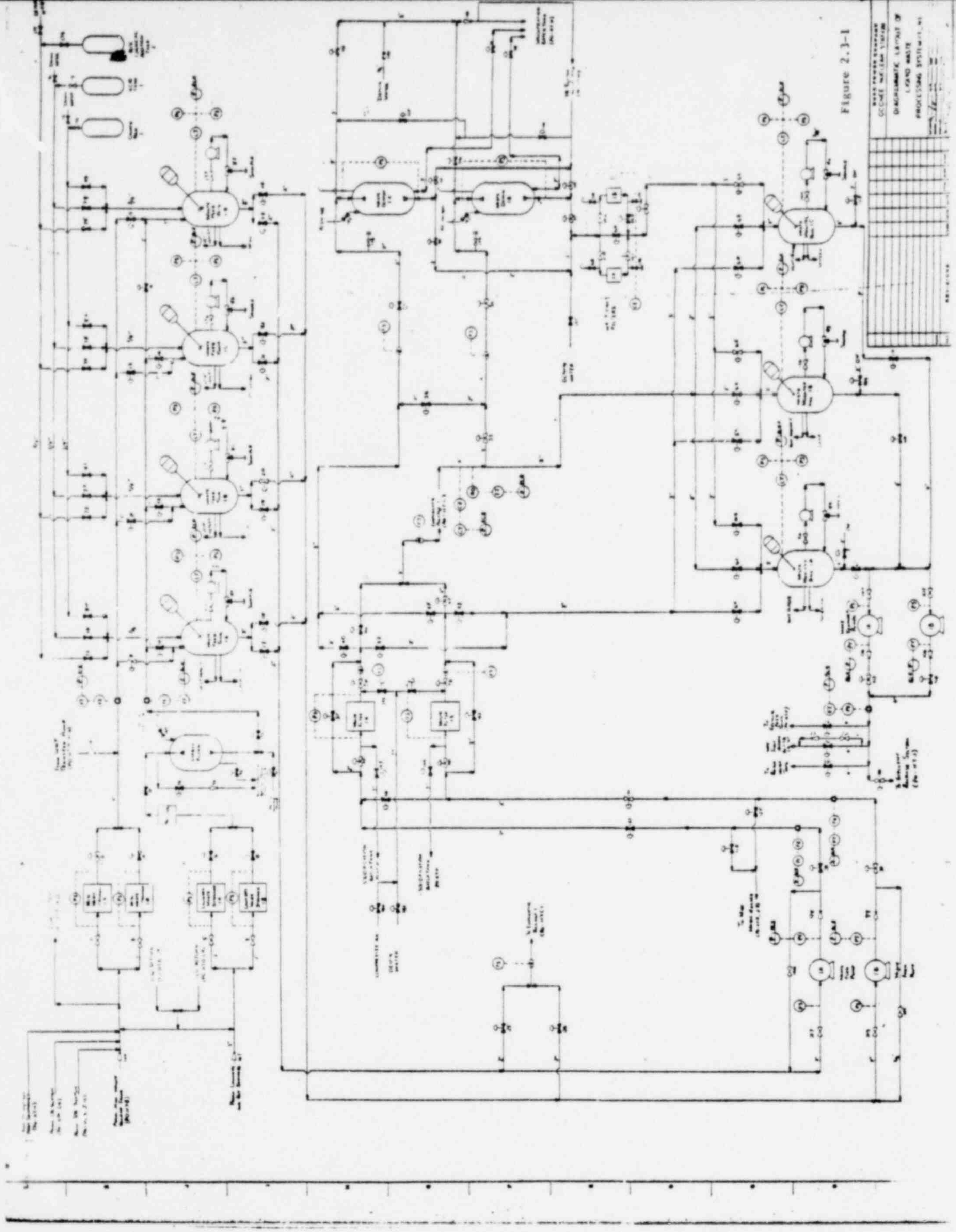

Figure 2.3-1

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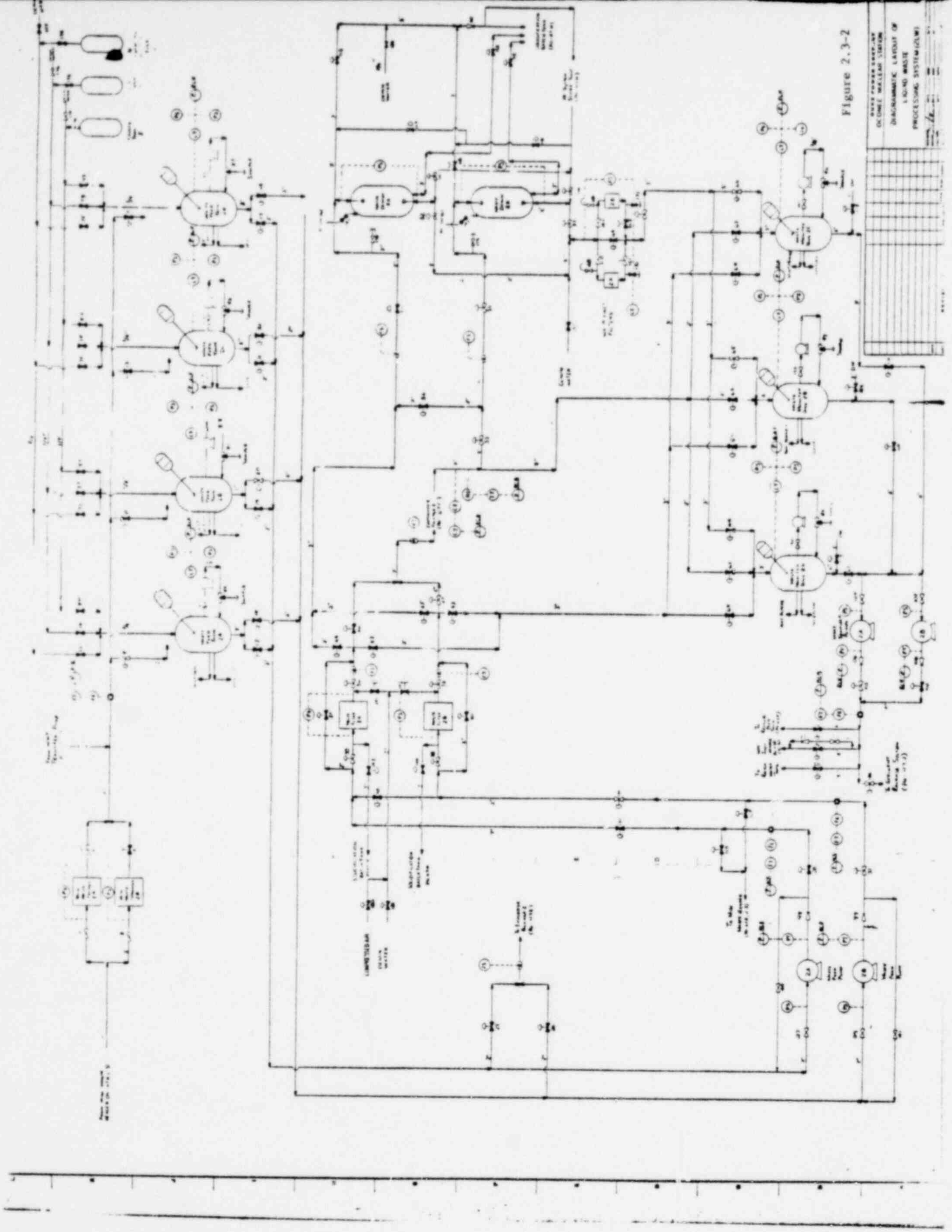
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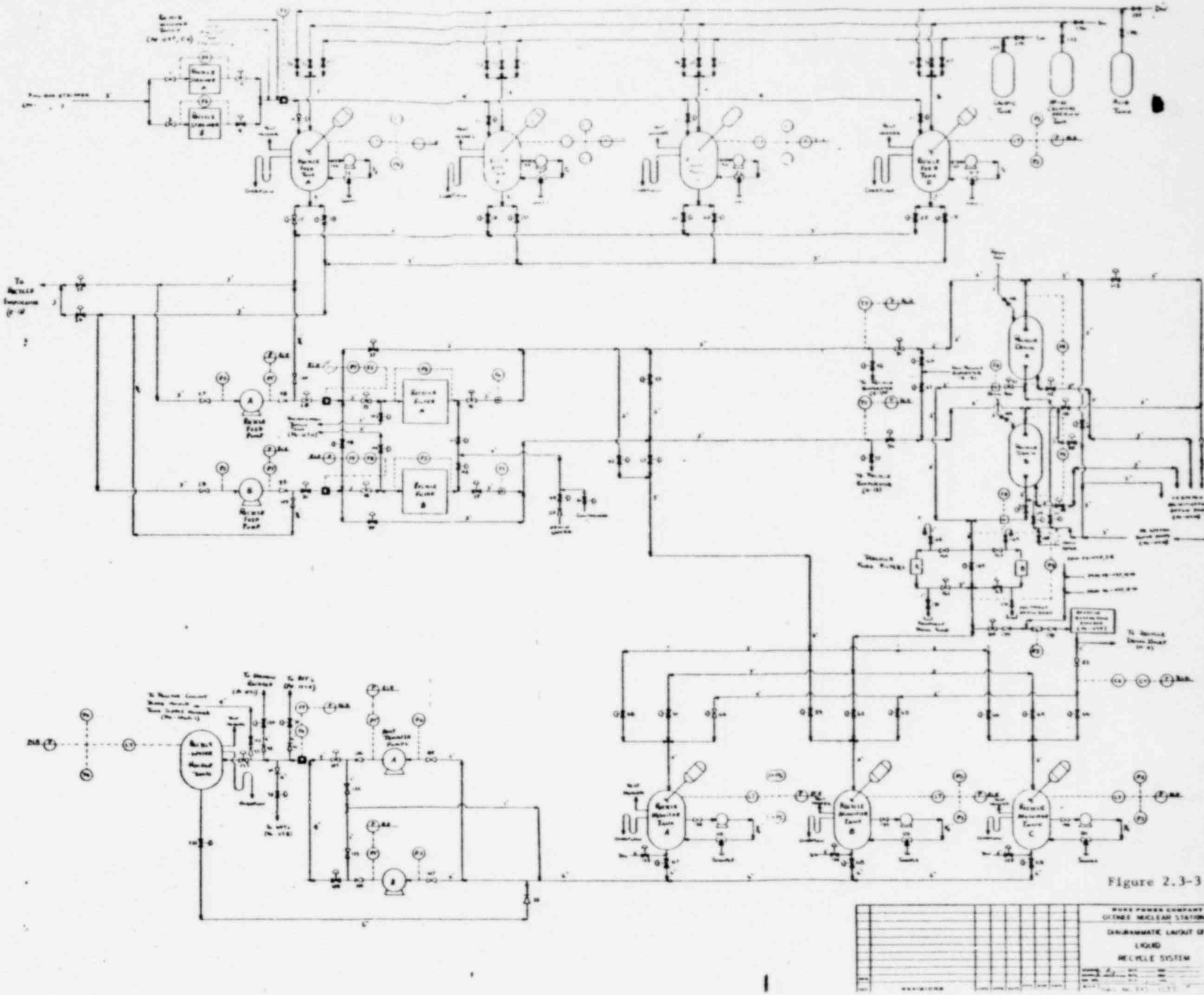
DIAGRAMMATIC LAYOUT OF
LIQUID WASTE
PROCESSING SYSTEM (LW)

Figure 2.3-2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DIAGRAMMATIC LAYOUT OF
LIQUID
RECYCLE SYSTEM

Figure 2.3-3

Concentrated wastes which are not chemically suitable for recycling are transferred to the VR system. The by-products include waste evaporator concentrates, spent demineralizer resins, spent carbon from the carbon filter, backflush from the filter and feed tank strainers. Waste evaporator concentrates are sent to the WECHT prior to being transferred to a solidification batch tank. Spent resins and carbon are sluiced to a SBT, and the sluice water is returned to a waste feed tank for treatment as miscellaneous liquid waste. Backflush is sent directly to a SBT.

2.3.2.3 Effluent Monitoring

Subsequent to processing, the effluent is transferred to one of the three waste monitor tanks, which are identical in size and design to the waste feed tanks. Prior to being discharged to the environment the following criteria must be met:

pH	6-9
hydrazine concentration	F0.1 ppm
boron concentration	F1.0 ppm
chromate concentration	F1.0 ppm
phosphate concentration	F1.0 ppm

2.3.3 ABNORMAL OPERATION

Redundancy and cross-connection capabilities between the liquid processing systems ensure that the loss of individual components does not result in inoperability of the system. Redundancy also allows for operation of independent flow paths simultaneously for processing relatively large volumes of wastes.

The filter and demineralizer trains are cross-connected by means of the waste feed pumps, so that flow from one train can be diverted to the filter or demineralizer of another, assuring availability of the filtration and demineralization processes in case of loss of components.

The liquid processing systems are not designed to be operated during a loss of electrical power. The WECHT and concentrates transfer lines are insulated to prevent crystallization of their contents during brief power losses.

TABLE 2.3-1
WASTE FEED TANK
EFFLUENT CHEMISTRY REQUIREMENTS

PARAMETER	SPECIFICATION
pH	3-10
suspended solids concentration	<500 ppm
chloride concentration	<10 ppm
fluoride concentration	<10 ppm
lithium concentration	<2 ppm
oil concentration	<15 ppm
organic concentration	<1000 ppm
dissolved oxygen	saturated
specific conductivity	<2000 μmho/cm
boric acid concentration	<12000 ppm as H_3BO_3
chromate concentration	<500 ppm
phosphate concentration	<300 ppm

Note: If the total halogen concentration exceeds 1 ppm, the pH should be adjusted to greater than 8 in order to prevent damage to the waste evaporator.

TABLE 2.3-2
TYPICAL PROCESS FLOW PATHS

INFLUENT CHEMISTRY	TREATMENT SEQUENCE
Negligible radioactivity and suspended solids	divert directly to monitor tanks
High conductivity	filter, evaporator, demineralizer
Low conductivity	filter, demineralizer
High organic concentration	carbon filter, filter, evaporator, demineralizer
Recyclable drains	filter, demineralizer, evaporator

3.0 POWDERED RESIN RECOVERY SYSTEM

The purpose of the Powdered Resin Recovery System is to collect and sample backwash from the condensate polishing demineralizers and to separate out the contaminated resins, which are then processed by the VR System.

3.1 DESIGN BASES

3.1.1 PUMPS

The pumps used in the Powdered Resin Recovery System are of two types. Centrifugal pumps are used for pumping decant and liquids with a low concentration of solids. Positive displacement pumps are used for pumping liquids with high concentrations of solids, such as those containing settled resins.

Two backwash tank decant pumps are included. Backwash tank decant pump A is normally used in decanting the contaminated backwash receiving tanks (CBRT) and contaminated resing holding tank (CRHT). Backwash decant tank B is normally used in decanting the two backwash receiving tanks (BRT's). Each pump may be aligned with any one of the four tanks. Each pump is designed to deliver 250 gpm at a head of 100 ft. through the resin fines trap to the decant monitor tank (DMT). At this flowrate, a typical backwash volume can be decanted in one hour. One of the two DMT pumps is used to transfer decant from the DMT to one of the waste feed tanks, the ER System, the condensate storage tank, or the chemical treatment pond (CTP). Each of the DMT pumps is also capable of delivering 250 gpm at a head of 100 ft. The decant monitor tank can be discharged within two hours.

The two BRT resin pumps are used to sluice a concentrated backwash from the BRT's. Backwash which is contaminated is pumped to a solidification batch tank. Non-contaminated backwash is pumped to the CTP. The pumps can be run simultaneously to drain both BRT's, or each can drain either tank. Each pump is capable of delivering 700 gpm at a head of 200 ft., based on the optimum velocity in existing piping. The BRT's can therefore be drained in half an hour.

Two contaminated resin pumps are used to sluice concentrated backwash from the CBRT. The backwash is transferred either to a SBT, or to the CHRT and then to a SBT. At the design flowrate of 100 gpm at 25 ft. of head, the CBRT and CHRT can each be discharged within one hour.

3.1.2 TANKS

Three backwash receiving tanks are provided to collect backwash, consisting of a mixture of spend powdered resin and water, from the condensate polishing demineralizers. Each BRT has a volume of 30,000 gallons above a conical bottom, which directs resin to the outlet nozzle. The CBRT receives backwash from a unit with a steam generator tube leak. The other two BRT's are used for backwash which is not expected to be contaminated. If sampling indicates that the backwash is contaminated, the BRT will be cleaned thoroughly subsequent to processing the wastes. The tanks are equipped with wash headers and have smooth interiors to facilitate cleaning.

The CRHT provides reserve capacity for contaminated resins which cannot be processed by the VR System immediately. The CRHT also provides an additional decanting step to remove as much water as possible prior to solidification. The DMT allows for collection and sampling of decant which has passed through the resin fines trap. The DMT has sufficient volume to accept the decant from a full BRT. This tank allows a determination of the quality of the decant based on sampling the contents after they have been thoroughly mixed.

3.1.3 RESIN FINES TRAP

Pending the results of further testing, the resin fines trap will consist of a two-stage centrifugal (cyclone-type) separator in series with a bag filter. The filter retains carryover from the separator, with particle size retention yet to be determined from test data. The collected resin fines from the separator must be sluiced to the CHRT or to a SBT periodically.

3.2 DESIGN DESCRIPTION

3.2.1 SYSTEM COMPONENT DESIGN PARAMETERS

3.2.1.1 Pumps

Design data for the pumps to be used in the Resin Recovery System are listed in Table 3.2-1. The pumps are constructed of stainless steel.

3.2.1.2 Tanks

The design parameters for the tanks used in the Powdered Resin Recovery System are listed in Table 3.2-2. All tanks are constructed of stainless steel, and are designed for atmospheric pressure. Each tank is equipped with one or more top-mounted agitators.

3.2.1.3 Resin Fines Traps

The design information for the centrifugal separator and filters used in the resin fines trap is listed in Table 3.2-3.

3.2.2 INSTRUMENTATION AND CONTROL

The Powdered Resin Recovery System will be operated remotely from the Radwaste Control Room. Only component isolation valves and valves which are operated infrequently are manually operated.

All tanks are equipped with level instrumentation with indicators located in the RCR, along with high and low-level annunciators. Automatic shutoff on low tank level is provided for all pumps and agitators.

Pumps are provided with locally mounted suction pressure gauges. In addition, each pump is equipped with pressure switches which trip the pump on high discharge pressure. Discharge pressure is also indicated in the RCR. Differential pressure instrumentation is also provided for the resin fines trap, with an annunciator in the RCR to alert the operator to plugging of the filters.

Each backwash tank decant pump is provided with a pressure transmitter which supplies differential pressure across a flow orifice to a manual loader in the RCR.

TABLE 3.2-1
PUMP DESIGN PARAMETERS

PUMPS	NUMBER	TYPE	TEMPERATURE	PRESSURE	FLOWRATE	DEVELOPED HEAD
Backwash Tank Decant	2	Centrifugal	150°F	150 psig	250 gpm	100 ft.
DMT Transfer	2	Centrifugal	150°F	150 psig	250 gpm	100 ft.
BRT Resin	2	Centrifugal*	150°F	150 psig	700 gpm	200 ft.
Contaminated Tank Resin	2	Positive Displacement**	150°F	150 psig	100 gpm	25 ft.

*Designed to pump 0.5 to 2 wgt. % powdered resin.
**Designed to pump 0.5 to 50 wgt. % powdered resin.

TABLE 3.2-2
TANK DESIGN PARAMETERS

	NUMBER	TYPE	VOLUME	TEMPERATURE
Contaminated Backwash Receiving Tank	1	(1)	30,000 gal.	150°F
Backwash Receiving Tanks	2	(1)	30,000 gal.	150°F
Contaminated Resin Holding Tank	1	(2)	20,000 gal.	150°F
Decant Monitor Tank	1	(2)	30,000 gal.	150°F

(1) Flat vertical tank with conical bottom. Tank has a cross-sectional area of 500 ft^2, and is equipped with a wash header and sight glasses.

(2) Horizontal tank.

TABLE 3.2-3
RESIN FINES TRAP
DESIGN PARAMETERS

	NUMBER	TYPE	FLOWRATE	TEMPERATURE	PRESSURE
Centrifugal Separator	1	two-stage cyclone	250 gpm	150°F	150 psig
Filter	2 (parallel)	bag	250 gpm	150°F	150 psig

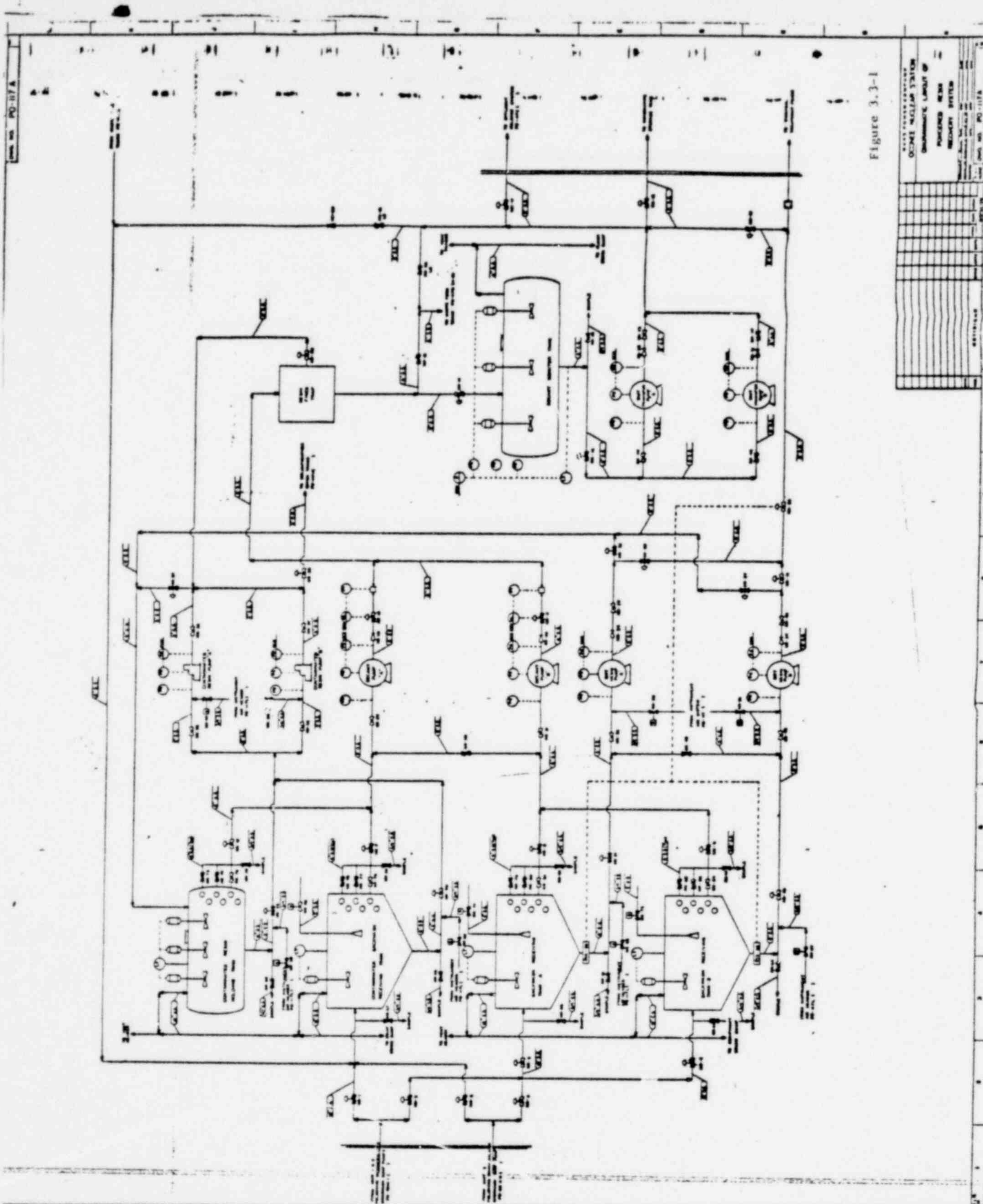
OCONEE NUCLEAR STATION
DIAGRAMMATIC LAYOUT OF
POWDERED RESIN
RECOVERY SYSTEM
DWG NO. PO-117A

Figure 3.3-1

3.3.2.2 Backwash Receiving Tanks

The remaining two BRT's are used to accomodate backwash from condensate polisher demineralizer cells which is not anticipated to be contaminated. A sample is taken from the BRT inlet, and if the level of radioactivity is acceptable, the contents of the tank are agitated for five minutes and the outlet piping is sprayed, after which they are sluiced to the chemical treatment ponds. A radiation indication alarm monitors the effluent and automatically closes the resin valve to the pond in the event that an unacceptable level of activity is detected. If the batch is found to be contaminated, the BRT is operated in the same manner as the CBRT but is then cleaned thoroughly to remove the contamination. The BRT's also provide reserve capacity for handling excessive amounts of backwash, or backwash from more than one source. The BRT's are cross-connected so that each can overflow into the other. If both tanks are full, they overflow to the local equipment drain sump.

3.3.2.3 Contaminated Resin Holding Tank

Contaminated resin from the BRT's is transferred to the CRHT. In addition, the CRHT provides holdup capability for resins from the CBRT if the solidification system is unavailable. The tank is large enough to accomodate four transfers from backwash receiving tanks prior to beginning the settling and decanting process. The contents of the tank are allowed to settle for six to eight hours, after which a sample is taken. When the particle size and contamination level is sufficiently low, the decanting is begun. If excessive levels of activity are found in the water, it is diverted to a waste feed tank. Otherwise, the decant is pumped to the DMT. The flowrate is controlled to minimize carryover to the resin fines trap. The decant pump is stopped on low suction level, and the agitator is operated for five minutes prior to pumping the resins to a solidification batch tank.

3.3.2.4 Resin Fines Trap

The resin fines trap requires minimal operator manipulation. The two stages of the centrifugal separator have automatic controls for sluicing accumulated resin fines to the CRHT. A clogged filter will be identified by a high differential pressure, and the operater must change flow paths to the second filter.

3.3.2.5 Decant Monitor Tank

The DMT receives decanted liquid from the other tanks in the Powdered Resin Recovery System. After receipt of each batch, the agitator is operated for five minutes and a sample is taken in order to determine any further processing which may be required. If activity levels are within the limits listed in Column 2, Table 1 of 10CFR20, Appendix B, the batch may be transferred to the chemical treatment ponds. If the chemistry of the water is acceptable, it may be diverted to the condensate storage tank. If the activity level is too high to allow release to the chemical treatment ponds, but is not high enough to necessitate further processing, the batch is sent to the ER System. Batches with activity levels which are too high to allow release to the environment are transferred to the waste feed tanks for further processing. The batch is returned to the CBRT in the event that resin particles carry over to the DMT.

4.0 WASTE SOLIFICATION SYSTEM

The purpose of the Waste Solification (VR) System is to prepare contaminated wastes for long-term storage. Liquid and wet solid wastes will be solidified and packaged for storage and shipment offsite to licensed commercial burial facilities.

4.1 SYSTEM DESIGN CRITERIA

4.1.1 SCOPE

Effluents from other waste processing systems transferred to the VR System will be received by one of the solidification batch tanks, where final preparation for solidification is made. The VR System will include provisions for filling containers, solidifying their contents, and handling and storing prior to shipment to the permanent storage facilities.

The VR System will be procurred in its entirety from one or mor suppliers, who will provide the system engineering and general arrangement, subject to approval by Duke Power Company.

4.1.2 OPERATION AND MAINTENANCE REQUIREMENTS

The system will be designed with sufficient instrumentation and control to permit remote operation. In order to monitor systems processes, provisions will be included for obtaining samples at appropriate locations.

All operation and maintenance activities will conform to the ALARA guidelines for occupational exposure. Processing equipment will be shielded, and provisions for removing wastes from system components will be included to minimize exposure during maintenance.

4.1.3 SYSTEM INFLUENTS

The VR System will be required to process the effluents from the other radwaste processing systems as outlined in Table 4.1-1.

4.2 SUMMARY SYSTEM DESCRIPTION

Although the system will be designed by the supplier, the following discussion generally describes the components which will be included. Specific design parameters will be provided when they are available.

4.2.1 EQUIPMENT

4.2.1.1 Batch Tanks

Three solidification batch tanks will be included. One will normally receive evaporator concentrates, another will receive bead resin, and the third will receive slurries from a holding tank powdered resin filter backwash and spent carbon. The tanks will be designed for a pressure of at least 120 psig so that transfers can be made by pressurizing the source tank. Each tank will be equipped with an outlet screen so that spent bead resin and carbon can be dewatered prior to solidification.

TABLE 4.1-1
WASTE SOLIDIFICATION INFLUENTS

INFLUENT	QUANTITY	COMPOSITION
Evaporator Concentrates	20,000 ft^3/hr	solids: 10-50 % halogens: 500 ppm oils: 750 ppm pH: 3-10
Powdered Resin	24,000 ft^3/hr*	spent powdered resin; iron oxide
Bead Resin	3,000 ft^3/yr*	spent mixed-bed ion-exchange resin
Spent Carbon	200 ft^3/yr*	carbon contaminated with organics
Filter Backwash	3,000 ft^3/hr	solids (from floor drains and RCS crud): 5%

*Volume does not include transport water.

4.2.1.2 Pumps

Pumps used to transfer the contents of the solidification batch tanks through the solidification process will be chosen for high reliability in handling solids due to the relatively high levels of radioactivity which will be processed.

4.2.1.3 Material Handling and Storage Equipment

The material handling and storage equipment will provide for the following: receipt and storage of empty drums and raw solidification agents, and transfer of them to locations where wastes are combined; transfer of filled drums to an intermediate storage area; placement of dry radioactive material in empty drums; and loading of shipment vehicles with filled drums.

4.2.1.4 Liquid and Gaseous Effluent Handling Equipment

Gaseous effluents which are radioactive or chemically hazardous will be controlled prior to release to assure that they present no personnel hazard. Any liquids which are returned to the LW Systems for further processing will be free from agents added during the solidification processes.

4.3.2 OPERATION

It is expected that the system will process the contents of only one solidification batch tank at a time. The contents of the batch tank will be uniform to the extent that changes in operating parameters during the processing of a batch will not be necessary. The system will be remotely operated, and will include automatic protective features to the extent possible.

5.2.3 MOTOR CONTROL CENTERS

The 600 volt and 208 volt motor control centers will employ magnetic combination motor starters for motor control. Each combination starter will consist of a molded-case circuit breaker, one or more magnetic contactors, a control power transformer, a thermal overload relay, control power fuses, terminal blocks, and various other hardware items. The starters will be mounted in NEMA rated cabinets of modular design. Each motor control center will be equipped with two incoming line breakers to facilitate double-ended feeding.

5.2.4 DISTRIBUTION TRANSFORMERS

The low-voltage distribution transformers will be of the dry type, either floor or wall-mounted depending on their size. These transformers will supply current to various circuits through circuit breaker panelboards and motor control centers.

6.0 RADIOLOGICAL EFFLUENT TREATMENT BUILDING

The Radiological Effluent Treatment Building will be a reinforced concrete structure, approximately 183 ft. by 243 ft. The building will have three floors, at elevations 797+0, 817+0, and 837+0 The building will be designed for normal static and dynamic loads, as well as wind, tornado and earthquake loadings. The following discussion outlines the individual design loads and the applicable load combinations.

6.1 DESIGN BASES

6.1.1 WIND AND TORNADO LOADINGS

The RETB design is capable of withstanding the effects of wind and tornado loadings without loss of structural integrity. The following sections provide the bases for determining design criteria and the methods used to assure wind and tornado loadings are accounted for.

6.1.1.1 Wind Loadings

The design wind velocity is 95 mph at 30 ft. above the nominal ground elevation. According to ASCE Paper 3269, "Wind Forces on Structures", this represents the fastest wind velocity with a recurrence interval of 100 years. ANSI A58.1-1972, "Building Code Requirements for Minimum Design Loads in Buildings and Other Structures", recommends that buildings with a height-to-minimum-horizontal-dimension ratio exceeding five should be dynamically analyzed to determine the effect of gust factors. However, since this structure will have a height-to-width ratio less than five, a gust factor of unity is used in determining wind forces.

6.1.1.2 Tornado Loadings

The tornado loads assumed in performing design calculations conform to Regulatory Guide 1.76. The calculations are performed in accordance with ASCE Paper 3269, using the maximum tornado wind velocities. The spectrum and characteristics of tornado-generated missiles are discussed in a later section.

6.1.2 WATER LEVEL DESIGN

The yard grade is at elevation 796+0. All openings into the structure will be no lower than elevation 797+0. The yard is provided with a surface water drainage system.

6.1.3 MISSILE PROTECTION

The structure is designed to withstand the impact of missiles generated by tornadoes. The missiles are postulated in accordance with NRC Standard Review Plan 3.5.1.4, Revision 1, and Regulatory Guide 1.76. Penetration depths for the missiles are calculated using both the modified NRDC formula and the modified Petry formula. The minimum barrier thickness will be three times the calculated maximum depth of penetration for postulated missiles. The exterior barrier thicknesses of the structure are designed to preclude perforation and scabbing, and therefore eliminate the possibility for secondary missiles.

6.1.4 SEISMIC DESIGN

The site smoothed-response spectra for the Operating Basis Earthquake (OBE) and Safe Shutdown Earthquake (SSE) are consistent with the guidelines of Regulatory Guide 1.60. The spectra defined in Figure 6.1-1 represent the response at the top of sound rock. Both horizontal and vertical ground movements will be investigated. It has not yet been determined whether the building foundation will be on a spread footing at the existing grade or whether piles or caissons will be required. A subsurface investigation is underway to determine the suitability of the in situ material to support the structure. A soil-structure interaction analysis will be performed if it is determined that the in situ material is suitable.

6.2 DESIGN GUIDELINES

The building will be a poured-in-place, reinforced-concrete structure, as shown in Figures . The structure itself is designed to serve as biological shielding.

The structure is designed in accordance with the following codes and standards:

STRUCTURAL COMPONENT	DESIGN CODES
Concrete	ACI 318.71
Concrete Reinforcement	ASTM A615-72, Grades 40 & 60
Cadwelds	Regulatory Guide 1.10
Structural Steel & Plates	ASTM A-36 and AISC, 1978

6.2.1 LOADS

6.2.1.1 Normal Loads

Normal loadings are those which are expected to be encountered during routine operation. They include the following:

D: static (dead) loads or their related internal moments and forces, including any permanent equipment loads.

L: dynamic (live) loads or their related internal moments and forces, including any movable equipment loads and other loads which vary with intensity and occurrence, such as soil pressure.

6.2.1.2 Severe Environmental Loads

Severe environmental loadings are those which are expected to occur infrequently during plant life. Included in this category are the following:

E: loads generated by the OBE, and

W: loads generated by the design winds specified for the site.

6.2.1.3 Extreme Environmental Loads

Extreme environmental loadings are those which are credible but are considered to be highly improbable. They include the following:

E^1: loads generated by the SSE

W_t: loads generated by the Design Basis Tornado specified for the site. These include loads due to tornado wind pressure (W_w), loads due to tornado-created differential pressures (W_p), and loads due to missiles generated by tornadoes (W_m).

The combined effects of the three tornado loadings (W_w, W_p and W_m) will be determined in a conservative manner using the following combinations as appropriate:

(i) $W_t = W_w$
(ii) $W_t = W_p$
(iii) $W_t = W_m$
(iv) $W_t = W_w + 0.5\ W_p$
(v) $W_t = W_w + W_m$
(vi) $W_t = W_w + 0.5\ W_p + W_m$

6.2.2 LOAD COMBINATIONS FOR CONCRETE STRUCTURES

6.2.2.1 Service Load Combinations

The following service load combinations will be satisfied:

(i) U = 1.4D + 1.7L
(ii) (a) U = 1.4D + 1.7L + 1.9E
(b) U = 1.2D + 1.9E
(iii) (a) U = 1.4D + 1.7L + 1.7W
(b) U = 1.2D + 1.7W

6.2.2.2 Faulted Load Conditions

For faulted load combinations, which represent Extreme Environmental, Abnormal, Abnormal/Severe Environmental and Abnormal/Extreme Environmental conditions, the Strength Design method will be used, and the following load combinations will be satisfied:

(iv) U = D + L
(v) $U = D + L + E^1$
(vi) $U = D + L + W_t$

In addition to the load combinations listed above, the structure foundation design will account for sliding and overturning due to earthquakes, winds, and tornadoes.

6.2.3 LOAD COMBINATIONS FOR STEEL STRUCTURES

6.2.3.1 Load Combinations for Service Load Conditions

The AISC Elastic Working Stress or Plastic Design method will be used.

If the Elastic Working Stress design method is used, the loads will be calculated as follows:

(i) $S = D + L$
(ii) $S = D + L + E$
(iii) $S = D + L + W$

If the Plastic Design Method is used, the loads will be calculated as follows:

(i) $Y = 1.7D + 1.7L$
(ii) $Y = 1.7D + 1.7L + 1.7E$
(iii) $Y = 1.7D + 1.7L + 1.7W$

6.2.3.2 Load Combinations for Faulted Load Conditions

If the Elastic Working Stress Design Method is used, the loads will be calculated as follows:

(iv) $1.6S = D + L$
(v) $1.6S = D + L + E^1$
(vi) $1.6S = D + L + W_t$

If the Plastic Design Method is used, the loads will be calculated as follows:

(iv) $0.9Y = D + L$
(v) $0.9Y = D + L + E^1$
(vi) $0.9Y = D + L + W_t$

This structure is analyzed as a series of rigid plane frames (or a series of three-dimensional space frames) subjected to the loads summarized above. The Structural Design Language (STRUDL) computer program is used to perform both the static and dynamic analyses.

7.0 SAFETY EVALUATION

The proposed addition of the radiological treatment building and incorporated systems represents an extension of the existing treatment systems. As such, the addition does not represent an unreviewed safety question, and review of the additional systems is within the purview of Duke Power Company pursuant to 10CFR50.59.

All systems are classified as non-nuclear safety related. The structure housing the system is Seismic Category 1, and it will therefore limit the possibility for offsite releases under abnormal conditions. Operation of the system cannot result in an accident which has not been previously analyzed, nor can it increase the consequences of those accidents which have been analyzed. Moreover, the additional capacity will serve to enhance Oconee Nuclear Station's ability to meet the ALARA guidelines of 10CFR50 Appendix I.