ANTICIPATED ANNUAL RELEASES OF RADIOACTIVE MATERIALS IN GASEOUS EFFLUENT FROM OCONEE NUCLEAR POWER STATION - UNITS 1, 2, & 3

(BASED ON 60 DAYS HOLDUP)

Nuclides	Containment Purge Units 1, 2, & 3* (Ci/yr)	Waste Gas System Units 1 & 2 (Ci/yr)	Waste Gas System Unit 3 (Ci/yr)	Steam Air Ejectors Units 1, 2, & 3** (Ci/yr)	Total Units 1, 2, & 3
Kr-85	39.6	1466.	733.	6.63	2245.
Kr-87	0.12	- -		8.73	8.9
Kr-88	0.93	- -		27.9	28.8
Xe-131m	29.7	48.2	24.1	10.6	113.
Xe-133	3078.	101.	50.3	2091.	5320.
Xe-135	1.05	- -	- -	9.66	10.7
Xe-138	0.021	- -	- -	6.45	6.[illegible]
I-131	0.78	- -	- -	0.024	0.80
I-133	1.14	- -	- -	0.03	1.17

* Each unit will have a separate plant vent

** Each steam air ejector discharges to the individual plant vent

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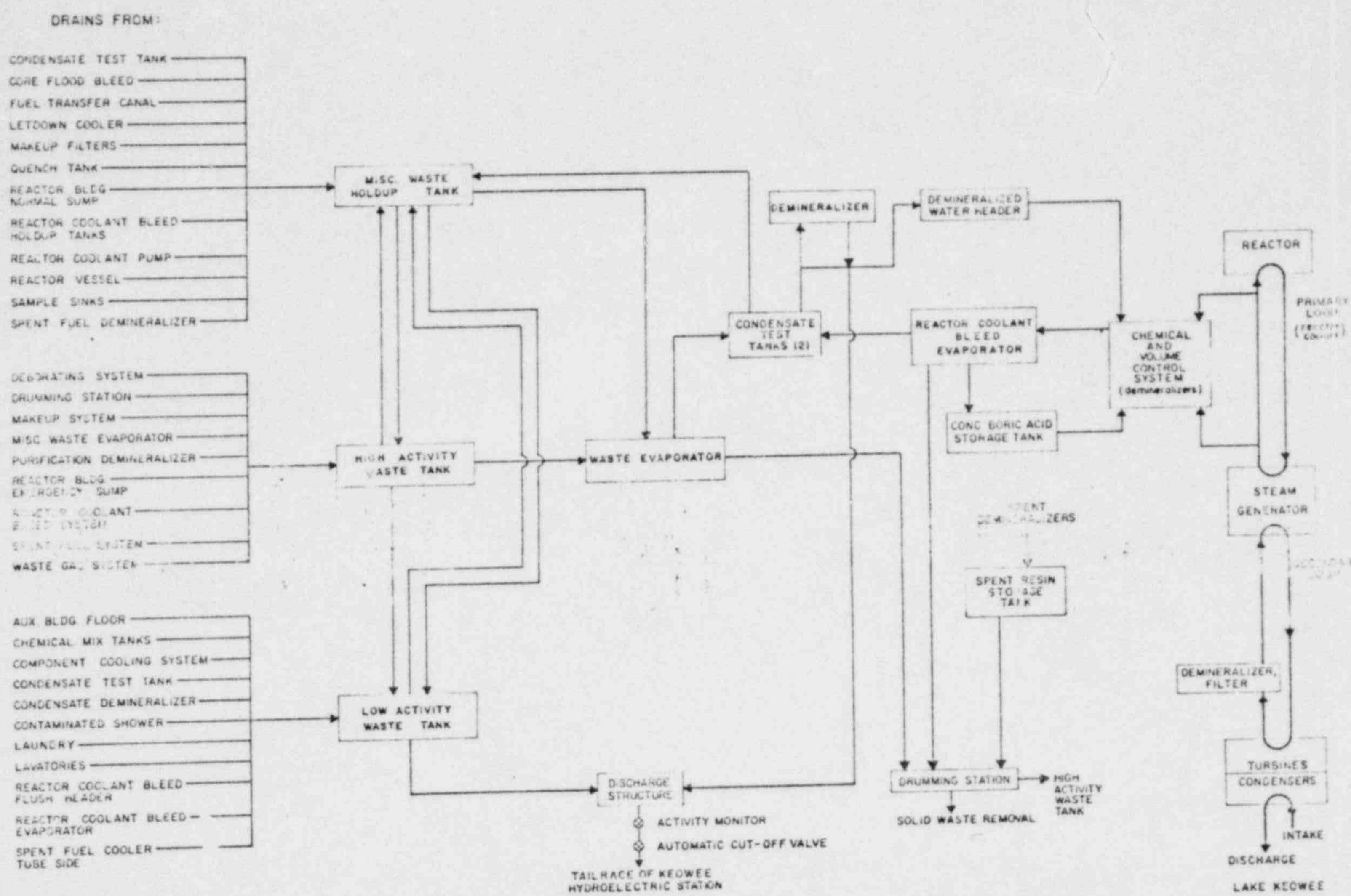

DRAINS FROM:
CONDENSATE TEST TANK
CORE FLOOD BLEED
FUEL TRANSFER CANAL
LETDOWN COOLER
MAKEUP FILTERS
QUENCH TANK
REACTOR BLDG NORMAL SUMP
REACTOR COOLANT BLEED HOLDUP TANKS
REACTOR COOLANT PUMP
REACTOR VESSEL
SAMPLE SINKS
SPENT FUEL DEMINERALIZER
DEBORATING SYSTEM
DRUMMING STATION
MAKEUP SYSTEM
MISC WASTE EVAPORATOR
PURIFICATION DEMINERALIZER
REACTOR BLDG EMERGENCY SUMP
WASTE GAS SYSTEM
AUX BLDG FLOOR
CHEMICAL MIX TANKS
COMPONENT COOLING SYSTEM
CONDENSATE TEST TANK
CONDENSATE DEMINERALIZER
CONTAMINATED SHOWER
LAUNDRY
LAVATORIES
REACTOR COOLANT BLEED FLUSH HEADER
REACTOR COOLANT BLEED EVAPORATOR
SPENT FUEL COOLER TUBE SIDE
MISC. WASTE HOLDUP TANK
HIGH ACTIVITY WASTE TANK
LOW ACTIVITY WASTE TANK
WASTE EVAPORATOR
CONDENSATE TEST TANKS (2)
DEMINERALIZER
DEMINERALIZED WATER HEADER
REACTOR COOLANT BLEED EVAPORATOR
CONC BORIC ACID STORAGE TANK
CHEMICAL AND VOLUME CONTROL SYSTEM (demineralizers)
REACTOR
PRIMARY LOOP
STEAM GENERATOR
DEMINERALIZER, FILTER
TURBINES CONDENSERS
INTAKE
DISCHARGE
LAKE KEOWEE
SPENT RESIN STORAGE TANK
DRUMMING STATION
HIGH ACTIVITY WASTE TANK
SOLID WASTE REMOVAL
DISCHARGE STRUCTURE
ACTIVITY MONITOR
AUTOMATIC CUT-OFF VALVE
TAILRACE OF KEOWEE HYDROELECTRIC STATION

RADWASTE SECTIONS FOR ENVIRONMENTAL STATEMENT
OCONEE NUCLEAR POWER STATION UNITS 1, 2 & 3 AT 100 PERCENT POWER

Radioactive Waste

The operation of a nuclear reactor results in the production of radioactive fission products, the bulk of which remain within the cladding of the fuel rods. During operation of the reactor, small amounts of fission products may escape from the fuel cladding into the primary coolant; also, some radioactive materials are produced as a result of neutron activation of corrosion products in the coolant. Some of these materials in low concentrations may be released into the atmosphere as gases or released in liquids to the tailrace of the Keowee Hydroelectric Station which ultimately discharges to the Keowee River by controlled processes after appropriate monitoring, treatment and sampling.

The radioactive waste treatment systems presently incorporated in the Oconee Nuclear Power Station are described in the Duke Power Company's Final Safety Analysis Report and the applicant's Environmental Report dated July 1970 including the Supplemental Report dated October 18, 1971 and Revision 1 to the Supplement dated November 2, 1971. The radioactive waste handling and treatment systems of the Oconee Nuclear Power Station are designed to collect and process the liquid, gaseous, and solid wastes that are byproducts of station operation and that might contain radioactive materials. The liquid waste treatment system is sized to accommodate the waste produced during simultaneous operation of Units 1, 2 & 3 and is common to all three units. Units 1 and 2 will share a common gaseous waste treatment system. Unit 3 will have a separate treatment system which can be interconnected to the system for Units 1 and 2; however, these systems will normally be operated independently. The radioactivity that may be released during operation of Units 1, 2, and 3 at full power will be as low as practicable and in accordance with Commission regulations, as set forth in 10 CFR Part 20 and 10 CFR Part 50.

Gaseous Waste

During power operation of the facilities, radioactive materials released to the atmosphere in gaseous effluents include low concentrations of fission product noble gases (krypton and xenon), halogens (mostly iodines), tritium contained in water vapor, and particulate material including both fission products and activated corrosion products.

The primary source of gaseous radioactive wastes is from the degassing of the primary coolant during letdown of the cooling water into the various holding tanks. Additional sources of gaseous waste activity include the auxiliary building exhaust, spent fuel area exhaust, the discharge from the steam jet air ejectors, purging of the reactor contaminant building, and ventilation air exhausted from the turbine building. The gaseous waste handling and treatment systems for the Oconee Nuclear Power Station are shown schematically in Figure ____.

Components that can contain potentially radioactive gases will be collected in a vent header. All liquid waste tanks are vented to the gaseous waste vent header to provide for filling and emptying without overpressurization or creating a vacuum. The vent gases are subsequently drawn from the vent header by one of two compressors or a waste gas exhauster. The gas compressor discharges through a gas separator to one of two waste gas storage tanks (each system has two storage tanks with a unit capacity of 1,100 cubic feet at a pressure of 100 psig) where the gases will be held up for radioactive decay. The operation of the waste gas storage tank is such that it can function both as a surge and a storage decay tank. When filled, the storage tanks will be sampled and analyzed to determine the release rate or the need for additional holdup for radioactive decay. Table 1 is based on a holdup time of 30 days. The gas storage tanks and the waste exhauster will discharge to the unit vent after passing through a filter bank consisting of a prefilter, high-efficiency particulate filter, and a charcoal adsorber. The gas will be further diluted by ventilation air from the various operating areas prior to being released to the atmosphere through the unit vent 200 feet above ground level. The waste gas exhauster normally will not operate and is intended to be used when large volumes of gases containing little or no radioactivity are available for release to the unit vent.

Radioactive gases may be released inside the reactor containment building when components of the primary system are opened to the building atmosphere for operational reasons or where minor leaks occur in the primary system. Prior to access, the reactor containment atmosphere will be purged through prefilters, high-efficiency particulate filters, and charcoal adsorbers and released to atmosphere through the unit vent. The purge equipment is sized for a flow rate of 50,000 CFM providing approximately 1.5 air changes per hour in the reactor building. Units 1, 2 & 3 will have a separate vent stack from each reactor building.

Radioactive gases may also be released to the auxiliary building through leaks and open equipment. Units 1 & 2 share a common building while Unit 3 will have a separate auxiliary building. To minimize the release of radioactive materials, the buildings will be maintained at negative pressure with respect to the outside pressure. Ventilation air will move from areas of low potential towards areas of higher potential. Gases purged from the auxiliary buildings will be continually monitored and released to the atmosphere, untreated through the unit vents. A common fuel storage area will serve Units 1 and 2 while a separate fuel storage area will be provided for Unit 3. Ventilation air in these areas will be exhausted untreated through the auxiliary building exhaust systems and discharged to the unit vents.

The turbine building will be ventilated by 12 roof-mounted exhaust fans. Ventilation air is pulled through outside air louvers and discharged without treatment through the roof exhaust fans.

Radioactive gases which may enter the secondary coolant loop through a leak in the steam generator tubes will be removed from the steam system by the air ejectors and will be discharged from the monitored systems to the individual unit vents.

Table 1 shows the anticipated annual release of radioactive materials in gaseous effluent for each unit based on the systems as described in the applicant's Final Safety Analysis Report and considers operation with 0.25 percent leaking fuel and a 20 gallon per day primary to secondary system leak rate. The applicant has considered additional modifications which could theoretically further reduce radioactivity in the plant such as filters and a cryogenic system; however, the applicant is convinced that such improvements would be of negligible value in view of the already small quantities of activity anticipated to be released from the station.

Liquid Waste

The liquid radioactive waste treatment system common to all three units will consist of tanks, piping, pumps, evaporators, process equipment and instrumentation necessary to collect, process, store, analyze, monitor and discharge potentially radioactive wastes from Units 1, 2, and 3. Treated liquid wastes will be handled on a batch basis as required to permit optimum control and reduce the chance for an inadvertent release of radioactive liquid. Prior to release of any treated liquid wastes, samples will be analyzed to determine the type and amount of radioactivity in a batch to assure conformance with release limits. Liquid waste will be released through a single discharger header to the tailrace of the Keowee Hydroelectric Station which ultimately discharges to the Keowee River. Releases will be controlled by radiation monitors which will automatically terminate liquid waste discharges if high radiation levels are detected in the discharge line. Nearly half the estimated total radioactivity discharged as liquid will originate from system leakages, which will be collected in three different types of storage tanks (miscellaneous waste, high-activity waste and low-activity waste) and processed as shown on the flow diagram in Figure ___. Most of the rest of the activity will come from the reactor coolant bleed treatment system. Both types of high-activity liquids (from systems and reactor coolant) will normally be processed through evaporators; additionally, in the reactor coolant bleed treatment system, the liquid will be processed through a demineralizer prior to evaporation.

Liquid wastes expected to have a low level of radioactivity will be collected in the low-activity waste tank. Auxiliary building floor drains and laundry wastes are expected to make up the major fractions of these wastes. After sampling and analysis, these wastes will either be discharged directly to the tailrace of the Keowee Hydroelectric Station or transferred to the miscellaneous waste holdup tanks for further processing.

Liquid wastes expected to have an intermediate level of radioactivity will be collected in the high-activity waste tank. After sampling and analysis, the contents of this tank will be transferred either to the low-activity waste tank for release to the tailrace or to the miscellaneous waste holdup tank for further radioactive decay or to the waste evaporator feed tank for processing. Our evaluation assumed that most of this waste will be processed through the waste evaporator, which will concentrate the impurities for disposal through the solid waste drumming facility. The distillate from the evaporator will be returned to the condensate test tanks, where it may be used as reactor coolant makeup or released to tailrace. Before being released to the tailrace, it is possible to purify the liquid waste through a polishing demineralizer to further reduce any activity present.

Liquid wastes expected to have a high level of radioactivity will be collected in the miscellaneous waste holdup tank. From there, they will be sent either to the low-activity tank for discharge (approximately 300,000 gallons/year) to the tailrace or to the miscellaneous waste evaporator feed tank for processing as described previously.

The reactor coolant treatment system will purify the coolant, which is the liquid of highest activity, in three different ways. Ordinarily, part of the coolant will be circulated through demineralizers, which will remove the ionic corrosion products and the fission products which may have leaked from the fuel elements. After this purification, part of the coolant will be bled from the system and fed to the reactor coolant bleed evaporator in order to remove some of the boric acid from the system. Reduction in boron concentration is accomplished primarily in the reactor coolant bleed evaporator; by using this evaporator most of the boric acid can be recovered from the coolant and stored in the concentrated boric acid storage tank (Fig.____). It is anticipated that approximately 1,000,000 gallons of reactor coolant will be processed annually by the evaporator when all three units are in operation. The distillate from the evaporator will be collected in the condensate test tanks and either discharged to the tailrace or used as makeup water for the reactor coolant. If necessary, the condensate can be recycled through the evaporator to further reduce its activity. By continuously bleeding some of the reactor coolant as feed to the evaporator and simultaneously adding demineralized makeup water, the concentration of boron in the coolant can be lowered to the required concentration. The reactor coolant storage tanks for all three units are arranged so that they can be utilized to store liquid from the other units if needed. The reactor coolant bleed evaporator is common for all three units.

Small quantities of primary coolant which leak into the steam generator feedwater system should not result in any significant discharge of radioactivity to the environment, since full-flow demineralizers continuously purify the steam generator feedwater and there is no generator blowdown. The applicant has estimated a leak rate of 10-20 gallons per minute of steam generator feedwater from the secondary system into the turbine room sump. This leakage would normally be discharged into Lake Keowee via the cooling condenser discharge. However, if significant activity occurs in this liquid (as a result of a large leak from the primary coolant into the secondary system), provisions have been made for routing this liquid into the radioactive waste treatment system for reuse as coolant makeup or release to the tailrace. Before being released to the tailrace, it is possible to purify the liquid waste through a polishing demineralizer to further reduce any activity present.

The radioactive liquid waste released from the station will be from either the low-activity waste tank or the condensate test tank. In order to achieve highest c'lution ratios, the applicant intends, where possible, to coordinate the rel ases with the operation of the Keowee Hydroelectric Station. Table 2 lists radioactive fission and corrosion products which are expected to be present in the reactor coolant system and the liquid waste treatment system. Our estimates of anticipated annual releases are based on the assumption that all of the reactor coolant bleed will be released each year after processing. Other conditions assumed include 0.25 percent leaking fuel, a 30-day holdup in the letdown system, a 10^4 decontamination factor (D.F.) for both the waste evaporator and the coolant bleed evaporator and a D.F. of 10 for the demineralizers. Exceptions to the decontamination factors for specific isotopes have been taken; for example, a tritium D.F. of 1 is used for both evaporation and demineralization. No removal by demineralization was considered for yttrium, molybdenum, and cesium. A decontamination factor of 10^3 was used for the evaporation of iodines.

Based on the assumptions noted above, the anticipated releases from the primary souces for normal operation were calculated to be a fraction of those shown in Table 2. To compensate for treatment equipment downtime and expected operational occurrences, the values shown in Table 2 have been normalized to 1 curie per year releas _rom each unit.

Solid Wastes

The sources of solid radioactive waste will be spent demineralizer resins, filter and strainer elements, evaporator concentrates, and miscellaneous items such as contaminated clothing, filters, rags, paper, gloves and shoe covers. The spent resins will be slurried to the drumming facility from the spent resin storage tanks and collected in suitable containers. These containers will be equipped with filters to retain the solids and the liquid portion will be returned to the high-activity liquid waste tank. The evaporator concentrates will be either stored and shipped as liquids or mixed with vermiculite or concrete and shipped as solid waste. The applicant has not yet made a final decision regarding this matter. Miscellaneous solid wastes (clothing, rags, paper, etc.) will be hydraulically compressed in 55-gallon steel drums. All solid radioactive waste will be packaged and shipped offsite to a licensed burial ground in accordance with AEC and DOT regulations. The radioactivity to be shipped annually from the station has been estimated by the applicant to be 2×10^5 curies contained in 2,500 cubic feet of spent resins. It has also been estimated that about 100 55-gallon drums of low level contaminated solid waste will be produced annually from each unit. The staff concurs in the applicant's estimate of the activity to be released in solid waste.

TABLE 1

ANTICIPATED ANNUAL RELEASES OF RADIOACTIVE MATERIALS
IN GASEOUS EFFLUENT FROM OCONEE NUCLEAR POWER STATION - UNITS 1, 2 AND 3
POWER LEVEL 2452 MWt
(BASED ON 30 DAYS HOLDUP)

Nuclides	Containment Purge Units 1, 2, & 3* (Ci/yr)	Waste Gas System Units 1 & 2 (Ci/yr)	Waste Gas System Unit 3 (Ci/yr)	Steam Air Ejectors Units 1, 2, & 3** (Ci/yr)	Total Units 1, 2, & 3
Kr-85	34.2	1478.	739.	5.73	2257.
Kr-87	0.12	--	--	8.70	8.8
Kr-88	0.93	--	--	27.9	28.8
Xe-131m	26.6	294.	147.	9.54	477.
Xe-133	2644.	[illegible]542	[illegible]571.	[illegible]2.	12,786.
Xe-135	1.05	--	--	9.66	10.7
Xe-138	0.02	--	--	6.45	6.47
I-131	0.78	--	--	0.024	0.80
I-133	1.14	--	--	0.03	1.17

* Each unit will have a separate plant vent

** Each steam air ejector discharges to the individual plant vent

TABLE 2

ANTICIPATED ANNUAL RELEASES OF RADIOACTIVE MATERIALS
IN LIQUID EFFLUENTS FROM OCONEE 1, 2, 3
POWER LEVEL 2452 MWt

Nuclides*	Reactor Coolant Bleed (Ci/yr)	Liquid Waste System (Ci/yr)	
Sr-89	0.002	0.006	
Y-91	0.14	0.034	
Y-90	0.002	0.002	
Mo-99	0.018	0.004	
Te-99m	0.002	0.004	
Te-129m	0.018	0.042	
Te-129	0.018	0.042	
I-131	0.06	0.14	
Cs-134	0.19	0.44	
Cs-136	0.022	0.042	
Cs-137	0.012	0.032	
Ba-137m	0.012	0.032	
La-140	0.002	0.002	
Ba-140	0.002	0.002	
Cr-51	0.022	0.006	
Mn-54	0.048	0.01	
Fe-55	0.102	0.022	
Fe-59	0.018	0.008	
Co-58	1.1	0.26	
Co-60	0.048	0.008	
Total (Units 1,2,3)	~ 1.84	~ 1.14	≅ 3.0
H-3 (Units 1,2,3)	~ 3000 Ci/yr		

*Nuclides not listed are considered to be < 0.002 Ci/yr.

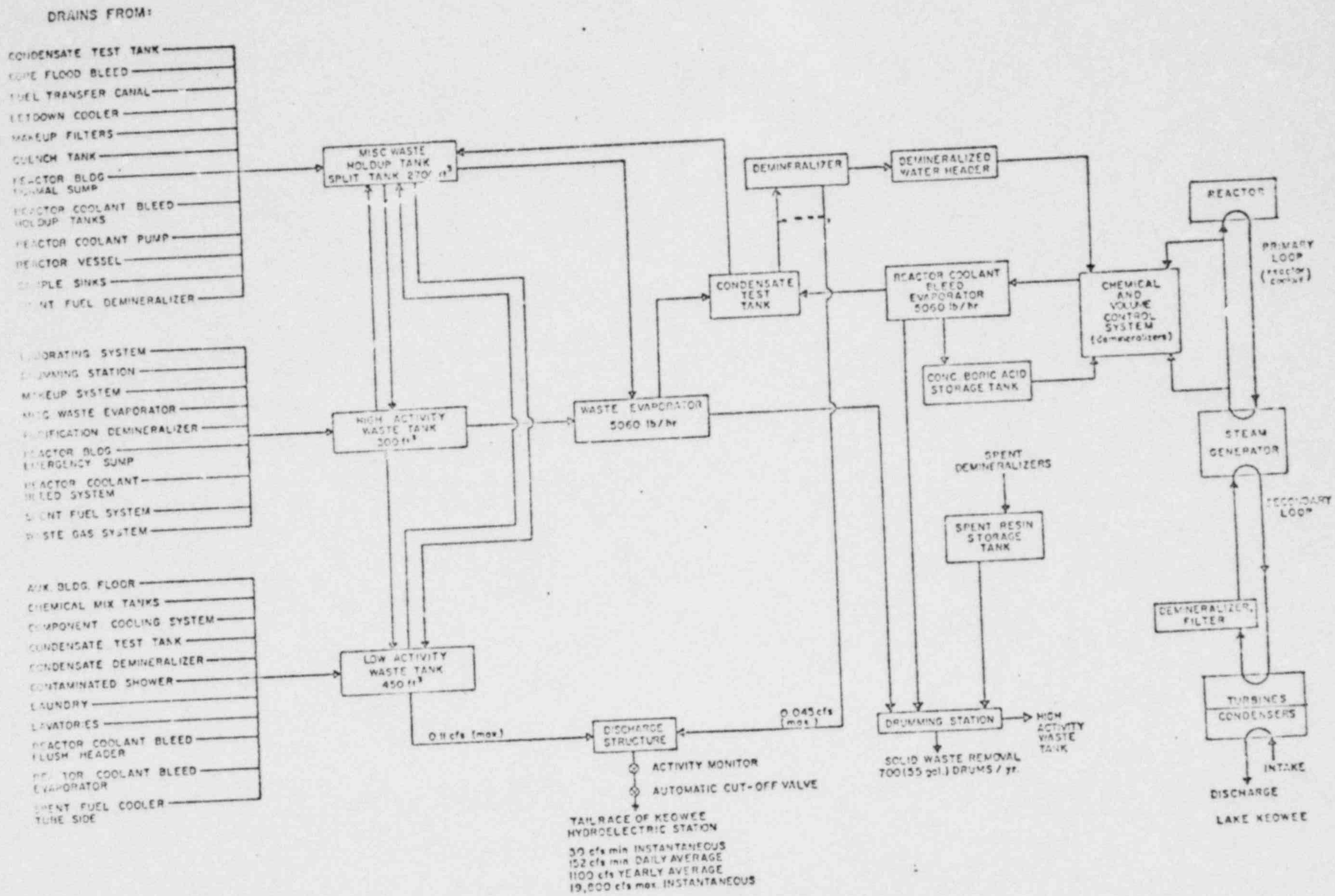

Fig. III-10
RADWASTE LIQUID AND SOLID DISCHARGE SYSTEM
OCONEE NUCLEAR STATION

POOR ORIGINAL

REFERENCES

OCONEE NUCLEAR POWER STATION - UNITS 1, 2 AND 3

1. Final Safety Analysis Report on Oconee Units 1, 2 and 3.

2. Environmental Quality Features of Duke Power Company's Keowee-Toxaway Project, July 1970, Letter to Dr. P. A. Morris from A. C. Thies, Duke Power Company.

3. Duke Power Company, "Supplement to Environmental Quality Features of Duke Power Company's Keowee-Toxaway Project" October 18, 1971. Letter to Dr. P. A. Morris from A. C. Thies, Duke Power Company.

4. Safety Evaluation by the Division of Reactor Licensing, USAEC, in the Matter of Duke Power Company, Oconee Nuclear Station, Units 1, 2, and 3, dated August 4, 1967.

5. Draft Detailed Statement on the Environmental Consideration by the USAEC, Division of Radiological and Environmental Protection, Related to the Proposed Issuance of an Operating License to the Duke Power Company for the Oconee Nuclear Station, Unit 1.

6. Revision 1 to Supplemental Environmental Report, Letter to Dr. P. A. Morris from A. C. Thies, Duke Power Company, dated November 2, 1971.

7. Statement by the applicant, Why The Construction Permit Should Not Be Suspended, October 18, 1971.

TECHNICAL BACKGROUND
OCONEE NUCLEAR POWER STATION UNITS 1, 2 & 3 - 100 PERCENT POWER

The following parameters were used in the calculation of estimated releases from Oconee Nuclear Power Station, Units 1, 2 & 3 - 100 percent power:

Percent fuel leak - 0.25%

Power level - 2,452 MWt (Ref. DRL Safety Evaluation)

Primary to secondary leakage - 20 gal/day

Steam generator blowdown - zero

Containment purge - 12 times/yr

Decay time: Waste Gas Processing System - 30 days
Reactor Coolant Bleed System - 30 days

I. Liquids

A decontamination factor (D.F.) of 10^4 was assumed for both the waste evaporator and the coolant bleed evaporator and a D.F. of 10 for the demineralizers except for H-3 for which we assumed a D.F. of 1 for evaporation - demineralization.

No removal by demineralization was considered for yttrium, molybdenum, and cesium. A. D.F. of 10^3 was used for the evaporation of iodines.

Assumed 255,160 gal/yr processed by the waste disposal system and a 30 day holdup time. Assumed 1,060,800 gal/yr processed by the reactor coolant bleed treatment system.

II. Gases

Containment Purge Releases

Assumed 12 purges annually. We assumed a 120 gal/day leakage into the containment building and a D.F. of 10 for iodine removal in the charcoal absorbers installed in the purge exhaust system.

Strip main coolant 12 times per year. Combined fill-hold release time yields 30 days decay.

TECHNICAL BACKGROUND

AUXILIARY BUILDING LEAKAGE*

Nuclides	Units 1 & 2	Unit 3	Total
Kr-85	1.6	.8	2.4
Kr-87	2.0	1.0	3.0
Kr-88	6.0	3.0	9.0
Xe-131	2.0	1.0	3.0
Xe-133	475.0	237.5	713.0
Xe-135	2.0	1.0	3.0
Xe-138	1.5	.8	2.3
I-131	10^{-4}	5×10^{-5}	1.5×10^{-4}

* Assumes 5 gallon per day leak into the auxiliary building.