ENCLOSURE 1

REQUESTED INFORMATION
OF TVA
BY NRC
CONCERNING BFNP UNITS 1-3
COMPLIANCE WITH 10CFR50
APPENDIX I

INFORMATION REQUESTED
IN ENCLOSURE 1 OF THE
FOLLOWING LETTERS

R. A. PURPLE TO J.E. WATSON,
BROWNS FERRY NUCLEAR PLANT, UNITS 1 AND 2
DATED FEBRUARY 19, 1976

R. C. DEYOUNG TO J. E. WATSON,
BROWNS FERRY 3
DATED FEBRUARY 13, 1976

Enclosure I Question 1

Licensees should provide an evaluation showing their facility's capability to meet the requirements set forth in Section II of Appendix I to 10 CFR Part 50.

Response

TVA has evaluated the capability of the Browns Ferry Nuclear Plant to meet the requirements in Section II of Appendix I to 10CFR50. The dose to man from liquid effluents was calculated using equations and models compatible with Regulatory Guide 1.109. The pathways considered were ingestion of water, ingestion of fish, immersion, above-water, and shoreline exposures. At Browns Ferry, the limiting individual was assumed to drink water from the nearest downriver public water supply (Champion Paper Co.), eat fish caught in Wheeler Lake, and conduct all recreational activities within one mile downriver of the plant. The doses from liquid effluents (shown below) are within the limits specified in Appendix I.

LIQUID EFFLUENTS

Limiting Individual

Pathway	Limit	Dose (mrem/year)
Total Body	3	.15
Thyroid	10	2.8

For gaseous effluent dose calculations, the dispersion and dosimetry models used were compatible with Regulatory Guides 1.111 and 1.109, respectively. Information on radioactivity release rates and meteorology are provided in Responses I.2 and II.4, respectively.

Gamma and beta air doses were calculated at the point of maximum exposure. External exposures to the total body and skin were evaluated at the limiting residence expected to be occupied. In order to determine the limiting receptor for internal exposures, TVA conducted an extensive agricultural survey in the Browns Ferry area. The limiting receptor was identified as an infant residing 4,880 meters from the plant in the south sector. The exposure pathways were the consumption of unprocessed milk, inhalation, and external exposures from radioactivity in the air and deposited on the ground. The infant exposures from these pathways exceeded exposures for other age groups from all pathways (including meat and vegetable consumption).

An evaluation of Browns Ferry Nuclear Plant's capability of meeting the gaseous effluent exposure limits defined in Appendix I is provided in Table I.1. Gamma and beta air doses at the point of maximum exposure are less than 11 percent of the limits. Total body and skin doses from external exposure at the point of expected occupancy are less than 15 percent of the limits. For internal exposures from radioiodines and particulates, the limiting receptor receives less than 7 percent of the 15 mrem/year limit to any organ.

Enclosure I Question 4

Dose Calculations should be consistent with Draft Regulatory Guide 1.AA.

Response

Dosimetry models used for dose calculations were compatible with the models described in Regulatory Guide 1.109.

ENCLOSURE 2

REQUESTED INFORMATION
OF TVA
BY NRC
CONCERNING BFNP UNITS 1-3
COMPLIANCE WITH 10CFR50
APPENDIX I

INFORMATION REQUESTED
IN ENCLOSURE 2 OF THE
FOLLOWING LETTERS

R. A. PURPLE TO J.E. WATSON,
BROWNS FERRY NUCLEAR PLANT, UNITS 1 AND 2
DATED FEBRUARY 19, 1976

R. C. DEYOUNG TO J. E. WATSON,
BROWNS FERRY 3
DATED FEBRUARY 13, 1976

Enclosure II Question 1
Provide the information requested in Appendix D of Draft Regulatory Guide 1.BB or 1.CC, as appropriate:

Response
I. General

a. The maximum core thermal power (MWt) evaluated for safety considerations in the SAR. (Note: All of the following responses should be adjusted to this power level.)

Response: The maximum core thermal power (MWt) is 3292. (BFN FSAR Section 1.1 page 1.1-1.)

b. (1) The total mass (lbs) of uranium and plutonium in an equilibrium core (metal weight).

Response: The total mass of uranium and plutonium at the beginning of an equilibrium cycle is 306,000 lbs and at the end of an equilibrium cycle is 303,475.

(2) The percent enrichment of uranium in reload fuel.

Response: The percent enrichment of uranium in reload fuel is 2.74 w/o U-235.

(3) The percent of fissile plutonium in reload fuel.

Response: The percent of fissile plutonium in reload fuel is 0 percent.

c. If methods and parameters used in estimating the source terms in the primary coolant are different from those given in Regulatory Guide 1.CC, describe in detail the methods and parameters used. Include the following information:

(1) Plant capacity factor.

(2) Isotopic release rates of noble gases to the reactor coolant at 30 minutes decay (uCi/sec).

(3) Concentrations of fission, corrosion, and activation products in the reactor coolant (uCi/gm). Provide the basis for the values used.

Response: The methods and parameters used in estimating the source terms in the primary coolant are those given in Regulatory Guide 1.CC.

d. The quantity of tritium released in liquid and gaseous effluents (Ci/yr/reactor).

Response: The quantity of tritium released in liquid and gaseous effluents is 51 Ci/yr/reactor (BFN ER Table 2.4-2).

2. Nuclear Steam Supply System

a. Total steam flow rate (lbs/hr).

Response: Total steam flow rate is 13,380,581 lb/hr.

b. Mass of reactor coolant (lbs) and steam (lbs) in the reactor vessel at full power.

Response: The mass of reactor coolant and steam in the reactor vessel at full power is 5.64×10^5 lbs and 2.04×10^4 lbs respectively.

3. Reactor Coolant Cleanup System

a. Average flow rate (lbs/hr).

Response: Average flow rate is 260 gallons per minute or 130,200 lbs/hr.

b. Demineralizer type (deep bed or powdered resin).

Response: Demineralizer type is powdered resin.

c. Number and size (ft^3) of demineralizers.

d. Regeneration volume (gal/event) and activity.

Response: Items c and d do not apply to a powdered resin type demineralizer. The resin replacement frequency is between 14 and 28 days.

4. Condensate Demineralizers

a. Average flow rate (lbs/hr).

Response: Average flow rate is 26,800 gallons per minute or 1.34×10^7 lbs/hr.

b. Demineralizer type (deep bed or powdered resin)

Response: Demineralizer type is powdered resin.

c. Number and size (ft^3) of demineralizers.

d. Regeneration frequency.

e. Indicate whether ultrasonic resin cleaning is used and waste liquid volume associated with its use.

f. Regenerant volume (gal/event) and activity.

Response: Items c through f do not apply to a powdered resin type demineralizer. The resin replacement frequency is between 5 and 14 days.

5. Liquid Waste Processing Systems

a. For each liquid waste processing system provide in tabular form the following information:

(1) Sources, flow rates (gpd) and expected activities (fraction of primary coolant activity, PCA) for all inputs to each system.

Response: Sources, flow rates and expected activities are tabulated in table 9.2-3 and on figure 9.2-2 of the BFN FSAR.

(2) Holdup times associated with collection, processing, and discharge.

Response: Holdup times associated with collection, processing, and discharge are given in Table A.

(3) Capacities of all tanks (gal) and processing equipment (gpd) considered in calculating holdup times.

Response: Capacities of all tanks and processing equipment appear in Table 9.2-3 and on figure 9.2-2 of the BFN FSAR.

(4) Decontamination factors for each processing step.

Response: Decontamination factors for each processing step are those in R.G. 1.CC except for the evaporator. D.F.'s for the evaporator are listed in Table 9.2-2 of the BFN FSAR which is provided here as an attachment.

(5) Fraction of each processing stream expected to be discharged over the life of the plant.

Response: Fraction of each processing stream expected to be discharged over the life of the plant were those of R.G. 1.CC.

(6) For waste demineralizer regeneration provide: time between regenerations, regenerant volumes and activities, treatment of regenerants and fractions of regenerant discharged. Include parameters used in making these determinations.

Response: There is no regeneration of the demineralizers.

(7) Liquid source term by radionuclide in Ci/yr for normal operation including anticipated operational occurrences.

Response: Liquid source term by radionuclide in Ci/yr for normal operation including anticipated operational occurrences are tabulated in Table 9.2-2,of the BFN FSAR which is provided here as an attachment.

b. Provide piping and instrumentation diagrams (P&ID's) and process flow diagrams for the liquid radwaste systems along with all other systems influencing the source term calculations.

Response: Piping and instrumentation diagrams and process flow diagrams for the liquid radwaste system are shown in the BFN FSAR figures 9.2-2, and 9.2-3A through G.

6. Main Condenser and Turbine Gland Seal Air Removal Systems

a. The holdup time (hrs) for offgases from the main condenser air ejector prior to processing by the offgas treatment system.

Response: The holdup time for offgases from the main condenser air ejector prior to processing by the offgas treatment system is 6 hours.

b. Description and expected performance of the gaseous waste treatment systems for the offgases from the condenser air ejector and mechanical vacuum pump. The expected air inleakage per condenser shell, the number of condenser shells, and the iodine source term from the condenser.

Response: Description and expected performance of the gaseous waste treatment systems for the offgases from the condenser air ejector and mechanical vacuum pump is given in section 9.5.4 of the BFN FSAR. The expected air inleakage per condenser shell is 7 ft^3/min., the number of condenser shells is 3, and the iodine activity in the prefilter before the charcoal adsorbers after one year operating time is 8.7 x 10^4uCi. For calculation of holdup time in the charcoal delay system the inleakage was conservatively taken as 10 cfm/shell.

c. The mass of charcoal (tons) in the charcoal delay system used to treat the offgases from the main condenser air ejector, the operating and dew point temperatures of the delay system, and the dynamic adsorption coefficients for Xe and Kr.

Response: The mass of charcoal in the charcoal delay system used to treat *each unit* the offgases from the main condenser air ejector is 18 tons, the operating and dew point temperatures of the delay system are 77°F and 45°F respectively, and the dynamic adsorption coefficient for Xe is 330, and for Kr is 18.5.

d. Description of cryogenic distillation system, fraction of gases partitioned during distillation, holdup in system, storage following distillation, and expected system leakage rate.

Response: There is no cryogenic distillation system.

e. The steam flow (lbs/hr) to the turbine gland seal and the source of the steam (primary or auxiliary).

Response: The steam flow to the turbine gland seal is 780 lbs/hr of primary steam.

f. The design holdup time (hrs) for gas vented from the gland seal condenser, the iodine partition factor for the condenser, and the fraction of radioiodine released through the system vent. Description of the treatment system used to reduce radioiodine and particulate releases from the gland seal system.

Response: The releases from the turbine gland seal air removal system were taken from General Electric Licensing Topical Report "Airborne Releases From BWR's for Environmental Impact Evaluations," NEDO-21159 by T. R. Marrero, March 1976, which is based on measurements at existing plants; therefore, the information requested in questions e and f was not used in calculations. The design holdup time for gas vented from the gland seal condenser is 1.75 minutes. According to the NEDO report, the radioiodine released through the system vent due to the gland seal system is 1.1165 Ci/yr, the total radioiodine released is 8.1532 Ci/yr; thus the ratio is 0.137.

g. Provide piping and instrumentation diagrams (P&ID's) and process flow diagrams for the gaseous waste treatment system along with all other systems influencing the source term calculations.

Response: Piping and instrumentation diagrams and process flow diagrams for the gaseous waste treatment system are provided as attachments.

7. Ventilation and Exhaust Systems

For each plant building housing system that contains radioactive materials, the main condenser evacuation system and the turbine gland sealing system exhaust, provide the following:

a. Provisions incorporated to reduce radioactivity releases through the ventilation or exhaust systems.

Response: Provisions incorporated to reduce radioactivity releases through the ventilation or exhaust systems are discussed in section 10.12 of the BFN FSAR.

b. Decontamination factors assumed and the bases (include charcoal adsorbers, HEPA filters, mechanical devices).

Response: See response to 7.c.

c. Release rates for radioiodines, noble gases, and radioactive particulates (Ci/yr) and the bases.

Response: The releases from the ventilation and exhaust systems were taken from NEDO-21159 Licensing Topical Report, referenced in response to 6.f., which is based on measurements at existing plants. These releases are given in Table B.

d. Release point description, including height above grade, height above and relative location to adjacent structures, relative temperature difference between gaseous effluent and ambient, flow rate, velocity, and size and shape of the flow orifice.

Response: Release point description, including height above grade, flow rate, velocity, and size and shape of the flow orifice are tabulated in Table C. Height above and relative location to adjacent structures is depicted in drawings 47W200-1, 47W200-8, and 47W200-15 which are enclosed as attachments.

e. For the containment building indicate the expected purge and venting frequencies and duration, and continuous purge rate (if used).

Response: The releases from the containment building were taken from NEDO-21159 Licensing Topical Report which is based on measurements at existing plants; therefore, the information requested was not used.

8. Solid Waste Processing Systems

a. Provide in tabular form the following information concerning all inputs to the solid waste processing system: Source, volume (cu.ft./yr/reactor), and activity (Ci/yr/reactor) of principal radionuclides along with bases for values.

Response: Section 9.3.2 of the BFN FSAR contains a table of source, volume, and activity.

b. Onsite storage provisions (location, capacity) and expected onsite storage times for all solid wastes prior to shipment.

Response: Section 9.3.4.1 of the BFN FSAR discusses onsite storage.

c. Provide piping and instrumentation diagrams (P&ID's) and process flow diagrams for the solid radwaste system.

Response: Piping and instrumentation diagrams and process flow diagrams for the solid waste processing systems are provided as attachments.

TABLE A

Liquid Stream	Collection Time	Processing Time	Discharge Time
Waste Collector Tank Stream	.57 days	.05 days	.05 days
Floor Drain Collector Stream	1.11 days	.22 days	.22 days
Laundry Drain Tank Stream	.89 days	.02 days	.02 days

TABLE B

ISOTOPIC COMPOSITION OF GASEOUS RELEASES AT BROWNS FERRY NUCLEAR PLANT, CURIES/YEAR

ISOTOPE	REACTOR COMPLEX VENT	RADWASTE BUILDING VENT	TURBINE BUILDING VENTS	STACK[a]
Kr-85m	6	<1	2	1.10 E4
Kr-87	6	<1	95	873
Kr-88	9	<1	102	1.22 E4
Kr-89	1	34	503	0
Xe-133m	0	60	0	633
Xe-133	103	294	581	5.43 E4
Xe-135m	111	667	464	1212
Xe-135	173	328	672	1068
Xe-137	78	113	386	0
Xe-138	12	2	1179	1483
I-131 I	0.0594	0.0050	0.0156	0.0041
I-132 I	0.594	0.050	0.1786	0.0469
I-133 I	0.297	0.025	0.1231	0.0323
I-134 I	1.485	0.125	0.0267	0.0070
I-135 I	0.594	0.050	0.1231	0.0323
I-131 O	0.0316	0.029	0.0065	0.0332
I-132 O	0.316	0.290	0.0744	0.3801
I-133 O	0.158	0.145	0.0513	0.2619
I-134 O	0.790	0.725	0.0111	0.0568
I-135 O	0.316	0.290	0.0513	0.2619
Cr 51	3 E-3	9 E-4	1 E-3	1 E-4
Mn 54	3 E-3	5 E-3	2 E-3	4 E-5
Co 58	2 E-3	4 E-4	9 E-5	2 E-5
Fe 59	1 E-4	8 E-4	4 E-4	2 E-4
Co 60	3 E-2	6 E-3	3 E-3	1 E-5
Zn 65	3 E-3	2 E-4	4 E-4	9 E-5
Sr 89	1 E-2	3 E-1	*	*
Sr 90	2 E-3	4 E-3	*	*
Nb 95	3 E-4	2 E-4	9 E-6	8 E-5
Zr 95	1 E-4	1 E-4	8 E-6	8 E-5
Ru 103	3 E-5	1 E-4	2 E-4	1 E-4
Ag 110m	7 E-6	*	*	*
Sb 124	3 E-5	3 E-4	6 E-5	8 E-5
Cs 134	5 E-3	3 E-4	5 E-4	2 E-5
Cs 136	2 E-3	5 E-5	1 E-4	9 E-8
Cs 137	7 E-3	4 E-4	2 E-3	7 E-4
Ba 140	4 E-3	5 E-4	2 E-2	8 E-3
Ce 141	4 E-4	2 E-4	2 E-3	2 E-5
Ce 144	5 E-6	*	*	4 E-6
Ar-41	25	0	0	0
C-14	0	0	0	9.5
H-3	0	9.5	0	0

[a]This includes Gland Seal System, MVP, and Off-Gas System

*Not available

I denotes non-organic iodine (elemental, particulate, HIO)

O denotes organic iodine

Table 9.2-2
RADIOACTIVITY CONTENT OF LIQUID EFFLUENT

Isotope	10 CFR Part 20 Limits (μCi/ml)	Evaporator Decontamination Factor	Release Rate (Ci/yr)	Annual Average Concentration (μCi/ml)	Fraction of Part 20 Limit
Sr-89	3×10^{-6}	100	2.9×10^{-3}	1.01×10^{-12}	3.40×10^{-7}
Sr-90	3×10^{-7}	100	7.8×10^{-4}	2.72×10^{-13}	9.10×10^{-7}
Sr-91	7×10^{-5}	100	3.6×10^{-2}	1.25×10^{-11}	1.80×10^{-7}
Mo-99	2×10^{-4}	100	7.7×10^{-2}	2.69×10^{-11}	1.35×10^{-7}
I-131	3×10^{-7}	10	3.6×10^{-1}	1.25×10^{-10}	4.20×10^{-4}
I-133	1×10^{-6}	10	6.0×10^{-1}	2.01×10^{-10}	2.01×10^{-4}
I-135	4×10^{-6}	10	2.7×10^{-1}	9.40×10^{-12}	2.35×10^{-5}
Cs-134	9×10^{-6}	100	3.9×10^{-4}	1.36×10^{-13}	1.51×10^{-8}
Cs-137	2×10^{-5}	100	7.8×10^{-4}	2.72×10^{-13}	1.36×10^{-8}
Ba-140	3×10^{-5}	100	7.7×10^{-2}	2.68×10^{-11}	8.93×10^{-8}
Ce-144	1×10^{-5}	100	1.0×10^{-4}	3.19×10^{-14}	3.49×10^{-9}
Np-239	1×10^{-4}	100	7.8×10^{-2}	2.72×10^{-11}	2.72×10^{-7}
Co-58	1×10^{-4}	100	4.2×10^{-3}	1.46×10^{-12}	1.46×10^{-8}
Co-60	5×10^{-5}	100	4.2×10^{-4}	1.46×10^{-13}	2.93×10^{-11}
Gross	1×10^{-7}		1.51	5.26×10^{-10}	5.26×10^{-3}

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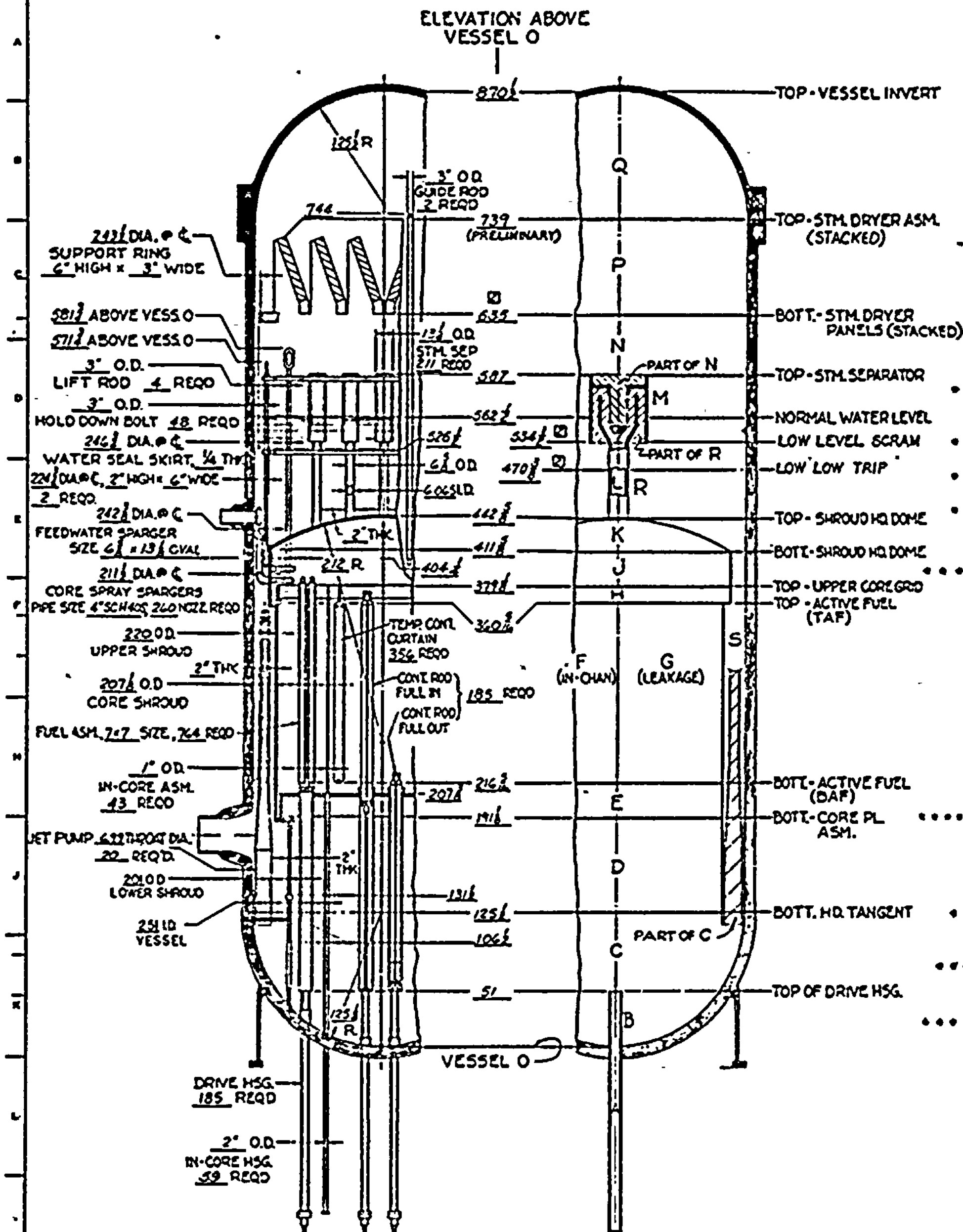
Table 9.2-3
NORMAL AND MAXIMUM CONCENTRATION OF LIQUID RADIOACTIVE WASTES AND WORKING VOLUMES OF RADWASTE TANKAGE

Vessel Name	No. of Tanks	Working Vol (Each) Gal.	Liquid (each)				Solid (each)	
			Normal Conc. μCi/cc	Max Conc. μCi/cc	Normal Act. μCi	Max Act. μCi	Normal Act. μCi	Max. Act. μCi
Waste Surge	1	65,000	—	—	2×10^3	2×10^5	—	—
Waste Sample	4	17,000	3×10^{-5}	3×10^{-3}	2×10^3	2×10^5	—	—
Floor Drain Sample	2	14,500	7×10^{-6}	2×10^{-3}	4×10^2	1×10^5	—	—
Laundry Drain	2	1,000	1×10^{-5}	1×10^{-5}	4×10^1	4×10^1	—	—
Waste Collector	1	34,000	1×10^{-2}	1×10^0	1×10^6	1×10^8	—	—
Floor Drain Collector	1	29,000	3×10^{-5}	8×10^{-3}	5×10^3	1×10^6	—	—
Cleanup Phase Separator	3	2,000	2×10^{-2}	1×10^0	2×10^5	1×10^7	1×10^9	1×10^9
Cleanup Backwash Receiving (a)	3	2,000	2×10^{-2}	1×10^0	2×10^5	1×10^7	6×10^7	5×10^9
Condensate Phase Separator	6	6,500	5×10^{-5}	1×10^{-4}	1×10^3	2×10^3	2×10^7	5×10^7
Condensate Backwash Receiving (b)	3	6,500	5×10^{-5}	1×10^{-4}	1×10^3	2×10^3	3×10^6	1×10^8
Spent Resin	1	1,500	5×10^{-5}	1×10^{-4}	3×10^2	7×10^2	2×10^6	2×10^8
Waste Backwash Receiver	1	7,000	5×10^{-5}	1×10^{-4}	1×10^3	2×10^3	8×10^6	2×10^8
Chemical Waste	1	4,500	2×10^{-4}	7×10^{-3}	3×10^3	1×10^5	—	—
TOTAL	29	310,500			1.4×10^6	1.2×10^8	1.1×10^9	6.6×10^9

(a) Cleanup Backwash Receiving Tanks in Reactor Building
(b) Condensate Backwash Receiving Tanks in Turbine Building

REACTOR PRIMARY SYS WTS &



ZONE	ZONE TOTAL VOL. (FT.³)	SOLID VOL. (FT.³)	FLUID VOLUME (FT.³) *** SEE NOTE 5			FLUID WEIGHT (KIPS)		
			SUB CLD.	SAT.	STM.	RATED	HOT STANDBY	COLD, VESS FULL
• A_1	354.74	43.42	311.32			14.99	14.37	18.57
•• A_2	354.74	123.95	230.79			11.11	10.66	14.36
B	422.65	2.74	419.91			20.22	19.39	26.13
• C_1	2040.29	107.94	1932.35			93.05	89.21	120.85
•• C_2	2040.29	114.48	1925.81			92.74	88.91	119.84
• D_1	1200.72	142.56	1058.15			50.96	48.85	65.85
•• D_2	1200.72	148.33	1052.39			60.68	48.57	65.49
• E_1	491.14	113.20	377.94			18.20	17.45	23.52
•• E_2	491.14	114.31	376.83			18.15	17.40	23.45
F	1815.22	846.39	187.75	486.58	294.54	32.18	44.73	60.29
G_1	992.59	217.94	774.65			37.30	35.72	48.21
G_2	992.59	110.22	882.37			42.49	40.74	54.91
G_3	992.59	202.35	790.24			38.05	36.49	49.19
G_4	992.59	125.61	866.78			41.74	40.02	53.94
H	415.84	185.53		79.90	148.58	4.03	10.56	14.21
J	715.94	40.09		236.55	439.30	11.92	31.20	42.06
K	509.65	46.79		162.00	300.86	8.17	21.37	28.80
L	440.46	71.32		129.20	239.94	6.51	17.04	22.97
M	289.04	13.05			275.99	0.49	0.49	17.17
N	1625.29	24.95			1600.34	3.65	3.65	99.59
P	3149.83	152.72			2997.12	6.83	6.83	186.51
Q	2395.78				2395.78	6.44	5.46	149.09
R	3189.97	158.27		2910.43	121.27	124.65	139.97	188.66
S	2837.84	52.48	2785.36			134.13	128.59	173.33
SUB TOTALS (TO BAF)	4509.50	409.9	4099.7	0.0	0.0	197.42	189.27	255.12
SUB TOTALS (TO TAF)	7317.40	1474.2	5062.1	486.6	294.5	265.91	269.77	363.62
TOTALS	22825.0	2219.4	7847.4	4004.7	8813.6	582.89	636.1	1286.0

• A_1, C_1, D_1, E_1 – CONTROL RODS, FULL IN.

•• A_2, C_2, D_2, E_2 – " " , " OUT.

••• G_1 – CONTROL RODS FULL IN, CURTAINS IN.
G_2 – " " OUT, " OUT.
G_3 – " " IN, " .
G_4 – " " OUT, " IN.

•••• CONTROL RODS FULL IN, CURTAINS OUT.

NOTES:

1. SATURATED FLUID SPECIFIC VOLUMES @ 1015 PSIA.:
   a. WATER — .02166 FT.³/LB.
   b. STEAM — .4385 FT.³/LB.
2. CORE RATED AVERAGE EXIT QUALITY OF 13.6 % GIVES A STEAM VOLUME FRACTION OF 0.66.
3. THE RATED CORE AVERAGE VOID FRACTION IS .404.
4. SEE SHEET 2 FOR COMPONENT WEIGHT TABULATION.
5. RATED POWER BREAKDOWN OF PHASE