DOCKET 50-346

DAVIS - BESSE
NUCLEAR POWER STATION
UNIT NO. 1

EVALUATION OF COMPLIANCE WITH APPENDIX I TO 10 CFR 50

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TOLEDO EDISON

DAVIS-BESSE NUCLEAR POWER STATION UNIT 1
APPENDIX I EVALUATION

I. SUMMARY AND CONCLUSIONS

The Davis-Besse Nuclear Power Station Unit 1 has been evaluated with respect to its ability to meet the requirements set forth in Section II of Appendix I to 10CFR50.[1] Specifically, Section II of Appendix I sets forth the following design objectives:

A. The calculated annual total quantity of all radioactive material above background to be released from each light-water-cooled nuclear power reactor to unrestricted areas will not result in an estimated annual dose or dose commitment from liquid effluents for any individual in an unrestricted area from all pathways of exposure in excess of 3 millirems to the total body or 10 millirems to any organ.

B.1. The calculated annual total quantity of all radioactive material above background to be released from each light-water-cooled nuclear power reactor to the atmosphere will not result in an estimated annual air dose from gaseous effluents at any location near ground level which could be occupied by individuals in unrestricted areas in excess of 10 millirads for gamma radiation or 20 millirads for beta radiation.

2. Notwithstanding the guidance of paragraph B.1:

(a) The Commission may specify, as guidance on design objectives, a lower quantity of radioactive material above background to be releases to the atmosphere if it appears that the use of the design objectives in paragraph B.1 is likely to result in an estimated annual external dose from gaseous effluents to any individual in an unrestricted area in excess of 5 millirems to the total body; and

(b) Design objectives based upon a higher quantity of radioactive material above background to be released to the atmosphere than the quantity specified in paragraph B.1 will be deemed to meet the requirements for keeping levels of radioactive material in gaseous effluents as low as is reasonably achievable if the applicant provides reasonable assurance that the proposed higher quantity will not result in an estimated annual external dose from gaseous effluents to any individual in unrestricted areas in excess of 5 millirems to the total body or 15 millirems to the skin.

C. The calculated annual total quantity of all radioactive iodine and radioactive material in particulate form above background to be released from each light-water-cooled nuclear power reactor in effluents to the atmosphere will not result in an estimated annual dose or dose commitment from such radioactive iodine and radioactive material in particulate form for any individual in an unrestricted area from all pathways of exposure in excess of 15 millirems to any organ.

This evaluation shows that the doses associated with proposed operation of Unit 1 meet these objectives. Maximum individual doses have been estimated under normal operating conditions using typical meteorological characteristics. These doses from liquid effluents are:

0.032 mrem whole body and

0.041 mrem to the liver (maximum dose to an organ).

Table 1 presents the detailed pathway results from liquid releases.

From airborne releases, the doses are:

0.97 mrad/year gamma air dose at the site boundary,

3.1 mrad/year beta air dose at the site boundary,

0.39 mrem/year whole body to the maximum individual, 1

1.25 mrem/year skin to the maximum individual

9.2 mrem/year to the thyroid from radioactive iodine and radioactive material in particulate form.

Table 2 presents the detailed pathway results for the airborne releases.

Radioactive source terms were calculated in a manner consistent with Regulatory Guide 1.112.[2] Specific data used are given in Appendix A. Also shown in Appendix A are flow diagrams of the primary waste processing and the miscellaneous waste processing systems. Meteorological information used in the calculation of doses was consistent with Regulatory Guide 1.111.[3]

Dose calculations were done in a manner consistent with Regulatory Guide 1.109.[4] The NRC LADTAP and GASPAR computer codes were used.

These calculations indicate that the maximum radiation dose from all radiation sources as calculated for off-site individuals is well within the requirements of Appendix I to 10CFR50. Similarly, the integrated dose from all radiation sources as a result of normal operation of Unit 1 will have a negligible effect on population radiation burden as summarized in Tables 3 and 4 for liquid and gaseous releases.

II. RADIATION EXPOSURE FROM LIQUID EFFLUENTS

When it is necessary to discharge liquid radioactive waste from Davis-Besse Unit No. 1, the liquid waste will be injected into a dilution flow consisting of: 1) the normal cooling tower blowdown flow and 2) an extra dilution flow of at least 10,000 gpm. The annual average cooling tower blowdown flow is expected to be 8,125 gpm. Thus, the average total dilution flow into which radwaste will be released amounts to an estimated 18,125 gpm. This dilution flow rate and an assumed mixing factor of 0.8 have been used to calculate the doses. The estimated annual activity releases for liquid radioactive dose analysis are presented in Table 5. A recycle time of 0.313 hours for a recirculation fraction of 0.08 has been used in the LADTAP analysis.

A. Estimated Liquid Effluents and Concentrations(5)

The maximum potential individual for liquid radioactive exposure is conservatively located approximately 0.6 miles NNE of Unit 1. Also of concern is the total integrated population exposure due to liquid releases. Since the population groups affected are at relatively large distances from the site, it is necessary to obtain some estimate of the maximum radioactivity concentrations due to Unit 1 as a function of lake transport distance and direction.

The modified Fickian dispersion model provides an adequate mathematical approach for predicting minimum dispersion effects in Lake Erie as a function of distance and direction. It yields the following equation for predicting the plume centerline concentrations:

$$C(x) = \frac{1.59 \times 10^{-3}}{x} Qf$$

where:

$C(x)$	=	average centerline concentration, µCi/cc,
Q	=	point source continuous release source term, µCi/sec,
x	=	the downstream distance, centimeters,
f	=	frequency of surface flow in the direction of interest.

The concentration predictions must be weighted by an assumed frequency of flow in the direction of interest. Annual average wind directional frequencies, presented in Table 6, have been used to establish the necessary values of the parameter "f". Winds out of the SSE, SE, ESE, and E directions are assumed to produce a lake current lake flow towards Toledo and Oregon. Winds out of the ENE, NE, NNE, N, and NNW are assumed to produce surface currents towards Erie Industry Park, Camp Perry, and Sandusky. Thus, the frequency of flow towards Toledo, after accounting for calms, is about 19.5%, and about 23.0% towards Erie Industry Park and Camp Perry.

Effective dilution factors have been obtained for the locations of concern by taking the ratio of the annual average discharge concentration for tritium (1.90×10^{-5} µCi/cc) and the concentrations predicted by the model. The predicted tritium concentrations, affected populations and derived dilution factors at the locations of interest are presented in Table 7. The derived effective dilution factors are then utilized to predict the annual average radioactivity concentrations for the given locations. The affected population at each location was calculated by ratioing the 1970 populations affected [(6)] by the increase in segment population which included the affected municipality.

B. Estimated Radiation Exposure

The maximum individual for liquid exposure was assumed to be located at the nearest residence located on the shore of Lake Erie. The residence is located 0.6 mile NNE of Unit 1 and 0.6 mile NW of the submerged discharge. The maximum individual usage factors are given in Table 8.

The data for commercial fish and sportfish catches within 50 miles were taken from the Unit 1 FSAR.[7] They are summarized in Table 9.

Recreational usage (boating, swimming, shoreline use) was based on data obtained from References 8 and 9. Table 10 summarizes the data. For dose calculations, it was assumed that each user would partake in four hours per visit in swimming and four hours in shoreline activities. It was also assumed that all those that visited Magee Marsh boated eight hours per visit.

The results, in terms of maximum individual doses from liquid effluents, are 0.032 mrem/year to the whole body, and 0.041 mrem/year to the liver. The liver is the organ receiving the maximum dose. The child thyroid dose is calculated to be 0.034 mrem/year, and the doses to other organs are less than 0.001 mrem/year.

In terms of integrated population dose from liquid effluents, the results are whole body, 0.64 person-rem/year, and the thyroid, 0.41 person-thyroid-rem/year.

III. DOSES FROM GASEOUS EFFLUENTS

Doses from radioactive gaseous effluent releases have been calculated, considering both the maximum dose received by an individual and the integrated population dose to persons within 50 miles of the site. Source terms were calculated using the GALE computer program and input data as presented in Appendix A. Radioisotopic source terms are shown in Table 11. The dose calculations were performed by the NRC GASPAR code, using the models of Regulatory Guide 1.109.

Dose contributions from the following pathways were calculated:

1. Immersion in the plume
2. Ground contamination
3. Inhalation
4. Consumption of vegetables, meat and milk

The location of the maximum individual depends on the pathway being considered. For plume immersion, the nearest residence was located 0.6 mile NNE of Unit 1. For exposure to radioactive iodines and particulates, the radioactive exposures were evaluated at the nearest residence associated with a vegetable garden 0.7 mile W of Unit 1.

For calculation of the integrated population doses, the 50-mile region was divided into 160 subregions (segments) formed by sectors centered on the 16 cardinal compass points and annuli of 0-1, 1-2, 2-3, 3-4, 4-5, 5-10, 10-20, 20-30, 30-40 and 40-50 miles. For each of these segments the estimated population for the year 2010 was input, as was data on meat, milk and vegetable production. Grazing was assumed for six months of the year.

Appendix A details the meteorological methodology and calculation. In summary, the data were based on a full year of field measurements, taken and reduced in accordance with Regulatory Guide 1.23.[10] Straight-line χ/Q's were used, with appropriate depletion and terrain correction factors, in accordance with Regulatory Guide 1.111. Because of the location and characteristics of the release points, ground level releases were assumed. Table A3 lists and describes the release points.

Data on population, milk, meat and vegetable production in each subregion are shown in Table 12. The production data are based on county-by-county production information.[11, 12]

The results of the dose calculations indicate that the maximum individual whole body doses from noble gas effluents will be 0.39 mrem/year and a skin dose of 1.25 mrem/year. These doses would be accrued by a resident NNE of Unit 1. 1

The maximum individual thyroid dose would be 9.2 mrem/ year. This dose would be accrued at the nearest residence with a garden. Maximum air doses at the site boundary are calculated to be 0.97 mrad/year gamma and 3.1 mrad/year beta. 1

These results are within the guidelines of Appendix I to 10CFR50.

The integrated population doses from airborne effluents are:

- Integrated whole body dose 0.41 person-rem/year from noble gases 1
- Integrated thyroid dose 4.86 person-rem/year from radioiodines and particulates
- Integrated whole body dose 0.54 person-rem/year from radioiodines and particulates

TABLE 1

MAXIMUM INDIVIDUAL DOSES

From Liquid Effluents*

Pathway	mrem/year		
	Whole Body Dose	Liver Dose	Thyroid Dose
Fish	.025	.034	.005
Drinking Water	.007	.007	.029
Total	.032	.041	.034

*Other pathways each contributing less than 0.001 mrem/year include boating, swimming.

TABLE 2

MAXIMUM INDIVIDUAL DOSES

From Airborne Effluents

Pathway	mrem/yr Whole Body Dose	mrem/yr Skin	mrem/yr Thyroid Dose	
	Noble Gases*			
Plume	0.39	1.25	0.39	
	Radioiodine and Particulates**			
Ground	0.046	0.054	0.05	
Vegetables				
Adult	0.38	0.36	6.96	1
Child	0.91	0.88	8.78	
Inhalation				
Adult	0.064	0.063	0.37	
Child	0.036	0.035	0.37	

*Location is nearest residence, NNE of Unit 1

**Location is nearest residence and garden, W of Unit 1. This location does not have a cow either for meat or milk. Doses include tritium and carbon-14.

TABLE 3

POPULATION DOSES FROM LIQUID RELEASES

Pathway	Whole Body Dose Person-Rem	Thyroid Dose Person-Rem
Fish Consumption	0.51	0.061
Drinking water	0.13	0.35
Shoreline Use,	0.00098	0.00098
Boating	0.000001	0.000001
Swimming	0.000011	0.000011
	0.64	0.41

TABLE 4

POPULATION DOSES FROM GASEOUS RELEASES

Pathway	Whole Body Dose Person-Rem	Thyroid Dose Person-Rem	
Noble Gases			
Plume immersion	0.41	0.41	
Radioiodine and Particulates*			
Ground contamination	0.026	0.026	
Inhalation	0.22	..11	
Vegetable Consumption	0.066	0.90	1
Milk Consumption	0.18	2.70	
Meat Consumption	0.045	0.090	
TOTAL FOR RADIOIODINE AND PARTICULATES	0.54	4.86	

* Includes tritium and carbon-14

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TABLE 5

RADIOISOTOPIC SOURCE DATA FOR LIQUID RELEASES

NUCLIDE	CURIE/YEAR
H 3	5.50E + 02
Cr 51	1.10E - 04
Mn 54	1.00E - 03
Fe 55	1.00E - 04
Fe 59	6.00E - 05
Co 58	5.00E - 03
Co 60	8.80E - 03
Br 83	4.00E - 05
Rb 86	2.00E - 05
Sr 89	2.00E - 05
Sr 91	2.00E - 05
Y 91m	1.00E - 05
Mo 99	3.20E - 02
Tc 99m	2.20E - 02
Te 127m	1.00E - 05
Te 127	3.00E - 05
Te 129m	9.00E - 05
Te 129	6.00E - 05
Te 131m	6.00E - 05
Te 131	1.00E - 05
Te 132	1.20E - 05
I 130	1.40E - 04
I 131	5.70E - 02
I 132	2.30E - 03
I 133	3.80E - 02
I 134	1.00E - 05
I 135	6.80E - 03
Cs 134	2.10E - 02
Cs 136	2.70E - 03
Cs 137	3.00E - 02
Ba 140	1.00E - 05
Np 239	6.00E - 05

TABLE 6

ANNUAL AVERAGE WIND DIRECTION FREQUENCIES
AT THE DAVIS-BESSE SITE

Direction	Frequency, %
NNE	4.10
NE	6.04
ENE	5.90
E	7.70
ESE	3.99
SE	3.81
SSE	3.96
S	6.28
SSW	11.25
SW	12.65
WSW	10.11
W	7.92
WNW	3.88
NW	5.28
NNW	3.85
N	3.15
CALM	0.13

TABLE 7

APPLICABLE DILUTION FACTORS FOR POTABLE WATER INTAKES WITHIN 50 MILES

Potable Water Intake	Location Relative to Davis-Besse	Affected Population*	Estimated Frequency of Surface Flow Towards Intake	Predicted H-3 Concentration, Ci/cc	Derived Dilution Factor
Erie Ind. Park	3.6 mi SE	900	0.230	1.10-8	1,700
Camp Perry	4.6 mi SE	490	0.230	8.62-9	2,200
Port Clinton	8.6 mi SE	14,700	0.230	4.61-9	4,100
Toledo	12.0 mi W	661,000	0.195	2.80-9	6,800
Oregon	12.0 mi W	25,000	0.195	2.80-9	6,800
Sandusky	21.0 mi ESE	69,000	0.230	1.89-9	10,100
Monroe	27.0 mi NNW	68,300	0.195	1.25-9	15,300
Huron	30.0 mi ESE	11,200	0.230	1.32-9	14,400
Kingsville	36.0 mi NNE	2,800	0.295	9.33-10	20,400
Vermilion	38.0 mi ESE	13,400	0.230	1.04-9	18,300
Leamington	41.0 mi NE	19,800	0.127	5.34-10	35,700
Lorain	48.0 mi ESE	145,400	0.230	8.26-10	23,100
Wheatley	50.0 mi NE	2,100	0.127	4.38-10	43,600
Nearest residence	0.6 mi NW of discharge	—	0.195	5.60-8	300

*Based on extrapolated 1970 data

TABLE 8

MAXIMUM INDIVIDUAL USAGE FACTORS FOR LIQUID EXPOSURES

	Activities							
	Adult		Teenager		Child		Infant	
Pathway	hr/day	hr/yr	hr/day	hr/yr	hr/day	hr/yr	hr/day	hr/yr
Boating	1	90	2	180	2	180	0	0
Swimming	1	90	2	180	2	180	0	0
Shoreline	1	90	2	180	2	180	1	90

	Ingestion (kg/yr)			
	Adult	Teenager	Child	Infant
Fish	21	16	6.9	0
Invertebrate	5	3.8	1.7	0
Water	730	510	510	0

TABLE 9

COMMERCIAL FISH AND SPORTFISH CATCH

Type of Catch	Landing	Amount Caught (lbs)	DF*
Commercial	Lake Erie	8.420×10^6	5000
Commercial	Port Clinton	5.897×10^5	4100
Commercial	Sandusky Bay	2.869×10^6	10100
Sport	Lake Erie	1.298×10^7	5000

*DF of 5000 was assumed for Lake Erie. For Port Clinton and Sandusky Bay a DF identical to the drinking water DF was used.

TABLE 10

PUBLIC RECREATIONAL USES OF LAKE ERIE

Swimming and Shoreline Activities	Annual Attendance
Crane Creek State Park (2.5 miles W of site)	364,284 users
Boating	
Magee Marsh (3 miles W of site)	48,000 users

TABLE 11

RADIOISOTOPIC SOURCE DATA FOR GASEOUS RELEASES

Nuclide	Ci/Yr	
H 3	5.50E + 02	
C 14	8.00E + 00	
Mn 54	4.40E - 04	
Fe 59	1.50E - 04	
Co 58	1.50E - 03	
Co 60	6.80E - 04	
Sr 89	3.30E - 05	
Sr 90	6.00E - 06	
Cs 134	4.40E - 04	
Cs 137	7.50E - 04	
Kr 85m	4.00E + 00	1
Kr 85	4.00E + 02	
Kr 87	1.00E + 00	
Kr 88	9.00E + 00	
I 131	2.20E - 01	
I 133	1.40E - 01	
Xe 131m	4.50E + 01	1
Xe 133m	3.90E + 01	
Xe 133	5.20E + 03	
Xe 135	2.00E + 01	

TABLE 12

50 MILE POPULATION, VEGETABLE, MILK & MEAT PRODUCTION

DAVIS-BESSE UNIT 1 SPECIAL LOCATIONS

SITE POPULATION DATA

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.	TOTAL
N	1.000E+01	0.	0.	0.	0.	0.	0.	1.230E+02	6.217E+04	7.620E+05	8.243E+05
NNE	2.800E+01	0.	0.	0.	0.	0.	0.	1.356E+03	3.012E+04	3.618E+04	6.769E+04
NE	4.000E+00	0.	0.	0.	0.	0.	0.	0.	1.530E+04	2.229E+04	3.759E+04
ENE	0.	0.	0.	0.	0.	0.	6.200E+02	0.	0.	0.	6.200E+02
E	0.	0.	0.	0.	0.	0.	1.955E+03	1.430E+02	0.	1.763E+04	1.973E+04
ESE	0.	0.	0.	0.	0.	0.	1.340E+04	6.762E+04	2.389E+04	2.697E+05	3.747E+05
SE	0.	0.	0.	0.	1.200E+02	8.244E+03	7.707E+03	8.921E+03	2.913E+04	1.236E+04	6.649E+04
SSE	0.	4.400E+01	4.700E+01	8.600E+01	9.200E+01	1.329E+03	4.713E+03	1.677E+04	5.91[illegible]E+03	2.167E+04	5.066E+04
S	1.100E+01	4.400E+01	6.500E+01	5.[illegible]00E+01	7.500E+01	9.310E+02	3.385E+04	8.118E+03	3.303E+04	8.109E+03	8.429E+04
SSW	1.800E+01	3.700E+01	3.700E+01	5.600E+01	8.100E+01	4.572E+03	5.589E+03	5.033E+03	2.738E+04	1.067E+04	5.347E+04
SW	1.600E+01	0.	3.100E+01	5.300E+01	5.900E+01	1.125E+03	1.058E+04	1.292E+04	1.258E+04	7.528E+04	1.126E+05
WSW	0.	1.000E+01	1.000E+01	3.700E+01	5.300E+01	7.900E+02	9.299E+03	1.696E+04	5.921E+04	1.562E+04	1.020E+05
W	1.600E+01	5.600E+01	3.100E+01	5.000E+01	8.100E+01	7.720E+02	1.878E+04	3.187E+05	5.541E+04	2.376E+04	4.176E+05
WNW	0.	3.100E+01	1.520E+02	0.	0.	0.	1.506E+04	2.570E+05	5.502E+04	1.407E+04	3.413E+05
NW	4.000E+00	1.330E+02	3.700E+01	0.	0.	0.	0.	6.351E+04	2.323E+04	2.871E+04	1.156E+05
NNW	[illegible].900E+01	1.800E+01	0.	0.	0.	0.	0.	2.557E+04	4.112E+04	1.180E+05	1.847E+05
TOTAL	[illegible].660E+02	3.730E+02	4.100E+02	3.[illegible]50E+02	5.610E+02	1.776E+04	1.216E+05	8.027E+05	4.735E+05	1.436E+06	2.853E+06

DENSITY(/M**2) = 1.43E-04

SITE VEGETATION PRODUCTION, KGR

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.	TOTAL
N	0.	0.	0.	0.	0.	0.	0.	0.	1.207E+06	1.550E+06	2.757E+06
NNE	0.	0.	0.	0.	0.	0.	0.	3.445E+04	1.131E+06	1.550E+06	2.716E+06
NE	0.	0.	0.	0.	0.	0.	0.	0.	1.381E+05	7.566E+05	9.447E+05
ENE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E	0.	0.	0.	0.	0.	0.	3.049E+04	0.	0.	1.519E+05	1.824E+05
ESE	0.	0.	0.	0.	0.	0.	3.039E+05	3.445E+05	6.403E+05	1.513E+06	2.802E+06
SE	0.	4.909E+03	5.169E+03	5.424E+03	7.751E+03	9.173E+04	5.168E+05	6.613E+05	1.206E+06	1.550E+06	4.249E+06
SSE	0.	5.167E+03	8.615E+03	1.205E+04	1.550E+04	1.292E+05	5.168E+05	8.613E+05	1.206E+06	1.550E+06	4.305E+06
S	0.	5.167E+03	8.615E+03	1.205E+04	1.550E+04	1.292E+05	5.168E+05	8.613E+05	1.206E+06	1.550E+06	4.305E+06
SSW	0.	5.167E+03	8.615E+03	1.205E+04	1.550E+04	1.292E+05	5.168E+05	8.613E+05	1.206E+06	1.550E+06	4.305E+06
SW	0.	5.167E+03	8.615E+03	1.205E+04	1.550E+04	1.292E+05	5.168E+05	8.613E+05	1.206E+06	1.550E+06	4.305E+06
WSW	0.	5.167E+03	8.615E+03	1.205E+04	1.550E+04	1.292E+05	5.168E+05	8.613E+05	1.206E+06	1.550E+06	4.305E+06
W	0.	5.167E+03	8.615E+03	1.205E+04	1.550E+04	1.292E+05	5.168E+05	8.613E+05	1.206E+06	1.550E+06	4.305E+06
WNW	0.	5.167E+03	7.754E+03	9.643E+03	9.301E+03	6.666E+04	3.039E+05	8.268E+05	1.206E+06	1.550E+06	3.985E+06
NW	0.	2.842E+03	0.	0.	0.	0.	0.	5.512E+05	1.206E+06	1.550E+06	3.310E+06
NNW	0.	0.	0.	0.	0.	0.	0.	3.445E+05	1.206E+06	1.550E+06	3.101E+06
TOTAL	0.	4.392E+04	6.461E+04	8.739E+04	1.101E+05	9.335E+05	4.256E+06	8.131E+06	1.522E+07	2.103E+07	4.988E+07

DENSITY(/M**2) = 2.49E-03

TABLE 12 (Continued)

50 MILE POPULATION, VEGETABLE, MILK & MEAT PRODUCTION

DAVIS-BESSE UNIT 1 SPECIAL LOCATIONS

SITE MILK PRODUCTION, LITERS

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.	TOTAL
N	0.	0.	0.	0.	0.	0.	0.	0.	9.856E+06	1.112E+07	2.097E+07
NNE	0.	0.	0.	0.	0.	0.	0.	0.	1.377E+07	2.061E+07	3.438E+07
NE	0.	0.	0.	0.	0.	0.	0.	0.	2.444E+06	9.288E+06	1.173E+07
ENE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.488E+05	5.488E+05
ESE	0.	0.	0.	0.	0.	0.	2.074E+06	1.831E+06	3.646E+06	1.094E+07	1.849E+07
SE	0.	0.	0.	0.	0.	3.074E+05	2.477E+06	3.614E+06	5.953E+06	7.959E+06	2.031E+07
SSE	0.	0.	0.	0.	0.	4.651E+05	2.785E+06	4.304E+06	6.289E+06	6.561E+06	2.040E+07
S	0.	0.	0.	0.	0.	4.020E+05	1.667E+06	4.434E+06	5.590E+06	5.045E+06	1.714E+07
SSW	0.	0.	0.	0.	0.	4.730E+05	3.334E+06	4.672E+06	4.932E+06	4.131E+06	1.754E+07
SW	0.	0.	0.	0.	0.	5.203E+05	2.617E+06	3.295E+06	1.305E+06	2.564E+06	1.030E+07
WSW	0.	0.	2.534E+05	0.	0.	5.203E+05	1.317E+06	1.190E+06	1.237E+06	3.215E+06	7.733E+06
W	0.	0.	0.	0.	0.	4.730E+05	1.480E+06	1.127E+06	1.844E+06	7.717E+06	1.264E+07
WNW	0.	0.	0.	0.	0.	6.306E+04	5.415E+05	1.148E+06	4.665E+06	1.373E+07	2.015E+07
NW	0.	0.	0.	0.	0.	2.523E+05	0.	1.101E+06	1.764E+06	9.519E+06	1.264E+07
NNW	0.	0.	0.	0.	0.	0.	0.	5.507E+05	1.532E+06	3.348E+06	5.431E+06
TOTAL	0.	0.	2.534E+05	0.	0.	3.476E+06	1.829E+07	2.727E+07	6.482E+07	1.163E+08	2.304E+08

DENSITY(/M**2) = 1.15E-02

SITE ANNUAL MEAT PRODUCTION, KGR

DIR	0.0-1.	1.-2.	2.-3.	3.-4.	4.-5.	5.-10.	10.-20.	20.-30.	30.-40.	40.-50.	TOTAL
N	0.	0.	0.	0.	0.	0.	0.	0.	9.203E+05	1.036E+06	1.956E+06
NNE	0.	0.	0.	0.	0.	0.	0.	0.	1.287E+06	1.926E+06	3.212E+06
NE	0.	0.	0.	0.	0.	0.	0.	0.	2.284E+05	8.678E+05	1.096E+06
ENE	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.176E+04	5.176E+04
ESE	0.	0.	0.	0.	0.	0.	3.312E+05	2.841E+05	5.860E+05	1.206E+06	2.409E+06
SE	0.	0.	0.	0.	0.	5.018E+04	4.541E+05	6.597E+05	1.254E+06	1.634E+06	4.052E+06
SSE	0.	0.	0.	0.	0.	7.592E+04	7.661E+05	1.122E+06	1.504E+06	2.476E+06	5.944E+06
S	0.	0.	0.	0.	0.	6.562E+04	4.587E+05	1.175E+06	1.467E+06	2.498E+06	5.664E+06
SSW	0.	0.	0.	0.	0.	7.720E+04	9.173E+05	1.256E+06	1.497E+06	2.032E+06	5.780E+06
SW	0.	0.	0.	0.	0.	8.492E+04	6.547E+05	1.364E+06	1.184E+06	2.096E+06	5.383E+06
WSW	0.	0.	0.	0.	0.	8.492E+04	3.058E+05	1.093E+06	1.136E+06	1.902E+06	4.522E+06
W	0.	0.	0.	0.	0.	7.720E+04	5.051E+05	6.297E+05	5.128E+05	5.350E+06	7.075E+06
WNW	0.	0.	0.	0.	0.	1.029E+04	1.506E+05	2.472E+05	4.772E+05	9.733E+05	1.859E+06
NW	0.	0.	0.	0.	0.	4.117E+04	0.	1.619E+05	2.593E+05	6.403E+05	1.103E+06
NNW	0.	0.	0.	0.	0.	0.	0.	6.097E+04	2.057E+05	1.830E+05	4.697E+05
TOTAL	0.	0.	0.	0.	0.	5.674E+[illegible]	[illegible].544E+06	8.075E+06	1.252E+07	2.487E+07	5.058E+07

DENSITY(/M**2) = 2.53E-03

APPENDIX A

RESPONSES TO REQUEST FOR INFORMATION

(Enclosure 2)

Request 1

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

Response

This information is given in Tables A1 through A6 and in Figures A1 through A8.

Request 2

Provide, in tabular form, the distances from the centerline of the first nuclear unit to the following for each of the 22½ degree radial sectors centered on the 16 cardinal compass directions.

a. Nearest milk cow (to a distance of 5 miles)

b. Nearest meat animal (to a distance of 5 miles)

c. Nearest milk goat (to a distance of 5 m[illegible]

d. Nearest residence (to a distance of 5 mi[illegible]s)

e. Nearest vegetable garden greater than 500 ft^2 (to a distance of 5 miles)

f. Nearest site boundary

For radioactive releases from stacks which qualify as elevated releases as defined in Draft Regulatory Guide 1.DD, identify the locations of all milk cows, milk goats, meat animals, residences, and vegetable gardens, in a similar manner, out to a distance of 3 miles for each radial sector.

Response

Table A7 presents the requested information.

Request 3

Based on considerations in Draft Regulatory Guide 1.DD, provide estimates of relative concentration (X/Q) and deposition (D/Q) at locations specified in response to item 2 above for each release point specified in response to item 1 above.

Response

Tables A8 and A9 present the X/Q and D/Q for each location specified in response to item 2 above.

These values were based on the straight-line method in accordance with Regulatory Guide 1.111 guidelines. Terrain correction factors based on open terrain were used for all onshore flow computations.

Request 4

Provide a detailed description of the meteorological data, models and parameters used to determine the X/Q and D/Q values. Include information concerning the validity and accuracy of the models and assumptions for your site and the representativeness of the meteorological data used.

Response

Annual average atmospheric dilution factors (χ/Q) were based on Davis-Besse site data for the August 4, 1974, through August 3, 1975, period. The following equation which assumes a uniform horizontal distribution within a 22.5 degree sector and a ground-level release was used for the calculations.[3]

$$\left(\frac{\chi}{Q}\right)_j = \frac{2.032}{x} \sum_{i=1}^{m} \frac{F_{ij}}{S_{z_i}} \left\langle \frac{1}{u_{ij}} \right\rangle_{ave}$$

where:

$(\chi/Q)_j$	=	relative ground level concentration (χ) normalized to source strength (Q) for sector j, seconds per cubic meter
S_{z_i}	=	effective vertical dispersion parameter for stability class i, meters
$\langle 1/u_{ij} \rangle_{ave}$	=	average inverse wind speed for stability class i and sector j, seconds per meter
F_{ij}	=	fraction of time (based on all observations) that stability class i occurs within sector j
x	=	downwind distance, meters
m	=	number of stability categories, seven (A through G)

An effective vertical dispersion parameter, S_{z_i}, is used to account for building wake effects as follows:

$$S_{z_i} = \left(\sigma_{z_i}^2 + \frac{cH^2}{\pi}\right)^{1/2}$$

with the constraint that (Ref. 1)

$$S_{z_i} \leq \sqrt{3}\ \sigma_{z_i}$$

where

σ_{z_i}	=	vertical dispersion parameter for stability class i, meters
c	=	building shape factor (0.5), dimension-less
H	=	height of the reactor building = 73.5 meters

Stability was based on $\Delta T_{250'-35'}$ data and wind data used were from the 35-ft level. These data sets are representative of surface meteorological conditions for ground-level releases. Calms were distributed within each stability class among the sectors in proportion to the distribution of winds in the 0.6 to 1.5 mph range and were assigned a speed of 0.25 mph.

Since the annual average χ/Q values were calculated using a straight-line Gaussian model, conservative adjustment factors were applied based on the guidance of Regulatory Guide 1.111. All χ/Q and D/Q values presented contain these adjustment factors. The adjustment factors used are as presented in Regulatory Guide 1.111 for sites in open terrain. Although the Davis-Besse site is located near the shore of Lake Erie, the effect of short term changes in wind trajectories due to lake/land breeze circulations (see Response to No. 7) is small enough, when averaged over a one year period, to be comparable to an inland, open terrain location.[13] This is shown when comparing annual onsite wind distributions with distributions from Toledo Express Airport (20 miles inland from Lake Erie, far enough to be out of the lake/land breeze regime during normal inland penetrations). The two locations do not show any significant differences in wind distributions.[14] Lake Erie has the only significant topographic affect on site meteorology.

A discussion of the representativeness of the meteorological data used was provided to the Nuclear Regulatory Commission on February 23, 1976.[14] A description of the data was provided in References 14 and 15.

Request 5

If an onsite program commensurate with the recommendations and intent of Regulatory Guide 1.23 exists:

a) Provide representative annual and monthly, if available, joint frequency distributions of wind speed and direction by atmospheric stability class covering at least the most recent one year period of record, preferably two or more years of record. Wind speed and direction should be measured at levels applicable to release point elevations and stability should be determined from the vertical temperature gradient between measurement levels that represent conditions into which the effluent is released.

b) Describe the representativeness of the available data with respect to expected long-term conditions at the site.

Response

a) These data were provided to the Nuclear Regulatory Commission on October 24, 1975.[15]

b) A discussion of the representativeness of the meteorological data used was provided to the Nuclear Regulatory Commission on February 23, 1976.

Request 6

Not applicable.

Request 7

Describe airflow trajectory regimes of importance in transporting effluents to the locations for which these calculations are made.

Response

The major local influence on site meteorology is Lake Erie, which induces lake (onshore) and land (offshore) breezes generally during periods when gradient winds are light and insolation relatively strong. In spring and summer, solar radiation heats the land surface more rapidly than the water surface. The air above the land is warmed more than that above the water and rises, causing an inflow of air from over the water. There may be a compensating return flow at higher levels completing a cellular-type circulation. The trajectory of the wind during a lake breeze, which begins nearly perpendicular to the shoreline, is deflected due to the earth's rotation (Coriolis force) and becomes more nearly parallel to the shore by late afternoon or early evening. The opposite phenomenon, the land breeze, amy occur during fall and early winter or during summer nights, times when the water is warmer than the land. Land breezes, however, are generally weaker and less frequent than lake breezes.[16] As noted in the response to No. 4, these variations in wind flow trajectories near the lake shore are small enough when averaged over a one year period that the use of site data for determining effluent trajectories to all locations for dose calculations is valid. There are no other significant topographic influences on wind flow trajectories in the site region. Figures showing monthly, seasonal and annual average wind flows are presented in Reference 11.

Request 8

Provide a map showing the detailed topographical features (as modified by the plant) on a large scale, within a 10-mile radius of the plant and a plot of the maximum topographic elevation versus distance from the center of the plant in each of the sixteen $22\frac{1}{2}$ degree cardinal compass point sectors (centered on true north), radiating from the center of the plant, to a distance of 10 miles.

Response

The attached Figures A9a through A9d contain plots of the topographic elevation versus distance from the center of Unit 1 on each of the sixteen cardinal compass points out to 10 miles. Due to the very flat terrain, this method of displaying the topographic elevations was selected. For each sector, the maximum elevation is within 20 feet of the elevation displayed. A map showing the topographic features within 10 miles is shown in Figure 2-1 of the Unit 1 FSAR.

Request 9

Provide the dates and times of radioactivity releases from intermittent sources by source location based on actual plant operation and, if available, appropriate hourly meteorological data (i.e., wind direction and speed, and atmospheric stability) during each period of release.

Response

There have been no releases as Unit 1 is not yet operational.

TABLE A1

DAVIS-BESSE UNIT 1 LIQUID EFFLUENTS

Nuclide	Half-Life (Days)	Coolant Contrations- Primary (μCi/ml)	Secondary (μCi/ml)	Annual Releases to Collection Box - Boron Rs (Ci)	Misc. Wastes (Ci)	Secondary (Ci)	Turb Bldg (Ci)	Total LWS (Ci)	Adjusted Total (Ci/yr)	Detergent Wastes (Ci/yr)	Total (Ci/yr)
Corrosion and Activation Products											
Cr51	2.78+01	2.43-03	1.42-09	.00000	.00001	.00000	.00001	.00002	.00011	.00000	.00011
Mn54	3.03+02	3.99-04	3.18-10	.00000	.00000	.00000	.00000	.00000	.00002	.00100	.00100
Fe55	9.50+02	2.06-03	1.27-09	.00000	.00001	.00000	.00001	.00002	.00010	.00000	.00010
Fe59	4.50+01	1.28-03	7.93-10	.00000	.00000	.00000	.00001	.00001	.00006	.00000	.00006
Co58	7.13+01	2.05-02	1.27-08	.00000	.00005	.00000	.00013	.00018	.00101	.00400	.00500
Co60	1.92+03	2.57-03	1.43-09	.00000	.00001	.00000	.00001	.00002	.00012	.00870	.00880
Np239	2.35+00	1.46-03	9.05-10	.00000	.00000	.00000	.00001	.00001	.00006	.00000	.00006
Fission Products											
Br83	1.00-01	4.85-03	2.88-09	.00000	.00000	.00000	.00001	.00001	.00004	.00000	.00004
Rb86	1.87+01	1.06-04	1.08-10	.00000	.00000	.00000	.00000	.00000	.00002	.00000	.00002
Sr89	5.20+01	4.49-04	3.17-10	.00000	.00000	.00000	.00000	.00000	.00002	.00000	.00002
Sr91	4.03-01	7.10-04	4.05-10	.00000	.00000	.00000	.00000	.00000	.00002	.00000	.00002
Y91m	3.47-02	3.54-04	2.43-10	.00000	.00000	.00000	.00000	.00000	.00001	.00001	.00001
Mo99	2.79+00	1.03-01	6.06-07	.00000	.00020	.00000	.00569	.00589	.03232	.00000	.03200
Tc99m	2.50-01	5.08-02	2.62-07	.00000	.00018	.00000	.00385	.00403	.02211	.00000	.02200
Te127m	1.09+02	3.60-04	1.59-10	.00000	.00000	.00000	.00000	.00000	.00001	.00000	.00001
Te127	3.92-01	9.26-04	5.39-10	.00000	.00000	.00000	.00000	.00001	.00003	.00000	.00003
Te129m	3.40+01	1.79-03	1.11-09	.00000	.00000	.00000	.00001	.00002	.00009	.00000	.00009
Te129	4.79-02	1.58-03	9.79-10	.00000	.00000	.00000	.00001	.00001	.00006	.00000	.00006
I130	5.17-01	2.33-03	1.37-09	.00000	.00002	.00000	.00001	.00003	.00014	.00000	.00014
Te131m	1.25+00	2.93-03	7.30-10	.00000	.00000	.00000	.00001	.00001	.00006	.00000	.00006
Te131	1.74-02	1.07-03	6.03-10	.00000	.00000	.00000	.00000	.00000	.00001	.00000	.00001
I131	8.05+00	3.41-01	2.03-07	.00028	.00808	.00000	.00198	.01034	.05675	.00006	.05700
Te132	3.25+00	3.33-02	1.53-08	.00000	.00007	.00000	.00014	.00021	.00117	.00000	.00120
I132	9.58-02	1.01-01	5.87-08	.00000	.00021	.00000	.00022	.00043	.00234	.00000	.00230
I133	8.75-01	4.38-01	2.57-07	.00001	.00487	.00000	.00210	.00698	.03828	.00000	.03800
I134	3.67-02	4.63-02	2.68-08	.00000	.00000	.00000	.00000	.00000	.00001	.00000	.00001
Cs134	7.49+02	3.16-02	3.13-08	.00104	.00008	.00000	.00031	.00143	.00785	.01300	.02100
I135	2.79-01	2.02-01	1.19-07	.00000	.00060	.00000	.00063	.00123	.00677	.00000	.00680
Cs136	1.30+01	1.62-02	1.54-08	.00029	.00004	.00000	.00015	.00048	.00265	.00000	.00270
Cs137	1.10+04	2.28-02	2.35-08	.00075	.00006	.00000	.00023	.00105	.00575	.02400	.03000
Ba137m	1.77-03	1.55-02	9.58-09	.00071	.00006	.00000	.00022	.00098	.00537	.00000	.00540
Ba140	1.28+01	2.80-04	1.57-10	.00000	.00000	.00000	.00000	.00000	.00001	.00000	.00001
All Others		1.98-01	2.42-07	.00000	.00000	.00000	.00001	.00001	.00004	0.0	.00004
Total (Except Tritium)		1.65+00	1.90-06	.00310	.01456	.00000	.01577	.03343	.18343	.06234	.25000
Tritium Release		550	Curies per year								

TABLE A2

DAVIS-BESSE UNIT 1 GASEOUS EFFLUENTS

Gaseous Release Rate - Curies Per Year

	Primary Coolant (Microci/GM)	Secondary Coolant (Microci/GM)	Gas Stripping		Building Ventilation			Blowdown Vent Offgas	Air Ejector Exhaust	Total
			Shutdown	Continuous	Reactor	Auxiliary	Turbine			
Kr-83M	2.025-02	7.135-09	.0	.0	.0	.0	.0	.0	.0	.0
Kr-85M	1.058-01	3.801-08	.0	.0	1.0+00	2.0+00	.0	.0	1.0+00	4.0+00
Kr-85	7.428-02	2.653-08	3.1+01	3.2+02	4.6+01	2.0+00	.0	.0	.0	4.0+02
Kr-87	5.791-02	1.970-08	.0	.0	.0	1.0+00	.0	.0	.0	1.0+00
Kr-88	1.927-01	6.758-08	.0	.0	2.0+00	4.0+00	.0	.0	3.0+00	9.0+00
Kr-89	4.833-03	1.726-09	.0	.0	.0	.0	.0	.0	.0	.0
Xe-131M	8.438-02	3.033[illegible]	1.0+00	4.0+00	3.7+01	2.0+00	.0	.0	1.0+00	4.5+01
Xe-133M	1.999-01	7.186-[illegible]	.0	.0	3.2+01	4.0+00	.0	.0	3.0+00	3.9+01
Xe-133	1.531+01	5.423-06	4.0+00	5.0+00	4.7+03	3.2+02	.0	.0	2.0+02	5.2+03
Xe-135M	1.256-02	4.437-09	.0	.0	.0	.0	.0	.0	.0	.0
Xe-135	3.345-01	1.182-07	.0	.0	9.0+00	7.0+00	.0	.0	4.0+00	2.0+01
Xe-137	8.700-03	3.082-09	.0	.0	.0	.0	.0	.0	.0	.0
Xe-138	4.252-02	1.479-08	.0	.0	.0	.0	.0	.0	.0	.0
Total Noble Gases										5.7+03
I-131	3.413-01	2.032-07	.0	.0	1.3-01	5.4-02	1.1-03	.0	3.4-02	2.2-01
I-133	4.380-01	2.566-07	.0	.0	2.8-02	7.0-02	1.4-03	.0	4.4-02	1.4-01

Tritium gaseous release - 550 curies/year, C-14 release 8 curies/year, AR-41 release 25 curies/year.

.0 appearing in the table indicates release is less than 1.0 curies/year for noble gas, 0.0001 curies/year for I.

Airborne Particulate Release Rate - Curies per Year

Nuclide	Waste Gas System	Building Ventilation		Total
		Reactor	Auxiliary	
Mn-54	4.5-05	2.2-04	1.8-04	4.4-04
Fe-59	1.5-05	7.5-05	6.0-05	1.5-04
Co-58	1.5-04	7.5-04	6.0-04	1.5-03
Co-60	7.0-05	3.4-04	2.7-04	6.8-04
Sr-89	3.3-06	1.7-05	1.3-05	3.3-05
Sr-90	6.0-07	3.0-06	2.4-06	6.0-06
Cs-134	4.5-05	2.2-04	1.8-04	4.4-04
Cs-137	7.5-05	3.8-04	3.0-04	7.5-04

1

TABLE A3

RELEASE POINT DESCRIPTION

Source	Release Point	Height Above Grade	Location of Adjacent Structures	Estimated Discharge Temperature	Flow Rate (CFM)	Size and Shape of Flow Orifice	Exit Velocity (ft/sec)
Gaseous Waste System	Station Vent	el 834'6"	Exhausted vertically upward 10 feet above and 79 feet away from the shield building roof centerline, 142'2" above turbine building roof, 174'6" above the auxiliary building roof	120°F	0.1*	7' OD pipe ¼" wall thickness with 10' section of 3/8" wall thickness or 38 ft² (37.8 ft² at the restriction).	
Containment Purge				120°F	50,000		
Auxiliary Building Radwaste Areas Ventillation				104°F	80,000		
Steam Jet Air Ejectors				71.5°F	60		
Station Vent Totals				104°F to 110°F	80,060 to 130,060		35.1 to 57.0
Turbine Building Ventilation System	Auxiliary Building Roof	el 654'	West of and adjacent to turbine building which rises 37.7 feet above release point	110°F	55,000	62" x 62" square opening or 26.7 ft²	34.3
	Turbine Building North Wall C45	el 593'	There are no adjacent buildings in this area other than the turbine building	110°F	700	16" x 16" opening with louvre, assuming 50% open 0.9 ft²	13.0
	C24-1 Turbine Building Roof	el 688'	The shield building is 33 ft away and rises 136.5' above this release point	110°F	55,000	70" x 70" square opening or 34.0 ft²	27.0
	C24-2 Turbine Building Roof	el 688'	The shield building is 33 ft away and rises 136.5' above this release point	110°F	55,000	70" x 70" square opening or 34.0 ft²	27.0
	C24-3 Turbine Building Roof	el 688'	The shield building is 43 ft away and rises 136.5' above this release point	110°F	55,000	70" x 70" square opening or 34.0 ft²	27.0
	C24-4 Turbine Building Roof	el 688'	The shield building is 138 ft away and rises 136.5' above this release point	110°F	55,000	70" x 70" square opening or 34.0 ft²	27.0
	C24-5 Turbine Building Roof	el 688'	The shield building is 187 ft away and rises 136.5' above this release point	110°F	10,000	45" x 45" square opening or 14.1 ft²	11.8
	Turbine Building East Wall C47	el 669'	Release point is 11 feet above office building	110°F	11,250	21' x 3' opening with louvre, assuming 50% open 31.5 ft²	6.0

* Yearly Average

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TABLE A4

QUANTITIES OF SOLID WASTES PER YEAR

Source	Waste Input to Solid Radwaste System	Solid Waste Volume Shipped from Station	Comments
Spent Bead Resins	600 ft^3 gross displacement volume (includes 35% void space)	600 ft^3	The 600 ft^3 shipped volume includes 60 ft^3 of evaporator bottoms and 150 ft^3 of solidification agent.
Powdex Resins	600 ft^3	800 ft^3	Shipped volume based on a 3:1 volume ratio of waste to solidification agent.
Evaporator Bottoms	3305 ft^3	4327 ft^3	Shipped volume based on a 3:1 volume ratio of waste to solidification agent. 60 ft^3 of bottoms used to solidify resins was not taken into account.
Filter Cartridges	29 cartridges	29 drums (214 ft^3)	One (1) cartridge per drum.
Miscellaneous Paper, Cloth, etc.	4960 ft^3	992 ft^3	A volume compaction ratio of 5:1 in baler.

TABLE A5

ESTIMATED TOTAL QUANTITY AND ACTIVITY OF SOLID WASTE

Estimated Total Radioisotopic Inventories (Ci)	Spent Bead-Type Resins		Spent Powdered Resins		Evaporator Bottoms		Spent Filter Cartridges		Paper, Clothing, etc.	
Annual Quantity	600 ft^3		600 ft^3		3305 ft^3		29 cartridges		1000 ft^3 (compacted)	
	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
Corrosion Products*										
Cr-51	313.07	313.07	0.44	0.44	313.07	313.07	313.07	313.07	3.69×10^{-4}	3.69×10^{-4}
Mn-54	35.83	35.83	0.06	0.06	35.83	35.83	35.83	35.83	4.23×10^{-5}	4.23×10^{-5}
Fe-55	1237.97	1237.97	1.74	1.74	1237.97	1237.97	1237.97	1237.97	1.46×10^{-3}	1.46×10^{-3}
Fe-59	35.83	35.83	0.06	0.06	35.83	35.83	35.83	35.83	4.23×10^{-5}	4.23×10^{-5}
Co-58	1880.76	1880.76	2.65	2.65	1880.76	1880.76	1880.76	1880.76	2.22×10^{-3}	2.22×10^{-3}
Co-60	10.08	10.08	0.02	0.02	10.08	10.08	10.08	10.08	1.19×10^{-5}	1.19×10^{-5}
Zr-95	2464.03	2464.03	3.47	3.47	2464.03	2464.03	2464.03	2464.03	2.91×10^{-3}	2.91×10^{-3}
Ionic Radionuclides										
Rb-88	635.45	63.55	321.95	32.20	690.46	69.05	-	-	0.27	2.70×10^{-2}
Sr-89	87.57	8.76	0.54	0.06	1.16	0.12	-	-	4.51×10^{-4}	4.51×10^{-5}
Sr-90	19.66	1.97	0.02	1.74×10^{-3}	0.04	3.74×10^{-3}	-	-	1.46×10^{-5}	1.46×10^{-6}
Sr-91	10.66	1.07	3.40	0.34	7.29	0.73	-	-	2.85×10^{-3}	2.85×10^{-4}
Sr-92	2.37	0.24	1.04	0.11	2.24	0.23	-	-	8.72×10^{-4}	8.72×10^{-5}
Y-90	19.40	1.94	1.21	0.13	[illegible]	0.26	-	-	1.01×10^{-3}	1.01×10^{-4}
Y-91	12.96	1.30	6.75	0.68	[illegible]	1.45	-	-	5.66×10^{-3}	5.66×10^{-4}
Mo-99	979.17	97.92	491.28	49.13	1052.96	105.30	-	-	0.42	4.12×10^{-2}
I-131	9954.04	995.41	385.15	38.52	825.97	82.60	-	-	0.33	3.23×10^{-2}
I-132	3185.53	318.56	268.30	26.83	575.68	57.57	-	-	0.23	2.25×10^{-2}
I-133	2033.27	203.33	450.73	45.08	966.65	96.67	-	-	0.38	3.78×10^{-2}
I-134	111.71	11.18	54.62	5.47	117.38	11.74	-	-	4.58×10^{-2}	4.58×10^{-3}
I-135	625.51	62.56	226.56	22.66	485.92	48.60	-	-	0.19	1.90×10^{-2}
Cs-134	3925.06	392.51	487.70	48.77	1052.96	105.30	-	-	0.41	4.09×10^{-2}
Cs-136	200.80	20.08	88.24	8.83	189.88	18.99	-	-	7.40×10^{-2}	7.40×10^{-3}
Cs-137	8900.00	890.00	1514.36	151.44	3245.16	324.52	-	-	1.27	0.13
Cs-138	279.76	27.98	87.53	8.76	188.16	18.82	-	-	7.34×10^{-2}	7.34×10^{-3}
Ba-137m	8900.00	890.00	1395.12	139.52	2994.49	299.49	-	-	1.17	0.12
Ba-139	19.15	1.92	9.07	0.91	19.51	1.96	-	-	7.60×10^{-5}	7.60×10^{-6}
Ba-140	26.81	2.69	0.68	0.07	1.45	0.15	-	-	5.63×10^{-6}	5.63×10^{-7}
La-140	27.36	2.74	0.27	0.03	0.58	0.06	-	-	2.25×10^{-5}	2.25×10^{-7}
Ce-144	25.92	2.60	0.07	6.18×10^{-3}	0.14	0.02	-	-	5.18×10^{-7}	5.18×10^{-8}

Sources of Solid Waste

* Due to the difficulty of determining a realistic distribution of crud in solid waste, the same activity is assigned to more than one source.

TABLE A6 (Page 1 of 8)

DRAFT REGULATORY GUIDE 1.BB APPENDIX D QUESTIONS

Item No.	Quantity	Value	Reference*
1.a.	Maximum Core Power	2772 Megawatts Thermal	(1) Subsection 15.1
1.b.1)	Total mass of Uranium in equilibrium core	178262 lbs.	---
	Total mass of Plutonium in equilibrium core	414 lbs. of fissionable Plutonium	---
1.b.2)	Percent enrichment of Uranium in reload fuel	2.21%	---
1.b.3)	Percent fissile Plutonium in reload fuel	0%	---
1.c.	List items which are not consistent with Regulatory Guide 1.BB	The methods and parameters used in this analysis are as described in Regulatory Guide 1.BB; however, Chapter 11 of the FSAR has not been changed to reflect Regulatory Guide 1.BB	---
1.d.	Quantity of Tritium released	1108.8 ci/yr	(2) Page B103
2.a.	Total mass of primary coolant excluding the volume in the pressurizer and the make-up and purification system	463850 lbs.	(1) Tables 5-3, 5-4, 5-5, 5-6, 5-7 and subsection 11.1.2.1
2.b.	Average letdown rate	46.7 gpm	(1) Tables 9-10 and 11-14
2.c.	Average flow through cation demineralizers	4.7 gpm	0.1 letdown flow assumed to go through cation demineralizer
2.d.	Average shim bleed flow	1.65 gpm	(1) Table 11-14 and (2) Page B21
3.a.	Number of Steam Generators	2	(1) Page 5-1
	Type of Steam Generators	Once through	(1) Page 5-1
	Carry over factor for Iodine and nonvolatiles	1.0	(2) Page B58

TABLE A6 (Page 2 of 8)

Item No.	Quantity	Value	Reference*
3.b.	Total steam flow in secondary system	11.76×10^6 lbs/hr	(1) Table 10-1
3.c.	Mass of steam in each steam generator at full power	5100 lbs.	Equipment supplier
3.d.	Mass of liquid in each steam generator at full power	49,900 lbs.	Equipment supplier
3.e.	Mass of coolant in the secondary system at full power	2.93×10^6 lbs.	---
3.f.	Primary to secondary leakage used in the evaluation	100 lbs/day	(2) Page B57
3.g.	Description of steam generator blowdown	not applicable	---
3.h.	Fraction of feedwater processed through the condensate demineralizers	0.67	(1) Page 11-16
	Condensate Demineralizer DF's	Anion 10 Cs 2 other 10	(2) Page B23
3.i.1)	Condensate Demineralizer average flow rate	1.96×10^6 lbs/hr average flow through each of 4 demin. Note only 3 are in service at one time.	Items 3.b., 3.h. and 3.i.3) and (1) Page 10-22
3.i.2)	Demineralizer type	Powdered resin	Equipment manual
3.i.3)	Number of demineralizers	4(3 inservice +1instandby)	(1) Page 10-22
	Size of demineralizers	374 ft.^{3} filter volume 12 ft.^{3} resin volume	Equipment manual (1) Page 11-44
3.i.4)	Regeneration frequency	not applicable	---
3.i.5)	Is ultrasonic resin cleaning used	no	---
3.i.6)	Regeneration volume and activity	not applicable	---
4.a	For shim bleed**		
1)	Source	shim bleed	---
	Flow rate	2380 gpd	(1) Table 11-14

TABLE A6 (Page 3 of 8)

Item No.	Quantity	Value	Reference*
4.a.	Shim bleed		
1)	Fraction of primary coolant activity	in GALE code	(2) Page B29
2)	Collection time	20.8 days	Item 4.a.3) & (2) Page B37 - B39
	Processing time	1.9 days	Item 4.a.3) & (2) Page B37 - B39
	Discharge time	0.2 days	Item 4.a.3) & (2) Page B37 - B39
3)	Capacity of tanks	Clean waste receiver tank 103,000 gal.	(1) Table 11-12
		Clean waste monitor tank 23,200 gal.	(1) Table 11-12
	Equipment flows	Boric acid evaporators 21,600 gpd each	(1) Table 11-12
		Primary demineralizers 201,600 gpd each	(1) Table 11-12
		Clean waste polishing demineralizers 57,600 gpd each	(1) Table 11-12
		Discharge flow 100,800 gpd	(1) Page 11-62
4)	Decontamination factors	Anion 10^5	(2) Page B35, B108
		Cs,Rb 2×10^4	(2) Page B35, B108
		Other 10^6	(2) Page B35, B108
5)	Fraction discharged	0.28	(1) Table 11-14
4.a.	For Equipment Drains**,***		
1)	Source	Equipment drains	---
	Flow rate	1573 gpd	(1) Table 11-14
	Fraction of primary coolant activity	1.0	(1) Table 11-14
2)	Collection time	20.8 days	Item 4.a.3)
	Processing time	1.9 days	Item 4.a.3)
	Discharge time	0.2 days	Item 4.a.3)
3)	Capacity of tanks	Clean waste receiver tanks 103,000 gal.	(1) Table 11-12
		Clean waste monitor tanks 23,200 gal.	(1) Table 11-12
	Equipment flows	Boric acid evaporators 21,600 gpd each	(1) Table 11-12
		Primary demineralizers 201,600 gpd each	(1) Table 11-12

TABLE A6 (Page 4 of 8)

Item No.	Quantity	Value	Flow(gpd)	FPCA	Reference*
4.a. 3) (cont.)		Clean waste polishing demineralizers 57,600 gpd each			(1) Table 11-12
		Discharge flow 100,800 gpd			(1) Page 11-62
4)	Decontamination factors	Anion 2.6×10^5			(2) Page B35, B108
		Cs,Rb 3.0×10^4			(2) Page B35, B108
		Other 2.6×10^6			(2) Page B35, B108
5)	Fraction discharged	0.14			(1) Table 11-14
4.a.	<u>For clean waste, regeneration waste, and blowdown waste</u>	not applicable			---
4.a.	<u>For dirty waste</u>**				
1)	Sources	Sample drains	35	1	(2) Page B33
		Auxiliary building floor drains	200	0.1	(2) Page B33
		Laboratory drains	400	0.002	(2) Page B33
		Misc. waste	700	0.01	(2) Page B33
		Deborating demin resin waste	130	0.25	(1) Tables 11-15, 11-16, 11-17
		Condensate demin backwash waste	1336	0.0156	(1) Table 11-15 Page 11-44
		Demineralizer sluicing	34.25	1	(1) Tables 11-15 11-16, 11-17
		Containment sump	40	1	(2) Page B33
	Flow rate	2875 gpd			Item 4.a.1) source
	Fraction of primary coolant activity	0.066			Item 4.a.1) source and (2) Page B34
2)	Collection time	1.9 days			Item 4.a.3) & (2) Pages B37 - B39
	Processing time	0.25 days			Item 4.a.3) & (2) Pages B37- B39
	Discharge time	0.035 days			Item 4.a.3) & (2) Pages B37 - B39
3)	Capacity of tanks	Misc. waste drain tank 13,400 gal.			(1) Table 11-13
		Misc. waste monitor tank 8,700 gal.			(1) Table 11-13

TABLE A6 (Page 5 of 8)

Item No.	Quantity	Value	Reference*
4.a. 3) (cont.)	Equipment flows	Misc. waste evaporator 21,600 gpd	(1) Table 11-13
		Waste polishing demineralizer 57,600 gpd	(1) Table 11-13
		Discharge flow 100,800 gpd	(1) Page 11-69
4)	Decontamination factors	Anion 10^4	(2) Page B35, B108
		Cs,Rb 10^5	(2) Page B35, B108
		Other 10^5	(2) Page B35, B108
5)	Fraction discharged	1.0	(1) Page 11-76
4.a.	For detergent waste**		
1)	Source	Detergent waste	---
	Flow rate	450 gpd	(2) Page B33
4.a.	For turbine building** drains		
1)	Source	Turbine building drains	---
	Flow rate	7200 gpd	(2) Page B33
4.a.6)	Condensate demineralizer Regeneration data	not applicable	
4.a.7)	Liquid source term by radionuclide in ci/yr. for normal operating occurrences	See Table A1	---
4.b	Provide piping and instrumentation diagrams and process flow diagrams for the liquid radwaste processing systems	See Figures A1, A2, A3, A6 and A7.	---
5.a	Volume of gases stripped from the primary coolant	50,000 ft^3/yr	(2) Page B41 (1) Page 11-120
5.b	Description of process used to hold up gases stripped from the primary system	The gases are removed from the primary system by a degasifier and are sent to a low pressure tank (waste gas surge tank). Using a compressor the	(1) Page 11-123, 11-119, Figure 3, and drawing 7749 M-038

Item No.	Quantity	Value	Reference*
		gases are sent to a waste gas decay tank where they are held for a minimum of 30 days. The gases are then released through the station vent after passing through a HEPA and charcoal filter. Figure 3 is a flow diagram of the system.	
5.c	Describe the normal operation of the system	This system contains three high pressure storage tanks. One tank is used to collect gases, one tank is used for decay, and the third tank is used as part of the clean waste receiver tank cover gas system.	---
	What is the fill time	56.7 days	Ref. (2) Pages B41 and B42, Ref. (1) Table 11-34
	What is the minimum hold up time	56.7 days used in evaluation.	Ref. (1) Table 11-34, Ref. (2) Pages B41 and B42
		Note: 30 days is the minimum hold up time required to meet ref. (1) commitment on pages 11-117 and 11-123	Ref. (1) Pages 11-117 and 11-123
5.d	DF for HEPA filters	100 for particulates	Ref. (2) Page B87
5.e	Describe charcoal delay system	not applicable	---
5.f	Provide piping and instrumentation diagrams and flow diagrams	See Figures A4 and A8	---
6.	<u>For gaseous waste processing vent</u>		
a)	What provisions are incorporated to reduce radioactivity releases	HEPA and charcoal filters	Figure A8
b)	DF assumed	100 for particulates 10 for iodine 1 for others	Ref. (2) Page B87

TABLE A6 (Page 7 of 8)

Item No.	Quantity	Value	Reference*
6.	<u>For containment purge</u>		
a)	What provisions are incorporated to reduce radioactivity releases	HEPA filter	----
b)	DF assumed	100 for particulates 1 for others	Ref. (2) Page B87
6.	<u>For auxiliary building ventilation</u>		
a)	What provisions are incorporated to reduce radioactivity releases	HEPA filter	----
b)	DF assumed	100 for particulates 1 for others	Ref. (2) Page B87
6.	<u>For turbine building ventilation</u>		
a)	What provisions are incorporated to reduce radioactive releases	none	----
b)	DF assumed	1	---
6.	<u>For steam jet air ejectors</u>		
a)	What provisions are incorporated to reduce radioactive releases	Charcoal and HEPA filters can be placed in the flow path however, none assumed for this evaluation	----
b)	DF assumed	1	
6.c.	Gaseous release rates in Ci/yr.	See Table A2	----
6.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	See Table A3	----

TABLE A6 (Page 8 of 8)

Item No.	Quantity	Value	Reference*
6.e.	Containment free volume	2.834×10^6 ft^3	Ref. (1) Page 6-5
	Describe internal clean-up system	not applicable	---
	Purge and venting frequencies and duration	20 purges/year at power operation and 4 purges/year at shutdown. This number of purges is assumed for dose analysis only.	Ref. (1) Pg. 11-103,104 Ref. (2) Pg. B81 — 1
7.a.	Provide in tabular form the following information concerning all inputs to the solid waste processing system: source, volume, activity and bases	See Tables A4 and A5 - the bases are 1.0% failed fuel for maximum and 0.1% failed fuel for average concentrations. The other bases are described in subsection 11.5 of reference (1)	Ref. (1) Table 11-54 and 11-55 and subsection 11.5
7.b.	Onsite storage provisions	The solid waste handling area has shielded storage space for a number of 55-gallon drums and 5 full casks	Ref. (1) Page 11-166
	Expected onsite storage times	None assumed	Ref. (1) Page 11-173
7.c	Provide piping and instrumentation diagrams for the solid radwaste system	See Figure A5	

* Reference (1) DAVIS-BESSE NUCLEAR POWER STATION UNIT I, FINAL SAFETY ANALYSIS REPORT

Reference (2) NUCLEAR REGULATORY COMMISION, Draft Regulatory Guide 1.BB "Calculation of Releases of Radioactive Materials in Liquid and Gaseous Effluents from Pressurized Water Reactors."

**Upon discharge these waste streams are diluted with a minumum 20,000 gpm. (reference (1) pages 11-61, 11-69, and 11-73)

***Wastes other than shim bleed collected in the clean radwaste receiver tank are listed as Equipment Drains. Since these have different fractions of PCA for different isotopes the PCA used is 1.0 and the DF's have been modified to indicate the different PCA's for different isotopes.

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TABLE A7

DISTANCE OF NEAREST COW, MEAT ANIMAL, MILK GOAT, RESIDENCE AND GARDEN

	Distance In Miles To The Nearest				
Direction	Cow	Meat Animal	Milk Goat	Residence	Vegetable Garden
N	NA	NA	NA	0.6	NA
NNE	NA	NA	NA	0.6	NA
NE	NA	NA	NA	NA	NA
ENE	NA	NA	NA	NA	NA
E	NA	NA	NA	NA	NA
ESE	NA	NA	NA	NA	NA
SE	NA	NA	NA	NA	NA
SSE	NA	NA	NA	1.0	1.2
S	NA	NA	NA	0.9	1.1
SSW	NA	NA	NA	0.7	1.2
SW	NA	NA	NA	0.9	0.9
WSW	2.7	2.7	NA	0.7	0.7
W	NA	NA	NA	0.7	0.6
WNW	NA	NA	NA	1.1	1.8
NW	NA	NA	NA	1.4	1.5
NNW	NA	NA	NA	0.8	NA

NA - Not applicable; nearest point >5 miles.

TABLE A8

χ/Q AND D/Q FOR ITEM 2 LOCATIONS

Direction	Location	sec/m^3 χ/Q*	m^{-2} D/Q*
N	Residence	9.05(-6)	5.43(-8)
NNE	Residence	1.03(-5)	9.73(-8)
SSE	Residence	7.45(-7)	1.02(-8)
SSE	Garden	4.99(-7)	3.30(-9)
S	Residence	2.52(-6)	1.13(-8)
S	Garden	1.01(-6)	6.60(-9)
SSW	Residence	1.73(-6)	2.71(-8)
SSW	Garden	5.31(-7)	3.51(-9)
SW	Residence and Garden	1.58(-6)	2.17(-8)
WSW	Residence and Garden	2.69(-6)	3.89(-8)
WSW	Cow/Meat Animal	1.35(-7)	1.30(-9)
W	Residence	3.70(-6)	5.08(-8)
W	Garden	4.62(-6)	6.66(-8)
WNW	Residence	9.71(-7)	8.36(-9)
WNW	Garden	4.40(-7)	7.05(-9)
NW	Residence	6.62(-7)	4.36(-9)
NW	Garden	5.72(-7)	3.63(-9)
NNW	Residence	3.13(-6)	1.86(-8)

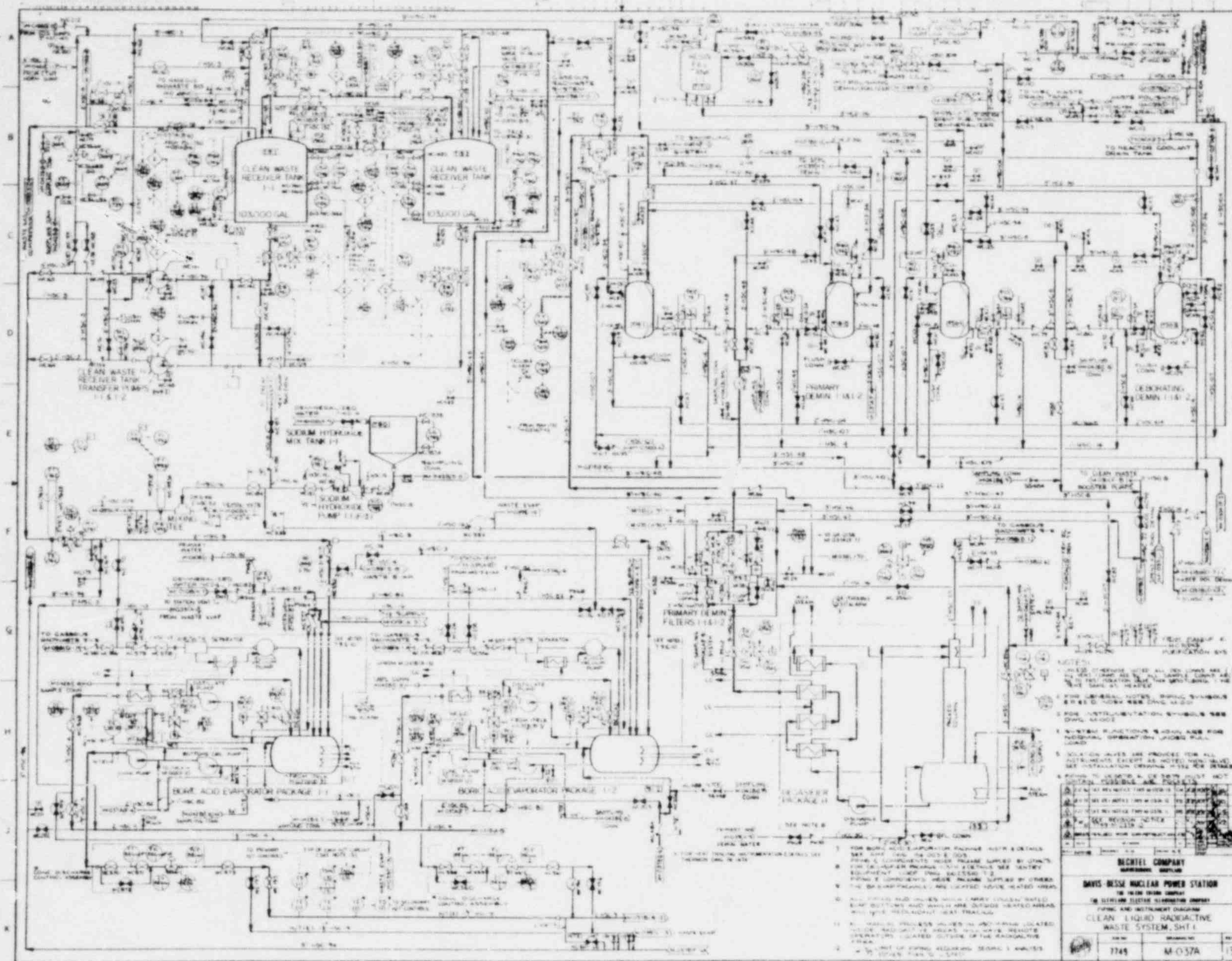
*Includes terrain correction factor

TABLE A9

SITE BOUNDARY DISTANCES, χ/Q AND D/Q

Direction	Distance (meters)	sec/m^3 χ/Q*	m^{-2} D/Q*
N	720	1.4(-5)	8.88(-8)
NNE	730	1.5(-5)	1.57(-7)
NE	825	1.2(-5)	1.44(-7)
ENE	960	6.4(-6)	8.90(-7)
E	1210	3.6(-6)	4.67(-8)
ESE	1565	7.8(-7)	1.14(-8)
SE	1075	2.2(-6)	3.90(-8)
SSE	915	2.2(-6)	3.64(-8)
S	880	2.1(-6)	3.14(-8)
SSW	900	2.4(-6)	3.94(-8)
SW	965	3.4(-6)	5.29(-8)
WSW	830	4.0(-6)	6.66(-8)
W	815	6.0(-6)	8.85(-8)
WNW	835	4.0(-6)	4.38(-8)
NW	870	4.4(-6)	3.84(-8)
NNW	740	7.6(-6)	5.34(-8)

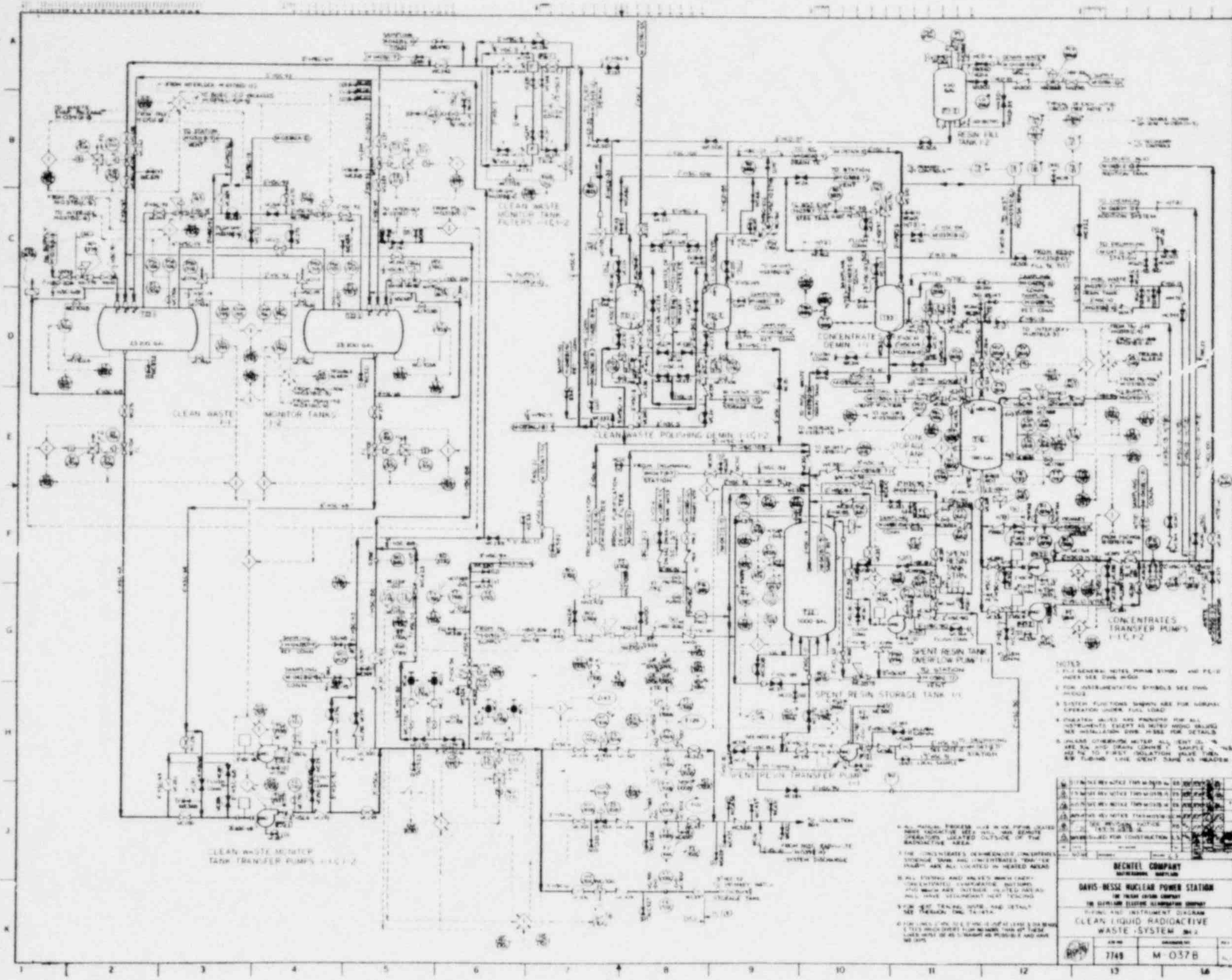
*Includes terrain correction factor



DAVIS–BESSE NUCLEAR POWER STATION
UNIT NO. 1

CLEAN LIQUID RADIOACTIVE WASTE SYSTEM
SHEET 1

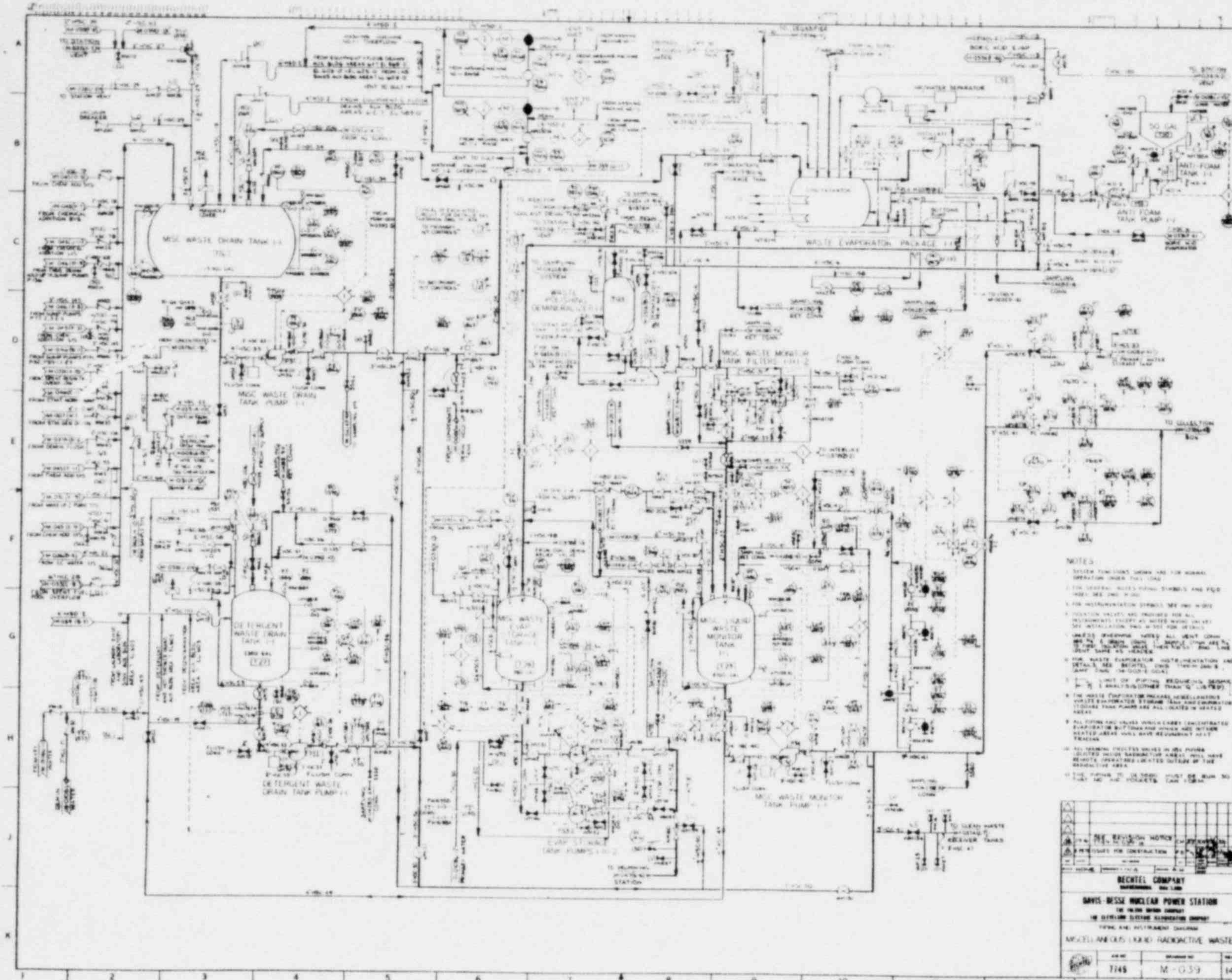
FIGURE A1



DAVIS–BESSE NUCLEAR POWER STATION
UNIT NO. 1

CLEAN LIQUID RADIOACTIVE WASTE SYSTEM
SHEET 2

FIGURE A2

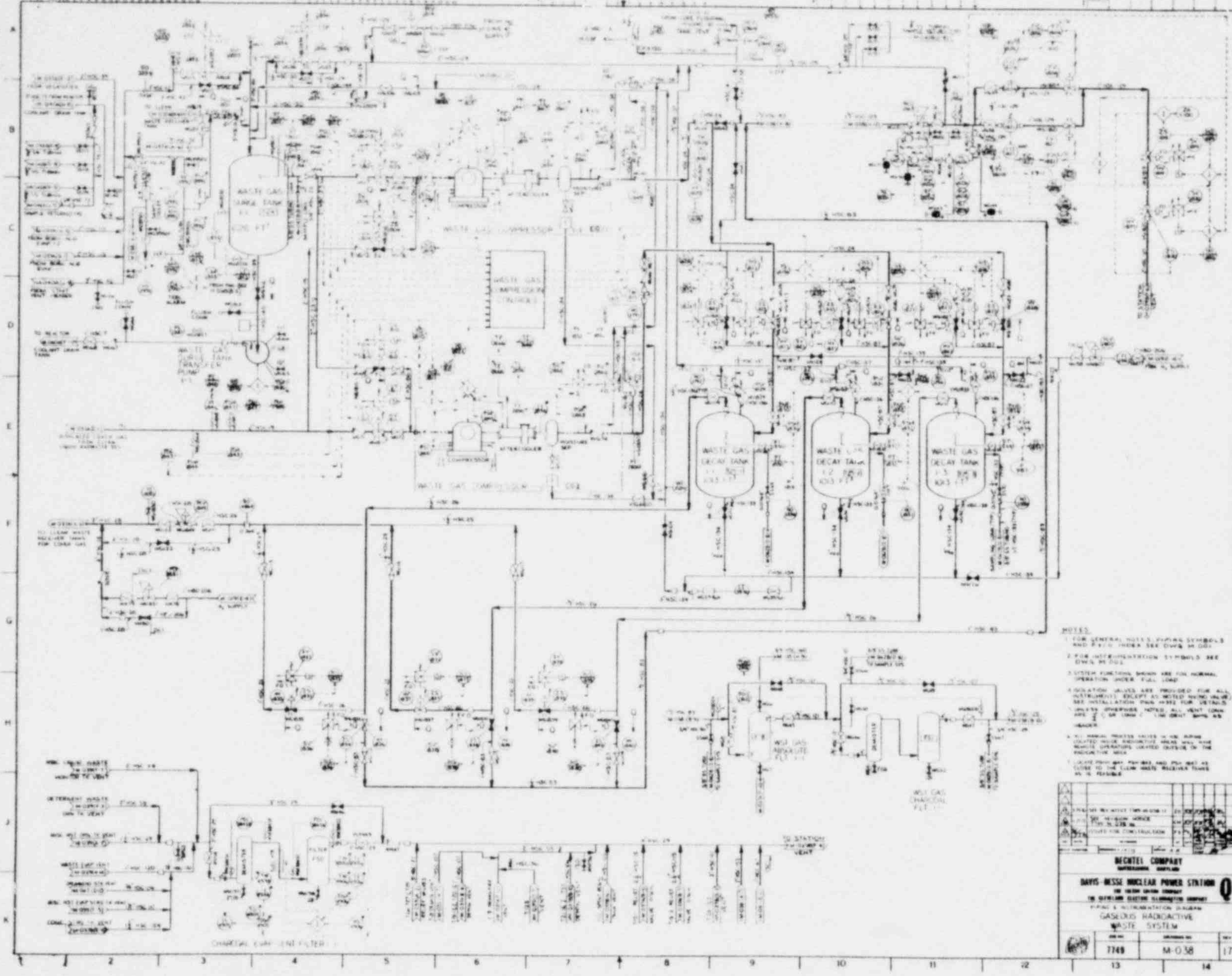


POOR ORIGINAL

DAVIS–BESSE NUCLEAR POWER STATION
UNIT NO. 1

MISCELLANEOUS LIQUID RADIOACTIVE WASTE

FIGURE A3

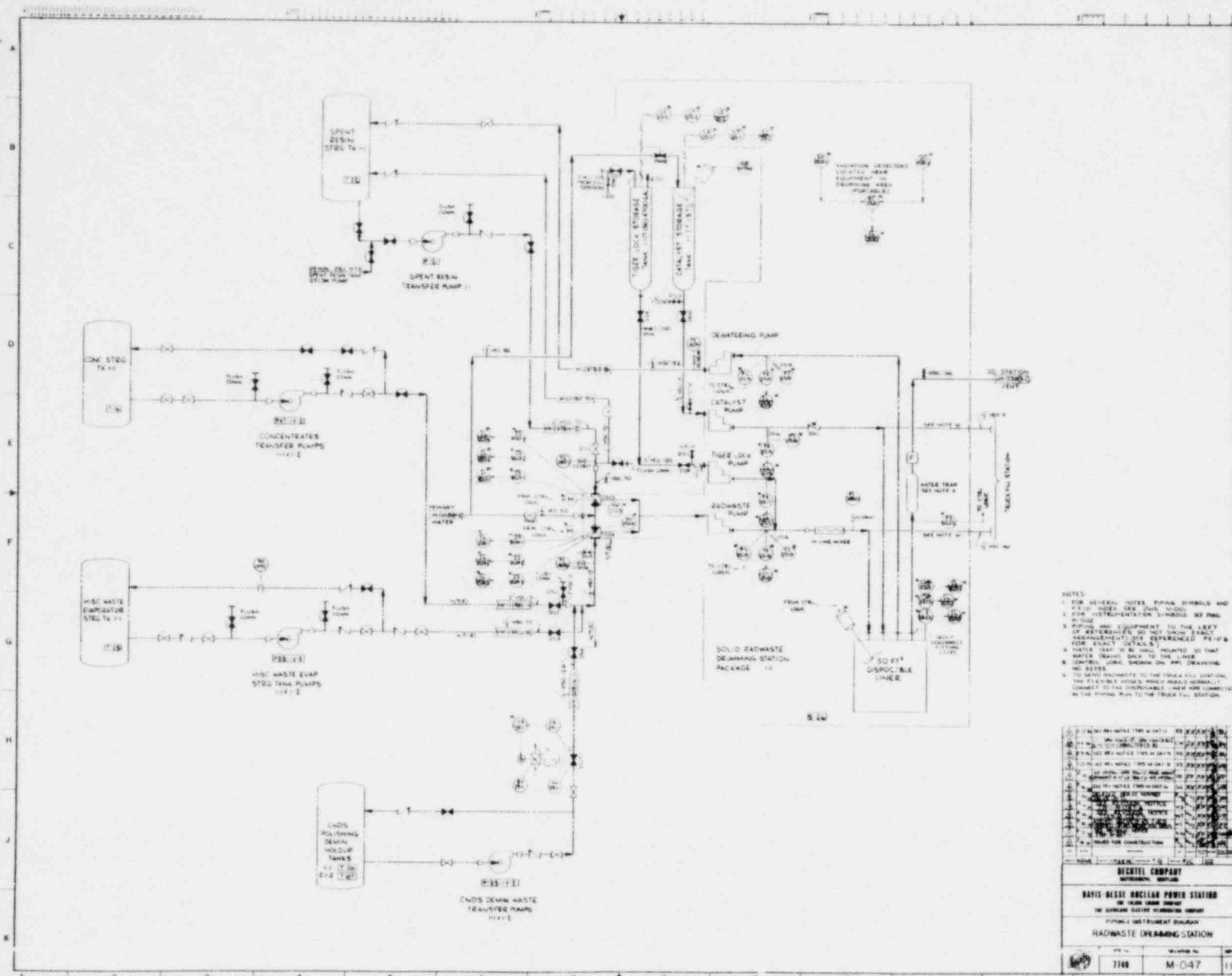


POOR ORIGINAL

DAVIS-BESSE NUCLEAR POWER STATION
UNIT NO. 1

GASEOUS RADIOACTIVE WASTE SYSTEM

FIGURE A4

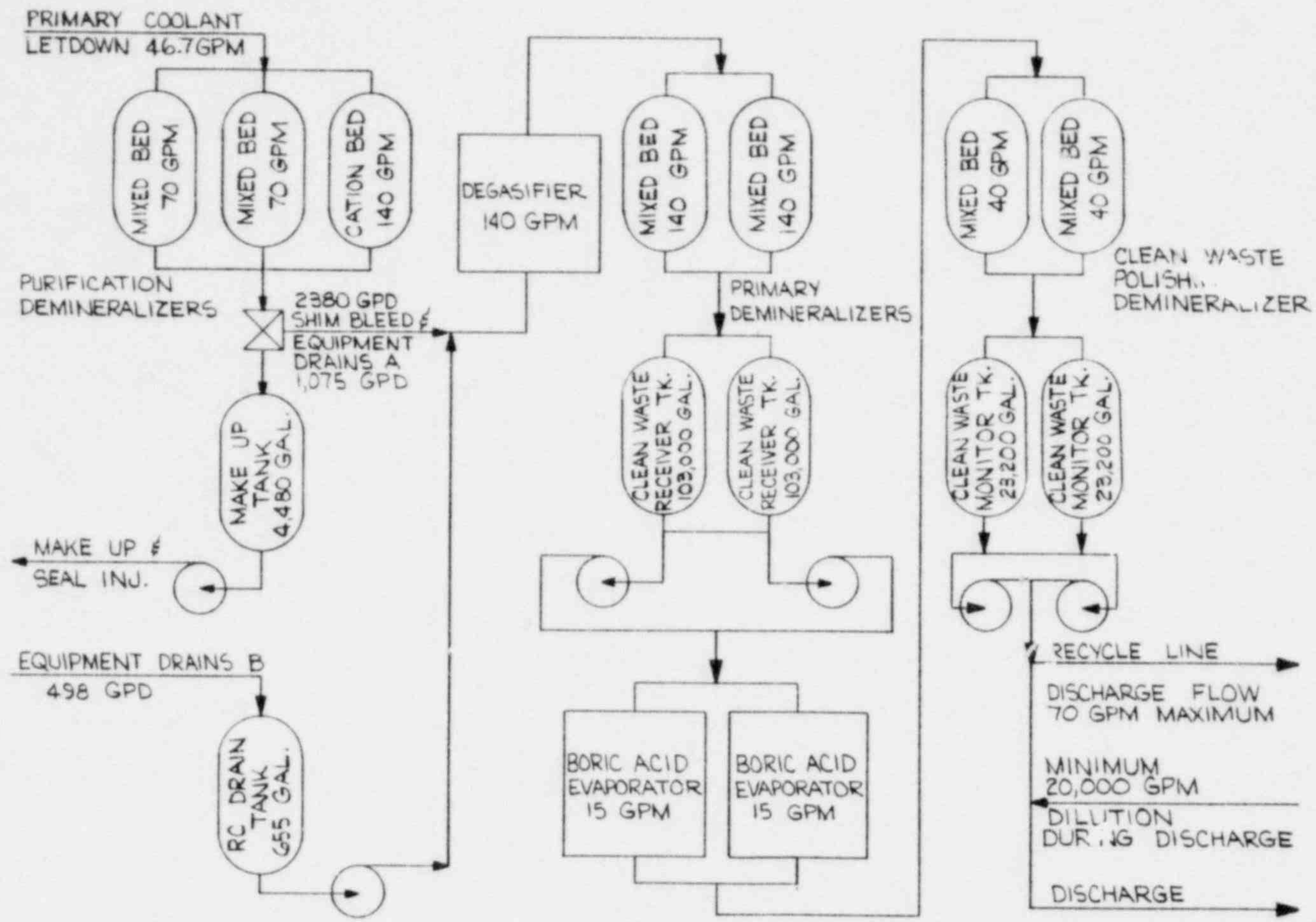


POOR ORIGINAL

DAVIS–BESSE NUCLEAR POWER STATION
UNIT NO. 1

RADWASTE DRUMMING STATION

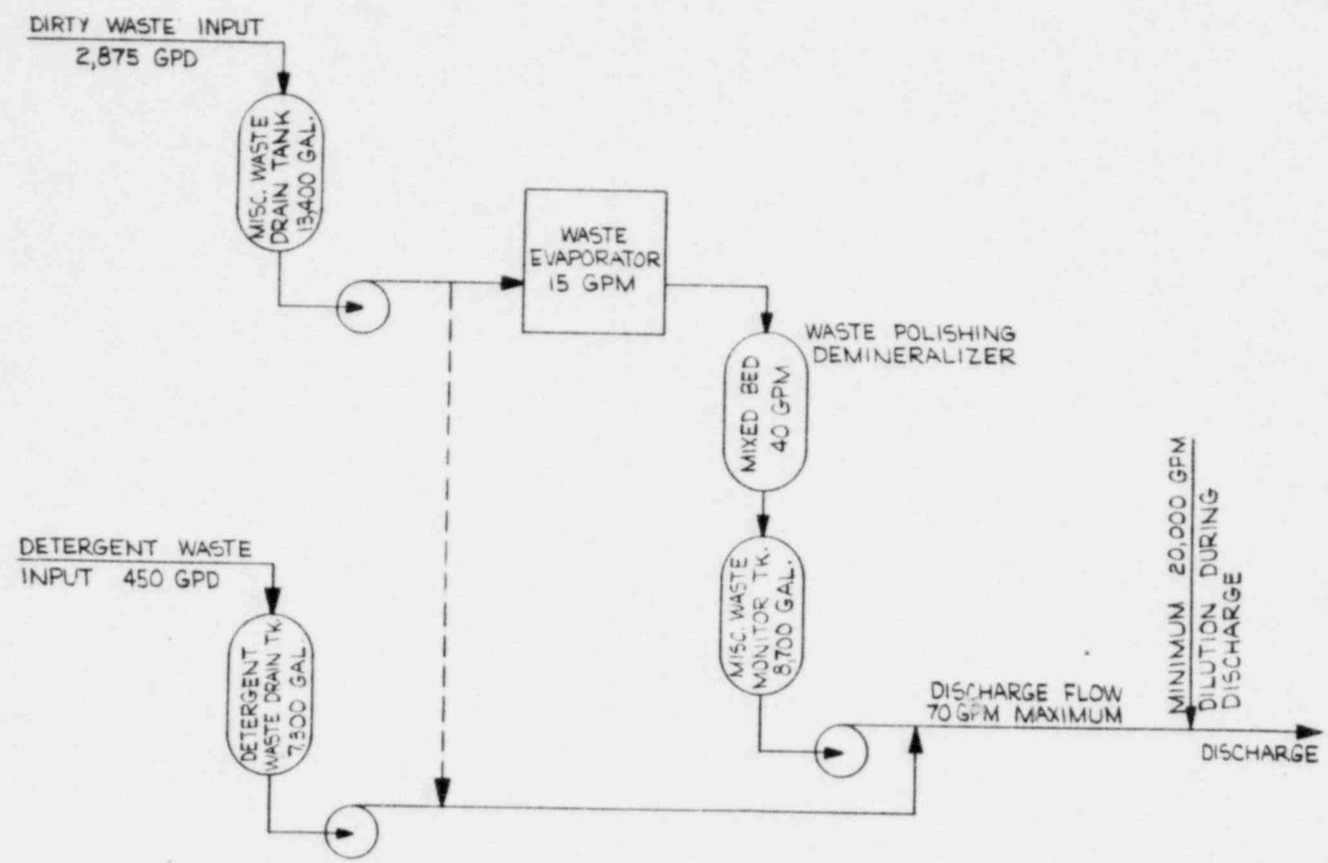
FIGURE A5



DAVIS–BESSE NUCLEAR POWER STATION
UNIT NO. 1

MAKE-UP & PURIFICATION & CLEAN LIQUID RADIOACTIVE WASTE SYSTEMS FLOW DIAGRAM

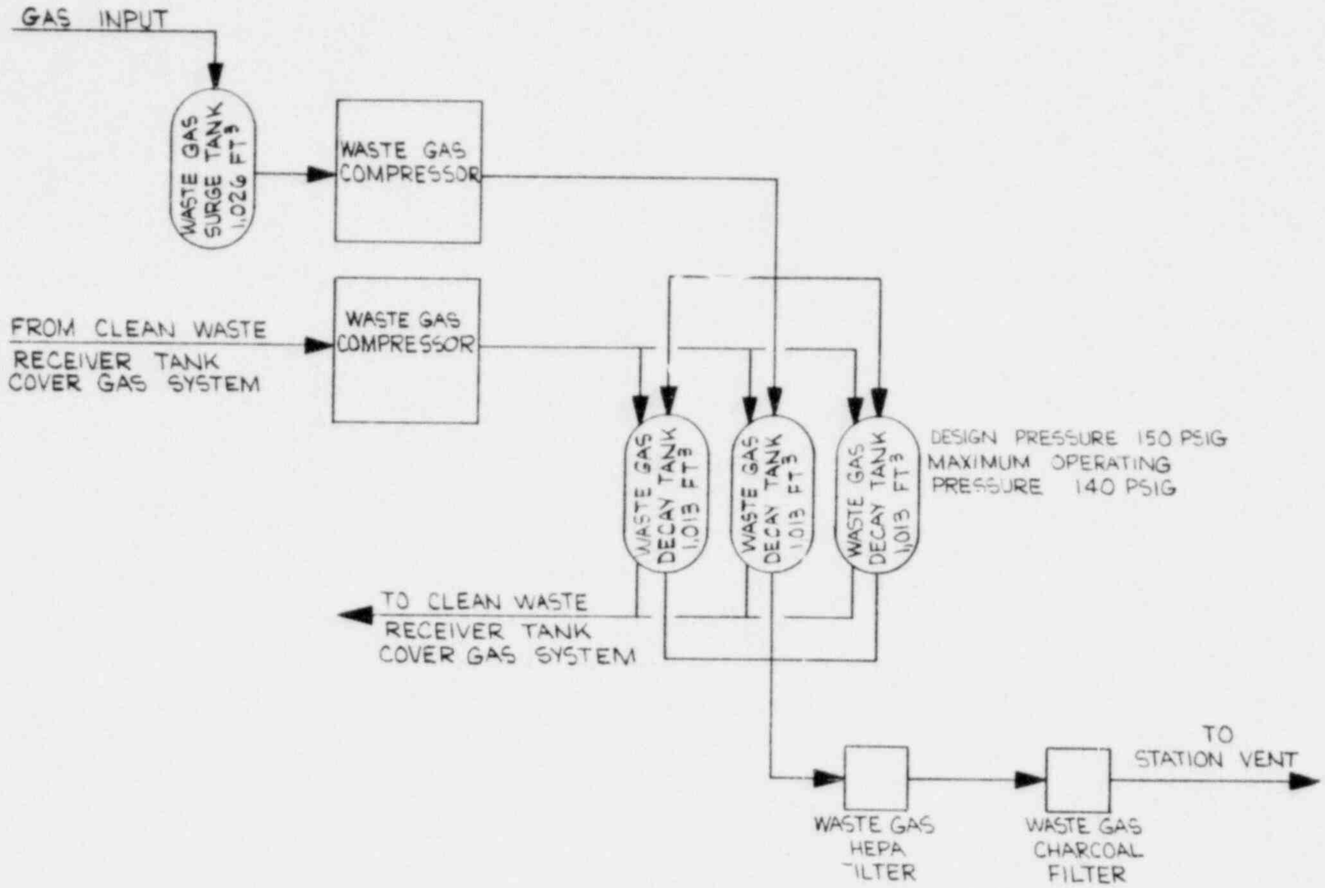
FIGURE A6



DAVIS–BESSE NUCLEAR POWER STATION
UNIT NO. 1

MISCELLANEOUS WASTE SYSTEM
FLOW DIAGRAM

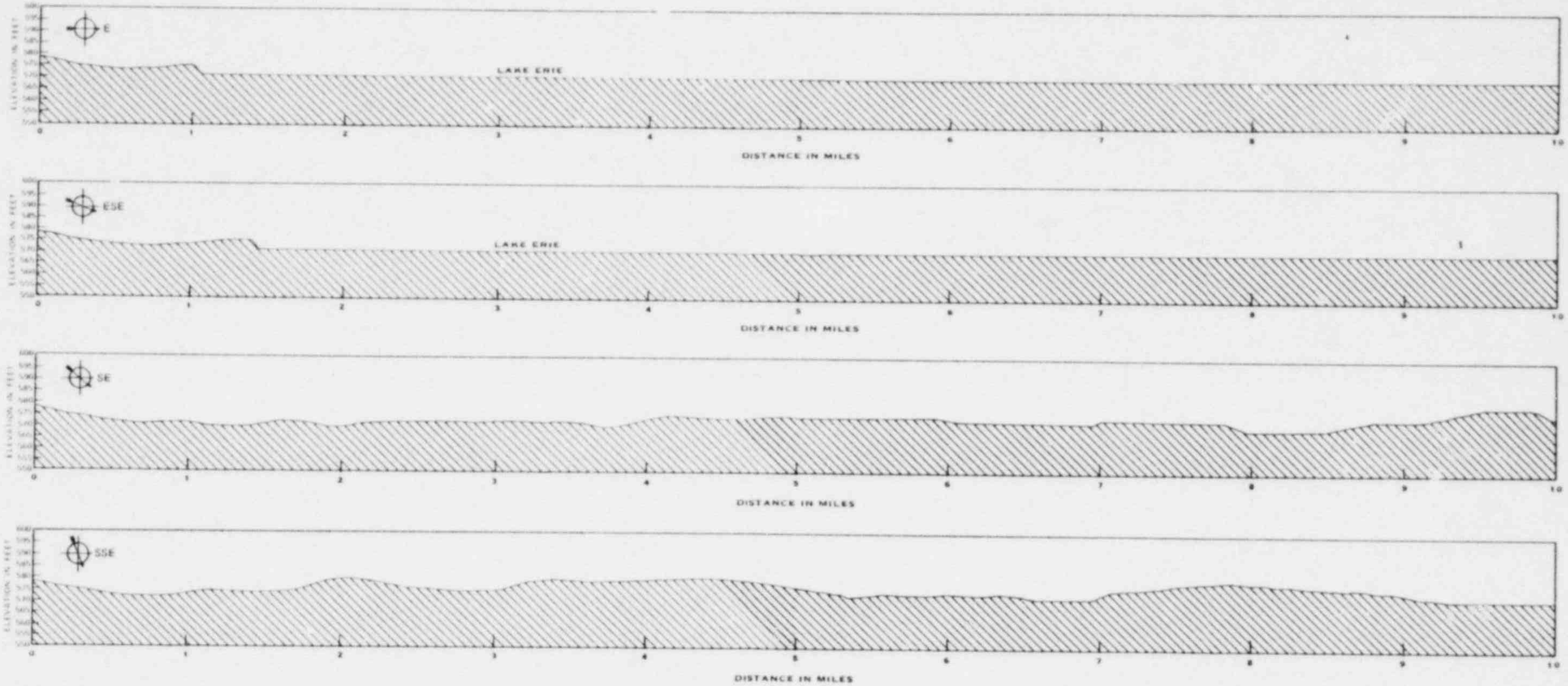
FIGURE A7



DAVIS-BESSE NUCLEAR POWER STATION
UNIT NO. 1

WASTE GAS SYSTEM
SYSTEMS FLOW DIAGRAM

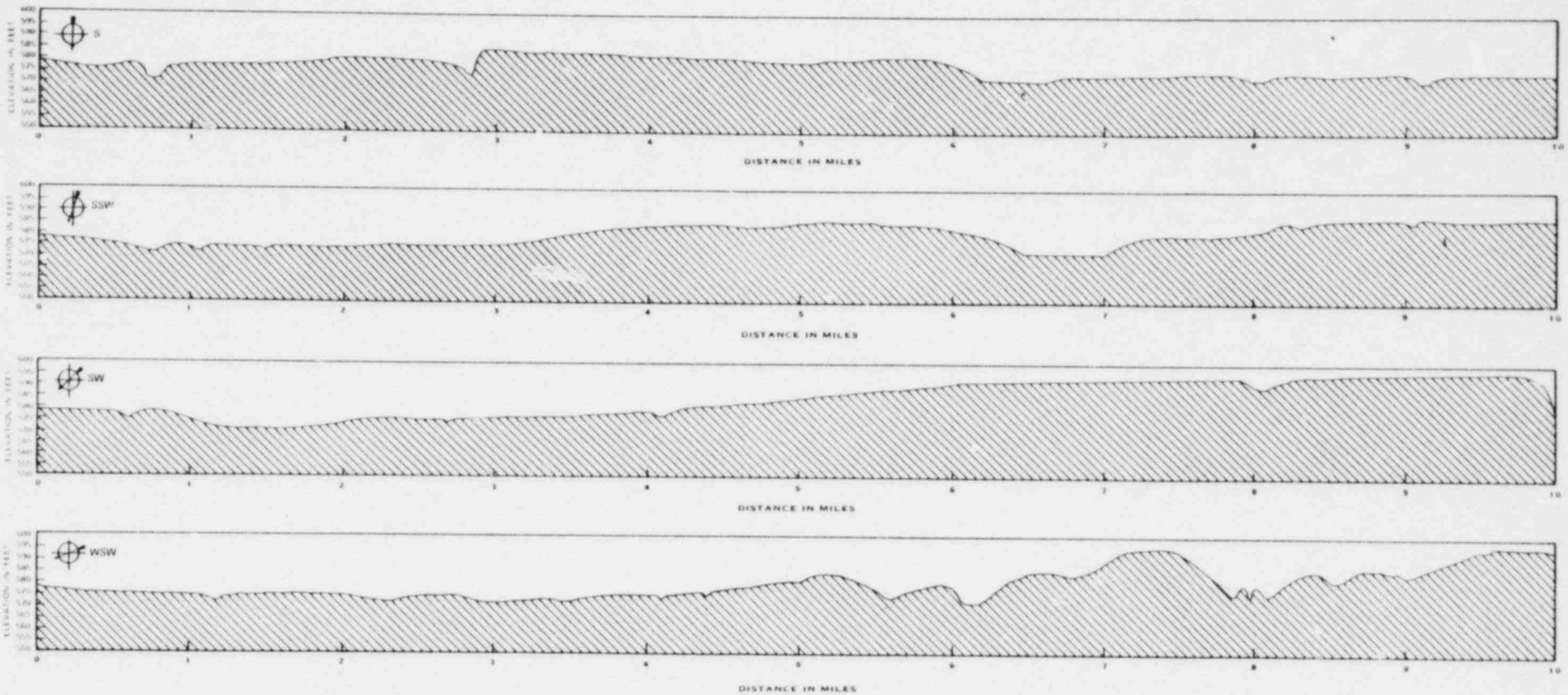
FIGURE A8



DAVIS–BESSE NUCLEAR POWER STATION
UNIT NO. 1

SITE REGION TOPOGRAPHIC PROFILES

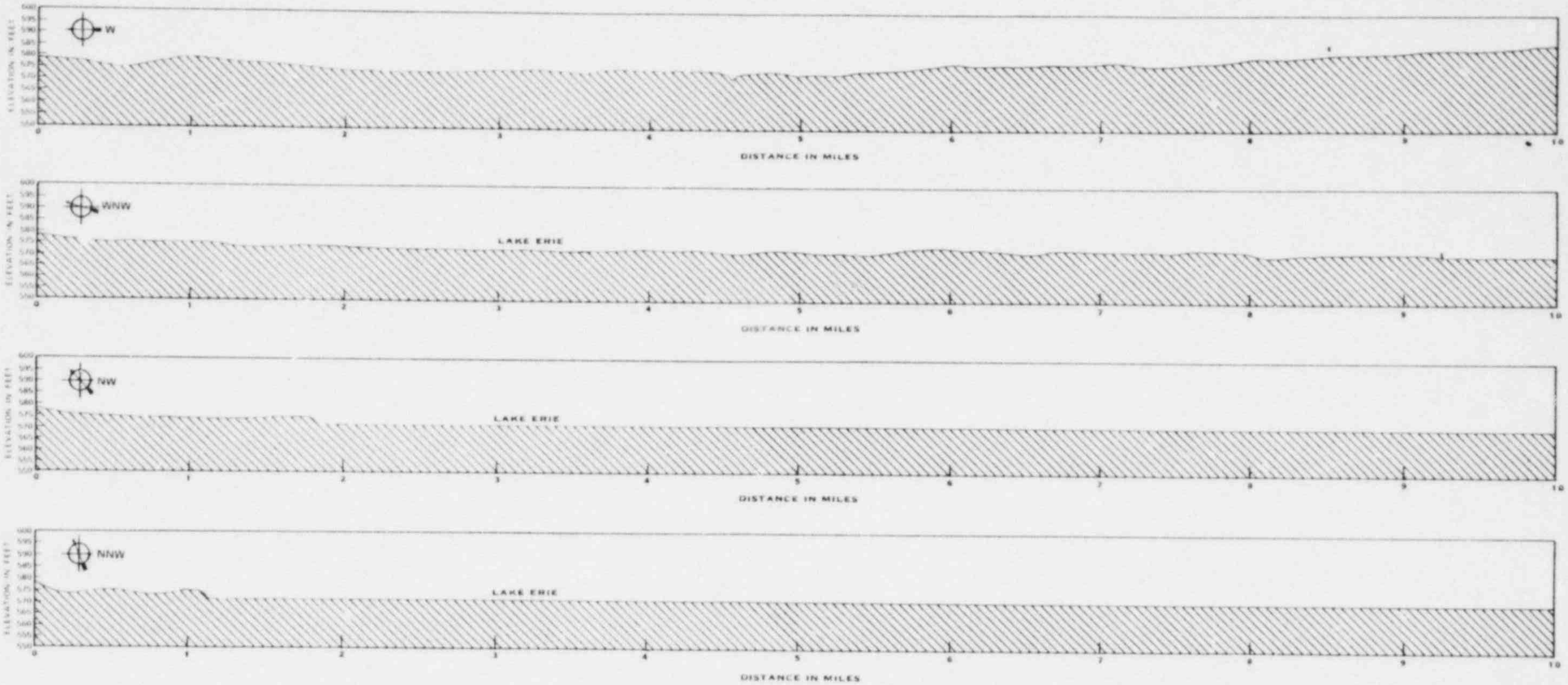
FIGURE A9a



DAVIS–BESSE NUCLEAR POWER STATION
UNIT NO. 1

SITE REGION TOPOGRAPHIC PROFILES

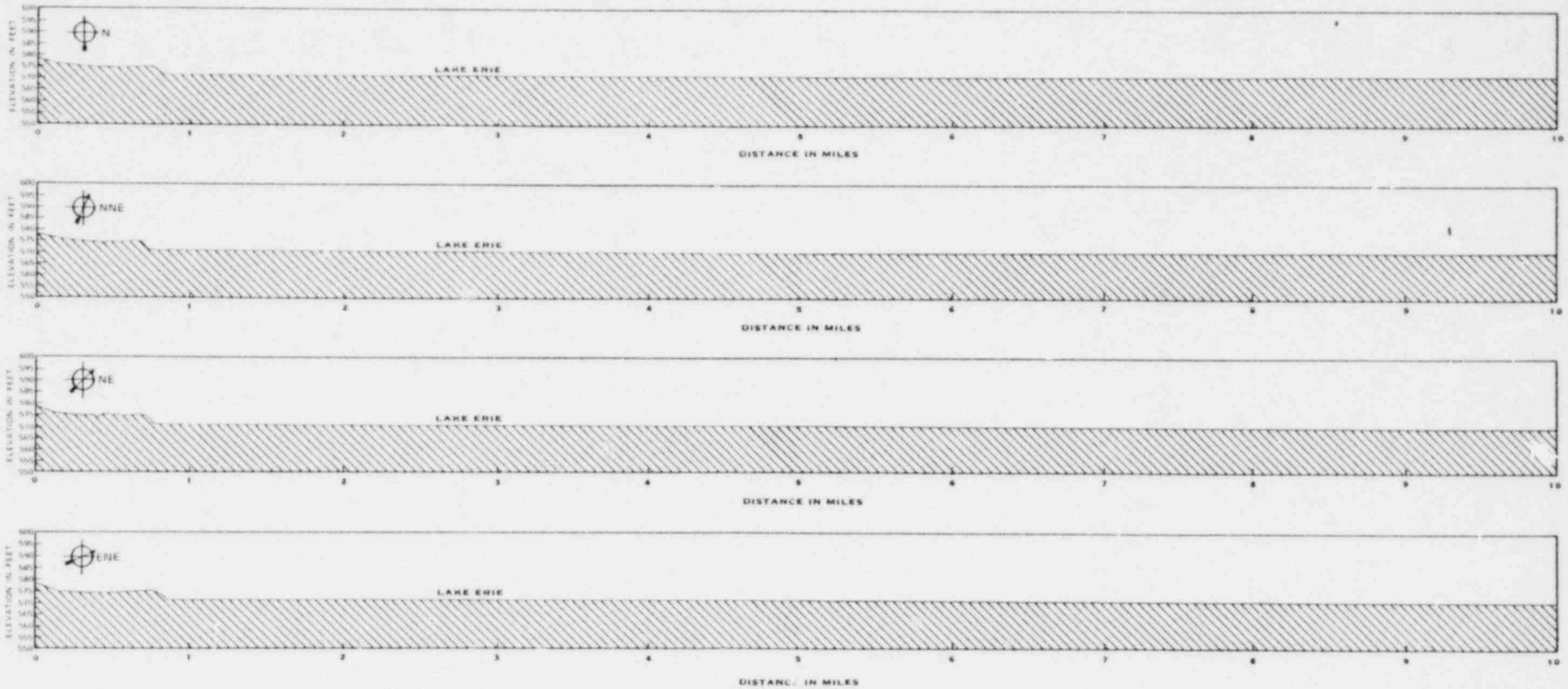
FIGURE A9b



DAVIS–BESSE NUCLEAR POWER STATION
UNIT NO. 1

SITE REGION TOPOGRAPHIC PROFILES

FIGURE A9c



DAVIS–BESSE NUCLEAR POWER STATION
UNITS NO. 2 & 3

SITE REGION TOPOGRAPHIC PROFILES

FIGURE A9d

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5. Environmental Report Operating License Stage, Davis-Besse Nuclear Power Station - Unit 1, Docket No. 50-346, Appendix A5, Section IV.A.

6. Environmental Report Operating License Stage, Davis-Besse Nuclear Power Station - Unit 1, Docket No. 50-346, Appendix A5, Table XV.

7. Final Safety Analysis Report, Davis-Besse Nuclear Power Station, Docket No. 50-346, Revision 19 dated May 1976, Table 2-12.

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