McGUIRE NUCLEAR STATION

Calculational Methodology For Equipment Qualification Radiation Dose

This report illustrates the model used for calculating dose rates and integrated doses for equipment qualification purposes. Information pertaining to releases of radioisotopes are from NUREG 0588 and NUREG 0737. The Core isotopic inventory is calculated using the ORIGEN computer code for maximum equilibrium concentrations at maximum fuel burnup. See Table 1 for the list of major radioisotopes important to radiation dose.

I. Containment

I. a. Gamma Dose Inside Containment

The source terms used to calculate radiation dose rates inside containment are: 100% noble gases, 50% iodines and 1% remaining fission products both in the containment atmosphere and in the liquid of the containment sump. Concentrations of radioisotopes in the atmosphere and in the sump are listed in Table 1. Source Strengths and energies are included in this table. It is assumed that these fission products are instantaneously released into the containment free volume and distributed throughout upper and lower containment.

The containment is modeled as a right-circular cylinder 55.77 feet in radius, 106.2 feet in height or a free volume of 1.038 ft.^3. For conservatism, the detector point representing equipment inside of containment is chosen at the centerline. $(r, z, \theta) = 0, 53 \text{ feet}, 0^o)$. A dose rate of 5.06×10^6 Rads/hour is calculated using the KAP-VI computer code assuming no credit for decay, shielding, leakage, plateout or washout by sprays. This dose rate is determined to be the maximum value at any location within containment post-accident.

Source terms and dose rates are generated at this containment location for times following the DBA to account for radioactive decay. Dose rates are normalized to the maximum time-zero value and integrated using trapezoidal methodology for one year post-accident. This integration factor (20.9) times the time zero dose rate represents the one year integrated dose inside of containment (1.06×10^8 Rads). In this way, a time dependent fraction of the one-year accident dose can be plotted vs. time for equipment qualification duration less than one year, See Figure 6, (for 30 days the integration fraction is .7 or 70% of the one-year dose = 7.4×10^7 Rads). The Reactor Building is sectioned into radiation zones to account for variations in the 40-year normal operating dose. The sum of this 40-year dose and the post-accident dose is added to give the total integrated dose to equipment. See Table 2 "Reactor Building," Example 1 and Figure 1 for radiation dose data.

I. b. Inside Containment Compartment Doses

For equipment located inside of lower containment compartments, i.e., accumulator tank rooms, credit is taken for concrete shielding from the containment atmosphere activity. Analysis performed assumed source terms the same as in Section I. a. Two independent calculations were performed using different analysis; point kernal methodology using KAP-VI as in Section I. a. and volume adjusted semi-infinite cloud methodology from Regulatory Guide 1.4. Both analyses gave results of 5.5×10^5 Rads/Hour dose rate at time = 0 hours post-accident. Since the same source of activity is used for the accumulator room, the fraction of the one-year integrated dose, Figure 6, can be used for equipment qualified for times less than one year. The one-year integrated dose is the product of the integration factor times the T = 0 hour dose rate: $5.5 \times 10^5 \times 20.9 = 1.2 \times 10^7$ Rads.

See example 4 for tables corresponding to the accumulator tank room dose data.

I. c. Beta Dose In-Containment

A beta dose calculation was performed assuming an infinite uniform cloud containing concentrations equivalent to those used in Section I. a. above. The calculation uses the beta dose equation in Regulatory Guide 1.4 with average beta energies per isotope from ORNL/NUREG/TM-102.

The one-year accident dose from beta radiation was calculated to be 8.4×10^8 Rads. Based on guidance from IE Bulletin 79-01B and NUREG-0588, 70 mils thickness of cable insulation is sufficient to reduce the beta dose to approximately one-tenth of the gamma dose and therefore can be considered negligible.

All Class 1E equipment located inside containment that is required to mitigate a LOCA, MSLB, or HELB has sufficient shielding to prevent the exposure of any organic materials associated with this equipment to a beta radiation environment.

II. Reactor Building Annulus

The equipment located in the annulus, i.e., between the containment shell and Reactor Building wall, will be subjected to radiation exposure from the in-containment atmosphere and from containment leakage into the Annulus. The source terms for in-containment exposure are the same as Section I above. The geometry of the source is separated into three zones: sources inside of the cranewall, sources outside of the cranewall, and sources in the containment dome. Detector points are distributed at various elevations inside of the annulus to account for the three source geometries and credit is taken for the 3 feet thick concrete cranewall and the 1" steel containment shell shielding.

Annulus gaseous activity is determined as in Section I above. Radio-isotopes are distributed equally throughout the annulus volume and a dose rate is calculated at detector point locations vertically distributed throughout the annulus. The total integrated dose to equipment in the Annulus is the sum of exposure from in-containment activity,

gaseous activity in the annulus and exposure from 40 years of normal operation. See example 2.

III. Auxiliary Building

Sources of exposure in the Auxiliary Building are from recirculating Reactor sump liquids through the safety injection, containment spray and residual heat removal systems.

Fractions of core radioisotopes in the liquid containing systems are:

100% noble gases
50% iodines
1% remaining fission products

(See sump concentrations at T = 0 time in Table 1)

A 10-minute delay time is assumed for the start of recirculation, after which, the only method of removal is decay.

Shielding models for piping and components for each room are developed for use in the computer codes SHIELD and KAP-VI. Average dose rates are calculated for 10-minute decayed liquid activity in each room affected by the LOCA. (See example 3).

A normalized dose rate decay curve from a standard geometry model is integrated over the one-year post-accident, the sum of which gives an integrating factor to be applied to the maximum dose rate in each room to give the one-year integrated dose. It was shown that the 10-minute delay time has a negligible effect on this integration factor compared to the in-containment model. Therefore, Figure 6 can be used for equipment qualification times less than one year post-accident for equipment located inside of the Auxiliary Building affected by recirculating sump liquids.

IV. Areas Affected by In-Containment Radiation Streaming Outside of Containment

The McGuire Reactor Building has two personnel access hatches which lack Reactor Building concrete shielding. Personnel access hatches were modeled to reflect radiation streaming exposure to areas adjacent to these "openings". Areas affected are the spent fuel pool area and the lower electrical penetration room. (See Table 4 and Figure 5 for radiation data.)

V. Auxiliary Building Ventilation

Sources of activity in Auxiliary Building results from the use of the Annulus Ventilation System. Due to containment leakage, and the need to maintain a negative pressure in the annulus, post-accident periodic purges are necessary through the VE System filter bed. The 4" equivalent carbon bed is assumed to remove 100% of the iodine. The only method of removal is through decay of the isotopes of iodine. In the same way as Section I and III, the integrated dose to the area affected by the VE filters is plotted versus time for equipment operating for less than one-year post-accident (Figure 7).

The second source of activity results from containment bypass leakage into the Auxiliary Building through the Reactor Building concrete wall. A special computer code, BPAUX was developed to give the Auxiliary Building Ventilation System, VA, filter bed loading as a function of time post-accident. The resultant equipment exposure is the sum of the effects of annulus purge and bypass leakage (See Table 3, el. 767 and Figure 4 for radiation dose data.)

An additional calculation was performed for a source of activity in the VA filter bed assuming leakage from ECCS components. This source was considered negligible compared to bypass leakage.

RGE/sr

McGUIRE NUCLEAR STATION

Examples of Radiation Data Reported in NUREG 0588 Response

1. Equipment ID: Valve Motor (Table 5)
Operators (Upper Containment)

Manufacturer: Limitorque Model #SMB

Radiation Accident environment for operation time post-accident of 5 minutes. Assuming 1 hour time duration see Figure 6 for the fraction of the 1-year dose.

Read ~ .035 from Figure 6

Next, find radiation zone on Figure 2 where valve operator is located.

Read: Zone 23 El. 778+10

Next, find on Table 2, the Zone number and Reactor Building elevation.

Read:	Normal operating 40-year dose (Rads)	LOCA Dose (Rads)
	5.0×10^4	1.0E8

Next, multiply the 1-year LOCA dose by the fraction of the 1-year integrated dose.

$1.0E8 \times .035 = 3.5 \times 10^6$ Rads

Add 40-year normal operating dose to this value to obtain the Total Integrated Dose (TID) for this equipment:

1 Hour Post-LOCA Dose + 40-Year Normal Operating Dose = TID

3.5×10^6 Rads + 5×10^4 Rads = 3.6×10^6 Rads

or 4×10^6 Rads reported in 0588 submittal.

2. Equipment ID: Transmitter-Pressurizer Level (Table 8)
Manufacturer: Barton
Model #764 (Lot 2)

Operability required in accident environment = 2 weeks

See Figure 6 for the fraction of the one-year integrated dose

Read: ~ 0.6

Next, see manufacturer's file for location of equipment and radiation zone. (Table 8)

Read: Radiation Zone 8a
Elevation 738+3

See Table 2 for Zone 8a, elevation 738+3.

Read:	Normal Operating 40-Year Dose (Rads)	LOCA Dose (Rads)
	2.0E4	2.0E7

Next, multiply the fraction of the one-year integrated dose times the one year LOCA dose to obtain the 2-week accident dose:

2.0×10^7 Rads x 0.6 = 1.2×10^7 Rads

Add the 40-year normal operating dose to get the total integrated dose:

1.2×10^7 Rads + 2.0×10^4 Rads = 1.2×10^7 Rads or

1.4×10^7 Rads as reported in NUREG 0588 response.

3. Equipment Located in the Annulus: Table 6

Equipment ID: Transmitter - RCS Pressure (WR)

Manufacturer: Rosemount Model # 1153 GA9

Operability required in accident environment = 2 weeks

See Figure 6 for the fraction of the LOCA dose absorbed in 2 weeks or 336 hours.

Read: ~ 0.6 from Figure 6

Next, find location and elevation of the equipment in the Annulus. (From equipment qualification file).

Zone 10, elevation 738 + 3

Read:	Normal Operation 40-year dose (Rads)	LOCA Dose (Rads)
	1.0E4 Rads	2.0E7

Now, multiply the LOCA dose times the fraction of the one year integrated dose, to get the 2 week dose.

2.0E7 x .6 = 1.2×10^7 Rads

Now, add the 40-year normal operating dose to the post-accident dose to get the total integrated dose.

1.2×10^7 Rads + 1.0×10^4 Rads = 1.2×10^7 Rads

as reported in NUREG 0588 response.

4. Equipment located in the Auxiliary Building effected by post-LOCA recirculating fluid. Table 7.

Containment spray pump motoes
Manufacturer: Westinghouse, Buffalo
Model # - 73F56019-1573, -2573, -3573, -4573.

See Figure 3 for radiation zone number for elevation 695

Read: Zone 3

See Table 3, Zone 3, elevation 695 for the Auxiliary Building

Read:	DBA-LOCA Dose (Rads)	Normal Operating 40-year Dose (Rads)
	5.2×10^5	1.0×10^3

This equipment is qualified for the entire one-year post-LOCA, therefore add both values to get:

TID = 5.2×10^5 Rads

```
?
1.09E7 1.86E7 2.38E7 1.26E5 6.45E7 8.40E7
IS DATA RIGHT? INPUT 0 TO KEEP OR NUMBER TO CHANGE
?
0
INPUT   7 THROUGH  12
?
8.64E7 4.48E6 1.09E8 1.18E8 4.65E6 1.11E8
IS DATA RIGHT? INPUT 0 TO KEEP OR NUMBER TO CHANGE
?
0
INPUT  13 THROUGH  18
?
6.31E7 1.18E8 1.37E8 1.50E8 1.46E8 1.49E8
IS DATA RIGHT? INPUT 0 TO KEEP OR NUMBER TO CHANGE
?
0
INPUT  19 THROUGH  24
?
1.72E8 1.16E8 4.36E7 1.46E8 3.73E7 1.44E6
IS DATA RIGHT? INPUT 0 TO KEEP OR NUMBER TO CHANGE
?
0
INPUT  25 THROUGH  30
?
9.20E7 1.34E8 1.90E8 2.06E8 1.78E8 1.11E5
IS DATA RIGHT? IN UT 0 TO KEEP OR NUMBER TO CHANGE
?
0
INPUT  31 THROUGH  36
?
8.22E6 1.12E6 2.77E7 7.47E6 8.08E7 1.35E7
IS DATA RIGHT? INPUT 0 TO KEEP OR NUMBER TO CHANGE
?
0
INPUT  37 THROUGH  42
?
1.33E8 1.51E8 1.37E7 5.53E6 6.32E6 1.65E8
IS DATA RIGHT? INPUT 0 TO KEEP OR NUMBER TO CHANGE
?
0
INPUT  43 THROUGH  48
?
6.0E6 1.69E8 1.65E8 1.69E8 1.54E8 1.43E8
IS DATA RIGHT? INPUT 0 TO KEEP OR NUMBER TO CHANGE
?
0
INPUT  49 THROUGH  54
```

TABLE 1

Table 1

CORE EQUILIBRIUM ACTIVITY

(CURIES)

(see table listing below for radioisotope index number)

```
0
INPUT  55 THROUGH  60
?
6.34E7 7.86E7 6.12E5 1.90E8 2.71E7 6.83E7
IS DATA RIGHT? INPUT 0 TO KEEP OR NUMBER TO CHANGE
?
0
INPUT  61 THROUGH  66
?
3.78E7 1.69E8 1.55E3 0. 0. 0.
IS DATA RIGHT? INPUT 0 TO KEEP OR NUMBER TO CHANGE
?
0
INPUT  67 THROUGH  72
?
6*0.
IS DATA RIGHT? INPUT 0 TO KEEP OR NUMBER TO CHANGE
?
0
ALL INPUT ASSUMED IN UCI/ML .INPUT APPROIATE  CONFAC =
?
3.402E-5  Containment Free Volume Confac =
OPERATION MODE = 1.0 (DECAY RUN) 2.0 (DEMFIL RUN)        3.0 (DEMFIL-DECAY) 4.0 (DECAY DEMFIL )
?
1.0
ARE THERE ANY CHANGES TO BE Y OR N
Y
?
3*.5 20*.01 6*.5 21*.01 22*1.0
ARE THERE ANY CHANGES TO BE? Y OR N
N
DECAY TIME (HOURS)=
?
0.0
                SPECIFIC ACTIVITY BY ENERGY
                 (GAMMAS/CC-SEC)     (MEV)
        0.0-0.3  0.3-0.7  0.7-1.2  1.2-1.7  1.7-2.4  >2.4
TOTALS 3.79E+08 6.48E+08 5.22E+08 1.71E+08 1.71E+08 3.00E+07

ENERGY 1.38E-01 5.15E-01 8.97E-01 1.39E+00 2.02E+00 2.99E+00


PRINT TABLE OF CALCULATED ISOTROPIC ACTIVITIES? 1=YES
?
1
    INPUT ACTIVITY (UCI/ML)      RESULTANT ACTIVITY (UCI/ML)          RE(1)          RE(2)
```

$\frac{10^6\ \mu Ci/Ci}{\text{Free Volume (ft}^3\text{)} \times 28.481\ cc/ft^3} = \mu Ci/cc$

100% noble gases
50% halogens
1% remaining fission products

In-Containment Atmospheric
T=0 hour Source Terms

multiplied by RE values

after decay

TABLE 1

TABLE 1

BR85	4.05E+02	4.05E+02	5.00E-01	1.00E+00
RB86	4.29E-02	4.29E-02	1.00E-02	1.00E+00
RB88	2.19E+01	2.19E+01	1.00E-02	1.00E+00
RB89	2.86E+01	2.86E+01	1.00E-02	1.00E+00
SR89	2.94E+01	2.94E+01	1.00E-02	1.00E+00
SR90	1.52E+00	1.52E+00	1.00E-02	1.00E+00
SR91	3.71E+01	3.71E+01	1.00E-02	1.00E+00
SR92	4.01E+01	4.01E+01	1.00E-02	1.00E+00
Y 90	1.58E+00	1.58E+00	1.00E-02	1.00E+00
Y 91	3.78E+01	3.78E+01	1.00E-02	1.00E+00
Y 91M	2.15E+01	2.15E+01	1.00E-02	1.00E+00
Y 92	4.01E+01	4.01E+01	1.00E-02	1.00E+00
Y 93	4.66E+01	4.66E+01	1.00E-02	1.00E+00
ZR95	5.10E+01	5.10E+01	1.00E-02	1.00E+00
NB95	4.97E+01	4.97E+01	1.00E-02	1.00E+00
TC99M	5.07E+01	5.07E+01	1.00E-02	1.00E+00
MO99	5.85E+01	5.85E+01	1.00E-02	1.00E+00
RH103M	4.97E+01	4.97E+01	1.00E-02	1.00E+00
RH106	1.48E+01	1.48E+01	1.00E-02	1.00E+00
RU103	4.97E+01	4.97E+01	1.00E-02	1.00E+00
RU106	1.27E+01	1.27E+01	1.00E-02	1.00E+00
I 130	2.45E+01	2.45E+01	5.00E-01	1.00E+00
I 131	1.56E+03	1.56E+03	5.00E-01	1.00E+00
I 132	2.28E+03	2.28E+03	5.00E-01	1.00E+00
I 133	3.23E+03	3.23E+03	5.00E-01	1.00E+00
I 134	3.50E+03	3.50E+03	5.00E-01	1.00E+00
I 135	3.03E+03	3.03E+03	5.00E-01	1.00E+00
TE125M	3.78E-02	3.78E-02	1.00E-02	1.00E+00
TE127	2.80E+00	2.80E+00	1.00E-02	1.00E+00
TE127M	3.81E-01	3.81E-01	1.00E-02	1.00E+00
TE129	9.42E+00	9.42E+00	1.00E-02	1.00E+00
TE129M	2.54E+00	2.54E+00	1.00E-02	1.00E+00
TE131	2.75E+01	2.75E+01	1.00E-02	1.00E+00
TE131M	4.59E+00	4.59E+00	1.00E-02	1.00E+00
TE132	4.52E+01	4.52E+01	1.00E-02	1.00E+00
TE134	5.14E+01	5.14E+01	1.00E-02	1.00E+00
CS134	4.66E+00	4.66E+00	1.00E-02	1.00E+00
CS136	1.88E+00	1.88E+00	1.00E-02	1.00E+00
CS137	2.15E+00	2.15E+00	1.00E-02	1.00E+00
CS138	5.61E+01	5.61E+01	1.00E-02	1.00E+00
BA137M	2.04E+00	2.04E+00	1.00E-02	1.00E+00
BA139	5.75E+01	5.75E+01	1.00E-02	1.00E+00
BA140	5.61E+01	5.61E+01	1.00E-02	1.00E+00
LA140	5.75E+01	5.75E+01	1.00E-02	1.00E+00
CE141	5.24E+01	5.24E+01	1.00E-02	1.00E+00
CE143	4.86E+01	4.86E+01	1.00E-02	1.00E+00
CE144	3.02E+01	3.02E+01	1.00E-02	1.00E+00

TABLE 1

KR87	1.52E+03	1.52E+03	1.00E+00	1.00E+00
KR88	2.16E+03	2.16E+03	1.00E+00	1.00E+00
KR89	2.67E+03	2.67E+03	1.00E+00	1.00E+00
XE131M	2.08E+01	2.08E+01	1.00E+00	1.00E+00
XE133	6.46E+03	6.46E+03	1.00E+00	1.00E+00
XE133M	9.22E+02	9.22E+02	1.00E+00	1.00E+00
XE135	2.32E+03	2.32E+03	1.00E+00	1.00E+00
XE135M	1.29E+03	1.29E+03	1.00E+00	1.00E+00
XE137	5.75E+03	5.75E+03	1.00E+00	1.00E+00
XE138	5.27E+03	5.27E+03	1.00E+00	1.00E+00
MN54	0.0	0.0	1.00E+00	1.00E+00
MN56	0.0	0.0	1.00E+00	1.00E+00
CO58	0.0	0.0	1.00E+00	1.00E+00
CO60	0.0	0.0	1.00E+00	1.00E+00
FE59	0.0	0.0	1.00E+00	1.00E+00
CR51	0.0	0.0	1.00E+00	1.00E+00
CU64	0.0	0.0	1.00E+00	1.00E+00
HF181	0.0	0.0	1.00E+00	1.00E+00
NP239	0.0	0.0	1.00E+00	1.00E+00

DO YOU WISH TO RUN AGAIN? 1=YES 2=NO
?
1
DO YOU WISH TO INPUT NEW SAC VALUES? 1=YES 2=NO
?
2
ALL INPUT ASSUMED IN UCI/ML .INPUT APPROIATE CONFAC =
?
4.121E-4 Sump Liquid Confac = $\frac{1*10^6\ \mu Ci/Ci}{35,300 ft^3 * (30.48)^3 cc/ft^3} * \text{input in Ci} = \mu Ci/cc$
OPERATION MODE = 1.0 (DECAY RUN) 2.0 (DEMFIL RUN) 3.0 (DEMFIL-DECAY) 4.0 (DECAY DEMFIL)
?
1.0
ARE THERE ANY CHANGES TO RE ? Y OR N
N
ARE THERE ANY CHANGES TO PE? Y OR N
N
DECAY TIME (HOURS)=
?
0.0

SPECIFIC ACTIVITY BY ENERGY
(GAMMAS/CC-SEC) (MEV)

	0.0-0.3	0.3-0.7	0.7-1.2	1.2-1.7	1.7-2.4	>2.4
TOTALS	4.60E+09	7.86E+09	6.33E+09	2.07E+09	2.07E+09	3.63E+08
ENERGY	1.39E-01	5.15E-01	8.97E-01	1.39E+00	2.02E+00	2.93E+00

Containment Sump

T=0 hour Source Terms

TABLE 1

BR83	2.25E+03	2.25E+03	5.00E-01	1.00E+00
BR84	3.84E+03	3.84E+03	5.00E-01	1.00E+00
BR85	4.91E+03	4.91E+03	5.00E-01	1.00E+00
RB86	5.20E-01	5.20E-01	1.00E-02	1.00E+00
RB88	2.66E+02	2.66E+02	1.00E-02	1.00E+00
RB89	3.46E+02	3.46E+02	1.00E-02	1.00E+00
SR89	3.56E+02	3.56E+02	1.00E-02	1.00E+00
SR90	1.85E+01	1.85E+01	1.00E-02	1.00E+00
SR91	4.50E+02	4.50E+02	1.00E-02	1.00E+00
SR92	4.87E+02	4.87E+02	1.00E-02	1.00E+00
Y 90	1.92E+01	1.92E+01	1.00E-02	1.00E+00
Y 91	4.58E+02	4.58E+02	1.00E-02	1.00E+00
Y 91M	2.60E+02	2.60E+02	1.00E-02	1.00E+00
Y 92	4.87E+02	4.87E+02	1.00E-02	1.00E+00
Y 93	5.65E+02	5.65E+02	1.00E-02	1.00E+00
ZR95	6.19E+02	6.19E+02	1.00E-02	1.00E+00
NB95	6.02E+02	6.02E+02	1.00E-02	1.00E+00
TC99M	6.14E+02	6.14E+02	1.00E-02	1.00E+00
MO99	7.09E+02	7.09E+02	1.00E-02	1.00E+00
RH103M	6.02E+02	6.02E+02	1.00E-02	1.00E+00
RH106	1.80E+02	1.80E+02	1.00E-02	1.00E+00
RU103	6.02E+02	6.02E+02	1.00E-02	1.00E+00
RU106	1.54E+02	1.54E+02	1.00E-02	1.00E+00
I 130	2.97E+02	2.97E+02	5.00E-01	1.00E+00
I 131	1.90E+04	1.90E+04	5.00E-01	1.00E+00
I 132	2.76E+04	2.76E+04	5.00E-01	1.00E+00
I 133	3.92E+04	3.92E+04	5.00E-01	1.00E+00
I 134	4.25E+04	4.25E+04	5.00E-01	1.00E+00
I 135	3.67E+04	3.67E+04	5.00E-01	1.00E+00
TE125M	4.58E-01	4.58E-01	1.00E-02	1.00E+00
TE127	3.39E+01	3.39E+01	1.00E-02	1.00E+00
TE127M	4.62E+00	4.62E+00	1.00E-02	1.00E+00
TE129	1.14E+02	1.14E+02	1.00E-02	1.00E+00
TE129M	3.08E+01	3.08E+01	1.00E-02	1.00E+00
TE131	3.33E+02	3.33E+02	1.00E-02	1.00E+00
TE131M	5.57E+01	5.57E+01	1.00E-02	1.00E+00
TE132	5.48E+02	5.48E+02	1.00E-02	1.00E+00
TE134	6.23E+02	6.23E+02	1.00E-02	1.00E+00
CS134	5.65E+01	5.65E+01	1.00E-02	1.00E+00
CS136	2.28E-01	2.28E+01	1.00E-02	1.00E+00
CS137	2.61E+01	2.61E+01	1.00E-02	1.00E+00
CS138	6.80E+02	6.80E+02	1.00E-02	1.00E+00
BA137M	2.47E+01	2.47E+01	1.00E-02	1.00E+00
BA139	6.97E+02	6.97E+02	1.00E-02	1.00E+00
BA140	6.80E+02	6.80E+02	1.00E-02	1.00E+00

PR144	3.70E+02	3.70E+02	1.00E-02	1.00E+00
KR83M	4.45E+03	4.45E+03	1.00E+00	1.00E+00
KR85	2.30E+02	2.30E+02	1.00E+00	1.00E+00
KR85M	9.98E+03	9.98E+03	1.00E+00	1.00E+00
KR87	1.84E+04	1.84E+04	1.00E+00	1.00E+00
KR88	2.61E+04	2.61E+04	1.00E+00	1.00E+00
KR89	3.24E+04	3.24E+04	1.00E+00	1.00E+00
XE131M	2.52E+02	2.52E+02	1.00E+00	1.00E+00
XE133	7.84E+04	7.84E+04	1.00E+00	1.00E+00
XE135M	**2.82E+04**	**2.82E+04**	**1.00E+00**	**1.00E+00**
XE135M	1.56E+04	1.56E+04	1.00E+00	1.00E+00
XE137	6.97E+04	6.97E+04	1.00E+00	1.00E+00
XE138	6.39E+04	6.39E+04	1.00E+00	1.00E+00
MN54	0.0	0.0	1.00E+00	1.00E+00
MN56	0.0	0.0	1.00E+00	1.00E+00
CO58	0.0	0.0	1.00E+00	1.00E+00
CO60	0.0	0.0	1.00E+00	1.00E+00
FE59	0.0	0.0	1.00E+00	1.00E+00
CR51	0.0	0.0	1.00E+00	1.00E+00
CU64	0.0	0.0	1.00E+00	1.00E+00
HF181	0.0	0.0	1.00E-00	1.00E+00
NP239	0.0	0.0	1.00E+00	1.00E+00

DO YOU WISH TO RUN AGAIN? 1=YES 2=NO

?

2

READY

LOGOFF

RGE8371 LOGGED OFF TSO AT 16:37:37 ON FEBRUARY 4, 1993

LAST STEP COMPLETION CODE WAS USER 000

TABLE 1

TABLE 2

REACTOR BUILDING

Radiation Data

Elevation	Zone	Normal Oper. Dose Rate (R/Hr.)	Normal Oper. 40 Yr. Dose (Rads)	LOCA Dose Rate (R/Hr.)	LOCA Dose[1] (Rads)	TID[2] (Rads)
696 + 11	1	2.9E2	1.0E7	4.8E6	1.0E8	1.1E8
725 + 0	2	2.9E1	2.0E7	4.8E6	1.0E8	1.2E8
	3	2.9E0	1.0E6	4.8E6	1.0E8	1.0E8
	4	2.9E-2	1.0E4	1.0E6	2.0E7	2.0E7
738 + 3	5	1.4E1	5.0E6	4.8E6	1.0E8	1.0E8
	6	5.7E1	2.0E7	4.8E6	1.0E8	1.2E8
	7	2.9E-1	1.0E5	4.8E6	1.0E8	1.0E8
	8	5.7E-2	2.0E4	4.8E6	1.0E8	1.0E8
	8a	5.7E-2	2.0E4	6.0E5	2.0E7	2.0E7
	9	5.7E-1	2.0E5	4.8E6	1.0E8	1.0E8
	10	2.9F-2	1.0E4	1.0E6	2.0E7	2.0E7
767 + 11	11	1.4E1	5.0E6	4.8E6	1.0E8	1.0E8
	12	5.7E0	2.0E6	4.8E6	1.0E8	1.0E8
	13	5.7E1	2.0E7	4.8E6	1.0E8	1.2E8
	14	2.9E-1	1.0E5	4.8E6	1.0E8	1.0E8
	15	5.7E1	2.0E7	4.8E6	1.0E8	1.2E8
	16	5.7E-2	2.0E4	4.8E6	1.0E8	1.0E8
	17	2.9E-2	1.0E4	1.5E6	3.0E7	3.0E7
778 + 10	18	1.0E1	3.5E6	4.8E6	1.0E8	1.0E8
	19	2.9E-1	1.0E5	4.8E6	1.0E8	1.0E8
	20	1.4E1	5.0E6	4.8E6	1.0E8	1.0E8
	21	5.7E0	2.0E6	4.8E6	1.0E8	1.0E8
	22	5.7E-2	2.0E4	4.8E6	1.0E8	1.0E8

TABLE 2

TABLE 2 (Sheet 2)

REACTOR BUILDING

Radiation Data

Elevation	Zone	Normal Oper. Dose Rate (R/Hr.)	Normal Oper. 40 Yr. Dose (Rads)	LOCA Dose Rate (R/Hr.)	LOCA Dose[1] (Rads)	TID[2] (Rads)
778+10	23	1.4E-1	5.0E4	4.8E6	1 0E8	1.0E8
	24	2.9E-2	1.0E4	1.5E6	3.0E7	3.0E7
841 + 10	25	1.4E1	5.0E6	4.8E6	1.0E8	1.1E8
	26	1.4E-1	5.0E4	4.8E6	1.0E8	1.0E8
	27	5.7E-2	2.0E4	4.8E6	1.0E8	1.0E8
	28	2.9E-2	1.0E4	2.2E6	4.5E7	4.5E7
842 + 5	29	1.4E-1	5.0E4	4.8E6	1.0E8	1.0E8
& Above	30	2.9E-2	1.0E4	4.8E6	1.0E8	1.0E8

TABLE 2

NOTES: [1]Use Figure 5.0-1 to determine fraction of 1-year dose.

[2]TID = Total Integrated Dose. Equal to total of 40-year normal operating dose plus 1-year LOCA dose.

TABLE 3

AUXILIARY BUILDING

Radiation Data

Elevation	Zone	Max. Dose Rate (R/Hr.)	DBA-LOCA[1,2] Dose (Rads)	Normal Oper. 40 Yr. Dose (Rads)	TID[3] (Rads)
695 + 0	1	2.8E4	6.0E5	1.0E5	7.0E5
	2	1.5E4	3.2E5	1.4E5	4.6E5
	3	2.4E4	5.2E5	1.0E3	5.2E5
	4	4.1E3	8.8E4	1.0E3	9.0E4
	5	2.8E2	5.9E3	1.0E3	7.0E3
	6	-----	-----	1.4E5	1.4E5
	7	-----	-----	1.0E5	1.0E5
	8	-----	-----	4.6E5	4.6E5
	9	-----	-----	5.0E3	5.0E3
716 + 0	10	1.7E4	3.5E5	2.0E4	3.7E5
	11	8.6E4	1.8E6	2.0E4	1.8E6
	12	3.1E4	7.2E5	2.0E4	7.4E5
	13	1.7E3	3.4E4	2.0E4	5.4E4
	14	1.1E1	2.4E2	3.5E4	3.5E4
	15	1.3E4	2.8E5	1.0E3	2.8E5
	16	5.6E2	1.2E4	-----	1.2E4
	17	2.3E2	5.0E3	5.0E3	1.0E4
	18	2.3E4	5.0E5	2.0E4	5.2E5
	19	2.3E2	5.0E3	2.0E4	2.5E4
	20	2.5E3	5.3E4	3.5E4	8.8E4
	21	1.4E1	3.0E2	1.0E3	1.3E3
	22	4.6E0	1.0E2	1.0E3	1.1E3
	23	2.7E0	5.7E1	1.0E3	1.1E3
	24	4.6E1	9.8E2	1.0E3	2.0E3
	25	-----	-----	1.0E3	1.0E3
	26	1.5E-1	5.0E0	5.0E2	5.0E2
	27	4.0E4	7.5E5	1.1E8	1.1E8

TABLE 3

TABLE 3 (Sheet 4)

AUXILIARY BUILDING

Radiation Data

Elevation	Zone	Max. Dose Rate (R/Hr.)	DBA-LOCA[1],[2] Dose (Rads)	Normal Oper. 40 Yr. Dose (Rads)	TID[3] (Rads)
750 + 0 (Cont'd)	81	1.6E2	3.4E3	1.0E3	4.4E3
	82	4.7E0	1.0E1	1.0E3	1.0E3
	83	4.7E1	1.0E2	1.0E3	1.1E3
	84	4.7E2	1.0E3	1.0E3	2.0E3
	85	1.4E4	3.0E5	5.0E3	3.1E5
	86	-----	-----	3.6E5	3.6E5
	87	-----	-----	1.7E8	1.7E8
	88	2.1E4	3.9E5	8.4E4	4.8E5
	89	-----	-----	5.0E3	5.0E3
	90	-----	-----	2.9E6	2.9E6
	91	-----	-----	4.4E6	4.4E6
	92	-----	-----	1.0E3	1.0E3
	93	-----	-----	3.5E2	3.5E2
767 + 0[2]	94	4.2E-6	2.3E-5	1.0E3	1.0E3
	95	5.6E-3	1.3E0	3.5E2	3.5E2
	96	1.8E-1	2.5E1	3.5E2	3.8E2
	97	3.8E3	1.6E6	3.5E2	1.6E6
	98	8.03	3.1E3	3.5E2	3.5E3
	99	1.1E3	3.0E5	3.5E2	3.0E5
	100	3.3E5	2.0E8	-----	2.0E8

NOTES: [1]Use Figure 5.0-1 to determine fraction of 1-year dose except for zones on Elevation 767+0.
[2]for zones on Elevation 767+0 use Figure 5.0-2 to determine fraction of 1-year dose.
[3]TID = Total Integrated Dose. Equal to total of 40-year normal operating dose plus 1-year DBA-LOCA dose.

TABLE 3 (Sheet 5)

AUXILIARY BUILDING

Radiation Data

Elevation	Zone	Max. Dose Rate (R/Hr.)	DBA-LOCA[1],[2] Dose (Rads)	Normal Oper. 40 Yr. Dose (Rads)	TID[3] (Rads)
767 + 0[2] (Cont'd)	101	1.2E3	6.0E5	1.0E3	6.0E5
	102	1.0E2	5.2E4	1.0E3	5.3E4
	103	6.5E3	3.3E6	1.0E3	3.3E6
	104	1.1E3	5.4E5	1.0E3	5.4E5
	105	6.5E3	3.3E6	1.0E3	3.3E6
	106	3.8E3	2.0E6	1.0E3	2.0E6
	107	5.2E2	2.7E5	1.0E3	2.7E5
	108	6.2E-2	1.2E1	1.0E3	1.0E3
	109	4.6E4	2.4E7	1.0E3	2.4E7
	110	8.5E5	4.7E-3	1.0E3	1.0E3
	111	3.0E-4	5.5E-1	1.0E3	1.0E3
	112	3.5E-3	4.9	3.5E2	3.5E2
	113	2.5E-2	4.6	2.0E2	2.0E2
	114	-----	-----	3.5E2	3.5E2

NOTES: [1]Use Figure 5.0-1 to determine fraction of 1-year dose except for zones on Elevation 767+0.
[2]for zones on Elevation 767+0 use Figure 5.0-2 to determine fraction of 1-year dose.
[3]TID = Total Integrated Dose. Equal to total of 40-year normal operating dose plus 1-year DBA-LOCA dose.

TABLE 4

DIESEL GENERATOR DATA

Radiation Area

Elevation	Zone	Max. Dose Rate (R/Hr.)	DBA-LOCA[1] Dose (Rads)	Normal Oper. 40 Yr. Dose (Rads)	TID[2] (Rads)
736 +6	1	4.5	100	3.5E2	4.5E2
	2	4.5E2	1.0E4	3.5E2	1.0E4
	3	1.8E3	4.0E4	3.5E2	4.0E4
	4	2.8E3	6.0E4	3.5E2	6.0E4
	5	1.8E3	4.0E4	3.5E2	4.0E4
	6	4.5E1	1.0E3	3.5E2	1.4E3
	7	1.4	30	3.5E2	3.8E2
	8	9.1E2	2.0E4	3.5E2	2.0E4
	9	6.8E1	1.5E3	3.5E2	1.9E3
	10	4.5E1	1.0E3	3.5E2	1.4E3
	11	4.5	100	3.5E2	4.5E2
	12	4.5	100	3.5E2	4.5E2
	13	2.3	500	3.5E2	8.5E2
	14	1.4	30	3.5E2	3.8E2

TABLE 4

NOTES: [1]Use Figure 5.0-1 to determine fraction of 1-year dose.

[2]TID = Total Integrated Dose. Equal to total of 40-years normal operating dose plus 1-year DBA-LOCA dose.

TABLE 5

McGUIRE NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED INSIDE CONTAINMENT

EQUIPMENT ID: (1) Valve Motor Operators (Upper Containment)

MANUFACTURER: Limitorque

MODEL #: SMB

ACCIDENT ENVIRONMENT (2)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN ACCIDENT ENVIRONMENT(3)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 180°F Press: 14.8 psig RH: 100% Rad: $4X10^6R$ Chem Spray: Boric acid and sodium tetraborate soln.	Temp: 340°F Press: 105 psig RH: 100% Rad: $2X10^8R$ Chem Spray: Boric acid and sodium hydroxide soln. 3000 ppm Boron, 10.5 pH	5 min. (Notes 7 and 8)	30 days post DBE	N/A	N/A

From the Manufacturer's File Location:
Radiation Zone 23
Elevation 778+10

QUALIFICATION REPORT (4): Limitorque Test Report: B0058, January 11, 1980

METHOD: Test

TABLE 6

McGUIRE NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED IN THE ANNULUS

EQUIPMENT ID: Transmitter-RCS Pressure (WR) MANUFACTURER: Rosemount MODEL #: 1153GA9

ACCIDENT ENVIRONMENT (1)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN ACCIDENT ENVIRONMENT	OPERABILITY DEMONSTRATED (2)	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 142°F RH: 100% Rad: $1.2X10^7$R	Temp: 350°F RH: 100% Rad: $4X10^7$R	2 weeks post DBE	1 year post DBE	± 10%	± 8% Upper Range

From the Manufacturer's File
Radiation Zone: 10
Elevation: 738+3

QUALIFICATION REPORT: Test Report RMT Report #3788, Rev. A

METHOD: Similarity & Type Test

TABLE 6

TABLE 7

McGUIRE NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED OUTSIDE CONTAINMENT AND EXPOSED TO THE POST-LOCA RECIRCULATION ENVIRONMENT

EQUIPMENT ID: (1) Containment Spray Pump Motors MANUFACTURER: Westinghouse, Buffalo MODEL #: 73F56019-1S73, 73F56019-2S73, 73F56019-3S73, 73F56019-4S73

	RECIRCULATION RADIATION ENVIRONMENT (TID) (2)	RADIATION LEVEL TO WHICH QUALIFIED (TID)
	$5.2X10^5$RAD	$2X10^8$RAD

From the Manufacturer's File
Radiation Zone: 3
Elevation: 695

QUALIFICATION REPORT: WCAP 8754 Rev. 1, WCAP 7829

METHOD: Test and Analysis

TABLE 7

TABLE 8

McGUIRE NUCLEAR STATION - UNITS 1 AND 2
SUMMARY OF ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT
LOCATED INSIDE CONTAINMENT

EQUIPMENT ID: (1) Transmitter - Pressurizer Level (Lower Containment) (Unit 1)

MANUFACTURER: Barton

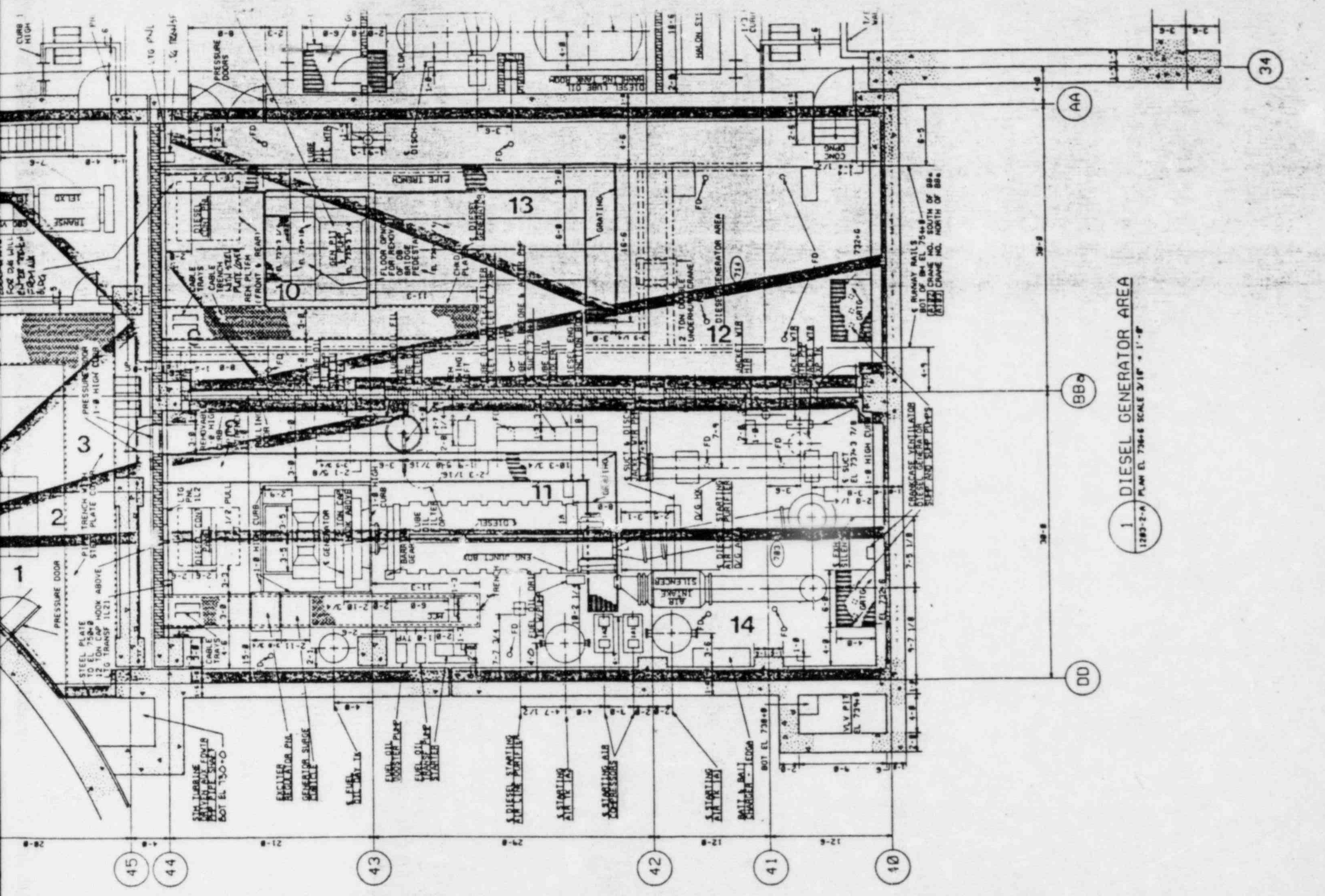
MODEL #: 764 (Lot 2)

ACCIDENT ENVIRONMENT (2)	ENVIRONMENT TO WHICH QUALIFIED	OPERABILITY REQUIRED IN ACCIDENT ENVIRONMENT(3)	OPERABILITY DEMONSTRATED	ACCURACY REQUIRED (% OF SPAN)	ACCURACY DEMONSTRATED (% OF SPAN)
Temp: 327°F Press: 14.8 psig RH: 100% Rad: $1.4X10^7$R Chem Spray: Boric acid and sodium tetraborate soln.	Temp: 380°F Press: 75 psig RH: 100% Rad: $5X10^7$R Chem Spray: Boric acid and sodium hydroxide soln. 2750 ppm Boron 8.5 pH	2 weeks post DBE	4 months post DBE	± 25%	Max. Error 15%

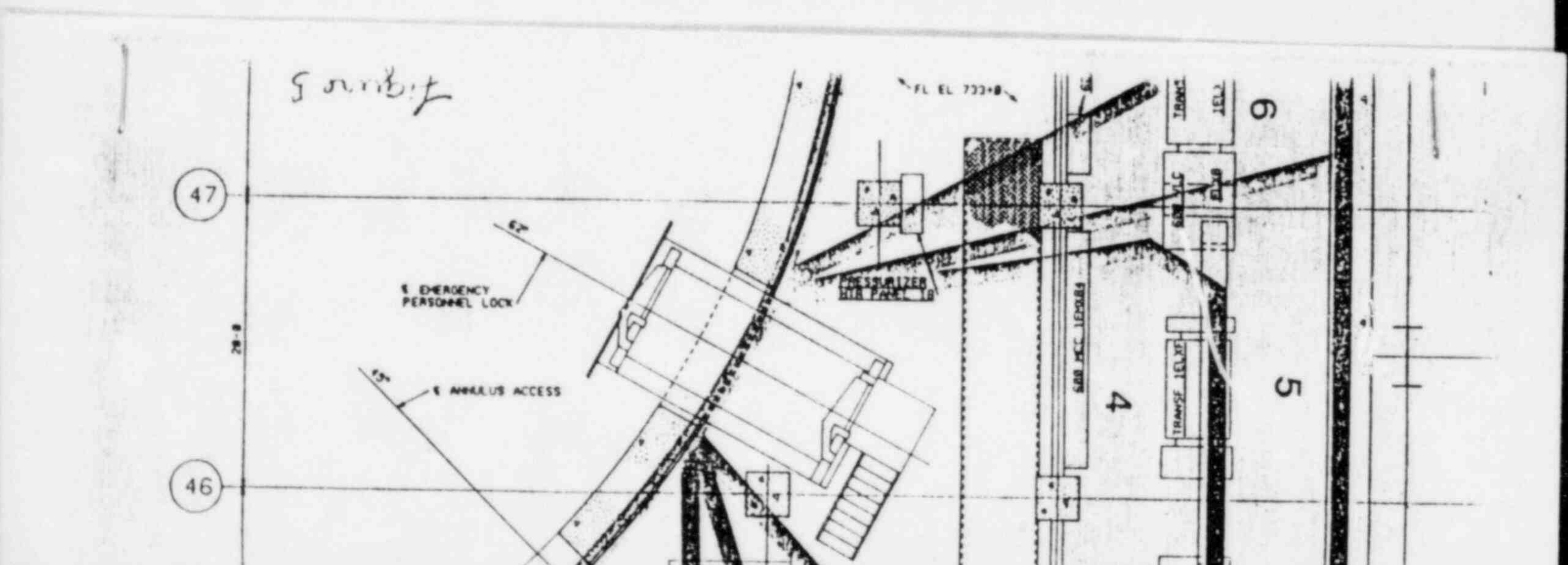
From Manufacturer's File:
Radiation Zone: 8a
Elevation: 738+3

QUALIFICATION REPORT (4): WCAP 9885

METHOD: Test



Radiation Zone Map
Diesel Generator Area
Elevation 736 + 6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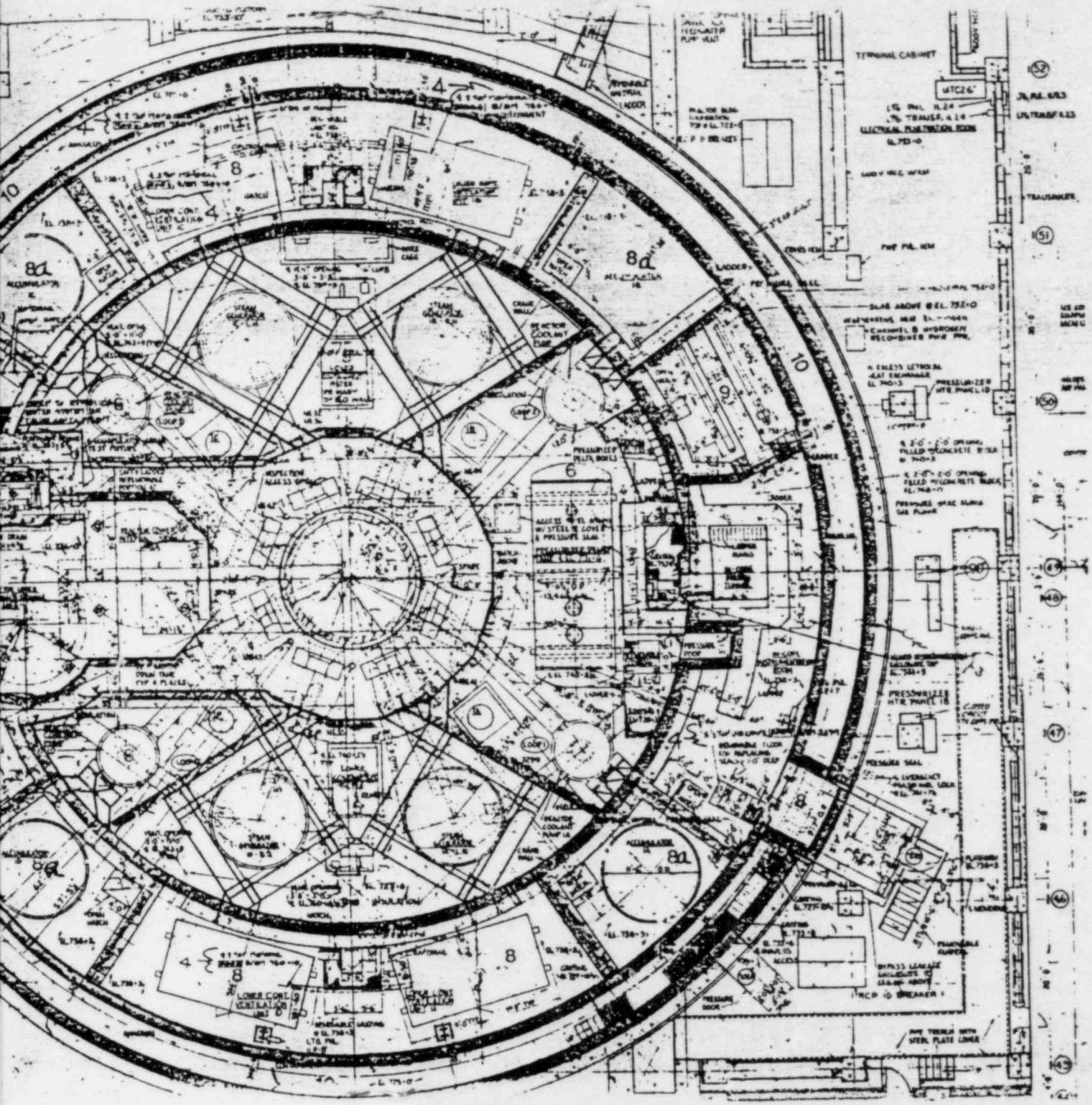
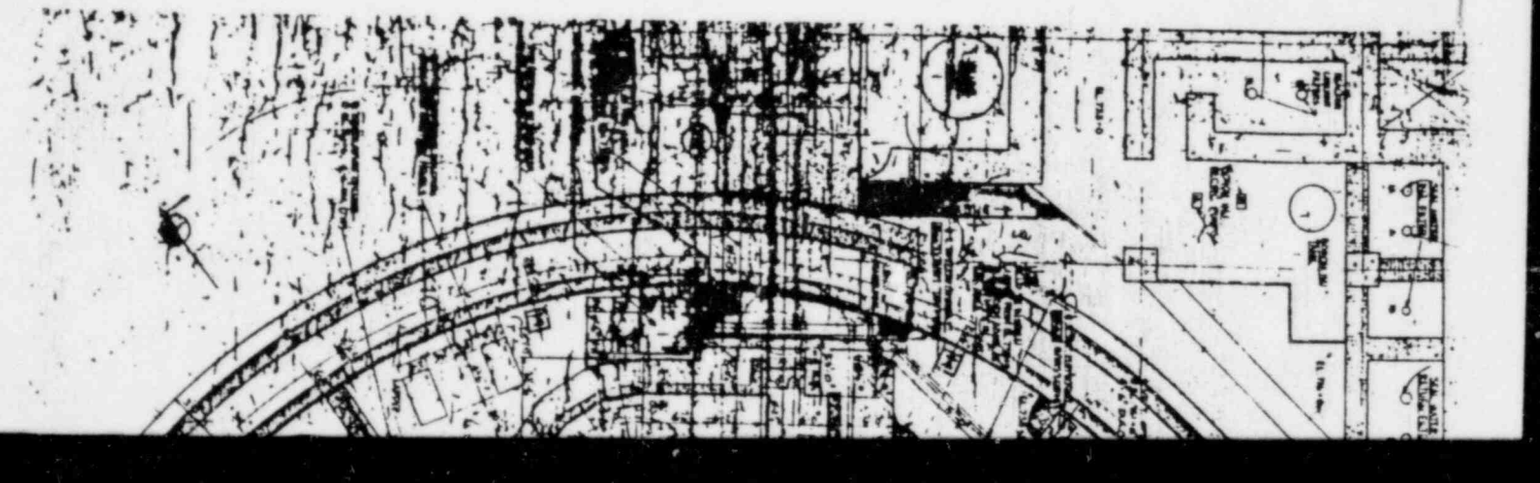
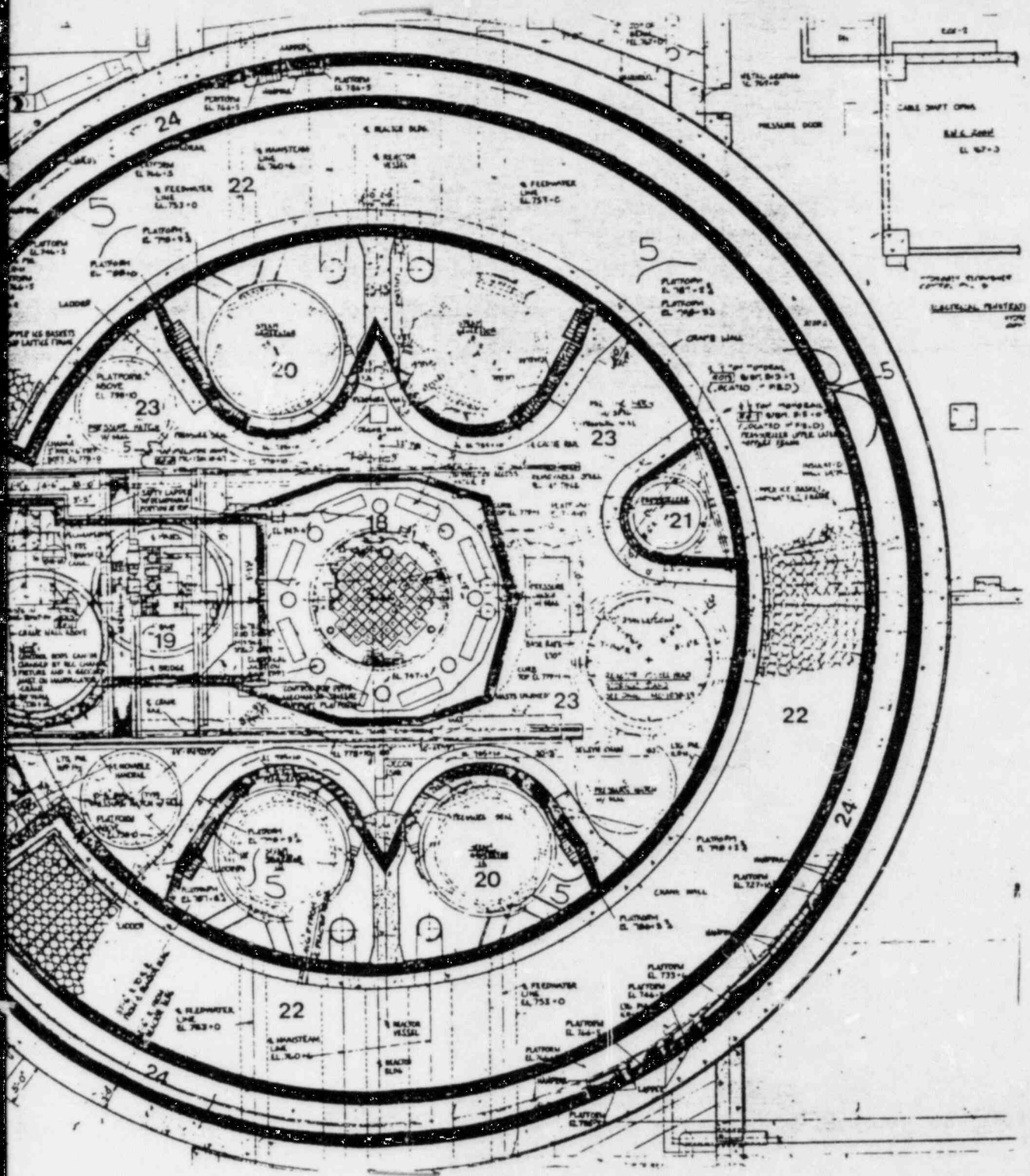
46
EMERGENCY PERSONNEL LOCK
ANNULUS ACCESS
PRESSURIZER HTR PANEL 1B
4
5
6



Radiation Zone Map
Reactor Building
Elevation 738 + 3

McGUIRE NUCLEAR STATION
Figure 1





Radiation Zone Map
Reactor Building
Elevation 778 + 10
McGUIRE NUCLEAR STATION
Figure 2

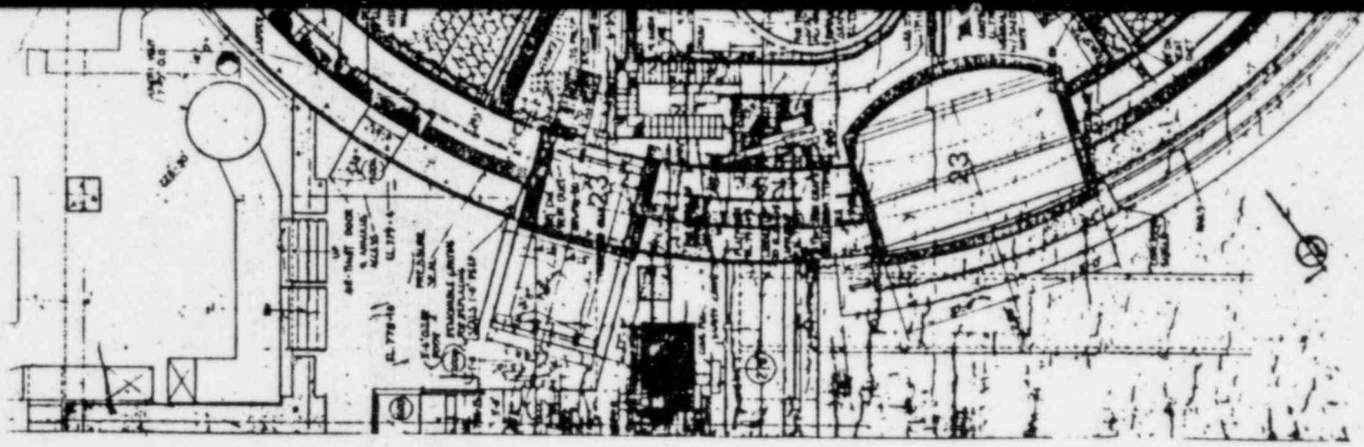
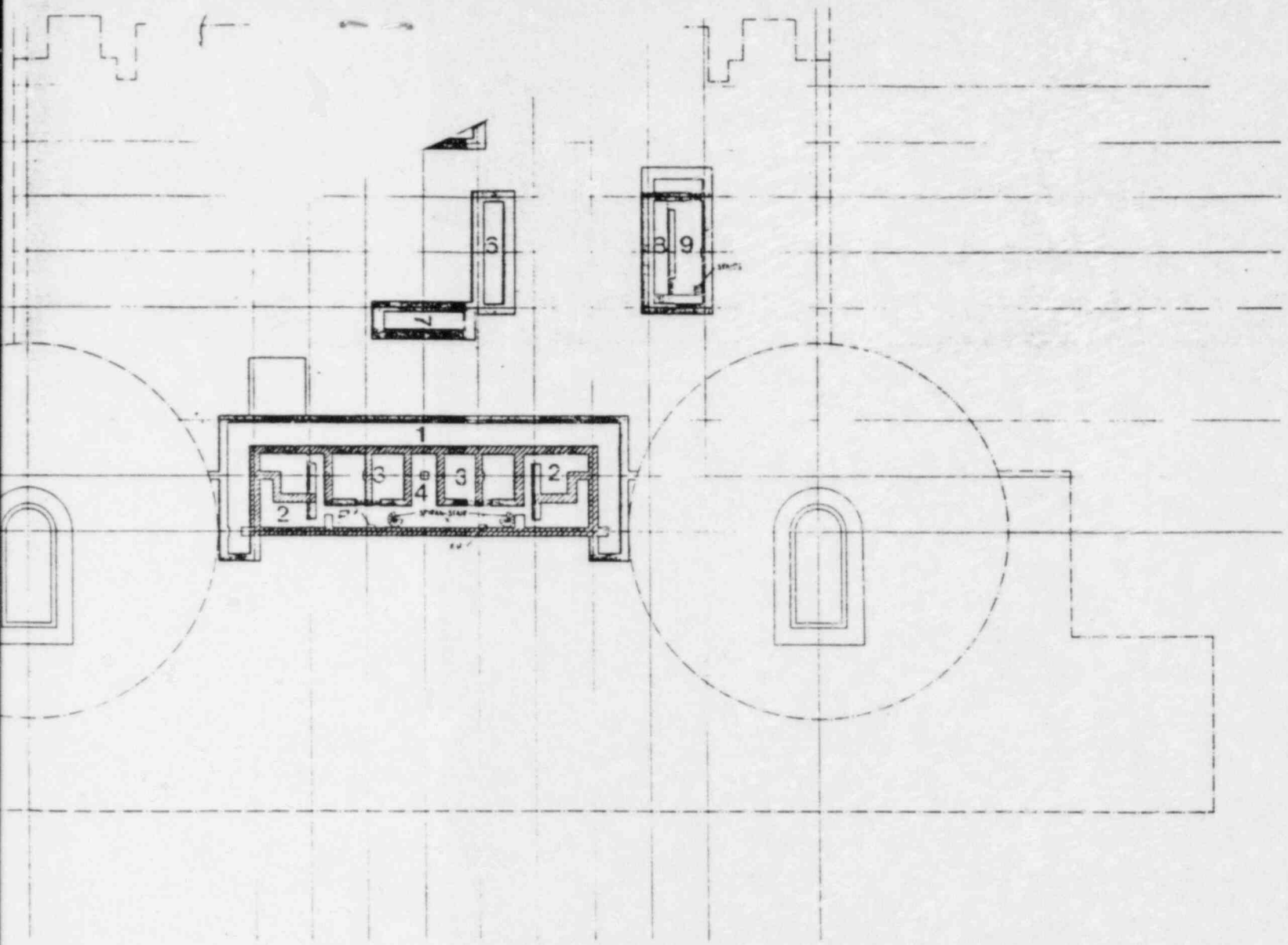


figure 2



Radiation Zone Map
Auxiliary Building
Elevation 695 + 0

DUKE POWER

McGUIRE NUCLEAR STATION

Figure 3

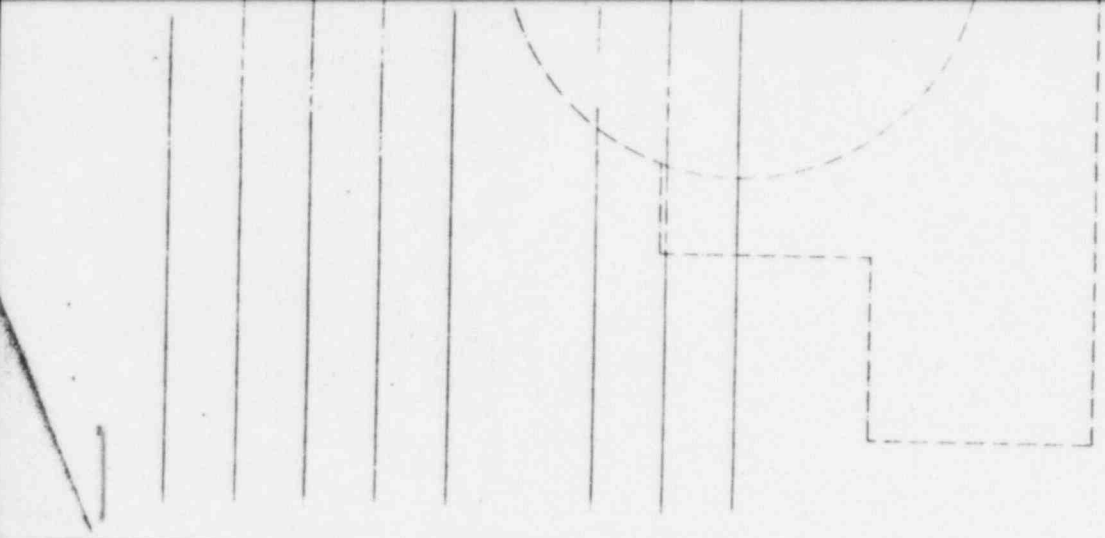
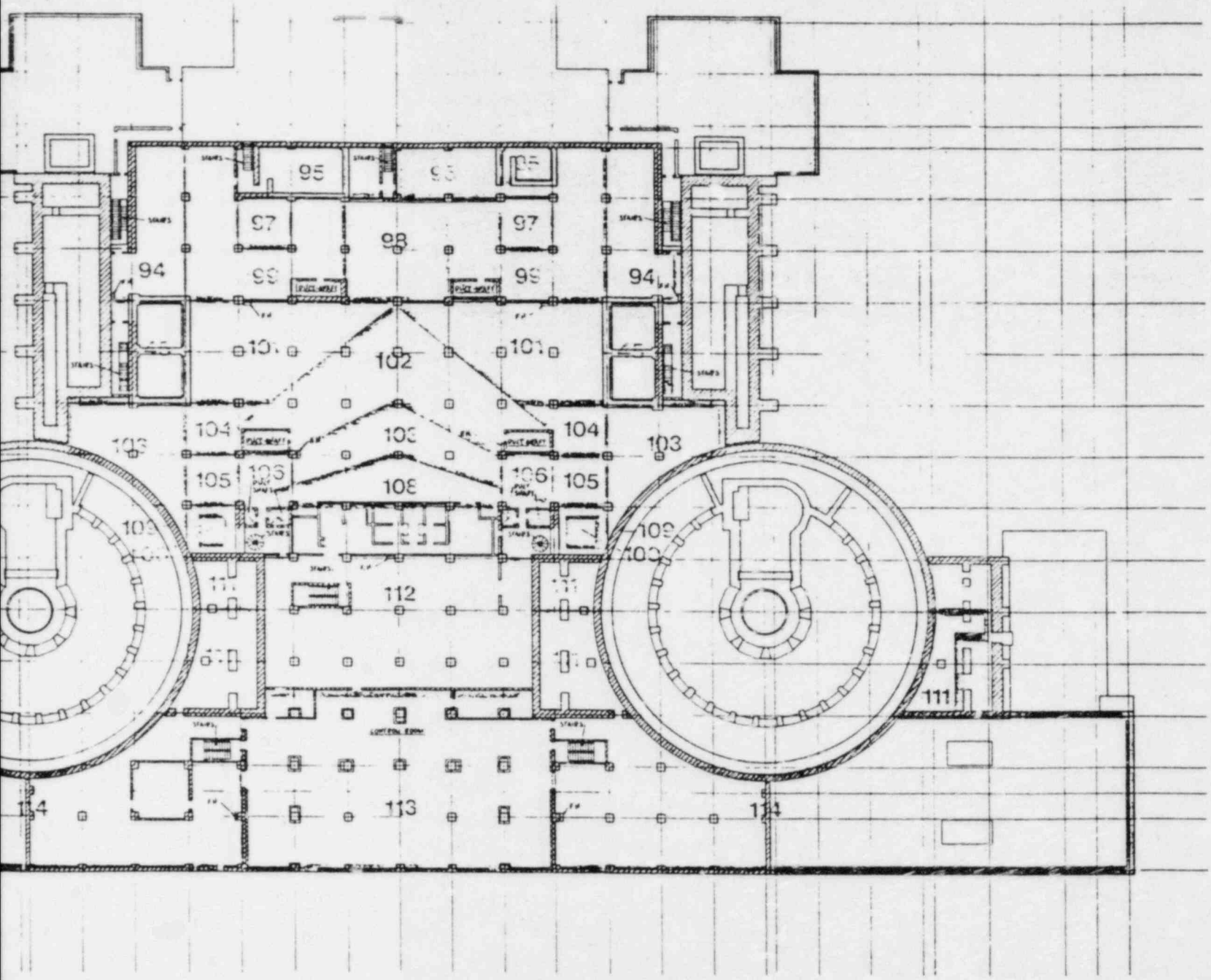


figure 3



Radiation Zone Map
Auxiliary Building
Elevation 767 + 0

McGUIRE NUCLEAR STATION

Figure A

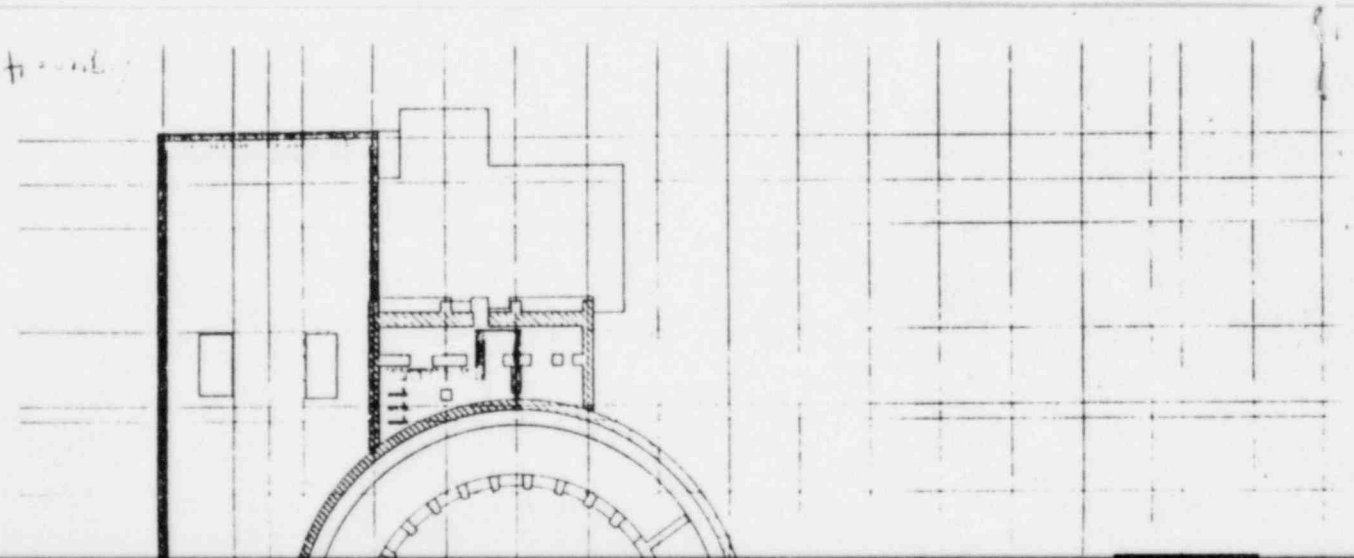
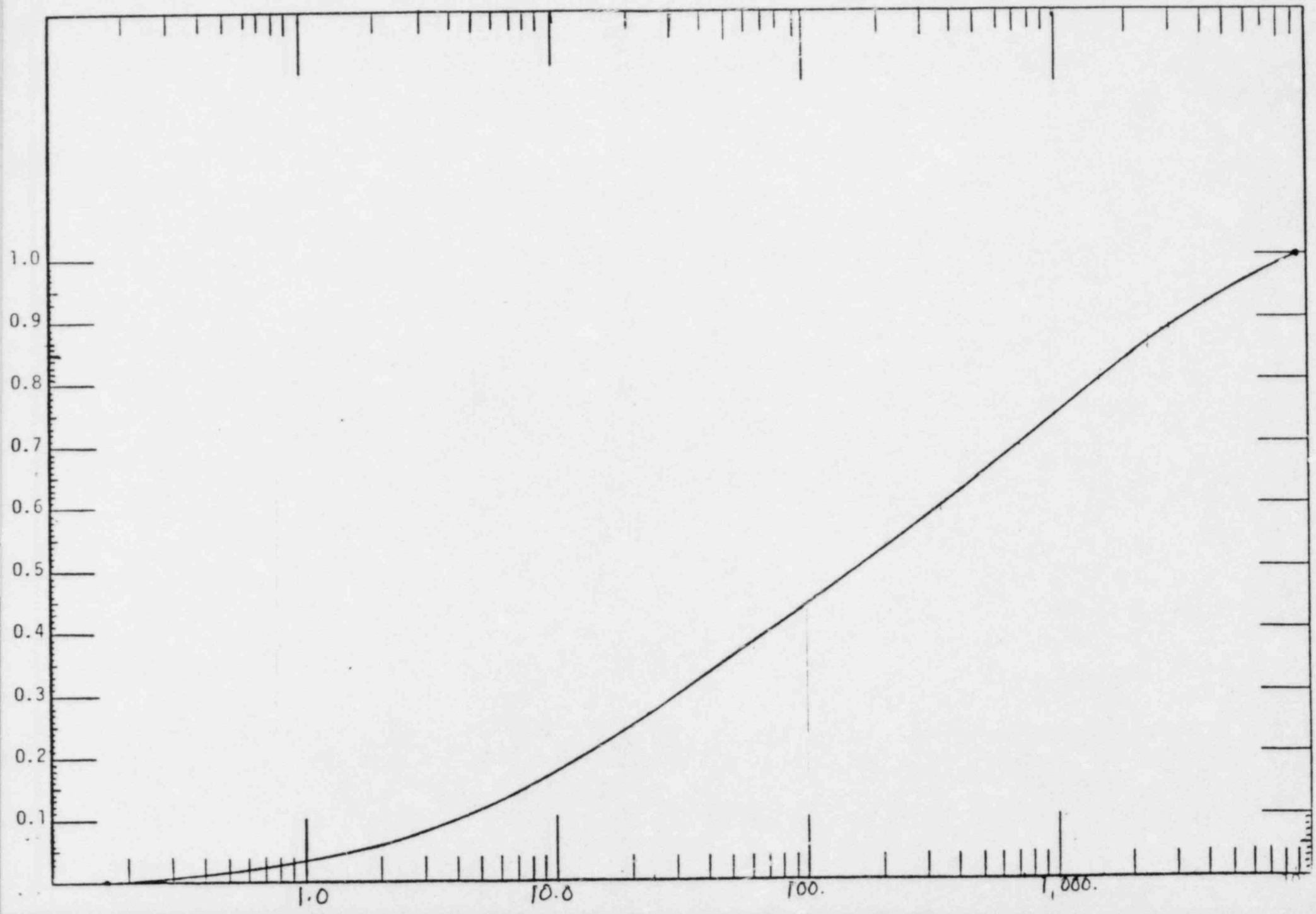


FIGURE 6

REACTOR & AUXILIARY BUILDING INTEGRATION FRACTIONS



AUXILIARY BUILDING INTEGRATED FRACTIONS

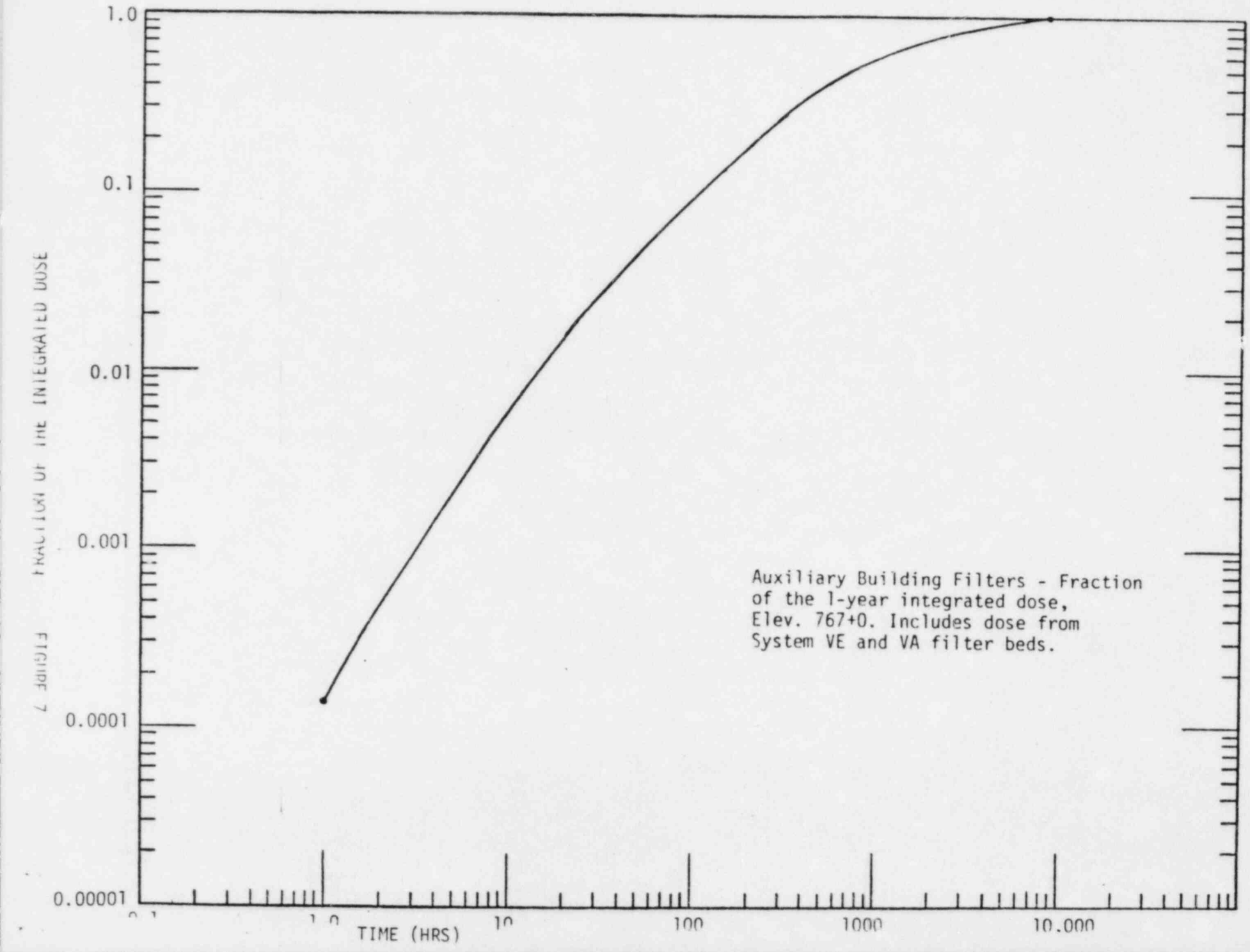


FIGURE 7