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ENVIRONMENTAL QUALIFICATION OF ELECTRICAL EQUIPMENT

H. B. ROBINSON E. G. PLANT UNIT 2

NRC IE BULLETIN 79-01B (90-DAY REPORT)

CAROLINA POWER & LIGHT COMPANY

RALEIGH, NORTH CAROLINA

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ENVIRONMENTAL QUALIFICATION OF
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NRC Bulletin 79-01B
(90-Day Report)

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1.0 GENERAL

1.1 Introduction

The United States Nuclear Regulatory Commission Office of Inspection and Enforcement Bulletin 79-01B issued on January 17, 1980 required two responses--a 45-day and 90-day report. Carolina Power and Light responded to the 45-day report on March 10, 1980. The submitted volume is used as a base document for this 90-day report which will be referenced, extracted and updated within this volume to comply with the total requirements of IE Bulletin 79-01B and subsequent NRC Region meeting minutes.

The 45-day report provided an overview listing of all electrical equipment within the Engineered Safety Systems which is required to function under the postulated accident conditions and did not limit the listing to only Class IE equipment. It also was concerned with equipment inside and outside the containment related to the detection of accident conditions, initial actuation of safety systems and the long-term mitigation of postulated events.

The postulated events covered within containment are LOSS OF COOLANT ACCIDENT (LOCA) and MAIN STEAM HIGH ENERGY LINE BREAK (MSLB). Also covered was the HIGH ENERGY LINE BREAK (HELB) inside and outside of containment.

Review of the 45-day report indicates only a small number of electrical equipment is exposed to any actual harsh accident environment which would endanger functioning if not designed and qualified to withstand the postulated conditions. All other identified equipment must perform within near normal environments during and after postulated accident events. Therefore this report will be limited to detailing in full the qualification of equipment identified as within the postulated accident environment. An area of exception is the RHR pump compartment which will have high radiation level fluid circulating through the pumps and piping during the mitigation aspect of accident condition. Therefore, electrical equipment outside of containment exposed to these radiation levels are also included in this report.

Additionally, the LOCA environment is more limiting when compared with Steam Line Breaks or High Energy Line Breaks within containment.[1] Therefore, the LOCA parameters will be used when qualifying or reviewing qualifications programs for all the accident conditions associated with the safety electrical equipment addressed in this report.

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[1] Recent study performed for NRC IE Bulletin 80-04 (Analysis of a PWR Main Steam Line Break with Continued Feedwater Addition) indicates a maximum containment pressure of 34.4 psig and a temperature of 257°F attained. Therefore, LOCA conditions still remain as limiting parameters for qualification.

1.2 Preparation of Report

The preparation of this 90-day report proceeded as follows:

The A/E; Ebasco Services, Incorporated, was consulted to establish validity of data associated with original purchase orders and vendor preshipment testing.

The NSSS supplier, Westinghouse, was consulted to establish qualification coverage of electrical equipment in containment by WCAP or manufactured product testing programs.

Original manufacturers of containment electrical equipment and manufacturers of replacement equipment and hardware were contacted to provide qualification test programs/reports related to the types of equipment supplied.

Plant operating report data from original commercial operation date was reviewed to determine any electrical equipment failure trends.

Factors affecting operational life and accident condition performance were compiled and a program of preventative maintenance and/or replacement devised.

Reviewed the qualification parameters and compared them with current data to obtain realistic qualification values.

Compared current data against the previously submitted 45-day report and revised forms.

Compiled a testing program, where required, to establish or complete qualification of the safety electrical equipment where data is unavailable.

1.3 Report Parameters

1.3.1 Flood Level

The H. B. Robinson containment lower level consists of a reactor vessel sump area and compartmented base floor. The floor level elevation is at 228 feet.

The sump geometry will account for a filled volume of 68,000[2] gallons of water. The containment geometry is such that each additional 120,000 gallons will add a one- (1) foot depth of water within containment. R2

The anticipated volume of water available to flood the containment during an accident is 451,000 gallons. This is comprised of Refueling Water Storage Tank, Accumulators, Spray Addition Storage Tank, and Reactor Coolant Loop water volumes emptied within containment.

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(2)See Appendix B to this report for calculations.

This will produce a floor flood level of approximately 3.2 feet or a flood elevation of 231.2 feet within containment. Three (3) instruments mounted on the shield wall at a level of 230 ft. will be covered by the postulated flood elevation. These are LT-459, LT-460 and LT-461, associated with pressurizer water level indicating and alarming. These instruments are not the only source of data for operator assessment and decision needed for HELB and LOCA situations. Emergency Instruction (E.I.1) states that information may be erroneous because of transmitter malfunction or failure due to accident environment in containment or abnormal conditions within the reactor coolant system. Operators are instructed to use confirmed data for pressurizer level and if level data is suspect, or lacking, to utilize other system information in decision situations. The major contribution of pressurizer level information in an accident situation is to alert the operator that an accident has happened and initially aid in identifying the type of accident. This occurs early in the accident scenerio. As pressurizer level is not essential information to achieve accident mitigation, their assumed failure under submergence will not necessitate relocation or replacement. R2

The lowest mounted elevation of electrical equipment used for accident detection and mitigation is 231.5 feet. Revision 1, dated August 21, 1980, of the 90-day report stated a flood level of 231.67 feet would be experienced and that certain instrumentation would be partially submerged. Only the nonelectronic sections of the instruments were affected and no operational difficulties were anticipated. With more exact data on flood level as reported in Appendix B, it was determined that the flood level would not achieve the 231.67-foot height but only 231.2 feet; therefore, the instruments previously listed as partially submerged are no longer in contact with flood water.

However, due to the close proximity of Instruments PT-444, PT-445 (Pressurizer Pressure Control), PT-455, PT-456, PT-457 (Pressurizer Pressure Safety Injection Signal), FT-474, FT-475 (Steam Line Break Monitor - Generator A), FT-484, FT-485 (Steam Line Break Monitor - Generator B), FT-494 and FT-495 (Steam Line Break Monitor - Generator C) to the calculated flood level, additional radiation source exposure has been assigned and used to determine qualification (see Paragraph 1.3.2). To establish additional distance between flood level and instruments, replacement transmitters for the above listed have been mounted with the maximum height permissible in the instrument cabinets and still maintain operability.

For illustration purposes each identified class IE equipment location is listed and compared with the established flood level on the enclosed Environmental Qualification Equipment Required to Function Under Postulated Accident Conditions forms.

1.3.2 Radiation

Inside containment accumulated radiation dosage for forty- (40) year life and single accident incident for H. B. Robinson had been designated as 1.5×10^8 RADS.[(3)] This figure, when applied, was used for design performance and testing requirement within equipment specifications.

This figure is one of a series of calculated values associated with Westinghouse NSS supplied plants. Initially a point kernel attentuation program modeled on the R. E. Ginna nuclear plant was used in 1971 to derive an accumulated dosage figure of $\geq 2.0 \times 10^8$ RADS. A refinement of this figure was performed by Westinghouse to accommodate the requirements of IEEE 323, 1974. The resultant figure of 1.5×10^8 RADS in the original issuance of WCAP 8587, Westinghouse Environmental Qualification of NSSS Class IE Equipment, was stated as conservative and subject to revision when the source term issue was resolved. Noted within this environmental program is the differential parameter for radiation exposure of equipment inside containment by physical location.

Subsequent revision of WCAP 8587 accounts for location of equipment by level within containment to establish radiation exposure during both operation and under accident condition. A figure of 2.7×10^7 RADS is established as the most significant dosage accumulated.

For consideration within this report the radiation service condition of 1.4×10^7 RADS[(4)], determined by use of IE Bulletin 79-01B, Appendix B, will be used when reviewing in containment electrical equipment. This figure is representative of H. B. Robinson parameters and depicts a thirty- (30) day integrated gamma dose.

Dose rates as listed in Table 1.3.1 have been used to evaluate equipment by location and application within containment to determine forty- (40) year life dose accumulation. To support these radiation levels an evaluation was made of data accumulated during actual plant operation. Six separate radiation readings at varied plant locations were collected during sequential years. Approximate locations are shown in Figure 1.3.1. Radiation readings are charted on Figure 1.3.2 and Table 1.3.1 projects the data for a forty- (40) year operating period.

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(3)FSAR Section 7A.

(4)See Appendix A to this report for calculations.

Operating time after design event occurrence will determine the additional radiation dose accumulated. After the application of a ten (10) percent margin, a total radiation dosage is listed in Table 1.3.3. This total dosage will be used for comparison with equipment tests performed and/or calculated values to determine overall qualification.

Outside of containment areas where recirculation fluids from inside containment are encountered the radiation dose of 4×10^6 RADS as stated within section 4.3.2 of IE Bulletin 79-01B represents the anticipated total dosage found at the outer diameter of pipe carrying Reactor Coolant water for a period of thirty (30) days after postulated event.

Use of Table 1.3.2 indicates a 4:1 ratio between pipe outer diameter and general area where affected electrical equipment is located. Therefore, a one- (1) month accumulated dose of 1.0×10^6 RADS is what can be expected within the RHR compartment when evaluating qualification of electrical equipment used to establish recirculation of containment sump water.

In containment following postulated accident, the flood level as established in Paragraph 1.3.1 will bring contaminated water close to and over some electrical transmitters. Transmitters[5] close to the water level will be exposed to an additional radiation source. Source levels are established in Table D-8, Containment Sump Gamma Dose Rates and Integrated Doses Vs. Time, within <u>NUREG 0588</u>, <u>Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment</u>, Appendix D. Since time will be required for the water level to rise close to the transmitters, the total integrated gamma dose at the surface utilized to calculate the total anticipated radiation exposure and listed in Table 1.3.3 is conservative. Therefore, no additional radiation margin is required. R2

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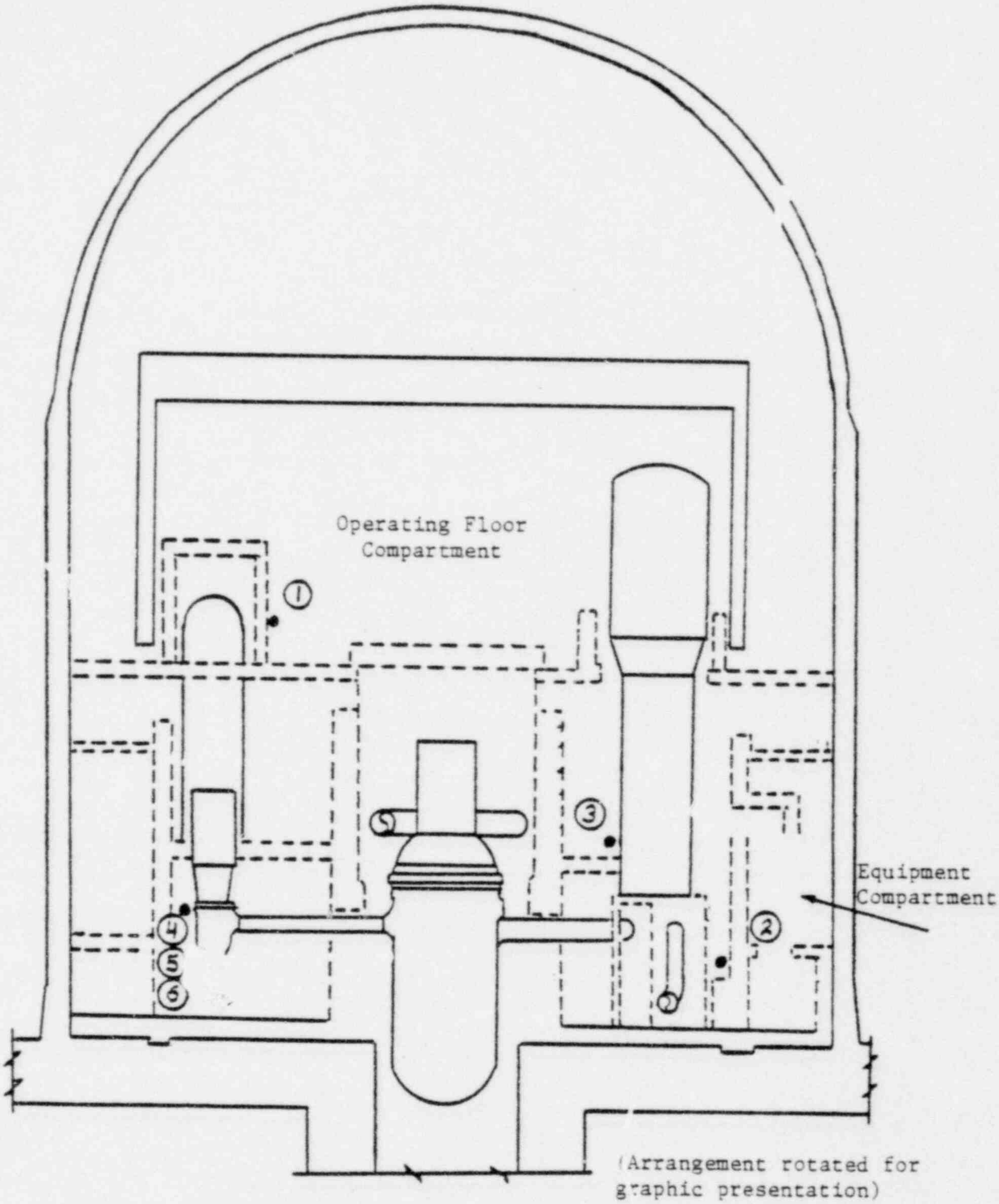
(5) Transmitters affected are:

PT-444, PT-445, PT-455, PT-456, PT-457 - (30-minute operation required - 1-hour minimum used in calculation.) FT-474, FT-475, FT-484, FT-485, FT-494, FT-495 - 1-day operation. R2

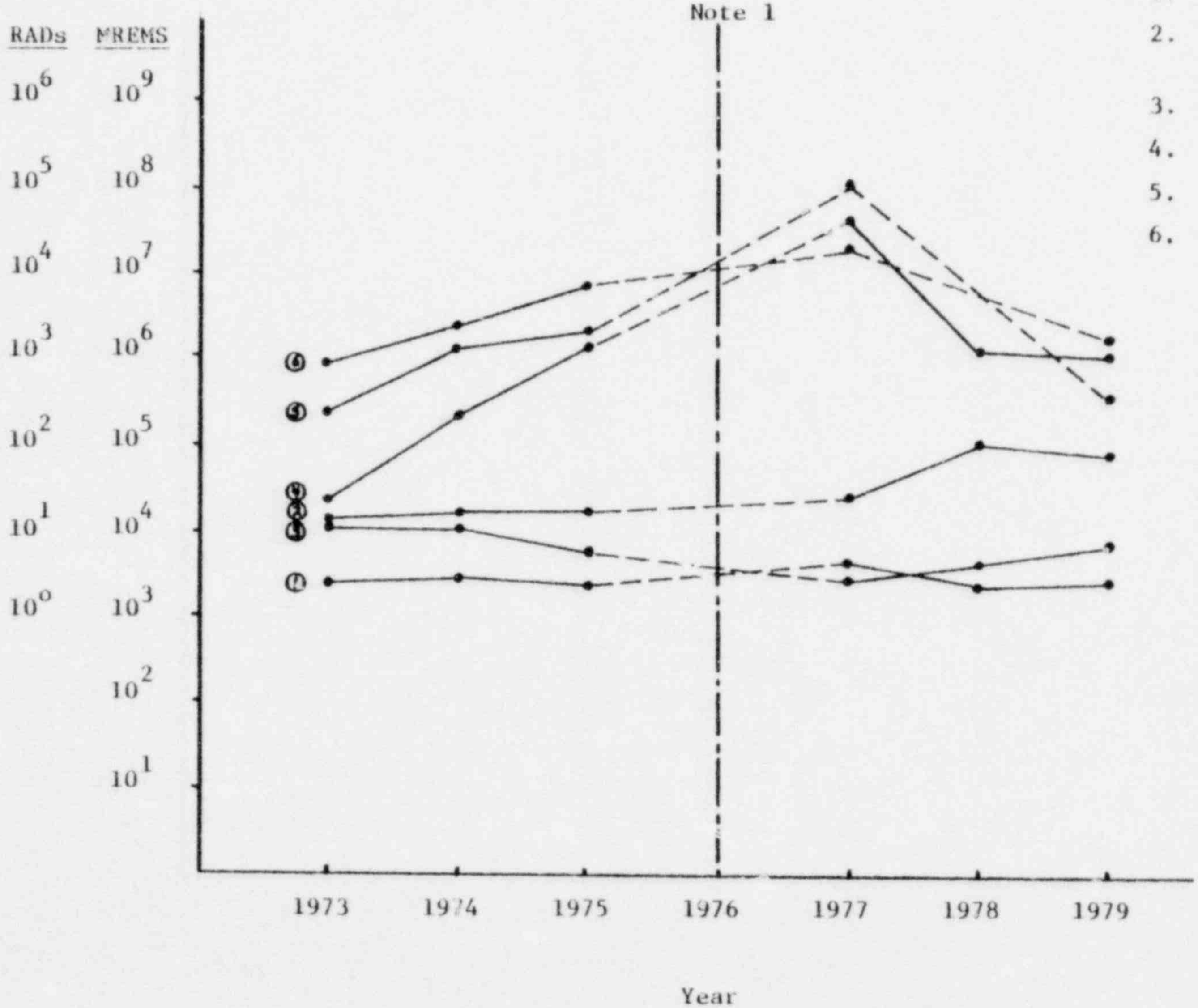
H.B. ROBINSON REACTOR CONTAINMENT RADIATION LEVEL MEASUREMENT LOCATIONS



1 CV Operating Deck (Pressurizer)
2 CV Lower Level Polar Crane Wall (Regen. Heat Exchanger)
3 CV Second Level Seal Table Room
4 Reactor Coolant Pump Bay A
5 Reactor Coolant Pump Bay B
6 Reactor Coolant Pump Bay C

Figure 1.3.1

H. B. ROBINSON CONTAINMENT RADIATION LEVEL MEASUREMENTS



Recording Stations

1. CV Operating Deck (pressurizer)
2. CV Lower Level Polar Crane Wall (Regen. Heat Exchanger)
3. CV Second Level - Seal Table Room
4. Reactor Coolant Pump BAY-A
5. Reactor Coolant Pump BAY-B
6. Reactor Coolant Pump BAY-C

Notes:

1 No data recorded for the year 1976

.______. Known data

._ _ _. Extrapolated data

Figure 1.3.2

TABLE 1.3.1

H. B. ROBINSON CALCULATED RADIATION ACCUMULATION

AREA [1]	YR. ACCUM. [2]	40 YR. ACCUM. [2]	ELEV.(ft)
1. CV Operating Deck (Pressure)	4.8×10^{0}	1.9×10^{2}	280
2. CV Lower Level Polar Crane	5.7×10^{1}	2.3×10^{3}	233
3. CV Second Level-Seal Table Rm.	8.5×10^{0}	3.4×10^{2}	254
4. Reactor Coolant Pump - Bay A	1.1×10^{4}	4.4×10^{5}	243
5. Reactor Coolant Pump - Bay B	2.8×10^{4}	1.1×10^{6}	243
6. Reactor Coolant Pump - Bay C	9.6×10^{3}	3.9×10^{5}	243
	7.2×10^{3} [3]	2.9×10^{5} [3]	

(1) See figure 1.3.1 for locations.
(2) Calculations in (RADs)
(3) Total Containment (Averaged)

TABLE 1.3.2

REACTOR COOLANT SYSTEM DOSES

LOCATION	DOSE r/hr
PIPE CENTER	820
PIPE ID	470
PIPE OD	200
GENERAL AREA	50

TABLE 1.3.3

EQUIPMENT TOTAL RADIATION ACCUMULATION BY LOCATION AND LOCA OPERATING TIME

Component	Location	Level (ft) (Approx.)	Time Of Operation	Radiation Exp. (40 yrs)(1)	Accident(3) Radiation Exp.	Margin (10%)	Total Anticipated Radiation Exposure	
TRANSMITTERS								
PT-444(2)	CV	231.5	30 MIN.(4)	2.3×10^3	9.5×10^5	-	1.0×10^6 (8)	
PT-445(2)	CV	231.5	30 MIN.(4)	2.3×10^3	9.5×10^5	-	1.0×10^6 (8)	
PT-456(2)	CV	231.5	30 MIN.(4)	2.3×10^3	9.5×10^5	-	1.0×10^6 (8)	R1, R2
PT-457(2)	CV	231.5	30 MIN.(4)	2.3×10^3	9.5×10^5	-	1.0×10^6 (8)	
PT-455	CV	231.5	30 MIN.(4)	2.3×10^3	9.5×10^5	-	1.0×10^6 (8)	
LT-474	CV	233	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	3.8×10^6	
LT-475	CV	233	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	3.8×10^6	
LT-476	CV	233	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	3.8×10^6	
LT-477	CV	233	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	3.8×10^6	
LT-484	CV	233	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	3.8×10^6	
LT-485	CV	233	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	3.8×10^6	
LT-486	CV	233	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	3.8×10^6	
LT-487	CV	233	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	3.8×10^6	
LT-494	CV	233	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	3.8×10^6	
LT-495	CV	233	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	3.8×10^6	
LT-496	CV	233	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	3.8×10^6	
LT-497	CV	233	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	3.8×10^6	
LT-459(2)	CV	230	30 MIN.(4)	2.3×10^3	9.5×10^5	-	9.5×10^5	
LT-460(2)	CV	230	30 MIN.(4)	2.3×10^3	9.5×10^5	-	9.5×10^5	R1
LT-461(2)	CV	230	30 MIN.(4)	2.3×10^3	9.5×10^5	-	9.5×10^5	
FT-474	CV	231.5	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	5.0×10^6 (9)	
FT-475	CV	231.5	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	5.0×10^6 (9)	
FT-484	CV	231.5	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	5.0×10^6 (9)	R2
FT-485	CV	231.5	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	5.0×10^6 (9)	
FT-494	CV	231.5	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	5.0×10^6 (9)	
FT-495	CV	231.5	1 DAY	2.3×10^3	3.5×10^6	3.5×10^5	5.0×10^6 (9)	
FT-940	RAB	230	30 DAYS	—	1.0×10^6 (6)	1.0×10^5	1.1×10^6	
FT-943	RAB	230	30 DAYS	-	1.0×10^6 (6)	1.0×10^5	1.1×10^6	
PT-934	RAB	230	30 DAYS	-	1.0×10^6 (6)	1.0×10^5	1.1×10^6	
PT-940	RAB	230	30 DAYS	-	1.0×10^6 (6)	1.0×10^5	1.1×10^6	
PT-943	RAB	230	30 DAYS	-	1.0×10^6 (6)	1.0×10^5	1.1×10^6	
MOV								
V-866A	CV	241	1 HR.	2.3×10^3	9.5×10^5	9.5×10^4	1.0×10^6	
V-866B	CV	241	1 HR.	2.3×10^3	9.5×10^5	9.5×10^4	1.0×10^6	
V869	RAB	241	30 DAYS	-	1.0×10^6	1.0×10^5	1.1×10^6	
V-744A	CV	240	5 MIN.(4)	2.3×10^3	9.5×10^5	-	9.5×10^5	
V-[illegible]48	CV	240	5 MIN.(4)	2.3×10^3	9.5×10^5	-	9.5×10^5	

TABLE 1.3.3 (Continued)

EQUIPMENT TOTAL RADIATION ACCUMULATION BY LOCATION AND LOCA OPERATING TIME

Component	Location	Level (ft) (Approx.)	Time Of Operation	Radiation Exp. (40 yrs)(1)	Accident(3) Radiation Exp.	Margin (10%)	Total Anticipated Radiation Exposure
V-860A	RAB	212	30 DAYS	-	1.0×10^6	1.0×10^5	1.1×10^6
V-860B	RAB	212	30 DAYS	-	1.0×10^6	1.0×10^5	1.1×10^6
V-861A	RAB	212	30 DAYS	-	1.0×10^6	1.1×10^5	1.1×10^6
V-861B	RAB	212	30 DAYS	-	1.0×10^6	1.1×10^5	1.1×10^6
V-863A	RAB	212	30 DAYS	-	1.0×10^6	1.1×10^5	1.1×10^6
V-863B	RAB	212	30 DAYS	-	1.0×10^6	1.1×10^5	1.1×10^6
CVC-381	RAB	240	30 DAYS	-	1.0×10^6	1.1×10^5	1.1×10^6
<u>SOLENOIDS</u>							
V12-7	CV	233	5 MIN.(4)	2.3×10^3	9.5×10^5	-	9.5×10^5
V12-9	CV	233	5 MIN.(4)	2.3×10^3	9.5×10^5	-	9.5×10^5
V12-11	CV	233	5 MIN.(4)	2.3×10^3	9.5×10^5	-	9.5×10^5
V12-13	CV	233	5 MIN.(4)	2.3×10^3	9.5×10^5	-	9.5×10^5
<u>MOTORS</u>							
HVH-1	CV	275	3 HRS.	1.9×10^2	3.1×10^6	3.1×10^5	3.4×10^6
HVH-2	CV	275	3 HRS.	1.9×10^2	3.1×10^6	3.1×10^5	3.4×10^6
HVH-3	CV	275	3 HRS.	1.9×10^2	3.1×10^6	3.1×10^5	3.4×10^6
HVH-4	CV	275	3 HRS.	1.9×10^2	3.1×10^6	3.1×10^5	3.4×10^6
<u>ELECTRICAL PENETRATIONS</u>							
Type 2	CV	234 - 246	30 DAYS	2.3×10^3	-	-	1.4×10^7 (5)
<u>TEMPERATURE ELEMENTS</u>							
TE-412B	CV	243	(7)	1.1×10^6	-	-	1.5×10^7 (5)
TE-412D	CV	243	(7)	1.1×10^6	-	-	1.5×10^7 (5)
TE-422B	CV	243	(7)	1.1×10^6	-	-	1.5×10^7 (5)
TE-422D	CV	243	(7)	1.1×10^6	-	-	1.5×10^7 (5)
TE-432B	CV	243	(7)	1.1×10^6	-	-	1.5×10^7 (5)
TE-432D	CV	243	(7)	1.1×10^6	-	-	1.5×10^7 (5)

(1) Extrapolated from plant data (See Table 1.3.1)

(2) Equipment located in instrument cabinets.

(3) Calculation based on IE Bulletin 79-01B, Appendix B. CHARTS/GRAPHS, Procedures for Evaluating Gamma Radiation Service Conditions.

(4) Charts/Graphs per IE Bulletin 79-01B, Appendix B allow calculation to a minimum of 1 hour exposure. This figure is conservative--no margin required.

(5) Total Integrated Radiation for accident condition (30 days) per IE Bulletin 79-01B, Appendix B. CHARTS/GRAPHS.

(6) Calculation based on Accident Radiation figure - 2×10^7 RADS.

(7) Not required for DBE--used only for outside containment MSLB protection.

(8) Includes added 7.9×10^4 RADS for 1 hour total integrated gamma dose at the surface of containment sump water (Per Appendix D, Table D-8, NUREG 0588).

(9) Includes added 1.15×10^6 RADS for 1 day total integrated gamma dose at the surface of containment sump water (Per Appendix D, Table D-8, NUREG 0588).

R2

1.3.3 Aging

Since class IE electrical equipment; specified, designed and built for H. B. Robinson did not require continued thermal and radiation aging called for under present qualification programs each component has to be reviewed using broad spectrum data sources. Three (3) sources have been selected as best meeting the requirements of IE Bulletin 79-01B. These are: (1) identification of similar equipment tested more recent than H. B. Robinson's equipment, (2) reinterpretation of existing test data performed during qualification testing but not specifically for aging purposes, and (3) evaluation of equipment materials for susceptibility to degradation due to thermal and radiation exposure.

Aging data available per the three categories above for listed components in section 3.0 of this report will be shown within the ENVIRONMENT, Qualification column of the System Component Evaluation Work Sheet forms. For the third category listed above degradation susceptibility sources utilized are: (1) NRC IE Bulletin 79-01B, Environmental Qualification of Class IE Equipment, Appendix C, (2) Radiation Effects Design Handbook, Section 3, NASA CR-1787, and (3) A Review of Equipment Aging Theory and Technology, (Draft Copy) EPRI RP-890-1.

Empirical data to date for H. B. Robinson gives a time base of ten (10) years' life for the electrical equipment identified within the Master List of Electrical Equipment Required to Function Under Postulated Accident Condition. No significant failure rate has been experienced at H. B. Robinson with the listed equipment and only routine maintenance and alignment/calibration procedures have been required.

1.4 Engineered Safety Feature Systems Electrical Equipment

The following engineered safety feature systems were identified as having electrical equipment required to function under the defined accident conditions:

- Safety Injection
- Containment Isolation
- Air Recirculation
- Containment Spray

Electrical equipment associated with these systems is listed in Tables 1.4.1, 1.4.2, and 1.4.3. The FSAR lists the above as Engineered Safety Feature Systems. They are segregated by plant design systems and identified as to their functions by use of reference sheet 2.1 within Section 2.0, Master List of Electrical Equipment Required to Function Under Postulated Accident Conditions of the 45-day report previously submitted. The reference sheet 2.1 of this report segregates the equipment to be further evaluated and details additionally identified systems and equipment.

Graphic portrayal of the listed instrumentation by accident function is located in figures 2.1.1 through 2.1.4 within the 45-day report submitted by CP&L in March 1980 and are not repeated for this submittal.

The environmental test profiles used for qualification programs included in the 45-day report have not been resubmitted for this report. It is noted that the formal documents referred and used to substantiate qualification contain the formated environmental profiles required. When these documents are reviewed for qualification confirmation, the profiles can be checked for plant accident parametric coverage.

TABLE 1.4.1

EQUIPMENT LIST FOR SAFETY INJECTION AND AIR RECIRCULATION

1. V478, 488, 498 Main Feedwater Valve
2. V479, 489, 499 Bypass Feedwater Valve
3. V867 A, B Boron Injection Inlet
4. V870 A, B Boron Injection Discharge
5. V866 A, B Hot Leg Injection (a)
6. V744 A, B Core Deluge
7. Safety Injection Pump Motor A, B, C
8. * Residual Heat Removal Pump Motor A, B
9. Service Water Pump Motor A, B, C, D
10. Service Water Booster Pump Motor A, B
11. * Containment Fans HVH-1, 2, 3, 4
12. Auxiliary Feedwater Pump Motor A, B
13. Containment Spray Pump Motor A, B
14. V878 A, B Safety Injection Pump Crosstie

* Equipment used for Air Recirculation

(a) Removed from automatic activation by Safety Injection Signal.

TABLE 1.4.2

EQUIPMENT LIST FOR CONTAINMENT ISOLATION (PHASE A)

1.	CVC-200A	Letdown orifice isolation
2.	CVC-200B	Letdown orifice isolation
3.	CVC-200C	Letdown orifice isolation
4.	CVC-204A	Letdown line isolation
5.	CVC-204B	Letdown line isolation
6.	PS-956A	Sample line isolation (pressurizer steam)
7.	PS-956B	Sample line isolation (pressurizer steam)
8.	PS-956C	Sample line isolation (pressurizer liquid)
9.	PS-956D	Sample line isolation (pressurizer liquid)
10.	PS-956E	Sample line isolation (hot leg)
11.	PS-956F	Sample line isolation (hot leg)
12.	PS-956G	Sample line isolation (accumulator)
13.	PS-956H	Sample line isolation (accumulator)
14.	RC-HC-516	Pressurizer relief tank to gas analyzer
15.	RC-HC-519A	Primary water to pressurizer relief tank
16.	RC-HC-519B	Primary water to pressurizer relief tank
17.	RC-HC-553	Pressurizer relief tank to gas analyzer
18.	CC-HC-739	Component cooling from excess letdown heat exchanger
19.	SI-855	Nitrogen supply for the accumulators
20.	WD-1721	Reactor coolant drain tank pump discharge
21.	WD-1722	Reactor coolant drain tank pump discharge
22.	WD-1723	Containment sump to waste holdup tank
23.	WD-1728	Containment sump to water holdup tank
24.	WD-1786	Vent header from reactor coolant drain tank
25.	WD-1787	Vent header from reactor coolant drain tank
26.	WD-1789	Gas analyzer from reactor coolant drain tank
27.	WD-1794	Gas analyzer from reactor coolant drain tank
28.	SGB-FCV-1930A	Steam generator A blowdown line
29.	SGB-FCV-1930B	Steam generator A blowdown line
30.	SGB-FCV-1931A	Steam generator B blowdown line

TABLE 1.4.2 (Continued)

31.	SGB-FCV-1931B	Steam generator B blowdown line |R1
32.	SGB-FCV-1932A	Steam generator C blowdown line
33.	SGB-FCV-1932B	Steam generator C blowdown line
34.	SGB-FCV-1933A	Steam generator A sample line
35.	SGB-FCV-1933B	Steam generator A sample line
36.	SGB-FCV-1934A & B	Steam generator B sample line
37.	SGB-FCV-1935A	Steam generator C sample line
38.	SGB-FCV-1935B	Steam generator C sample line
39.	RM-1	Radiation monitoring pump outlet
40.	RM-2	Radiation monitoring pump inlet
41.	RM-3	Containment outlet
42.	RM-4	Containment inlet
43.	IVSW-PCV-1922A	Isolation valve seal water system
44.	IVSW-PCV-1922B	Isolation valve seal water system
45.	HVAC-V12-6	Containment ventilation isolation valve
46.	HVAC-V12-7	Containment ventilation isolation valve
47.	HVAC-V12-8	Containment ventilation isolation valve
48.	HVAC-V12-9	Containment ventilation isolation valve
49.	HVAC-V12-10	Containment ventilation isolation valve
50.	HVAC-V12-11	Containment ventilation isolation valve
51.	HVAC-V12-12	Containment ventilation isolation valve
52.	HVAC-V12-13	Containment ventilation isolation valve
53.	V841A, B	Boron Injection Tank Recirculation

TABLE 1.4.3

EQUIPMENT LIST FOR CONTAINMENT SPRAY
ACTUATION AND CONTAINMENT ISOLATION
PHASE B

1. Containment Spray Pump A, B
2. V880 A, B, C. D - Containment Spray Discharge Valves
* 3. V381 - Reactor Coolant Pump Seal Water Return Line
* 4. V626 - Reactor Coolant Pump Thermal Barrier Cooling Water Return Line
* 5. V735 - Reactor Coolant Pump Thermal Barrier Cooling Water Return Line
* 6. V716 A, B - Reactor Coolant Pump Cooling Water Inlet Line
* 7. V730 - Reactor Coolant Pump Bearing Oil Cooler Cooling Water Return Line
* 8. V1-3A, V1-3B, V1-3C - Main Steam Isolation Valves

* Equipment used for Containment Isolation Phase B

TABLE 1.4.4

EQUIPMENT LIST FOR LONG TERM ACCIDENT MITIGATION

1. Residual Heat Removal Pump Motor A, B
2. V869 Hot Leg Injection
3. V860 A, B C.V. Sump to RHR Suction
4. V861 A, B C.V. Sump to RHR Suction
5. V863 A, B RHR Discharge to SI/Spray Suction

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2.0 MASTER LIST OF ELECTRICAL EQUIPMENT REQUIRED TO FUNCTION UNDER POSTULATED ACCIDENT CONDITIONS

2.0 MASTER LIST OF ELECTRICAL EQUIPMENT REQUIRED TO FUNCTION UNDER POSTULATED ACCIDENT CONDITIONS

The master list was developed by reviewing the FSAR, Westinghouse Technical Descriptions, Emergency Instructions, System Flow Diagrams and Plant Modifications. Both safety-related equipment and associated equipment for accident mitigation were addressed and evaluated per the environmental conditions existing during their accident and post-accident application.

Systems presented on the Master List sheets represent the plant systems as shown on the flow diagrams contained in the FSAR and Westinghouse PWR NSSS drawings. To aid in cross referencing the plant systems to the Appendix A, Typical Equipment/Functions Needed for Mitigation of a LOCA or MSLB Accident, listing the following descriptive paragraphs apply. In some cases equipment in the Plant System will appear in more than one Appendix A listing.

Engineered Safeguards Actuation

All devices required for engineered safeguards initiation that are subject to a harsh environment are included in the Master List under the Safety Injection System. The processors of the signals (logic cabinets) are not included as they are located in the control room area and are not subject to any accident harsh environment conditions. R2

Reactor Protection

Reactor Coolant System and Reactor Protection System list the instrumentation (RTDs, Pressure and Level Transmitters) required to provide Reactor Protection.

Containment Isolation

Containment isolation valves are located outside containment and close shortly after the accident occurs. They are not exposed to the containment harsh accident environment. Therefore, they are not listed or evaluated in this section. As they are part of the Engineered Safety Feature Systems actuated by Phase A containment isolation signal, they are listed in Table 1.4.2, Equipment List for Containment Isolation (Phase A).

Main and Auxiliary Steam Line Isolation

The main steam line isolation and break protection electrical equipment is included in the Master List under Main Steam System. The electrical equipment for this system is located outside of containment and does not see the harsh accident environment and is not evaluated in this report. Evaluation data on these items is found in the H. B. Robinson 45-day Report.

Main and Auxiliary Feedwater Isolation

Electrical Equipment related to LOCA and Steam Line Break for this title are listed under Feedwater System. The electrical equipment for this system located outside of containment does not see the harsh accident environment and are not evaluated in this report. Evaluation data on these items is found in the H. B. Robinson 45-day Report.

Emergency Power

The Emergency Diesel Generators, 4 kV Switchgear, 600 volt Load Centers and D.C. Systems are not part of this report as they are physically located away from containment and any other accident environment areas.

Containment Heat Removal

HVAC System equipment list provides the electrical equipment provided for this function. This includes fan motors and containment isolation valves.

Containment Ventilation

The equipment required for this function is described under Containment Heat Removal and Containment Isolation paragraphs of this section. R1

Control Room Habitability Systems and Ventilation for Areas Containing Safety-Related Equipment

This equipment is not subject to any harsh environment conditions due to accident and is not included in this report for evaluation.

Service Water

The equipment list for Service and Cooling Water System includes this title. As this equipment is not in the harsh accident environment, evaluation is presented in the 45-day Report.

Emergency Shutdown

This function has been covered by reviewing the Plant Emergency Procedures and assuring that all electrical equipment stated pertaining to shutdown has been covered by listing and evaluation.

Post-Accident Sampling and Monitoring

Equipment included for post-accident monitoring purposes is located in Main Steam System and Feedwater System listings. Evaluation sheets are included in the 45-day Report.

Radiation Monitoring

The H. B. Robinson radiation monitoring system is not safety related and is not included in this report.

R2

Safety-Related Display Information

All of the display instrumentation associated with accident evaluation and accident mitigation is located in the control room or other non-harsh environment locations. Therefore, they are not included in the Master List.

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2.1 REFERENCE SHEET

(2) Component is not exposed to DBE. No qualification required. Evaluation Work Sheet is not included in this report. See H.B.Robinson 45-day report on IE Bulletin 79-01B for data and evaluation.

(3) Component is not exposed to DBE but used for long term accident mitigation. Evaluation Work Sheet included in the report.

(4) Component was not included in H.B.Robinson 45-day report on IE Bulletin 79-01B . Evaluation Work Sheet included in this report.

(5) Component is required for Main Steam Line Break detection only. Evaluation Work Sheet included in this report.

(6) Component is being replaced by another more significantly qualified component. See Evaluation Work Sheets this report for replacements. For known qualification information on this component seeH.B.Robinson 45-day report on IE Bulletin 79-01B.

SYSTEM: SAFETY INJECTION			
COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
FT-940 (3) (4)	FLOW TRANSMITTER		X
FT-943 (3) (4)	FLOW TRANSMITTER		X
PT-934 (3) (4)	PRESSURE TRANSMITTER		X
PT-940 (3) (4)	PRESSURE TRANSMITTER		X
PT-943 (3) (4)	PRESSURE TRANSMITTER		X
PT-950 (2)	PRESSURE TRANSMITTER		X
PT-951 (2)	PRESSURE TRANSMITTER		X
PT-952 (2)	PRESSURE TRANSMITTER		X
PT-953 (2)	PRESSURE TRANSMITTER		X
PT-954 (2)	PRESSURE TRANSMITTER		X
PT-955 (2)	PRESSURE TRANSMITTER		X
LS-1925A (4)	LEVEL SWITCH	X	
LS-1925B (4)	LEVEL SWITCH	X	

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

SYSTEM: SAFETY INJECTION (continued)

COMPONENTS

Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
V-841A (2)	VALVE, SOLENOID		X
V-841B (2)	VALVE, SOLENOID		X
V-866A	VALVE, MOTOR OPERATOR	X	
V-866B	VALVE, MOTOR OPERATOR	X	
V-867A (2)	VALVE, MOTOR OPERATOR		X
V-867B (2)	VALVE, MOTOR OPERATOR		X
V-869 (3) (4)	VALVE, MOTOR OPERATOR		X
V-870A (2)	VALVE, MOTOR OPERATOR		X
V-870B (2)	VALVE, MOTOR OPERATOR		X
V-878A (2)	VALVE, MOTOR OPERATOR		X
V-878B (2)	VALVE, MOTOR OPERATOR		X
V-880A (2)	VALVE, MOTOR OPERATOR		X
V-880B (2)	VALVE, MOTOR OPERATOR		X
V-880C (2)	VALVE, MOTOR OPERATOR		X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

SYSTEM: SAFETY INJECTION (continued)			
COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
V-880D (2)	VALVE, MOTOR OPERATOR		X
SI-A (2)	SAFETY INJECTION PUMP, MOTOR		X
SI-B (2)	SAFETY INJECTION PUMP, MOTOR		X
SI-C (2)	SAFETY INJECTON PUMP, MOTOR		X
CS-A (2)	CONTAINMENT SPRAY PUMP, MOTOR		X
CS-B (2)	CONTAINMENT SPRAY PUMP, MOTOR		X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

SYSTEM: SAFETY INJECTION EQUIPMENT/COMPONENTS			
COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
2/C SHIELDED #16	INSTRUMENTATION CABLE	X	X
AMP #16/9 INSULATED	TERMINAL LUG	X	X
3/C #19/22	CABLE	X	X
HEAT SHRINK TUBING	CABLE SPLICE	X	X
C-3	ELECTRICAL PENETRATION	X	
D-2	ELECTRICAL PENETRATION	X	
D-8	ELECTRICAL PENETRATION	X	
D-9	ELECTRICAL PENETRATION	X	
SILICONE RUBBER TAPE #70	CONNECTION PROTECTION	X	
2/C #16, 3/C #16	CONTROL CABLE	X	X
1 C 500 MCM	POWER CABLE		X

|R

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

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SYSTEM: REACTOR COOLANT

COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
LT-459 (6)	LEVEL TRANSMITTER	X	
LT-460 (6)	LEVEL TRANSMITTER	X	
LT-461 (6)	LEVEL TRANSMITTER	X	
PT-444 (6)	PRESSURE TRANSMITTER	X	
PT-445 (6)	PRESSURE TRANSMITTER	X	
PT-455 (6)	PRESSURE TRANSMITTER	X	
PT-456 (6)	PRESSURE TRANSMITTER	X	
PT-457 (6)	PRESSURE TRANSMITTER	X	

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

(Rev-1)

SYSTEM: REACTOR COOLANT

EQUIPMENT/COMPONENTS

COMPONENTS

Plant Identification Number (1)	Generic Name	Location: Inside Primary Containment	Location: Outside Primary Containment
2/C SHIELDED #16	INSTRUMENTATION CABLE	X	
AMP #16 INSULATED	TERMINAL LUG	X	
B-2	ELECTRICAL PENETRATION	X	
B-5	ELECTRICAL PENETRATION	X	
B-9	ELECTRICAL PENETRATION	X	
CROUSE HINDS RPC-317-160-SOIN/SO8N	CONNECTOR, ELECTRICAL	X	X
CROUSE HINDS RPC-117-150-POIN/PO8N	CONNECTOR, ELECTRICAL	X	X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

SYSTEM: MAIN STEAM			
COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
FT-474 (6)	FLOW TRANSMITTER	X	
FT-475 (6)	FLOW TRANSMITTER	X	
FT-484 (6)	FLOW TRANSMITTER	X	
FT-485 (6)	FLOW TRANSMITTER	X	
FT-494 (6)	FLOW TRANSMITTER	X	
FT-495 (6)	FLOW TRANSMITTER	X	
PT-474 (2)	PRESSURE TRANSMITTER		X
PT-475 (2)	PRESSURE TRANSMITTER		X
PT-476 (2)	PRESSURE TRANSMITTER		X
PT-484 (2)	PRESSURE TRANSMITTER		X
PT-485 (2)	PRESSURE TRANSMITTER		X
PT-486 (2)	PRESSURE TRANSMITTER		X
PT-494 (2)	PRESSURE TRANSMITTER		X
PT-495 (2)	PRESSURE TRANSMITTER		X
PT-496 (2)	PRESSURE TRANSMITTER		X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

SYSTEM: MAIN STEAM (Continued)			
COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
PT 464 (2)	PRESSURE TRANSMITTER		X
PT 466 (2)	PRESSURE TRANSMITTER		X
PT 468 (2)	PRESSURE TRANSMITTER		X
V1-3A (2)	VALVE, SOLENOID		X
V1-3B (2)	VALVE, SOLENOID		X
V1-3C (2)	VALVE, SOLENOID		X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

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SYSTEM: MAIN STEAM EQUIPMENT/COMPONENTS

COMPONENTS

Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
2/C SHIELDED #16	INSTRUMENTATION CABLE	X	X
AMP #16 INSULATED	TERMINAL LUG	X	X
B-1	ELECTRICAL PENETRATION	X	
C-1	ELECTRICAL PENETRATION	X	
HEAT SHRINK TUBING	CABLE SPLICE	X	
SILICON RUBBER TAPE 70	CONNECTION PROTECTION	X	
3/C #16 2/C #16	CONTROL CABLE		X
CROUSE-HINDS RPC-317-160-S01N/S08N	CONNECTOR, ELECTRICAL	X	X
RPC-117-150-P01N/P08N	CONNECTOR, ELECTRICAL	X	X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

(Rev-1)

SYSTEM: FEEDWATER			
COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
LT-474 (6)	LEVEL TRANSMITTER	X	
LT-475 (6)	LEVEL TRANSMITTER	X	
LT-476 (6)	LEVEL TRANSMITTER	X	
LT-477 (6)	LEVEL TRANSMITTER	X	
LT-484 (6)	LEVEL TRANSMITTER	X	
LT-485 (6)	LEVEL TRANSMITTER	X	
LT-486 (6)	LEVEL TRANSMITTER	X	
LT-487 (6)	LEVEL TRANSMITTER	X	
LT-494 (6)	LEVEL TRANSMITTER	X	
LT-495 (6)	LEVEL TRANSMITTER	X	
LT-496 (6)	LEVEL TRANSMITTER	X	
LT-497 (6)	LEVEL TRANSMITTER	X	
V-478 (2)	VALVE, SOLENOID		X
V-479 (2)	VALVE, SOLENOID		X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

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SYSTEM: FEEDWATER (Continued)

COMPONENTS

Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
V-488 (2)	VALVE, SOLENOID		X
V-489 (2)	VALVE, SOLENOID		X
V-498 (2)	VALVE, SOLENOID		X
V-499 (2)	VALVE, SOLENOID		X
AFW-A (2)	FEEDWATER PUMP, MOTOR		X
AFW-B (2)	FEEDWATER PUMP, MOTOR		X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

(Rev-1)

SYSTEM: FEEDWATER	EQUIPMENT/COMPONENTS		
COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
2/C SHIELDED #16	INSTRUMENTATION CABLE	X	X
AMP #16 INSULATED	TERMINAL LUG	X	X
HEAT SHRINK TUBING	CABLE SPLICE	X	
C-1	ELECTRICAL PENETRATION	X	
C-2	ELECTRICAL PENETRATION	X	
C-4	ELECTRICAL PENETRATION	X	
C-9	ELECTRICAL PENETRATION	X	
3/C #16, 2/C #16	CONTROL CABLE		X
SILICON RUBBER TAPE	CONNECTION PROTECTION	X	
CROUSE-HINDS RPC-317-160-S01N/S08N	CONNECTOR, ELECTRICAL	X	X
CROUSE -HINDS RPC-117-150-P01N/P08N	CONNECTOR, ELECTRICAL	X	X
1/C 500 MCM	POWER CABLE		X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

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SYSTEM: AUXILIARY COOLING

COMPONENTS

Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
V-626 (2)	VALVE, MOTOR OPERATOR		X
V-716A (2)	VALVE, MOTOR OPERATOR		X
V-716B (2)	VALVE, MOTOR OPERATOR		X
V-730 (2)	VALVE, MOTOR OPERATOR		X
V-735 (2)	VALVE, MOTOR OPERATOR		X
V-744A	VALVE, MOTOR OPERATOR	X	
V-744B	VALVE, MOTOR OPERATOR	X	
RHR-A (3)	RESIDUAL HEAT REMOVAL PUMP, MOTOR		X
RHR-B (3)	RESIDUAL HEAT REMOVAL PUMP, MOTOR		X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

SYSTEM: AUXILARY COOLING (RESIDUAL HEAT REMOVAL)			
COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
V-860A (3) (4)	VALVE, MOTOR OPERATOR		X
V-860B (3) (4)	VALVE, MOTOR OPERATOR		X
V-861A (3) (4)	VALVE, MOTOR OPERATOR		X
V-861B (3) (4)	VALVE, MOTOR OPERATOR		X
V-863A (3) (4)	VALVE, MOTOR OPERATOR		X
V-863B (3) (4)	VALVE, MOTOR OPERATOR		X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

SYSTEM: AUXILIARY COOLING	EQUIPMENT/COMPONENTS		
COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
D-2	ELECTRICAL PENETRATION	X	
1/C 500 MCM	POWER CABLE		X
AMP #16/9 INSULATED	TERMINAL LUG	X	X
HEAT SHRINK TUBING	CABLE SPLICE	X	X
SILICON RUBBER TAPE 70	CONNECTION PROTECTION	X	
3/C #19/22	CONTROL CABLE	X	X
2/C #16/3C #16	CONTROL CABLE	X	X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

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SYSTEM: REACTOR PROTECTION

COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
TE-412B (5)	TEMPERATURE ELEMENT	X	
TE-412D (5)	TEMPERATURE ELEMENT	X	
TE-422B (5)	TEMPERATURE ELEMENT	X	
TE-422D (5)	TEMPERATURE ELEMENT	X	
TE-432B (5)	TEMPERATURE ELEMENT	X	
TE-432D (5)	TEMPERATURE ELEMENT	X	

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

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SYSTEM: REACTOR PROTECTION		EQUIPMENT/COMPONENTS	
COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
4/C SHIELDED #16	INSTRUMENTATION CABLE	X	X
AMP #16	TERMINAL LUG	X	
C-4	ELECTRICAL PENETRATION	X	
C-9	ELECTRICAL PENETRATION	X	
CROUSE-HINDS RPC-317-160-S01N/S08N	CONNECTOR, ELECTRICAL	X	X
CROUSE-HINDS RPC 117-150-P01N/P08N	CONNECTOR, ELECTRICAL	X	X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

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SYSTEM: SERVICE AND COOLING WATER

COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
SW-A (2)	SERVICE WATER PUMP MOTOR		X
SW-B (2)	SERVICE WATER PUMP, MOTOR		X
SW-C (2)	SERVICE WATER PUMP, MOTOR		X
SW-D (2)	SERVICE WATER PUMP, MOTOR		X
SWB-A (2)	SERVICE WATER BOOSTER PUMP, MOTOR		X
SWB-B (2)	SERVICE WATER BOOSTER PUMP, MOTOR		X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

SYSTEM: SERVICE AND COOLING WATER		EQUIPMENT/COMPONENTS	
COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
1/C 500 MCM	POWER CABLE		X
RUBBER TAPE	MOTOR CABLE SPLICE		X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

SYSTEM: CHEMICAL & VOLUME CONTROL

COMPONENTS

Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
CVC-200A (6)	VALVE, SOLENOID	X	
CVC-200B (6)	VALVE, SOLENOID	X	
CVC-200C (6)	VALVE, SOLENOID	X	
CVC-381 (3)(4)	VALVE, Motor Operator		X

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

SYSTEM: CHEMICAL & VOLUME CONTROL — EQUIPMENT/COMPONENT

COMPONENTS

Plant Identification Number (1)	Generic Name	Location		
		Inside Primary Containment	Outside Primary Containment	
2/C #16	CONTROL CABLE	X		
3/C #19/22 (2)	CABLE		X	R
2/C #16, 3/C #16	CONTROL CABLE	X	X	
SILICON RUBBER TAPE #70	MOTOR CABLE SPLICE	X		
HEAT SHRINK TUBING	CABLE SPLICE	X		
C-3	ELECTRICAL PENETRATION	X		R
D-9	ELECTRICAL PENETRATION	X		

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

SYSTEM: HVAC			
COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
V12-6 (2)	VALVE, SOLENOID		X
V12-7 (6)	VALVE, SOLENOID	X	
V12-8 (2)	VALVE, SOLENOID		X
V12-9 (6)	VALVE, SOLENOID	X	
V12-10 (2)	VALVE, SOLENOID		X
V12-11 (6)	VALVE, SOLENOID	X	
V12-12 (2)	VALVE, SOLENOID		X
V12-13 (6)	VALVE, SOLENOID	X	
HVH-1	FAN, MOTOR	X	
HVH-2	FAN, MOTOR	X	
HVH-3	FAN, MOTOR	X	
HVH-4	FAN, MOTOR	X	

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

(Rev-1)

SYSTEM: HVAC		EQUIPMENT/COMPONENT	
COMPONENTS			
Plant Identification Number (1)	Generic Name	Location	
		Inside Primary Containment	Outside Primary Containment
3/C #16, 2/C #16	CONTROL CABLE	X	X
AMP #16	TERMINAL LUG	X	X
C-3	ELECTRICAL PENETRATION	X	
C-6	ELECTRICAL PENETRATION	X	
C-8	ELECTRICAL PENETRATION	X	
D-1	ELECTRICAL PENETRATION	X	
D-3	ELECTRICAL PENETRATION	X	
D-5	ELECTRICAL PENETRATION	X	
HEAT SHRINK TUBING	CABLE SPLICE	X	
1/C 500 MCM	POWER CABLE	X	
SILICON RUBBER TAPE #70	CONNECTION PROTECTION MOTOR CABLE SPLICE	X	

(1) When a component is not identified by plant identification number, the manufacturer, model number, serial number, etc., will be used.

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3.0 ENVIRONMENTAL QUALIFICATION OF ELECTRICAL EQUIPMENT REQUIRED TO FUNCTION UNDER POSTULATED ACCIDENT CONDITIONS

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3.1 DOCUMENTATION REFERENCE SHEET

1. Specification CPL-R2-E3 - Containment Structure Electrical Penetrations
2. Westinghouse Letter CPL-77-550 (Electrical Penetrations)
3. Crouse Hinds Quality Control Inspection Reports (Electrical Penetrations)
4. NPR Penetration - Steam Incident and Helium Leakage Tests-with attached Stress Analysis Report
5. Ebasco Specification: CPL-R2-E13, Electrical cable, I&C
6. Ebasco Specification: CPL-R2-E14, Electrical Cable, 4160v and 480v
7. * Ebasco Specification: CPL-R2-E-1, Motor Operators for Valves
8. * Westinghouse Specification: E-676258, Motor Operated Valves
9. * Westinghouse Specification: E-676270, Control Valves
10. * Ebasco PO NY-435227 to McIntosh Equipment Corp. for Containment Level Switches
11. * Ebasco Specification CPL-R2-IN-7, Level Switches
12. * Westinghouse Specification 676410, Instruments, general, inside containment
13. Crouse Hinds Connector Data, Electrical Penetrations
14. WCAP - 7410-L Vol. I Environmental Testing of ESF Related Equipment

* References not used within the 90-Day Report.

3.1 DOCUMENTATION REFERENCE SHEET (continued)

15. WCAP - 7410-L Vol. II Environmental Testing of ESF Related Equipment

16. WCAP - 9003 Fan Cooler Motor Unit Test

17. WCAP - 7744-L Environmental Testing of ESF Related Equipment

18. WCAP - 7829-L Fan Cooler Motor Unit Test

19. WCAP - 8587 Environmental Qualification of Westinghouse NSSS Class IE Equipment

* 20. H. B. Robinson Modification and Setpoint Revision No. 212 MSLB Transmitter Shielding

21. Postulated Pipe Failure Analysis Outside of Containment

* 22. Rosemount Test Report 117415 Rev. B, Model 1152 Transmitter

23. Rosemount Test Report 3788, Model 1153A Transmitter

* 24. Rosemount Product Data Sheet 2256, Model 1151 Transmitter

* 25. Rosemount Test Report 97215A, Model 1151 Transmitter

* 26. Rosemount Test Report 127227 Rev. A, Model 1151 Transmitter

* 27. ASCO Service Bulletin, Solenoid Valves

* 28. WCAP-7153 Investigation of Chemical Additions for Reactor Containment Sprays

29. Vendor Drawing 5379-4093 Motor Terminal Lead

30. Emergency Instructions (E.I. - 1) Incident Involving Reactor coolant System Depressurization

* 31. FSAR, pg. 5.1.2-28, Electrical Penetrations

* 32. FSAR, pg. 7.5-11, Environmental Capability

3.1 DOCUMENTATION REFERENCE SHEET (continued)

* 33. FSAR, pg. 6.3-14 to 6.3-20, Fan Cooler Evaluation

34. FSAR, pg. 6.2-14, Motor Design Criteria

35. FSAR, pg. 6.2-31,32, Pump & Valve motor Criteria

36. FSAR, pgs. 6.3-4, 6.3-10, Air Recirculation System Criteria

* 37. FSAR, pg. 6.4-12, Containment Spray System Criteria

38. FSAR, Section 7, Amendment 7A, Component Environmental Testing Program

* 39. Standard Manufacturer's Testing Program to Meet Design Criteria

40. FSAR, pg. 7.5-11, Operating Time Requirements

41. Rosemount Report 37821, Model 1153 Transmitter

42. Limitorque Test Report FP-3271

43. Qualification Tests for a Modular Penetration, Report AB-11/12/13

44. RAYCHEM, Technical Report F-C4033-3, Tests of Raychem Thermofit Insulation Systems Under Simultaneous Exposure to Heat, Gamma Radiation, Steam and Chemical Spray

45. AMP Test Report 110-11002, Qualification Test Report on AMP - Radiation resistant PIDG Terminals R2

46. Continental Wire & Cable Company, Technical Report F-C2935, Test of Electrical Cables Under Simulated Post-Accident Reactor Containment Service

47. ASCO Test Report No. AQS21678/TR, Revision A, Qualification Tests of Solenoid Valves by Environmental Exposure to Elevated Temperature, Radiation, Wear Aging, Seismic Simulation, Vibration Endurance, Accident Radiation and LOCA Simulation

48. WCAP - 9157 Environmental Qualification of Safety Related Class 1E Process Instrumentation

3.1 DOCUMENTATION REFERENCE SHEET (continued)

49. KERITE COMPANY - Letter dated August 5, 1980
enclosures: LOCA QUALIFICATION OF KERITE 1000 VOLT
FR/FR CONTROL CABLE
LOCA QUALIFICATION OF KERITE 1000 VOLT
HTK/FR POWER CABLE R1

50. KERITE COMPANY - Letter dated October 21, 1980
in response to CP&L letter, CO-02726, dated October 13,1980
requesting qualification data on use of SCOTCH 70 Silicone
Rubber Tape R2

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SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (4)		
System: SAFETY INJECTION Plant ID No. FT-940 (1)	Operating Time	30 DAYS	2 HRS.	38	17	SIMULTANEOUS TEST	NONE
Component: FLOW TRANSMITTER	Temperature (°F)	AMBIENT	287	38	17	SIMULTANEOUS TEST	NONE
Manufacturer: FISHER & PORTER	Pressure (PSIA)	ATMOS.	75	38	17	SIMULTANEOUS TEST	NONE
Model Number: 10B2496PBBABBB	Relative Humidity (%)	AMBIENT	100	38	17	SIMULTANEOUS TEST	NONE
Function: SAFETY INJECTION Accuracy: Spec: ± 1/2% Demon:	Chemical Spray	NOT REQUIRED	–	–	–	–	
Service: HEADER FLOW (Hot Leg)	Radiation	1.1×10^6	2×10^8	(3)	17	SEQUENTIAL TEST (5)	NONE
Location: REACTOR AUXILIARY BLDG.	Aging						
Flood Level Elev: (2) Above Flood Level: Yes No	Submergence	NOT REQUIRED	–	–	–	–	

R2

(1) Transmitter not exposed to DBE - Long-term mitigation radiation exposure only
(2) Not involved in containment flood postulation
(3) See Section 1.3.2
(4) See Section 3.2.2 for evaluation.
(5) Test performed after LOCA simulated environmental exposure

R2

Facility: H. B. Robinson #2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (4)		
System: SAFETY INJECTION Plant ID No. FT-943 (1)	Operating Time	30 DAYS	2 HRS.	38	17	SIMULTANEOUS TEST	NONE
Component: FLOW TRANSMITTER	Temperature (°F)	AMBIENT	287	38	17	SIMULTANEOUS TEST	NONE
Manufacturer: FISHER & PORTER	Pressure (PSIA)	ATMOS.	75	38	17	SIMULTANEOUS TEST	NONE
Model Number: 10B2496PBBABBB	Relative Humidity (%)	AMBIENT	100	38	17	SIMULTANEOUS TEST	NONE
Function: SAFETY INJECTION Accuracy: Spec: Demon:	Chemical Spray	NOT REQUIRED	-	-	-	-	
Service: HEADER FLOW (Cold Leg)	Radiation	1.1×10^6	2×10^8	(3)	17	SEQUENTIAL TEST (5)	NONE
Location: REACTOR AUXILIARY BUILDING	Aging						
Flood Level Elev: (2) Above Flood Level: Yes No	Submergence	NOT REQUIRED	-	-	-	-	

R2

(1) Transmitter not exposed to DBE - Long-term mitigation radiation exposure only
(2) Not involved in containment flood postulation
(3) See Section 1.3.2
(4) See Section 3.2.2 for evaluation.
(5) Test performed after LOCA simulated environmental exposure

R2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (4)		
System: SAFETY INJECTION Plant ID No. PT-934 (1)	Operating Time	30 DAYS	2 HRS.	38	17	SIMULTANEOUS TEST	NONE
Component: PRESSURE TRANSMITTER	Temperature (°F)	AMBIENT	287	38	17	SIMULTANEOUS TEST	NONE
Manufacturer: FISHER & PORTER	Pressure (PSIA)	ATMOS.	75	38	17	SIMULTANEOUS TEST	NONE
Model Number: 50EP1041BCXA	Relative Humidity (%)	AMBIENT	100	38	17	SIMULTANEOUS TEST	NONE
Function: BORON INJECTION Accuracy: Spec: Demon:	Chemical Spray	NOT REQUIRED	–	–	–	–	–
Service: TANK HEADER PRESSURE	Radiation	1.1×10^6	2×10^8	(3)	17	SEQUENTIAL TEST (5)	NONE
Location: REACTOR AUXILIARY BLDG.	Aging						
Flood Level Elev: (2) Above Flood Level: Yes No	Submergence	NOT REQUIRED	–	–	–	–	–

|R2

(1) Transmitter not exposed to DBE - Long-term mitigation radiation exposure only
(2) Not involved in containment flood postulation
(3) See Section 1.3.2
(4) See Section 3.2.2 for evaluation.
(5) Test performed after LOCA simulated environmental expusure

|R2

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SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (4)		
System: SAFETY INJECTION Plant ID No. PT-940 (1)	Operating Time	30 DAYS	2 HRS.	38	17	SIMULTANEOUS TEST	NONE
Component: PRESSURE TRANSMITTER	Temperature (°F)	AMBIENT	287	38	17	SIMULTANEOUS TEST	NONE
Manufacturer: FISHER & PORTER	Pressure (PSIA)	ATMOS.	75	38	17	SIMULTANEOUS TEST	NONE
Model Number: 50EP1041	Relative Humidity (%)	AMBIENT	100	38	17	SIMULTANEOUS TEST	NONE
Function: SAFETY INJECTION Accuracy: Spec: Demon:	Chemical Spray	NOT REQUIRED	-	-	-	-	-
Service: HEADER PRESSURE (Hot Leg)	Radiation	1.1×10^6	2×10^8	(3)	17	SEQUENTIAL TEST (5)	NONE
Location: REACTOR AUXILIARY BUILDING	Aging						
Flood Level Elev: (2) Above Flood Level: Yes No	Submergence	NOT REQUIRED	-	-	-	-	-

R2

(1) Transmitter not exposed to DBE - Long-term mitigation radiation exposure only
(2) Not involved in containment flood postulation
(3) See Section 1.3.2
(4) See Section 3.2.2 for evaluation.
(5) Test performed after LOCA simulated environmental exposure

R2

Facility: H. B. Robinson #2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (4)		
System: SAFETY INJECTION (1) Plant ID No. PT-943	Operating Time	30 DAYS	2 HRS.	38	17	SIMULTANEOUS TEST	NONE
Component: PRESSURE TRANSMITTER	Temperature (°F)	AMBIENT	287	38	17	SIMULTANEOUS TEST	NONE
Manufacturer: FISHER & PORTER	Pressure (PSIA)	ATMOS.	75	38	17	SIMULTANEOUS TEST	NONE
Model Number: 50EP1041BCXA	Relative Humidity (%)	AMBIENT	100	38	17	SIMULTANEOUS TEST	NONE
Function: SAFETY INJECTION Accuracy: Spec: Demon:	Chemical Spray	NOT REQUIRED	-	-	-		
Service: HEADER PRESSURE (Cold Leg)	Radiation	1.1×10^6	2×10^8	(3)	17	SEQUENTIAL TEST (5)	NONE
Location: REACTOR AUXILIARY BUILDING	Aging						
Flood Level Elev: (2) Above Flood Level: Yes No	Submergence	NOT REQUIRED	-	-	-	-	

R2

(1) Transmitter not exposed to DBE - Long-term mitigation radiation exposure only
(2) Not involved in containment flood postulation
(3) See Section 1.3.2
(4) See Section 3.2.2 for evaluation.
(5) Test performed after LOCA simulated environmental exposure | R2

Facility: H. B. Robinson #2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (5)		
System: SAFETY INJECTION Plant ID No. V-866A (1)	Operating Time	1 HR	7 DAYS	38	14	SIMULTANEOUS TEST	NONE
Component: MOTOR OPERATOR	Temperature (°F)	(2)	308	35, 38	14, 17	SIMULTANEOUS TEST	NONE
Manufacturer: LIMITORQUE	Pressure (PSIA)	(3)	75	35	14, 17	SIMULTANEOUS TEST	NONE
Model Number: SMB-00	Relative Humidity (%)	100	100	35	14, 17	SIMULTANEOUS TEST	NONE
Function: HOT LEG INJECTION Accuracy: Spec: Demon:	Chemical Spray	H_3BO_3 N_aOH	H_3BO_3 N_aOH		14	SIMULTANEOUS TEST	NONE
Service: MOTOR OPERATED VALVE-SIS	Radiation	1.0×10^6	2×10^8	(4)	17	SEQUENTIAL TEST (6)	NONE
Location: CONTAINMENT 241	Aging		40 YRS		17	SEQUENTIAL TEST (6)	NONE
Flood Level Elev: 231.2' Above Flood Level: Yes X No	Submergence	NOT REQUIRED					

R2

NOTES:
(1) Same data this sheet applies to V-866B.
(2) See accident profile - Temperature - Figure 3.1-1.
(3) See accident profile - Pressure - Figure 3.1-2.
(4) See Section 1.3.2.
(5) See Section 3.2.3 for evaluation.
(6) Test performed prior to LOCA simulated environmental exposure

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SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (3)		
System: SAFETY INJECTION Plant ID No. V869	Operating Time	(1)	7 DAYS	30	14	SIMULTANEOUS TEST	NONE
Component: MOTOR OPERATOR	Temperature (°F)	AMBIENT	308	35	14,17	SIMULTANEOUS TEST	NONE
Manufacturer: LIMITORQUE	Pressure (PSIA)	ATMOS.	75	35	14,17	SIMULTANEOUS TEST	NONE
Model Number: SMB-00	Relative Humidity (%)	AMBIENT	100	35	14,17	SIMULTANEOUS TEST	NONE
Function: HOT LEG INJECTION BORON INJECTION Accuracy: Spec: Demon:	Chemical Spray	NOT REQUIRED	H_3BO_3 NaOH		14,17	SIMULTANEOUS TEST	NONE
Service: MOTOR OPERATED VALVE	Radiation	1.1×10^6	2.0×10^8	(2)	17	SEQUENTIAL TEST (5)	NONE
Location: REACTOR AUXILIARY BLDG.	Aging	–	40 YRS.		17	SEQUENTIAL TEST (5)	NONE
Flood Level Elev: (4) Above Flood Level: Yes No	Submergence	NOT APPLICABLE					

R2

R2

(1) To be used intermittantly during mitigation of LOCA

(2) See Section 1.3.2.

(3) See Section 3.2.3 for evaluation.

(4) Not involved in containment flood postulation

(5) Test performed prior to LOCA simulated environmental exposure

R2

Facility: H. B. Robinson #2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (4)		
System: SAFETY INJECTION Plant ID No. LS-1925A Component: LEVEL SWITCH	Operating Time	CONTINUOUS	NONE	-	-	-	(5)
	Temperature (°F)	(2)	NONE	-	-	-	(5)
Manufacturer: MADISON Model Number: 5602	Pressure (PSIA)	(3)	NONE	-	-	-	(5)
	Relative Humidity (%)	100	NONE	-	-	-	(5)
Function: CONTAINMENT SUMP WATER LEVEL MEASUREMENT Accuracy: Spec: 1/2" increment Demon:	Chemical Spray	H_3BO_3 NaOH	NONE	-	-	-	(5)
Service: DETECT WATER LEVEL CHANGES	Radiation	1.4×10^7	NONE	-	-	-	(5)
Location: CONTAINMENT 228'	Aging		NONE	-	-	-	(5)
Flood Level Elev: 231.2' Above Flood Level: Yes No X	Submergence		NONE				

R2

(1) Same data this sheet applies to LS-1925B
(2) See accident profile - Temperature - Figure 3.1-1
(3) See accident profie - Pressure - Figure 3.1-2
(4) See Section 3.2.7 for evaluation
(5) Function to be superceded by two channels of analog measurement equipment. No qualification testing required.

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SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS	
	Parameter	Specification	Qualification	Specification	Qualification (5)			
System: AUXILIARY COOLING Plant ID No. V-744A (1) Component: MOTOR OPERATOR	Operating Time	5 MIN	7 DAYS	40	14	SIMULTANEOUS TEST	NONE	
	Temperature (°F)	(2)	308	35, 38	14, 17	SIMULTANEOUS TEST	NONE	
Manufacturer: LIMITORQUE	Pressure (PSIA)	(3)	75	35	14, 17	SIMULTANEOUS TEST	NONE	
Model Number: SMB-3	Relative Humidity (%)	100	100	35	14, 17	SIMULTANEOUS TEST	NONE	
Function: REACTOR CORE DELUGE Accuracy: Spec: Demon:	Chemical Spray	H_3BO_3 N_aOH	H_3BO_3 N_aOH		14	SIMULTANEOUS TEST	NONE	R2
Service: MOTOR-OPERATED VALVE-SIS	Radiation	9.5×10^5	2×10^8	(4)	17	SEQUENTIAL TEST (6)	NONE	R2
Location: CONTAINMENT 245'	Aging		40 YRS		17	SEQUENTIAL TEST (6)	NONE	R2
Flood Level Elev: 231.2' Above Flood Level: Yes X No	Submergence							R2

NOTES:

(1) Same data this sheet applies to V-744B.
(2) See accident profile - Temperature - Figure 3.1-1.
(3) See accident profile - Pressure - Figure 3.1-2.
(4) See Section 1.3.2.
(5) See Section 3.2.3 for evaluation.
(6) Test performed prior to LOCA simulated environmental exposure | R2

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SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (4)		
System: AUXILIARY COOLING Plant ID No. V860A Component: MOTOR OPERATOR	Operating Time	(2)	7 DAYS	30	14	SIMULTANEOUS TEST	NONE
	Temperature (°F)	AMBIENT	308	35	14,17	SIMULTANEOUS TEST	NONE
Manufacturer: LIMITORQUE	Pressure (PSIA)	ATMOS.	75	35	14,17	SIMULTANEOUS TEST	NONE
Model Number: SMB-1	Relative Humidity (%)	AMBIENT	100	35	14,17	SIMULTANEOUS TEST	NONE
Function: CV SUMP TO RHR SUCTION Accuracy: Spec: Demon:	Chemical Spray	NOT REQUIRED	H_3BO_3 NaOH		14,17	SIMULTANEOUS TEST	NONE
Service: MOTOR OPERATED VALVE	Radiation	1.1×10^6	2.0×10^8	(3)	17	SEQUENTIAL TEST (6)	NONE
Location: REACTOR AUXILIARY BLDG.	Aging	-	40 YRS.		17	SEQUENTIAL TEST (6)	NONE
Flood Level Elev: (5) Above Flood Level: Yes No	Submergence	NOT APPLICABLE	-				

(1) Same data this sheet applies to V860B

(2) To be used intermittantly during mitigation of LOCA.

(3) See Section 1.3.2.

(4) See Section 3.2.3 for evaluation.

(5) Not involved in containment flood postulation

(6) Test performed prior to LOCA simulated environmental exposure

R2

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SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (4)		
System: AUXILIARY COOLING Plant ID No. V861A (1)	Operating Time	(2)	7 DAYS	30	14	SIMULTANEOUS TEST	NONE
Component: MOTOR OPERATOR	Temperature (°F)	AMBIENT	308	35	14,17	SIMULTANEOUS TEST	NONE
Manufacturer: LIMITORQUE	Pressure (PSIA)	ATMOS.	75	35	14,17	SIMULTANEOUS TEST	NONE
Model Number: SMB-1	Relative Humidity (%)	AMBIENT	100	35	14,17	SIMULTANEOUS TEST	NONE
Function: CV SUMP TO RHR SUCTION Accuracy: Spec: Demon:	Chemical Spray	NOT REQUIRED	H_3BO_3 NaOH		14,17	SIMULTANEOUS TEST	NONE
Service: MOTOR OPERATED VALVE	Radiation	1.1×10^6	2.0×10^8	(3)	17	SEQUENTIAL TEST (6)	NONE
Location: REACTOR AUXILIARY BLDG.	Aging	-	40 YRS.		17	SEQUENTIAL TEST (6)	NONE
Flood Level Elev: (5) Above Flood Level: Yes No	Submergence	NOT APPLICABLE					

R2

R2

(1) Same data this sheet applies to V861B
(2) To be used intermittantly during mitigation of LOCA.
(3) See Section 1.3.2.
(4) See Section 3.2.3 for evaluation.
(5) Not involved in containment flood postulation
(6) Test performed prior to LOCA simulated environmental exposure

R2

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Sheet 12 of 25

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (4)		
System: AUXILIARY COOLING Plant ID No. V863A	Operating Time	(2)	7 DAYS	30	14	SIMULTANEOUS TEST	NONE
Component: MOTOR OPERATOR	Temperature (°F)	AMBIENT	308	35	14,17	SIMULTANEOUS TEST	NONE
Manufacturer: LIMITORQUE	Pressure (PSIA)	ATMOS.	75	35	14,17	SIMULTANEOUS TEST	NONE
Model Number: SMB-00	Relative Humidity (%)	AMBIENT	100	35	14,17	SIMULTANEOUS TEST	NONE
Function: RHR DISCHARGE TO SI SPRAY SYSTEM Accuracy: Spec: Demon.	Chemical Spray	NOT REQUIRED	H_3BO_3 NaOH		14,17	SIMULTANEOUS TEST	NONE
Service: MOTOR OPERATED VALVE	Radiation	1.1×10^6	2.0×10^8	(3)	17	SEQUENTIAL TEST (6)	NONE
Location: REACTOR AUXILIARY BLDG.	Aging	-	40 YRS.		17	SEQUENTIAL TEST (6)	NONE
Flood Level Elev: (5) Above Flood Level: Yes No	Submergence	NOT APPLICABLE					

R2 (margin marks beside Chemical Spray, Radiation/Aging rows)

(1) Same data this sheet applies to V863B
(2) To be used intermittantly during mitigation of LOCA.
(3) See Section 1.3.2.
(4) See Section 3.2.3 for evaluation.
(5) Not involved in containment flood postulation
(6) Test performed prior to LOCA simulated environmental exposure | R2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (5)		
System: AUXILIARY COOLING Plant ID No. RHR-A (1) Component: MOTOR, PUMP	Operating Time	CONTINUOUS	CONTINUOUS	34, 35		(4)	(2)
	Temperature (^{o}F)	85 (AVG) AMBIENT	90^{o} C RISE	35, 19		(4)	(2)
Manufacturer: WESTINGHOUSE Model Number: 506UPZ	Pressure (PSIA)	15	15	35, 19		(4)	(2)
Function: CIRCULATE SUMP WATER & BORATED REFUELING WATER TO REACTOR COOLANT SYSTEM-POST LOCA	Relative Humidity (%)	AMBIENT	AMBIENT	35, 19		(4)	(2)
Accuracy: Spec: Demon:	Chemical Spray	NOT REQUIRED	NOT REQUIRED				
Service: RESIDUAL HEAT REMOVAL PUMP - SIS	Radiation	1.1 x 10^6	2.0 x 10^8	19 (3)	18	SEQUENTIAL TEST	NONE
Location: AUXILIARY BUILDING	Aging		40 yrs.		18	SEQUENTIAL TEST	NONE
Flood Level Elev: N/A Above Flood Level: Yes No	Submergence	NOT APPLICABLE					

NOTES:

(1) Same data this sheet applies to RHR-B.
(2) Motor not exposed to DBE, no qualification testing needed.
(3) See Section 1.3.2
(4) Information to be obtained from manufacturer.
(5) See Section 3.2.8 for evaluation

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SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification		
System: REACTOR PROTECTION Plant ID No. TE-412B (1)	Operating Time	1 HR.	2 WKS.	21	48	SIMULTANEOUS TEST	NONE (5)
Component: TEMPERATURE ELEMENT	Temperature (°F)	(2)	320	21	48	SIMULTANEOUS TEST	NONE (5)
Manufacturer: ROSEMOUNT	Pressure (PSIA)	(3)	81	21	48	SIMULTANEOUS TEST	NONE (5)
Model Number: 176KF	Relative Humidity (%)	100	100	21	48	SIMULTANEOUS TEST	NONE (5)
Function: MAIN STEAM LINE BREAK MONITOR Accuracy: Spec: Demon:	Chemical Spray	-	H_3BO_3 NaOH		48	SIMULTANEOUS TEST	NONE (5)
Service: T_{AV}-REACTOR COOLANT LOOP #1 SIS GENERATION	Radiation	1.5×10^7	1.0×10^8	(4)	48	SEQUENTIAL TEST (6)	NONE (5)
Location: CONTAINMENT 243'	Aging		40 YRS. + 2 WKS.		48	SEQUENTIAL TEST (6)	NONE
Flood Level Elev: 231.2' Above Flood Level: Yes X No	Submergence	NOT APPLICABLE					

R2

R2

NOTES:

(1) Same data this sheet applies to TE-412D
(2) See accident profile - Temperature - Figure 3.1-1
(3) See accident profile - Pressure - Figure 3.1-2
(4) See Section 1.3.2
(5) Not required for DBE - used only for outside containment Main Steam line Break protection
(6) Test performed prior to LOCA simulated environmental exposure

R2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification		
System: REACTOR PROTECTION Plant ID No. TE-422B (1)	Operating Time	1 HR.	2 WKS.	21	48	SIMULTANEOUS TEST	NONE (5)
Component: TEMPERATURE ELEMENT	Temperature (°F)	(2)	320	21	48	SIMULTANEOUS TEST	NONE (5)
Manufacturer: ROSEMOUNT	Pressure (PSIA)	(3)	81	21	48	SIMULTANEOUS TEST	NONE (5)
Model Number: 176 KF	Relative Humidity (%)	100	100	21	48	SIMULTANEOUS TEST	NONE (5)
Function: MAIN STEAM LINE BREAK MONITOR Accuracy: Spec: Demon:	Chemical Spray	–	H_3BO_3 NaOH		48	SIMULTANEOUS TEST	NONE (5)
Service: T_{AV}-REACTOR COOLANT LOOP #2 SIS GENERATION	Radiation	1.5×10^7	1.0×10^8	(4)	48	SEQUENTIAL TEST (6)	NONE (5)
Location: CONTAINMENT 243'	Aging		40 YRS. + 2 WK. POST ACCIDENT		48	SEQUENTIAL TEST (6)	NONE
Flood Level Elev: 231.2' Above Flood Level: Yes X No	Submergence	NOT APPLICABLE					

R2

R2

NOTES:

(1) Same data this sheet applied to TE-422D
(2) See accident profile - Temperature - Figure 3.1-1
(3) See accident profile - Pressure - Figure 3.1-2
(4) See Section 1.3.2
(5) Not required for DBE - only used for outside containment Main Steam Line Break protection
(6) Test performed prior to LOCA simulated environmental exposure

R2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification		
System: REACTOR PROTECTION Plant ID No. TE-432B (1)	Operating Time	1 HR.	2 WKS.	21	48	SIMULTANEOUS TEST	NONE (5)
Component: TEMPERATURE ELEMENT	Temperature (°F)	(2)	320	21	48	SIMULTANEOUS TEST	NONE (5)
Manufacturer: ROSEMOUNT	Pressure (PSIA)	(3)	81	21	48	SIMULTANEOUS TEST	NONE (5)
Model Number: 176KF	Relative Humidity (%)	100	100	21	48	SIMULTANEOUS TEST	NONE (5)
Function: MAIN STEAM-LINE BREAK MONITOR Accuracy: Spec: Demon:	Chemical Spray	-	H_3BO_3 NaOH		48	SIMULTANEOUS TEST	NONE (5)
Service: T_{VA} -REACTOR COOLANT LOOP #3 - SIS. GENERATION	Radiation	1.5×10^7	1.0×10^8	(4)	48	SEQUENTIAL TEST (6)	NONE (5)
Location: CONTAINMENT 243'	Aging		40 YRS. + 2 WKS.		48	SEQUENTIAL TEST (6)	
Flood Level Elev: 231.2' Above Flood Level: Yes X No	Submergence	NOT APPLICABLE					

R2

NOTES:

(1) Same data this sheet applies to TE-432D
(2) See accident profile - Temperature - Figure 3.1-1
(3) See accident profile - Pressure - Figure 3.1-2
(4) See Section 1.3.2
(5) Not required for DBE - only used for outside containment main steam line break protection
(6) Test performed prior to LOCA simulated environmental exposure

Facility: H. B. Robinson #2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (5)		
System: HVAC Plant ID No. HVH-1 (1) Component: MOTOR, FAN Manufacturer: WESTINGHOUSE Model Number: 685.5-S Function: TRANSFER HEAT FROM CONTAINMENT TO SERVICE WATER Accuracy: Spec: Demon: Service: CONTAINMENT FAN COOLER Location: CONTAINMENT 275'	Operating Time	3 hrs.	24 hrs. +	36	16	Simultaneous Test	None
	Temperature (°F)	(2)	315	36	16	Simultaneous Test	None
	Pressure (PSIA)	(3)	75-95	36	16	Simultaneous Test	None
	Relative Humidity (%)	100	100	36	16	Simultaneous Test	None
	Chemical Spray	H_3BO_3 NaOh	H_3BO_3 NaOh	34	16	Simultaneous Test	None
	Radiation	3.4×10^6	1.41×10^8	(4)	15	Sequential Test (6)	None
	Aging		40 yrs.	-	15	Sequential Test (6)	None
Flood Level Elev: 231.2' Above Flood Level: Yes X No	Submergence	NOT APPLICABLE					

R2

R2

NOTES:

(1) Same data this sheet applies to HVH-2, HVH-3, HVH-4
(2) See accident profile - Temperature - Figure 3.1-1
(3) See accident profile - Pressure - Figure 3.1-2
(4) See Section 1.3.2.
(5) See Section 3.2.8 for evaluation.
(6) Test performed on selected motor components - not part of LOCA simulated environmental exposure R2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification		
System: ALL Plant ID No. SEE NOTE(1)	Operating Time	CONTINUOUS	105 hrs.	1	2,43	SIMULTANEOUS TEST	NONE
Component: ELECTRICAL PENETRATION	Temperature (^oF)	(2)	340	1	2,3,4,43	SIMULTANEOUS TEST	NONE
Manufacturer: CROUSE-HINDS	Pressure (PSIA)	(3)	75	1	2,3,4,43	SIMULTANEOUS TEST	NONE
Model Number: 1.2.2 (745) 1.2.5 (751) 1.2.2 (747) 1.2.4 (749)	Relative Humidity (%)	100	100	1	2,4,43	SIMULTANEOUS TEST	NONE
Function: ACCIDENT CONDITION MONITORING	Chemical Spray	–	H_3BO_3 NaOH		43	SIMULTANEOUS TEST	NONE
Accuracy: Spec: Demon:	Radiation	1.4×10^7	2.13×10^8	(6)	43	SEQUENTIAL TEST (7)	NONE (5)
Service: PROVIDE CABLE CONTINUITY THROUGH CONTAINMENT SHELL Location: CONTAINMENT 234' - 246'	Aging	40	524 hrs. @ 150 C (40 yrs)	1	43	SEQUENTIAL TEST (7)	NONE
Flood Level Elev: 231.2' Above Flood Level: Yes X No	Submergence	NOT APPLICABLE					

R2

R2

NOTES:

(1) Data this sheet applies to penetrations B-1, B-2, B-5, B-9, C-1, C-2, C-3, C-4, C-6, C-8, C-9, D-1, D-2, D-3, D-5, D-8, D-9
(2) See accident profile - Temperature - Figure 3.1.1
(3) See accident profile - Pressure - Figure 3.1.2
(4) See Section 3.2.1 for evaluation
(5) Qualification established for penetration cartridge only. Pigtail cable requires separate testing as reported in Section 3.2.1
(6) See Section 1.3.2
(7) Test performed prior to LOCA simulated environmental exposure

R2

Facility: H. B. Robinson #2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (6)		
System: ALL Plant ID No. SEE NOTE(1)	Operating Time	1 HR.-1 DAY	67 HRS.	38	23	SIMULTANEOUS TEST	NONE
Component: TRANSMITTER	Temperature (^{o}F)	(2)	350	38	23	SIMULTANEOUS TEST	NONE
Manufacturer: ROSEMOUNT	Pressure (PSIA)	(3)	135	38	23	SIMULTANEOUS TEST	NONE
Model Number: 1153A	Relative Humidity (%)	100	100		23	SIMULTAN-TEST	NONE
Function: REPLACEMENT COMPONENT Accuracy: Spec: ± ¼% Demon:	Chemical Spray	H_3BO_3 NaOH	H_3BO_3 NaOH		23,41	SIMULTANEOUS TEST	NONE
Service:	Radiation	5.0×10^6	4.4×10^7	(5)	23	SEQUENTIAL TEST (7)	(4)
Location: CONTAINMENT	Aging	-	NOT WITHIN MFGR. TEST PROGRAM				(4)
Flood Level Elev: 231.2' Above Flood Level: Yes No	Submergence						

R2

R2

NOTES:

(1) Replacement transmitter to be supplied for: PT-444, PT-445, PT-455, PT-456, PT-457, LT-474, LT-475, LT-476, LT-477, LT-484, LT-486, LT-487, LT-494, LT-495 LT-496, LT-497, LT-459, LT-460, LT-461, FT-474, FT-475, FT-484, FT-485, FT-494, FT-495, LT-485

(2) See accident profile - Temperature - Figure 3.1-1

(3) See accident profile - Pressure - Figure 3.1-2

(4) Replacement transmitters tested under IEEE 323-1971 format, Rosemount currently performing transmitter testing to meet IEEE-323-1974 requirements.

(5) See Section 1.2.3

(6) See Section 3.2.1 for evaluation

(7) Test performed prior to LOCA simulated environmental exposure

R2

Facility: H. B. Robinson #2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (5)		
System: ALL Plant ID No. SEE NOTE (1)	Operating Time	5 min.	30 days	40	47	Simultaneous Test	None
Component: SOLENOID, VALVE	Temperature (°F)	(2)	346	40	47	Simultaneous Test	None
Manufacturer: ASCO	Pressure (PSIA)	(3)	125	40	47	Simultaneous Test	None
Model Number: NP831665E NP8316E35E 206-381-2U	Relative Humidity (%)	100	100	40	47	Simultaneous Test	None
Function: REPLACEMENT COMPONENT	Chemical Spray	H_3BO_3 NaOH	H_3BO_3 NaOH		47	Simultaneous Test	None
Accuracy: Spec: Demon: Service:	Radiation	9.5×10^5	2.0×10^8	(4)	47	Sequential Test (6)	None
Location: CONTAINMENT 283'	Aging	-	40 yrs. & 4.4 yrs.	(5)	47	Sequential Test (6)	None
Flood Level Elev: 231.2' Above Flood Level: Yes X No	Submergence	Not Applicable					

R2

NOTES:

(1) Replacement solenoid valves to be supplied for: V12-7, V12-9, V12-11, V12-13, CVC-200A, CVC-200B, CVC-200C R2
(2) See accident profile - Temperature - Figure 3.1-1
(3) See accident profile - Pressure - Figure 3.1-2
(4) See Section 1.3.2
(5) See Section 3.2.6 for evaluation
(6) Test performed prior to LOCA simulated environmental exposure R2

Facility: H. B. Robinson #2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification		
System: ALL Plant ID No.	Operating Time	CONTINUOUS	240 hrs.		46	SIMULTANEOUS TEST	NONE
Component: CABLE 4/C #16, 2/C #16, Shielded	Temperature (^oF)	(2)	340	5	46	SIMULTANEOUS TEST	NONE
Manufacturer: CONTINENTAL WIRE & CABLE	Pressure (PSIA)	(3)	115		46	SIMULTANEOUS TEST	NONE
Model Number: CC2115	Relative Humidity (%)	100	100		46	SIMULTANEOUS TEST	NONE
Function: FIELD CABLE	Chemical Spray		H_3BO_3		46	SEQUENTIAL TEST	NONE
Accuracy: Spec: Demon:							
Service: INSTRUMENTATION	Radiation	1.4×10^7	1.0×10^8	(1)	46	SEQUENTIAL TEST	NONE
Location: CONTAINMENT	Aging			5	(4)		
Flood Level Elev: 231.2' Above Flood Level: Yes No	Submergence	NOT APPLICABLE					

R2

NOTES:

(1) See Section 1.3.2
(2) See accident profile - Temperature - Figure 3.1.1
(3) See accident profile - Pressure - Figure 3.1.2
(4) See Section 3.2.4 for evaluation

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD (4)	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification		
System: ALL Plant ID No.	Operating Time	CONTINUOUS	50 DAYS		49	SIMULTANEOUS TEST	NONE
Component: CABLE 3/C #16, 2/C #16, 500 MCM, 3/C 19/#22	Temperature (^{o}F)	(2)	346	6	49	SIMULTANEOUS TEST	NONE
Manufacturer: KERITE	Pressure (PSIA)	(3)	128		49	SIMULTANEOUS TEST	NONE
Model Number: HIGH TEMP, FIRE RESISTANT	Relative Humidity (%)	100	100		49	SIMULTANEOUS TEST	NONE
Function: FIELD CABLE	Chemical Spray		H_3BO_3 NaOH		49	SIMULTANEOUS TEST	NONE
Accuracy: Spec: Demon: Service: CONTROL AND LOW POWER	Radiation	1.4×10^7	2.0×10^8	(1)	49	SIMULTANEOUS TEST	NONE
Location: CONTAINMENT	Aging		40 YEARS	6	49	SEQUENTIAL TEST	NONE
Flood Level Elev: 231.2' Above Flood Level: Yes No	Submergence	NOT APPLICABLE					

R1

R2

NOTES:

(1) See Section 1.3.2
(2) See accident profile - Temperature - Figure 3.1.1
(3) See accident profile - Pressure - Figure 3.1.2
(4) See Section 3.2.4

R1

Facility: H. B. Robinson #2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification (3)		
System: CHEMICAL & VOLUME Plant ID No. CVC-381	Operating Time	(1)	7 DAYS	30	14	SIMULTANEOUS TEST	NONE
Component: MOTOR OPERATOR	Temperature (°F)	AMBIENT	308	35	14,17	SIMULTANEOUS TEST	NONE
Manufacturer: LIMITORQUE	Pressure (PSIA)	ATMOS.	75	35	14,17	SIMULTANEOUS TEST	NONE
Model Number: SMB-00	Relative Humidity (%)	AMBIENT	100	35	14,17	SIMULTANEOUS TEST	NONE
Function: REACTOR COOLANT PUMP SEAL WATER RETURN Accuracy: Spec: Demon:	Chemical Spray	NOT REQUIRED	H_3BO_3 NaOH		14,17	SIMULTANEOUS TEST	NONE
Service: MOTOR OPERATED VALVE	Radiation	1.1×10^6	2.0×10^8	(2)	17	SEQUENTIAL TEST (5)	NONE
Location: 240' REACTOR AUXILIARY BLDG.	Aging		40 YRS.		17	SEQUENTIAL TEST (5)	NONE
Flood Level Elev: (4) Above Flood Level: Yes No	Submergence	NOT APPLICABLE					

R2

(1) To be used intermittantly during mitigation of LOCA
(2) See Section 1.3.2
(3) See Section 3.2.3 for evaluation
(4) Not involved in containment flood postulation
(5) Test performed prior to LOCA simulated environmental exposure

R2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification		
System: ALL Plant ID No.	Operating Time	CONTINUOUS	30 days		44	SIMULTANEOUS TEST	NONE
Component: CABLE SPLICES (1)	Temperature (°F)	(2)	357		44	SIMULTANEOUS TEST	NONE
Manufacturer: RAYCHEM	Pressure (PSIA)	(3)	85		44	SIMULTANEOUS TEST	NONE
Model Number: 1000-12N, 500-12N, 300-12N, 200-12N, 115-6N, 070-6N	Relative Humidity (%)	100	100		44	SIMULTANEOUS TEST	NONE
Function: SINGLE CONDUCTOR AND MULTICONDUCTOR CABLE SPLICING	Chemical Spray		H_3BO_3 NaOH		44	SIMULTANEOUS TEST	NONE
Accuracy: Spec: Demon:	Radiation	1.4×10^7	2.0×10^8	(5)	44	SEQUENTIAL TEST (6)	NONE
Service: ELECTRICAL PENETRATIONS Location: CONTAINMENT 234' - 246'	Aging		7 days @ 302°F 5×10^7 RAD		44	SIMULTANEOUS TEST	NONE
Flood Level Elev: 231.2' Above Flood Level: Yes X No	Submergence	NOT APPLICABLE					

R2

R2

NOTES:

(1) Plant procedure developed and approved for installation and checkout - M-521 (Revision 0)
(2) See accident profile - Temperature - Figure 3.1.1
(3) See accident profile - Pressure - Figure 3.1.2
(4) See Section 3.2.5 for evaluation
(5) See Section 1.3.2
(6) Test performed prior to (5×10^7R) and after (1.5×10^8R) LOCA simulated environmental exposure R2

Facility: H. B. Robinson #2

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS	
	Parameter	Specification	Qualification	Specification	Qualification			
System: ALL Plant ID No.	Operating Time	CONTINUOUS	4 days		45	SIMULTANEOUS TEST	NONE	R2
Component: TERMINALS, CABLE (1)	Temperature (°F)	(2)	350		45	SIMULTANEOUS TEST	NONE	R2
Manufacturer: AMP	Pressure (PSIA)	(3)	137		45	SIMULTANEOUS TEST	NONE	R2
Model Number: 53548-1 (wire size - 16)	Relative Humidity (%)	100	100		45	SIMULTANEOUS TEST	NONE	
Function: CONDUCTOR BUTT SPLICE	Chemical Spray		H_3BO_3 NaOH		45	SIMULTANEOUS TEST	NONE	
Accuracy: Spec: Demon:	Radiation	1.4 x 10^7	2.0 x 10^8	(5)	45	SEQUENTIAL TEST (6)	NONE	R2
Service: ELECTRICAL PENETRATIONS Location: CONTAINMENT 234' - 246'	Aging				(7)			
Flood Level Elev: 231.2' Above Flood Level: Yes X No	Submergence	NOT APPLICABLE						R2

NOTES:

(1) Plant procedure developed and approved for installation and checkout - M-521 (Revision 0)
(2) See accident profile - Temperature - Figure 3.1.1
(3) See accident profile - Pressure - Figure 3.1.2
(4) See Section 3.2.5 for evaluation
(5) See Section 1.3.2
(6) Test performed prior to LOCA simulated environmental exposure | R2
(7) Butt splice connection to be qualified during Wyle Lab test of PVC cable

SYSTEM COMPONENT EVALUATION WORK SHEET

EQUIPMENT DESCRIPTION	ENVIRONMENT			DOCUMENTATION REFERENCE		QUALIFICATION METHOD	OUTSTANDING ITEMS
	Parameter	Specification	Qualification	Specification	Qualification		
System: ALL Plant ID No.	Operating Time	CONTINUOUS			(4)		(6)
Component: TAPE, SILICON RUBBER	Temperature (°F)	(2)			(4)		(6)
Manufacturer: 3M/ELECTRO PRODUCTS DIVISION	Pressure (PSIA)	(3)			(4)		(6)
Model Number: SCOTCH 70	Relative Humidity (%)	100			(4)		(6)
Function: CABLE TERMINATION PROTECTION Accuracy: Spec: Demon:	Chemical Spray				(4)		(6)
Service:	Radiation	1.4×10^7		(1)	(4)		(6)
Location: CONTAINMENT	Aging				(4)		(6)
Flood Level Elev: 231.2' Above Flood Level: Yes X No	Submergence				(5)		

|R2

NOTES:

(1) See Section 1.3.2
(2) See accident profile - Temperature - Figure 3.1.1
(3) See accident profile - Pressure - Figure 3.1.2
(4) Qualification performed in conjunction with Kerite cable testing per IEEE 323-1974
(5) Not required
(6) Qualification per H.B. Robinson parameters to be performed by Wyle Labs. in conjunction with PVC cable test program

3.2 Electrical Equipment Qualification Evaluation

3.2.1 Electrical Penetrations and Connectors

The H. B. Robinson Nuclear Power Plant electrical penetrations are cartridge types with provisions for continuous pressurization. They were manufactured by Crouse-Hinds Company (Syracuse, N. Y.) to a Westinghouse design and specification CPL-R2-E3. Location within containment forms a grid pattern extending from elevation 234 feet to 246 feet. This places the penetrations above the established containment flood level of 231.2 feet. The electrical penetrations utilized by identified safety class electrical equipment are designated: Low Voltage (600V) 500 MCM, Low Voltage (600V) 3/C 19/#22, Low Voltage Control and Power (600V) 2/C #16, 3/C #16, and Instrumentation (600V) 2/C #16, 4/C #16 shielded. These types consist of a mixture of one-, two- and three-conductor cable interfaces and appropriate shields. Individual conductors are carried through the penetration and end in either a 60-inch or 72-inch pigtail. 2/C #16 and 3/C #16 pigtails are grouped and attached to electrical connectors (Crouse-Hinds model number RPC-317-160-SOIN/SO8N) to provide the appropriate cable match. The connectors are located in cable trays and lie in the horizontal plane. The cable tray runs are located essentially on the outside diameter of the polar crane shield wall to route cable to the respective instrumentation or control equipment.

The electrical penetration material which is located within containment and exposed to accident environment conditions consists of stainless steel (container) ceramic plate (conductor spacer) PVC and Kerite formula (conductor insulation) and aluminum (electrical connectors).

By specification each penetration type was designed to perform under the LOCA environmental conditions of pressure and temperature depicted within the H. B. Robinson FSAR (shown as Figure 3.1.1 and 3.1.2 in this report). Test information is recorded in References 3 and 4.

The CP&L Brunswick Nuclear Power Plant uses Westinghouse designed and fabricated electrical penetrations which are similar to those in use at H. B. Robinson. Both are cartridge type with stainless steel sleeves and both have potting compound seals for the internal connections of the feed-through solid copper conductors. Brunswick penetrations utilize heat-shrink tubing for small conductors internal insulation spliced to Okonite jacketed cables forming pigtails for field cable hookup. H. B. Robinson penetrations use silicone rubber internal insulation spliced with heat-shrink tubing to two (2) types of jacketed insulation cables (PVC and Kerite) forming pigtails for field cable hookup. Both use a ceramic seal to encapsulate pigtail entry and provide an impervious shield R2 with the cartridge sleeve. A greater degree of testing was performed on Brunswick type penetrations with results found in Reference 43. Briefly summarized:

Thermal cycling - $20^{\circ}C$ to $135^{\circ}C$ (5 cycles)
Pre-aging - 524 hrs. @ $70^{\circ}C$ (40 years)
Radiation - 2.13×10^{8} RAD
Steam Test - Temperature, Pressure, Humidity and Spray
(per report)

Due to the dual nature of the electrical penetrations, one side in containment the other outside, mock-up of only the in-containment area was required for testing purposes. The test data recorded and referenced above should validate qualification of the cartridge portion of the H. B. Robinson electrical penetrations.

The electrical connectors (Crouse-Hinds Model Number ((RPC-317-160-S01N/S08N)) used with the penetrations consist of an extruded aluminum shell with a hard anodized finish. The connector pins/sockets are silver-plated copper. The insert material is mineral filled diallyl phthalate with a thin wafer of silicone rubber provided for sealing purposes. R1

Mineral filled diallyl phthalate can withstand radiation exposure between 10^{8} and 10^{10} RADS with little or no permanent degradation.[2] The silicone rubber seal wafer is positioned between two plugs of diallyl phthalate and will not be significantly affected by irradiation. The connector proper will not be affected by normal plant life operation of forty (40) years or the added accident radiation dosage as presented in Table 1.3.3. R1

The aluminum shell is comprised of 6061 alloy which contains (%): .25 copper, .6 silicon, 1.0 magnesium and .25 chromium. A Martin hard-coat anodized finish is applied to a depth of 1.7 - 2.0 thousandths. The alloy used experiences a weight loss of 932 mg/dm^2 for the first day and an average of 370 mg/dm^2 per day thereafter when completely immersed in a NaOH adjusted boric acid solution (pH-9, heated to $200^{\circ}F$.[3] As the shell is anodized its corrosion resistance is improved. Additionally, the connectors will not be completely immersed in boric acid solution under spray conditions, nor will the high temperature be maintained for a thirty- (30) day period. Therefore, the worst case of loss of mass (.8 ounce per square decimeter after 30 days) will not be realized. Sufficient shell material will remain to preserve connector integrity. R1

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(2) See Appendix C to this report for reference information. R1

(3) WCAP 7153 Investigation of Chemical Additives for Reactor Containment Sprays. (Reference Table 8 and Figure 9.)

As reported by Crouse-Hinds, the anodized finish provides protection sufficient to enable specifying connector to be corrosion resistant to salt spray for 300 days (in tests per MIL C-5015D and MIL-E-4970A). Per manufacturer's installation instructions, connector will provide watertight seal and will exclude water by hose spray or stream. During refueling (August-October, 1980), all connectors in containment were checked and tightened to provide watertight fit. R2

A periodic check of connector clamp and shell cover screw tightness will be established and performed to assure connectors will function for the LOCA prescribed operation time of the penetrations (see Table 1.3.3). As the clamp seal was able to maintain connector operability after a three-hundred (300) day salt spray test per stated MIL SPECS, it is concluded that properly maintained clamp seals will provide chemical spray protection for the required operational times of electrical penetration connector circuits (thirty (30) minutes to one (1) day).

No significant degradation due to thermal aging will be experienced by the connector during operation plant life due to materials used in design and/or fabrication. The connector design temperature range is -80°F to 275°F and is sufficient to meet the operating and LOCA temperature range established for H. B. Robinson.

The electrical penetrations utilize a combination of five- (5) and six- (6) foot lengths of single or multiconductor cable to connect the penetration feed-through conductors to the field cable inside and outside containment. These "pigtail" cable were installed by the manufacturer and sleeved at the penetration end with heat-shrink tubing. For selective conductors, connectors were installed while the majority of pigtail cables required butt-style splicing for field cable connection. R1

The cabling used for pigtails was provided by CP&L/Ebasco specification/purchase and shipped to Crouse-Hinds Company for fabrication use. For the Low Voltage Power, (600V) electrical penetrations, 500 MCM Kerite cable with HI TEMP conductor insulation was provided (see Section 3.2.4 for qualification evaluation). For Low Voltage Control and Power (600V) electrical penetrations, 3/C #16 and 2/C #16 Kerite cable with FR conductor insulation was provided (see Section 3.2.4 for qualification evaluation). For Instrumentation (600V) electrical penetrations 2/C #16 (shielded) and 4/C #16 (shielded), Continental Wire and Cable Company cable with PVC conductor insulation was provided. No qualification data is available for this cable. CP&L has initiated a qualification test program to determine the ability of this cable to meet IEEE 323-1974 requirements using FSAR established accident parameters. Spare pigtails will be used and cable splices per Section 3.2.5 will be R1 utilized to maintain plant configuration during tests. Wyle Laboratories will perform the tests per Qualification Plan 543/4464/ES dated July 10, 1980. Testing and reporting will require thirty-five (35) weeks--after Receipt of Order. Major time factor will be thermal aging to achieve forty- (40) years' operating life before LOCA testing can be performed. After review of results, a report will be sent to NRC detailing any action by CP&L dictated by these tests. R1

These PVC insulated pigtails are used for instrumentation or within circuits which must perform their functions after short elapsed time periods; therefore, their long-term operability problems should not affect plant response to accident conditions. Results of the qualification test program will determine the ultimate disposition of these pigtails. If replacement is required, a plan and schedule for accomplishment will be included in the report already stated above. R1 R1

3.2.2 Electronic Transmitters

H. B. Robinson's original design and specification called for installation and use of Fisher and Porter electronic transmitter for the measurement of Pressure, Level and Flow parameters. As stated within CP&L response to NRC IE Bulletin 79-01 and the 45-day response to NRC IE Bulletin 79-01B CP&L preference, to obtain better operation and maintenance performance, is to change out the existing transmitters within containment--to be replaced by Rosemounts' Model No. 1153A.

Environmental tests performed on Fisher & Porter's transmitters (Model No. 10B2496) indicate failure occurs during the high temperature, steam/chemical spray testing stage while attempting to qualify to IEEE 323-1971 parameters. (Reference WCAP 9157 Environmental Qualification of Safety-Related Class IE Process Instrumentation).

Qualification testing of Rosemount Model 1153, Series A, per Rosemount Report No. 3788 states that the transmitter is qualified per the requirements of IEEE 323-1971. Missing from this report is the aging parameter not required for IEEE 323-1971 but necessary for complete LOCA qualification. Recent Rosemount testing to qualify a transmitter to meet IEEE 323-1974 requirements has resulted in failure. A combination of thermal aging, irradiation and chemical spray test specification parameters has resulted in failed components. The initial failed element was an O-ring comprised of sulphur cured polyethylene rubber. This allowed steam/chemical spray to affect electronic components. The O-ring mode of failure is attributed to high temperature vs. time necessary for the Arrhenius curve time compression to satisfy aging test requirements.

This testing failure does not preclude the use of the Rosemount 1153A within H. B. Robinson containment as it has successfully performed within the H. B. Robinson accident parameters of temperature, pressure and radiation levels. Transmitters located in containment will be required to perform within a maximum time period of twenty-four (24) hours following accident. O-ring failure due to high temperature should not occur during this time period. Reviewing Table C-1 of Appendix C, NRC IE Bulletin 79-01B, Thermal and Radiation Aging Degradation of Selected Materials, shows that polyethylene rubber has a potential for significant aging at ten (10) years and an allowable radiation susceptibility of 10^7 RADS before serious degradation occurs. Evaluating the above establishes the need to perform periodic changeout of transmitter O-rings.

Additionally, the time span to which Rosemount will qualify its IEEE 373-1974 transmitters is ten (10) years. To assure that listed transmitters within H. B. Robinson containment remain qualified a ten- (10) year replacement cycle will be adopted.[1]

For long-term accident mitigation, Fisher & Porter transmitters, Model Nos. 10B2496 and 50EP1041, located within the Reactor Auxiliary Building are used. Transmitter identification numbers are FT-940, FT-943, PT-934, PT-940 and PT-943. As these transmitters are not exposed to the LOCA accident environment, but will see the elevated radiation levels associated with reactor coolant recirculation, qualification is limited to their radiation withstand capability.

As previously stated, Fisher & Porter 10B2496 transmitters had failed environmental testing per IEEE 323-1971 requirements and reported in WCAP 9157. Failure occurred withing six (6) minutes of operation when in the high temperature/high pressure/spray testing environment (Table A-7, WCAP 9157). It is noted, though, and stated, that the "trip" function time of operation for the transmitters was accomplished. This portion of the test program is not relevant to H. B. Robinson use of the listed Fisher & Porter transmitters as they are not within containment and, therefore, not required to function under the harsh environmental conditions which caused test failure. Within the same report, it is stated that Fisher & Porter transmitters had successfully operated during and after irradiation testing (Table A-6, WCAP 9157). As only a total radiation level of 4×10^4 RADs were achieved, additional qualification was required to meet the radiation requirements established in Table 1.3.3. R2

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(1) Additional design changes/improvements by Rosemount would be followed to adopt improved components or materials to minimize changeout cycles.

Westinghouse WCAP 7744, Environmental Testing of Engineered Safety Features Related Equipment states that transmitters, identified by Westinghouse as Fisher & Porter, Model 10B2496, had been successfully tested to a level of 2.0×10^8 RADs. As the listed Fisher & Porter transmitters are exposed to a 1.1×10^6 RAD level, they are considered qualified for the application and functions stated within this report. To further identify the transmitters in use at H. B. Robinson with those tested, Westinghouse has stated that instruments used were ordered as NS (nonstandard) from Fisher & Porter. Check of purchase order and manufacturer's fabrication instructions show that the listed H. B Robinson Fisher & Porter transmitters were supplied as NS (nonstandard).

Westinghouse has been requested to supply the specific data and/or reports associated with the testing program, and it will be available for review after receipt.

3.2.3 Motor-Operated Valves

Within containment at H. B. Robinson four (4) motor operators are used for valve actuation for the listed equipment in this report. They are: V-744A and V-744B Auxiliary Cooling System and V-866A and V-866B, Safety Injection System. They are Limitorque Models SMB-00 (V-866A,B) and SMB-3, with motor brake (V-744A,B). Torque motors for V-744A&B have been wound with Class H insulation. V-866A&B Torque motors and V-744A&B motor brakes are wound with Class B insulation. Model SMB-00 has a Peerless built torque motor and Model SMB-3 has a Reliance built torque motor. | 81

Qualification testing of Limitorque motor operators was performed by Franklin Institute Research Laboratories and the test reports included in Westinghouse WCAP 7410-L, Environmental Testing of Engineered Safety Features Related Equipment. Limitorque Model SMB-0s, with and without motor brake, and Class B and Class H insulation were used during the tests. The results are applicable to the Models SMB-00 and SMB-3 used at H. B. Robinson as differences are dimensional and in torque rating only.

The qualification testing performed by FIRL encompasses the temperature, pressure, relative humidity and chemical spray parameters for H. B. Robinson; therefore, the Limitorque motor operations within containment are considered qualified per these parameters for H. B. Robinson operation.

Of concern was motor brake operation due to the results of FIRL Final Report F-C2485-01, Tests of a Limitorque Valve Operator and Motor Brake Assembly, Both with Class B Insulation Under Simulated Reactor Containment Post Accident Steam and Chemical Environments. Failure of the motor brake with subsequent valve operator failure was reported as occurring after seven (7) days within the test program. Performance prior to this time was recorded as satisfactory. Since the H. B. Robinson application of the motor brake, valve operator combination occurs within five (5) minutes after LOCA initiation, it is concluded that the intended function of this equipment will be met by the installed equipment; no further qualifying or changeout is planned.

Radiation exposure and aging tests are described within Westinghouse WCAP 7744, Environmental Testing of Engineered Safety Features Related Equipment. Total irradiation to 2×10^8 RADS and a thermal aging equivalent to forty (40) years is reported. Support data for these tests are on request from from Westinghouse and will be made available for review when received.

Outside of containment for long-term accident mitigation are additional Limitorque motor valve operators which will be exposed to elevated radiation levels only. These are CVC-381, V-860A, V-860B, V-861A, V-861B, V-863A, V-863B, V-869. The Limitorque models used are SMB-00 and SMB-1. No motor brakes are associated with these operators. As stated previously, Westinghouse WCAP 7744 reports a test which achieved irradiation levels of 2×10^8 RADS with no failures encountered. CP&L has requested copies of the test data from Westinghouse, and it will be made available upon receipt. No other accident environment parameters are experienced at this location; therefore, CP&L considers these motor valve operations qualified for their intended use and location. R2

3.2.4 Electrical Cable

The electrical equipment in containment and reported within the equipment list of this report is connected by either single conductors or multiconductor cables. These cables run via cable trays and conduit from the electrical penetrations to the equipment. Connections to the electrical penetrations are made by individual or grouped cable splices, or by electrical connectors. At the equipment end, formal component terminals with overall tape or crimped terminals with overall tape are used for connection.

The connectors used (Crouse-Hinds Model No. RPC-117-150-POIN/PO8N) were supplied with the electrical penetrations and mounted on the matching cable during construction. For details concerning qualification of this connector, see Section 3.2.1. For details concerning cable splices and terminals see Section 3.2.5.

The electrical cable used for equipment hookup is divided into three (3) classifications:

- o multiconductor - 2/C #16, 3/C #16, 3/C 19/#22
- o multiconductor - 2/C #16, 4/C #16 (single drain wire utilized as shield)
- o single conductor - 500 MCM

The unshielded multiconductor cable is used to power the identified motor-operated valves (3C 19/#22), control the identified solenoid valves and provide limit switch outputs (2/C #16, 3/C #16). The shielded multiconductor cable is used for analog signals obtained from the listed transmitter and the listed RTD temperature elements (2/C #16, 4/C #16 shielded). The single conductor cable (500 MCM) provides power for the containment fans (HVH-1 through HVH-4). The shielded cables used for containment instrumentation utilize the provided electrical connectors at the penetration end.

For instrumentation within containment, a silicon rubber conductor insulation with glass binder, an untinned bare copper drain wire and an overall silicon rubber jacket cable is used. The manufacturer, Continental Wire and Cable Company, used their formulated insulation type CC-2115. This formulation has been tested by the Franklin Institute Research Laboratories under Continental Wire and Cable Company instruction. Final Report F-C2935 dated, October 1970 with addendum dated November 1970, details the testing specifics which included a preconditioning (aging) period of six (6) hours at 151^{o}F, and a subsequent test achieved exposures of 1 x 10^{8} RADS. Also included was a chemical spray for one hundred and twenty (120) hours. The combined data for this cable insulation material indicates there should be no problems associated with LOCA pressure, temperature, humidity, spray, or radiation. At this time aging is the only unknown variable. Basically, silicon rubber cable insulation is designed and recommended for high temperature applications. CP&L has no plans to conduct separate testing to further qualify this cable.

For limit switch and solenoid valve operation, a Kerite fire-resistant conductor insulation with overall fire-resistant jacket cable is in use within containment.

Inspection of in-containment field cable hookup to limit switches and solenoid valves performed the week of August 18, 1980 through August 22, 1980 determined that Kerite fire-resistant conductor insulation with overall fire-resistant jacket cable is used. R1

The Kerite Company has attested to the ability of this cable supplied for H. B. Robinson to withstand the FSAR LOCA conditions of temperature, pressure and radiation. In addition, test qualification included forty- (40) year aging, borated spray and 100% relative humidity to meet IEEE 323-1974 and IEEE 383-1974 requirements. Referenced reports are: R1

FIRL Report F-C4020-1 dated March 1975.

Kerite Proprietary Engineering Memo No. 178 entitled, "Determining Temperature Ratings of Cables and Pre-aging Requirements for LOCA Simulation Tests," dated December 27, 1974 (superseded by EM178A dated May 1, 1979).

For motor power required for valve operation, a Kerite HI TEMP conductor insulation with asbestos fillers, nylon binder tape, neoprene treated tape, with fire-resistant jacket reinforced with a cotton-sleeve cable is in use within containment.

For containment fan power, a Kerite HI TEMP conductor insulation with overall fire-resistant jacket, reinforced by cotton-sleeve cable is in use within containment.

The Kerite Company has attested to the ability of this cable supplied for H. B. Robinson to withstand the FSAR LOCA conditions of temperature, pressure and radiation. In addition, test qualification included forty- (40) year aging, borated spray and 100% relative humidity exposure to meet IEEE 323-1974 and IEEE 383-1974 requirements. Referenced reports are: R1

FIRL Report F-C4020-2 dated March 1975.

Proprietary Engineering Memo No. 178 entitled, "Determining Temperature Ratings of Cables and Pre-aging Requirements for LOCA Simulation Tests" dated December 27, 1974 (superseded by EM 178A dated May 1, 1979 and EM 178B dated December 1, 1979).

To provide protection for cable termination at equipment end, when no formal termination method was provided, a silicone rubber tape was used. SCOTCH 70, high temperature silicone rubber tape, is used for safety-related terminations. This product has undergone radiation testing by the manufacturer, Minnesota Mining & Manufacturing Company (3M) up to 1.0×10^8 RADs at $40^\circ C$ temperature with no major degradation of performance. R2

A more comprehensive testing program to meet IEEE 323-1974, requirements has been performed by Kerite Company utilizing SCOTCH 70 tape and Kerite Cable within LOCA testing chamber. Kerite has certified the use of SCOTCH 70 as detailed in Reference Number 50.

To assure tape qualification for H. B. Robinson application, SCOTCH 70 tape will be used in conjunction with test control cables during qualification testing of the electrical penetrations PVC pigtail cable being performed at Wyle Laboratories. Results will be documented and available after completion of PVC cable testing. R2

3.2.5 Cable Terminals and Splices

As no qualification information could be obtained on the current in containment cable splices to the listed electrical equipment, it was decided to change out the splices with qualified components, prescribed tools and approved procedure. This changeout was completed during the plant refueling outage (August - October) 1980.

Individual conductor splices will utilize AMP Radiation Resistant/150°C Preinsulated Splices (#53548-1), T&B 2-way Cable Connectors for Copper Cable, 500 MCM and T&B 2-way Cable Connectors for Copper Cable, #9 AWG. The splice/connector component will be crimped to the designated conductors using the manufacturer's specified crimping tool.

An appropriate sized RAYCHEM SHRINK TUBING will be applied over the individual conductor cable splice and heat shrunk using the manufacturer's specified torch. For the two- (2) and three- (3) conductor cables after the individual conductors are spliced using AMP PIDG (53548-1) splices, an overall jacket RAYCHEM SHRINK TUBING will be applied and heat shrunk.

The work described above has been detailed within H. B Robinson S.E.P. Modification and Setpoint Revision Form No. M-521 (revised) and will be the means to sign off the completed work.

Original splices specified as AMP Nuclear Preinsulated Environmentally Sealed Splices (#52979) were found to be incompatible with the conductor insulation thickness of installed cable. Therefore, another butt-splice component, AMP Radiation resistant/150°C preinsulated splice (#53548-1) was ordered and installed. AMP Qualification Test Report 110-11002 dated October 1, 1978 describes a program that included total radiation exposure of 2.0×10^8 RADs, maximum temperature of 350°F, maximum pressure of 137 PSIA and a borated chemical spray lasting four (4) days. To assure qualification of the H. B. Robinson in-containment splices, cable undergoing testing at Wyle Laboratories will be connected with AMP PIDG terminals Raychem thermofit (heat shrink) tubing overall per the Installation Procedure M-521, Safety-Related Cable Splices Inside Containment. Appropriate matrix combinations of splice/cable and individual cables and splices will assure identification of any single component failure which could occur during qualification testing. Each R2 component has sufficient manufacturer-supplied test data to assure qualification by analytical means. The opportunity to obtain actual test results is available and will be used. R2

RAYCHEM Thermofit Insulation Systems (heat-shrink tubing) used to complete the replacement splice have been qualified per the H. B. Robinson accident parameters. Franklin Institute Research Laboratories Technical Report F-C4033-3 dated January 1975 describes a program that included 40-year aging, total irradiation exposure of 2.1 x 10^8 RADS, maximum temperature of 351°F, maximum pressure of 85 PSIA and a borated spray in excess of nine days. The results of this documented test are acceptable to CP&L that the heat-shrink tubing to be used in changeover is fully qualified.

3.2.6 Solenoid Valves

As reported in CP&L responses to NRC IE Bulletins 79-01 and 79-01B (45-day report), the listed solenoid valves in containment are to be replaced by qualified equipment. The in-place ASCO solenoid valves have not exhibited poor performance or required excessive maintenance. When manufactured and supplied, ASCO Company was not required to maintain the QC/QA procedures and programs necessary to allow traceability and certification needed for qualification.

The replacement valves are also ASCO Company equipment ___ Model Nos. NP831665E, NP8316E35E and 206-381-2U used singly or in combination to achieve their valving function. These solenoid valve types were included in a qualification testing program to meet IEEE Standards 323, 344, and 382. Results of this testing are published in AUTOMATIC SWITCH COMPANY, Test Report No. AQS21678/TR, Revision A, entitled Qualification Tests of Solenoid Valves by Environmental Exposure to Elevated Temperature, Radiation, Wear Aging, Seismic Simulation, Vibration Endurance, Accident Radiation and LOCA Simulation.

The test parameters subjected the valves to a maximum temperature of 346°F, a maximum pressure of 125 PSIA, a relative humidity of 100%, a borated spray during the LOCA simulation and a total radiation of 2.0 x 10^8 RADS. The test results are divided into two (2) parts--first the evaluation of the elastomers and coil materials and second the valve mechanisms and housing. The elastomers and coil materials, as reported, are qualified for a 4.4 year life (includes a 10% margin figure). The valve proper is qualified for a 40-year life.

This will require the coils and elastomers to be replaced on a scheduled basis to maintain the serviceability of the entire valve as well as its qualification. The proposed schedule is replacement of stated components on a four- (4) year cycle. Replacement will be performed during the closest outage or refueling to that time period.

With the maintaining of the replacement component schedule, CP&L considers the ASCO solenoid valves fully qualified within H. B. Robinson parameters and need do no further testing or qualifying.

3.2.7 Level Switches

As reported in CP&L's responses to NRC IE Bulletin 79-01 containment level switches (LS-1925A, LS-1925B) located within containment sump would be replaced with qualified equipment as the in-place equipment was never qualified. As supplied, the level switches are magnetic in operation and provided incremental one- (1) foot level data as water would rise in the sump. This equipment could operate completely submerged. | R2

A market search did not uncover any source of qualified equipment for replacement purposes. However, a parallel investigative effort by CP&L to meet the requirements of NRC NUREG 0578, TMI Short-Term Lessons Learned, ACRS2 Containment Water Level Indication, has concluded that there should be an analog level signal generated for combined sump and containment water level to aid in reporting and mitigating TMI type accident conditions--if ever experienced.

The current incremental level switches, Madison Model 5602 Switch Units with Type 316 Stainless Steel Stem, 10 ft. 6 inches long, with eight (8) 316 Stainless Steel Floats and one (1) Dry Contact Switch at each level, wired with 22AWG conductors with Silicone Rubber insulation, will remain in place. The function of these switches will be assumed by the analog system. The schedule for completion of installation is January 1, 1981. CP&L will take no further action on these level switches in conjunction with NRC IE Bulletin 79-01B.

3.2.8 Motors

Within containment at H. B. Robinson included in the equipment list for the report is one (1) motor type. This is a Westinghouse Type 685.5-S used with the containment fans. There are four (4) fans mounted in containment designated HVH-1 through HVH-4.

Qualification testing on a complete motor/fan assembly and on individual motor elements has been performed by Westinghouse. Results are published within WCAP-9003, Fan Cooler Motor Unit Test, 1969; WCAP-7829, Fan Cooler Motor Unit Test, 1972. WCAP-9003 testing included: thermal preaging to an equivalent of seven (7) years, a maximum pressure of 95 psia, a maximum temperature of 315°F, and use of borated spray for thirty-five (35) hours. WCAP-7829 testing included: total irradiation of equipment/components to 2×10^8 RADs, preaging to a 40-year life expectancy.

Evaluation of the test reports concludes that the H. B Robinson accident parameters are covered by the test envelopes and parameters performed on the similar Westinghouse motor/components subjected to qualification testing. Therefore, the containment fan motors at H. B. Robinson are considered qualified.

Outside of containment, the RHR pump motors are in use during long-term mitigation of LOCA conditions. The only accident parameters experienced by these pumps/motors is radiation. The most susceptible elements/components of the motors are covered by the testing reported within WCAP-7829. Since the RHR pump motors are of a similar type and motor windings are Thermalastic Epoxy insulated, it is concluded that the RHR pump motor is qualified for the service intended and the environment experienced during post LOCA.

Data supporting the Westinghouse testing reported within the stated WCAPs has been requested from Westinghouse and will be available for review upon receipt.

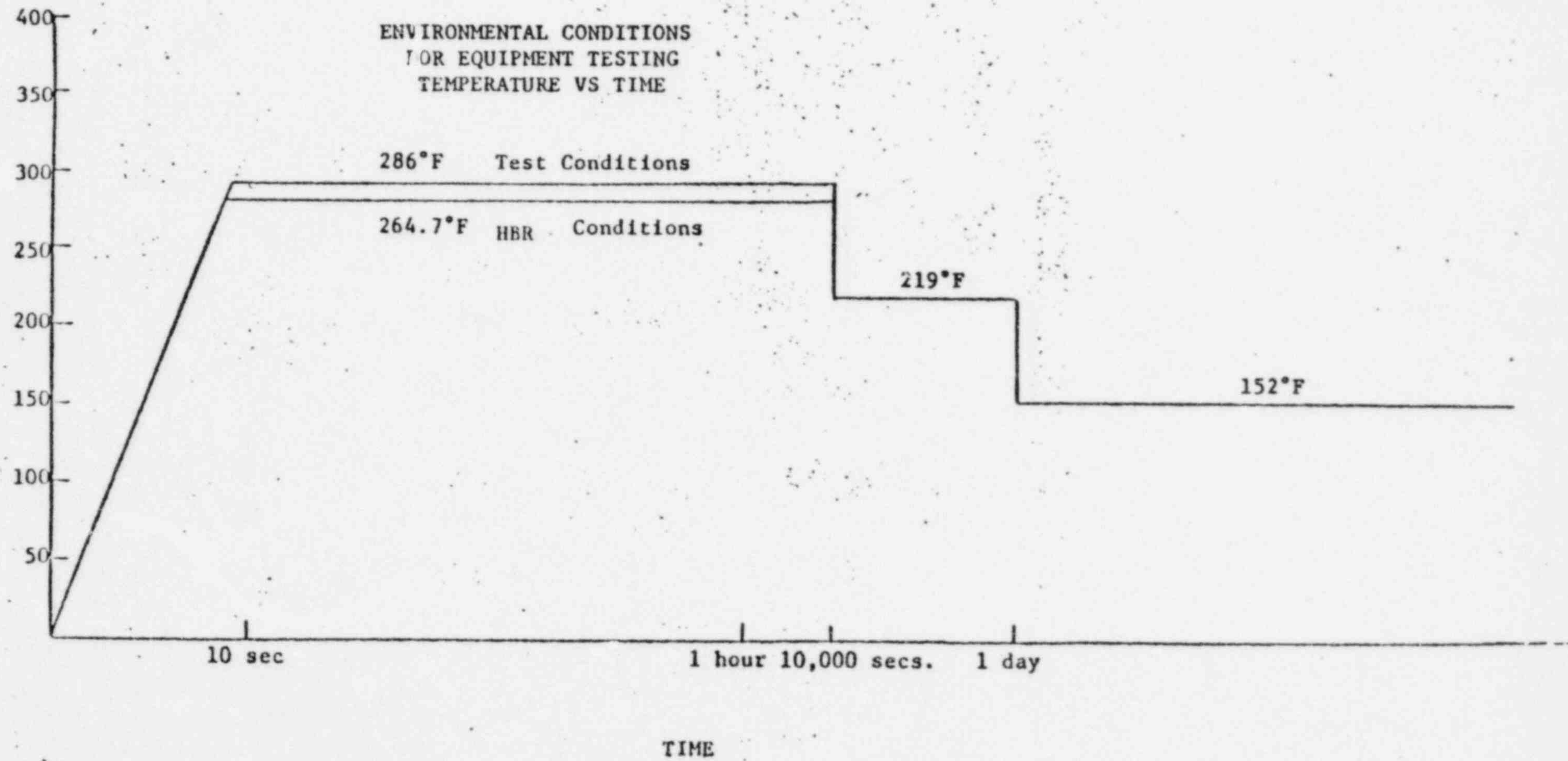
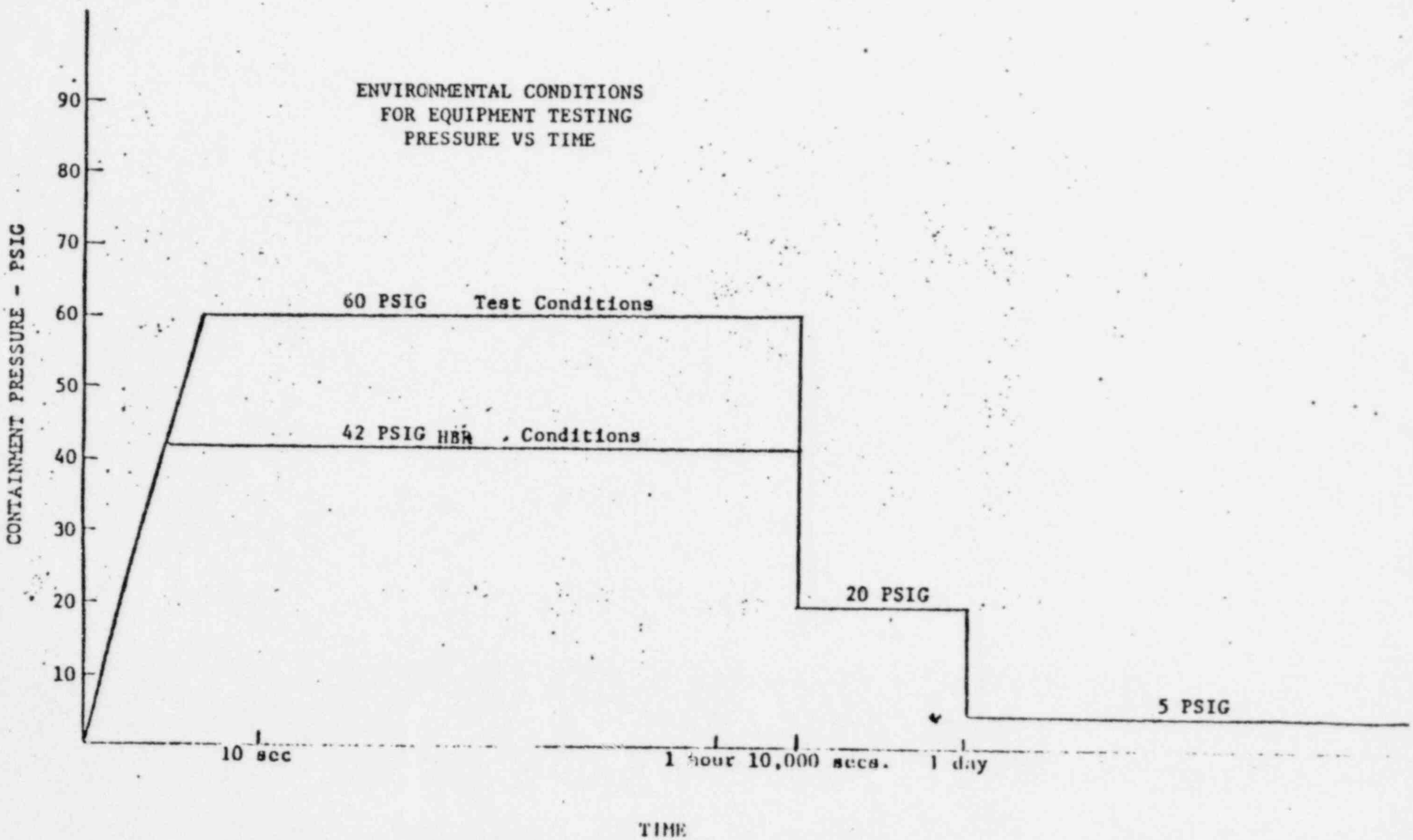


Figure 3.1.1
CONTAINMENT TEMPERATURE vs. TIME



CONTAINMENT PRESSURE vs. TIME

Figure 3.1.2

Amendment 7

4.0 Conclusions

The electrical equipment listed within the H. B Robinson emergency safeguard systems and associated plant system instrumentation (Reference Section 2.0) were evaluated by equipment groups (Reference Section 3.2) and are summarized as follows:

4.1 Electrical Penetrations

Containment Sleeve Sections - qualified by individual manufacturer's test reports and similar type qualification testing.

Additional action required - None.

Conductor Pigtails (Kerite Co.) penetrations having Kerite insulated pigtail cables are considered qualified by manufacturer's testing program and reports (Paragraph 3.1, Reference 49).

Additional action required - None.

Conductor Pigtails (Continental Wire and Cable Co.) penetrations having PVC, conductor and jacket, insulated pigtail cables are considered nonqualified. R2

Additional action required - Separate qualification testing program has been initiated and contracted with Wyle Laboratories, Huntsville, Alabama. Results will determine whether any further action is required. When obtained, they will be relayed to the NRC. Analysis of operating time radiation exposure concludes that the plant can continue operation until testing is completed and reviewed (LER submitted). Current schedule calls for the test program to be completed by May, 1981 (35-week test program).

Electrical Connectors - considered qualified by analysis of materials.

Additional action required - None.

4.2 Electronic Transmitters

Replacement of in-containment transmitters identified within this report has been performed within the 1980 refueling outage (August - October, 1980). At this time, no fully qualified transmitter is available for nuclear plant in-containment operation. Rosemount 1153A transmitters, qualified to IEEE 323-1971 version, were used as replacements. R2

Additional action required - A program of periodic transmitter housing O-ring replacement (performed during yearly instrument calibration check) will provide boron spray protection capability if an accident ever occurs. (See Pargaraph 3.2.2.) To assure operational capability, a ten- (10) year transmitter replacement schedule has been adopted, to be modified when Rosemount can certify, by test, longer life equipment is available. R2

4.3 Motor-Operated Valves

The Limitorque motor operators listed are considered qualified by similar type testing as reported within qualification reports available from Westinghouse and Limitorque.

Additional required - None.

4.4 Electrical Cable

The identified silicone rubber insulated cables and the Kerite insulated cables are considered qualified by similar type testing as reported within qualification reports available from the manufacturers.

Additional action required - None.

(Inspection held in containment August 18, 1980 through August 22, 1980 concluded no PVC field cable in use to the identified instrumentation and switches.)

4.5 Cable Terminals and Splices

Replacement of in-containment terminals and splices identified within Plant Procedure M-521-1 has been performed during the refueling outage (August - October, 1980).

Additional action required - The splice procedure and materials are being tested during the qualification testing of the penetration pigtail cables at Wyle Laboratories to assure compatibility of materials and to assure the procedure provides proper LOCA protection for splices. The overall heat-shrink tubing is qualified per IEEE 323-1974 by manufacturer's test. R2

4.6 Solenoid Valves

Replacement of in-containment solenoid valves identified within this report has been performed during the 1980 refueling outage (August - October, 1980). The ASCO valves specified as replacements are considered qualified by similar type testing performed by the manufacturer and reported within available qualification reports (Paragraph 3.1, Reference 47). R2

Additional action required - Noted in the manufacturer's report is a certified life of 4.4 years for the coil and elastomers within these solenoid valves. These elements will be replaced on a four- (4) year cycle to maintain complete operational capability.

4.7 Level Switches

Original plans for replacement of the nonqualfied containment sump level switches with qualified equipment is no longer considered necessary. The function of level determination is being assumed by a dual analog system provided in the TMI Short-Term Lessons Learned Program (Equipment will be GEMS Level Sensor - Transmitter XM36496, XM36495 and Receiver RE36562.) The existing system will be left in place. Check of E.I.-1 procedure, Incident Involving Reactor Coolant System Depressurization, does not reference use of this equipment; therefore, no changes are required in this procedure when switchover is accomplished.

Additional action required - None.

4.8 Motors

The Westinghouse motors listed are considered qualified by similar type testing and component testing as reported within qualification reports and documents available from Westinghouse.

Additonal action required - None.

Where required, the plant will assure a periodic maintenance program to inspect as well as replace stated elements and components. In addition, maintenance will be performed in a manner to assure equipment is returned to operation in its qualified configuration and installation.

5.0 Report Quality Assurance

Basic information for NRC IE Bulletin 79-01B was initially accummulated in response to NRC IE Bulletin 79-01, issued February 8, 1979. System Flow Diagrams were reviewed and Class IE electrical equipment was listed. A compiled "Q" list for H. B. Robinson was also reviewed to supplement the basic list. Westinghouse Instruction Book of Control and Protection Instrumentation System - Volume I - entitled "System Description and Installation" was used to confirm each item and complete the list.

To assure the list was current, a review of plant modifications and "as-built" drawings was performed at the plant site. Also, at the site, an inspection was undertaken to obtain nameplate data of listed electrical equipment - inside and outside of containment -for use in identifying manufacturer, model number and, where practicable, serial numbers. To complete the in-containment Class IE system's loops, a study was performed to identify the electrical penetration, by canister and pin number, associated with control of, and power for, listed equipment. Utilized were Control Wiring Diagrams (B190628) and Cable Penetration Schedules (B-190670) to establish a list of field cables and electrical penetrations associated with Class IE electrical equipment.

Next, a search of plant documentation was made to retrieve Purchase Orders, Specifications, Quality Compliance Reports, and correspondence related to the listed electrical equipment. The retrieved documents were reviewed to determine the level of testing originally performed and qualification data available to determine qualification level against FSAR parameters and requirements. R1

The data collected above was formulated to respond to NRC IE Bulletin 79-01. CP&L's submittal letter (June 12, 1979) identified components which were to be replaced because of: operational choice, lack of qualification data, need for further review to determine qualification disposition.

Upon receipt of NRC IE Bulletin 79-01B, dated January 14, 1980, CP&L organized to use the 79-01 data as a base and add the supplemental data required--all within the formats designated within the bulletin. After attending the NRC Region II Meeting held in Atlanta January 31, 1980 to clarify response to the bulletin, CP&L assigned personnel and resources to meet the 45-day and 90-day report requirements as clarified. The 45-day report essentially reformatted the 79-01 response within the designated 79-01B forms and compared qualification data accummulated under 79-01 with the requirements of the FSAR. Differences, if any, were noted and plans for any additional qualification testing or researching were formulated. For the report, greater emphasis was placed on effects of High Energy Line Breaks outside of containment. Westinghouse's Postulated Pipe

Failure Analysis Outside of Containment Report, November 9, 1973, was reviewed and it was determined that the LOCA environmental conditions would still provide the limiting environmental parameters. As concluded in the report and H. B. Robinson Modification and Setpoint Revision 212, MSLB shielding of vulnerable transmitters (Steam Line Pressure Transmitters PT 474, 475, 476, PT 484, 485, 486, PT 494, 495, 496) was installed and verified. Due to "open-air" turbine deck construction, any external MSLB event will not result in area elevated temperature or pressures--minimizing any environmental effects on detection, or mitigation, electrical equipment.

CP&L's 45-day response to IE Bulletin 79-01B was transmitted to the NRC on March 10, 1980. In its conclusions, commitments on changeout of: safety-class transmitters in containment, designated solenoid valves in containment, and safety-class penetration splices in containment were again stated. Also included was commitment for changeouts to occur during the next refueling outage at HBR. Two items were identified as requiring further qualification investigation. They were penetration connectors and Limitorque operator motor brakes.

During the development of the 45-day report, ground work for the 90-day report was established and initial activity to add the necessary material and data began. Initiated was the contact of original vendors--as identified by purchase orders--to collect qualification data, past or current, that related to the listed safety-class equipment. Requested were specific reports with supportive test data and/or partial data which could be additively useful in determination of guidelines established qualification. The NSSS supplier, Westinghouse, as well as "turnkey" contractor, was requested to supply qualification data in support of its FSAR statements on specific safety-class electrical equipment. Current Westinghouse test data (WCAP topical reports) related to installed electrical equipment were reviewed for applicability and negotiations were started to purchase recent supportive data.

To aid in qualifying, H. B. Robinson Unit 2 listed components, many of which were built and installed prior to the Standards, Regulatory Guides and Codes related to qualification; the Guidelines for Evaluating Environmental Qualification of Class IE Electrical Equipment in Operating Reactors (part of NRC IE Bulletin 79-01B) were utilized to establish radiation and aging parameters. Rather than use the generalized values stated in the HBR FSAR, individual calculations were made for each item presented in the 90-day report exposed to the harsh accident environment or used in accident mitigation. Appendix B, Procedures For Evaluating Gamma Radiation Service Conditions, of the DOR Guidelines was used as source material and calculations derived are included in this report as Appendix A. Utilization of this data is described in Paragraph 1.3.2.

For aging considerations, material identification within components was made and data extracted from either DOR Guidelines' supplied charts or related charts compiled by other research laboratories. (Reference Paragraph 1.3.3, Aging) Appendix C, <u>Thermal and Radiation Aging Degradation of Selected Materials</u>, of the DOR Guidelines was the basic source of information. Additional sources were researched and utilized when more definitive data was needed to cover variations of materials.

<u>Example</u> - Diallyl Phaphlate radiation resistance increases with added fillers, either glass, orlon, asbestos, etc.

Appendix C of this report expanded the data needed to cover the H. B. Robinson connector insert material and provide qualification.

Qualification was established in four ways. One, vendor supplied test reports completely responsive to H. B. Robinson parameters and formatted to IEEE 323, 1974 Standard, General Guide for Qualifying Class I Electrical Equipment for Nuclear Power Generating Stations. A majority of the stated replacement 22
components were qualified in this manner. Two, vendor supplied reports responsive to H. B. Robinson parameters, formatted to IEEE 323, Standard 1971 version, and analyzed to meet radiation and aging requirements. Replacement transmitters were qualified in this manner. Three, identified Westinghouse WCAP documents either containing detailed test reports or backup data within Westinghouse possession. Motor operators, external to containment transmitters, and RTDs were qualified in this manner. Fourth, vendor test data, specification information and users' test reports formed a base for analytical comparison with H. B. Robinson parameters and use of DOR Guidelines to analyze material acceptability to provide acceptable equipment qualification. Electrical penetrations and cable were qualified in this manner.

Though not formally requested by IE Bulletin 79-01B, an additional paragraph, 3.2, Electrical Equipment Evaluation, was added to the 90-day response to aid in presenting qualification conclusions. These are genus oriented and not on a plant identification number basis.

Additionally required was a flood level established in containment for the LOCA accident. Each contributive tankage and water source was identified from reports, drawings and specifications and the volumes added together to determine the total amount of water available in containment. A previously reported RCP seal leak at HBR established the 120,000 gallon-per-foot-in-containment figure, as well as the volumetric configuration of the sump and containment floor. (Reference Appendix B) With the calculated flood level (3.2 ft.), each electrical equipment location (height) was compared to this figure. Location was determined by height measurement above the containment floor of accessible equipment and by estimation of height within containment against known equipment in the vicinity whose location height is identified on drawings. Height of electrical equipment close to flood level was measured exactly to assure conclusions on equipment submergence are accurate. Where achieveable, replacement transmitters were installed in a manner to obtain greatest height above the base floor to prevent submergence of electronic compartment sections of the instruments. Review of operational requirements concluded there was no need to reposition the pressurizer water level alarm instrumentation to avoid submergence as it was not required for accident mitigation. Additionally, a time factor will be involved as the flood height will not be realized immediately.

To assure conformity of listed equipment to mounting drawings and procedures, an in-containment inspection was performed. Conduit and condulets were checked for cracks, separations, and improper terminations. Electrical tape was checked for complete coverage, neat application and correct type use. R2
Field cable to listed electrical equipment was verified to be other than PVC jacketed. Nameplate information was collected from equipment added to the master list and verified for the already listed equipment. Cable used as pigtails for select electrical penetrations was confirmed as being PVC jacketed.

Upon confirmation, contact was made with Wyle Laboratories to perform a LOCA qualification test on the PVC pigtail cable using calculated radiation levels presented in Table 1.3.3. A test program is underway. Completion date is still uncertain as material identification by the manufacturer is needed to establish energization levels to determine base time and temperature to achieve Arrhenius-Curve aging. Lowest temperature per generic material results in a thirty-five week program.

To maximize use of the test program, it was arranged to include cable splices, per installation procedure, and termination tape in the test chamber so that direct qualification data can be obtained on H. B. Robinson application. A developed installation matrix will assure if any failure occurs, it can be attributed to the faulty item.

Two submittals were made to the NRC relaying information required for the 90-day response to IE Bulletin 79-01B. Initial transmittal of July 7, 1980 was supplemented on August 29, 1980 to provide data not available at the first submittal and to add typographical or information correction.

During the week of August 25-29, 1980, an NRC on-site inspection was held at H. B. Robinson to verify designated equipment status and to review CP&L's 45- and 90-day responses to IE Bulletin 79-01B. In-containment inspection indicated no items of noncompliance and observed techniques and reviewed procedures used for changeouts being performed.

An NRC report covering this inspection (RII:NW 50-261/80-20) dated September 30, 1980 relayed the no items of noncompliance information as well as the request for added clarification of selected material within CP&L's 90-day response. These clarifications required additional use of Appendix C of the DOR Guidelines and selected use of data found in NUREG 0588, Appendix D Sample Calculation and Type Methodology for Radiation Qualification Dose, to aid in determination of effect of radiation levels in containment sump water on electrical equipment close to the flood level. R2

The added clarification material has altered a portion of the originally submitted 90-day response material. To aid in identifying the added and altered portions, a R2 marking has been made to the affected pages. A total report document is being made to meet the November 1, 1980 requirement date for IE Bulletin 79-01B information submittal.

APPENDIX A

Calculations per Appendix B of IE Bulletin 79-01B to
Determine Total Anticipated Radiation

VOLUMETRIC CALCULATIONS FOR EQUIPMENT COMPARTMENT

Step 1:

Reactor Power Level = 2300 MW_{th}
Containment Volume = 2.1×10^6 ft.^{3}

30-day dose = 1.4×10^7 RADS

Step 2:

36" Wall (Concrete Shielding)

Dose = 1.5×10^3 RADS

Step 3:

Compartment Volume = 2.8×10^5 ft.^{3}

Correction Factor = 0.45

$0.45(1.4 \times 10^7) + 1.5 \times 10^3 = 6.3015 \times 10^6$
$= 6.3 \times 10^6$ RADS (30-day dose)

Step 4:

1/2 hour Correction Factor = 0.09 $0.09(6.3 \times 10^6) = 5.7 \times 10^5$ RADS

1 hour Correction Factor = 0.15 $0.15(6.3 \times 10^6) = 9.5 \times 10^5$ RADS

24 hour Correction Factor = 0.55 $0.55(6.3 \times 10^6) = 3.5 \times 10^6$ RADS

Time (hrs.)	Dose (RADS)	Dose + 10% Margin (RADS)
1/2	5.7×10^5	
1	9.5×10^5	1.0×10^6
24	3.5×10^6	3.8×10^6

VOLUMETRIC CALCULATIONS FOR OPERATING FLOOR COMPARTMENT

Step 1:

Reactor Power Level = 2300 MWth
Containment Volume = 2.1×10^6 ft.^{3}

30-day dose = 1.4×10^7 RADS

Step 2:

Not Applicable

Step 3:

Compartment Volume = 1.6×10^6 ft.^{3}

Correction Factor = 0.80

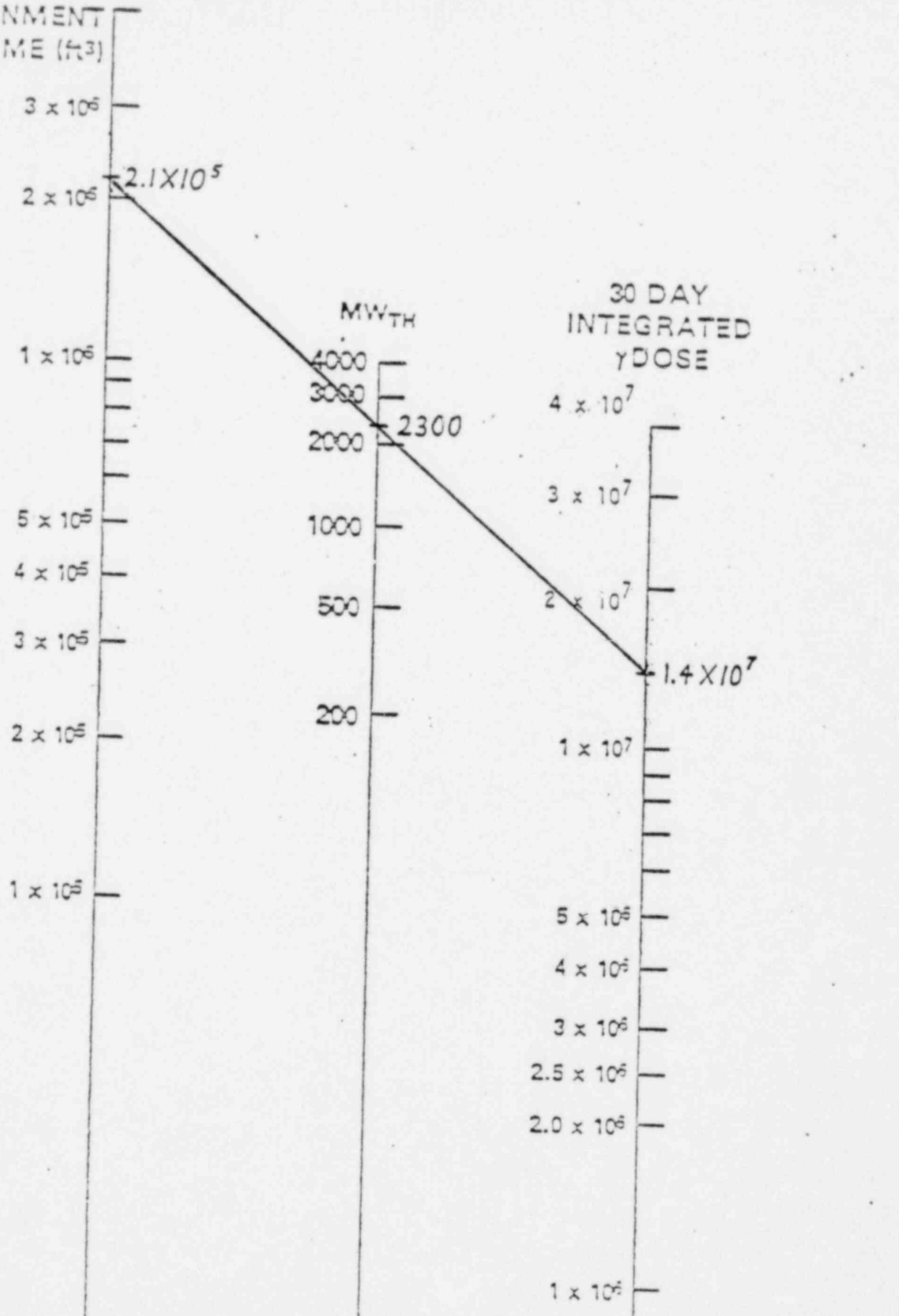
$0.08(1.4 \times 10^7) = \underline{1.12 \times 10^7 \text{ RADS}}$ (30-day dose)

Step 4:

1/2 hour Correction Factor = 0.09 $0.09(1.12 \times 10^7) = \underline{1.0 \times 10^6 \text{ RADS}}$

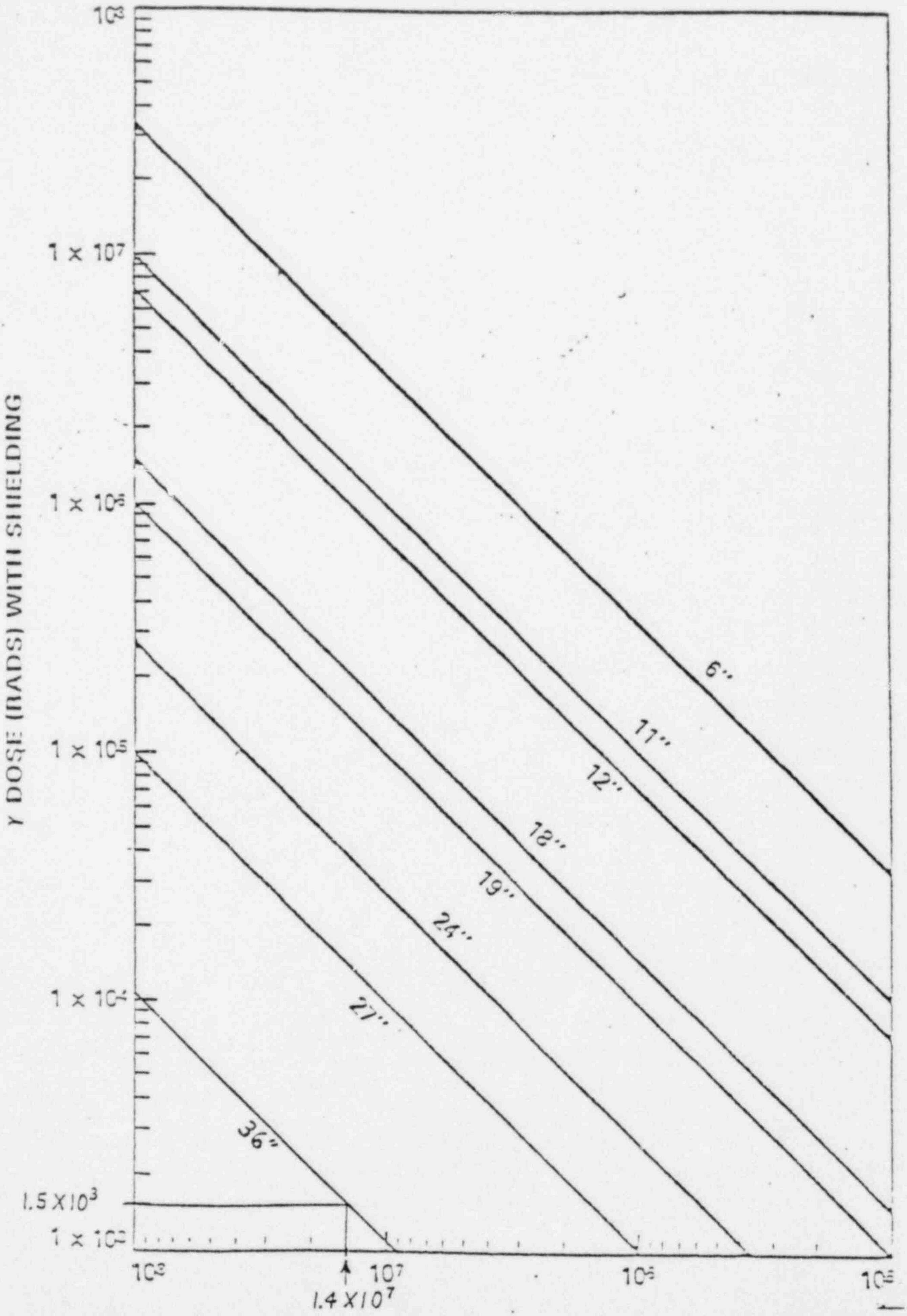
3 hour Correction Factor = 0.28 $0.28(1.12 \times 10^7) = \underline{3.1 \times 10^6 \text{ RADS}}$

Time (hrs.)	Dose (RADS)	Dose + 10% Margin (RADS)
1/2	1.0×10^6	------
3	3.1×10^6	3.4×10^6

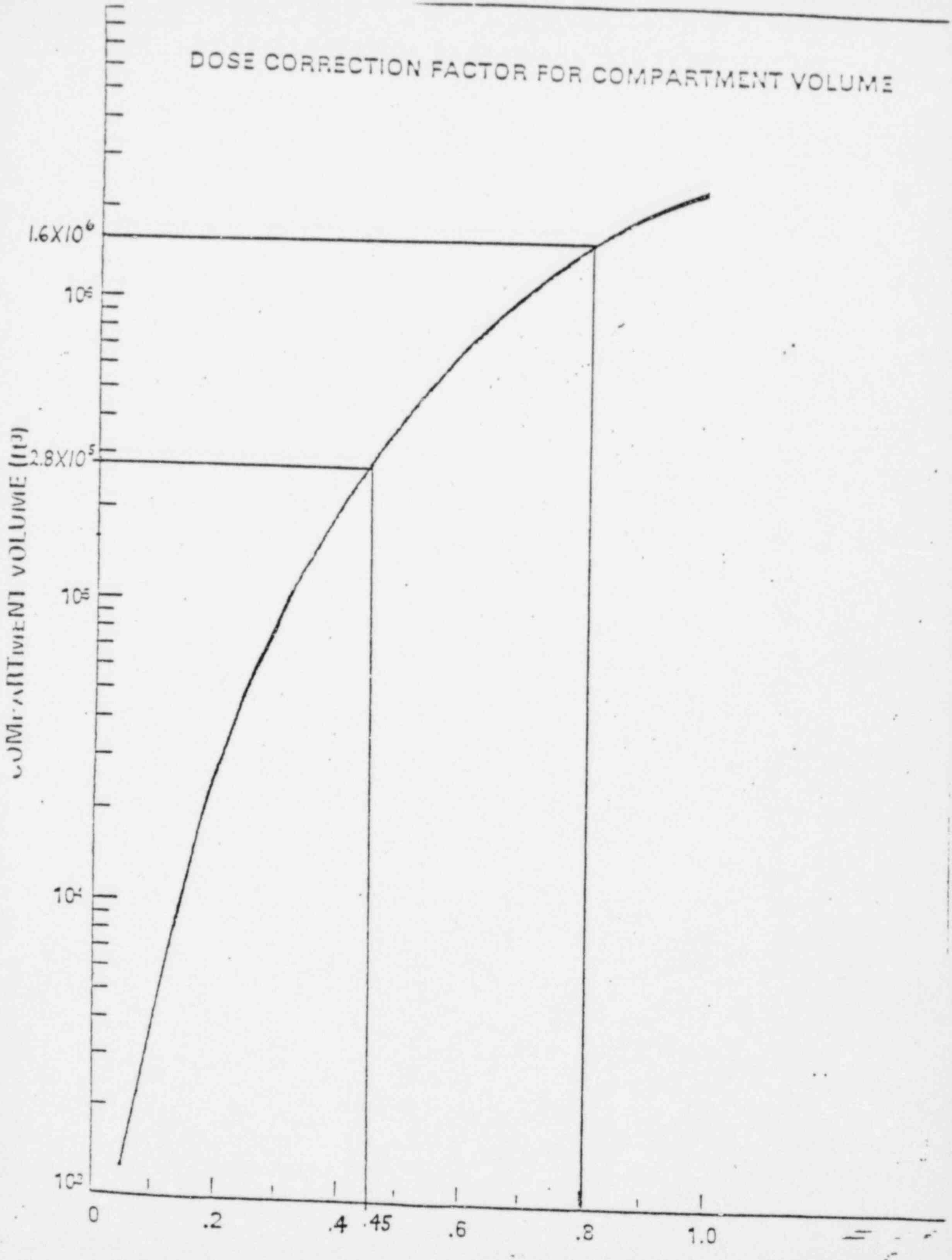


*MSLB ACCIDENT DOSES SHOULD BE READ AS A FACTOR OF 10 LESS

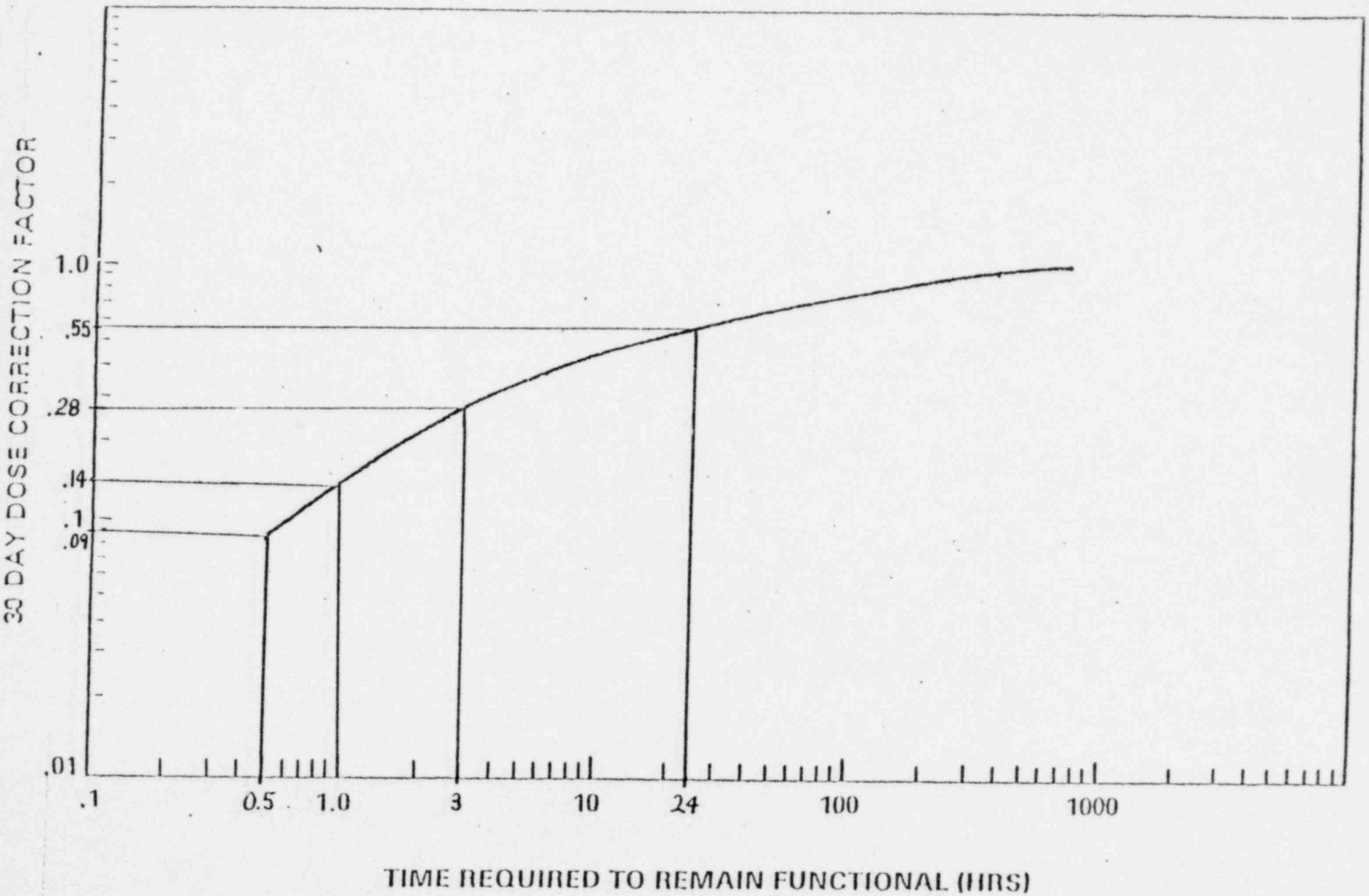
DOSE CORRECTION FACTOR FOR CONCRETE SHIELDING
(γ ONLY)



DOSE CORRECTION FACTOR FOR COMPARTMENT VOLUME



DOSE CORRECTION FOR TIME REQUIRED TO REMAIN FUNCTIONAL



APPENDIX B

Calculations per Appendix II to H.B. Robinson 10th Semi-Annual Operating Report to Determine Submergence Depth

R2

APPENDIX II

to

10th SEMI-ANNUAL OPERATING REPORT

REACTOR COOLANT PUMP OUTAGE

Calculation 1

Calculating the Wetted Volume of the Containment Vessel

V_{cv} - Wetted volume of the containment vessel

V_s - Volume of containment sump

A_1 - Containment floor area at 228'level outside the polar crane wall

A_2 - Containment floor area at 228'level inside the polar crane wall

H_w - Height of water above the 228'level ($12\frac{1}{2}$" = 1.04 ft.)

$$V_{cv} = \underline{V_s} + (A_1 + A_2) H_w$$

V_s can be approximated as the volume of a cylinder, V_1 minus the volumes of a cylinder, V_2 and a hemisphere (the reactor vessel), V_3 plus the volumes of two rectangular prisms, $V_4 \neq V_5$

$$V_s = V_1 - (V_2 + V_3) + V_4 + V_5$$

$$V_1 = \pi r^2 h$$
$$= 3.14\ (7.5)^2 27$$
$$= 4771\ ft^3$$

$$V_4 = l \cdot w \cdot h$$
$$= 28(10)(15)$$
$$= 4200\ ft^3$$

$$V_2 = \pi r^2 h$$
$$= 3.14\ (7)^2 6$$
$$= 924\ ft^3$$

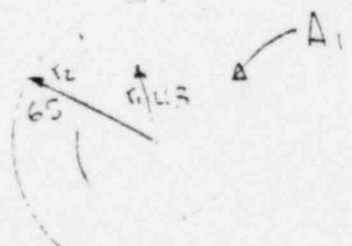
$$V_5 = l \cdot w \cdot h$$
$$= 14(10)(12)$$
$$= 1680\ ft^3$$

$$V_3 = \tfrac{1}{2}(\tfrac{4}{3}\pi r^3)$$
$$= \tfrac{4}{6}\ (3.14)(7)^3$$
$$= 718\ ft^3$$

$$V_s = 4771 - (924 + 718) + 4200 + 1680$$
$$= 9009\ ft^3$$

$$V_{cs} = 9009\ ft^3 \times 7.48\ gal/ft^3$$
$$= 67{,}390 \text{ gallons}$$

A_1 can be approximated by subtracting the area included in the polar crane wall from the cross sectional area of the containment vessel



$$A_1 = \pi r_2^2 - \pi r_1^2$$
$$= 3.14(65)^2 - 3.14(48)^2$$
$$= 6034\ ft^2$$

Calculation 2

Calculating the Quantity of Water Removed From the Containment Vessel

Trucked Off-Site	27,900 gal
Emptied into A CVCS Holdup Tank (0% to 96%)	49,000 gal
Emptied into Refueling Water Storage Tank (67% to 83%)	54,500 gal
Emptied to Waste Holdup Tank (39.5% to 45%)	1,600 gal
Total Water Removed From Containment	133,000 gallons

Calculation 3

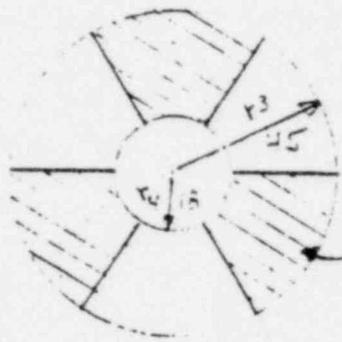
Calculating the Quantity of Water Emptied Into the Containment Vessel

From the Refueling Water Storage Tank (92% to 67%) 318,000 gal -232,000 gal 86,000 gallons	86,000 gal
From the Boric Acid Blender 21,986 gal primary water + 1,252 gal boric acid 23,238 gallons	23,238 gal
From the Reactor Coolant System Operating Level Compensated to 200°F=48,186 gal Drain Down Level at 200°F -28,424 Amount spilled onto floor 19,762 gal	19,762 gal
Total Quantity Spilled	129,000 gallons

129,000 gallons ÷ 1.06 ft = 121,698 gal/ft

1 ft = 120,000 gallons

A_2 can be approximated as half of the area between the missile shield and the inside of the polar crane wall.



A_2 (area at 228' level)

$$A_2 = \frac{1}{2}(\pi r_3^2 - \pi r_4^2)$$

$$= \frac{1}{2}\left[3.14(45)^2 - 3.14(18)^2\right]$$

$$= 2671 \text{ ft}^2$$

$$V_{cv} = V_s + (A_1 + A_2)\,Hw$$

$$= 9009 \text{ ft}^3 + (6034 + 2671) \text{ ft}^2 \,(1.04 \text{ ft})$$

$$= 18062 \text{ ft}^3$$

$$V_{cv} = 18062 \text{ ft}^3 \times 7.48 \text{ gal/ft}^3$$

$$= 135105 \text{ gallons}$$

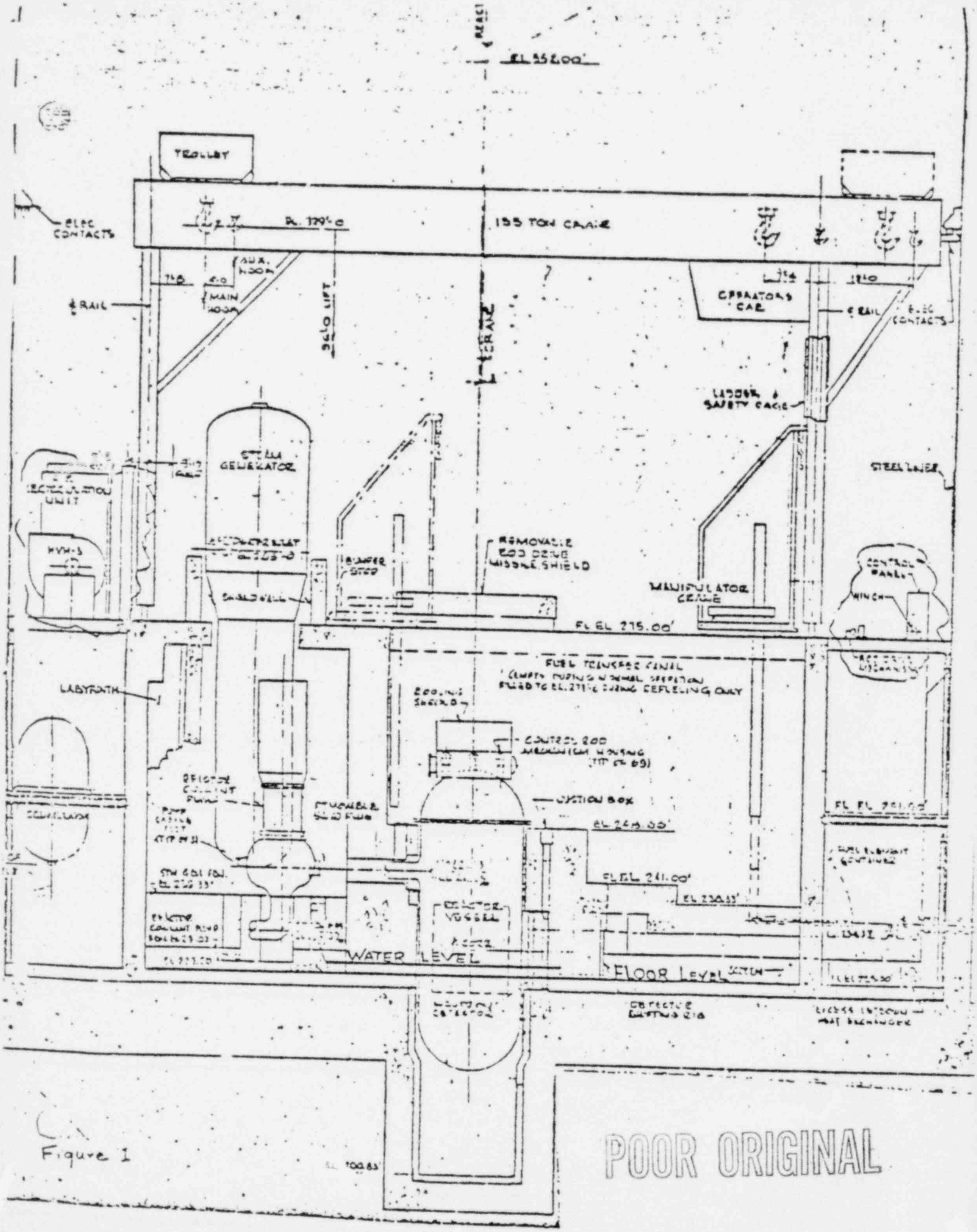

TROLLEY
ELEC CONTACTS
135 TON CRANE
AUX. HOOK
MAIN HOOK
RAIL
OPERATORS CAR
ELEC CONTACTS
LADDER & SAFETY CAGE
STEAM GENERATOR
STEEL LINER
HVH-5
REMOVABLE ROD DRIVE MISSILE SHIELD
BUMPER STOP
SHIELD WALL
MANIPULATOR CRANE
CONTROL PANEL
WINCH
FL EL 275.00'
FUEL TRANSFER CANAL
LABYRINTH
JUNCTION BOX
REACTOR VESSEL
WATER LEVEL
FLOOR LEVEL

Figure 1

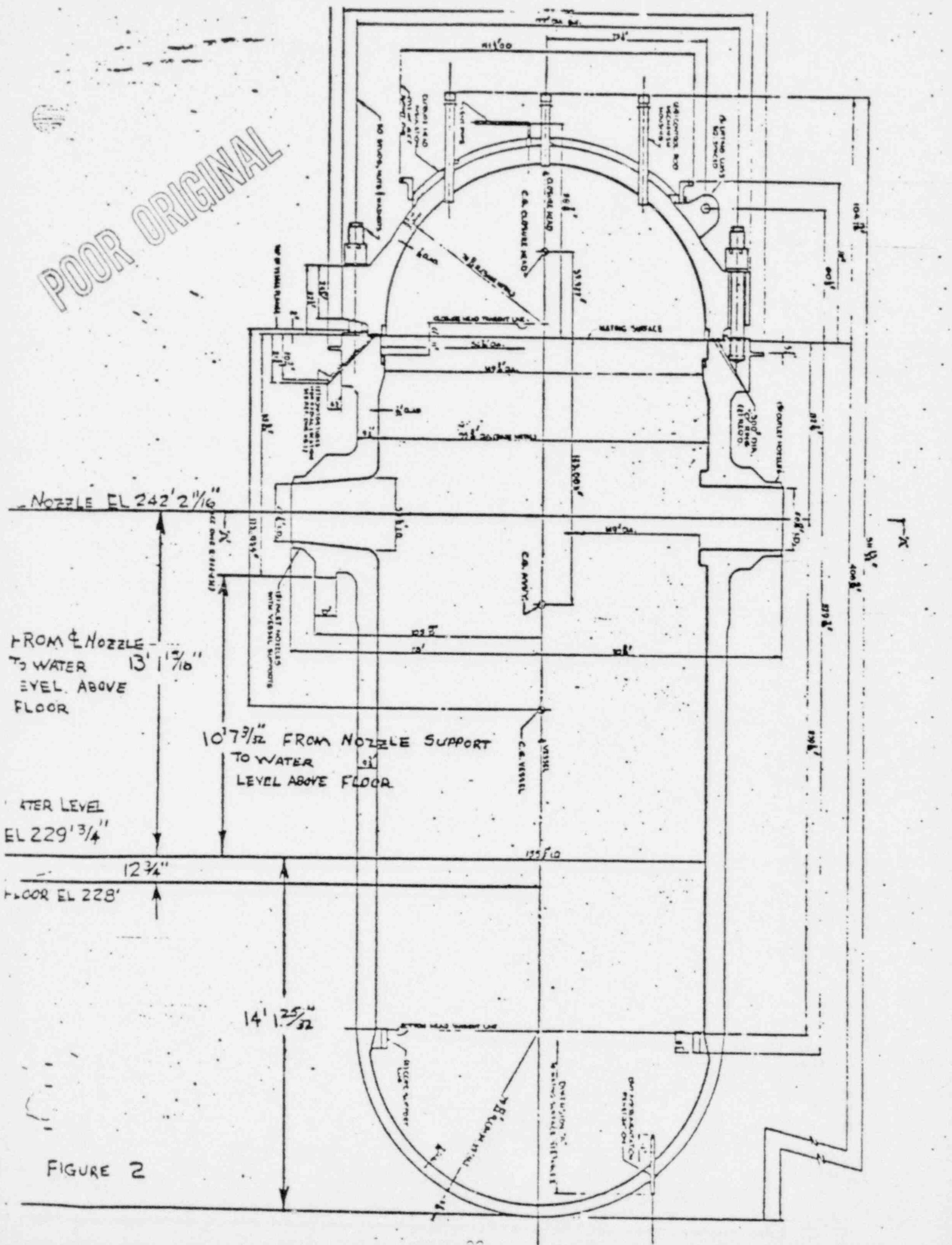

NOZZLE EL 242' 2 11/16"
FROM ℄ NOZZLE TO WATER LEVEL ABOVE FLOOR 13' 1 15/16"
10' 7 3/32" FROM NOZZLE SUPPORT TO WATER LEVEL ABOVE FLOOR
WATER LEVEL EL 229' 3/4"
12 3/4"
FLOOR EL 228'
14' 1 25/32"

FIGURE 2

APPENDIX C

Extracted Information Related To
Radiation Exposure of Diallyl Phthalate

R2

POOR ORIGINAL

1. Report No. NASA CR-1787	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle RADIATION EFFECTS DESIGN HANDBOOK SECTION 3. ELECTRICAL INSULATING MATERIALS AND CAPACITORS		5. Report Date July 1971
		6. Performing Organization Code
7. Author(s) C. L. Hanks and D. J. Hamman		8. Performing Organization Report No.
9. Performing Organization Name and Address RADIATION EFFECTS INFORMATION CENTER Battelle Memorial Institute Columbus Laboratories Columbus, Ohio 43201		10. Work Unit No.
		11. Contract or Grant No. NASW-1568
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546		13. Type of Report and Period Covered Contractor Report
		14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This document contains summarized information relating to steady-state radiation effects on electrical insulating materials and capacitors. The information is presented in both tabular and graphical form with text discussion. The radiation considered includes neutrons, gamma rays, and charged particles. The information is useful to design engineers responsible for choosing candidate materials or devices for use in a radiation environment.

17. Key Words (Suggested by Author(s)) Radiation Effects, Electrical Insulators, Capacitors, Radiation Damage	18. Distribution Statement Unclassified-Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	88	$3.00

*For sale by the National Technical Information Service, Springfield, Virginia 22151 material experiences threshold damage at a dose of 8.6×10^5 rads (C) and 25 percent damage at 4.7×10^6 rads (C). These doses are based upon losses in ultimate elongation and impact strength. Another property of polyamide that deteriorates from radiation exposure is stiffness in flexure, which has increased between 52 and 181 percent, depending upon the nylon type, after exposure to an electron dose of 5.8×10^{16} e/cm^2 (E = 1.0 MeV) at 60 C[11]. This same exposure improved the tensile strength by 49 to 107 percent. These results agree with other radiation studies which have shown increases in tensile strength of 25 percent for doses over 10^9 rads (C).

Information on the effects of radiation on the electrical properties of polyamide is limited to results of the electron irradiation mentioned above. Exposure to this radiation environment produced an increase of approximately one order of magnitude in the insulation resistance and a decrease of less than an order of magnitude for the dissipation factor. A decrease in dielectric constant was insignificant at 1 MHz and varied between 5 and 32 percent at 1 KHz, depending on the polyamide type.

Diallyl Phthalate

Diallyl phthalate with various fillers such as glass or Orlon has shown exceptional radiation tolerance for a plastic insulating material. Little or no permanent degradation of physical or electrical properties have been observed with radiation exposures to doses of between 10^8 and 10^{10} rads (C). Insignificant changes are observed in the hardness and flexibility of this material when irradiated to these total doses. The ultimate elongation and tensile strength of Orlon-filled diallyl phthalate actually increased or improved with exposure to an electron dose of 5.8×10^{16} e/cm^2 (E = 1.0 MeV) at 60 C.

The electrical properties of diallyl phthalate such as dielectric constant, dissipation factor, and insulation resistance are affected by exposure to a radiation environment such as described above. The amount of degradation or change in these parameters because of this exposure is of little practical significance. Permanent changes in dielectric constant were less than 6 percent while the dissipation factor recovered to below the initial value. Increases in insulation resistance during exposure are followed by complete recovery within approximately 1 hour after the irradiation is terminated.

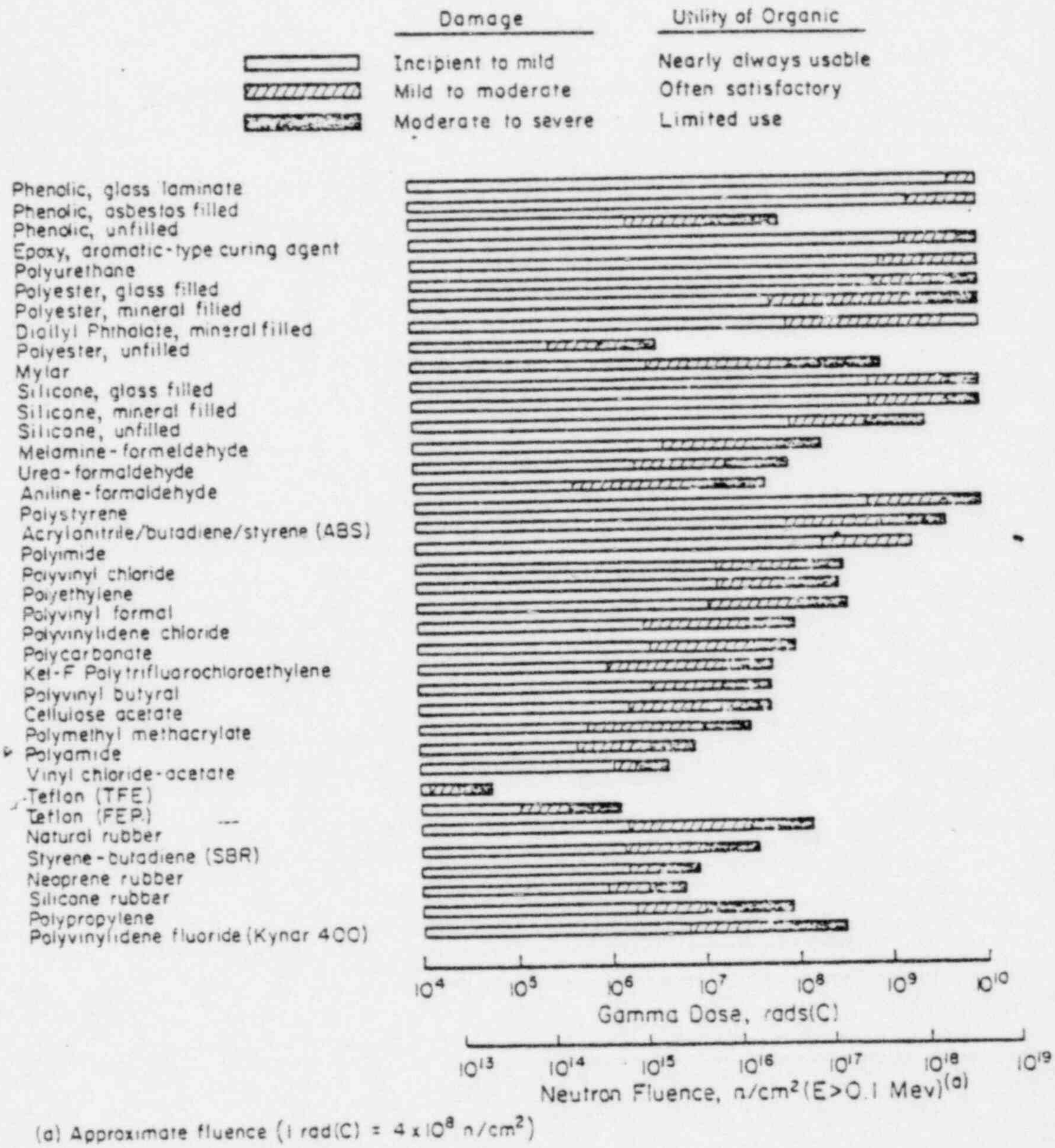


FIGURE 3. RELATIVE RADIATION RESISTANCE OF ORGANIC INSULATING MATERIALS BASED UPON CHANGES IN PHYSICAL PROPERTIES