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Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

References:
(1) W. G. Counsil letter to D. G. Eisenhut, dated October 31, 1980.
(2) T. M. Novak letter to W. G. Counsil, dated April 14, 1981.
(3) R. A. Clark letter to W. G. Counsil, dated October 24, 1980.
(4) B. H. Grier letter to W. G. Counsil, dated October 24, 1980, transmitting Supplement 3 to I&E Bulletin 79-01B.
(5) D. G. Eisenhut letter to All Licensees, dated January 19, 1981.
(6) W. G. Counsil letter to D. G. Eisenhut, dated April 15, 1981.

Gentlemen:

Millstone Nuclear Power Station, Unit No. 2
Environmental Qualification of Safety Related
Electrical Equipment

By Reference (1), Northeast Nuclear Energy Company (NNECO) docketed a comprehensive submittal responding to the Commission's requirements regarding environmental qualification, thereby fulfilling the Order for Modification of License imposed on DPR-65. By Reference (2), the NRC stated that NNECO should review the identified deficiencies, and their ramifications, contained in the "Partial Review of the Equipment Evaluation Report by the Office of Nuclear Reactor Regulation" for Millstone Unit No. 2. Further, the Staff requested an overall finding regarding the continued safe operation of the facilities. Accordingly, the following information is provided.

The review of Reference (2) has not altered the conclusions docketed in Reference (1). Specifically, NNECO concludes that continued operation of Millstone Unit No. 2 is safe and is, therefore, warranted. This conclusion is based upon the detailed qualification documentation presented in Reference (1). It is also noted that no components were categorized by the Staff as "Equipment Requiring Immediate Corrective Action," referring to Section 4.1 of Reference (2).

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Reference (2) also stated that a negative finding concerning the safety of continued operation would result in a unit shutdown, and would require docketing of a Licensee Event Report (LER). It is noted that the requirement to submit LER's was explicitly specified in previous NRC correspondence on the subject of environmental qualification, and NNECO has been operating under this provision for many months. Inclusion of this requirement in Reference (2) is, therefore, viewed as reiteration of an existing requirement.

Based upon the content of the "Partial Review," it is not clear that Reference (1) and correspondence referenced therein were fully reviewed and evaluated by the Staff, although the absence of the Safety Evaluation Report (SER) makes it impossible to completely address all the concerns raised in Reference (2).

There are a number of specific concerns with the content of the "Partial Reviews" which merit delineation at this stage, even though the Staff has stated that an item-by-item reevaluation must be provided at a later date. There are limitations to the comparison which can be completed at this juncture, largely because of the absence of the SER. Nonetheless, the following points are noted:

1. In Section 3.1, the Staff states that:

   "Instrumentation which is not considered to be safety-related but which is mentioned in the emergency procedure should appear on the list. For these instruments, (1) justification should be provided for not considering the instrument safety related and (2) assurance should be provided that its subsequent failure will not mislead the operator or adversely affect the mitigation of the consequences of the accident."

   NNECO had previously stated its position that the mere inclusion of specific components in plant procedures does not necessarily require that the subject components be fully environmentally qualified. Plant procedures rightfully include equipment which is not fully qualified, in the event that such equipment is available during or following the occurrence of off-normal conditions. This concern can be addressed in more specific terms subsequent to the Staff identifying the equipment which falls into this category.

2. Also in Section 3.1, the Staff states that they assessed 251 items of equipment. NNECO notes that 48 items were listed in Appendix B, and 86 items were listed in Appendix C. NNECO's review was, therefore, limited to these 134 components rather than the 251 stated by the Staff in Section 3.1.

3. In Section 3.2, the Staff states that NNECO must verify that the containment spray system is not subjected to a disabling single failure to satisfy the DOR Guideline requirements of Section 4.2.1.

   The containment spray system consists of two completely independent and redundant trains. The majority of the active components for each train are located in a watertight room separated from its corresponding train. Since the suction pipe for the "B" train is required to be routed through the "A" safeguards room, this pipe is enclosed in a guard pipe to ensure that a failure of the "B" suction pipe will not disable train "A" equipment.

The containment spray pipes penetrate the containment building approximately 80° apart and are then routed to positions approximately 180° apart before ascending to the containment dome. Each train is tied into independent spray headers. The only components in containment other than the piping and spray nozzles are one locked open manual valve and one check valve per train. There is no electrical equipment within the containment building that is associated with the containment spray system.

A detailed description of the containment spray system was provided in Section 6.4 of the Millstone Unit No. 2 FSAR. The failure mode analysis provided in the FSAR further substantiates the independence of the redundant trains.

Section 6.3.2 of the Millstone Unit No. 2 SER dated May 10, 1974, also evaluates the containment spray system. On Page 6-13, of the SER, the Staff states that:

"It is a Seismic Category I system consisting of redundant piping, valves, pumps, and spray headers."

On Page 6-14, the Staff states that:

"The containment spray system is not designed to meet the single failure criterion since it does not have two completely redundant subsystems."

Please be advised that the above quotation is <u>in error</u>. As summarized above, the containment spray system consists of two fully independent and redundant trains. It is recommended that the Staff issue a supplement to the SER to correct this error.

4. In Section 3.3, the Staff states that the results of the accident analyses for the Main Steam Line Break (MSLB) are "not provided," thereby implying that the Reference (1) submittal was deficient in this respect. Regarding this issue, the following points are noted.

By Reference (3) the Staff ordered and modified License DPR-65 to require compliance with the provisions of the DOR Guidelines of NUREG-0588. In Section 4.2 of the DOR Guidelines, Service Conditions for a PWR MSLB Inside Containment, the Staff states that:

"Equipment qualified for a LOCA environment is considered qualified for a MSLB accident environment in plants with automatic spray systems not subject to disabling single component failures."

NNECO concludes that the relevant NRC requirements imposed by Order on Millstone Unit No. 2 did not mandate submittal of MSLB containment parameters.

The above conclusion notwithstanding, the Staff is referred to Section B.1 of Reference (1), wherein NNECO stated that the temperature and pressure profiles resulting from the MSLB were bounded by those resulting from a postulated LOCA. For specific MSLB profiles, the Staff is referred to Amendment 15 to the Millstone Unit No. 2 FSAR dated February 16, 1973.

Also in Section 3.3, the Staff is concluding that the minimum temperature profile should include a margin to account for higher than average temperatures in the upper regions of containment. This position raises serious concerns regarding both the method of imposition of this requirement, and its technical validity. The techniques employed by NNECO to determine temperature and pressure profiles conforms to the requirements of the DOR guidelines. Recent publications such as NUREG-CR-1511 suggest that the methodologies programmed into the codes endorsed by NUREG-0588 are conservative for calculating temperatures resulting from postulated MSLB events. It is inappropriate that the requirements of DPR-65 be superseded by the Reference (2) "Partial Review." The postulated stratification phenomenon, even if realized, is inconsequential as there is no safety-related electrical equipment in the upper regions of the containment.

5. In Section 3.5, the Staff provides its evaluation of NNECO's information regarding the submergence parameter.

   To substantiate the adequacy of the 8.1 ft maximum submergence level, conservatisms inherent in the calculation are identified as follows:

   a. Tanks with Technical Specification maximum levels were assumed to be at the maximum level and all contents were assumed to be delivered to the sump.

b. Tanks without Technical Specification maximum levels were assumed to be full with all contents delivered to the sump.

c. All water was assumed to be delivered at 50°F and heated (and expanded) to 200°F. This assumption is extremely conservative for the RCS inventory.

d. A 5% contingency is included for uncertainties.

In addition, the following sources of water were assumed to deliver their contents to the sump:

a. RWST

b. Both concentrated Boric Acid Tanks (CBAT)

c. All Safety Injection Tanks (SIT)

d. Total RCS Volume

These assumptions assure that the 8.1 ft level utilized as the qualification parameter is conservative.

Section 3.5 also identifies one component, item number 16-C, containment sump level transmitter, "as having the potential for becoming submerged after a postulated event." The Staff requires NNECO:

"... to supplement the information presented and justify the adequacy of the design on an interim basis."

NNECO finds this requirement perplexing, as this component is being installed in accordance with the requirements of NUREG-0737, item II.F.1, Attachment 5, Containment Water Level Monitor. This Action Plan Item is not required to be implemented until January 1, 1982, and documentation is not required to be submitted until January 1, 1982. Furthermore, the applicable section of Reference (4) states that:

"Qualification documentation for TMI Action Plan equipment not yet installed which does not require pre-implementation review should be submitted to NRC for review by the implementation date."

In this case the applicable date is January 1, 1982. This position was reiterated in item (3) of Reference (5), thereby reinforcing the Staff's position that qualification documentation need not be submitted until January 1, 1982.

In any event, it is not possible to relocate the containment sump level monitor to an elevation where it will not be submerged and have it remain functional as defined in NUREG-0737. In light of the above circumstances, NNECO concludes that "justification of the adequacy of the design on an interim basis" is an inappropriate and misleading requirement. As required by NUREG-0737, and reinforced by References (4) and (5), NNECO intends to docket the qualification documentation on or before January 1, 1982. NNECO is confident that the equipment purchased will be proven to be fully qualified.

Section 3.5 also states that:

"It is not clear from the information submitted that submergence of safety-related electrical equipment outside of containment was addressed. The licensee should address this area more specifically in the 90-day response and upgrade the CES as appropriate."

In response to this concern, the following excerpts from Amendment 17 of the Millstone Unit No. 2 FSAR are provided:

Main Steam Line Break Section 5.1.7

"The postulated break in the main steam line will release steam, much of which will be vented. Any moisture separated from the escaping steam or formed by condensate can be adequately handled by the floor drains system."

Main Feedwater Line Break Section 5.2.7

"Water discharged from a postulated feedwater line rupture .... will drain from the Elevation 38' - 6" floor through the vertical pipeway near column line H-4, downward to the Elevation (-) 25' - 6" level ...., and then through a second vertical pipeway to Elevation (-) 45' - 6" ... Substantial quantities of water will not collect on either the Elevation 38' - 6" or Elevation (-) 25' - 6" levels. Water collected in the Elevation (-) 45' - 6" level will not exceed the structural capacity of the floor. This water will eventually be removed from the Elevation (-) 45' - 6" level by sump pumps. All safety related equipment necessary for a safe shutdown in the path of water flow are housed in watertight compartments ......

Therefore, a postulated rupture of the main feedwater in the Auxiliary Building will have no adverse effects due to flooding.

The postulated rupture of a main feedwater line in the Turbine Building will have no adverse effects on required safety related equipment."

Letdown Line Break Section 5.8.5

"Adverse environmental effects due to a letdown line rupture are expected to be minimal. The floor drains system can adequately handle the water discharge from the break."

Charging Line Break Section 5.9.7

"Flooding effects due to a postulated rupture in the charging system was considered. The maximum charging flowrate is 132 gpm, supplied when all three positive displacement charging pumps are operating. Normally only one pump is operating. A break in the charging line will be detected in the control room by low pressure in the line. Shutting off the charging pumps can be accomplished either from the control room or by local hand switches. The floor drain system is adequate to handle the maximum discharge from the break of 132 gpm."

Auxiliary Steam System Section 5.10.7

"The operability of required electrical equipment in the vicinity of the auxiliary steam lines will not be impaired due to the steam environment."

Control Room Habitability Section 5.11

"....the layout is such that the postulated rupture of any high energy line cannot damage the control room by either pipe whipping or jet impingement."

Staff concurrence with the above information was documented in Section 10.6.3 of the Millstone Unit No. 2 SER. NNECO has confirmed the continued applicability of the previous conclusion that submergence of safety-related electrical equipment outside contianment is not of concern at Millstone Unit No. 2.

6. In Section 3.7, the Staff identifies three specific actions which are "required" to respond to aging concerns. NNECO notes that the aging parameter was addressed in Reference (1) for all components in accordance with the DOR Guidelines, which identify options beyond those listed in Section 3.7.

7. In Section 3.8, the Staff identifies some concerns regarding the radiation service conditions used to qualify the safety-related electrical equipment, and states that the value used by NNECO:

"....does not envelope the DOR Guideline requirements (4×10^7 rads) and therefore is not acceptable."

NNECO disagrees with this position. The DOR Guideline requirement is not 4×10^7 rads as stated in Reference (2), but is actually 2×10^7

rads gamma provided it is demonstrated that the affects of beta radiation are not significant. It is also of interest to note that the above requirements differ from those delineated in NUREG-0588.

In response to the Staff requirement to provide additional details regarding the determination of the appropriate radiation service conditions, NNECO hereby provides Attachment 1, Radiation Service Conditions Inside Containment, Millstone Unit No. 2. The bases, assumptions, calculations, and results are included to substantiate the validity of the values utilized in the equipment qualification process. An explicit quantification of the beta dose in air is provided in the Attachment.

8. Regarding components included in Appendix B, it is not possible to address the specific nature of the Staff concerns in all cases in the absence of the SER. Nonetheless, the following points are relevant:

   a. Of the 48 components listed in Appendix B, NNECO concludes that full qualification for 8 of those components was provided in Reference (1).

   b. In the case of some 34 components included in Appendix B, plans for providing full qualification and justification for continued operation was provided in Reference (1). No further justification or action beyond that detailed in Reference (1) is planned for these 34 components.

   c. Regarding the remaining 6 components included in Appendix B, all are being installed as TMI Action Plan requirements, and the documentation requirements are being fulfilled in accordance with NUREG-0737, Reference (4) and Reference (5). For item numbers 15C and 16C, the due date for submitting qualification documentation has not yet passed, and implementation is not required until January 1, 1982. NNECO intends to comply with schedular requirements of NUREG-0737, Reference (4) and Reference (5). Item numbers 17C, 18C, 19C, and 20C all relate to Action Plan requirement II.D.3, Direct Indication of Relief and Safety Valve Position. The qualification status of this equipment was summarized in Reference (6), and additional details can be found in correspondence referenced therein.

In light of the above points, NNECO suggests that the current status of the Staff's Safety Evaluation Reports (SER) does not accurately reflect the qualification status of electrical equipment at Millstone Unit No. 2. It would appear to be in our mutual best interests to have the above concerns evaluated in detail prior to issuance of the SER's, and the Technical Evaluation Report (TER) discussed in Section 3 of Reference (2). Subsequent to receipt of those documents, including the basis for the conclusions in Appendices B and C of the Partial Review, a complete and meaningful reevaluation can be completed. For the interim period, NNECO reiterates its conclusion that the Staff's concerns identified in Reference (2) do not alter the determination that Millstone Unit No. 2 can continue to be operated safely.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

W. G. Counsil

Senior Vice President

STATE OF CONNECTICUT)
) ss. Berlin
COUNTY OF HARTFORD)

April 30, 1981

Then personally appeared before me W. G. Counsil, who being duly sworn, did state that he is Senior Vice President of Northeast Nuclear Energy Company, Licensee herein, that he is authorized to execute and file the foregoing information in the name and on behalf of the Licensee herein and that the statements contained in said information are true and correct to the best of his knowledge and belief.

Patricia R. McGee

Notary Public

My Commission Expires 3-31-81

Docket No. 50-336

Millstone Nuclear Power Station, Unit No. 2

Attachment 1

Radiation Service Conditions Inside Containment

April, 1981

MILLSTONE UNIT NO. 2

RADIATION SERVICE CONDITIONS INSIDE CONTAINMENT

1. GENERAL

By Reference 1, the NRC provided the detailed methodology for determining the radiation service conditions inside containment for the Millstone Unit No. 2. In reviewing the material given in Reference 1, NNECO determined that a detailed radiation environment analysis which was performed in 1979 fulfilled the requirements of Reference 1. The methodology and assumptions used to generate these radiation service conditions and the results are provided below.

2. SCENARIO

The shielding analysis was performed assuming design basis accident assumptions. The scenario is based upon the guidance given in NUREG0588 in that an accident occurs which totally depressurizes the reactor vessel and releases substantial fission products into the containment atmosphere.

3. SOURCE TERMS AND DISTRIBUTION OF ACTIVITY

NNECO assumed an initial release of 50% of the core iodine and 100% of the noble gas activity to be uniformly distributed in the containment atmosphere at t=0. For conservatism, no plateout on the containment walls and no removal of iodine from the containment sprays were assumed.

NOTE: It should be emphasized that 50% of the core iodine activity has been assumed to be uniformly mixed in the containment atmosphere (e.g., no plateout assumed) because this assumption is conservative and simplifies the modeling by avoiding the necessity of calculating the plateout dose rate. NNECO does not believe that 50% of the core iodines would be available for release from containment in a DBA. For off-site dose calculations to comply with 10CFR100, we assume that 25% of the iodines are available for release from the containment. This is consistent with criteria given in Regulatory Guide 1.3. Decay of fission products was the only means of removal assumed in the analysis.

Core activity levels were based on TID-14844 source terms. In order to simulate the band of gamma ray spectra emitted by the nuclides, the source was broken up into a seven energy group gamma source. The mean energies of the source are: 0.4, 0.8, 1.3, 1.7, 2.2, 2.5 and 3.5 Mev.

4. METHOD OF ANALYSIS

a. Gamma Dose

A modified version of the QAD-P5F (Reference 2) computer code was used to evaluate the gamma dose rates at various locations inside the containment. The airborne source was broken up into four main source regions. The source volume in these regions was represented by a total of 36,000 point sources.

Shielding which surrounds the steam generators was modeled in the QAD runs. Since the shielding is irregular, the shield wall was modeled as a cylinder in order to simplify the calculation. The inside radius of the cylindrical wall was conservatively taken to be about 35 feet, and the wall thickness was 3.5 feet. The density of the concrete was assumed to be 2.24 gm/cm^3.

Twelve receptor points were placed throughout the containment and the highest dose rate was used to compute the integrated dose at 30 days after the accident. This receptor location corresponds to a receptor point located on the containment centerline. The dose from this receptor location was used to qualify all equipment inside containment except the equipment at the electrical penetrations. Another specific dose calculation was performed at the electrical penetrations using the same methodology.

b. Beta

Beta doses inside the containment were obtained using the semi-infinite cloud dose model based on the concentration of fission products which exist inside the containment. This method is appropriate because of the short range of beta particles in air. The beta dose in Table 1 represent the beta dose in air and does not represent the beta dose the equipment will actually receive. Actual beta doses to equipment are expected to be significantly lower due to local shielding considerations (e.g., metal casing around electric motors will absorb most of the betas, etc.).

5. SAMPLE CALCULATION

a. Gamma-LOCA Dose

The calculation of the dose at the center of the containment will be used as a sample case.

A detailed description of the geometry model of the containment is given in Figure 1. This figure is based on information contained in Drawing #25203-11177 and represents the containment as 5 different regions. Regions 1 through 4 represent different source regions, whereas, Region 5 is the concrete shield wall. All boundaries and regions are clearly depicted in the figure.

A seven energy group representation of the source was obtained using source data (see Tables 2 and 3) provided by Stone and Webster for the Connecticut Yankee (CY) electrical equipment qualification project. The CY source terms were ratioed by core power level and containment volume to obtain appropriate values for MP-2. The appropriate ratio to multiply the CY source terms is:

$$\text{Ratio} = R = \frac{V_{CY}}{V_{MP-2}} \times \frac{P_{MP-2}}{P_{CY}}$$

Where: V_{CY} = volume of CY containment

$= 2.23 \times 10^6 \ ft^3$

V_{MP-2} = volume of MP-2 containment

$= 1.9 \times 10^6 \ ft^3$

P_{MP-2} = MP-2 core thermal power level = 2700 Mwt

P_{CY} = CY core thermal power level = 1825 Mwt

$$R = \frac{2.23 \times 10^6 \ ft^3}{1.9 \times 10^6 \ ft^3} \times \frac{2700 \text{ Mwt}}{1825 \text{ Mwt}} = 1.74$$

The CY source terms (Tables 2 and 3) were multiplied by the above ratio in order to obtain the MP-2 source concentrations. The resulting MP-2 source terms which were used in the QAD code are given in Table 4.

In order to simplify the geometry, the containment was modeled as a cylinder of radius 1981 cm and effective height of 4785 cm. The effective height was based on a total containment volume of 5.853×10^{10} cm^3.

The gross volume of each source region was computed as follows:

Region	Volume Calculation	Gross Volume
1	$V_1 = \pi(r_1^2 - r_2^2)h = \pi(1982^2 - 1071.9^2)\ 487.7 =$	$4.258 \times 10^9\ cm^3$
2	$V_2 = \pi(r_1^2 - r_2^2)h = \pi(1982^2 - 1178.6^2)\ (1173.5 - 487.7) =$	$5.471 \times 10^9\ cm^3$
3	$V_3 = \pi\ r^2 L = \pi(1071.9)^2 4785$	$= 1.727 \times 10^{10}\ cm^3$
4	$V_4 = \pi(1982^2 - 1071.9^2)\ (4785 - 1173.5)$	$= 3.153 \times 10^{10}\ cm^3$

$$\text{Total Volume} = V_1 + V_2 + V_3 + V_4 = 5.853 \times 10^{10}\ cm^3$$

Because the free air volume in the containment is 1.9×10^6 ft^3 (5.4×10^{10} cm^3), the gross volume of each region calculated above must be ratioed by the factor:

$$\frac{5.4 \times 10^{10}}{5.853 \times 10^{10}} = .9266$$

in order to account for the actual free air volume of the containment. Therefore, the free air volume of each region is:

Region	Free Air Volume
1	$V_1 = 4.258 \times 10^9\ cm^3 \times .9266 = 3.945 \times 10^9\ cm^3$
2	$V_2 = 5.471 \times 10^9\ cm^3 \times .9266 = 5.069 \times 10^9\ cm^3$
3	$V_3 = 1.727 \times 10^{10}\ cm^3 \times .9266 = 1.600 \times 10^{10}\ cm^3$
4	$V_4 = 3.153 \times 10^{10}\ cm^3 \times .9266 = 2.921 \times 10^{10}\ cm^3$

The entire listing of QAD input parameters which were used in the QAD computer runs are given in Tables 5 to 8. For conservatism, a density of air has been taken to be 0.0012 gms/cm^3 and for concrete, the assumed density was 2.24 gm/cm^3. All attenuation, build-up, and dose conversion factors which were used in the analysis were obtained from the Stone & Webster RP8A shielding manual (Reference 3). The source was assumed to be uniformly distributed in each region.

The results of the QAD runs for each source region are given below (see Appendix A for QAD runs).

Source Region	Dose Rate (mR/HR)
1	1.213×10^7
2	8.324×10^7
3	2.124×10^9
4	1.149×10^9
	3.4×10^9

The (0-30) day integrated LOCA dose was calculated by ratioing results obtained from a Stone & Webster calculation regarding

CY electrical equipment qualification. Figure 2 shows the gamma dose rate and integrated dose as a function of time at an area on the CY charging floor. Since the same mixture of isotopes (e.g. 50% core iodine, 100% core noble gas) was assumed to be released into the containment, the integrated dose for a similar geometric configuration would just be a constant factor multiplied by the initial dose rate. The integrated dose for MP-2 would be obtained using the following equation:

$$D_{I_{MP-2}} = \frac{D_{R_{MP-2}}}{D_{R_{CY}}} \times D_{I_{CY}}$$

where: $D_{I_{MP-2}}$ = 30-day integrated dose in the MP2 containment

$D_{I_{MP-2}}$ = dose rate at t=0 in the MP2 containment

= 3.4×10^6 R/HR

$D_{R_{CY}}$ = dose rate at t=0 in the CY containment

= 1.2×10^6 R/HR (see Figure 2)

$D_{I_{CY}}$ = integrated dose in the CY containment at 30 days (see Figure 2)

$$D_{I_{MP-2}} = \frac{3.4 \times 10^6 \text{ R/HR}}{1.2 \times 10^6 \text{ R/HR}} \times 6.6 \times 10^6 \text{ Rads} = 1.9 \times 10^7 \text{ rads}$$

b. Beta-Dose-LOCA

The beta dose calculation was based on a Stone & Webster computer calculation for dose rates and integrated doses inside the CY containment. Since the particular computer run assumed a 25% iodine and a 100% noble gas release, a correction was made to account for a 50% iodine release.

The computer doses are based on a semi-infinite cloud dose model and are given in Table 9. Corrections to the numbers in these tables are given below to account for MP-2 plant specific parameters.

Total Dose (Noble Gas & Halogens) = 6.12×10^7 rads (from Table 9)

Halogen Dose (based on a 25% halogen release) = 1.39×10^7 rads

Noble Gas Dose Only = 4.73×10^7 rads

Dose from 50% Halogen Release = 1.39×10^7 rads x 2 = 2.78×10^7 rads

Total Beta Dose in MP-2 Containment = $(4.73 \times 10^7 + 2.78 \times 10^7) \times 1.74 = 1.3 \times 10^8$ rads

c. 40-Year Normal Operating Dose

The 40-year normal operating dose was calculated based on surveys (Reference 4) performed in the MP-2 containment. The receptor location from the survey was taken to be point N-5 (see Figure 3). It should be recognized that at the time these surveys were taken, MP-2 did not have a neutron shield in the cavity area. A neutron shield was installed during the second refueling outage and appropriate dose reduction factors have been used to specify the normal operating dose rates.

Neutron Dose Rate = 65,000 mR/HR

Gamma Dose Rate = 10,000 mR/HR

Assumptions:

1) This neutron dose is a result of streaming

2) The neutron shield will reduce the neutron dose by a factor of 20. This assumption is conservative since Reference 5 specifies that the reduction is about a factor of 65.

3) Quality factor for neutrons = 2.0

4) No attenuation taken credit for gamma rays because of neutron shield

5) Plant Capacity factor of .8 assumed

The neutron dose rate is, therefore:

$$65{,}000 \text{ mRem/HR} \times \frac{1 \text{ Rem}}{10^3 \text{ mRem}} \times \frac{1 \text{ rad}}{2 \text{ rem}} \times \frac{1}{20} = 1.6 \text{ Rad/HR}$$

Total Dose Rate = neutron + gamma

$= 1.6$ R/HR + 10 R/HR = 12 R/HR

Total 40-Year Normal Operating Dose

$40 \text{ years} \times 365 \frac{\text{days}}{\text{year}} \times 24 \frac{\text{hours}}{\text{day}} \times .8 \times 12\text{R/HR} = 3.4 \times 10^6 \text{ Rad}$

Assuming 50% higher radiation levels due to changes in core configuration from when surveys were performed would give a dose of:

3.4×10^6 Rads + $.5 \times 3.4 \times 10^6$ rads = 5.1×10^6 rads

Total Gamma Dose = LOCA + Normal Operating

= 1.9×10^7 rads + 5.1×10^6 rads = 2.4×10^7 rads

A summary of the computed doses is given in Table 1.

6. COMPARISON WITH NRC NUREG 0588

The NRC performed a detailed calculation of the LOCA doses at several locations in a PWR containment in Appendix D of NUREG 0588. The sample calculation was performed for a 4000 Mwt reactor housed in a 2.52×10^6 ft^3 containment. Integrated 30-day doses developed by the NRC were 1.5×10^7 rads gamma at the containment centerline and 9.1×10^6 rads gamma on the containment wall. Correcting for MP-2 power level and containment volume we obtain corresponding values for MP-2 of 1.34×10^7 rads gamma (at the center of containment) and 8.1×10^6 rads gamma (at the containment wall).

The NNECO calculated LOCA gamma dose at the containment center is 1.9×10^7 rads and 9.4×10^6 rads at the containment wall. The NNECO LOCA calculation, therefore, bounds the NRC calculation and supports the position that the values used for equipment qualification are conservative and acceptable.

The Beta LOCA dose calculated by NNECO at the center of containment is 1.3×10^8 rads. After correcting NRC NUREG 0588 Beta LOCA dose of 1.4×10^8 rads for MP-2 power level and containment volume, we obtain a beta dose of 1.25×10^8 rads.

The NNECO calculated LOCA beta dose, therefore, bounds the NRC calculated value.

TABLE 1

30 DAY INTEGRATED DOSE IN MP-2 CONTAINMENT

Receptor Point Location	40 Year Normal Operating Doses (Rads)	30 Day Integrated LOCA Doses (Rads)		Total Dose (Rads)	
	$n + \gamma$	Gamma	Beta	Gamma	Beta
Center of Containment	5.1×10^6	1.9×10^7	1.3×10^8	2.4×10^7	1.3×10^8
Containment Wall	1.0×10^4	9.4×10^6	1.3×10^8	9.4×10^6	1.3×10^8

Table 2

********** RESULTS **********

RADIOISOTOPE * * * REVISED 3/16/68

CONN YANKEE LOCA STUDY INSIDE CONTAINMENT IODINES (T=0)

DECAY TIME (HOURS)= 0.0

PURIFICATION CODE NUMBER= 0

NUMBER OF ISOTOPES HAVING INITIAL ACTIVITIES= 5

NUMBER OF ALTERATIONS TO LIBRARY PART 1= 0

NUMBER OF ALTERATIONS TO LIBRARY PART 2= 0

ISOTOPE	INITIAL ACTIVITY (UC/CC)	FINAL ACTIVITY (UC/CC)	SPECIFIC ACTIVITY (MEV/CC-SEC) AT ENERGY (MEV) OF 0.40	0.80	1.30	1.70	2.20	2.50	3.50
FISSION PRODUCTS - NOBLE GASES									
FISSION PRODUCTS - HALOGENS									
I131	0.335D 03	0.335E 03	0.388E 07	0.967E 06	0.0	0.0	0.0	0.0	0.0
I132	0.500D 03	0.500E 03	0.0	0.280E 08	0.555E 07	0.303E 07	0.185E 07	0.0	0.0
I133	0.818D 03	0.818E 03	0.0	0.167E 08	0.0	0.424E 06	0.0	0.0	0.0
I134	0.869D 03	0.869E 03	0.0	0.527E 08	0.193E 08	0.119E 08	0.0	0.0	0.0
I135	0.774D 03	0.774E 03	0.0	0.347E 07	0.272E 08	0.172E 08	0.286E 07	0.0	0.0
FISSION PRODUCTS - REMAINDER									
CORROSION/ACTIVATION PRODUCTS									

	TOTAL SPECIFIC ACTIVITY (MEV/CC-SEC) AT ENERGY (MEV) OF 0.40	0.80	1.30	1.70	2.20	2.50	3.50
FISSION PRODUCTS - NOBLE GASES	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FISSION PRODUCTS - HALOGENS	0.388E 07	0.102E 09	0.520E 08	0.325E 08	0.471E 07	0.0	0.0
FISSION PRODUCTS - REMAINDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CORROSION/ACTIVATION PRODUCTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2 (continued)

SUM OF FISSION AND CORROSION PROD.	0.388E 07	0.102E 09	0.520E 08	0.325E 08	0.471E 07	0.0	0.0

END OF THIS PROBLEM

Table 3

********** RESULTS **********

RADIOISOTOPE * * * REVISED 3/16/68

CONN YANKEE LOCA STUDY NOBLE GASES ***NO CONTAINMENT LEAKAGE**

DECAY TIME (HOURS)= 0.0

PURIFICATION CODE NUMBER= 0

NUMBER OF ISOTOPES HAVING INITIAL ACTIVITIES= 13

NUMBER OF ALTERATIONS TO LIBRARY PART 1= 0

NUMBER OF ALTERATIONS TO LIBRARY PART 2= 0

ISOTOPE	INITIAL ACTIVITY (UC/CC)	FINAL ACTIVITY (UC/CC)	SPECIFIC ACTIVITY (MEV/CC-SEC) AT ENERGY (MEV) OF 0.40	0.80	1.30	1.70	2.20	2.50	3.50
FISSION PRODUCTS - NOBLE GASES									
KR83M	0.130D 03	0.130E 03	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KR85M	0.380D 03	0.380E 03	0.221E 07	0.0	0.0	0.0	0.0	0.0	0.0
KR85	0.128D 02	0.128E 02	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KR87	0.579D 03	0.579E 03	0.0	0.309E 08	0.0	0.0	0.214E 07	0.214E 08	0.0
KR88	0.881D 03	0.881E 03	0.326E 07	0.469E 07	0.117E 07	0.707E 07	0.196E 08	0.261E 08	0.0
KR89	0.113D 04	0.113E 04	0.0	0.0	0.0	0.460E 08	0.0	0.0	0.502E 08
XE131M	0.401D 01	0.401E 01	0.148E 03	0.0	0.0	0.0	0.0	0.0	0.0
XE133M	0.436D 02	0.436E 02	0.419E 05	0.0	0.0	0.0	0.0	0.0	0.0
XE133	0.164D 04	0.164E 04	0.405E 07	0.0	0.0	0.0	0.0	0.0	0.0
XE135M	0.464D 03	0.464E 03	0.0	0.714E 07	0.0	0.0	0.0	0.0	0.0
XE135	0.533D 03	0.533E 03	0.479E 07	0.355E 06	0.0	0.0	0.0	0.0	0.0
XE137	0.144D 04	0.144E 04	0.0	0.480E 07	0.0	0.639E 08	0.0	0.0	0.0
XE138	0.151D 04	0.151E 04	0.0	0.131E 08	0.0	0.0	0.584E 08	0.0	0.0
FISSION PRODUCTS - HALOGENS									
FISSION PRODUCTS - REMAINDER									
CORROSION/ACTIVATION PRODUCTS									

Table 3 (continued)

	TOTAL SPECIFIC ACTIVITY (MEV/CC-SEC) AT ENERGY (MEV) OF						
	0.40	0.80	1.30	1.70	2.20	2.50	3.50
FISSION PRODUCTS - NOBLE GASES	0.152E 08	0.410E 08	0.117E 07	0.117E 09	0.801E 08	0.475E 08	0.502E 08
FISSION PRODUCTS - HALOGENS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FISSION PRODUCTS - REMAINDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CORROSION/ACTIVATION PRODUCTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUM OF FISSION AND CORROSION PROD.	0.152E 08	0.410E 08	0.117E 07	0.117E 09	0.801E 08	0.475E 08	0.502E 08

BY ______ DATE 3/18/71
CHKD. BY ______ DATE ______
CAT. 1 CALC. # 73-771-26 RA
SHEET NO. 6 OF 191

TABLE 4: Conservative Source Terms

Specific Activity (Mev/cc-sec)

Conn Yankee[3]

Energy of Gamma (Mev)	.4	.8	1.3	1.7	2.2	2.5	3.5
Halogens[1]	3.88×10^6	1.02×10^8	5.2×10^7	3.25×10^7	4.71×10^6	0.0	0.0
Noble Gases[2]	1.52×10^7	4.1×10^7	1.17×10^6	1.17×10^8	8.01×10^7	4.75×10^7	5.02×10^7
Total	1.91×10^7	1.43×10^8	5.32×10^7	1.50×10^8	8.50×10^7	4.75×10^7	5.02×10^7

MP 2

Energy of Gamma (Mev)	.4	.8	1.3	1.7	2.2	2.5	3.5
Halogens[1]	6.751×10^6	1.775×10^8	9.048×10^7	5.655×10^7	8.195×10^6	0.0	0.0
Noble Gases[2]	2.645×10^7	7.134×10^7	2.036×10^6	2.036×10^8	1.394×10^8	8.265×10^7	8.735×10^7
Total	3.320×10^7	2.488×10^8	9.252×10^7	2.602×10^8	1.476×10^8	8.265×10^7	8.735×10^7

- 6 -

1 50% of core inventory of Halogens released to containment atmosphere

2 100% of core inventory of Noble Gases released to containment atmosphere

3 as calculated in S&W Cat. 1 Calc #'s PR(B)-008, PR(B)-009, PR(B)-010 (Computer Runs 8024, 8025)

Table 5

```
**** TSO FOREGROUND HARDCOPY ****
DSNAME=DMILLER.QADDATA5.DATA

MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE=REGION 1) 00000010
  20  20   20   2    2   5    8   7    0   1    2   0                  00000020
   1   0    4   0    0   0    1                                        00000030
                                                                      200000040
3.945E09                                                               00000050
  1071.9  1117.4   1162.9   1208.4   1253.9   1299.4  1344.9    1390.4 00000060
  1435.9  1481.4   1527.    1572.5   1618.    1663.5   1709.    1754.5 00000070
  1800.5  1845.5   1891.    1936.5   1982.0                            00000080
     0.0    24.4     46.8     73.2     97.5    121.9   146.3     170.7 00000090
    195.   219.4    243.8    268.2    292.6    317.    341.4     365.8 00000100
   390.2   414.5    438.9    463.3    487.7                            00000110
     0.0     .31      .63      .94     1.25     1.57    1.88       2.2 00000120
     2.5     2.8      3.1      3.5      3.8      4.1     4.4       4.7 00000130
    5.03    5.34     5.65     5.97    6.283                            00000140
 0  7  5                                                               00000150
 1  0 12      0.0    1982.      0.0    1982.                           00000160
 2  0 12      0.0    1178.6     0.0    1178.6                          00000170
 3  0 12      0.0    1071.9     0.0    1071.9                          00000180
 4  0  3      0.0                                                      00000190
 5  0  3    487.7                                                      00000200
 6  0  3   1173.5                                                      00000210
 7  0  3    4785.                                                      00000220
 1     1  1  3  4  5                           1900.      0.0    300.000000230
 2     1  1  2  5  6                           1900.      0.0    500.000000240
 3     1  3  4  7                                0.0       0.      1.000000250
 4     1  3  1  6  7                           1500.       0.   3000.000000260
 5     2  2  3  5  6                           1100.0      0.    500.000000270
   .0012     0.0                                                       00000280
     0.0    2.24                                                       00000290
12 13                                                                  00000300
 3.320E7  2.488E8  9.252E7  2.602E8  1.476E8  8.265E7  8.735E7  1.E-2000000310
MEV/CM2-SEC                MREM/HR                                     00000320
     0.0      0.0   2382.5     1                                       00000330
                              -1                                       00000340
```

Table 6

```
**** TSO FOREGROUND HARDCOPY ****
DSNAME=DMILLER.Q-CDATA7.DATA

MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE=REGION 2) 00000010
  20  20    20   2    2   5    6   7    0   1    2   0                  00000020
   1   0     4   0    0   0    1                                        00000030
                                                                       200000040
5.069E09                                                                00000050
  1178.6  1218.8   1258.9   1299.1   1339.3   1379.5  1419.6    1459.8 00000060
  1500.0  1540.1   1580.3   1620.5   1660.6   1700.8  1741.0    1781.1 00000070
  1821.3  1861.5   1901.7   1941.8   1982.0                            00000080
   437.7   522.0    556.3    590.6    624.9    659.2   693.4     727.7 00000090
    762.   796.3    830.6    864.9    899.2    933.5   967.8    1002.1 00000100
  1036.3  1070.6   1104.9   1139.2   1173.5                            00000110
     0.0     .31      .63      .94     1.25     1.57    1.88       2.2 00000120
     2.5     2.8      3.1      3.5      3.8      4.1     4.4       4.7 00000130
    5.03    5.34     5.65     5.97    6.283                            00000140
 0  7  5                                                               00000150
 1  0 12       0.0    1982.       0.0    1982.                         00000160
 2  0 12       0.0   1178.6       0.0   1178.6                         00000170
 3  0 12       0.0   1071.9       0.0   1071.9                         00000180
 4  0  3       0.0                                                     00000190
 5  0  3     487.7                                                     00000200
 6  0  3    1173.5                                                     00000210
 7  0  3     4785.                                                     00000220
 1      1  1  3  4  5                            1900.       0.0    300.000000230
 2      1  1  2  5  6                            1900.       0.0    500.000000240
 3      1  3  4  7                                 0.0        0.      1.000000250
 4      1  3  1  6  7                            1500.        0.   3000.000000260
 5      2  2  3  5  6                           1100.0        0.    500.000000270
   .0012     0.0                                                   00000280
     0.0    2.24                                                   00000290
12 13                                                              00000300
 3.320E7  2.488E8  9.252E7  2.602E8  1.476E8  8.265E7  8.7[illegible]E7  1.E-2000000310
MEV/CM2-SEC                 MREM/HR                                00000320
     0.0       0.0   2362.5    1                                   00000330
                              -1                                   00000340
```

Table 7

```
**** TSO FOREGROUND HARDCOPY ****
DSNAME=DMILLER.G DDATA4.DATA

MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE=REGION 3) 00000010
  20  30   20   2    2   5    8   7    0   1    2   0                  00000020
   1   0    4   0    0   0    1                                        00000030
                                                                      200000040
 1.600E10                                                              00000050
     0.0     53.6    107.2    160.8    214.4    268.    321.6    375.2 00000060
   428.8    482.4    536.0    589.6    643.1   696.7    750.3    803.9 00000070
   857.5    911.1    964.7   1018.3   1071.9                           00000080
     0.0    159.5    319.     478.5    638.    797.5    957.    1116.5 00000090
   1276.   1435.5   1595.   1754.5    1914.   2073.5   2233.   2392.5  00000100
   2552.   2711.5   2871.   3030.5    3190.   3349.5   3509.   3668.5  00000110
  3828.0   3987.5   4147.   4306.5    4466.   4625.5  4785.0           00000120
     0.0      .31      .63      .90     1.25    1.57    1.88      2.2 00000130
     2.5      2.8      3.1      3.5      3.8     4.1     4.4      4.7 00000140
    5.03     5.34     5.65     5.97    6.283                           00000150
 0  7  5                                                               00000160
 1  0 12      0.0   1982.      0.0   1982.                             00000170
 2  0 12      0.0  1178.6      0.0  1178.6                             00000180
 3  0 12      0.0  1071.9      0.0  1071.9                             00000190
 4  0  3      0.0                                                      00000200
 5  0  3    487.7                                                      00000210
 6  0  3   1173.5                                                      00000220
 7  0  3    4785.                                                      00000230
 1     1  1  3  4  5                         1900.      0.0    300.00000240
 2     1  1  2  5  6                         1900.      0.0    500.00000250
 3     1  3  4  7                              0.0       0.      1.000000260
 4     1  3  1  6  7                         1500.       0.   3000.00000270
 5     2  2  3  5  6                        1100.0       0.    500.00000280
   .0012    0.0                                                        00000290
     0.0   2.24                                                        00000300
 12 13                                                                 00000310
 3.320E7  2.488E8  9.252E7  2.602E8  1.476E8  8.265E7  8.735E7  1.E-2000000320
 MEV/CM2-SEC             MREM/HR                                       00000330
     0.0      0.0   2382.5    1                                        00000340
                             -1                                        00000350
```

Table 9

CONN YANKEE LOCA STUDY INSIDE CONTAINMENT

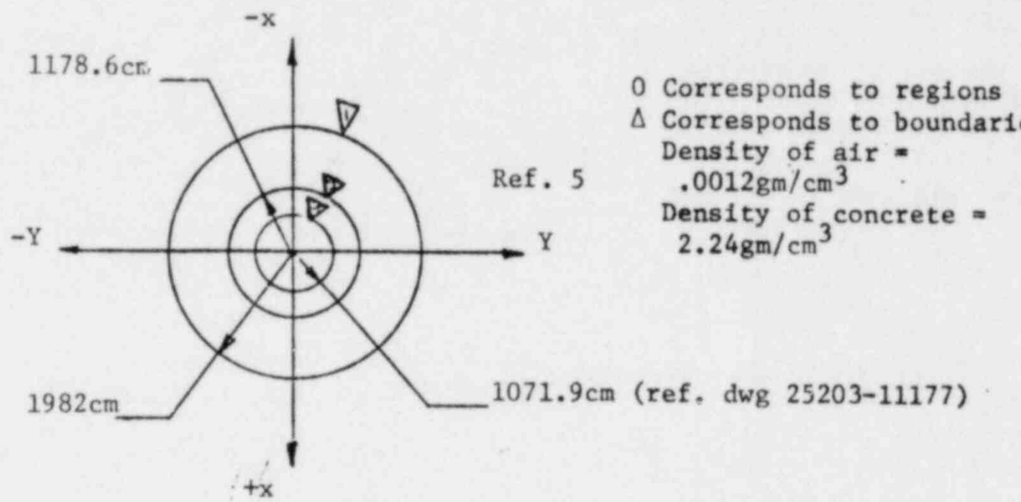
INTEGRATED DOSE (REM) IN VOLUME 1 (PRIMARY CONTAINMENT) BETWEEN TIME T(J-1) AND T(J)

T(J) HRS	2.00	8.00	24.00	24.00	96.00	720.00	720.00	1440.00	2160.00
BETA DOSE									
I129	2.45E-04	1.47E-03	3.93E-03	2.62E-08	1.77E-02	1.53E-01	2.40E-07	1.77E-01	1.77E-01
I131	2.89E+04	1.71E+05	4.39E+05	2.85E+00	1.69E+06	5.13E+06	2.15E+00	5.66E+05	4.28E+04
I132	5.56E+04	1.31E+05	2.52E+04	6.41E-03	1.98E+02	6.40E-08	0.0	0.0	0.0
I133	1.30E+05	6.97E+05	1.31E+06	6.62E+00	1.70E+06	1.74E+05	6.36E-09	1.97E-04	9.38E-15
I134	6.29E+04	5.16E+04	4.50E+02	1.19E-07	1.41E-03	2.42E-28	0.0	0.0	0.0
I135	1.30E+05	5.53E+05	5.21E+05	1.36E+00	1.23E+05	7.25E+01	7.32E-31	7.26E-27	3.58E-59
I136	6.23E-10	7.87E-23	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BR83	5.86E+03	1.40E+04	2.72E+03	7.15E-04	2.22E+01	8.64E-09	0.0	0.0	0.0
BR84	7.23E+03	2.86E+03	1.49E+00	3.52E-13	2.62E-09	1.04E-48	0.0	0.0	0.0
BR85	3.27E-03	3.12E-09	2.39E-45	0.0	0.0	0.0	0.0	0.0	0.0
BR87	1.80E-16	1.06E-35	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KR83M	3.31E+03	1.15E+04	3.65E+03	1.34E-03	4.34E+01	1.99E-08	0.0	0.0	0.0
KR85M	2.53E+04	9.07E+04	5.30E+04	7.78E-02	4.62E+03	5.42E-02	1.55E-48	1.01E-44	0.0
KR85	2.42E+03	1.45E+04	3.88E+04	2.59E-01	1.75E+05	1.51E+06	2.36E+00	1.73E+06	1.72E+06
KR87	2.24E+05	3.05E+05	1.30E+04	1.47E-04	2.58E+00	5.64E-17	0.0	0.0	0.0
KR88	1.55E+05	4.26E+05	1.22E+05	6.27E-02	2.37E+03	4.26E-05	7.80E-76	3.22E-72	0.0
KR89	1.63E-01	3.70E-07	5.06E-41	0.0	0.0	0.0	0.0	0.0	0.0
XE131M	4.51E+02	2.72E+03	7.36E+03	4.96E-02	3.44E+04	2.30E+05	2.29E-01	9.01E+04	1.90E+04
XE133M	6.91E+03	4.14E+04	1.07E+05	6.91E-01	3.49E+05	2.72E+05	1.34E-03	1.09E+02	1.29E-02
XE133	1.70E+05	1.02E+06	2.67E+06	1.75E+01	1.03E+07	2.18E+07	4.06E+00	7.49E+05	1.50E+04
XE135M	3.08E+04	1.31E+05	1.23E+05	3.22E-01	2.91E+04	1.71E+01	1.73E-31	1.72E-27	8.46E-60
XE135	1.58E+05	1.10E+06	2.43E+06	1.13E+01	1.69E+06	1.02E+04	1.65E-21	2.22E-17	3.03E-41
XE137	4.22E+00	1.15E-04	4.66E-32	0.0	0.0	0.0	0.0	0.0	0.0
XE138	2.28E+04	2.16E+03	9.02E-04	2.30E-24	8.81E-21	0.0	0.0	0.0	0.0
TOTAL	1.22E+06	4.76E+06	7.87E+06	4.11E+01	1.61E+07	2.91E+07	8.79E+00	3.14E+06	1.80E+06
CUM. TOTAL	3.40E+06	8.16E+06	1.60E+07	1.60E+07	3.21E+07	6.12E+07	6.12E+07	6.44E+07	6.62E+07
HALOGEN CONTRIBUTION TOTALS									
ELEMENTAL	4.21E+05	1.62E+06	2.29E+06	1.08E+01	3.52E+06	5.30E+06	2.15E+00	5.66E+05	4.28E+04
METHYL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HALOGEN CONTRIBUTION CUM. TOTALS									
ELEMENTAL	1.14E+06	2.76E+06	5.06E+06	5.06E+06	8.57E+06	1.39E+07	1.39E+07	1.44E+07	1.45E+07
METHYL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 8

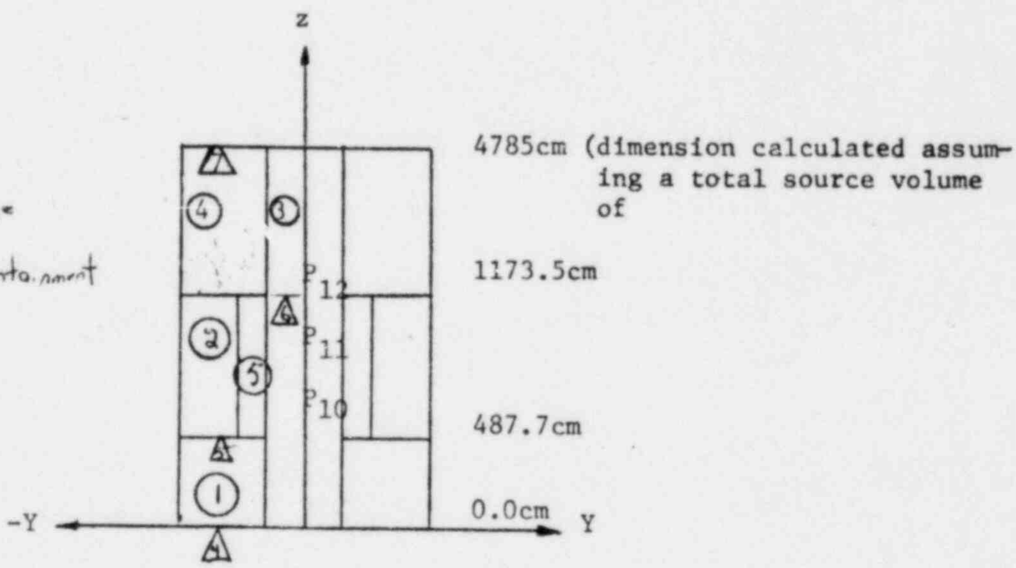
```
**** TSO FOREGROUND HARDCOPY ****
DSNAME=DMILLER.GADDATA5.DATA

 MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE=REGION 4) 00000010
   20  20   20   2    2   5    8   7    0   1    2   0                 00000020
    1   0    4   0    0   0    1                                       00000030
                                                                      200000040
 2.921E10                                                              00000050
   1071.9  1117.4   1162.9   1208.4   1253.9   1299.4  1344.9   1390.4 00000060
   1435.9  1481.4    1527.   1572.5    1618.   1663.5   1709.   1754.5 00000070
   1800.5  1845.5    1891.   1936.5   1982.0                           00000080
   1173.5  1354.1   1534.7   1715.2   1895.8   2076.4  2257.0   2437.500000090
   2618.1  2798.7   2979.3   3159.8   3340.4   3521.0  3701.5   3882.1 00000100
   4062.7  4243.3   4423.8   4604.4    4785.                           00000110
      0.0     .31      .63      .94     1.25     1.57    1.88      2.2 00000120
      2.5     2.8      3.1      3.5      3.8      4.1     4.4      4.7 00000130
     5.03    5.34     5.65     5.97    6.283                           00000140
  0  7  5                                                              00000150
  1  0 12     0.0    1982.      0.0    1982.                           00000160
  2  0 12     0.0   1178.6      0.0   1178.6                           00000170
  3  0 12     0.0   1071.9      0.0   1071.9                           00000180
  4  0  3     0.0                                                      00000190
  5  0  3   487.7                                                      00000200
  6  0  3  1173.5                                                      00000210
  7  0  3   4785.                                                      00000220
  1     1  1  3  4  5                              1900.     0.0    300.000000230
  2     1  1  2  5  6                              1900.     0.0    500.000000240
  3     1  3  4  7                                   0.0      0.      1.000000250
  4     1  3  1  6  7                              1500.      0.   3000.000000260
  5     2  2  3  5  6                             1100.0      0.    500.000000270
    .0012     0.0                                                      00000280
      0.0    2.24                                                      00000290
 12 13                                                                 00000300
  3.320E7  2.488E8  9.252E7  2.602E8  1.476E8  8.265E7  8.735E7  1.E-2000000310
 MEV/CM2-SEC                MREM/HR                                    00000320
      0.0      0.0   2382.5      1                                     00000330
                                -1                                     00000340
```

Figure 1
QAD Geometry Model
(Conservative Analysis)



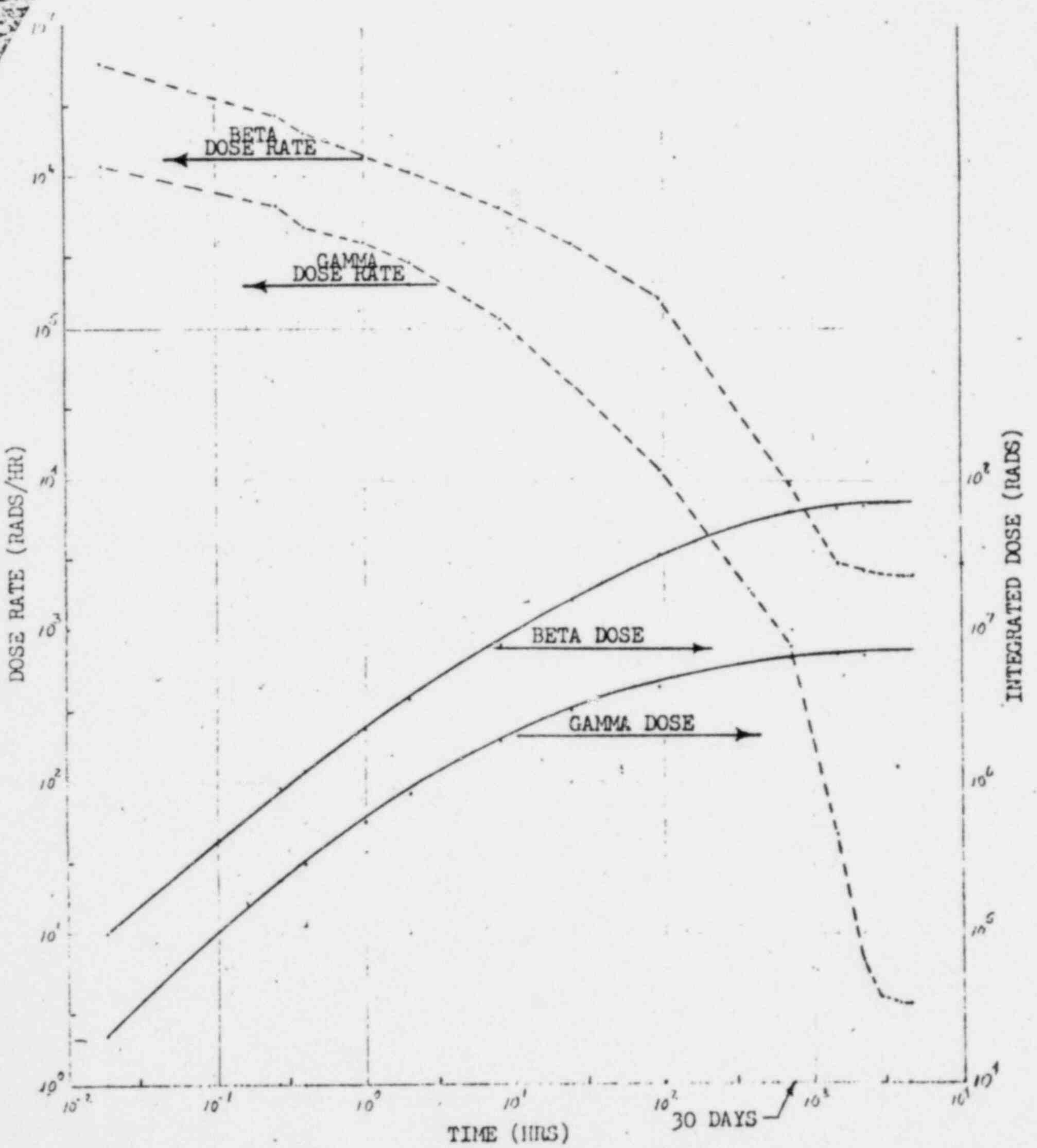
Dose Point Locations

D_p	X	Y	Z	
P_1	1433.	0	487.7	
P_2	1433.	0	830.6	
P_3	1433.	0	1173.5	
P_4	1707.	0	1173.5	
P_5	1707.	0	830.6	
P_6	1707.	0	487.7	
P_7	1981.	0	1173.5	
P_8	1981.	0	830.6	
P_9	1981.	0	487.7	
P_{10}	0.0	0	1066.8	Flange
P_{11}	0.0	0	1935	CRD
P_{12}	0.0	0	2382.5	c. Containment



Ref. Dwg. 25203-27021, 25203-11177

Figure 2



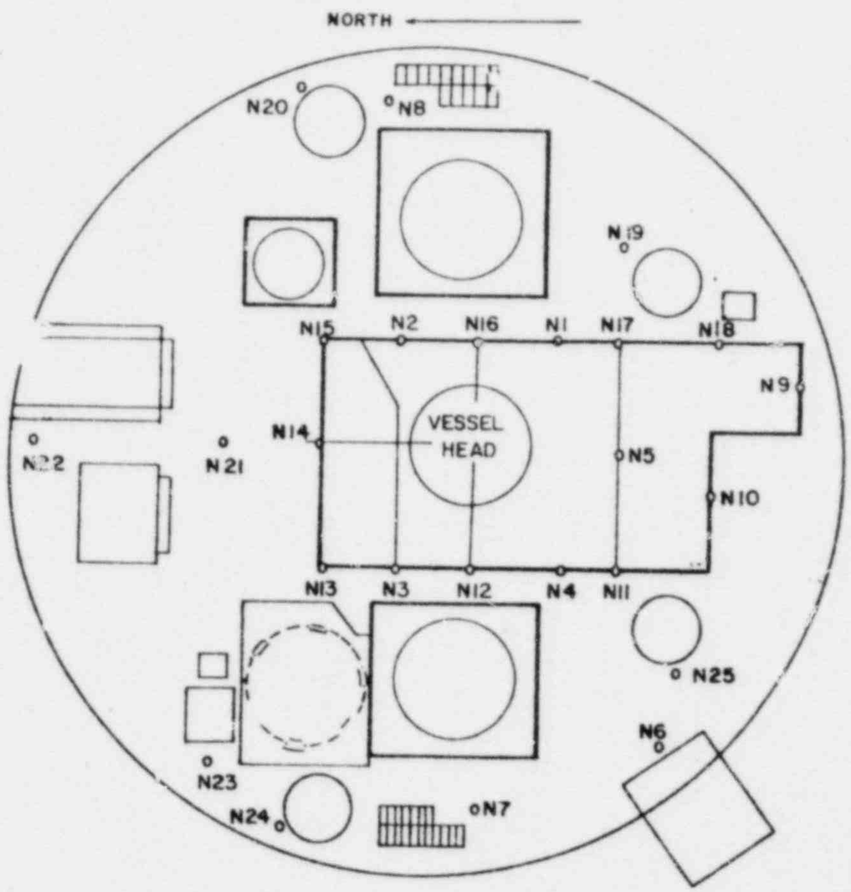
TIME DISTRIBUTION OF DOSE RATE AND DOSE AT REFUELING CAVITY TERMINAL BOARDS (100% NOBLE GASES, 50% HALOGENS)

2

Figure 3

NEUTRON and GAMMA LEVELS as EXTRAPOLATED to 100% REACTOR POWER

+1 LEVEL CONTAINMENT (38'6")



POINT	NEUTRON LEVELS m rem /hr.	GAMMA LEVELS m R/hr.
N 1	60,000	8,000
N 2	60,000	8,000
N 3	60,000	8,000
N 4	60,000	8,000
N 5	65,000	10,000
N 6	4,000	450
N 7	1,500	225
N 8	1,500	225
N 9	5,000	1,000
N10	20,000	4,000
N11	10,000	2,500
N12	6,000	1,500
N13	10,000	2,500
N14	10,000	3,200
N15	10,000	2,500
N16	6,000	1,500
N17	10,000	2,500
N18	6,000	1,500
N19	5,000	1,000
N20	1,400	180
N21	7,000	1,100
N22	2,000	400
N23	2,000	350
N24	2,000	450
N25	3,000	450

REFERENCES

1. I&E Bulletin 79-01B Supplement 2.

2. AKERN, RSCI Computer Code Collection, CCC-190.

3. Radiation Shielding Design and Analysis Approach for Light Water Reactor Power Plants, RP-8A, Stone & Webster Engineering Corporation, May 1975.

4. D. C. Switzer letter to G. Lear dated April 15, 1976, transmitting Millstone Nuclear Power Station Unit 2, "Radiation Survey Results In and Around Millstone Unit 2 Containment Building", Northeast Nuclear Energy Company, Hartford, Connecticut, April 1976.

5. W. G. Counsil letter to R. Reid dated November 9, 1979, transmitting, Evaluation of Neutron Shield Effectivenss Report.

APPENDIX A

Computer Code Output

NORTHEAST UTILITIES SERVICES COMPANY
RADIOLOGICAL ASSESSMENT
BERLIN CONNECTICUT

QADP5-F PROGRAM

04/23/81

MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE=REGION 1)

***** PROGRAM CONTROL *****

NUMBER OF SOURCE POINTS ALONG THE X AXIS,MAX. 30	=	20
NUMBER OF SOURCE POINTS ALONG THE Z AXIS,MAX. 30	=	20
NUMBER OF SOURCE POINTS ALONG THE Y AXIS,MAX. 30	=	20
NUMBER OF MATERIALS,MAX. 30	=	2
NUMBER OF COMPOSITIONS,MAX. 50	=	2
NUMBER OF ZONES,MAX. 200	=	5
NUMBER OF PHOTON ENERGY GROUPS,MAX. 30	=	8
NUMBER OF BOUNDARIES,MAX. 200	=	7
SOURCE GEOMETRY TYPE OPTION	=	0
MOST PROBABLE SOURCE ZONE	=	1
SOURCE COMPUTATION OPTION	=	2
NUMBER OF NEUTRON BASE MATERIAL AND ENERGY GROUPS	=	0
FIRST SOURCE-DETECTOR TRAVERSE FOR GEOMETRY PRINT	=	0
LAST SOURCE-DETECTOR TRAVERSE FOR GEOMETRY PRINT	=	0
DEL SOURCE-DETECTOR TRAVERSE FOR GEOMETRY PRINT	=	0
GAMMA RAY AND NEUTRON REFERENCE MATERIALS	=	0
CONVERSION OF GAMMA RAY AND NEUTRON OUTPUT OPTION	=	0
GAMMA FTOD FACTORS, CARD INPUT=0, INTERNAL= NO.	=	1
BUILDUP FACTORS, CARD INPUT=0,INTERNAL=NO.	=	4
GAMMA HEAT CONVERSION FACTORS (NO=0,YES=1)	=	0

SOURCE	3.9450D+09	0.0	0.0	0.0	0.0	0.0	0.0

R	1.0719D+03	1.1174D+03	1.1629D+03	1.2084D+03	1.2539D+03	1.2994D+03	1.3449D+03	1.3904D+03
	1.4359D+03	1.4814D+03	1.5270D+03	1.5725D+03	1.6180D+03	1.6635D+03	1.7090D+03	1.7545D+03
	1.8005D+03	1.8455D+03	1.8910D+03	1.9365D+03	1.9820D+03			
Z	0.0	2.4400D+01	4.8800D+01	7.3200D+01	9.7500D+01	1.2190D+02	1.4630D+02	1.7070D+02
	1.9500D+02	2.1940D+02	2.4380D+02	2.6820D+02	2.9260D+02	3.1700D+02	3.4140D+02	3.6580D+02
	3.9020D+02	4.1[illegible]50D+02	4.3890D+02	4.6330D+02	4.8770D+02			
PHI	0.0	3.1000D-01	6.3000D-01	9.4000D-01	1.2500D+00	1.5700D+00	1.8800D+00	2.2000D+00
	2.5000D+00	2.8000D+00	3.1000D+00	3.5000D+00	3.8000D+00	4.1000D+00	4.4000D+00	4.7000D+00
	5.0300D+00	5.3400D+00	5.6500D+00	5.9700D+00	6.2830D+00			
F(L)	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00			
F(M)	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00			
F(N)	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00			

GEOMETRY DESCRIPTION

```
1   0  12  0.0          1.9820D+03  0.0         1.9820D+03  0.0         0.0         0.0          00000160
2   0  12  0.0          1.1786D+03  0.0         1.1786D+03  0.0         0.0         0.0          00000170
3   0  12  0.0          1.0719D+03  0.0         1.0719D+03  0.0         0.0         0.0          00000180
4   0   3  0.0          0.0         0.0         0.0         0.0         0.0         0.0          00000190
5   0   3  4.0770D+02   0.0         0.0         0.0         0.0         0.0         0.0          00000200
6   0   3  1.1735D+03   0.0         0.0         0.0         0.0         0.0         0.0          00000210
7   0   3  4.7850D+03   0.0         0.0         0.0         0.0         0.0         0.0          00000220
1   0   1   1   3   4   5   0   0   0   0   0   0.0         1.9000D+03  0.0         3.0000D+02   00000230
2   0   1   1   2   5   6   0   0   0   0   0   0.0         1.9000D+03  0.0         5.0000D+02   00000240
3   0   1   3   4   7   0   0   0   0   0   0   0.0         0.0         0.0         1.0000D+00   00000250
4   0   1   3   1   6   7   0   0   0   0   0   0.0         1.5000D+03  0.0         3.0000D+03   00000260
5   0   2   2   3   [illegible]   6   0   0   0   0   0   0.0         1.1000D+03  0.0         5.0000D+02   00000270
```

COMP/MAT	1	2
1	1.2000D-03	0.0
2	0.0	2.2400D+00

MATERIAL REFERENCE NUMBERS
12 13

GAMMA ATTENUATION COEFFICIENT

MAT/GRP	1	2
1	9.5400D-02	9.6300D-02
2	7.0700D-02	7.0900D-02
3	5.6500D-02	5.6600D-02
4	4.8900D-02	4.9100D-02
5	4.2800D-02	4.3100D-02
6	4.0200D-02	4.0700D-02
7	3.3300D-02	3.4200D-02
8	2.5200D-02	2.7000D-02

GRP	SOURCE SPECTRA	CONVERSION FACTORS	B0	B1	B2	B3
1	3.3200D+07	2.1000D-03	9.9958D-01	1.1054D+00	2.6319D-01	4.1881D-03
2	2.4680D+08	2.0000D-03	9.9568D-01	9.1546D-01	1.5940D-01	-6.5060D-04
3	9.2520D+07	1.8000D-03	9.9334D-01	8.2479D-01	8.2983D-02	-1.2038D-03
4	2.6020D+08	1.7000D-03	9.9420D-01	7.7514D-01	5.2323D-02	-8.2951D-04
5	1.4760D+08	1.6000D-03	9.9616D-01	7.2817D-01	3.1157D-02	-5.0390D-04
6	8.2650D+07	1.5000D-03	9.9722D-01	7.0133D-01	2.4519D-02	-3.7916D-04
7	8.7350D+07	1.4000D-03	1.0012D+00	6.2686D-01	6.5545D-03	-2.4947D-05
8	1.0000D-20	1.1000D-03	1.0053D+00	4.8738D-01	7.7364D-03	2.4680D-04

MEAN ENERGY FOR GROUP

4.0000D-01 8.0000D-01 1.3000D+00 1.7000D+00 2.2000D+00 2.5000D+00 3.5000D+00 6.1500D+00

COORDINATE TYPE 0   SOURCE INTENSITY OPTION 2

R COORDINATE

	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY
1	1.0946D+03	2.9884D+05	1.1401D+03	3.1126D+05	1.1856D+03	3.2368D+05	1.2311D+03	3.3610D+05
5	1.2766D+03	3.4853D+05	1.3221D+03	3.6095D+05	1.3676D+03	3.7337D+05	1.4131D+03	3.8579D+05
9	1.4586D+03	3.9821D+05	1.5042D+03	4.1155D+05	1.5497D+03	4.2308D+05	1.5952D+03	4.3550D+05
13	1.6407D+03	4.4792D+05	1.6862D+03	4.6035D+05	1.7317D+03	4.7277D+05	1.7775D+03	4.9059D+05
17	1.8230D+03	4.9221D+05	1.8682D+03	5.1003D+05	1.9137D+03	5.2245D+05	1.9592D+03	5.3488D+05

PHI COORDINATE

	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY
1	1.5500D-01	6.2000D-01	4.7000D-01	6.4000D-01	7.8500D-01	6.2000D-01	1.0950D+00	6.2000D-01
5	1.4100D+00	6.4000D-01	1.7250D+00	6.2000D-01	2.0400D+00	6.4000D-01	2.3500D+00	6.0000D-01
9	2.6500D+00	6.0000D-01	2.9500D+00	6.0000D-01	3.3000D+00	8.0000D-01	3.6500D+00	6.0000D-01
13	3.9500D+00	6.0000D-01	4.2500D+00	6.0000D-01	4.5500D+00	6.0000D-01	4.8650D+00	6.6000D-01
17	5.1850D+00	6.2000D-01	5.4950D+00	6.2000D-01	5.8100D+00	6.4000D-01	6.1265D+00	6.2600D-01

Z COORDINATE

	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY
1	1.2200D+01	1.8837D+00	3.6600D+01	1.8837D+00	6.1000D+01	1.8837D+00	8.5350D+01	1.8760D+00
5	1.0970D+02	1.8837D+00	1.3410D+02	1.8837D+00	1.5850D+02	1.8837D+00	1.8285D+02	1.8760D+00
9	2.0720D+02	1.8837D+00	2.3160D+02	1.8837D+00	2.5600D+02	1.8837D+00	2.8040D+02	1.8837D+00
13	3.0480D+02	1.8837D+00	3.2920D+02	1.8837D+00	3.5360D+02	1.8837D+00	3.7800D+02	1.8837D+00
17	4.0235D+02	1.8760D+00	4.2670D+02	1.8837D+00	4.5110D+02	1.8837D+00	4.7550D+02	1.8837D+00

**** CASE SETUP TIME IN MIN. = 0.0

NTRYZN MATRIX(30XNBOUND)

BNDRY NO.

1	1	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
2	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
3	1	3	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
4	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
5	1	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
6	2	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
7	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											

L B D MATRIX (15 X NREG)

ZONE NO.															
1	1	-3	-4	5	0	0	0	0	0	0	0	0	0	0	0
2	1	-2	-5	6	0	0	0	0	0	0	0	0	0	0	0
3	3	-4	7	0	0	0	0	0	0	0	0	0	0	0	0
4	-3	1	-6	7	0	0	0	0	0	0	0	0	0	0	0
5	2	-3	-5	6	0	0	0	0	0	0	0	0	0	0	0

MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE=REGION 1)

RECEIVER NUMBER 1 COORDINATES - X 0.0 Y 0.0 Z [illegible].3825E+03

GEOMETRY PRINT FOR PSEUDO SOURCE POINT AT THE COORDINATE ORIGIN

ZONE	BOUNDARY	DISTANCE	X	Y	Z
3	0	2.3922D+03	1.0719D+03	0.0	2.4385D+02

MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE=REGION 1)

RECEIVER NUMBER 1 COORDINATES - X 0.0 Y 0.0 Z 2.3825E+03

GRP NO	MEAN ENERGY MEV	ENERGY GROUP LIMITS MEV	MEAN BUILDUP FACTORS	ENERGY FLUX DIRECT BEAM MEV/CM2-SEC	ENERGY FLUX WITH BUILDUP MEV/CM2-SEC	DOSE RATE DIRECT BEAM MREM/HR	DOSE RATE WITH BUILDUP MREM/HR
1	0.4000		1.3941D+00	1.7599D+08	2.4535D+08	3.6959D+05	5.1523D+05
2	0.8000		1.2517D+00	1.4363D+09	1.7978D+09	2.8727D+06	3.5957D+06
3	1.3000		1.1886D+00	5.6332D+08	6.6958D+08	1.0140D+06	1.2052D+06
4	1.7000		1.1628D+00	1.6338D+09	1.8998D+09	2.7775D+06	3.2296D+06
5	2.2000		1.1448D+00	9.5186D+08	1.0897D+09	1.5230D+06	1.7435D+06
6	2.5000		1.1369D+00	5.3936D+08	6.1320D+08	8.0904D+05	9.1980D+05
7	3.5000		1.1187D+00	5.9004D+08	6.6008D+08	8.2605D+05	9.2412D+05
8	6.1500		1.0977D+00	7.0823D-20	7.7744D-20	7.7906D-23	8.5519D-23
TOTAL	1.2864			5.8907E+09	6.9755D+09	1.0192E+07	1.2133E+07
WOBU	1.3247						

ENERGY FLUX BUILDUP 1.1841D+00

DOSE BUILDUP 1.1905E+00

**** TIME FOR DETECTOR IN MIN. = 0.0

*** END OF JOB E16103 ***

NORTHEAST UTILITIES SERVICES COMPANY
RADIOLOGICAL ASSESSMENT
BERLIN CONNECTICUT

QADF5-F PROGRAM

04/23/81

MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE=REGION 2)

***** PROGRAM CONTROL *****

NUMBER OF SOURCE POINTS ALONG THE X AXIS,MAX. 30	=	20
NUMBER OF SOURCE POINTS ALONG THE Z AXIS,MAX. 30	=	20
NUMBER OF SOURCE POINTS ALONG THE Y AXIS,MAX. 30	=	20
NUMBER OF MATERIALS,MAX. 30	=	2
NUMBER OF COMPOSITIONS,MAX. 50	=	2
NUMBER OF ZONES,MAX. 200	=	5
NUMBER OF PHOTON ENERGY GROUPS,MAX. 30	=	8
NUMBER OF BOUNDARIES,MAX. 200	=	7
SOURCE GEOMETRY TYPE OPTION	=	0
MOST PROBABLE SOURCE ZONE	=	1
SOURCE COMPUTATION OPTION	=	2
NUMBER OF NEUTRON BASE MATERIAL AND ENERGY GROUPS	=	0
FIRST SOURCE-DETECTOR TRAVERSE FOR GEOMETRY PRINT	=	0
LAST SOURCE-DETECTOR TRAVERSE FOR GEOMETRY PRINT	=	0
DEL SOURCE-DETECTOR TRAVERSE FOR GEOMETRY PRINT	=	0
GAMMA RAY AND NEUTRON REFERENCE MATERIALS	=	0
CONVERSION OF GAMMA RAY AND NEUTRON OUTPUT OPTION	=	0
GAMMA FTCD FACTORS, CARD INPUT=0, INTERNAL= NO.	=	1
BUILDUP FACTORS, CARD INPUT=0,INTERNAL=NO.	=	4
GAMMA HEAT CONVERSION FACTORS (NO=0,YES=1)	=	0

SOURCE	5.0690D+09	0.0	0.0	0.0	0.0	0.0	0.0	
R	1.1786D+03	1.2188D+03	1.2589D+03	1.2991D+03	1.3393D+03	1.3795D+03	1.4196D+03	1.4598D+03
	1.5000D+03	1.5401D+03	1.5803D+03	1.6205D+03	1.6606D+03	1.7008D+03	1.7410D+03	1.7811D+03
	1.8213D+03	1.8615D+03	1.9017D+03	1.9418D+03	1.9820D+03			
Z	4.8770D+02	5.2200D+02	5.5630D+02	5.9060D+02	6.2490D+02	6.5920D+02	6.9340D+02	7.2770D+02
	7.6200D+02	7.9630D+02	8.3060D+02	8.6490D+02	8.9920D+02	9.3350D+02	9.6780D+02	1.0021D+03
	1.0363D+03	1.0706D+03	1.1049D+03	1.1392D+03	1.1735D+03			
PHI	0.0	3.1000D-01	6.3000D-01	9.4000D-01	1.2500D+00	1.5700D+00	1.8800D+00	2.2000D+00
	2.5000D+00	2.8000D+00	3.1000D+00	3.5000D+00	3.8000D+00	4.1000D+00	4.4000D+00	4.7000D+00
	5.0300D+00	5.3400D+00	5.6500D+00	5.9700D+00	6.2830D+00			
F(L)	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00			
F(M)	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00			
F(N)	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00			

GEOMETRY DESCRIPTION

```
1   0  12  0.0          1.9820D+03  0.0         1.9820D+03  0.0         0.0         0.0          00000160
2   0  12  0.0          1.1786D+03  0.0         1.1786D+03  0.0         0.0         0.0          00000170
3   0  12  0.0          1.0719D+03  0.0         1.0719D+03  0.0         0.0         0.0          00000180
4   0   3  0.0          0.0         0.0         0.0         0.0         0.0         0.0          00000190
5   0   3  4.8770D+02   0.0         0.0         0.0         0.0         0.0         0.0          00000200
6   0   3  1.1735D+03   0.0         0.0         0.0         0.0         0.0         0.0          00000210
7   0   3  4.7850D+03   0.0         0.0         0.0         0.0         0.0         0.0          00000220
1   0   1   1   3   4   5   0   0   0   0   0   0.0         1.9000D+03  0.0         3.0000D+02   00000230
2   0   1   1   2   5   6   0   0   0   0   0   0.0         1.9000D+03  0.0         5.0000D+02   00000240
3   0   1   3   4   7   [illegible]   0   0   0   0   0   0.0         0.0         0.0         1.0000D+00   00000250
4   0   1   3   1   6   7   0   0   0   0   0   0.0         1.5000D+03  0.0         3.0000D+03   00000260
5   0   2   2   3   5   6   0   0   0   0   0   0.0         1.1000D+03  0.0         5.0000D+02   00000270
```

COMP/MAT	1	2
1	1.2000D-03	0.0
2	0.0	2.2400D+00

MATERIAL REFERENCE NUMBERS
12 13

GAMMA ATTENUATION COEFFICIENT

MAT/GRP	1	2
1	9.5400D-02	9.6300D-02
2	7.0700D-02	7.0900D-02
3	5.6500D-02	5.6600D-02
4	4.8900D-02	4.9100D-02
5	4.2800D-02	4.3100D-02
6	4.0200D-02	4.0700D-02
7	3.3300D-02	3.4200D-02
8	2.5200D-02	2.7000D-02

GRP	SOURCE SPECTRA	CONVERSION FACTORS	B0	B1	B2	B3
1	3.3200D+07	2.1000D-03	9.9958D-01	1.1054D+00	2.6019D-01	4.1861D-03
2	2.4880D+08	2.0000D-03	9.9568D-01	9.1546D-01	1.5940D-01	-8.5060D-04
3	9.2520D+07	1.8000D-03	9.9334D-01	8.2479D-01	8.2983D-02	-1.2038D-03
4	2.6020D+08	1.7000D-03	9.9420D-01	7.751[illegible]-01	5.2323D-02	-8.2951D-04
5	1.4760D+08	1.6000D-03	9.9616D-01	7.2817D-01	3.1157D-02	-5.0390D-04
6	8.2650D+07	1.5000D-03	9.9722D-01	7.0133D-01	2.4519D-02	-3.7916D-04
7	8.7350D+07	1.4000D-03	1.0012D+00	6.2686D-01	4.55[illegible]D-03	-2.4947D-05
8	1.0000D-20	1.1000D-03	1.0053D+00	4.8738D-01	7.7364D-03	2.4680D-04

MEAN ENERGY FOR GROUP

4.0000D-01 8.0000D-01 1.3000D+00 1.7000D+00 2.2000D+00 2.5000D+00 3.5000D+00 6.1500D+00

COORDINATE TYPE 0   SOURCE INTENSITY OPTION 2

R COORDINATE

	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY
1	1.1987D+03	2.8913D+05	1.2388D+03	2.9807D+05	1.2790D+03	3.0849D+05	1.3192D+03	3.1819D+05
5	1.3594D+03	3.2769D+05	1.3995D+03	3.3673D+05	1.4397D+03	3.4726D+05	1.4799D+03	3.5695D+05
9	1.5200D+03	3.6572D+05	1.5602D+03	3.7632D+05	1.6004D+03	3.8602D+05	1.6405D+03	3.9472D+05
13	1.6807D+03	4.0538D+05	1.7209D+03	4.1508D+05	1.7610D+03	4.2371D+05	1.8012D+03	4.3445D+05
17	1.8414D+03	4.4415D+05	1.8816D+03	4.5384D+05	1.9217D+03	4.6237D+05	1.9619D+03	4.7321D+05

PHI COORDINATE

	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY
1	1.5500D-01	6.2000D-01	4.7000D-01	6.4000D-01	7.8500D-01	6.2000D-01	1.0950D+00	6.2000D-01
5	1.4100D+00	6.4000D-01	1.7250D+00	6.2000D-01	2.0400D+00	6.4000D-01	2.3500D+00	6.0000D-01
9	2.6500D+00	6.0000D-01	2.9500D+00	6.0000D-01	3.3000D+00	8.0000D-01	3.6500D+00	6.0000D-01
13	3.9500D+00	6.0000D-01	4.2500D+00	6.0000D-01	4.5500D+00	6.0000D-01	4.8650D+00	6.6000D-01
17	5.1850D+00	6.2000D-01	5.4950D+00	6.2000D-01	5.8100D+00	6.4000D-01	6.1265D+00	6.2600D-01

Z COORDINATE

	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY
1	5.0485D+02	2.6485D+00	5.3915D+02	2.6485D+00	5.7345D+02	2.6485D+00	6.0775D+02	2.6485D+00
5	6.4205D+02	2.6485D+00	6.7630D+02	2.6408D+00	7.1055D+02	2.6485D+00	7.4485D+02	2.6485D+00
9	7.7915D+02	2.6485D+00	8.1345D+02	2.6485D+00	8.4775D+02	2.6485D+00	8.8205D+02	2.6485D+00
13	9.1635D+02	2.6485D+00	9.5065D+02	2.6485D+00	9.8495D+02	2.6485D+00	1.0192D+03	2.6408D+00
17	1.0534D+03	2.6485D+00	1.0877D+03	2.6485D+00	1.1220D+03	2.6485D+00	1.1563D+03	2.6485D+00

**** CASE SETUP TIME IN MIN. =   0.0

NTRYZN MATRIX(30XNBOUND)

BNDRY NO.

1	1	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
2	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
3	1	3	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
4	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
5	1	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
6	2	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
7	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											

L B D MATRIX (15 X NREG)

ZONE NO.															
1	1	-3	-4	5	0	0	0	0	0	0	0	0	0	0	0
2	1	-2	-5	6	0	0	0	0	0	0	0	0	0	0	0
3	3	-4	7	0	0	0	0	0	0	0	0	0	0	0	0
4	-3	1	-6	7	0	0	0	0	0	0	0	0	0	0	0
5	2	-3	-5	6	0	0	0	0	0	0	0	0	0	0	0

MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE=REGION 2)

RECEIVER NUMBER 1 COORDINATES - X 0.0 Y 0.0 Z 2.3825E+03

GEOMETRY PRINT FOR PSEUDO SOURCE POINT AT THE COORDINATE ORIGIN

ZONE	BOUNDARY	DISTANCE	X	Y	Z
5	-3	1.7642D+02	1.1786D+03	0.0	8.3060D+02
3	0	1.7723D+03	1.0719D+03	0.0	9.7110D+02

MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE-REGION 2)

RECEIVER NUMBER 1 COORDINATES - X 0.0 Y 0.0 Z 2.3825E+03

GRP NO	MEAN ENERGY MEV	ENERGY GROUP LIMITS MEV	MEAN BUILDUP FACTORS	ENERGY FLUX DIRECT BEAM (MEV/CM2-SEC)	ENERGY FLUX WITH BUILDUP (MEV/CM2-SEC)	DOSE RATE DIRECT BEAM (MREM/HR)	DOSE RATE WITH BUILDUP (MREM/HR)
1	0.4000		1.3129D+00	1.3094D+09	1.7191D+09	2.7497D+06	3.6101D+06
2	0.8000		1.1882D+00	1.0512D+10	1.2491D+10	2.1025D+07	2.4981D+07
3	1.3000		1.1332D+00	4.0714D+09	4.6138D+09	7.3266D+06	8.3049D+06
4	1.7000		1.[illegible]00D+00	1.1709D+10	1.2997D+10	1.9906D+07	2.2095D+07
5	2.2000		1.0937D+00	6.7657D+09	7.3996D+09	1.0825D+07	1.1839D+07
6	2.5000		1.0867D+00	3.8188D+09	4.1500D+09	5.7283D+06	6.2250D+06
7	3.5000		1.0709D+00	4.1255D+09	4.4180D+09	5.7757D+06	6.1852D+06
8	6.1500		1.0520D+00	4.8544D-19	5.1070D-19	5.3399D-22	5.6177D-22
TOTAL	1.2781			4.2312E+10	4.7788D+10	7.3338E+07	8.3241E+07
WOBU	1.3134						

ENERGY FLUX BUILDUP 1.1294D+00

DOSE BUILDUP 1.1350E+00

**** TIME FOR DETECTOR IN MIN. = 0.0

*** END OF JOB E16103 ***

NORTHEAST UTILITIES SERVICES COMPANY
RADIOLOGICAL ASSESSMENT
BERLIN CONNECTICUT

QADPS-F PROGRAM

04/23/81

MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE=REGION 3)

***** PROGRAM CONTROL *****

NUMBER OF SOURCE POINTS ALONG THE X AXIS,MAX. 30	=	20
NUMBER OF SOURCE POINTS ALONG THE Z AXIS,MAX. 30	=	30
NUMBER OF SOURCE POINTS ALONG THE Y AXIS,MAX. 30	=	20
NUMBER OF MATERIALS,MAX. 30	=	2
NUMBER OF COMPOSITIONS,MAX. 50	=	2
NUMBER OF ZONES,MAX. 200	=	5
NUMBER OF PHOTON ENERGY GROUPS,MAX. 30	=	8
NUMBER OF BOUNDARIES,MAX. 200	=	7
SOURCE GEOMETRY TYPE OPTION	=	0
MOST PROBABLE SOURCE ZONE	=	1
SOURCE COMPUTATION OPTION	=	2
NUMBER OF NEUTRON BASE MATERIAL AND ENERGY GROUPS	=	0
FIRST SOURCE-DETECTOR TRAVERSE FOR GEOMETRY PRINT	=	0
LAST SOURCE-DETECTOR TRAVERSE FOR GEOMETRY PRINT	=	0
DEL SOURCE-DETECTOR TRAVERSE FOR GEOMETRY PRINT	=	0
GAMMA RAY AND NEUTRON REFERENCE MATERIALS	=	0
CONVERSION OF GAMMA RAY AND NEUTRON OUTPUT OPTION	=	0
GAMMA FTOD FACTORS, CARD INPUT=0, INTERNAL= NO.	=	1
BUILDUP FACTORS, CARD INPUT=0,INTERNAL=NO.	=	4
GAMMA HEAT CONVERSION FACTORS (NO=0,YES=1)	=	0

SOURCE	1.6000D+10	0.0	0.0	0.0	0.0	0.0	0.0	
R	0.0	5.3600D+01	1.0720D+02	1.6080D+02	2.1440D+02	2.6800D+02	3.2160D+02	3.7520D+02
	4.2880D+02	4.8240D+02	5.3600D+02	5.8950D+02	6.4310D+02	6.9670D+02	7.5030D+02	8.0390D+02
	8.5750D+02	9.1110D+02	9.6470D+02	1.0183D+03	1.0719D+03			
Z	0.0	1.5950D+02	3.1900D+02	4.7850D+02	6.3800D+02	7.9750D+02	9.5700D+02	1.1165D+03
	1.2760D+03	1.4355D+03	1.5950D+03	1.7545D+03	1.9140D+03	2.0735D+03	2.2330D+03	2.3925D+03
	2.5520D+03	2.7115D+03	2.8710D+03	3.0305D+03	3.1900D+03	3.3495D+03	3.5090D+03	3.6685D+03
	3.8280D+03	3.9875D+03	4.1470D+03	4.3065D+03	4.4660D+03	4.6255D+03	4.7850D+03	
PHI	0.0	3.1000D-01	6.3000D-01	9.4000D-01	1.2500D+00	1.5700D+00	1.8800D+00	2.2000D+00
	2.5000D+00	2.8000D+00	3.1000D+00	3.5000D+00	3.8000D+00	4.1000D+00	4.4000D+00	4.7000D+00
	5.0300D+00	5.3400D+00	5.6500D+00	5.9700D+00	6.2830D+00			
F(L)	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00			
F(M)	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	
F(N)	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00			

```
GEOMETRY DESCRIPTION
1   0  12  0.0          1.9820D+03  0.0         1.9820D+03  0.0         0.0         0.0          00000170
2   0  12  0.0          1.1786D+03  0.0         1.1786D+03  0.0         0.0         0.0          00000180
3   0  12  0.0          1.0719D+03  0.0         1.0719D+03  0.0         0.0         0.0          00000190
4   0   3  0.0          0.0         0.0         0.0         0.0         0.0         0.0          00000200
5   0   3  4.8770D+02   0.0         0.0         0.0         0.0         0.0         0.0          00000210
6   0   3  1.1735D+03   0.0         0.0         0.0         0.0         0.0         0.0          00000220
7   0   3  4.7850D+03   0.0         0.0         0.0         0.0         0.0         0.0          00000230
1   0   1   1   3   4   5   0   0   0   0   0   0.0         1.9000D+03  0.0         3.0000D+02   00000240
2   0   1   1   2   5   6   0   0   0   0   0   0.0         1.9000D+03  0.0         5.0000D+02   00000250
3   0   1   3   4   7   0   0   0   0   0   0   0.0         0.0         0.0         1.0000D+00   00000260
4   0   1   3   1   6   7   0   0   0   0   0   0.0         1.5000D+03  0.0         3.0000D+03   00000270
5   0   2   2   3   5   6   0   0   0   0   0   0.0         1.1000D+03  0.0         5.0000D+02   00000280
```

COMP/MAT	1	2
1	1.2000D-03	0.0
2	0.0	2.2400D+00

MATERIAL REFERENCE NUMBERS
12 13

GAMMA ATTENUATION COEFFICIENT

MAT/GRP	1	2
1	9.5400D-02	9.6300D-02
2	7.0700D-02	7.0900D-02
3	5.6500D-02	5.6600D-02
4	4.8900D-02	4.9100D-02
5	4.2800D-02	4.3100D-02
6	4.0200D-02	4.0700D-02
7	3.3300D-02	3.4200D-02
8	2.5200D-02	2.7000D-02

GRP	SOURCE SPECTRA	CONVERSION FACTORS	B0	B1	B2	B3
1	3.3200D+07	2.1000D-03	9.9958D-01	1.1054D+00	2.6019D-01	4.1881D-03
2	2.4880D+08	2.0000D-03	9.9568D-01	9.1546D-01	1.5940D-01	-8.5060D-04
3	9.2520D+07	1.8000D-03	9.9334D-01	8.2479D-01	8.2983D-02	-1.2038D-03
4	2.6020D+08	1.7000D-03	9.9420D-01	7.7514D-01	5.2323D-02	-8.2951D-04
5	1.4760D+08	1.6000D-03	9.9616D-01	7.2817D-01	3.1157D-02	-5.0390D-04
6	8.2650D+07	1.5000D-03	9.9722D-01	7.0133D-01	2.4519D-02	-3.7916D-04
7	8.7350D+07	1.4000D-03	1.0012D+00	6.2686D-01	4.5545D-03	-2.4947D-05
8	1.0000D-20	1.1000D-03	1.0053D+00	4.8738D-01	7.7364D-03	2.4680D-04

MEAN ENERGY FOR GROUP

4.0000D-01 8.0000D-01 1.3000D+00 1.7000D+00 2.2000D+00 2.5000D+00 3.5000D+00 6.1500D+00

COORDINATE TYPE 0   SOURCE INTENSITY OPTION 2

R COORDINATE

	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY
1	2.6800D+01	8.6189D+03	8.0400D+01	2.5857D+04	1.3400D+02	4.3094D+04	1.8760D+02	6.0332D+04
5	2.4120D+02	7.7570D+04	2.9480D+02	9.4808D+04	3.4840D+02	1.1205D+05	4.0200D+02	1.2928D+05
9	4.5560D+02	1.4652D+05	5.0920D+02	1.6376D+05	5.6275D+02	1.8064D+05	6.1630D+02	1.9820D+05
13	6.6990D+02	2.1544D+05	7.2350D+02	2.3268D+05	7.7710D+02	2.4992D+05	8.3070D+02	2.6715D+05
17	8.8430D+02	2.8439D+05	9.3790D+02	3.0163D+05	9.9150D+02	3.1887D+05	1.0451D+03	3.3610D+05

PHI COORDINATE

	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY
1	1.5500D-01	6.2000D-01	4.7000D-01	6.4000D-01	7.8500D-01	6.2000D-01	1.0950D+00	6.2000D-01
5	1.4100D+00	6.4000D-01	1.7250D+00	6.2000D-01	2.0400D+00	6.4000D-01	2.3500D+00	6.0000D-01
9	2.6500D+00	6.0000D-01	2.9500D+00	6.0000D-01	3.3000D+00	8.0000D-01	3.6500D+00	6.0000D-01
13	3.9500D+00	6.0000D-01	4.2500D+00	6.0000D-01	4.5500D+00	6.0000D-01	4.8650D+00	6.6000D-01
17	5.1850D+00	6.2000D-01	5.4950D+00	6.2000D-01	5.8100D+00	6.4000D-01	6.1265D+00	6.2600D-01

Z COORDINATE

	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY
1	7.9750D+01	1.2313D+01	2.3925D+02	1.2313D+01	3.9875D+02	1.2313D+01	5.5525D+02	1.2313D+01
5	7.1775D+02	1.2313D+01	8.7725D+02	1.2313D+01	1.0367D+03	1.2313D+01	1.1962D+03	1.2313D+01
9	1.3557D+03	1.2313D+01	1.5152D+03	1.2313D+01	1.6747D+03	1.2313D+01	1.8342D+03	1.2313D+01
13	1.9937D+03	1.2313D+01	2.1532D+03	1.2313D+01	2.3127D+03	1.2313D+01	2.4722D+03	1.2313D+01
17	2.6317D+03	1.2313D+01	2.7912D+03	1.2313D+01	2.9507D+03	1.2313D+01	3.1102D+03	1.2313D+01
21	3.2697D+03	1.2313D+01	3.4292D+03	1.2313D+01	3.5887D+03	1.2313D+01	3.7482D+03	1.2313D+01
25	3.9077D+03	1.2313D+01	4.0672D+03	1.2313D+01	4.2267D+03	1.2313D+01	4.3862D+03	1.2313D+01
29	4.5457D+03	1.2313D+01	4.7052D+03	1.2313D+01	0.0	0.0	8.6189D+03	3.3200D+07

**** CASE SETUP TIME IN MIN. =   0.0

NTRYZN MATRIX(30XNBOUND)

BNDRY NO.

1	1	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
2	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
3	1	3	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
4	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
5	1	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
6	2	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											
7	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											

L B D MATRIX (15 X NREG)

ZONE NO.															
1	1	-3	-4	5	0	0	0	0	0	0	0	0	0	0	0
2	1	-2	-5	6	0	0	0	0	0	0	0	0	0	0	0
3	3	-4	7	0	0	0	0	0	0	0	0	0	0	0	0
4	-3	1	-6	7	0	0	0	0	0	0	0	0	0	0	0
5	2	-3	-5	6	0	0	0	0	0	0	0	0	0	0	0

MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE=REGION 3)

RECEIVER NUMBER 1 COORDINATES - X 0.0 Y 0.0 Z 2.3825E+03

GEOMETRY PRINT FOR PSEUDO SOURCE POINT AT THE COORDINATE ORIGIN

ZONE	BOUNDARY	DISTANCE	X	Y	Z
3	0	1.0000D+01	0.0	0.0	2.3925D+03

MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE=REGION 3)

RECEIVER NUMBER 1 COORDINATES - X 0.0 Y 0.0 Z 2.3825E+03

GRP NO	MEAN ENERGY MEV	ENERGY GROUP LIMITS MEV	MEAN BUILDUP FACTORS	ENERGY FLUX DIRECT BEAM MEV/CM2-SEC	ENERGY FLUX WITH BUILDUP MEV/CM2-SEC	DOSE RATE DIRECT BEAM MREM/HR	DOSE RATE WITH BUILDUP MREM/HR
1	0.4000		1.1033D+00	3.9286D+10	4.3343D+10	8.2500D+07	9.1020D+07
2	0.8000		1.0591D+00	3.0146D+11	3.1928D+11	6.0292D+08	6.3856D+08
3	1.3000		1.0389D+00	1.1365D+11	1.1807D+11	2.0457D+08	2.1253D+08
4	1.7000		1.0312D+00	3.2200D+11	3.3206D+11	5.4740D+08	5.6449D+08
5	2.2000		1.0266D+00	1.8374D+11	1.8864D+11	2.9399D+08	3.0182D+08
6	2.5000		1.0248D+00	1.0315D+11	1.0571D+11	1.5473D+08	1.5856D+08
7	3.5000		1.0216D+00	1.0975D+11	1.1213D+11	1.5366D+08	1.5690D+08
8	6.1500		1.0174D+00	1.2665D-17	1.2885D-17	1.3932D-20	1.4174D-20
TOTAL	1.2784			1.1730E+12	1.2192D+12	2.0398E+09	2.1240E+09
WOBU	1.2919						

ENERGY FLUX BUILDUP 1.0394D+00

DOSE BUILDUP 1.0413E+00

**** TIME FOR DETECTOR IN MIN. = 0.0

*** END OF JOB E16103 ***

NORTHEAST UTILITIES SERVICES COMPANY
RADIOLOGICAL ASSESSMENT
BERLIN CONNECTICUT

GADP5-F PROGRAM

04/23/81

MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE=REGION 4)

***** PROGRAM CONTROL *****

```
NUMBER OF SOURCE POINTS ALONG THE X AXIS,MAX. 30 =  20
NUMBER OF SOURCE POINTS ALONG THE Z AXIS,MAX. 30 =  20
NUMBER OF SOURCE POINTS ALONG THE Y AXIS,MAX. 30 =  20
NUMBER OF MATERIALS,MAX. 30                      =   2
NUMBER OF COMPOSITIONS,MAX. 50                   =   2
NUMBER OF ZONES,MAX. 200                         =   5
NUMBER OF PHOTON ENERGY GROUPS,MAX. 30           =   8
NUMBER OF BOUNDARIES,MAX. 200                    =   7
SOURCE GEOMETRY TYPE OPTION                      =   0
MOST PROBABLE SOURCE ZONE                        =   1
SOURCE COMPUTATION OPTION                        =   2
NUMBER OF NEUTRON BASE MATERIAL AND ENERGY GROUPS=   0
FIRST SOURCE-DETECTOR TRAVERSE FOR GEOMETRY PRINT=   0
LAST SOURCE-DETECTOR TRAVERSE FOR GEOMETRY PRINT =   0
DEL SOURCE-DETECTOR TRAVERSE FOR GEOMETRY PRINT  =   0
GAMMA RAY AND NEUTRON REFERENCE MATERIALS        =   0
CONVERSION OF GAMMA RAY AND NEUTRON OUTPUT OPTION=   0
GAMMA FTOD FACTORS, CARD INPUT=0, INTERNAL= NO.  =   1
BUILDUP FACTORS, CARD INPUT=0,INTERNAL=NO.       =   4
GAMMA HEAT CONVERSION FACTORS (NO=0,YES=1)       =   0
```

SOURCE	2.9210D+10	0.0	0.0	0.0	0.0	0.0	0.0	
R	1.0719D+03	1.1174D+03	1.1629D+03	1.2084D+03	1.2539D+03	1.2994D+03	1.3449D+03	1.3904D+03
	1.4359D+03	1.4814D+03	1.5270D+03	1.5725D+03	1.6180D+03	1.6635D+03	1.7090D+03	1.7545D+03
	1.8005D+03	1.8455D+03	1.8910D+03	1.9365D+03	1.9820D+03			
Z	1.1735D+03	1.3541D+03	1.5347D+03	1.7152D+03	1.8958D+03	2.0764D+03	2.2570D+03	2.4375D+03
	2.6181D+03	2.7987D+03	2.9793D+03	3.1598D+03	3.3404D+03	3.5210D+03	3.7015D+03	3.8821D+03
	4.0627D+03	4.2433D+03	4.4238D+03	4.6044D+03	4.7850D+03			
PHI	0.0	3.1000D-01	6.3000D-01	9.4000D-01	1.2500D+00	1.5700D+00	1.8800D+00	2.2000D+00
	2.5000D+00	2.8000D+00	3.1000D+00	3.5000D+00	3.8000D+00	4.1000D+00	4.4000D+00	4.7000D+00
	5.0300D+00	5.3400D+00	5.6500D+00	5.9700D+00	6.2830D+00			
F(L)	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00			
F(M)	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00			
F(N)	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00
	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00	1.0000D+00			

```
GEOMETRY DESCRIPTION
1   0  12  0.0          1.9820D+03  0.0          1.9820D+03  0.0          0.0          0.0          00000160
2   0  12  0.0          1.1786D+03  0.0          1.1786D+03  0.0          0.0          0.0          00000170
3   0  12  0.0          1.0719D+03  0.0          1.0719D+03  0.0          0.0          0.0          00000180
4   0   3  0.0          0.0         0.0          0.0         0.0          0.0          0.0          00000190
5   0   3  4.8770D+02   0.0         0.0          0.0         0.0          0.0          0.0          00000200
6   0   3  1.1735D+03   0.0         0.0          0.0         0.0          0.0          0.0          00000210
7   0   3  4.7850D+03   0.0         0.0          0.0         0.0          0.0          0.0          00000220
1   0   1   1   3   4   5   0   0   0   0   0   0.0          1.9000D+03   0.0          3.0000D+02   00000230
2   0   1   1   2   5   6   0   0   0   0   0   0.0          1.9000D+03   0.0          5.0000D+02   00000240
3   0   1   3   4   7   0   0   0   0   0   0   0.0          0.0          0.0          1.0000D+00   00000250
4   0   1   3   1   6   7   0   0   0   0   0   0.0          1.5000D+03   0.0          3.0000D+03   00000260
5   0   2   2   3   5   6   0   0   0   0   0   0.0          1.1000D+03   0.0          5.0000D+02   00000270
```

COMP/MAT	1	2
1	1.2000D-03	0.0
2	0.0	2.2400D+00

MATERIAL REFERENCE NUMBERS
12 13

GAMMA ATTENUATION COEFFICIENT

MAT/GRP	1	2
1	9.5400D-02	9.6300D-02
2	7.0700D-02	7.0900D-02
3	5.6500D-02	5.6600D-02
4	4.8900D-02	4.9100D-02
5	4.2800D-02	4.3100D-02
6	4.0200D-02	4.0700D-02
7	3.3300D-02	3.4200D-02
8	2.5200D-02	2.7000D-02

GRP	SOURCE SPECTRA	CONVERSION FACTORS	B0	B1	B2	B3
1	3.3200D+07	2.1000D-03	9.9958D-01	1.1054D+00	2.6019D-01	4.1881D-03
2	2.4880D+08	2.0000D-03	9.9565D-01	9.1546D-01	1.5940D-01	-8.5060D-04
3	9.2520D+07	1.8000D-03	9.9334D-01	8.2479D-01	8.2983D-02	-1.2036D-03
4	2.6020D+08	1.7000D-03	9.9420D-01	7.7514D-01	5.2323D-02	-8.2951D-04
5	1.4760D+08	1.6000D-03	9.9616D-01	7.2817D-01	3.1157D-02	-5.0390D-04
6	8.2650D+07	1.5000D-03	9.9722D-01	7.0133D-01	2.4519D-02	-3.7916D-04
7	8.7350D+07	1.4000D-03	1.0012D+00	6.2686D-01	4.5545D-03	-2.4947D-05
8	1.0000D-20	1.1000D-03	1.0053D+00	4.8738D-01	7.7364D-03	2.4680D-04

MEAN ENERGY FOR GROUP

4.0000D-01 8.0000D-01 1.3000D+00 1.7000D+00 2.2000D+00 2.5000D+00 3.5000D+00 6.1500D+00

COORDINATE TYPE 0 SOURCE INTENSITY OPTION 2

R COORDINATE

	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY
1	1.0946D+03	2.9884D+05	1.1401D+03	3.1126D+05	1.1856D+03	3.2368D+05	1.2311D+03	3.3610D+05
5	1.2766D+03	3.4853D+C5	1.3221D+03	3.6095D+05	1.3676D+03	3.7337D+05	1.4131D+03	3.8579D+05
9	1.4586D+03	3.9821D+05	1.5042D+03	4.1155D+05	1.5497D+03	4.2308D+05	1.5952D+03	4.3550D+05
13	1.6407D+03	4.4792D+05	1.6862D+03	4.6035D+05	1.7317D+03	4.7277D+05	1.7775D+03	4.9059D+05
17	1.8230D+03	4.9221D+05	1.8682D+03	5.1003D+05	1.9137D+03	5.2245D+05	1.9592D+03	5.3486D+05

PHI COORDINATE

	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY
1	1.5500D-01	6.2000D-01	4.7000D-01	6.4000D-01	7.8500D-01	6.2000D-01	1.0950D+00	6.2000D-01
5	1.4100D+00	6.4000D-01	1.7250D+00	6.2000D-01	2.0400D+00	6.4000D-01	2.3500D+00	6.0000D-01
9	2.6500D+00	6.0000D-01	2.9500D+00	6.0000D-01	3.3000D+00	8.0000D-01	3.6500D+00	6.0000D-01
13	3.9500D+00	6.0000D-01	4.2500D+00	6.0000D-01	4.5500D+00	6.0000D-01	4.8650D+00	6.6000D-01
17	5.1850D+00	6.2000D-01	5.4950D+00	6.2000D-01	5.8100D+00	6.4000D-01	6.1265D+00	6.2600D-01

Z COORDINATE

	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY	COORDINATE	INTENSITY
1	1.2638D+03	1.3941D+01	1.4444D+03	1.3941D+01	1.6249D+03	1.3933D+01	1.8055D+03	1.3941D+01
5	1.9861D+03	1.3941D+01	2.1667D+03	1.3941D+01	2.3472D+03	1.3933D+01	2.5278D+03	1.3941D+01
9	2.7084D+03	1.3941D+01	2.8890D+03	1.3941D+01	3.0695D+03	1.3933D+01	3.2501D+03	1.3941D+01
13	3.4307D+03	1.3941D+01	3.6112D+03	1.3933D+01	3.7918D+03	1.3941D+01	3.9724D+03	1.3941D+01
17	4.1530D+03	1.3941D+01	4.3335D+03	1.3933D+01	4.5141D+03	1.3941D+01	4.6947D+03	1.3941D+01

**** CASE SETUP TIME IN MIN. = 0.0

NTRYZN MATRIX (30XNBOUND)

BNDRY NO.

1	1	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	1	3	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	1	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	2	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	[illegible]	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0

L B D MATRIX (15 X NREG)

ZONE NO.															
1	1	-3	-4	5	0	0	0	0	0	0	0	0	0	0	0
2	1	-2	-5	6	0	0	0	0	0	0	0	0	0	0	0
3	3	-4	7	0	0	0	0	0	0	0	0	0	0	0	0
4	-3	1	-6	7	0	0	0	0	0	0	0	0	0	0	0
5	2	-3	-5	6	0	0	0	0	0	0	0	0	0	0	0

MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE=REGION 4)

RECEIVER NUMBER 1 COORDINATES - X 0.0 Y 0.0 Z 2.3825E+03

GEOMETRY PRINT FOR PSEUDO SOURCE POINT AT THE COORDINATE ORIGIN

ZONE	BOUNDARY	DISTANCE	X	Y	Z
3	0	1.2268D+03	1.0719D+03	0.0	2.9792D+03

MP-2 RADIATION QUALIFICATION OF ELECTRICAL EQUIPMENT (SOURCE=REGION 4)

RECEIVER NUMBER 1 COORDINATES - X 0.0 Y 0.0 Z 2.3825E+03

GRP NO	MEAN ENERGY MEV	ENERGY GROUP LIMITS MEV	MEAN BUILDUP FACTORS	ENERGY FLUX (MEV/CM2-SEC) DIRECT BEAM	ENERGY FLUX (MEV/CM2-SEC) WITH BUILDUP	DOSE RATE (MREM/HR) DIRECT BEAM	DOSE RATE (MREM/HR) WITH BUILDUP
1	0.4000		1.2314D+00	1.9319D+10	2.3790D+10	4.0571D+07	4.9958D+07
2	0.8000		1.1353D+00	1.5248D+11	1.7310D+11	3.0495D+08	3.4620D+08
3	1.3000		1.0926D+00	5.8418D+10	6.3825D+10	1.0515D+08	1.1489D+08
4	1.7000		1.0746D+00	1.6694D+11	1.7939D+11	2.8380D+08	3.0496D+08
5	2.2000		1.0621D+00	9.5922D+10	1.0187D+11	1.5347D+08	1.6300D+08
6	2.5000		1.0568D+00	5.4007D+10	5.7075D+10	8.1011D+07	8.5612D+07
7	3.5000		1.0452D+00	5.7915D+10	6.0533D+10	8.1060D+07	8.4746D+07
8	6.1500		1.0313D+00	6.7444D-18	6.9552D-18	7.4189D-21	7.6507D-21
TOTAL	[illegible].2760			6.0500E+11	6.5958D+11	1.0500E+09	1.1494E+09
WOBU	1.3045						

ENERGY FLUX BUILDUP 1.0902D+00

DOSE BUILDUP 1.0946E+00

**** TIME FOR DETECTOR IN MIN. = 0.0

*** END OF JOB E16103 ***