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**Examination of Criticality
Accident Alarm Coverage on the
Operating Floors of the X-333,
X-330, and X-326 Facilities at
the Portsmouth Gaseous
Diffusion Plant**

by

Billy L. Lee, Jr.
M. Christian Dobelbower
Jeffrey Woollard
Catherine W. Skapik

January 1996

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Under LMUS Contract 400183

**LOCKHEED MARTIN UTILITY SERVICES, INC.
P.O. Box 628 Piketon, Ohio 45661**

**Under Contract USECHQ-93-C-0001
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EXECUTIVE SUMMARY

This report summarizes the results of an evaluation of Criticality Accident Alarm System (CAAS) coverage of the operating floors (first floors) of the X-333, X-330, and X-326 buildings. CAAS coverage of the process cell floors (second floors) has been evaluated in previous reports.^{1,2} Coverage of the roadways around the three processing buildings by the cell floor detectors in these buildings has also been verified in a previous report.³

In order to evaluate coverage, the facilities were modeled using the Monte Carlo N-Particle Transport Computer Code (MCNP). MCNP was then used to simulate criticality accidents at various locations throughout the operating floors of the buildings and the associated neutron flux at the current detector locations was calculated. The neutron flux was then converted to an absorbed dose rate (in tissue) and compared with the Portsmouth criticality accident alarm set-point of 5mrad/hr.⁴ The parameters defining the simulated criticality accidents have been calculated as "the minimum accident of concern" as defined in ANSI Standard ANS 8.3-1986.⁵ These calculations are documented in Portsmouth report number POEF-SH-31.⁶

The results of this evaluation indicate that the X-333 Operating Floor CAAS may not alarm in response to a minimum accident of concern. This is primarily because of shielding provided by the numerous concrete columns used to support the second floor of this building and the large distances between the CAAS detectors.

Conversely, the results indicate that the X-326 and the X-330 CAAS systems would alarm in response to a minimum accident of concern occurring on the operating floors of these buildings. It should be noted that the cell floors in these two buildings are supported with steel I-beams instead of the concrete columns used in the X-333 building.

1.0 INTRODUCTION

The Portsmouth Gaseous Diffusion Plant (PORTS), located in Piketon, Ohio, is one of two operating gaseous diffusion plants leased from the U.S. Department of Energy (DOE) by the United States Enrichment Corporation (USEC) and managed and operated by Lockheed Martin Utility Services (LMUS). At these plants, uranium (U) in the form of uranium hexafluoride (UF_6), is enriched (using a gaseous diffusion process) from its naturally occurring isotopic concentration of about 0.7% ^{235}U , to approximately 5% ^{235}U , with a plant maximum of 10%. The diffusion cascade processing equipment is located in the X-333, X-330, and X-326 buildings. These buildings are referred to as the cascade buildings.

Since uranium operations are performed within these process facilities, the potential for a criticality accident exists. A Criticality Accident Alarm System (CAAS) is in place to alarm in the event of a criticality accident. According to ANSI standard ANS 8.3-1986 "Criticality Accident Alarm System,"⁵ the CAAS "shall be designed to detect immediately the minimum accident of concern." In order to meet this requirement, CAAS detectors are located at various positions throughout the Portsmouth cascade process buildings and in some of the support services buildings. This report summarizes an analysis which was performed to evaluate whether or not the operating floor CAAS systems in buildings X-333, X-330, and X-326, provide complete coverage of the operating floors within each building. CAAS coverage of the cell floors of the three processing buildings and coverage of the roadways surrounding the buildings has been verified in previous reports.^{1,2,3}

2.0 FACILITY DESCRIPTIONS

Feed material (UF_6) is introduced into the enrichment cascade in building X-333. This UF_6 feed material is enriched in the fissile isotope ^{235}U during the gaseous diffusion process. The gaseous diffusion process is conceptually similar to the distillation process, except that a different physical phenomenon is exploited to effect separation of the desirable component ^{235}U . In a distillation process, the separative driving force is a difference in vapor pressure of two or more materials. In gaseous diffusion, the separative driving force is the slightly different atomic weights of the ^{235}U and ^{238}U isotopes. $^{235}\text{UF}_6$ is slightly lighter than $^{238}\text{UF}_6$ and, therefore, moves faster at the same temperature and pressure. Subsequently, $^{235}\text{UF}_6$ strikes the surfaces of its container more frequently than $^{238}\text{UF}_6$ and has a greater likelihood of diffusing through microscopic pores in the separation medium or "barrier."

UF_6 withdrawals are performed at various cascade locations. Three main fixed facilities compress the UF_6 gas and condense it into a liquid, which drains into product (or tails) cylinders. These liquid-phase withdrawal facilities are the Extended Range Product (ERP) Station in X-326, the Low Assay Withdrawal (LAW) Station in X-333, and the Tails Withdrawal Facility in X-330. Assay control for all material withdrawn from the cascade is performed using assay spectrometers and gas samples. The filled cylinders are moved to a cool-down area where the UF_6 solidifies. Gas-phase withdrawals may be performed at various locations in the cascade. Because the gas is frozen directly to solid UF_6 in these withdrawals, cylinders filled in this manner may be moved without the need for a cool-down period.

The X-326, X-330, and X-333 buildings are steel-framed, transite-covered, two-story buildings. In each building, the diffusion equipment is located on the cell floor (second floor) and the electrical switchgear and control instrumentation is located on the operating floor (first floor). The cell floor in the X-333 building is supported by concrete columns. The cell floors

of the X-326 and X-330 buildings are supported by steel I-beams. These three buildings are briefly described in the sections that follow. Table 1 lists the detector locations existing on the operating floor of each of the buildings.

Table 1. CAAS Detector Locations

See Figures 1, 2, and 3 for the Column Locations

Building	Detector	Column Location
X-333	SE-1	41-Mb
	33-LS-1	LAW Station
	33-1G	20-C
X-330	T	87-DD
	SE-2	65-Q
	CR	40-AA
	SE-3	30-S
	IP	7-AA
X-326	ERP	5-A
	SE-4	23-H
	SE-5	63-H
	SE-6	93-H
	PW	101-W

In addition to housing the diffusion cascade, these buildings are also used to provide storage areas for low level contaminated waste. Though contaminated with uranium, the majority of the waste does not present a criticality accident concern. What it does do however, is provide additional shielding between the alarm cluster locations and potential criticality accident location. These areas are identified in Figures 1, 2, and 3.

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2.1 The X-333 Building

The X-333 building is approximately 1,456 ft long, 970 ft wide, and 82 ft high. The two floors have a combined space of about 65 acres. The largest diffusion equipment is housed in building X-333 and is used to produce the lowest level of enrichment. Eleven criticality alarm clusters are located throughout the building. Three of these clusters are located on the operating floor, as shown on Figure 1. The cell floor is supported by approximately 2,925 18-inch square concrete columns.

The maximum enrichment in the X-333 building is about 2.3% except for enriched material from further up the cascade which is "recycled" back the LAW station for withdrawal.

2.2 The X-330 Building

The X-330 building is approximately 2,176 ft long, 640 ft wide, and 66 ft high. Its combined floor space is about 55 acres. The building has 17 criticality alarm clusters. Five of these clusters are located on the operating floor, as shown in Figure 2. Material entering the X-330 building is typically around 2% enriched in ^{235}U . It can be further enriched to approximately 15% before it is sent to the X-326 building for further enriching but the current plant demands are for material of approximately 5% enrichment.

2.3 The X-326 Building

The X-326 building is approximately 2,230 ft long, 552 ft wide and 62 ft high. Its two floors have a combined floor space of about 58 acres. The equipment for producing highly enriched uranium (currently out of service) is located in building X-326. Seventeen criticality

alarm clusters are located throughout the building. Five of these clusters are located on the operating floor as shown in Figure 3.

The X-326 building also houses the ^{252}Cf Shuffler in the NDA lab. This device is used to perform NDA measurements on waste for fissile (^{235}U) material content. Beneath the shuffler is a small pit, constructed to house support equipment for the shuffler. A criticality accident occurring in this pit would be very well shielded. As will be discussed later, this pit was specifically included in the model and examined.

Figure 1. Building X-333

Figure 2. Building X-330

Figure 3. Building X-326

3.0 ANALYSIS

The analysis of CAAS coverage of the operating floors was performed in four steps. A suitable geometry approximating the buildings was developed. An accurate source term describing an appropriate criticality accident was determined. The CAAS detectors were then modeled using the MCNP code and flux tallies were implemented, with appropriate variance reduction techniques, in a manner which provided accurate values of the flux spectrum at the detector locations. Finally, a flux to dose conversion was applied to the tally results to determine the detector response. These steps are described in detail in the sections that follow.

3.1 Facility Models

Each of the three buildings was modeled individually. Building components were simplified in order to allow the computer analysis to be completed in a reasonable amount of time. Simplifications include the elimination of doors and windows. All significant concrete walls and support columns were included. Each facility was modeled on 30 m thick concrete ground and surrounded by a large hemisphere of air with a radius of 8 km. Most of the walls in these buildings are concrete block, which was modeled as half-density concrete of the appropriate thickness. Interior structures such as Area Control Rooms, battery rooms, etc., are included in each model. These are identified in Figures 4, 7, and 9 for the X-333, X-330, and X-326 models respectively.

An exception to this is the NDA lab in the X-326 building. Though modeled as concrete block, it was discovered after the analysis was completed that the walls of the NDA lab are actually solid concrete. This does not affect the validity of the results due to the fact that coverage within the NDA lab is provided by a portable CAAS unit, and transmission of

neutrons through the NDA lab is not depended upon to show coverage for the remainder of the facility.

The concrete support columns in the X-333 building were included in the building model. Figure 5 shows several of these concrete columns as well as one of the interior structures and several of the waste storage areas. Buildings X-330 and X-326 have steel I-beam support columns which were also included in the building models. Figures 8 and 10 show several of these I-beams as well as some of the model details. Figure 6 is a "close-up" SABRINA¹⁴ representation of the concrete columns.

As mentioned in Section 2.0, waste storage areas were included in the models. These areas are identified in Figures 1, 2 and 3. The waste is generally made up of Personal Protective Equipment (PPE), pea gravel from the roofs of the process buildings, dirt, scrap metal, floor sweepings, and oil absorbing media. Since the waste is not segregated by type, it was conservatively modeled as wood at 50% density. Wood was used because it adequately represents these other materials from a neutron shielding standpoint, thus providing a reasonable approximation of the waste. Each building has a number of rooms for battery storage. Because these batteries contain water, they may provide significant shielding and were therefore included in the model.

For consistency with previous calculations of criticality alarm response in the PORTS buildings, the number densities of air, concrete, and steel used in these analyses were taken from Westfall et al.⁸ The number densities for wood (assumed to be half-density oak) were taken from the Standard Composition Library for Scale 4.2¹³. Table 2 lists the materials used and their number densities.

Figure 4. SABRINA¹⁴ representation of the X-333 Building Model

Figure 5. SABRINA¹⁴ representation showing the concrete support columns and some of the areas defined as part of the Building X-333 MCNP model

Figure 6. SABRINA¹⁴ representation showing a "close-up" view of the concrete columns.

Figure 7. SABRINA¹⁴ representation of the X-330 Building Model

Figure 8. SABRINA¹⁴ representation showing some of the structure details included in the Building X-330 model

Figure 9. SABRINA¹⁴ representation of the X-326 Building Model

Figure 10. SABRINA¹⁴ representation showing one of the battery rooms and several of the steel I-beam support columns included in the X-326 model.

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Table 2. Material Compositions

Material	Element	Number Density (Atom barn-1 cm-1)
Air	Nitrogen	3.570E-05
	Oxygen	7.840E-06
Concrete	Hydrogen	1.487E-02
	Carbon	3.814E-03
	Oxygen	4.152E-02
	Sodium	3.040E-04
	Magnesium	5.870E-04
	Aluminum	7.350E-04
	Silicon	6.037E-03
	Calcium	1.159E-02
	Iron	1.968E-04
Steel	Carbon	3.921E-03
	Iron	8.349E-02
Wood	Carbon	2.86E-01
	Hydrogen	4.76E-01
	Oxygen	2.38E-01

3.2 Source

To completely model the criticality accident sources used in the MCNP analysis, the source location, source neutron production rate (power level), and the source neutron energy spectra must be known. The development of each is discussed briefly below.

3.2.1 Source Locations

Source locations were chosen that would maximize the distance and/or shielding between the source and the detector. These source locations result in the smallest absorbed dose rates at the detectors. Therefore, any other source location would result in a smaller distance or smaller thickness of shielding between the source and detector and will be bounded by the cases analyzed. Several different source locations were used in this analysis. These source locations are tabulated in Table 3 and briefly described below.

Two sources were selected for the X-333 building. The locations of these sources are identified as numbers 1 and 2 in Figure 1. These source locations were chosen because they maximized the distance and shielding between the source and detector. Both sources were modeled as having a ^{235}U enrichment of 5%.

Five source locations were chosen for the X-330 building. These locations are identified in Figure 2. Again, the locations were chosen to maximize distance and shielding thus providing worst case scenarios to analyze. All sources were modeled to have an enrichment of 5% ^{235}U with the exception of source point 5. The enrichment level for source point number 5 was raised to 20%. This was done to represent the increase in enrichment as material moves up the cascade through the X-330 building.

Six source locations were defined for the X-326 building. These source locations are shown in Figure 3. Sources 1,2,4,5, and 6 were modeled to have a ^{235}U enrichment of 100%. Source point 3 was modeled at 20%. Again, this was done to simulate the increase in enrichment as material moves up the cascade through the X-326 building. Note that even though current plant operations do not require material to be enriched to these levels, the

possibility exists that higher enriched material from past operations may be held up in the equipment.

3.2.2 Source Power Level and Energy Spectrum

In each case, an isotropic point source of an appropriate ^{235}U enrichment was modeled. The associated power level and neutron energy spectrum were taken from POEF-SH-31.⁶ The level of enrichment was varied because of the increase in enrichment as material moves up the cascade. In each case, the power level and neutron energy spectrum simulate the minimum accident of concern as defined in ANSI Standard ANS/ANSI 8.3-1986⁵ and further defined in POEF-SH-31.⁶

Table 3. Criticality Accident Source Locations

Source	Building	Description	^{235}U Enrichment (%)	Power Level (W)
333-1	X-333	NE Corner of Building	5	2881
333-2	X-333	East side of storage area "N" in Figure 1	5	2881
330-1	X-330	NW corner of building	5	2881
330-2	X-330	Column S-80	5	2881
330-3	X-330	Column A-53 (on West wall)	5	2881
330-4	X-330	Column Y-53 (South of ACR-2)	5	2881
330-5	X-330	Column V-16 (South of ACR-3)	20	1722
326-1	X-326	Midway between ACR-4 & ACR-5	100	1281
326-2	X-326	Column 34-D	100	1281
326-3	X-326	Column 16-Y	20	1722
326-4	X-326	Column 90-Q	100	1281
326-5	X-326	Column 80-C	100	1281
326-6	X-326	Beneath ^{252}Cf Shuffler	100	1281

3.3 Flux Tallies and Variance Reduction

The CAAS detectors used at the PORTS site are set to alarm at an absorbed dose rate in tissue of 5 mrad/hr⁴. Values of the neutron flux in air, calculated by MCNP, will be converted to absorbed dose rates in tissue through the use of an appropriate flux to absorbed dose rate conversion factor (see section 3.4). Therefore, the detectors modeled in MCNP must tally the neutron flux spectra in air.

The MCNP detectors were modeled at locations corresponding to the currently installed CAAS detectors. The neutron fluence at the various detectors was calculated using a next event estimator (point detector) at the center of the detector model. Because of the enormous amount of computer time required to track all neutron events, and the minimal contribution to detector response from neutrons below 17 keV for the applied response function, a 17 keV cut-off was used to kill neutrons and prevent their further tracking once they drop below 17 keV.

3.4 Flux to Absorbed Dose Rate Conversion

MCNP was used to calculate the neutron fluence per source neutron at the modeled detector locations. In order to calculate the absorbed dose rate in the detector, the neutron fluence per source neutron was first converted to neutron flux. Then, a flux to neutron absorbed dose rate conversion factor was applied to calculate the neutron absorbed dose rate in the detector.

To convert the neutron fluence per source particle to neutron flux, the neutron production rate of the source must be known. The source neutron production rate was determined according to the following equation:

$$N\left(\frac{\text{neutrons}}{\text{sec}}\right) = \phi_p\left(\frac{\#}{\text{cm}^2\text{-sec-watt}}\right) * P(W) * A(\text{cm}^2)$$

where

N = the source neutron production rate

ϕ_p = the neutron flux per unit power

P = power for the minimum critical accident of concern

A = the surface area of the detector sphere ($r=2\text{m}$)

Because the criticality accident sources used in this analysis have differing levels of moderation and ^{235}U enrichments, different power levels and neutron spectra correspond to the minimum accident of concern. Using the appropriate values for ϕ_p and P from POEF-SH-31⁶, the neutron source rates for each source term were calculated. The neutron source rate corresponding to the 20% ^{235}U enriched source terms is 5.202×10^{13} n/s. The neutron source rate corresponding to the 100% ^{235}U enriched source terms is 5.467×10^{13} n/s. It should be noted that these neutron sources are based on the Henderson Flux to Dose Conversion Factors in POEF-SH-31⁶ and should not be used with any other response function.

A neutron flux to neutron absorbed dose rate conversion factor was applied to the neutron flux to calculate the neutron absorbed dose rate. In this analysis, the neutron absorbed dose rate was calculated on a per energy bin basis. The absorbed dose rate at the detector was calculated using the following equation:

$$D\left(\frac{mrad}{hr}\right) = \sum_{i=1}^{27} N\left(\frac{n}{s}\right) * \phi_{i,mcnp}\left(\frac{\frac{\#}{cm^2}}{n}\right) * k_i\left(\frac{\frac{rad}{n}}{cm^2}\right) * \left(\frac{3600sec}{hr}\right) * \left(\frac{1000mrad}{rad}\right)$$

where

- D = neutron absorbed dose rate at detector
 $\phi_{i,mcnp}$ = the neutron fluence per source particle at the detector
 N = source neutron production rate
 k = neutron flux to neutron absorbed dose rate conversion factor
 i = energy bin index

The Henderson Free in Air flux to dose conversion factors, as shown in Table 4, were used.

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Table 4. Henderson Free-in-Air Flux-to-Dose Conversion Factors

Upper Energy Boundary (MeV)	Henderson Free in Air Flux-to-Dose Conversion Factor (rads/(n/cm ²))
1.00E-11	0.00E+00
1.00E-08	6.03E-17
3.00E-08	2.46E-16
5.00E-08	3.69E-16
1.00E-07	6.52E-16
2.25E-07	1.40E-15
3.25E-07	2.54E-15
4.00E-07	3.37E-15
8.00E-07	5.39E-15
1.00E-06	8.37E-15
1.13E-06	9.93E-15
1.30E-06	1.13E-14
1.77E-06	1.42E-14
3.05E-06	2.20E-14
1.00E-05	5.46E-14
3.00E-05	1.70E-13
1.00E-04	5.43E-13
5.50E-04	2.36E-12
3.00E-03	1.35E-11
1.70E-02	7.20E-11
1.00E-01	3.12E-10
4.00E-01	1.08E-09
9.00E-01	1.79E-09
1.40E+00	2.44E-09
1.85E+00	2.79E-09
3.00E+00	3.22E-09
6.43E+00	4.18E-09
2.00E+01	4.72E-09

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4.0 RESULTS

Table 5 lists the highest detector response with statistical significance for each point analyzed. As a result of the large thicknesses of material between the source and the detectors, only the detectors nearest the source yielded a statistically significant response for the computer time used. Appendix B has the complete tabulated results of the detector responses for each point that was analyzed.

Table 5. Detector Responses

Source Location	Detector Location	Detector Response (mrad/hr)	Standard Deviation (mrad/hr)
333-1*	Column Z-66	---	---
333-2	Column Mb-3	0.16	0.032
330-1**	Column 87-DD	4.88	0.45
330-2	Column 87-DD	26.6	1.1
330-3	Column 65-Q	8.37	0.78
330-4	Column 40-AA	32.43	3.76
330-5	Column 30-S	37.63	2.15
326-1	Column 23-H	21.95	0.67
326-2	Column 23-H	37.54	1.06
326-3**	Column 23-H	9.05	1.14
326-4	Column 63-H	24.60	0.95
326-5	Column 93-H	20.88	1.88
326-6	Column 93-H	2.83	0.48

*Not calculated because of low detector response.

**Best statistics achievable in allotted time.

5.0 DISCUSSION

This analysis determines coverage or non-coverage of a source location by comparing calculated detector responses to the PORTS CAAS alarm setpoint of 5 mrad/hr⁴. MCNP was run using point detectors to tally the neutron fluence per source particle. The problem was run until the tally for one of the detectors had a fractional uncertainty of about 5%. At this point, the response of the detector was calculated as outlined in Section 3.5. If the calculated detector response was greater than or equal to 5 mrad/hr, the area was then considered to be covered by the CAAS. Using this method, the operating floor of the X-330 building is considered completely covered. All source points examined in the X-326 facility were also considered covered with the exception of point 6 in the NDA lab beneath the ²⁵²Cf shuffler. Though not specifically examined, coverage for the NDA lab is provided by a portable CAAS unit. Since it is portable, this unit is not connected to the plant alarm system, and as such only sounds local alarms. Since it is a requirement of operation that the portable CAAS be operational in the NDA lab, full coverage of the building can be claimed.

For the X-333 building, however, coverage could not be shown. This is due to the conservative nature of the Henderson Flux to Dose Response Function and that there is an enormous amount of shielding provided by the concrete support columns in the building. The use of a detector response function that more appropriately treats the interaction of thermal neutrons in the detector may generate results indicating that the X-333 is covered. The development of such a response function had been discussed with the NCS department at PORTS, but was outside the scope of this analysis and was not possible within the allocated resources. Also desirable, but not possible within the allocated resources, was the generation of an iso-dose map of the X-333 building specifically showing which areas coverage could or could not be shown for. However the application of a less conservative response function would likely make this unnecessary.

6.0 CONCLUSIONS

Complete coverage of the operating floors of the three cascade buildings could not be shown. None of the points examined in the X-333 facility produced a detector response that exceeded the alarm set point of 5 mrad/hr. However, much better results were achieved in the X-326 and X-330 buildings

In the X-326 and X-330 buildings, only one source point in each failed to generate an alarm condition. In the X-326 building, the only point that did not alarm a detector was point 6. This source point was located beneath the ^{252}Cf Shuffler. Coverage for this area is provided by a portable CAAS unit installed locally.

In the X-330 building also, only one point failed to generate an alarm condition. However, the analysis of this point was very calculationally intensive and statistical significance was not achieved in the allotted amount of computer time. The detector response for this point was approximately 4.9 ± 0.5 mrad/hr, very close to the alarm setpoint. An examination of the output for this point indicates that, with additional computer time, the results will converge on a value exceeding 5.0, allowing the conclusion to be made that full coverage exists.

7.0 REFERENCES

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January 1996

*Examination of Criticality Accident Alarm Coverage on the Operating
Floors of the X-333, X-330, and X-326 Facilities at the
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APPENDIX A

SAMPLE MCNP INPUTS FOR THE X-333, X-330, AND X-326 MODELS

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Floors of the X-333, X-330, and X-326 Facilities at the
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30 20 3.9827e-2 180 -230 430 -440 1010 -1030 imp:n=1 \$

storage areas

00	40 -0.375	80	-110 590 -600 1010 -1020 imp:n=1 \$ lot A
10	40 -0.375	70	-100 600 -610 1010 -1020 imp:n=1 \$ B
20	40 -0.375	20	-60 590 -600 1010 -1020 imp:n=1 \$ C
30	40 -0.375	25	-40 660 -670 1010 -1020 imp:n=1 \$ D
40	40 -0.375	60	-110 660 -670 1010 -1020 imp:n=1 \$ F
50	40 -0.375	25	-40 720 -750 1010 -1020 imp:n=1 \$ E
60	40 -0.375	40	-60 780 -790 1010 -1020 imp:n=1 \$ G
70	40 -0.375	20	-30 780 -790 1010 -1020 imp:n=1 \$ H
80	40 -0.375	40	-60 810 -840 1010 -1020 imp:n=1 \$ I
90	40 -0.375	70	-90 790 -800 1010 -1020 imp:n=1 \$ J
00	40 -0.375	70	-110 880 -890 1010 -1020 imp:n=1 \$ K
10	40 -0.375	120	-140 880 -890 1010 -1020 imp:n=1 \$ L
20	40 -0.375	130	-140 900 -920 1010 -1020 imp:n=1 \$ M
30	40 -0.375	170	-200 900 -930 1010 -1020 imp:n=1 \$ N
40	40 -0.375	240	-290 900 -910 1010 -1020 imp:n=1 \$ O
50	40 -0.375	240	-270 880 -890 1010 -1020 imp:n=1 \$ P
60	40 -0.375	300	-310 850 -890 1010 -1020 imp:n=1 \$ Q
70	40 -0.375	320	-330 880 -890 1010 -1020 imp:n=1 \$ R
80	40 -0.375	340	-350 880 -890 1010 -1020 imp:n=1 \$ S
90	40 -0.375	280	-290 780 -790 1010 -1020 imp:n=1 \$ T
00	40 -0.375	50	-80 410 -420 1010 -1020 imp:n=1 \$ U

walls of building

50	30 8.7411e-2	15	-360 400 -405 1010 -1050 imp:n=1 \$ west wall
60	30 8.7411e-2	10	-15 400 -945 1010 -1050 imp:n=1 \$ north wall
70	30 8.7411e-2	15	-360 940 -945 1010 -1050 imp:n=1 \$ east wall
80	30 8.7411e-2	360	-365 400 -945 1010 -1050 imp:n=1 \$ south wall
00	20 3.9827e-2	15	-360 405 -940 1040 -1050 imp:n=1 \$ concrete process floor
10	20 3.9827e-2	1000	-1010 -1998 imp:n=1 \$ concrete floor

roofs on offices

00	30 8.7411e-2	170	-240 430 -540 1030 -1035 imp:n=1 \$ west room roof
10	30 8.7411e-2	150	-240 550 -650 1030 -1035 imp:n=1 \$ middle room roof
20	30 8.7411e-2	(150 -260 680 -830 1030 -1035):	
		(150 -210 830 -870 1030 -1035) imp:n=1 \$ west room roof	

air in building

000	0	(-80:110:-590:600:-1010:1020)	
		(-70:100:-600:610:-1010:1020)	
		(-20:60:-590:600:-1010:1020)	
		(-50:80:-410:420:-1010:1020)	
		(-150:240:-550:650:-1010:1035)	
		(-170:240:-430:540:-1010:1035)	
		(15 -290 405 -660 1010 -1040) 1110	
		fill=1 imp:n=1	\$ northwest air
1010	0	(-60:110:-660:670:-1010:1020)	
		(-25:40:-660:670:-1010:1020)	
		(-25:40:-720:750:-1010:1020)	
		(-40:60:-780:790:-1010:1020)	
		(-20:30:-780:790:-1010:1020)	
		(-40:60:-810:840:-1010:1020)	
		(-70:90:-790:800:-1010:1020)	

this is a model of the first floor of the X333
Building to determine alarm coverage

cell cards

0	10 4.354e-5	180 -230 440 -450 1010 -1030	imp:n=1	\$
0	10 4.354e-5	180 -230 460 -470 1010 -1030	imp:n=1	\$
0	10 4.354e-5	180 -230 480 -490 1010 -1030	imp:n=1	\$
0	10 4.354e-5	180 -230 500 -510 1010 -1030	imp:n=1	\$
0	10 4.354e-5	180 -230 520 -530 1010 -1030	imp:n=1	\$
0	10 4.354e-5	160 -230 560 -570 1010 -1030	imp:n=1	\$
0	10 4.354e-5	160 -230 580 -620 1010 -1030	imp:n=1	\$
0	10 4.354e-5	160 -170 630 -640 1010 -1030	imp:n=1	\$
0	10 4.354e-5	180 -230 630 -640 1010 -1030	imp:n=1	\$
0	10 4.354e-5	160 -170 690 -700 1010 -1030	imp:n=1	\$
0	10 4.354e-5	160 -170 710 -760 1010 -1030	imp:n=1	\$
20	10 4.354e-5	(180 -230 690 -760 1010 -1030):		
		(230 -250 740 -760 1010 -1030) imp:n=1	\$	
30	10 4.354e-5	240 -250 690 -730 1010 -1030	imp:n=1	\$
40	10 4.354e-5	(160 -250 770 -820 1010 -1030):		
		(160 -200 820 -860 1010 -1030) imp:n=1	\$	

here are the concrete walls

50	20 3.9827e-2	150 -160 680 -870 1010 -1030	imp:n=1	\$
60	20 3.9827e-2	170 -180 680 -770 1010 -1030	imp:n=1	\$
70	20 3.9827e-2	200 -210 820 -870 1010 -1030	imp:n=1	\$
80	20 3.9827e-2	230 -240 680 -740 1010 -1030	imp:n=1	\$
90	20 3.9827e-2	250 -260 680 -830 1010 -1030	imp:n=1	\$
00	20 3.9827e-2	160 -200 860 -870 1010 -1030	imp:n=1	\$
05	20 3.9827e-2	210 -250 820 -830 1010 -1030	imp:n=1	\$
10	20 3.9827e-2	160 -170 760 -770 1010 -1030	imp:n=1	\$
20	20 3.9827e-2	180 -250 760 -770 1010 -1030	imp:n=1	\$
30	20 3.9827e-2	160 -170 700 -710 1010 -1030	imp:n=1	\$
40	20 3.9827e-2	240 -250 730 -740 1010 -1030	imp:n=1	\$
50	20 3.9827e-2	160 -170 680 -690 1010 -1030	imp:n=1	\$
60	20 3.9827e-2	180 -230 680 -690 1010 -1030	imp:n=1	\$
70	20 3.9827e-2	240 -250 680 -690 1010 -1030	imp:n=1	\$
80	20 3.9827e-2	160 -170 640 -650 1010 -1030	imp:n=1	\$
90	20 3.9827e-2	180 -230 640 -650 1010 -1030	imp:n=1	\$
00	20 3.9827e-2	160 -170 620 -630 1010 -1030	imp:n=1	\$
10	20 3.9827e-2	180 -230 620 -630 1010 -1030	imp:n=1	\$
20	20 3.9827e-2	160 -230 570 -580 1010 -1030	imp:n=1	\$
30	20 3.9827e-2	160 -230 550 -560 1010 -1030	imp:n=1	\$
40	20 3.9827e-2	150 -160 550 -650 1010 -1030	imp:n=1	\$
45	20 3.9827e-2	170 -180 620 -650 1010 -1030	imp:n=1	\$
50	20 3.9827e-2	230 -240 550 -650 1010 -1030	imp:n=1	\$
60	20 3.9827e-2	170 -180 430 -540 1010 -1030	imp:n=1	\$
70	20 3.9827e-2	230 -240 430 -540 1010 -1030	imp:n=1	\$
80	20 3.9827e-2	180 -230 530 -540 1010 -1030	imp:n=1	\$
90	20 3.9827e-2	180 -230 510 -520 1010 -1030	imp:n=1	\$
00	20 3.9827e-2	180 -230 490 -500 1010 -1030	imp:n=1	\$
10	20 3.9827e-2	180 -230 470 -480 1010 -1030	imp:n=1	\$
20	20 3.9827e-2	180 -230 450 -460 1010 -1030	imp:n=1	\$

```

(15 -110 660 -880 1010 -1040)
fill=1 imp:n=1 $ air
012 0 (-70:110:-880:890:-1010:1020)
(-120:140:-880:890:-1010:1020)
(-130:140:-900:920:-1010:1020)
(-170:200:-900:930:-1010:1020)
(-240:290:-900:910:-1010:1020)
(-240:270:-880:890:-1010:1020)
(15 -290 880 -940 1010 -1040)
fill=1 imp:n=1 $ air
014 0 (-280:290:-780:790:-1010:1020)
(-150:260:-680:830:-1010:1035)
(-150:210:-830:870:-1010:1035)
(110 -290 660 -880 1010 -1040) 1100
fill=1 imp:n=1 $ northeast air
020 0 (-300:310:-850:890:-1010:1020)
(-320:330:-880:890:-1010:1020)
(-340:350:-880:890:-1010:1020)
(290 -360 660 -940 1010 -1040)
fill=1 imp:n=1 $ southeast air
030 0 (290 -360 405 -660 1010 -1040) 1120
fill=1 imp:n=1 $ southwest air

```

repeated structures cells

```

200 20 3.9827e-2 1520 -1500 1620 -1600 u=2 imp:n=1 $
210 10 4.354e-5 -1520:1500:-1620:1600 u=2 imp:n=1 $
220 10 4.354e-5 -1550 1540 -1650 1640 -1700 1730 u=1 lat=1
imp:n=1 fill=0:45 0:65 0:0
2 3035r $ repeated unit cell

500 10 4.354e-5 -1100 imp:n=1 $ detector se-1
510 10 4.354e-5 -1110 imp:n=1 $ detector 33-ls-1
520 10 4.354e-5 -1120 imp:n=1 $ detector 33-lg
998 10 4.354e-5 ((-10:365:-400:945) -1998 -1050 1010):
(-1998 1050) imp:n=1 $ air around building
999 0 (-1000 -1999):(1998 -1999) imp:n=1 $ internal world
000 0 1999 imp:n=0 $ external world

```

```

*****
surface cards
*****

```

```

0 px 0 $
5 px 0.191 $
20 px 1463 $
25 px 1920 $
30 px 3078 $
40 px 3779 $
50 px 4328 $
60 px 5639 $
70 px 6370 $
80 px 7010 $
90 px 7559 $
100 px 8230 $
110 px 9510 $

```

20	px	11369	\$
30	px	12009	\$
40	px	12710	\$
50	px	13259	\$
60	px	13279	\$
70	px	14021	\$
80	px	14041	\$
00	px	14752	\$
10	px	14772	\$
30	px	15464	\$
40	px	15484	\$
50	px	16286	\$
60	px	16306	\$
70	px	16825	\$
80	px	17435	\$
90	px	18075	\$
00	px	20025	\$
10	px	20665	\$
20	px	21275	\$
30	px	23165	\$
40	px	23805	\$
50	px	25116	\$
60	px	29566	\$
65	px	29566.191	\$
00	py	0	\$
05	py	0.191	\$
10	py	732	\$
20	py	1402	\$
30	py	6414	\$
40	py	6434	\$
50	py	7074	\$
60	py	7094	\$
70	py	7734	\$
80	py	7754	\$
90	py	9034	\$
00	py	9054	\$
10	py	10243	\$
20	py	10263	\$
30	py	12103	\$
40	py	12123	\$
50	py	19347	\$
60	py	19367	\$
70	py	19885	\$
80	py	19905	\$
90	py	21287	\$
00	py	21897	\$
10	py	22629	\$
20	py	23411	\$
30	py	23431	\$
40	py	23949	\$
50	py	23969	\$
60	py	26591	\$
70	py	27292	\$
80	py	27352	\$
90	py	27372	\$
00	py	27707	\$
10	py	27727	\$
20	py	28146	\$
30	py	28195	\$
40	py	28215	\$

750	py	28786	\$
760	py	28835	\$
770	py	28855	\$
780	py	32047	\$
790	py	32748	\$
800	py	33449	\$
810	py	34120	\$
820	py	34311	\$
830	py	34331	\$
840	py	34790	\$
850	py	36741	\$
860	py	36891	\$
870	py	36911	\$
880	py	37381	\$
890	py	37990	\$
900	py	38935	\$
910	py	39606	\$
920	py	40276	\$
930	py	42227	\$
940	py	44379	\$
945	py	44379.191	\$
1000	pz	-3000	\$
1010	pz	0	\$
1020	pz	197	\$ top of drums
1030	pz	305	\$ top of rooms
1035	pz	305.09	\$ top of roof on rooms
1040	pz	777	\$ top of first floor
1050	pz	853	\$ process cell floor
1100	s	14752 27241 200 50	\$ detector se-1
1110	s	14752 1351 200 50	\$ detector 33-ls-1
1120	s	28225 12933 200 50	\$ detector 33-lg
1520	px	-0.1	\$
1500	px	45.72	\$
1510	px	642.73	\$
1530	px	642.83	\$
1540	px	-0.01	\$
1550	px	642.74	\$
1620	py	-0.1	\$
1600	py	45.72	\$
1610	py	672.39	\$
1630	py	672.49	\$
1640	py	-0.01	\$
1650	py	672.4	\$
1710	pz	-0.1	\$
1700	pz	900	\$
1720	pz	900.1	\$
1730	pz	-0.01	\$
1998	so	200000	\$
1999	so	600000	\$

c *****

c source term

c *****

c sdef pos=4785 2746 -380.9 erg=d1

sdef sur=1998 nrm=-1 dir=d1

sb1 -21 2

c scl from h/u=15 5% enrichment normalized to 2881 W

c sil h 1.00e-11 1.00e-8 3.00e-8 5.00e-8 1.00e-7 2.25e-7

3.25e-7	4.00e-7	8.00e-7	1.00e-6	1.13e-6	1.3e-6
1.77e-6	3.05e-6	1.00e-5	3.00e-5	1.00e-4	5.5e-4
0.003	0.017	0.1	0.4	0.9	1.4
1.85	3.0	6.43	20		

spl d 0 1.46e+2 8.00e+2 9.71e+2 1.50e+3 1.04e+3
 3.00e+2 1.62e+2 5.54e+2 1.74e+2 8.59e+1 1.04e+2
 2.53e+2 4.73e+2 9.48e+2 1.03e+3 1.18e+3 1.68e+3
 1.82e+3 2.18e+3 2.96e+3 4.36e+3 5.07e+3 3.40e+3
 2.72e+3 5.56e+3 4.90e+3 6.11e+2

material cards

10	7014.50c	3.570e-5	\$ air
	8016.50c	7.840e-6	
20	1001.50c	1.487e-2	\$ concrete
	6012.50c	3.814e-3	
	8016.50c	4.152e-2	
	11023.50c	3.040e-4	
	12000.51c	5.870e-4	
	13027.50c	7.350e-4	
	14000.50c	6.037e-3	
	20000.51c	1.159e-2	
	26000.50c	1.968e-4	
30	6012.50c	3.921e-3	\$ steel
	26000.50c	8.349e-2	
40	6012.50c	6.0	\$ wood
	1001.50c	10.0	
	8016.50c	5.0	
60	92238.50c	8.682e-3	\$ UF6
	9019.50c	5.209e-2	

tally cards

fc4	track length				
f4:n	1500				
fc14	track length				
f14:n	1510				
fc24	track length				
f24:n	1520				
fc5	point				
f5:n	14752 27241 200 50				
fc15	point				
f15:n	14752 1351 200 50				
f25c	point				
f25:n	28225 12933 200 50				
e0	1.00e-11	1.00e-8	3.00e-8	5.00e-8	1.00e-7 2.25e-7
	3.25e-7	4.00e-7	8.00e-7	1.00e-6	1.13e-6 1.3e-6
	1.77e-6	3.05e-6	1.00e-5	3.00e-5	1.00e-4 5.5e-4
	0.003	0.017	0.1	0.4	0.9 1.4
	1.85	3.0	6.43	20	

peripheral cards

ode n
17 keV cut off
cut:n j 0.017
tme 5
oid
ps 50000000
rdmp 3j 4
dbcn 31277116122605
rint

Model of the first floor of the X-330 building

cell cards

0	70	-1.0	10	-15	520	-531	810	-830	imp:n=1 \$	battery rm. #1
0	10	4.354e-5	21	-50	441	-460	810	-830	imp:n=1 \$	
0	10	4.354e-5	21	-30	411	-430	810	-830	imp:n=1 \$	
0	10	4.354e-5	(21	-31	431	-440	810	-830):		
			(31	-40	411	-440	810	-830)	imp:n=1 \$	
0	10	4.354e-5	41	-50	431	-440	810	-830	imp:n=1 \$	
0	70	-1.0	53	-54	520	-531	810	-830	imp:n=1 \$	battery rm. #2
0	70	-1.0	55	-56	520	-531	810	-830	imp:n=1 \$	battery rm. #3
0	10	4.354e-5	61	-80	481	-520	810	-830	imp:n=1 \$	
5	10	4.354e-5	71	-80	521	-530	810	-830	imp:n=1 \$	
00	10	4.354e-5	61	-70	471	-480	810	-830	imp:n=1 \$	
10	10	4.354e-5	71	-80	471	-480	810	-830	imp:n=1 \$	
20	70	-1.0	85	-88	520	-531	810	-830	imp:n=1 \$	battery rm. #4
30	10	4.354e-5	91	-100	501	-510	810	-830	imp:n=1 \$	
40	70	-1.0	100	-105	520	-531	810	-830	imp:n=1 \$	battery rm. #5
42	10	4.354e-5	111	-130	591	-600	810	-830	imp:n=1 \$	
43	10	4.354e-5	111	-130	571	-590	810	-830	imp:n=1 \$	
44	10	4.354e-5	111	-130	561	-570	810	-830	imp:n=1 \$	
45	10	4.354e-5	111	-130	541	-560	810	-830	imp:n=1 \$	
50	10	4.354e-5	(121	-150	441	-500	810	-830):		
			(121	-130	421	-441	810	-830)	imp:n=1 \$	
70	10	4.354e-5	121	-130	411	-420	810	-830	imp:n=1 \$	
90	10	4.354e-5	131	-140	411	-440	810	-830	imp:n=1 \$	
200	10	4.354e-5	141	-150	431	-440	810	-830	imp:n=1 \$	
210	10	4.354e-5	141	-150	421	-430	810	-830	imp:n=1 \$	
220	10	4.354e-5	141	-150	411	-420	810	-830	imp:n=1 \$	
230	70	-1.0	145	-150	520	-531	810	-830	imp:n=1 \$	battery rm. #6
240	70	-1.0	153	-154	520	-531	810	-830	imp:n=1 \$	battery rm. #7
250	70	-1.0	155	-156	520	-531	810	-830	imp:n=1 \$	battery rm. #8
260	10	4.354e-5	161	-170	521	-530	810	-830	imp:n=1 \$	
270	10	4.354e-5	171	-180	521	-530	810	-830	imp:n=1 \$	
280	10	4.354e-5	161	-180	481	-520	810	-830	imp:n=1 \$	
290	10	4.354e-5	161	-170	471	-480	810	-830	imp:n=1 \$	
300	10	4.354e-5	171	-180	471	-480	810	-830	imp:n=1 \$	
310	70	-1.0	185	-188	520	-531	810	-830	imp:n=1 \$	battery rm. #9
320	10	4.354e-5	191	-200	401	-450	810	-830	imp:n=1 \$	
330	70	-1.0	195	-200	520	-531	810	-830	imp:n=1 \$	battery rm. #10
340	10	4.354e-5	211	-230	421	-490	810	-830	imp:n=1 \$	
350	70	-1.0	235	-240	520	-531	810	-830	imp:n=1 \$	battery rm. #11
360	10	4.354e-5	241	-250	399	-400	810	-830	imp:n=1 \$	

c

c

c

these are the concrete walls

c

c

500	20	3.9827e-2	20	-21	410	-461	810	-830	imp:n=1 \$	
510	20	3.9827e-2	30	-31	410	-431	810	-830	imp:n=1 \$	
520	20	3.9827e-2	40	-41	410	-441	810	-830	imp:n=1 \$	
530	20	3.9827e-2	50	-51	430	-461	810	-830	imp:n=1 \$	
540	20	3.9827e-2	21	-50	460	-461	810	-830	imp:n=1 \$	
550	20	3.9827e-2	21	-40	440	-441	810	-830	imp:n=1 \$	
555	20	3.9827e-2	41	-50	440	-441	810	-830	imp:n=1 \$	
560	20	3.9827e-2	21	-30	430	-431	810	-830	imp:n=1 \$	
570	20	3.9827e-2	41	-50	430	-431	810	-830	imp:n=1 \$	

80	20	3.9827e-2	21	-30	410	-411	810	-830	imp:n=1	\$
90	20	3.9827e-2	31	-40	410	-411	810	-830	imp:n=1	\$
00	20	3.9827e-2	60	-61	470	-521	810	-830	imp:n=1	\$
10	20	3.9827e-2	70	-71	520	-531	810	-830	imp:n=1	\$
20	20	3.9827e-2	70	-71	470	-481	810	-830	imp:n=1	\$
30	20	3.9827e-2	80	-81	470	-531	810	-830	imp:n=1	\$
40	20	3.9827e-2	61	-70	520	-521	810	-830	imp:n=1	\$
45	20	3.9827e-2	71	-80	520	-521	810	-830	imp:n=1	\$
50	20	3.9827e-2	71	-80	530	-531	810	-830	imp:n=1	\$
60	20	3.9827e-2	61	-70	480	-481	810	-830	imp:n=1	\$
70	20	3.9827e-2	71	-80	480	-481	810	-830	imp:n=1	\$
80	20	3.9827e-2	61	-70	470	-471	810	-830	imp:n=1	\$
90	20	3.9827e-2	71	-80	470	-471	810	-830	imp:n=1	\$
00	20	3.9827e-2	90	-91	500	-511	810	-830	imp:n=1	\$
10	20	3.9827e-2	100	-101	500	-511	810	-830	imp:n=1	\$
20	20	3.9827e-2	91	-100	510	-511	810	-830	imp:n=1	\$
30	20	3.9827e-2	91	-100	500	-501	810	-830	imp:n=1	\$
40	20	3.9827e-2	120	-121	410	-501	810	-830	imp:n=1	\$
50	20	3.9827e-2	130	-131	410	-441	810	-830	imp:n=1	\$
60	20	3.9827e-2	140	-141	410	-441	810	-830	imp:n=1	\$
70	20	3.9827e-2	150	-151	410	-501	810	-830	imp:n=1	\$
80	20	3.9827e-2	121	-150	500	-501	810	-830	imp:n=1	\$
90	20	3.9827e-2	131	-140	440	-441	810	-830	imp:n=1	\$
95	20	3.9827e-2	141	-150	440	-441	810	-830	imp:n=1	\$
00	20	3.9827e-2	141	-150	430	-431	810	-830	imp:n=1	\$
10	20	3.9827e-2	121	-130	420	-421	810	-830	imp:n=1	\$
20	20	3.9827e-2	141	-150	420	-421	810	-830	imp:n=1	\$
30	20	3.9827e-2	121	-130	410	-411	810	-830	imp:n=1	\$
40	20	3.9827e-2	131	-140	410	-411	810	-830	imp:n=1	\$
50	20	3.9827e-2	141	-150	410	-411	810	-830	imp:n=1	\$
60	20	3.9827e-2	160	-161	470	-531	810	-830	imp:n=1	\$
70	20	3.9827e-2	170	-171	520	-531	810	-830	imp:n=1	\$
80	20	3.9827e-2	170	-171	470	-481	810	-830	imp:n=1	\$
90	20	3.9827e-2	180	-181	470	-531	810	-830	imp:n=1	\$
00	20	3.9827e-2	161	-170	530	-531	810	-830	imp:n=1	\$
10	20	3.9827e-2	171	-180	530	-531	810	-830	imp:n=1	\$
20	20	3.9827e-2	161	-170	520	-521	810	-830	imp:n=1	\$
30	20	3.9827e-2	171	-180	520	-521	810	-830	imp:n=1	\$
40	20	3.9827e-2	161	-170	480	-481	810	-830	imp:n=1	\$
50	20	3.9827e-2	171	-180	480	-481	810	-830	imp:n=1	\$
60	20	3.9827e-2	161	-170	470	-471	810	-830	imp:n=1	\$
70	20	3.9827e-2	171	-180	470	-471	810	-830	imp:n=1	\$
80	20	3.9827e-2	190	-191	400	-451	810	-830	imp:n=1	\$
90	20	3.9827e-2	200	-201	400	-451	810	-830	imp:n=1	\$
000	20	3.9827e-2	191	-200	450	-451	810	-830	imp:n=1	\$
010	20	3.9827e-2	191	-200	400	-401	810	-830	imp:n=1	\$
020	20	3.9827e-2	210	-211	420	-491	810	-830	imp:n=1	\$
030	20	3.9827e-2	230	-231	420	-491	810	-830	imp:n=1	\$
040	20	3.9827e-2	211	-230	490	-491	810	-830	imp:n=1	\$
050	20	3.9827e-2	211	-230	420	-421	810	-830	imp:n=1	\$
060	20	3.9827e-2	240	-241	398	-401	810	-830	imp:n=1	\$
070	20	3.9827e-2	250	-251	398	-401	810	-830	imp:n=1	\$
080	20	3.9827e-2	241	-250	400	-401	810	-830	imp:n=1	\$
090	20	3.9827e-2	241	-250	398	-399	810	-830	imp:n=1	\$
092	20	3.9827e-2	110	-111	540	-601	810	-830	imp:n=1	\$
093	20	3.9827e-2	130	-131	540	-601	810	-830	imp:n=1	\$
094	20	3.9827e-2	111	-130	600	-601	810	-830	imp:n=1	\$
095	20	3.9827e-2	111	-130	590	-591	810	-830	imp:n=1	\$
096	20	3.9827e-2	111	-130	570	-571	810	-830	imp:n=1	\$
097	20	3.9827e-2	111	-130	560	-561	810	-830	imp:n=1	\$

098 20 3.9827e-2 111 -130 540 -541 810 -830 imp:n=1 \$

steel walls

100 30 8.7411e-2 1 -2 397 -611 810 -860 imp:n=1 \$
110 30 8.7411e-2 251 -252 397 -611 810 -860 imp:n=1 \$
120 30 8.7411e-2 2 -251 397 -398 810 -860 imp:n=1 \$
130 30 8.7411e-2 2 -251 610 -611 810 -860 imp:n=1 \$

sub-structure roofs

300 30 8.7411e-2 (20 -51 430 -461 830 -840):
(20 -41 410 -430 830 -840) imp:n=1 \$
310 30 8.7411e-2 (60 -81 470 -521 830 -840):
(70 -81 521 -531 830 -840) imp:n=1 \$
320 30 8.7411e-2 90 -101 500 -511 830 -840 imp:n=1 \$
330 30 8.7411e-2 120 -151 410 -501 830 -840 imp:n=1 \$
340 30 8.7411e-2 160 -181 470 -531 830 -840 imp:n=1 \$
350 30 8.7411e-2 190 -201 400 -451 830 -840 imp:n=1 \$
360 30 8.7411e-2 210 -231 420 -491 830 -840 imp:n=1 \$
370 30 8.7411e-2 240 -251 398 -401 830 -840 imp:n=1 \$
380 30 8.7411e-2 110 -131 540 -601 830 -840 imp:n=1 \$

concrete floor and ceiling

400 20 7.9654e-2 800 -810 -9998 imp:n=1 \$ this is the giant concrete floor
410 20 7.9654e-2 2 -251 398 -610 850 -860 imp:n=1 \$ conc. process cell floor

drum areas

500 40 -0.375 1050 -1060 550 -1030 810 -820 imp:n=1 \$ Drum area A
510 40 -0.375 1070 -190 550 -1030 810 -820 imp:n=1 \$ Drum area B
520 40 -0.375 1080 -220 1020 -1030 810 -820 imp:n=1 \$ Drum area C
530 40 -0.375 1090 -230 550 -1030 810 -820 imp:n=1 \$ Drum area D
540 40 -0.375 220 -1090 1000 -520 810 -820 imp:n=1 \$ Drum area E
550 40 -0.375 210 -1080 1000 -1010 810 -820 imp:n=1 \$ Drum area F
560 40 -0.375 1100 -1110 440 -1040 810 -820 imp:n=1 \$ Drum area G
600 10 4.354e-5 (-1:-397:252:611:860) -9998 810 imp:n=1 \$ air outside building

air in building

700 10 4.354e-5 (-10:15:-520:531:830)
(-53:54:-520:531:830)
(-20:41:-410:461:840)
(-41:51:-430:461:840)
(-55:56:-520:531:830)
(-60:81:-470:521:840)
(-70:81:-521:531:840)
(-85:88:-520:531:830)
(2 -90 398 -610 810 -850) 4040 4030 fill=1 imp:n=1 \$ air 1
710 10 4.354e-5 (-90:101:-500:511:840)
(-100:105:-520:531:830)

```

(-120:151:-410:501:840)
(-145:150:-520:531:830)
(-153:154:-520:531:830)
(-110:131:-540:601:840)
(90 -155 398 -610 810 -850) 4020 fill=1 imp:n=1 $ air 2

```

```

720 10 4.354e-5 (-155:156:-520:531:830)
(-160:181:-470:531:840)
(-185:188:-520:531:830)
(-1050:1060:-550:1030:820)
(-1070:190:-550:1030:820)
(-190:201:-400:451:840)
(-195:200:-520:531:830)
(155 -210 398 -610 810 -850) 4010 fill=1 imp:n=1 $ air 3
730 10 4.354e-5 (-210:1080:-1000:1010:820)
(-1080:220:-1020:1030:820)
(-220:1090:-1000:520:820)
(-1090:230:-550:1030:820)
(-210:231:-420:491:840)
(-235:240:-520:531:830)
(-1100:1110:-440:1040:820)
(-240:401:840)
(210 -251 398 -610 810 -850) 4000 fill=1 imp:n=1 $ air 4

```

repeating structures cells

```

800 30 8.7411e-2 (2000 -2010 2040 -2070):
(2010 -2020 2050 -2060):
(2020 -2030 2040 -2070) u=2 imp:n=1 $ I beam
810 10 4.354e-5 (2010 -2020 2040 -2050):
(2010 -2020 2060 -2070):
(-2000:2030:-2040:2070) u=2 imp:n=1 $ air around I beam
820 0 -3010 3000 -3030 3020 -3050 3040
u=1 lat=1 imp:n=1 fill=0:99 0:40 0:0
2 4099r $ lattice of cells

```

detector cells

```

900 10 4.354e-5 -4000 imp:n=1 $ det. col. 87-DD
910 10 4.354e-5 -4010 imp:n=1 $ det. col. 65-Q
920 10 4.354e-5 -4020 imp:n=1 $ det. col. 40-AA
930 10 4.354e-5 -4030 imp:n=1 $ det. col. 30-S
940 10 4.354e-5 -4040 imp:n=1 $ det. col. 7-AA

```

internal and external world

```

0000 0 (9998 -9999):(-9998 -800) imp:n=1 $ internal world
0010 0 9999 imp:n=0 $ external world

```

```

*****
surface cards
*****

```

```

px 0 $
px 0.191 $
px 1752 $
px 2134 $
px 4450 $
px 4470 $
px 5212 $

```

1	px	5232	\$
0	px	6584	\$
1	px	6604	\$
0	px	7346	\$
1	px	7366	\$
3	px	7498	\$
4	px	8108	\$
5	px	13472	\$
6	px	14082	\$
0	px	16398	\$
1	px	16418	\$
0	px	17160	\$
1	px	17180	\$
0	px	17922	\$
1	px	17942	\$
5	px	19446	\$
8	px	20056	\$
0	px	24506	\$
1	px	24526	\$
00	px	25400	\$
01	px	25420	\$
05	px	26030	\$
10	px	28346	\$
11	px	28366	\$
20	px	29108	\$
21	px	29128	\$
30	px	29870	\$
31	px	29890	\$
40	px	31242	\$
41	px	31262	\$
45	px	31394	\$
50	px	32004	\$
51	px	32024	\$
53	px	37368	\$
54	px	37978	\$
55	px	43343	\$
56	px	43953	\$
60	px	46269	\$
61	px	46289	\$
70	px	47031	\$
71	px	47051	\$
80	px	47793	\$
81	px	47813	\$
85	px	49317	\$
88	px	49927	\$
90	px	54376	\$
91	px	54396	\$
95	px	55290	\$
00	px	55900	\$
01	px	55920	\$
10	px	58217	\$
11	px	58237	\$
20	px	59741	\$
c 221	px	59761	\$
230	px	61112	\$
231	px	61132	\$
235	px	61264	\$
240	px	61874	\$
241	px	61894	\$
250	px	66304	\$

1	px	66324	\$
2	px	66324.191	\$
7	py	0	\$
8	py	0.191	\$
9	py	20	\$
0	py	1280	\$
1	py	1300	\$
0	py	2012	\$
1	py	2032	\$
0	py	2682	\$
1	py	2702	\$
0	py	3353	\$
1	py	3373	\$
0	py	4023	\$
1	py	4043	\$
0	py	5364	\$
1	py	5384	\$
0	py	5700	\$
1	py	5720	\$
0	py	6035	\$
1	py	6055	\$
0	py	6706	\$
1	py	6726	\$
0	py	7376	\$
1	py	7396	\$
0	py	8717	\$
1	py	8737	\$
0	py	9388	\$
1	py	9408	\$
20	py	10058	\$
21	py	10078	\$
30	py	10729	\$
31	py	10749	\$
40	py	12405	\$
41	py	12425	\$
50	py	12741	\$
551	py	12761	\$
60	py	13411	\$
61	py	13431	\$
70	py	14082	\$
71	py	14102	\$
580	py	14752	\$
581	py	14772	\$
90	py	15423	\$
91	py	15443	\$
00	py	16764	\$
01	py	16784	\$
10	py	19507	\$
11	py	19507.191	\$
00	pz	-3000	\$
10	pz	0	\$
20	pz	197	\$ top of drums
30	pz	305	\$ top of rooms
40	pz	305.09	\$ top of roof on rooms
50	pz	610	\$ top of first floor
60	pz	686	\$ process cell floor

here are drum area surfaces

000	py	8046	\$
-----	----	------	----

```

010 py 11400      $
020 py 12070      $
030 py 17435      $
040 py 18105      $
050 px 52242      $
060 px 53004      $
070 px 53766      $
080 px 58979      $
090 px 60351      $
100 px 64190      $
110 px 65714      $

```

repeating structures surfaces

```

000 px -0.01      $
010 px 0.847      $
020 px 29.633     $
030 px 30.48      $
040 py -0.01      $
050 py 7.1965     $
060 py 8.0435     $
070 py 15.24      $
000 px -0.001     $
010 px 745.22     $
020 py -0.001     $
030 py 629.26     $
040 pz -0.01      $
050 pz 611        $

```

detector planes

```

000 s 64190 1351 100 50 $ det. col. 87-DD
010 s 47864 10058 100 50 $ det. col. 65-Q
020 s 29057 3353 100 50 $ det. col. 40-AA
030 s 21610 8717 100 50 $ det. col. 30-S
040 s 4399 3353 100 50 $ det. col. 7-AA

```

internal & external world planes

```

998 so 800000    $ internal world
999 so 1000000   $ external world

```

source term

```

sdef sur=9998 nrm=-1 dir=d1
sbl -21 2

```

```

def pos=38740 4694 1 erg=d1
cl from h/u=15 5% enrichment normalized to 2881 W
ii h 1.00e-11 1.00e-8 3.00e-8 5.00e-8 1.00e-7 2.25e-7
      3.25e-7 4.00e-7 8.00e-7 1.00e-6 1.13e-6 1.3e-6
      1.77e-6 3.05e-6 1.00e-5 3.00e-5 1.00e-4 5.5e-4
      0.003 0.017 0.1 0.4 0.9 1.4
      1.85 3.0 6.43 20
spl d 0 1.46e+2 8.00e+2 9.71e+2 1.50e+3 1.04e+3
      3.00e+2 1.62e+2 5.54e+2 1.74e+2 8.59e+1 1.04e+2

```


2.53e+2	4.73e+2	9.48e+2	1.03e+3	1.18e+3	1.68e+3
1.82e+3	2.18e+3	2.96e+3	4.36e+3	5.07e+3	3.40e+3
2.72e+3	5.56e+3	4.90e+3	6.11e+2		

material cards

10	7014.50c	3.570e-5	
	8016.50c	7.840e-6	\$ air
20	1001.50c	1.487e-2	
	6012.50c	3.814e-3	
	8016.50c	4.152e-2	
	11023.50c	3.040e-4	
	12000.51c	5.870e-4	
	13027.50c	7.350e-4	
	14000.50c	6.037e-3	
	20000.51c	1.159e-2	
	26000.50c	1.968e-4	\$ concrete
30	6012.50c	3.921e-3	
	26000.50c	8.349e-2	\$ steel
40	6012.50c	6.0	
	1001.50c	10.0	
	8016.50c	5.0	\$ wood
60	92238.50c	8.682e-3	
	9019.50c	5.209e-2	\$ UF6
70	1001.50c	2.0	
	8016.50c	1.5	\$ water

tally cards

c4	track det 1. on col 87-DD					
4:n	1900					
c14	track det 2 on col. 65-Q					
14:n	1910					
c24	track det 3 on col. 40-AA					
24:n	1920					
c34	track det 4 on col. 30-S					
34:n	1930					
c44	track det 5 on col. 7-AA					
44:n	1940					
c5	point det 1. on col 87-DD					
5:n	64190	1351	100	50		
c15	point det 2 on col. 65-Q					
15:n	47864	10058	100	50		
c25	point det 3 on col. 40-AA					
25:n	29057	3353	100	50		
c35	point det 4 on col. 30-S					
35:n	21610	8717	100	50		
c45	point det 5 on col. 7-AA					
45:n	4399	3353	100	50		
e0	1.00e-11	1.00e-8	3.00e-8	5.00e-8	1.00e-7	2.25e-7
	3.25e-7	4.00e-7	8.00e-7	1.00e-6	1.13e-6	1.3e-6

1.77e-6	3.05e-6	1.00e-5	3.00e-5	1.00e-4	5.5e-4
0.003	0.017	0.1	0.4	0.9	1.4
1.85	3.0	6.43	20		

peripheral cards

ode n
17 keV cut off
ut:n j 0.017
me 540
void
bs 50000000
rdmp 3j 4
dbcn 31277116122605
rint

this is a model of the first floor of the x326 process building

cell cards

air in rooms

10 4.354e-5 15 -30 797 -798 820 -840 900 imp:n=1 \$

10 4.354e-5 62 -80 752 -760 820 -840 imp:n=1 \$

10 4.354e-5 62 -80 722 -750 820 -840):

10 4.354e-5 72 -80 702 -720 820 -840 imp:n=1 \$

10 4.354e-5 202 -210 732 -740 820 -840 imp:n=1 \$

10 4.354e-5 202 -230 732 -740 820 -840 imp:n=1 \$

10 4.354e-5 202 -240 722 -730 820 -840 imp:n=1 \$

10 4.354e-5 202 -240 692 -720 820 -840 imp:n=1 \$

10 4.354e-5 202 -240 682 -690 820 -840 imp:n=1 \$

10 4.354e-5 272 -290 752 -760 820 -840 imp:n=1 \$

10 4.354e-5 272 -290 722 -750 820 -840):

10 4.354e-5 (272 -280 702 -722 820 -840) imp:n=1 \$

10 4.354e-5 282 -290 702 -720 820 -840 imp:n=1 \$

10 4.354e-5 (342 -350 782 -790 820 -840):

10 4.354e-5 (350 -352 785 -790 820 -840):

10 4.354e-5 (352 -360 782 -790 820 -840) imp:n=1 \$

10 4.354e-5 342 -350 772 -780 820 -840 imp:n=1 \$

10 4.354e-5 (352 -362 772 -780 820 -840):

10 4.354e-5 (362 -370 772 -790 820 -840) imp:n=1 \$

10 4.354e-5 402 -430 752 -760 820 -840 imp:n=1 \$

10 4.354e-5 (402 -430 722 -750 820 -840):

10 4.354e-5 (402 -420 702 -722 820 -840):

10 4.354e-5 (402 -410 692 -702 820 -840) imp:n=1 \$

10 4.354e-5 422 -430 702 -720 820 -840 imp:n=1 \$

10 4.354e-5 (472 -490 642 -650 820 -840):

10 4.354e-5 (482 -490 650 -660 820 -840) imp:n=1 \$

10 4.354e-5 492 -500 642 -670 820 -840 imp:n=1 \$

10 4.354e-5 472 -480 632 -640 820 -840 imp:n=1 \$

10 4.354e-5 462 -470 602 -620 820 -840):

battery rooms

50 70 -1.0 20 -30 710 -720 820 -850 imp:n=1 \$ battery room
60 70 -1.0 40 -50 710 -720 820 -850 imp:n=1 \$ battery room
70 70 -1.0 90 -100 710 -720 820 -850 imp:n=1 \$ battery room
80 70 -1.0 160 -170 710 -720 820 -850 imp:n=1 \$ battery room
90 70 -1.0 180 -190 710 -720 820 -850 imp:n=1 \$ battery room
100 70 -1.0 250 -260 710 -720 820 -850 imp:n=1 \$ battery room
110 70 -1.0 300 -310 710 -720 820 -850 imp:n=1 \$ battery room
120 70 -1.0 320 -330 710 -720 820 -850 imp:n=1 \$ battery room
130 70 -1.0 380 -390 710 -720 820 -850 imp:n=1 \$ battery room
140 70 -1.0 440 -450 710 -720 820 -850 imp:n=1 \$ battery room

here are the PCB storage lots

50 40 -0.375 120 -130 680 -760 820 -830 imp:n=1 \$
 60 40 -0.375 (120 -130 765 -783 820 -830):
 (130 -150 770 -783 820 -830) imp:n=1 \$
 70 40 -0.375 110 -140 790 -795 820 -830 imp:n=1 \$

here are the concrete walls

80 20 3.9827e-2 14 -15 797 -798 820 -840 imp:n=1 \$
 85 20 3.9827e-2 14 -32 798 -800 820 -840 imp:n=1 \$
 90 20 3.9827e-2 30 -32 797 -798 820 -840 imp:n=1 \$
 95 20 3.9827e-2 14 -32 795 -797 820 -840 imp:n=1 \$
 00 20 3.9827e-2 60 -82 760 -762 820 -840 imp:n=1 \$
 10 20 3.9827e-2 60 -82 750 -752 820 -840 imp:n=1 \$
 20 20 3.9827e-2 70 -82 720 -722 820 -840 imp:n=1 \$
 30 20 3.9827e-2 60 -82 700 -702 820 -840 imp:n=1 \$
 40 20 3.9827e-2 60 -62 702 -750 820 -840 imp:n=1 \$
 50 20 3.9827e-2 60 -62 752 -760 820 -840 imp:n=1 \$
 60 20 3.9827e-2 80 -82 752 -760 820 -840 imp:n=1 \$
 70 20 3.9827e-2 80 -82 722 -750 820 -840 imp:n=1 \$
 80 20 3.9827e-2 80 -82 702 -720 820 -840 imp:n=1 \$
 90 20 3.9827e-2 70 -72 702 -720 820 -840 imp:n=1 \$
 00 20 3.9827e-2 200 -232 740 -742 820 -840 imp:n=1 \$
 10 20 3.9827e-2 200 -242 730 -732 820 -840 imp:n=1 \$
 20 20 3.9827e-2 200 -242 720 -722 820 -840 imp:n=1 \$
 30 20 3.9827e-2 200 -242 690 -692 820 -840 imp:n=1 \$
 40 20 3.9827e-2 200 -242 680 -682 820 -840 imp:n=1 \$
 50 20 3.9827e-2 200 -202 682 -690 820 -840 imp:n=1 \$
 60 20 3.9827e-2 200 -202 692 -720 820 -840 imp:n=1 \$
 70 20 3.9827e-2 200 -202 722 -730 820 -840 imp:n=1 \$
 80 20 3.9827e-2 200 -202 732 -740 820 -840 imp:n=1 \$
 90 20 3.9827e-2 210 -212 732 -740 820 -840 imp:n=1 \$
 00 20 3.9827e-2 220 -222 732 -740 820 -840 imp:n=1 \$
 10 20 3.9827e-2 230 -232 732 -740 820 -840 imp:n=1 \$
 20 20 3.9827e-2 240 -242 722 -730 820 -840 imp:n=1 \$
 30 20 3.9827e-2 240 -242 692 -720 820 -840 imp:n=1 \$
 40 20 3.9827e-2 240 -242 682 -690 820 -840 imp:n=1 \$
 50 20 3.9827e-2 270 -292 760 -762 820 -840 imp:n=1 \$
 60 20 3.9827e-2 270 -292 750 -752 820 -840 imp:n=1 \$
 70 20 3.9827e-2 280 -292 720 -722 820 -840 imp:n=1 \$
 80 20 3.9827e-2 270 -292 700 -702 820 -840 imp:n=1 \$
 90 20 3.9827e-2 270 -272 752 -760 820 -840 imp:n=1 \$
 00 20 3.9827e-2 290 -292 752 -760 820 -840 imp:n=1 \$
 10 20 3.9827e-2 290 -292 722 -750 820 -840 imp:n=1 \$
 20 20 3.9827e-2 290 -292 702 -720 820 -840 imp:n=1 \$
 30 20 3.9827e-2 280 -282 702 -720 820 -840 imp:n=1 \$
 40 20 3.9827e-2 270 -272 702 -750 820 -840 imp:n=1 \$
 50 20 3.9827e-2 340 -372 790 -792 820 -840 imp:n=1 \$
 60 20 3.9827e-2 340 -362 780 -782 820 -840 imp:n=1 \$
 70 20 3.9827e-2 340 -372 770 -772 820 -840 imp:n=1 \$
 80 20 3.9827e-2 340 -342 782 -790 820 -840 imp:n=1 \$
 90 20 3.9827e-2 350 -352 782 -785 820 -840 imp:n=1 \$
 00 20 3.9827e-2 360 -362 782 -790 820 -840 imp:n=1 \$
 10 20 3.9827e-2 370 -372 772 -790 820 -840 imp:n=1 \$
 20 20 3.9827e-2 350 -352 772 -780 820 -840 imp:n=1 \$
 30 20 3.9827e-2 340 -342 772 -780 820 -840 imp:n=1 \$
 40 20 3.9827e-2 400 -432 760 -762 820 -840 imp:n=1 \$
 50 20 3.9827e-2 400 -432 750 -752 820 -840 imp:n=1 \$
 60 20 3.9827e-2 420 -432 720 -722 820 -840 imp:n=1 \$
 70 20 3.9827e-2 410 -432 700 -702 820 -840 imp:n=1 \$


```

      (-14:32:-795:800:-820:850)) 910
      fill=1 imp:n=1 $ air 1
360 10 4.354e-5 ((110 -190 600 -800 820 -860)
      (-120:130:-680:760:-820:830)
      (-120:130:-765:783:-820:830)
      (-130:150:-770:783:-820:830)
      (-110:140:-790:795:-820:830)
      (-160:170:-710:720:-820:850)
      (-180:190:-710:720:-820:850)
      fill=1 imp:n=1 $ air 2
370 10 4.354e-5 ((190 -310 600 -800 820 -860)
      (-200:242:-680:732:-820:850)
      (-200:232:-732:742:-820:850)
      (-270:292:-700:762:-820:850)
      (-250:260:-710:720:-820:850)
      (-300:310:-710:720:-820:850)) 920
      fill=1 imp:n=1 $ air 3
380 10 4.354e-5 ((310 -440 600 -800 820 -860)
      (-320:330:-710:720:-820:850)
      (-380:390:-710:720:-820:850)
      (-340:372:-770:792:-820:850)
      (-400:432:-700:762:-820:850)
      (-400:412:-690:700:-820:850)) 930
      fill=1 imp:n=1 $ air 4
390 10 4.354e-5 ((440 -502 600 -800 820 -860)
      (-440:450:-710:720:-820:850)
      (-490:502:-662:672:-820:850)
      (-480:502:-652:662:-820:850)
      (-470:502:-632:652:-820:850)
      (-460:502:-600:632:-820:850)
      fill=1 imp:n=1 $ air 5
400 20 7.9654e-2 12 -502 600 -800 860 -870 imp:n=1 $ concrete roof
500 10 4.354e-5 ((-10:504:-598:802:870) 820) -1998 imp:n=1 $ air around building
600 10 4.354e-5 -900 imp:n=1 $ det. 5-A
610 10 4.354e-5 -910 imp:n=1 $ det. 23-H
620 10 4.354e-5 -920 imp:n=1 $ det. 63-H
630 10 4.354e-5 -930 imp:n=1 $ det. 93-H
640 10 4.354e-5 -940 imp:n=1 $ det. 101-W
700 20 7.9654e-2 810 -820 -1998 imp:n=1 $ concrete ground

repeating structures cells
800 30 8.7411e-2 (2000 -2010 2040 -2070):
      (2010 -2020 2050 -2060):
      (2020 -2030 2040 -2070) u=2 imp:n=1 $ I beam
810 10 4.354e-5 (2010 -2020 2040 -2050):
      (2010 -2020 2060 -2070):
      (-2000:2030:-2040:2070) u=2 imp:n=1 $ air around I beam
820 0 -3010 3000 -3030 3020 -3050 3040
      u=1 lat=1 imp:n=1 fill=0:104 0:24 0:0
      2 2624r $ lattice of cells

2000 0 (-1998 -810):(1998 -1999) imp:n=1 $ internal world
2010 0 1999 imp:n=0 $ external world

```

surface cards

0	px	0	\$
2	px	0.191	\$
4	px	2012	\$
5	px	2032	\$
0	px	2713	\$
0	px	3414	\$
2	px	3434	\$
0	px	9601	\$
0	px	10302	\$
0	px	13076	\$
2	px	13096	\$
0	px	14387	\$
2	px	14407	\$
0	px	15088	\$
2	px	15108	\$
0	px	16490	\$
00	px	17191	\$
10	px	19263	\$
20	px	20665	\$
30	px	21275	\$
40	px	21796	\$
50	px	22677	\$
60	px	23378	\$
70	px	24079	\$
80	px	30267	\$
90	px	30968	\$
00	px	33741	\$
02	px	33761	\$
10	px	33985	\$
12	px	34005	\$
20	px	34442	\$
22	px	34462	\$
30	px	35052	\$
32	px	35072	\$
40	px	35753	\$
42	px	35773	\$
50	px	37155	\$
60	px	37856	\$
70	px	40630	\$
72	px	40650	\$
80	px	41940	\$
82	px	41960	\$
90	px	42642	\$
92	px	42662	\$
00	px	44044	\$
10	px	44745	\$
20	px	50932	\$
30	px	51633	\$
40	px	53706	\$
42	px	53726	\$
50	px	54407	\$
52	px	54427	\$
60	px	55108	\$
62	px	55128	\$
70	px	55717	\$
72	px	55737	\$
80	px	57821	\$

```

pl d 0      1.04e+2  5.67e+2  7.14e+2  1.28e+3  1.29e+3
      4.84e+2  2.74e+2  9.66e+2  3.17e+2  1.68e+2  1.92e+2
      4.79e+2  7.91e+2  1.79e+3  1.71e+3  2.09e+3  3.21e+3
      3.52e+3  3.99e+3  5.83e+3  8.89e+3  1.03e+4  7.25e+3
      5.88e+3  1.13e+4  1.02e+4  1.28e+3

```

material cards

```

10  7014.50c  3.570e-5
    8016.50c  7.840e-6  $ air
20  1001.50c  1.487e-2
    6012.50c  3.814e-3
    8016.50c  4.152e-2
    11023.50c 3.040e-4
    12000.51c 5.870e-4
    13027.50c 7.350e-4
    14000.50c 6.037e-3
    20000.51c 1.159e-2
    26000.50c 1.968e-4  $ concrete
30  6012.50c  3.921e-3
    26000.50c 8.349e-2  $ steel
40  6012.50c  6.0
    1001.50c  10.0
    8016.50c  5.0      $ wood
70  1001.50c  2.0
    8016.50c  1.5      $ water

```

tally cards

```

c4  track det 1. on col 5-A
4:n  1600
c14 track det 2 on col. 23-H
14:n  1610
c24 track det 3 on col. 63-H
24:n  1620
c34 track det 4 on col. 93-H
34:n  1630
c44 track det 5 on col. 101-W
44:n  1640
c5  point det 1. on col 5-A
5:n  2713.1 16022.1 100 50
c15 point det 2 on col. 23-H
15:n  15088.1 11044.1 100 50
25c point det 3 on col. 63-H
25:n  42642.1 11044.1 100 50
35c point det 4 on col. 93-H
35:n  63304.1 11044.1 100 50
45c point det 5 on col. 101-W
45:n  68885.1 1463.1 100 50
0  1.00e-11 1.00e-8 3.00e-8 5.00e-8 1.00e-7 2.25e-7
   3.25e-7 4.00e-7 8.00e-7 1.00e-6 1.13e-6 1.3e-6

```



```

82 py 13553 $
83 py 13899 $
85 py 14265 $
90 py 14630 $
92 py 14650 $
95 py 15362 $
97 py 15382 $
98 py 16073 $
00 py 16093 $
02 py 16093.191 $
10 pz -3000 $ bottom of earth
20 pz 0 $ floor
30 pz 197 $ top of drums
40 pz 305 $ top of rooms
50 pz 305.09 $ top of roof on rooms
60 pz 610 $ top of first floor
70 pz 686 $ process cell floor
00 s 2713.1 16022.1 100 50 $ det. col.5-A
10 s 15088.1 11044.1 100 50 $ det. col 23-H
20 s 42642.1 11044.1 100 50 $ det. col 63-H
30 s 63304.1 11044.1 100 50 $ det. col 93-H
40 s 68885.1 1463.1 100 50 $ det. col 101-W
998 so 800000 $
999 so 1000000 $

```

repeating structures surfaces

```

000 px -0.01 $
010 px 0.847 $
020 px 29.633 $
030 px 30.48 $
040 py -0.01 $
050 py 7.1965 $
060 py 8.0435 $
070 py 15.24 $
000 px -0.001 $
010 px 688.06 $
020 py -0.001 $
030 py 764.77 $
040 pz -0.01 $
050 pz 611 $

```

source term

```

sdef sur=1998 nrm=-1 dir=d1
sbl -21 2

```

```

sdef pos=54405.9 14651.1 1 erg=d1
scl from h/u=120 100% enrichment normalized to 1281 W
sil h 1.00e-11 1.00e-8 3.00e-8 5.00e-8 1.00e-7 2.25e-7
      3.25e-7 4.00e-7 8.00e-7 1.00e-6 1.13e-6 1.3e-6
      1.77e-6 3.05e-6 1.00e-5 3.00e-5 1.00e-4 5.5e-4
      0.003 0.017 0.1 0.4 0.9 1.4
      1.85 3.0 6.43 20

```

90	px	58522	\$
00	px	61295	\$
02	px	61315	\$
10	px	61998	\$
12	px	62018	\$
20	px	62606	\$
22	px	62626	\$
30	px	63304	\$
32	px	63324	\$
40	px	64709	\$
50	px	65410	\$
60	px	67483	\$
62	px	67503	\$
70	px	68184	\$
72	px	68204	\$
80	px	68489	\$
82	px	68509	\$
90	px	68885	\$
92	px	68905	\$
000	px	69474	\$
002	px	69494	\$
004	px	69494.191	\$
098	py	-0.191	\$
000	py	0	\$
002	py	20	\$
010	py	244	\$
012	py	264	\$
020	py	488	\$
022	py	508	\$
030	py	732	\$
032	py	752	\$
040	py	2195	\$
042	py	2215	\$
050	py	2926	\$
052	py	2946	\$
060	py	3658	\$
062	py	3678	\$
070	py	4023	\$
072	py	4043	\$
080	py	4389	\$
082	py	4409	\$
090	py	5852	\$
092	py	5872	\$
100	py	6584	\$
102	py	6604	\$
110	py	6949	\$
120	py	7315	\$
122	py	7335	\$
130	py	8047	\$
132	py	8067	\$
140	py	8778	\$
142	py	8798	\$
150	py	10241	\$
152	py	10261	\$
160	py	10973	\$
162	py	10993	\$
165	py	12435	\$
170	py	13167	\$
172	py	13187	\$
180	py	13533	\$

1.77e-6	3.05e-6	1.00e-5	3.00e-5	1.00e-4	5.5e-4
0.003	0.017	0.1	0.4	0.9	1.4
1.85	3.0	6.43	20		

peripheral cards

ode n
17 keV cut off
ut:n j 0.017
tme 1440
void
ps 50000000
rdmp 3j 4
dbcn 31277116122605
rint

APPENDIX B

ABSORBED DOSE RATE CALCULATION SPREADSHEETS

Final Report

January 1996

*Examination of Criticality Accident Alarm Coverage on the Operating
Floors of the X-333, X-330, and X-326 Facilities at the
Portsmouth Gaseous Diffusion Plant*

No spreadsheet was required for X-333-1 because no calculations were performed.

Final Report

January 1996

*Examination of Criticality Accident Alarm Coverage on the Operating
Floors of the X-333, X-330, and X-326 Facilities at the
Portsmouth Gaseous Diffusion Plant*

Detector Response for the X-333 Process Building						
The source is located in the northeast corner of the X-333 Process Building						
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm ²))	Tally 5 Detector SE-1 Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
Source Rate (n/s)	1.00E-11		0.00E+00	0		
6.52E+13	1.00E-08	6.03E-17	0.00E+00	0	0	0
5% U-235	3.00E-08	2.46E-16	0.00E+00	0	0	0
P = 2881 W	5.00E-08	3.69E-16	0.00E+00	0	0	0
	1.00E-07	6.52E-16	0.00E+00	0	0	0
	2.25E-07	1.40E-15	0.00E+00	0	0	0
	3.25E-07	2.54E-15	0.00E+00	0	0	0
	4.00E-07	3.37E-15	0.00E+00	0	0	0
	8.00E-07	5.39E-15	0.00E+00	0	0	0
	1.00E-06	8.37E-15	0.00E+00	0	0	0
	1.13E-06	9.93E-15	0.00E+00	0	0	0
	1.30E-06	1.13E-14	0.00E+00	0	0	0
	1.77E-06	1.42E-14	0.00E+00	0	0	0
	3.05E-06	2.20E-14	0.00E+00	0	0	0
	1.00E-05	5.46E-14	0.00E+00	0	0	0
	3.00E-05	1.70E-13	0.00E+00	0	0	0
	1.00E-04	5.43E-13	0.00E+00	0	0	0
	5.50E-04	2.46E-12	0.00E+00	0	0	0
	3.00E-03	1.35E-11	0.00E+00	0	0	0
	1.70E-02	7.20E-11	0.00E+00	0	0	0
	1.00E-01	3.12E-10	6.03E-14	0.444	1.22524E-09	5.44E-10
	4.00E-01	1.08E-09	5.41E-14	0.3359	3.80621E-09	1.28E-09
	9.00E-01	1.79E-09	8.31E-14	0.6606	9.68814E-09	6.4E-09
	1.40E+00	2.44E-09	3.53E-14	0.4642	5.60809E-09	2.6E-09
	1.85E+00	2.79E-09	3.05E-14	0.5469	5.54344E-09	3.03E-09
	3.00E+00	3.22E-09	3.61E-14	0.3596	7.58191E-09	2.73E-09
	6.43E+00	4.18E-09	2.98E-14	0.3916	8.10852E-09	3.18E-09
	2.00E+01	4.72E-09	2.16E-15	0.714	6.6447E-10	4.74E-10
				Total AD (rad/s) =	4.2226E-08	8.75E-09
				Total AD (mrad/hr) =	0.152013661	0.031508

Tally 15 Detector 33-LS-1				Tally 25 Detector 1-G			
Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error	Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
0.00E+00	0			0.00E+00	0		
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0						

Detector Response for the X-330 Process Building (Operating Floor)						
The source is located near column 87-DD on the operating floor.						
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm^2))	Detector T (87-DD) Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
Source Rate (n/s)	1.00E-11			0		
6.52E+13	1.00E-08	6.03E-17		0	0	0
5% U-235	3.00E-08	2.46E-16		0	0	0
P = 2881 W	5.00E-08	3.69E-16		0	0	0
	1.00E-07	6.52E-16		0	0	0
	2.25E-07	1.40E-15		0	0	0
	3.25E-07	2.54E-15		0	0	0
	4.00E-07	3.37E-15		0	0	0
	8.00E-07	5.39E-15		0	0	0
	1.00E-06	8.37E-15		0	0	0
	1.13E-06	9.93E-15		0	0	0
	1.30E-06	1.13E-14		0	0	0
	1.77E-06	1.42E-14		0	0	0
	3.05E-06	2.20E-14		0	0	0
	1.00E-05	5.46E-14		0	0	0
	3.00E-05	1.70E-13		0	0	0
	1.00E-04	5.43E-13		0	0	0
	5.50E-04	2.46E-12		0	0	0
	3.00E-03	1.35E-11		0	0	0
	1.70E-02	7.20E-11			0	0
	1.00E-01	3.12E-10	3.02E-12	0.2443	6.13448E-08	1.49865E-08
	4.00E-01	1.08E-09	1.92E-12	0.0915	1.35137E-07	1.2365E-08
	9.00E-01	1.79E-09	3.53E-12	0.273	4.1179E-07	1.12419E-07
	1.40E+00	2.44E-09	1.33E-12	0.231	2.1149E-07	4.88541E-08
	1.85E+00	2.79E-09	6.14E-13	0.098	1.1164E-07	1.09407E-08
	3.00E+00	3.22E-09	9.99E-13	0.0776	2.09638E-07	1.62679E-08
	6.43E+00	4.18E-09	7.04E-13	0.072	1.91777E-07	1.38079E-08
	2.00E+01	4.72E-09	7.74E-14	0.103	2.38084E-08	2.45227E-09
				Total AD (rad/s)=	1.35662E-06	1.26425E-07
				Total AD (mrad/hr) =	4.883845744	0.455128395

[illegible]

[illegible]

Detector Response for the X-330 Process Building (Operating Floor)						
The source is located near column 87-DD on the operating floor. (inefa)						
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm^2))	Detector T (87-DD) Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
Source Rate (n/s)	1.00E-11			0		
6.52E+13	1.00E-08	6.03E-17		0	0	0
5% U-235	3.00E-08	2.46E-16		0	0	0
P = 2881 W	5.00E-08	3.69E-16		0	0	0
	1.00E-07	6.52E-16		0	0	0
	2.25E-07	1.40E-15		0	0	0
	3.25E-07	2.54E-15		0	0	0
	4.00E-07	3.37E-15		0	0	0
	8.00E-07	5.39E-15		0	0	0
	1.00E-06	8.37E-15		0	0	0
	1.13E-06	9.93E-15		0	0	0
	1.30E-06	1.13E-14		0	0	0
	1.77E-06	1.42E-14		0	0	0
	3.05E-06	2.20E-14		0	0	0
	1.00E-05	5.46E-14		0	0	0
	3.00E-05	1.70E-13		0	0	0
	1.00E-04	5.43E-13		0	0	0
	5.50E-04	2.46E-12		0	0	0
	3.00E-03	1.35E-11		0	0	0
	1.70E-02	7.20E-11		0	0	0
	1.00E-01	3.12E-10	9.83E-12	0.24	1.9987E-07	4.79689E-08
	4.00E-01	1.08E-09	1.22E-11	0.0746	8.56498E-07	6.38948E-08
	9.00E-01	1.79E-09	1.19E-11	0.0592	1.39162E-06	8.23837E-08
	1.40E+00	2.44E-09	6.09E-12	0.0639	9.67743E-07	6.18388E-08
	1.85E+00	2.79E-09	3.93E-12	0.0735	7.14397E-07	5.25082E-08
	3.00E+00	3.22E-09	7.36E-12	0.0684	1.54544E-06	1.05708E-07
	6.43E+00	4.18E-09	5.81E-12	0.1675	1.5818E-06	2.64952E-07
	2.00E+01	4.72E-09	4.67E-13	0.0676	1.43797E-07	9.72068E-09
				Total AD (rad/s)=	7.40116E-06	3.18151E-07
				Total AD (mrad/hr) =	26.64418014	1.145343503

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Detector Response for the X-330 Process Building (Operating Floor)						
The source is located near column 65-Q on the operating floor. (wwalla)						
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm ²))	Detector T (87-DD) Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
Source Rate (n/s)	1.00E-11			0		
6.52E+13	1.00E-08	6.03E-17		0	0	0
5% U-235	3.00E-08	2.46E-16		0	0	0
P = 2881 W	5.00E-08	3.69E-16		0	0	0
	1.00E-07	6.52E-16		0	0	0
	2.25E-07	1.40E-15		0	0	0
	3.25E-07	2.54E-15		0	0	0
	4.00E-07	3.37E-15		0	0	0
	8.00E-07	5.39E-15		0	0	0
	1.00E-06	8.37E-15		0	0	0
	1.13E-06	9.93E-15		0	0	0
	1.30E-06	1.13E-14		0	0	0
	1.77E-06	1.42E-14		0	0	0
	3.05E-06	2.20E-14		0	0	0
	1.00E-05	5.46E-14		0	0	0
	3.00E-05	1.70E-13		0	0	0
	1.00E-04	5.43E-13		0	0	0
	5.50E-04	2.46E-12		0	0	0
	3.00E-03	1.35E-11		0	0	0
	1.70E-02	7.20E-11		0	0	0
	1.00E-01	3.12E-10	6.08E-14	0.1774	1.23596E-09	2.19259E-10
	4.00E-01	1.08E-09	7.82E-14	0.2598	5.50369E-09	1.42986E-09
	9.00E-01	1.79E-09	9.00E-14	0.2408	1.05018E-08	2.52882E-09
	1.40E+00	2.44E-09	3.83E-14	0.2056	6.08777E-09	1.25165E-09
	1.85E+00	2.79E-09	3.28E-14	0.2409	5.96204E-09	1.43625E-09
	3.00E+00	3.22E-09	1.10E-13	0.282	2.3011E-08	6.48911E-09
	6.43E+00	4.18E-09	5.79E-14	0.4148	1.57657E-08	6.5396E-09
	2.00E+01	4.72E-09	1.37E-14	0.5881	4.22646E-09	2.48558E-09
				Total AD (rad/s)=	7.22944E-08	1.01573E-08
				Total AD (mrad/hr) =	0.260259776	0.036566156

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Detector Response for the X-330 Process Building (Operating Floor)						
The source is located near column 40-AA on the operating floor. (cont2)						
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm^2))	Detector T (87-DD) Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
Source Rate (n/s)	1.00E-11			0		
6.52E+13	1.00E-08	6.03E-17		0	0	0
5% U-235	3.00E-08	2.46E-16		0	0	0
P = 2881 W	5.00E-08	3.69E-16		0	0	0
	1.00E-07	6.52E-16		0	0	0
	2.25E-07	1.40E-15		0	0	0
	3.25E-07	2.54E-15		0	0	0
	4.00E-07	3.37E-15		0	0	0
	8.00E-07	5.39E-15		0	0	0
	1.00E-06	8.37E-15		0	0	0
	1.13E-06	9.93E-15		0	0	0
	1.30E-06	1.13E-14		0	0	0
	1.77E-06	1.42E-14		0	0	0
	3.05E-06	2.20E-14		0	0	0
	1.00E-05	5.46E-14		0	0	0
	3.00E-05	1.70E-13		0	0	0
	1.00E-04	5.43E-13		0	0	0
	5.50E-04	2.46E-12		0	0	0
	3.00E-03	1.35E-11		0	0	0
	1.70E-02	7.20E-11		0	0	0
	1.00E-01	3.12E-10	1.58E-13	0.5519	3.21179E-09	1.77259E-09
	4.00E-01	1.08E-09	3.45E-13	0.8738	2.43133E-08	2.1245E-08
	9.00E-01	1.79E-09	2.08E-13	0.5848	2.42497E-08	1.41813E-08
	1.40E+00	2.44E-09	1.29E-13	0.4331	2.05345E-08	8.89351E-09
	1.85E+00	2.79E-09	8.42E-14	0.25	1.5305E-08	3.82624E-09
	3.00E+00	3.22E-09	3.23E-13	0.1664	6.78535E-08	1.12908E-08
	6.43E+00	4.18E-09	2.74E-13	0.1429	7.45424E-08	1.06521E-08
	2.00E+01	4.72E-09	4.55E-14	0.0983	1.39859E-08	1.37481E-09
				Total AD (rad/s)=	2.43996E-07	3.14988E-08
				Total AD (mrad/hr) =	0.87838612	0.113395641

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Detector Response for the X-330 Process Building (Operating Floor)						
The source is located near column 30-S on the operating floor. (cont3)						
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm ²))	Detector T (87-DD) Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
Source Rate (n/s)	1.00E-11			0		
5.20E+13	1.00E-08	6.03E-17		0	0	0
20% U-235	3.00E-08	2.46E-16		0	0	0
P = 1722 W	5.00E-08	3.69E-16		0	0	0
	1.00E-07	6.52E-16		0	0	0
	2.25E-07	1.40E-15		0	0	0
	3.25E-07	2.54E-15		0	0	0
	4.00E-07	3.37E-15		0	0	0
	8.00E-07	5.39E-15		0	0	0
	1.00E-06	8.37E-15		0	0	0
	1.13E-06	9.93E-15		0	0	0
	1.30E-06	1.13E-14		0	0	0
	1.77E-06	1.42E-14		0	0	0
	3.05E-06	2.20E-14		0	0	0
	1.00E-05	5.46E-14		0	0	0
	3.00E-05	1.70E-13		0	0	0
	1.00E-04	5.43E-13		0	0	0
	5.50E-04	2.46E-12		0	0	0
	3.00E-03	1.35E-11		0	0	0
	1.70E-02	7.20E-11		0	0	0
	1.00E-01	3.12E-10	1.83E-15	0.9984	2.97398E-11	2.96922E-11
	4.00E-01	1.08E-09	1.58E-17	0.3682	8.89669E-13	3.27576E-13
	9.00E-01	1.79E-09	1.27E-15	0.6809	1.18641E-10	8.07825E-11
	1.40E+00	2.44E-09	5.89E-17	0.4059	7.4784E-12	3.03548E-12
	1.85E+00	2.79E-09	5.55E-17	0.2207	8.05213E-12	1.77711E-12
	3.00E+00	3.22E-09	2.89E-16	0.0628	4.84888E-11	3.0451E-12
	6.43E+00	4.18E-09	2.46E-16	0.1861	5.35918E-11	9.97343E-12
	2.00E+01	4.72E-09	3.88E-17	0.0924	9.51627E-12	8.79304E-13
				Total AD (rad/s)=	2.76398E-10	8.67723E-11
				Total AD (mrad/hr) =	0.000995031	0.00031238

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Tally 35				Tally 45			
Detector on Col 93-H				Detector on Col 101-W			
Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error	Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
0.00E+00	0			0.00E+00	0		
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
0.00E+00	0	0	0	0.00E+00	0	0	0
1.83E-15	0.4793	3.1189E-11	1.49489E-11	8.71E-16	0.1727	1.486E-11	2.57E-12
5.99E-15	0.1616	3.53525E-10	5.71296E-11	5.46E-15	0.4385	3.22635E-10	1.41E-10
1.72E-14	0.0737	1.67937E-09	1.2377E-10	1.24E-15	0.222	1.21435E-10	2.7E-11
1.37E-14	0.1242	1.8291E-09	2.27174E-10	4.44E-16	0.1911	5.91967E-11	1.13E-11
1.17E-14	0.2162	1.79082E-09	3.87174E-10	3.22E-16	0.3164	4.91369E-11	1.55E-11
2.82E-14	0.0637	4.96188E-09	3.16072E-10	3.05E-16	0.2144	5.37278E-11	1.15E-11
2.02E-14	0.032	4.60803E-09	1.47457E-10	4.30E-16	0.6294	9.81519E-11	6.18E-11
3.01E-15	0.1216	7.76235E-10	9.43902E-11	2.96E-17	0.1954	7.63457E-12	1.49E-12
Total AD (rad/s) =				Total AD (rad/s) =			
Total AD (mrad/hr) =				Total AD (mrad/hr) =			
1.60301E-08				7.26778E-10			
0.057708501				0.002616401			
5.92345E-10				1.58E-10			
0.002132442				0.00057			

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Detector Response for the X-326 Process Building First Floor											
The source is located on west wall of building on Col 16-Y (S3)											
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm ²))	Tally 5 Detector on Col 5-A Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error	Tally 15 Detector on Col 23-H Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error	
Source Rate (n/s)	1.00E-11		0.00E+00	0			0.00E+00	0			
5.20E+13	1.00E-08	6.03E-17	0.00E+00	0	0	0	0.00E+00	0		0	0
20% U-235	3.00E-08	2.46E-16	0.00E+00	0	0	0	0.00E+00	0		0	0
P = 1722 W	5.00E-08	3.69E-16	0.00E+00	0	0	0	0.00E+00	0		0	0
	1.00E-07	6.52E-16	0.00E+00	0	0	0	0.00E+00	0		0	0
	2.25E-07	1.40E-15	0.00E+00	0	0	0	0.00E+00	0		0	0
	3.25E-07	2.54E-15	0.00E+00	0	0	0	0.00E+00	0		0	0
	4.00E-07	3.37E-15	0.00E+00	0	0	0	0.00E+00	0		0	0
	8.00E-07	5.39E-15	0.00E+00	0	0	0	0.00E+00	0		0	0
	1.00E-06	8.37E-15	0.00E+00	0	0	0	0.00E+00	0		0	0
	1.13E-06	9.93E-15	0.00E+00	0	0	0	0.00E+00	0		0	0
	1.30E-06	1.13E-14	0.00E+00	0	0	0	0.00E+00	0		0	0
	1.77E-06	1.42E-14	0.00E+00	0	0	0	0.00E+00	0		0	0
	3.05E-06	2.20E-14	0.00E+00	0	0	0	0.00E+00	0		0	0
	1.00E-05	5.46E-14	0.00E+00	0	0	0	0.00E+00	0		0	0
	3.00E-05	1.70E-13	0.00E+00	0	0	0	0.00E+00	0		0	0
	1.00E-04	5.43E-13	0.00E+00	0	0	0	0.00E+00	0		0	0
	5.50E-04	2.46E-12	0.00E+00	0	0	0	0.00E+00	0		0	0
	3.00E-03	1.35E-11	0.00E+00	0	0	0	0.00E+00	0		0	0
	1.70E-02	7.20E-11	0.00E+00	0	0	0	0.00E+00	0		0	0
	1.00E-01	3.12E-10	1.97E-12	0.1573	3.19192E-08	5.02E-09	2.63E-12	0.0902	4.27253E-08	3.85E-09	
	4.00E-01	1.08E-09	4.40E-12	0.3293	2.47097E-07	8.14E-08	4.11E-12	0.1206	2.30981E-07	2.79E-08	
	9.00E-01	1.79E-09	7.54E-12	0.5816	7.01642E-07	4.08E-07	5.47E-12	0.1669	5.08922E-07	8.49E-08	
	1.40E+00	2.44E-09	1.36E-12	0.2867	1.72914E-07	4.96E-08	2.20E-12	0.1821	2.79792E-07	5.1E-08	
	1.85E+00	2.79E-09	1.44E-12	0.2483	2.08469E-07	5.18E-08	1.98E-12	0.2575	2.87645E-07	7.41E-08	
	3.00E+00	3.22E-09	3.12E-12	0.1317	5.22367E-07	6.88E-08	2.29E-12	0.0864	3.84238E-07	3.32E-08	
	6.43E+00	4.18E-09	1.92E-12	0.0719	4.1697E-07	3E-08	3.40E-12	0.389	7.38406E-07	2.87E-07	
	2.00E+01	4.72E-09	5.79E-13	0.3415	1.4216E-07	4.85E-08	1.67E-13	0.1373	4.10573E-08	5.64E-09	
Total AD (rad/s)=					2.44354E-06	4.32E-07	Total AD (rad/s)=				
Total AD (mrad/hr) =					8.796737536	1.553836	Total AD (mrad/hr) =

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Detector SE-6 (93-H)				Detector PW (101-W)			
Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error	Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
	0				0		
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
1.60E-11	0.23	2.73062E-07	6.28044E-08	1.38E-11	0.1415	2.35516E-07	3.33256E-08
3.61E-11	0.55	2.13264E-06	1.17295E-06	1.85E-11	0.115	1.09291E-06	1.25684E-07
1.40E-11	0.15	1.37078E-06	2.05617E-07	1.94E-11	0.1117	1.89951E-06	2.12176E-07
8.80E-12	0.4058	1.17452E-06	4.7662E-07	8.81E-12	0.2662	1.17585E-06	3.13012E-07
6.84E-12	0.41	1.04387E-06	4.27988E-07	5.61E-12	0.1311	8.56159E-07	1.12242E-07
1.21E-11	0.37	2.13122E-06	7.88552E-07	8.36E-12	0.0938	1.47248E-06	1.38119E-07
5.64E-12	0.29	1.28956E-06	3.73973E-07	3.90E-12	0.0948	8.91719E-07	8.4535E-08
5.40E-13	0.14	1.39419E-07	1.95187E-08	9.60E-13	0.4246	2.4	

Detector Response for the X-326 Process Building (Operating Floor)						
The source is located near column 80-C on the operating floor. (326_5)						
	Upper Energy Boundary (MeV)	Henderson Free in Air Tissue Kerma Factor (rads/(n/cm ²))	Detector ERP (5-A) Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
Source Rate (n/s)	1.00E-11			0		
5.47E+13	1.00E-08	6.03E-17		0	0	0
100% U-235	3.00E-08	2.46E-16		0	0	0
P = 1281 W	5.00E-08	3.69E-16		0	0	0
	1.00E-07	6.52E-16		0	0	0
	2.25E-07	1.40E-15		0	0	0
	3.25E-07	2.54E-15		0	0	0
	4.00E-07	3.37E-15		0	0	0
	8.00E-07	5.39E-15		0	0	0
	1.00E-06	8.37E-15		0	0	0
	1.13E-06	9.93E-15		0	0	0
	1.30E-06	1.13E-14		0	0	0
	1.77E-06	1.42E-14		0	0	0
	3.05E-06	2.20E-14		0	0	0
	1.00E-05	5.46E-14		0	0	0
	3.00E-05	1.70E-13		0	0	0
	1.00E-04	5.43E-13		0	0	0
	5.50E-04	2.46E-12		0	0	0
	3.00E-03	1.35E-11		0	0	0
	1.70E-02	7.20E-11		0	0	0
	1.00E-01	3.12E-10	4.98E-15	0.7706	8.49907E-11	6.54938E-11
	4.00E-01	1.08E-09	9.14E-15	0.4688	5.39955E-10	2.53131E-10
	9.00E-01	1.79E-09	6.09E-15	0.1061	5.9629E-10	6.32664E-11
	1.40E+00	2.44E-09	3.93E-15	0.1393	5.24529E-10	7.30669E-11
	1.85E+00	2.79E-09	3.68E-15	0.0658	5.61616E-10	3.69543E-11
	3.00E+00	3.22E-09	3.72E-14	0.2519	6.55218E-09	1.6505E-09
	6.43E+00	4.18E-09	2.10E-14	0.0154	4.80157E-09	7.39441E-11
	2.00E+01	4.72E-09	3.85E-15	0.0155	9.94008E-10	1.54071E-11
				Total AD (rad/s)=	1.46551E-08	1.67598E-09
				Total AD (mrad/hr) =	0.052758503	0.006033531

Detector SE-4 (23-H)				Detector SE-5 (63-H)			
Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error	Neutron Fluence/sp	Relative Error	Absorbed Dose Rate (rads/s)	Error
	0				0		
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
	0	0	0		0	0	0
1.22E-14	0.5293	2.0821E-10	1.10206E-10	7.08E-12	0.4723	1.2083E-07	5.70681E-08
6.83E-14	0.8041	4.03489E-09	3.24446E-09	9.81E-12	0.4721	5.79536E-07	2.73599E-07
3.23E-14	0.0759	3.16259E-09	2.40041E-10	7.49E-12	0.1714	7.33368E-07	1.25699E-07
2.25E-14	0.0997	3.00303E-09	2.99402E-10	3.28E-12	0.1809		

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these are closest
to source
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