

August 4, 2008

L-PI-08-070
10CFR50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Prairie Island Nuclear Generating Plant
Units 1 and 2
Dockets 50-282 and 50-306
License Nos. DPR-42 and DPR-60

Response to Acceptance Review Questions Re : License Amendment Request for
Technical Specifications Changes to Allow Use of Westinghouse 0.422-inch OD 14X14
VANTAGE+ Fuel (TACs MD9142/MD9143)

Reference: Letter from Michael D. Wadley (NMC) to Document Control Desk (NRC),
License Amendment Request for Technical Specifications Changes to Allow
Use of Westinghouse 0.422-inch OD 14x14 VANTAGE+ Fuel, dated
June 26, 2008 (ADAMS Accession ML081820137)

Nuclear Management Company, LLC (NMC) hereby transmits supplemental information in support of the previously submitted request for amendment to Prairie Island Nuclear Generating Plant (PINGP)(Reference). On July 22, 2008, the NRC staff provided NMC several acceptance review questions which were required to be addressed prior to the staff's completion of the acceptance review for the amendment request. The requested supplemental information to address the NRC comments is provided in Enclosures 1 and 2. Enclosure 1 provides responses to Questions 1 through 5. Enclosure 2 provides the analysis performed in support of the response to Question 5.

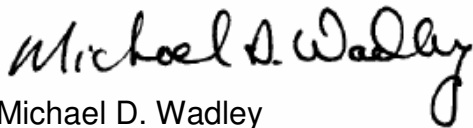
The supplemental information provided does not affect the No Significant Hazards Determination analysis provided by NMC in the referenced License Amendment Request. Pursuant to 10 CFR 50.91(b)(1), NMC has provided a copy of this letter to the appropriate state representative.

Summary of Commitments

This letter makes no new commitments and no revisions to existing commitments.

Should you have any questions regarding the information in this submittal, please contact Leonard Sueper at (612) 330-6917.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on August 4, 2008.

A handwritten signature in black ink that reads "Michael D. Wadley". The signature is written in a cursive style with a large, stylized 'M' and 'W'.

Michael D. Wadley
Site Vice President, Prairie Island Nuclear Generating Plant
Nuclear Management Company, LLC

Enclosures (2)

cc: Administrator, Region III, USNRC
Project Manager, Prairie Island Nuclear Generating Plant, USNRC
Resident Inspector, Prairie Island Nuclear Generating Plant, USNRC
State of Minnesota Department of Commerce

Enclosure 1

Response to Acceptance Review Questions Re : License Amendment Request for Technical Specifications Changes to Allow Use of Westinghouse 0.422-inch OD 14X14 VANTAGE+ Fuel

(1) Please clarify the difference between "evaluate" and "analyze" as discussed in Chapter 5 of the licensing report. For those sections that discuss particular analyses, it is clear what the analysis entailed. For evaluations, however, the NRC staff seeks to understand how the licensee assured itself that reanalysis was not required. Please provide a summary of the evaluation technique used.

The Westinghouse reload methodology (WCAP-9272-P-A) is based on the use of "bounding" analysis input assumptions which are then evaluated for continued conservatism on a cycle-specific basis. The bounding nature of these parameters leads to the use of parameter values that are often applicable to a variety of fuel types.

With respect to the Westinghouse 0.422-inch OD 14X14 VANTAGE+ Fuel (422V+) fuel transition at the Prairie Island Nuclear Generating Plant, the majority of the previously defined fuel-related input to the safety analyses was determined to remain bounding. For parameters with the input value unchanged, the results of any subsequent analyses would likewise be unchanged. For those parameter input values that were determined to no longer be bounding for operation with 422V+ fuel, an event-by-event evaluation of the modified value was performed. Additional details of this evaluation are provided below. It should be noted that the Westinghouse Quality Assurance requirements for an evaluation are identical to the requirements for an analysis in that both must meet the same documentation standards, be performed by a qualified author, reviewed by a qualified and independent verifier, and require appropriate management signoff.

The event-by-event evaluation included an initial determination as to whether or not the modified parameter was modeled in the analyses for each event. For those events that used a particular parameter, the evaluation determined if the new value associated with a modified parameter was conservative with respect to the analysis of record for that event. For example, the predicted departure from nucleate boiling ratio (DNBR) at nominal conditions was increased for operation with 422V+ fuel. Since an increase in the DNBR at nominal conditions would lead to an increase in the transient DNBR (including the transient minimum DNBR) for all DNB events, it was concluded that this change was conservative and no further action was necessary to address the change.

An assessment of the impact was made for each affected event from parameter changes that were determined to be non-conservative with respect to the previous "bounding" fuel parameters. For example, the "bounding" maximum fuel temperatures as a function of linear power are used to define minimum fuel-to-coolant heat transfer characteristics. The maximum fuel temperatures for the transition to 422V+ fuel are more limiting than those previously specified. The minimum fuel-to-coolant heat transfer characteristics are modeled in the Loss of External Electrical Load analysis. However, since the change in core heat flux during the transient is relatively small for this event, it was concluded that the minimum DNBR and maximum system pressures would be minimally impacted by the resulting change as the fuel-to-coolant heat transfer would be essentially constant and thus not impacted by a change in the heat transfer characteristics. In all instances, the reactor coolant system (RCS) and main steam system (MSS) transient responses associated with the events listed in Table 5.1-1 of the licensing report as being addressed via evaluation (i.e., identified via a "2" in the Notes column) were determined to be insignificantly impacted by any of the parameter changes required by the fuel transition.

There were events that were addressed for the fuel transition by performing a complete analysis. For example, it was determined that the fuel geometry and/or the associated pressure drop through the core could have a significant impact on the transient responses for certain events such that the acceptance criteria could be challenged. Thus, analyses were performed for each of these events which resulted in acceptable results as described in Section 5.1 of the licensing report.

(2) The excessive load increase section retains generic, boiler-plate language referring to general Westinghouse design features. Please clarify whether these design features (step and ramp load increase capabilities) apply to Prairie Island.

The load change capabilities defined as "typical" in Attachment 4 section 5.1.7 are applicable to Prairie Island. Specifically, the typical design features of 10 percent step and 5 percent per minute ramp load changes apply to Prairie Island.

The Prairie Island Updated Safety Analysis Report (USAR) Section 7.2.1 defines the Reactor Control System design as capable of responding to a 10 percent step change and a 5 percent per minute ramp change without a reactor trip.

(3) Section 5.2.4 of the licensing report states, "a post-LOCA core boric acid precipitation analysis was most recently performed as part of the Safety Analysis Transition Program/RSG Program (Reference 24)." The mentioned reference does not discuss this analysis. Please supplement the licensing report with a comprehensive discussion of post-LOCA long term core cooling, including the following:

- ***Discussion of different cases and scenarios analyzed***
- ***Modeling assumptions and their impact on boric acid solubility and precipitation***
- ***Description of thermal/hydraulic behavior in the lower plenum mixing volume, if credited***
- ***Limiting times for manual recovery actions, including the types of actions, minimum initiation times, and maximum initiation times***
- ***Predictions, calculations, and analyses of the behavior of various recovery systems, including RWST, SI accumulators, sump mixing behavior during recirculation, etc.***

The NRC has subsequently determined that the request for supplemental information pertaining to calculations for the post-LOCA long-term core cooling and post-LOCA core boric acid precipitation analyses are not required for acceptance of the application.

On July 24, 2008, the NRC staff performed a cursory review of the requested calculations during an audit at the Westinghouse office in Rockville, Maryland. The staff concluded from this audit that sufficient technical information exists to commence a detailed LOCA analyses review.

(4) Section 2.5 Seismic/LOCA Impact on Fuel Assemblies: The approved Westinghouse methodology to analyze the seismic and LOCA loading is WCAP-9401. Provide justification of the NKM0DE and WECAN codes. Also, provide the analytical description and results for mixed core.

NKM0DE is a pre-processor tool utilized to establish an equivalent finite element model that will preserve the dynamic properties of the fuel assembly. The NKM0DE fuel assembly model is further verified by using the general purpose finite element code, WECAN. Such a model is described in the licensed methodology, WCAP-9401-P-A/WCAP-9402-A, where the dynamic characteristics of the fuel assembly were modeled and analyzed using general purpose finite element computer codes. Appendix A of WCAP-9401-P-A/WCAP-9402-A describes an example (NRC sample problem) analysis where assumed damping coefficients and a lumped mass-spring system were used to construct a simplified fuel assembly finite element model. The representative simplified fuel assembly model shown in WCAP-9401-P-A/WCAP-9402-A Appendix A is consistent with a full assembly model of the same characteristics as constructed by NKM0DE.

The methods utilized by the WECAN computer code are described in detail in WCAP-9401-P-A/WCAP-9402-A. It is considered to be a general purpose finite element code verifiable by hand calculations or other equivalent finite element

codes such as ANSYS. The following text from the safety evaluation regarding WCAP-9401-P-A/WCAP-9402-A supports that conclusion:

"Although the WECAN computer code used in the systems analysis was not directly audited, the code has been benchmarked against hand calculations and problems in the open literature and is presently under review by the NRC staff and projected to have a favorable safety evaluation."

The response to the question on the modeling of the mixed core is as follows:

The mixed core effects were specifically examined to ensure that the interactions between the resident Westinghouse 0.400" Vantage+ (400V+) fuel and the new 422V+ fuel were captured. Each row of the core (3 assemblies, 7 assemblies, 9 assemblies, 11 assemblies and 13 assemblies) was modeled with different combinations of the resident 400V+ and new 422V+ fuel to encompass any expected core reload configuration. The limiting combinations analyzed included each row independently modeled with the resident 400V+ assembly on the baffle location and the inner assemblies modeled as the new 422V+ assemblies. In addition, the new 422V+ assemblies were placed on the baffle location for each row and the inner assemblies were modeled with the current 400V+ fuel assemblies. This ensures that the baffle-assembly and assembly-to-assembly interfaces for each combination of the fuel were addressed. This bounds any combination of the two fuel types and ensures that the analyses remain valid and that the conclusions of the USAR remain valid.

In addition to the above it should be noted that mixed core effects, including the seismic/LOCA effects, are addressed in the approved supplement to WCAP-9401/9402 and WCAP-9500 entitled "Supplemental Information for NRC Approved Version of WCAP-9401/9402 and WCAP-9500," dated February 1983.

(5) Are the core isotopics based on Westinghouse 14x14 VANTAGE+ fuel, as calculated using an approved isotopic depletion/generation code (e.g., ORIGEN), bounded by the core isotopics calculated for the current design basis accident analyses using the currently licensed fuel type?

Nuclear Management Company addressed the impacts of this new fuel type based on dose potential as opposed to comparing core isotopics. To accomplish this, new ORIGEN-S runs were created for both fuel types using a consistent set of inputs with the exception of the differences due to the two different fuel designs. This resulted in isotopic differences that were due only to the fuel type change (as opposed to unanticipated variations due to older code versions, operating assumptions, assumed cycle length, input errors etc). The results of these two ORIGEN-S runs were processed through a representative plant model for Prairie Island using appropriate accident assumptions and consideration of external dose for equipment qualification (EQ). The evaluation concluded the

422V+ fuel did not result in any increase in dose potential as compared to the existing 400V+ fuel type. A summary of this conclusion is included in Enclosure 1 to the license amendment request Section 2.5 (Reference). Based on the conclusion that the dose consequences were not negatively impacted by the new fuel type, no radiological analyses were rerun and submitted with this license amendment request.

Enclosure 2 presents the calculations completed to support this conclusion. For the purposes of this calculation, the fuel designated as "OFA" is the same as 400V+ fuel.

Enclosure 2

Prairie Island Dose Consequence Evaluation

CALCULATION TITLE PAGE

CALCULATION NUMBER: PSAT 3142CT.QA.04

CALCULATION TITLE:

"Calculation and Comparison of Dose Potential for PINGP OFA Fuel vs. Heavy Bundle Fuel"

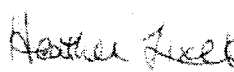
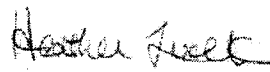
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REVISION: 0

James Metcalf

Heather Lucek

Heather Lucek

 4/29/08 4/30/08 4/30/08

REASON FOR REVISION:

Nonconformance Rpt

0 Initial Issue

N/A

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Appendix B – INPUT.DAT for Prairie Island Nuclear Generating Plant (5 pages)	
Appendix C – Excerpts of RESULTS.OUT files for STARDOSE Analyses (11 pages)	
Appendix D - MicroShield Analysis for Long-Term EQ Dose Rates (5 pages)	

Purpose

The purpose of this calculation is to establish that for the Prairie Island Nuclear Generating Plant (PINGP), OFA fuel bounds the dose potential of Heavy Bundle fuel for a dose analysis conforming to Regulatory Guide 1.4 [1] and TID-14844 [2].

Methodology

The methodology applied is as follows:

- Radionuclide information is compiled in the form of a STARDOSE [3] library file (LIBFILE1.TXT) based on RADTRAD [4] inputs for:
 - (1) dose conversion factors (DCFs) for cloud immersion and inhalation (thyroid and CEDE),
 - (2) decay constants, and

(3) identification of important decay daughters.

Note that the dose conversion factors in RADTRAD are based on the Federal Guidance Reports [5, 6] except that the DCFs for short-lived daughters (half-lives less than 90 minutes and also less than 10% of that of the parent) have been added to the DCFs of the parent.

Core activities are taken from Attachment 1 of reference [7] for both fuel types. Note that the core inventories are typically entered into the LIBFILE1.TXT file as Ci/MWt; in this instance, they are entered as Ci. Therefore, a core power of 1 MWt is used in the INPUT.DAT file.

The radionuclides considered represent an expansion of the nominal 60 radionuclides considered by RADTRAD. There are 77 considered including three chemical forms of iodine. Since there are six iodine isotopes considered, the actual number of isotopes considered in STARDOSE is 65. The two isotopes of cobalt considered in RADTRAD are omitted as is Te-129, so eight radionuclides are added. These include: Xe-131m, Xe-133m, Xe-135m, Xe-137, Xe-138, I-130, Rb-88, and Cs-138. The release fraction for the noble gases is 100% and that for the iodine is 25% (per reference [1]) making these eight added radionuclides far more important than the Co-58, Co-60, and Te-129 (release fractions = 1% per [1]) that have been removed. Rb-88 and Cs-138 are included as noble gas daughters (as well as Cs-137 which is already included in the RADTRAD list).

- Using the same information as that used above to prepare the STARDOSE LIBFILE1.TXT file, a spreadsheet is prepared in which the activity released according to the Maximum Hypothetical Accident (MHA) release fractions of reference [1] are integrated over $t = 0$ to $t = 30$ days using the expression $A_0(1 - e^{-\lambda t})/\lambda$ (where A_0 is the activity at $t = 0$ and λ is the decay constant) and then multiplied by the relevant DCF to obtain rem-sec for inhalation doses and rem-m³ for immersion doses. The inhalation product is then also multiplied by an assumed breathing rate of 3.5E-4 m³/sec to obtain rem-m³. The quantity rem-m³ is a dose index that when multiplied by the dilution due to dispersion (so-called “ χ/Q ” in units of sec/m³) and the fractional release rate to the environment over the 30 days (in units of /sec) provides the dose contribution in rem. By comparing the summation of dose indices, the relative dose potential for two core inventory sets can be estimated.
- The dose potential is confirmed using a STARDOSE plant model (INPUT.DAT) for PINGP prepared in accordance with Attachment 3 of reference [7]. **It is important to note that this is not a licensing-basis model for PINGP – it is intended only to be representative of PINGP in order to confirm the relative dose potential of two core inventory sets, not the absolute dose result. Note that the “1% other” release of reference [1] is considered to be airborne in the STARDOSE modeling applied herein. This is not required for the MHA offsite dose calculation of reference [1].**
- The STARGATE code [8] has been used to extract the non-noble gas activities from the “Airborne” location for the containment (Control Volume PC in the STARDOSE model)

at the end of the release to the containment (assumed to last two seconds). STARGATE creates input files for MicroShield 7.02 [9]. MicroShield is then run to obtain photons per second by energy group at $t = 90$ days and $t = 180$ days. These are compared to supplement the comparison of non-noble gas whole body dose indices integrated over 30 days. In this way, the equipment qualification (EQ) aspects for the non-noble gas radionuclides (i.e., waterborne sources) can be compared beyond 30 days.

Assumptions

Assumption 1: It is assumed that whatever multiplier would be applied to the OFA fuel core inventory (e.g., for fuel management flexibility) would also be applied to that for HB fuel.

Justification: See reference [7], Attachment 2.

Design Inputs

From Reference [7]:

1. Core inventory for OFA fuel (Item 1.1 without any multipliers per Item 1.3):

Nuclide	Total Core Activity Inventory, Curies									
	S/D	1 hour	24 hours	50 hours	100 hours	7 days	1 month	3 months	6 months	1 year
se 79	4.63E+00	4.63E+00	4.63E+00	4.63E+00	4.63E+00	4.63E+00	4.63E+00	4.63E+00	4.63E+00	4.63E+00
br 83	4.99E+06	4.02E+06	5.33E+03	2.93E+00	1.56E-06	4.62E-15				
br 84	8.92E+06	2.67E+06	2.31E-07	4.00E-22						
br 85	1.06E+07	6.34E+00								
kr 85	6.23E+05	6.23E+05	6.23E+05	6.23E+05	6.23E+05	6.23E+05	6.20E+05	6.14E+05	6.04E+05	5.84E+05
kr 85m	1.06E+07	9.22E+06	2.63E+05	4.71E+03	2.05E+00	5.54E-05				
rb 86	1.29E+05	1.29E+05	1.24E+05	1.19E+05	1.10E+05	9.93E+04	4.22E+04	4.53E+03	1.59E+02	1.63E-01
kr 87	2.08E+07	1.22E+07	4.38E+01	3.09E-05	4.51E-17					
kr 88	2.77E+07	2.17E+07	7.93E+04	1.39E+02	6.97E-04	4.33E-11				
rb 88	2.83E+07	2.40E+07	8.86E+04	1.56E+02	7.78E-04	4.83E-11				
sr 89	3.95E+07	3.95E+07	3.90E+07	3.84E+07	3.73E+07	3.59E+07	2.62E+07	1.15E+07	3.35E+06	2.65E+05
sr 90	4.93E+06	4.93E+06	4.93E+06	4.93E+06	4.93E+06	4.93E+06	4.92E+06	4.90E+06	4.87E+06	4.81E+06
y 90	5.20E+06	5.20E+06	5.14E+06	5.09E+06	5.02E+06	4.97E+06	4.92E+06	4.90E+06	4.87E+06	4.81E+06
sr 91	4.93E+07	4.59E+07	8.60E+06	1.30E+06	3.40E+04	2.40E+02	8.44E-16			
y 91	5.24E+07	5.24E+07	5.21E+07	5.14E+07	5.02E+07	4.85E+07	3.70E+07	1.82E+07	6.25E+06	6.99E+05
sr 92	5.33E+07	4.13E+07	1.15E+05	1.49E+02	4.15E-04	1.16E-11				
y 92	5.39E+07	5.27E+07	1.70E+06	1.23E+04	7.13E-01	1.18E-06				
y 93	6.17E+07	5.83E+07	1.20E+07	2.02E+06	6.52E+04	6.14E+02	2.17E-14			

Table 6-4 (continued)										
Nuclide	Total Core Activity Inventory, Curies									
	S/D	1 hour	24 hours	50 hours	100 hours	7 days	1 month	3 months	6 months	1 year
zr 95	7.35E+07	7.35E+07	7.27E+07	7.19E+07	7.03E+07	6.82E+07	5.31E+07	2.78E+07	1.05E+07	1.41E+06
nb 95	7.48E+07	7.48E+07	7.47E+07	7.47E+07	7.45E+07	7.43E+07	6.90E+07	4.85E+07	2.06E+07	3.05E+06
zr 97	7.36E+07	7.07E+07	2.75E+07	9.48E+06	1.22E+06	7.49E+04	1.10E-05			
mo 99	8.17E+07	8.09E+07	6.35E+07	4.83E+07	2.86E+07	1.40E+07	4.21E+04	1.12E-02	1.54E-12	
tc 99m	7.19E+07	7.19E+07	6.10E+07	4.68E+07	2.77E+07	1.35E+07	4.08E+04	1.09E-02	1.48E-12	
ru103	7.29E+07	7.28E+07	7.16E+07	7.02E+07	6.77E+07	6.44E+07	4.29E+07	1.49E+07	3.04E+06	1.16E+05
ru105	5.18E+07	4.58E+07	1.26E+06	2.18E+04	8.84E+00	2.17E-04				
rh105	4.83E+07	4.83E+07	3.48E+07	2.10E+07	7.87E+06	2.08E+06	4.14E+01	2.26E-11	9.15E-30	
ru106	2.85E+07	2.85E+07	2.84E+07	2.84E+07	2.83E+07	2.81E+07	2.69E+07	2.41E+07	2.04E+07	1.44E+07
sb127	4.19E+06	4.17E+06	3.55E+06	2.92E+06	2.01E+06	1.20E+06	1.92E+04	3.90E-01	3.58E-08	1.23E-22
te127	4.13E+06	4.13E+06	3.87E+06	3.38E+06	2.53E+06	1.79E+06	6.15E+05	4.08E+05	2.30E+05	7.10E+04
te127m	7.11E+05	7.11E+05	7.11E+05	7.10E+05	7.06E+05	6.98E+05	6.10E+05	4.18E+05	2.35E+05	7.25E+04
sb129	1.28E+07	1.10E+07	2.94E+05	4.90E+03	1.85E+00	4.14E-05				
te129	1.20E+07	1.16E+07	1.79E+06	1.43E+06	1.37E+06	1.29E+06	8.03E+05	2.33E+05	3.64E+04	8.01E+02
te129m	2.31E+06	2.31E+06	2.28E+06	2.23E+06	2.14E+06	2.01E+06	1.25E+06	3.64E+05	5.68E+04	1.25E+03
i129	1.63E+00	1.63E+00	1.63E+00	1.63E+00	1.63E+00	1.63E+00	1.64E+00	1.64E+00	1.64E+00	1.65E+00
i130	1.43E+06	1.36E+06	3.75E+05	8.73E+04	5.28E+03	1.17E+02	4.20E-12			
te131m	8.75E+06	8.58E+06	5.05E+06	2.77E+06	8.71E+05	1.81E+05	5.24E-01	1.86E-15		
i131	4.43E+07	4.42E+07	4.13E+07	3.80E+07	3.20E+07	2.51E+07	3.47E+06	1.97E+04	8.39E+00	9.93E-07
xe131m	4.97E+05	4.97E+05	4.95E+05	4.91E+05	4.78E+05	4.52E+05	1.89E+05	7.68E+03	4.28E+01	8.98E-04

Table 6-4 (continued)										
Nuclide	Total Core Activity Inventory, Curies									
	S/D	1 hour	24 hours	50 hours	100 hours	7 days	1 month	3 months	6 months	1 year
te132	6.25E+07	6.20E+07	5.05E+07	4.01E+07	2.58E+07	1.41E+07	1.06E+05	3.02E-01	1.46E-09	1.18E-26
i132	6.41E+07	6.38E+07	5.21E+07	4.14E+07	2.65E+07	1.45E+07	1.09E+05	3.11E-01	1.50E-09	1.21E-26
i133	8.97E+07	8.82E+07	4.15E+07	1.74E+07	3.29E+06	3.42E+05	3.51E-03	5.06E-24		
xe133	8.99E+07	8.99E+07	8.66E+07	7.89E+07	6.22E+07	4.34E+07	2.09E+06	7.52E+02	5.11E-03	1.22E-13
xe133m	2.81E+06	2.81E+06	2.54E+06	2.03E+06	1.16E+06	4.90E+05	3.42E+02	1.94E-06	8.24E-19	
i134	1.01E+08	7.14E+07	2.31E+00	2.77E-09	1.85E-26					
xe134m	1.37E+06	2.88E+00								
cs134	1.33E+07	1.33E+07	1.33E+07	1.33E+07	1.32E+07	1.32E+07	1.29E+07	1.22E+07	1.13E+07	9.48E+06
i135	8.57E+07	7.72E+07	6.82E+06	4.39E+05	2.24E+03	1.72E+00				
xe135	1.82E+07	2.30E+07	2.11E+07	4.25E+06	1.15E+05	6.94E+02	4.61E-16			
xe135m	1.92E+07	1.29E+07	1.11E+06	7.17E+04	3.66E+02	2.81E-01				
cs136	2.91E+06	2.90E+06	2.76E+06	2.60E+05	2.33E+06	2.01E+06	5.99E+05	2.54E+04	2.22E+02	1.30E-02
xe137	8.09E+07	1.59E+03								
cs137	6.80E+06	6.80E+06	6.80E+06	6.80E+06	6.80E+06	6.80E+06	6.79E+06	6.77E+06	6.73E+06	6.65E+06
xe138	7.59E+07	3.96E+06								
cs138	8.31E+07	3.61E+07	4.93E-06	1.20E-20						
ba139	7.92E+07	5.45E+07	6.71E+02	1.89E-03	3.97E-14	1.21E-28				
ba140	7.61E+07	7.60E+07	7.21E+07	6.80E+07	6.07E+07	5.20E+07	1.49E+07	5.71E+05	4.28E+03	1.84E-01
la140	8.01E+07	8.01E+07	7.80E+07	7.51E+07	6.86E+07	5.95E+07	1.72E+07	6.58E+05	4.93E+03	2.11E-01
la141	7.13E+07	6.42E+07	1.11E+06	1.12E+04	1.62E+00	9.72E-06				

Table 6-4 (continued)										
Nuclide	Total Core Activity Inventory, Curies									
	S/D	1 hour	24 hours	50 hours	100 hours	7 days	1 month	3 months	6 months	1 year
ce141	7.26E+07	7.26E+07	7.15E+07	6.99E+07	6.88E+07	6.29E+07	3.85E+07	1.07E+07	1.57E+06	3.04E+04
la142	6.87E+07	4.89E+07	1.35E+03	9.45E-03	1.14E-12	3.75E-26				
ce143	6.64E+07	6.55E+07	4.04E+07	2.34E+07	8.18E+06	1.96E+06	1.81E+01	1.32E-12	2.28E-32	
pr143	6.60E+07	6.60E+07	6.53E+07	6.34E+07	5.85E+07	5.12E+07	1.59E+07	7.41E+05	7.47E+03	5.88E-01
ce144	5.92E+07	5.92E+07	5.90E+07	5.89E+07	5.86E+07	5.82E+07	5.50E+07	4.75E+07	3.82E+07	2.44E+07
pr144	5.97E+07	5.92E+07	5.90E+07	5.89E+07	5.86E+07	5.82E+07	5.50E+07	4.75E+07	3.82E+07	2.44E+07
nd147	2.83E+07	2.83E+07	2.66E+07	2.48E+07	2.18E+07	1.82E+07	4.26E+06	9.65E+04	3.29E+02	2.79E-03
np239	8.95E+08	8.89E+08	6.71E+08	4.88E+08	2.64E+08	1.15E+08	1.34E+05	2.23E+03	2.23E+03	2.23E+03
pu238	2.10E+05	2.10E+05	2.11E+05	2.11E+05	2.12E+05	2.12E+05	2.13E+05	2.15E+05	2.18E+05	2.20E+05
pu239	1.24E+04	1.24E+04	1.24E+04	1.25E+04	1.25E+04	1.26E+04	1.26E+04	1.26E+04	1.26E+04	1.26E+04
pu240	2.00E+04	2.00E+04	2.00E+04	2.00E+04	2.00E+04	2.00E+04	2.00E+04	2.00E+04	2.00E+04	2.00E+04
pu241	5.44E+06	5.44E+06	5.44E+06	5.44E+06	5.43E+06	5.43E+06	5.42E+06	5.37E+06	5.31E+06	5.18E+06
am241	4.98E+03	4.98E+03	5.01E+03	5.03E+03	5.08E+03	5.15E+03	5.70E+03	7.11E+03	9.22E+03	1.35E+04
cm242	2.37E+06	2.37E+06	2.38E+06	2.38E+06	2.34E+06	2.31E+06	2.09E+06	1.62E+06	1.11E+06	5.04E+05
cm244	5.29E+05	5.29E+05	5.30E+05	5.30E+05	5.30E+05	5.30E+05	5.29E+05	5.25E+05	5.20E+05	5.10E+05

2. Core inventory for HB fuel (Item 1.2 without any multipliers per Item 1.3):

Table 6-5 422V+ Heavy Bundle Core Activity PSAT 3142CT.QA.04 Rev. 01234 HB Fuel Measurement Methodology										
Nuclide	Total Core Activity Inventory, Curies									
	S/D	1 hour	24 hours	50 hours	100 hours	7 days	1 month	3 months	6 months	1 year
se 79	5.19E+00	5.19E+00	5.19E+00	5.19E+00	5.19E+00	5.19E+00	5.19E+00	5.19E+00	5.19E+00	5.19E+00
br 83	4.89E+06	3.94E+06	5.22E+03	2.87E+00	1.53E-06	4.53E-15				
br 84	8.73E+06	2.62E+06	2.27E-07	3.92E-22						
br 85	1.04E+07	6.21E+00								
kr 85	6.88E+05	6.88E+05	6.88E+05	6.88E+05	6.87E+05	6.87E+05	6.84E+05	6.77E+05	6.65E+05	6.45E+05
kr 85m	1.04E+07	9.03E+06	2.57E+05	4.61E+03	2.01E+00	5.42E-05				
rb 88	1.27E+05	1.27E+05	1.23E+05	1.18E+05	1.09E+05	9.81E+04	4.17E+04	4.47E+03	1.57E+02	1.61E-01
kr 87	2.03E+07	1.19E+07	4.29E+01	3.03E-05	4.42E-17					
kr 88	2.72E+07	2.13E+07	7.77E+04	1.37E+02	6.82E-04	4.24E-11				
rb 89	2.77E+07	2.35E+07	8.68E+04	1.53E+02	7.62E-04	4.73E-11				
sr 89	3.83E+07	3.83E+07	3.78E+07	3.72E+07	3.62E+07	3.48E+07	2.54E+07	1.11E+07	3.24E+05	2.57E+05
sr 90	5.49E+06	5.49E+06	5.49E+06	5.49E+06	5.49E+06	5.49E+06	5.48E+06	5.48E+06	5.43E+06	5.36E+06
y 90	5.76E+06	5.76E+06	5.70E+06	5.65E+06	5.56E+06	5.53E+06	5.48E+06	5.46E+06	5.43E+06	5.36E+06
sr 91	4.82E+07	4.49E+07	8.42E+06	1.27E+06	3.33E+04	2.35E+02	8.27E-16			
y 91	5.13E+07	5.13E+07	5.10E+07	5.04E+07	4.92E+07	4.78E+07	3.62E+07	1.78E+07	6.13E+06	6.85E+05
sr 92	5.22E+07	4.04E+07	1.13E+05	1.46E+02	4.06E-04	1.14E-11				
y 92	5.28E+07	5.16E+07	1.66E+06	1.21E+04	6.98E-01	1.16E-06				
y 93	6.04E+07	5.70E+07	1.18E+07	1.98E+06	6.39E+04	6.01E+02	2.12E-14			

Table 6-5 (continued)										
Nuclide	Total Core Activity Inventory, Curies									
	S/D	1 hour	24 hours	50 hours	100 hours	7 days	1 month	3 months	6 months	1 year
zr 95	7.22E+07	7.21E+07	7.14E+07	7.06E+07	6.90E+07	6.69E+07	5.22E+07	2.72E+07	1.03E+07	1.39E+06
nb 95	7.35E+07	7.35E+07	7.34E+07	7.34E+07	7.32E+07	7.29E+07	6.77E+07	4.56E+07	2.02E+07	2.99E+06
zr 97	7.20E+07	6.91E+07	2.69E+07	9.27E+06	1.19E+06	7.33E+04	1.08E-05			
mo 99	7.99E+07	7.91E+07	6.21E+07	4.73E+07	2.79E+07	1.37E+07	4.12E+04	1.10E-02	1.50E-12	
tc 99m	7.03E+07	7.03E+07	5.97E+07	4.57E+07	2.70E+07	1.32E+07	3.99E+04	1.06E-02	1.46E-12	
ru103	7.12E+07	7.11E+07	6.99E+07	6.86E+07	6.61E+07	6.29E+07	4.19E+07	1.45E+07	2.97E+06	1.13E-05
ru105	5.05E+07	4.46E+07	1.23E+06	2.13E+04	8.63E+00	2.12E-04				
rh105	4.75E+07	4.76E+07	3.42E+07	2.06E+07	7.74E+06	2.04E+06	4.07E+01	2.23E-11	9.01E-30	
ru106	2.96E+07	2.96E+07	2.95E+07	2.95E+07	2.94E+07	2.92E+07	2.80E+07	2.50E+07	2.12E+07	1.50E+07
sb127	4.09E+06	4.08E+06	3.47E+06	2.85E+06	1.96E+06	1.18E+06	1.87E+04	3.81E-01	3.50E-08	1.20E-22
te127	4.05E+06	4.05E+06	3.79E+06	3.30E+06	2.45E+06	1.76E+06	6.11E+05	4.06E+05	2.29E+05	7.06E+04
te127m	7.08E+05	7.08E+05	7.08E+05	7.08E+05	7.03E+05	6.95E+05	6.07E+05	4.14E+05	2.34E+05	7.21E+04
i127										
sb129	1.25E+07	1.08E+07	2.87E+06	4.79E+03	1.81E+00	4.04E-05				
te129	1.17E+07	1.14E+07	1.75E+06	1.40E+06	1.34E+06	1.26E+06	7.86E+05	2.28E+05	3.56E+04	7.83E+02
te129m	2.26E+06	2.26E+06	2.23E+06	2.18E+06	2.08E+06	1.97E+06	1.23E+06	3.56E+05	5.55E+04	1.22E+03
i129	1.83E+00	1.83E+00	1.83E+00	1.83E+00	1.83E+00	1.83E+00	1.84E+00	1.84E+00	1.84E+00	1.84E+00
i130	1.40E+05	1.33E+05	3.66E+05	8.52E+04	5.15E+03	1.14E+02	4.09E-12			
te131m	8.56E+05	8.38E+05	4.93E+06	2.71E+06	8.52E+05	1.77E+05	5.12E-01	1.82E-15		
i131	4.33E+07	4.33E+07	4.04E+07	3.71E+07	3.13E+07	2.46E+07	3.39E+06	1.92E+04	8.20E+00	9.71E-07

Table 6-5 (continued)										
Nuclide	Total Core Activity Inventory, Curies									
	S/D	1 hour	24 hours	50 hours	100 hours	7 days	1 month	3 months	6 months	1 year
xe131m	4.86E+05	4.86E+05	4.85E+05	4.81E+05	4.68E+05	4.43E+05	1.85E+05	7.51E+03	4.18E+01	8.78E-04
te132	6.11E+07	6.05E+07	4.94E+07	3.92E+07	2.52E+07	1.38E+07	1.03E+05	2.96E-01	1.43E-09	1.15E-26
i132	6.26E+07	6.23E+07	5.09E+07	4.04E+07	2.59E+07	1.42E+07	1.06E+05	3.04E-01	1.47E-09	1.19E-26
i133	8.78E+07	8.63E+07	4.06E+07	1.71E+07	3.22E+06	3.34E+05	3.43E-03	4.95E-24		
xe133	8.80E+07	8.80E+07	8.48E+07	7.73E+07	6.09E+07	4.25E+07	2.05E+06	7.36E+02	5.00E-03	1.20E-13
xe133m	2.75E+06	2.75E+06	2.48E+06	1.98E+06	1.13E+06	4.80E+05	3.35E+02	1.89E-06	6.06E-19	
i134	9.83E+07	6.98E+07	2.26E+00	2.71E-09	1.81E-26					
xe134m	1.34E+06	2.81E+00								
cs134	1.43E+07	1.43E+07	1.43E+07	1.43E+07	1.43E+07	1.42E+07	1.39E+07	1.32E+07	1.21E+07	1.02E+07
i135	8.38E+07	7.54E+07	6.67E+06	4.29E+05	2.19E+03	1.69E+00				
xe135	1.99E+07	2.44E+07	2.10E+07	4.20E+06	1.14E+05	6.84E+02	4.55E-16			
xe135m	1.87E+07	1.27E+07	1.09E+06	7.01E+04	3.58E+02	2.75E-01				
cs136	3.00E+06	2.99E+06	2.85E+06	2.69E+06	2.41E+06	2.08E+06	6.18E+05	2.62E+04	2.29E+02	1.34E-02
xe137	7.91E+07	1.55E+03								
cs137	7.58E+06	7.58E+06	7.58E+06	7.58E+06	7.58E+06	7.58E+06	7.57E+06	7.54E+06	7.50E+06	7.41E+06
xe138	7.42E+07	3.88E+06								
cs138	8.13E+07	3.53E+07	4.82E-06	1.27E-20						
ba139	7.75E+07	5.33E+07	6.56E+02	1.85E-03	3.89E-14	1.19E-28				
ba140	7.43E+07	7.42E+07	7.04E+07	6.64E+07	5.93E+07	5.08E+07	1.46E+07	5.57E+05	4.18E+03	1.79E-01
la140	7.82E+07	7.81E+07	7.62E+07	7.33E+07	6.69E+07	5.81E+07	1.68E+07	6.42E+05	4.81E+03	2.06E-01

Table 6-5 (continued)										
Nuclide	Total Core Activity Inventory, Curies									
	S/D	1 hour	24 hours	50 hours	100 hours	7 days	1 month	3 months	6 months	1 year
la141	6.98E+07	6.29E+07	1.08E+06	1.10E+04	1.58E+00	9.51E-06				
ce141	7.11E+07	7.11E+07	6.99E+07	6.83E+07	6.54E+07	6.15E+07	3.77E+07	1.05E+07	1.54E+06	2.97E+04
la142	6.72E+07	4.78E+07	1.32E+03	9.25E-03	1.12E-12	3.67E-26				
ce143	6.50E+07	6.40E+07	3.95E+07	2.29E+07	8.01E+06	1.92E+06	1.77E+01	1.29E-12	2.28E-32	
pr143	6.46E+07	6.46E+07	6.39E+07	6.21E+07	5.72E+07	5.01E+07	1.55E+07	7.25E+05	7.31E+03	5.75E-01
ce144	6.01E+07	6.01E+07	5.99E+07	5.98E+07	5.95E+07	5.90E+07	5.58E+07	4.82E+07	3.88E+07	2.47E+07
pr144	6.05E+07	6.01E+07	5.99E+07	5.98E+07	5.95E+07	5.90E+07	5.58E+07	4.83E+07	3.88E+07	2.47E+07
nd147	2.78E+07	2.77E+07	2.61E+07	2.44E+07	2.14E+07	1.79E+07	4.18E+06	9.47E+04	3.23E+02	2.74E-03
nd239	8.73E+06	8.68E+06	6.55E+06	4.76E+06	2.58E+06	1.12E+06	1.31E+05	2.49E+03	2.49E+03	2.48E+03
pu238	2.39E+05	2.39E+05	2.39E+05	2.40E+05	2.40E+05	2.41E+05	2.42E+05	2.44E+05	2.47E+05	2.48E+05
pu239	1.39E+04	1.39E+04	1.40E+04	1.40E+04	1.41E+04	1.41E+04	1.41E+04	1.41E+04	1.41E+04	1.41E+04
pu240	2.24E+04	2.24E+04	2.24E+04	2.24E+04	2.24E+04	2.24E+04	2.24E+04	2.24E+04	2.24E+04	2.25E+04
pu241	6.07E+06	6.07E+06	6.07E+06	6.07E+06	6.07E+06	6.07E+06	6.05E+06	6.00E+06	5.93E+06	5.79E+06
am241	6.29E+03	6.29E+03	6.32E+03	6.35E+03	6.40E+03	6.48E+03	7.09E+03	8.67E+03	1.10E+04	1.58E+04
cm242	2.68E+06	2.68E+06	2.68E+06	2.67E+06	2.65E+06	2.62E+06	2.37E+06	1.84E+06	1.25E+06	5.71E+05
cm244	5.89E+05	5.89E+05	5.90E+05	5.90E+05	5.90E+05	5.90E+05	5.89E+05	5.85E+05	5.79E+05	5.68E+05

- Primary containment volume = $1.32E6 \text{ ft}^3$, Item 2.1
- Primary containment leakage rate = 0.25 %/day, Item 2.1 (with factor of two reduction at $t = 24$ hours and 0.14%/day leaked to Shield Building, 0.10%/day leaked to Auxiliary Building, and 0.01%/day leaked directly to Environment)
- Spray removal in primary containment (Item 2.1):

Species	Spray Removal Coefficient, hr^{-1}
Elemental	20
Organic	0 (conservative)
Particulate	0.45
Maximum DF	100 (conservative)
- Volume of Shield Building credited = 50% of $3.74E5 \text{ ft}^3 = 1.87E5 \text{ ft}^3$, Item 2.1
- Shield Building exhaust/leakage profile (Item 2.1):

Time Period	Shield Building Exhaust (CFM)	Shield Building Exhaust (HR-1)*	Shield Building Leakage (CFM)	Shield Building Leakage (HR-1)*	Shield Building Recirc. (CFM)	Shield Building Recirc. (HR-1)*
0 - 35 Sec.	0	0.0000	1558.3	0.5000	0	0.0000
36 Sec. - 4.5 Min.	6000	1.9251	1558.3	0.5000	0	0.0000
4.5 - 10 Min.	3000	0.9626	0	0.0000	0	0.0000
10 - 20 Min.	1300	0.4171	0	0.0000	0	0.0000
20 Min. - 30 Days	1000	0.3209	0	0.0000	4000	1.2834

*Leak Rate, 1/HR, based on a Shield Building Volume of $3.74E+04 \text{ Cu. Ft.}$ and a Participation Factor of 0.5

8. Filtration efficiency for Shield Building exhaust and recirculation = 90% for elemental iodine, 70% for organic iodine, 99% for particulate, Item 2.1
9. Effective filtration for Auxiliary Building including bypass = 81.8% for elemental iodine, 63.6% for organic iodine, 90% for particulate, Item 2.1
10. Volume of post-accident sump = $2.67\text{E}4 \text{ ft}^3$, Item 2.1
11. ESF component leakage = zero, Item 2.1
12. Iodine re-evolution percentage for ESF leakage – N/A

13. X/Qs for offsite doses, Item 2.1:

Time Period	715 Meters	8046 Meters
0 - 8 hrs.	6.49E-04	3.71E-05
8 - 24 hrs.		6.27E-06
1 - 4 days		1.09E-06
4 - 30 days		1.52E-07

Note that the 715 meter value is assumed for the EAB dose and the 8046 meter values are assumed for the LPZ dose. This assumption is not critical since only relative doses are being considered.

14. Breathing rates for offsite dose analysis (assumed):

Breathing rate	EAB	0 - 2 hrs	3.5E-04 (m ³ /sec)
	LPZ	0 - 8 hrs	3.5E-04 (m ³ /sec)
		8 - 24 hrs	1.8E-04 (m ³ /sec)
		1 - 30 days	2.3E-04 (m ³ /sec)

References

1. "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors", Regulatory Guide 1.4, June 1974.
2. J.J. DiNunno et al., "Calculation of Distance Factors for Power and Test Reactor Sites," USAEC TID-14844, U.S. Atomic Energy Commission (now USNRC), 1962
3. PSAT C109.05, "STARDOSE Validation Report", Revision 1 and PSAT C109.06, "STARDOSE User's Manual", Revision 1.
4. S.L. Humphreys, et. al., "RADTRAD, A Simplified Model for Radionuclide Transport and Removal and Dose Estimation", NUREG/CR-6604.
5. Federal Guidance Report No. 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion," EPA 520/1-88-020, U.S. Environmental Protection Agency, Washington, DC, 1988.

6. Federal Guidance Report No. 12, "External Exposure to Radionuclides in Air, Water and Soil," EPA 420-r-93-081 U.S. Environmental Protection Agency, Washington, DC, 1993.
7. PSAT 3142CT.QA.04, "Design Database for the Comparison of OFA Fuel and Heavy Bundle Fuel MHA Source Terms for Prairie Island Nuclear Power Plant"
8. PSAT CI18.QA.07, "STARGATE Programming Report" and PSAT CI18.QA.03, "Dedication of MicroShield and STARGATE"
9. PSAT CI18.QA.04, "MicroShield User's Manual, Version 7," October, 2006, Grove Software, Inc. and PSAT CI18.QA.03, "Dedication of MicroShield and STARGATE"

Calculation

Dose Index Comparisons

As described in the Methodology section, the following is the calculation of the radionuclide dose potential. The first column is the radionuclide name. The second is the core inventory (Ci). The third is the Ci/MWt (for information only). The fourth is the decay constant (per second). The fifth is the external exposure (EE) whole body (WB) DCF (rem-m³/Ci-sec). The sixth is the inhalation DCF (rem/Ci); thyroid for the thyroid dose and CEDE for the TEDE dose. The seventh is the activity integral (over 2 hours or 30 days). The units of the integrated expression are rem-sec. The eighth column is the RG 1.4 release fraction. The ninth column is the product of the external exposure DCF, the activity integral, and the release fraction in units of rem-m³. The tenth column is the product of the inhalation DCF, the breathing rate, the activity integral, and the release fraction in units of rem-m³. The breathing rate used is 3.5E-4 m³/sec.

The index sums are provided for the thyroid dose, the whole body dose due to external exposure, and the TEDE (equal to the inhalation CEDE plus the whole body dose due to external exposure). In addition, the whole body dose without noble gas is provided as an indicator of waterborne gamma exposure for EQ. Finally, for the two-hour integration period, the TEDE index is also provided for noble gas and iodine, only. This is an indicator for the Fuel Handling Accident in which only noble gas and iodine is released.

Table 1 – OFA Two Hour

MWt =	1650	BR =	3.50E-04	m3/s	Inhalation	2-hour		EE	Inhalation
Nuclide	Activity	Ci/MWt	DK /sec	EE DCF	DCF	Integral	Rel fract	Product	Product
I130	1.43E+06	8.67E+02	1.56E-05	3.85E-01	7.36E+04	9.74E+09	0.2500	9.37E+08	6.27E+10
I131	4.43E+07	2.68E+04	9.98E-07	6.73E-02	1.07E+06	3.18E+11	0.2500	5.35E+09	2.98E+13
I132	6.41E+07	3.88E+04	8.37E-05	4.14E-01	6.29E+03	3.47E+11	0.2500	3.59E+10	1.91E+11
I133	8.97E+07	5.44E+04	9.26E-06	1.09E-01	1.81E+05	6.25E+11	0.2500	1.70E+10	9.89E+12
I134	1.01E+08	6.12E+04	2.20E-04	4.81E-01	1.07E+03	3.65E+11	0.2500	4.39E+10	3.42E+10
I135	8.57E+07	5.19E+04	2.91E-05	3.07E-01	3.14E+04	5.57E+11	0.2500	4.27E+10	1.53E+12
								Thyroid =	4.15E+13
MWt =	1650	BR =	3.50E-04	m3/s	Inhalation	2-hour		EE	Inhalation
Nuclide	Activity	Ci/MWt	DK /sec	EE DCF	DCF	Integral	Rel fract	Product	Product
Kr85m	1.06E+07	6.42E+03	4.30E-05	2.77E-02	0	6.56E+10	1.0000	1.82E+09	0.00E+00
Kr85	6.23E+05	3.78E+02	2.05E-09	4.40E-04	0	4.49E+09	1.0000	1.97E+06	0.00E+00
Kr87	2.08E+07	1.26E+04	1.51E-04	1.52E-01	0	9.13E+10	1.0000	1.39E+10	0.00E+00
Kr88	2.77E+07	1.68E+04	6.78E-05	3.77E-01	0	1.58E+11	1.0000	5.95E+10	0.00E+00
Xe131m	4.97E+05	3.01E+02	6.74E-07	1.44E-03	0	3.57E+09	1.0000	5.14E+06	0.00E+00
Xe133m	2.81E+06	1.70E+03	3.67E-06	5.07E-03	0	2.00E+10	1.0000	1.01E+08	0.00E+00
Xe133	8.99E+07	5.45E+04	1.53E-06	5.77E-03	0	6.44E+11	1.0000	3.71E+09	0.00E+00
Xe135m	1.92E+07	1.16E+04	7.56E-04	7.55E-02	0	2.53E+10	1.0000	1.91E+09	0.00E+00
Xe135	1.82E+07	1.10E+04	2.12E-05	4.40E-02	0	1.22E+11	1.0000	5.35E+09	0.00E+00
Xe137	8.09E+07	4.90E+04	2.96E-03	3.03E-02	0	2.73E+10	1.0000	8.28E+08	0.00E+00
Xe138	7.59E+07	4.60E+04	6.80E-04	2.13E-01	0	1.11E+11	1.0000	2.36E+10	0.00E+00
I130	1.43E+06	8.67E+02	1.56E-05	3.85E-01	2.64E+03	9.74E+09	0.2500	9.37E+08	2.25E+09
I131	4.43E+07	2.68E+04	9.98E-07	6.73E-02	3.29E+04	3.18E+11	0.2500	5.35E+09	9.15E+11
I132	6.41E+07	3.88E+04	8.37E-05	4.14E-01	3.81E+02	3.47E+11	0.2500	3.59E+10	1.16E+10
I133	8.97E+07	5.44E+04	9.26E-06	1.09E-01	5.85E+03	6.25E+11	0.2500	1.70E+10	3.20E+11
I134	1.01E+08	6.12E+04	2.20E-04	4.81E-01	1.31E+02	3.65E+11	0.2500	4.39E+10	4.18E+09
I135	8.57E+07	5.19E+04	2.91E-05	3.07E-01	1.23E+03	5.57E+11	0.2500	4.27E+10	5.99E+10
Rb86	1.29E+05	7.82E+01	4.30E-07	1.78E-02	6.62E+03	9.27E+08	0.0100	1.65E+05	2.15E+07
Rb88	2.83E+07	1.72E+04	6.49E-04	1.24E-01	8.36E+01	4.32E+10	0.0100	5.36E+07	1.26E+07
Cs134	1.35E+07	8.18E+03	1.07E-08	2.80E-01	4.63E+04	9.72E+10	0.0100	2.72E+08	1.58E+10
Cs136	2.91E+06	1.76E+03	6.12E-07	3.92E-01	7.33E+03	2.09E+10	0.0100	8.20E+07	5.36E+08
Cs137	6.80E+06	4.12E+03	7.32E-10	1.01E-01	3.19E+04	4.90E+10	0.0100	4.94E+07	5.47E+09
Cs138	8.31E+07	5.04E+04	3.59E-04	4.48E-01	1.01E+02	2.14E+11	0.0100	9.59E+08	7.57E+07

Sb127	4.19E+06	2.54E+03	2.08E-06	1.23E-01	6.03E+03	2.99E+10	0.0100	3.68E+07	6.32E+08
Sb129	1.28E+07	7.76E+03	4.46E-05	2.64E-01	6.44E+02	7.88E+10	0.0100	2.08E+08	1.78E+08
Te127m	7.11E+05	4.31E+02	7.36E-08	5.44E-04	2.15E+04	5.12E+09	0.0100	2.78E+04	3.85E+08
Te127	4.13E+06	2.50E+03	2.06E-05	8.95E-04	3.18E+02	2.76E+10	0.0100	2.47E+05	3.08E+07
Te129m	2.31E+06	1.40E+03	2.39E-07	1.23E-02	2.40E+04	1.66E+10	0.0100	2.04E+06	1.40E+09
Te131m	8.75E+06	5.30E+03	6.42E-06	2.76E-01	6.50E+03	6.16E+10	0.0100	1.70E+08	1.40E+09
Te132	6.25E+07	3.79E+04	2.46E-06	3.81E-02	9.44E+03	4.46E+11	0.0100	1.70E+08	1.47E+10
Ba139	7.92E+07	4.80E+04	1.40E-04	8.03E-03	1.72E+02	3.59E+11	0.0100	2.88E+07	2.16E+08
Ba140	7.61E+07	4.61E+04	6.30E-07	3.17E-02	3.74E+03	5.47E+11	0.0100	1.73E+08	7.16E+09
Mo99	8.17E+07	4.95E+04	2.92E-06	2.69E-02	3.96E+03	5.82E+11	0.0100	1.57E+08	8.07E+09
Tc99m	7.19E+07	4.36E+04	3.20E-05	2.18E-02	3.26E+01	4.62E+11	0.0100	1.01E+08	5.28E+07
Ru103	7.29E+07	4.42E+04	2.04E-07	8.33E-02	8.96E+03	5.24E+11	0.0100	4.37E+08	1.64E+10
Ru105	5.18E+07	3.14E+04	4.34E-05	1.41E-01	4.55E+02	3.20E+11	0.0100	4.52E+08	5.10E+08
Ru106	2.85E+07	1.73E+04	2.18E-08	3.85E-02	4.77E+05	2.05E+11	0.0100	7.90E+07	3.43E+11
Rh105	4.83E+07	2.93E+04	5.45E-06	1.38E-02	9.55E+02	3.41E+11	0.0100	4.71E+07	1.14E+09
Y90	5.20E+06	3.15E+03	3.01E-06	7.03E-04	8.44E+03	3.70E+10	0.0100	2.60E+05	1.09E+09
Y91	5.24E+07	3.18E+04	1.37E-07	9.62E-04	4.88E+04	3.77E+11	0.0100	3.63E+06	6.44E+10
Y92	5.39E+07	3.27E+04	5.44E-05	4.81E-02	7.81E+02	3.21E+11	0.0100	1.54E+08	8.78E+08
Y93	6.17E+07	3.74E+04	1.91E-05	1.78E-02	2.15E+03	4.15E+11	0.0100	7.39E+07	3.12E+09
Zr95	7.35E+07	4.45E+04	1.25E-07	1.33E-01	2.36E+04	5.29E+11	0.0100	7.04E+08	4.37E+10
Zr97	7.36E+07	4.46E+04	1.14E-05	1.64E-01	4.33E+03	5.09E+11	0.0100	8.34E+08	7.71E+09
Nb95	7.48E+07	4.53E+04	2.28E-07	1.38E-01	5.81E+03	5.38E+11	0.0100	7.43E+08	1.09E+10
La140	8.01E+07	4.85E+04	4.78E-06	4.33E-01	4.85E+03	5.67E+11	0.0100	2.45E+09	9.62E+09
La141	7.13E+07	4.32E+04	4.90E-05	8.84E-03	5.81E+02	4.33E+11	0.0100	3.82E+07	8.80E+08
La142	6.87E+07	4.16E+04	1.25E-04	5.33E-01	2.53E+02	3.26E+11	0.0100	1.74E+09	2.89E+08
Pr143	6.60E+07	4.00E+04	5.92E-07	7.77E-05	8.10E+03	4.74E+11	0.0100	3.68E+05	1.34E+10
Nd147	2.83E+07	1.72E+04	7.31E-07	2.29E-02	6.85E+03	2.03E+11	0.0100	4.65E+07	4.87E+09
Am241	4.98E+03	3.02E+00	5.08E-11	3.03E-03	4.44E+08	3.59E+07	0.0100	1.09E+03	5.57E+10
Cm242	2.37E+06	1.44E+03	4.93E-08	2.11E-05	1.73E+07	1.71E+10	0.0100	3.60E+03	1.03E+12
Cm244	5.29E+05	3.21E+02	1.21E-09	1.82E-05	2.48E+08	3.81E+09	0.0100	6.93E+02	3.31E+12
Ce141	7.26E+07	4.40E+04	2.47E-07	1.27E-02	8.95E+03	5.22E+11	0.0100	6.63E+07	1.64E+10
Ce143	6.64E+07	4.02E+04	5.83E-06	4.77E-02	3.39E+03	4.68E+11	0.0100	2.23E+08	5.56E+09
Ce144	5.92E+07	3.59E+04	2.82E-08	1.03E-02	3.74E+05	4.26E+11	0.0100	4.39E+07	5.58E+11
Np239	8.95E+08	5.42E+05	3.41E-06	2.85E-02	2.51E+03	6.37E+12	0.0100	1.81E+09	5.59E+10
Pu238	2.10E+05	1.27E+02	2.50E-10	1.81E-05	2.88E+08	1.51E+09	0.0100	2.74E+02	1.52E+12
Pu239	1.24E+04	7.52E+00	9.13E-13	1.57E-05	3.08E+08	8.93E+07	0.0100	1.40E+01	9.62E+10

Pu240	2.00E+04	1.21E+01	3.36E-12	1.76E-05	3.08E+08	1.44E+08	0.0100	2.53E+01	1.55E+11
Pu241	5.44E+06	3.30E+03	1.53E-09	2.68E-07	4.96E+06	3.92E+10	0.0100	1.05E+02	6.80E+11
Sr89	3.95E+07	2.39E+04	1.59E-07	2.86E-04	4.14E+04	2.84E+11	0.0100	8.13E+05	4.12E+10
Sr90	4.93E+06	2.99E+03	7.54E-10	2.79E-05	1.30E+06	3.55E+10	0.0100	9.90E+03	1.62E+11
Sr91	4.93E+07	2.99E+04	2.03E-05	1.82E-01	1.68E+03	3.30E+11	0.0100	6.01E+08	1.94E+09
Sr92	5.33E+07	3.23E+04	7.10E-05	2.51E-01	8.07E+02	3.00E+11	0.0100	7.54E+08	8.49E+08
WB =								2.70E+11	9.58E+12
								TEDE =	9.85E+12
Ex NG =								1.60E+11	
								NG + I =	1.57E+12

Table 2 – OFA Thirty Day

MWt =	1650	BR =	3.50E-04	m3/s	Inhalation	30-day		EE	Inhalation
Nuclide	Activity	Ci/MWt	DK /sec	EE DCF	DCF	Integral	Rel fract	Product	Product
I130	1.43E+06	8.67E+02	1.56E-05	3.85E-01	7.36E+04	9.17E+10	0.2500	8.82E+09	5.90E+11
I131	4.43E+07	2.68E+04	9.98E-07	6.73E-02	1.07E+06	4.10E+13	0.2500	6.91E+11	3.84E+15
I132	6.41E+07	3.88E+04	8.37E-05	4.14E-01	6.29E+03	7.66E+11	0.2500	7.93E+10	4.21E+11
I133	8.97E+07	5.44E+04	9.26E-06	1.09E-01	1.81E+05	9.69E+12	0.2500	2.64E+11	1.53E+14
I134	1.01E+08	6.12E+04	2.20E-04	4.81E-01	1.07E+03	4.59E+11	0.2500	5.52E+10	4.30E+10
I135	8.57E+07	5.19E+04	2.91E-05	3.07E-01	3.14E+04	2.95E+12	0.2500	2.26E+11	8.09E+12
								Thyroid =	4.01E+15
MWt =	1650	BR =	3.50E-04	m3/s	Inhalation	30-day		EE	Inhalation
Nuclide	Activity	Ci/MWt	DK /sec	EE DCF	DCF	Integral	Rel fract	Product	Product
Kr85m	1.06E+07	6.42E+03	4.30E-05	2.77E-02	0	2.47E+11	1.0000	6.83E+09	0.00E+00
Kr85	6.23E+05	3.78E+02	2.05E-09	4.40E-04	0	1.61E+12	1.0000	7.09E+08	0.00E+00
Kr87	2.08E+07	1.26E+04	1.51E-04	1.52E-01	0	1.38E+11	1.0000	2.09E+10	0.00E+00
Kr88	2.77E+07	1.68E+04	6.78E-05	3.77E-01	0	4.09E+11	1.0000	1.54E+11	0.00E+00
Xe131m	4.97E+05	3.01E+02	6.74E-07	1.44E-03	0	6.09E+11	1.0000	8.77E+08	0.00E+00
Xe133m	2.81E+06	1.70E+03	3.67E-06	5.07E-03	0	7.66E+11	1.0000	3.88E+09	0.00E+00
Xe133	8.99E+07	5.45E+04	1.53E-06	5.77E-03	0	5.76E+13	1.0000	3.33E+11	0.00E+00
Xe135m	1.92E+07	1.16E+04	7.56E-04	7.55E-02	0	2.54E+10	1.0000	1.92E+09	0.00E+00
Xe135	1.82E+07	1.10E+04	2.12E-05	4.40E-02	0	8.58E+11	1.0000	3.78E+10	0.00E+00
Xe137	8.09E+07	4.90E+04	2.96E-03	3.03E-02	0	2.73E+10	1.0000	8.28E+08	0.00E+00
Xe138	7.59E+07	4.60E+04	6.80E-04	2.13E-01	0	1.12E+11	1.0000	2.38E+10	0.00E+00
I130	1.43E+06	8.67E+02	1.56E-05	3.85E-01	2.64E+03	9.17E+10	0.2500	8.82E+09	2.12E+10
I131	4.43E+07	2.68E+04	9.98E-07	6.73E-02	3.29E+04	4.10E+13	0.2500	6.91E+11	1.18E+14
I132	6.41E+07	3.88E+04	8.37E-05	4.14E-01	3.81E+02	7.66E+11	0.2500	7.93E+10	2.55E+10
I133	8.97E+07	5.44E+04	9.26E-06	1.09E-01	5.85E+03	9.69E+12	0.2500	2.64E+11	4.96E+12
I134	1.01E+08	6.12E+04	2.20E-04	4.81E-01	1.31E+02	4.59E+11	0.2500	5.52E+10	5.26E+09
I135	8.57E+07	5.19E+04	2.91E-05	3.07E-01	1.23E+03	2.95E+12	0.2500	2.26E+11	3.17E+11
Rb86	1.29E+05	7.82E+01	4.30E-07	1.78E-02	6.62E+03	2.02E+11	0.0100	3.59E+07	4.67E+09
Rb88	2.83E+07	1.72E+04	6.49E-04	1.24E-01	8.36E+01	4.36E+10	0.0100	5.41E+07	1.28E+07
Cs134	1.35E+07	8.18E+03	1.07E-08	2.80E-01	4.63E+04	3.45E+13	0.0100	9.66E+10	5.59E+12
Cs136	2.91E+06	1.76E+03	6.12E-07	3.92E-01	7.33E+03	3.78E+12	0.0100	1.48E+10	9.70E+10
Cs137	6.80E+06	4.12E+03	7.32E-10	1.01E-01	3.19E+04	1.76E+13	0.0100	1.78E+10	1.97E+12
Cs138	8.31E+07	5.04E+04	3.59E-04	4.48E-01	1.01E+02	2.31E+11	0.0100	1.04E+09	8.18E+07

Sb127	4.19E+06	2.54E+03	2.08E-06	1.23E-01	6.03E+03	2.01E+12	0.0100	2.47E+09	4.23E+10
Sb129	1.28E+07	7.76E+03	4.46E-05	2.64E-01	6.44E+02	2.87E+11	0.0100	7.58E+08	6.47E+08
Te127m	7.11E+05	4.31E+02	7.36E-08	5.44E-04	2.15E+04	1.68E+12	0.0100	9.13E+06	1.26E+11
Te127	4.13E+06	2.50E+03	2.06E-05	8.95E-04	3.18E+02	2.00E+11	0.0100	1.79E+06	2.23E+08
Te129m	2.31E+06	1.40E+03	2.39E-07	1.23E-02	2.40E+04	4.46E+12	0.0100	5.49E+08	3.75E+11
Te131m	8.75E+06	5.30E+03	6.42E-06	2.76E-01	6.50E+03	1.36E+12	0.0100	3.76E+09	3.10E+10
Te132	6.25E+07	3.79E+04	2.46E-06	3.81E-02	9.44E+03	2.54E+13	0.0100	9.66E+09	8.38E+11
Ba139	7.92E+07	4.80E+04	1.40E-04	8.03E-03	1.72E+02	5.66E+11	0.0100	4.54E+07	3.41E+08
Ba140	7.61E+07	4.61E+04	6.30E-07	3.17E-02	3.74E+03	9.72E+13	0.0100	3.08E+10	1.27E+12
Mo99	8.17E+07	4.95E+04	2.92E-06	2.69E-02	3.96E+03	2.80E+13	0.0100	7.52E+09	3.88E+11
Tc99m	7.19E+07	4.36E+04	3.20E-05	2.18E-02	3.26E+01	2.25E+12	0.0100	4.90E+08	2.56E+08
Ru103	7.29E+07	4.42E+04	2.04E-07	8.33E-02	8.96E+03	1.47E+14	0.0100	1.22E+11	4.60E+12
Ru105	5.18E+07	3.14E+04	4.34E-05	1.41E-01	4.55E+02	1.19E+12	0.0100	1.68E+09	1.90E+09
Ru106	2.85E+07	1.73E+04	2.18E-08	3.85E-02	4.77E+05	7.18E+13	0.0100	2.77E+10	1.20E+14
Rh105	4.83E+07	2.93E+04	5.45E-06	1.38E-02	9.55E+02	8.86E+12	0.0100	1.22E+09	2.96E+10
Y90	5.20E+06	3.15E+03	3.01E-06	7.03E-04	8.44E+03	1.73E+12	0.0100	1.21E+07	5.10E+10
Y91	5.24E+07	3.18E+04	1.37E-07	9.62E-04	4.88E+04	1.14E+14	0.0100	1.10E+09	1.95E+13
Y92	5.39E+07	3.27E+04	5.44E-05	4.81E-02	7.81E+02	9.91E+11	0.0100	4.77E+08	2.71E+09
Y93	6.17E+07	3.74E+04	1.91E-05	1.78E-02	2.15E+03	3.23E+12	0.0100	5.75E+08	2.43E+10
Zr95	7.35E+07	4.45E+04	1.25E-07	1.33E-01	2.36E+04	1.63E+14	0.0100	2.16E+11	1.34E+13
Zr97	7.36E+07	4.46E+04	1.14E-05	1.64E-01	4.33E+03	6.46E+12	0.0100	1.06E+10	9.78E+10
Nb95	7.48E+07	4.53E+04	2.28E-07	1.38E-01	5.81E+03	1.46E+14	0.0100	2.02E+11	2.98E+12
La140	8.01E+07	4.85E+04	4.78E-06	4.33E-01	4.85E+03	1.68E+13	0.0100	7.26E+10	2.84E+11
La141	7.13E+07	4.32E+04	4.90E-05	8.84E-03	5.81E+02	1.46E+12	0.0100	1.29E+08	2.96E+09
La142	6.87E+07	4.16E+04	1.25E-04	5.33E-01	2.53E+02	5.50E+11	0.0100	2.93E+09	4.87E+08
Pr143	6.60E+07	4.00E+04	5.92E-07	7.77E-05	8.10E+03	8.75E+13	0.0100	6.80E+07	2.48E+12
Nd147	2.83E+07	1.72E+04	7.31E-07	2.29E-02	6.85E+03	3.29E+13	0.0100	7.53E+09	7.89E+11
Am241	4.98E+03	3.02E+00	5.08E-11	3.03E-03	4.44E+08	1.29E+10	0.0100	3.91E+05	2.01E+13
Cm242	2.37E+06	1.44E+03	4.93E-08	2.11E-05	1.73E+07	5.77E+12	0.0100	1.22E+06	3.49E+14
Cm244	5.29E+05	3.21E+02	1.21E-09	1.82E-05	2.48E+08	1.37E+12	0.0100	2.49E+05	1.19E+15
Ce141	7.26E+07	4.40E+04	2.47E-07	1.27E-02	8.95E+03	1.39E+14	0.0100	1.76E+10	4.35E+12
Ce143	6.64E+07	4.02E+04	5.83E-06	4.77E-02	3.39E+03	1.14E+13	0.0100	5.43E+09	1.35E+11
Ce144	5.92E+07	3.59E+04	2.82E-08	1.03E-02	3.74E+05	1.48E+14	0.0100	1.52E+10	1.94E+14
Np239	8.95E+08	5.42E+05	3.41E-06	2.85E-02	2.51E+03	2.62E+14	0.0100	7.48E+10	2.31E+12
Pu238	2.10E+05	1.27E+02	2.50E-10	1.81E-05	2.88E+08	5.44E+11	0.0100	9.85E+04	5.48E+14
Pu239	1.24E+04	7.52E+00	9.13E-13	1.57E-05	3.08E+08	3.21E+10	0.0100	5.05E+03	3.46E+13

Pu240	2.00E+04	1.21E+01	3.36E-12	1.76E-05	3.08E+08	5.18E+10	0.0100	9.12E+03	5.59E+13
Pu241	5.44E+06	3.30E+03	1.53E-09	2.68E-07	4.96E+06	1.41E+13	0.0100	3.77E+04	2.44E+14
Sr89	3.95E+07	2.39E+04	1.59E-07	2.86E-04	4.14E+04	8.39E+13	0.0100	2.40E+08	1.22E+13
Sr90	4.93E+06	2.99E+03	7.54E-10	2.79E-05	1.30E+06	1.28E+13	0.0100	3.56E+06	5.81E+13
Sr91	4.93E+07	2.99E+04	2.03E-05	1.82E-01	1.68E+03	2.43E+12	0.0100	4.42E+09	1.43E+10
Sr92	5.33E+07	3.23E+04	7.10E-05	2.51E-01	8.07E+02	7.51E+11	0.0100	1.88E+09	2.12E+09
WB =								2.88E+12	3.01E+15
								TEDE =	3.01E+15
Ex NG =								2.30E+12	

Table 3 – HB Two Hour

MWt =	1650	BR =	3.50E-04	m3/s	Inhalation	2-hour		EE	Inhalation
Nuclide	Activity	Ci/MWt	DK /sec	EE DCF	DCF	Integral	Rel fract	Product	Product
I130	1.39E+06	8.45E+02	1.56E-05	3.85E-01	7.36E+04	9.50E+09	0.2500	9.14E+08	6.11E+10
I131	4.33E+07	2.62E+04	9.98E-07	6.73E-02	1.07E+06	3.10E+11	0.2500	5.22E+09	2.91E+13
I132	6.26E+07	3.79E+04	8.37E-05	4.14E-01	6.29E+03	3.39E+11	0.2500	3.50E+10	1.86E+11
I133	8.78E+07	5.32E+04	9.26E-06	1.09E-01	1.81E+05	6.11E+11	0.2500	1.67E+10	9.68E+12
I134	9.81E+07	5.94E+04	2.20E-04	4.81E-01	1.07E+03	3.54E+11	0.2500	4.26E+10	3.32E+10
I135	8.38E+07	5.08E+04	2.91E-05	3.07E-01	3.14E+04	5.45E+11	0.2500	4.18E+10	1.50E+12
								Thyroid =	4.05E+13
MWt =	1650	BR =	3.50E-04	m3/s	Inhalation	2-hour		EE	Inhalation
Nuclide	Activity	Ci/MWt	DK /sec	EE DCF	DCF	Integral	Rel fract	Product	Product
Kr85m	1.04E+07	6.29E+03	4.30E-05	2.77E-02	0	6.43E+10	1.0000	1.78E+09	0.00E+00
Kr85	6.88E+05	4.17E+02	2.05E-09	4.40E-04	0	4.95E+09	1.0000	2.18E+06	0.00E+00
Kr87	2.04E+07	1.24E+04	1.51E-04	1.52E-01	0	8.95E+10	1.0000	1.36E+10	0.00E+00
Kr88	2.71E+07	1.64E+04	6.78E-05	3.77E-01	0	1.54E+11	1.0000	5.82E+10	0.00E+00
Xe131m	4.87E+05	2.95E+02	6.74E-07	1.44E-03	0	3.49E+09	1.0000	5.03E+06	0.00E+00
Xe133m	2.75E+06	1.67E+03	3.67E-06	5.07E-03	0	1.95E+10	1.0000	9.91E+07	0.00E+00
Xe133	8.80E+07	5.33E+04	1.53E-06	5.77E-03	0	6.30E+11	1.0000	3.64E+09	0.00E+00
Xe135m	1.88E+07	1.14E+04	7.56E-04	7.55E-02	0	2.47E+10	1.0000	1.86E+09	0.00E+00
Xe135	1.99E+07	1.21E+04	2.12E-05	4.40E-02	0	1.33E+11	1.0000	5.85E+09	0.00E+00
Xe137	7.91E+07	4.79E+04	2.96E-03	3.03E-02	0	2.67E+10	1.0000	8.10E+08	0.00E+00
Xe138	7.42E+07	4.50E+04	6.80E-04	2.13E-01	0	1.08E+11	1.0000	2.31E+10	0.00E+00
I130	1.39E+06	8.45E+02	1.56E-05	3.85E-01	2.64E+03	9.50E+09	0.2500	9.14E+08	2.19E+09
I131	4.33E+07	2.62E+04	9.98E-07	6.73E-02	3.29E+04	3.10E+11	0.2500	5.22E+09	8.94E+11
I132	6.26E+07	3.79E+04	8.37E-05	4.14E-01	3.81E+02	3.39E+11	0.2500	3.50E+10	1.13E+10
I133	8.78E+07	5.32E+04	9.26E-06	1.09E-01	5.85E+03	6.11E+11	0.2500	1.67E+10	3.13E+11
I134	9.81E+07	5.94E+04	2.20E-04	4.81E-01	1.31E+02	3.54E+11	0.2500	4.26E+10	4.06E+09
I135	8.38E+07	5.08E+04	2.91E-05	3.07E-01	1.23E+03	5.45E+11	0.2500	4.18E+10	5.86E+10
Rb86	1.27E+05	7.70E+01	4.30E-07	1.78E-02	6.62E+03	9.13E+08	0.0100	1.63E+05	2.12E+07
Rb88	2.77E+07	1.68E+04	6.49E-04	1.24E-01	8.36E+01	4.23E+10	0.0100	5.24E+07	1.24E+07
Cs134	1.43E+07	8.68E+03	1.07E-08	2.80E-01	4.63E+04	1.03E+11	0.0100	2.89E+08	1.67E+10
Cs136	3.00E+06	1.82E+03	6.12E-07	3.92E-01	7.33E+03	2.16E+10	0.0100	8.45E+07	5.53E+08
Cs137	7.58E+06	4.59E+03	7.32E-10	1.01E-01	3.19E+04	5.46E+10	0.0100	5.51E+07	6.09E+09
Cs138	8.13E+07	4.93E+04	3.59E-04	4.48E-01	1.01E+02	2.09E+11	0.0100	9.38E+08	7.40E+07

Sb127	4.09E+06	2.48E+03	2.08E-06	1.23E-01	6.03E+03	2.92E+10	0.0100	3.60E+07	6.17E+08
Sb129	1.25E+07	7.58E+03	4.46E-05	2.64E-01	6.44E+02	7.70E+10	0.0100	2.03E+08	1.74E+08
Te127m	7.08E+05	4.29E+02	7.36E-08	5.44E-04	2.15E+04	5.09E+09	0.0100	2.77E+04	3.83E+08
Te127	4.05E+06	2.45E+03	2.06E-05	8.95E-04	3.18E+02	2.71E+10	0.0100	2.42E+05	3.01E+07
Te129m	2.26E+06	1.37E+03	2.39E-07	1.23E-02	2.40E+04	1.63E+10	0.0100	2.00E+06	1.37E+09
Te131m	8.56E+06	5.19E+03	6.42E-06	2.76E-01	6.50E+03	6.02E+10	0.0100	1.66E+08	1.37E+09
Te132	6.11E+07	3.70E+04	2.46E-06	3.81E-02	9.44E+03	4.36E+11	0.0100	1.66E+08	1.44E+10
Ba139	7.75E+07	4.70E+04	1.40E-04	8.03E-03	1.72E+02	3.52E+11	0.0100	2.82E+07	2.12E+08
Ba140	7.43E+07	4.50E+04	6.30E-07	3.17E-02	3.74E+03	5.34E+11	0.0100	1.69E+08	6.99E+09
Mo99	7.99E+07	4.84E+04	2.92E-06	2.69E-02	3.96E+03	5.69E+11	0.0100	1.53E+08	7.89E+09
Tc99m	7.03E+07	4.26E+04	3.20E-05	2.18E-02	3.26E+01	4.52E+11	0.0100	9.86E+07	5.16E+07
Ru103	7.12E+07	4.32E+04	2.04E-07	8.33E-02	8.96E+03	5.12E+11	0.0100	4.27E+08	1.61E+10
Ru105	5.05E+07	3.06E+04	4.34E-05	1.41E-01	4.55E+02	3.12E+11	0.0100	4.40E+08	4.97E+08
Ru106	2.96E+07	1.79E+04	2.18E-08	3.85E-02	4.77E+05	2.13E+11	0.0100	8.20E+07	3.56E+11
Rh105	4.75E+07	2.88E+04	5.45E-06	1.38E-02	9.55E+02	3.35E+11	0.0100	4.63E+07	1.12E+09
Y90	5.76E+06	3.49E+03	3.01E-06	7.03E-04	8.44E+03	4.10E+10	0.0100	2.88E+05	1.21E+09
Y91	5.13E+07	3.11E+04	1.37E-07	9.62E-04	4.88E+04	3.69E+11	0.0100	3.55E+06	6.31E+10
Y92	5.28E+07	3.20E+04	5.44E-05	4.81E-02	7.81E+02	3.15E+11	0.0100	1.51E+08	8.60E+08
Y93	6.04E+07	3.66E+04	1.91E-05	1.78E-02	2.15E+03	4.06E+11	0.0100	7.23E+07	3.06E+09
Zr95	7.22E+07	4.38E+04	1.25E-07	1.33E-01	2.36E+04	5.20E+11	0.0100	6.91E+08	4.29E+10
Zr97	7.20E+07	4.36E+04	1.14E-05	1.64E-01	4.33E+03	4.98E+11	0.0100	8.16E+08	7.54E+09
Nb95	7.35E+07	4.45E+04	2.28E-07	1.38E-01	5.81E+03	5.29E+11	0.0100	7.30E+08	1.08E+10
La140	7.82E+07	4.74E+04	4.78E-06	4.33E-01	4.85E+03	5.53E+11	0.0100	2.40E+09	9.40E+09
La141	6.98E+07	4.23E+04	4.90E-05	8.84E-03	5.81E+02	4.23E+11	0.0100	3.74E+07	8.61E+08
La142	6.72E+07	4.07E+04	1.25E-04	5.33E-01	2.53E+02	3.19E+11	0.0100	1.70E+09	2.82E+08
Pr143	6.46E+07	3.92E+04	5.92E-07	7.77E-05	8.10E+03	4.64E+11	0.0100	3.61E+05	1.32E+10
Nd147	2.78E+07	1.68E+04	7.31E-07	2.29E-02	6.85E+03	2.00E+11	0.0100	4.57E+07	4.79E+09
Am241	6.29E+03	3.81E+00	5.08E-11	3.03E-03	4.44E+08	4.53E+07	0.0100	1.37E+03	7.04E+10
Cm242	2.68E+06	1.62E+03	4.93E-08	2.11E-05	1.73E+07	1.93E+10	0.0100	4.07E+03	1.17E+12
Cm244	5.89E+05	3.57E+02	1.21E-09	1.82E-05	2.48E+08	4.24E+09	0.0100	7.72E+02	3.68E+12
Ce141	7.11E+07	4.31E+04	2.47E-07	1.27E-02	8.95E+03	5.11E+11	0.0100	6.50E+07	1.60E+10
Ce143	6.50E+07	3.94E+04	5.83E-06	4.77E-02	3.39E+03	4.58E+11	0.0100	2.19E+08	5.44E+09
Ce144	6.01E+07	3.64E+04	2.82E-08	1.03E-02	3.74E+05	4.33E+11	0.0100	4.46E+07	5.66E+11
Np239	8.73E+08	5.29E+05	3.41E-06	2.85E-02	2.51E+03	6.21E+12	0.0100	1.77E+09	5.45E+10
Pu238	2.39E+05	1.45E+02	2.50E-10	1.81E-05	2.88E+08	1.72E+09	0.0100	3.11E+02	1.73E+12
Pu239	1.39E+04	8.42E+00	9.13E-13	1.57E-05	3.08E+08	1.00E+08	0.0100	1.57E+01	1.08E+11

Pu240	2.24E+04	1.36E+01	3.36E-12	1.76E-05	3.08E+08	1.61E+08	0.0100	2.84E+01	1.74E+11
Pu241	6.07E+06	3.68E+03	1.53E-09	2.68E-07	4.96E+06	4.37E+10	0.0100	1.17E+02	7.59E+11
Sr89	3.83E+07	2.32E+04	1.59E-07	2.86E-04	4.14E+04	2.76E+11	0.0100	7.88E+05	3.99E+10
Sr90	5.49E+06	3.33E+03	7.54E-10	2.79E-05	1.30E+06	3.95E+10	0.0100	1.10E+04	1.80E+11
Sr91	4.82E+07	2.92E+04	2.03E-05	1.82E-01	1.68E+03	3.23E+11	0.0100	5.88E+08	1.90E+09
Sr92	5.22E+07	3.16E+04	7.10E-05	2.51E-01	8.07E+02	2.94E+11	0.0100	7.39E+08	8.31E+08
WB =								2.65E+11	1.04E+13
								TEDE =	1.07E+13
Ex NG =								1.56E+11	
								NG + I =	1.53E+12

Table 4 – HB Thirty Day

MWt =	1650	BR =	3.50E-04	m3/s	Inhalation	30-day		EE	Inhalation
Nuclide	Activity	Ci/MWt	DK /sec	EE DCF	DCF	Integral	Rel fract	Product	Product
I130	1.39E+06	8.45E+02	1.56E-05	3.85E-01	7.36E+04	8.94E+10	0.2500	8.60E+09	5.76E+11
I131	4.33E+07	2.62E+04	9.98E-07	6.73E-02	1.07E+06	4.01E+13	0.2500	6.75E+11	3.75E+15
I132	6.26E+07	3.79E+04	8.37E-05	4.14E-01	6.29E+03	7.48E+11	0.2500	7.74E+10	4.12E+11
I133	8.78E+07	5.32E+04	9.26E-06	1.09E-01	1.81E+05	9.48E+12	0.2500	2.58E+11	1.50E+14
I134	9.81E+07	5.94E+04	2.20E-04	4.81E-01	1.07E+03	4.46E+11	0.2500	5.36E+10	4.17E+10
I135	8.38E+07	5.08E+04	2.91E-05	3.07E-01	3.14E+04	2.88E+12	0.2500	2.21E+11	7.92E+12
								Thyroid =	3.91E+15
MWt =	1650	BR =	3.50E-04	m3/s	Inhalation	30-day		EE	Inhalation
Nuclide	Activity	Ci/MWt	DK /sec	EE DCF	DCF	Integral	Rel fract	Product	Product
Kr85m	1.04E+07	6.29E+03	4.30E-05	2.77E-02	0	2.42E+11	1.0000	6.69E+09	0.00E+00
Kr85	6.88E+05	4.17E+02	2.05E-09	4.40E-04	0	1.78E+12	1.0000	7.82E+08	0.00E+00
Kr87	2.04E+07	1.24E+04	1.51E-04	1.52E-01	0	1.35E+11	1.0000	2.05E+10	0.00E+00
Kr88	2.71E+07	1.64E+04	6.78E-05	3.77E-01	0	4.00E+11	1.0000	1.51E+11	0.00E+00
Xe131m	4.87E+05	2.95E+02	6.74E-07	1.44E-03	0	5.96E+11	1.0000	8.58E+08	0.00E+00
Xe133m	2.75E+06	1.67E+03	3.67E-06	5.07E-03	0	7.49E+11	1.0000	3.80E+09	0.00E+00
Xe133	8.80E+07	5.33E+04	1.53E-06	5.77E-03	0	5.64E+13	1.0000	3.26E+11	0.00E+00
Xe135m	1.88E+07	1.14E+04	7.56E-04	7.55E-02	0	2.48E+10	1.0000	1.87E+09	0.00E+00
Xe135	1.99E+07	1.21E+04	2.12E-05	4.40E-02	0	9.39E+11	1.0000	4.13E+10	0.00E+00
Xe137	7.91E+07	4.79E+04	2.96E-03	3.03E-02	0	2.67E+10	1.0000	8.10E+08	0.00E+00
Xe138	7.42E+07	4.50E+04	6.80E-04	2.13E-01	0	1.09E+11	1.0000	2.33E+10	0.00E+00
I130	1.39E+06	8.45E+02	1.56E-05	3.85E-01	2.64E+03	8.94E+10	0.2500	8.60E+09	2.06E+10
I131	4.33E+07	2.62E+04	9.98E-07	6.73E-02	3.29E+04	4.01E+13	0.2500	6.75E+11	1.15E+14
I132	6.26E+07	3.79E+04	8.37E-05	4.14E-01	3.81E+02	7.48E+11	0.2500	7.74E+10	2.49E+10
I133	8.78E+07	5.32E+04	9.26E-06	1.09E-01	5.85E+03	9.48E+12	0.2500	2.58E+11	4.85E+12
I134	9.81E+07	5.94E+04	2.20E-04	4.81E-01	1.31E+02	4.46E+11	0.2500	5.36E+10	5.11E+09
I135	8.38E+07	5.08E+04	2.91E-05	3.07E-01	1.23E+03	2.88E+12	0.2500	2.21E+11	3.10E+11
Rb86	1.27E+05	7.70E+01	4.30E-07	1.78E-02	6.62E+03	1.98E+11	0.0100	3.53E+07	4.60E+09
Rb88	2.77E+07	1.68E+04	6.49E-04	1.24E-01	8.36E+01	4.27E+10	0.0100	5.29E+07	1.25E+07
Cs134	1.43E+07	8.68E+03	1.07E-08	2.80E-01	4.63E+04	3.66E+13	0.0100	1.03E+11	5.94E+12
Cs136	3.00E+06	1.82E+03	6.12E-07	3.92E-01	7.33E+03	3.90E+12	0.0100	1.53E+10	1.00E+11
Cs137	7.58E+06	4.59E+03	7.32E-10	1.01E-01	3.19E+04	1.96E+13	0.0100	1.98E+10	2.19E+12
Cs138	8.13E+07	4.93E+04	3.59E-04	4.48E-01	1.01E+02	2.26E+11	0.0100	1.01E+09	8.01E+07

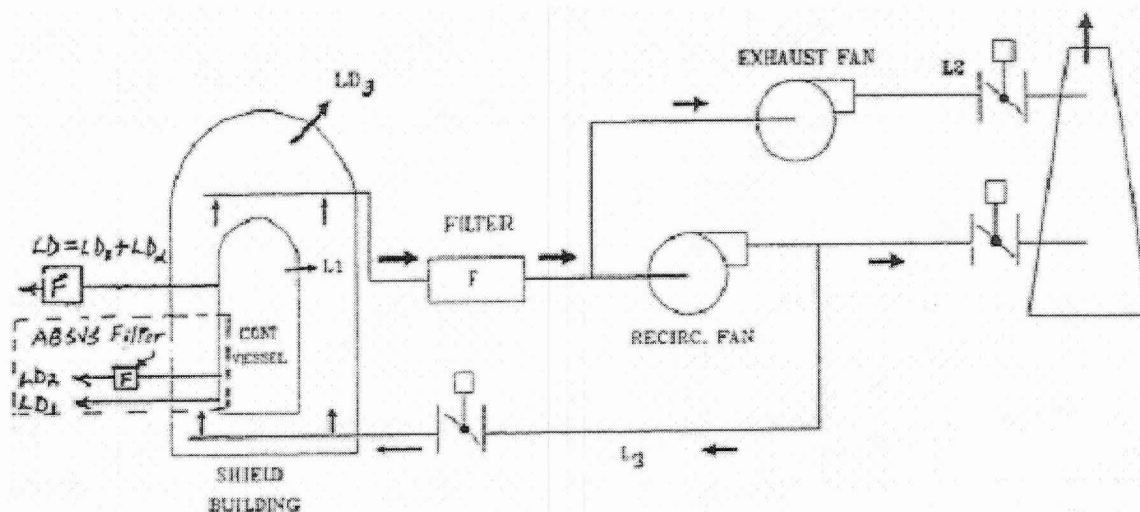
Sb127	4.09E+06	2.48E+03	2.08E-06	1.23E-01	6.03E+03	1.96E+12	0.0100	2.41E+09	4.13E+10
Sb129	1.25E+07	7.58E+03	4.46E-05	2.64E-01	6.44E+02	2.80E+11	0.0100	7.40E+08	6.32E+08
Te127m	7.08E+05	4.29E+02	7.36E-08	5.44E-04	2.15E+04	1.67E+12	0.0100	9.08E+06	1.26E+11
Te127	4.05E+06	2.45E+03	2.06E-05	8.95E-04	3.18E+02	1.97E+11	0.0100	1.76E+06	2.19E+08
Te129m	2.26E+06	1.37E+03	2.39E-07	1.23E-02	2.40E+04	4.37E+12	0.0100	5.37E+08	3.67E+11
Te131m	8.56E+06	5.19E+03	6.42E-06	2.76E-01	6.50E+03	1.33E+12	0.0100	3.68E+09	3.03E+10
Te132	6.11E+07	3.70E+04	2.46E-06	3.81E-02	9.44E+03	2.48E+13	0.0100	9.44E+09	8.19E+11
Ba139	7.75E+07	4.70E+04	1.40E-04	8.03E-03	1.72E+02	5.54E+11	0.0100	4.45E+07	3.33E+08
Ba140	7.43E+07	4.50E+04	6.30E-07	3.17E-02	3.74E+03	9.49E+13	0.0100	3.01E+10	1.24E+12
Mo99	7.99E+07	4.84E+04	2.92E-06	2.69E-02	3.96E+03	2.73E+13	0.0100	7.36E+09	3.79E+11
Tc99m	7.03E+07	4.26E+04	3.20E-05	2.18E-02	3.26E+01	2.20E+12	0.0100	4.79E+08	2.51E+08
Ru103	7.12E+07	4.32E+04	2.04E-07	8.33E-02	8.96E+03	1.43E+14	0.0100	1.19E+11	4.49E+12
Ru105	5.05E+07	3.06E+04	4.34E-05	1.41E-01	4.55E+02	1.16E+12	0.0100	1.64E+09	1.85E+09
Ru106	2.96E+07	1.79E+04	2.18E-08	3.85E-02	4.77E+05	7.46E+13	0.0100	2.87E+10	1.25E+14
Rh105	4.75E+07	2.88E+04	5.45E-06	1.38E-02	9.55E+02	8.72E+12	0.0100	1.20E+09	2.91E+10
Y90	5.76E+06	3.49E+03	3.01E-06	7.03E-04	8.44E+03	1.91E+12	0.0100	1.34E+07	5.65E+10
Y91	5.13E+07	3.11E+04	1.37E-07	9.62E-04	4.88E+04	1.12E+14	0.0100	1.08E+09	1.91E+13
Y92	5.28E+07	3.20E+04	5.44E-05	4.81E-02	7.81E+02	9.71E+11	0.0100	4.67E+08	2.65E+09
Y93	6.04E+07	3.66E+04	1.91E-05	1.78E-02	2.15E+03	3.16E+12	0.0100	5.63E+08	2.38E+10
Zr95	7.22E+07	4.38E+04	1.25E-07	1.33E-01	2.36E+04	1.60E+14	0.0100	2.13E+11	1.32E+13
Zr97	7.20E+07	4.36E+04	1.14E-05	1.64E-01	4.33E+03	6.32E+12	0.0100	1.04E+10	9.57E+10
Nb95	7.35E+07	4.45E+04	2.28E-07	1.38E-01	5.81E+03	1.44E+14	0.0100	1.99E+11	2.93E+12
La140	7.82E+07	4.74E+04	4.78E-06	4.33E-01	4.85E+03	1.64E+13	0.0100	7.08E+10	2.78E+11
La141	6.98E+07	4.23E+04	4.90E-05	8.84E-03	5.81E+02	1.42E+12	0.0100	1.26E+08	2.90E+09
La142	6.72E+07	4.07E+04	1.25E-04	5.33E-01	2.53E+02	5.38E+11	0.0100	2.87E+09	4.76E+08
Pr143	6.46E+07	3.92E+04	5.92E-07	7.77E-05	8.10E+03	8.56E+13	0.0100	6.65E+07	2.43E+12
Nd147	2.78E+07	1.68E+04	7.31E-07	2.29E-02	6.85E+03	3.23E+13	0.0100	7.40E+09	7.75E+11
Am241	6.29E+03	3.81E+00	5.08E-11	3.03E-03	4.44E+08	1.63E+10	0.0100	4.94E+05	2.53E+13
Cm242	2.68E+06	1.62E+03	4.93E-08	2.11E-05	1.73E+07	6.52E+12	0.0100	1.38E+06	3.95E+14
Cm244	5.89E+05	3.57E+02	1.21E-09	1.82E-05	2.48E+08	1.52E+12	0.0100	2.77E+05	1.32E+15
Ce141	7.11E+07	4.31E+04	2.47E-07	1.27E-02	8.95E+03	1.36E+14	0.0100	1.73E+10	4.26E+12
Ce143	6.50E+07	3.94E+04	5.83E-06	4.77E-02	3.39E+03	1.11E+13	0.0100	5.32E+09	1.32E+11
Ce144	6.01E+07	3.64E+04	2.82E-08	1.03E-02	3.74E+05	1.50E+14	0.0100	1.55E+10	1.97E+14
Np239	8.73E+08	5.29E+05	3.41E-06	2.85E-02	2.51E+03	2.56E+14	0.0100	7.30E+10	2.25E+12
Pu238	2.39E+05	1.45E+02	2.50E-10	1.81E-05	2.88E+08	6.19E+11	0.0100	1.12E+05	6.24E+14
Pu239	1.39E+04	8.42E+00	9.13E-13	1.57E-05	3.08E+08	3.60E+10	0.0100	5.66E+03	3.88E+13

Pu240	2.24E+04	1.36E+01	3.36E-12	1.76E-05	3.08E+08	5.81E+10	0.0100	1.02E+04	6.26E+13
Pu241	6.07E+06	3.68E+03	1.53E-09	2.68E-07	4.96E+06	1.57E+13	0.0100	4.21E+04	2.73E+14
Sr89	3.83E+07	2.32E+04	1.59E-07	2.86E-04	4.14E+04	8.14E+13	0.0100	2.33E+08	1.18E+13
Sr90	5.49E+06	3.33E+03	7.54E-10	2.79E-05	1.30E+06	1.42E+13	0.0100	3.97E+06	6.47E+13
Sr91	4.82E+07	2.92E+04	2.03E-05	1.82E-01	1.68E+03	2.37E+12	0.0100	4.32E+09	1.40E+10
Sr92	5.22E+07	3.16E+04	7.10E-05	2.51E-01	8.07E+02	7.35E+11	0.0100	1.85E+09	2.08E+09
WB =								2.84E+12	3.32E+15
								TEDE =	3.32E+15
Ex NG =								2.26E+12	

Preparation of the STARDOSE plant model

STARDOSE is used to confirm the results summarized in Table 5. The plant model is presented below.

Arrangement



Activity Releases from the Coolant and Core

The junctions from the Core control volume to the primary containment (PC) control volume and the Sump (explained below) allow the activity to be added according to hourly rates. The hourly rates are equal to the RG 1.4 release fractions (100% of the noble gas, 25% of the iodine, and 1% of the remaining activity) divided by 0.00056 hours (two seconds to simulate an instantaneous release).

The release tables used in STARDOSE reflecting the above modeling are as follows (the values are fractions per hour for the end times given in hours):

Release to PC

Time	N_Gas	I_Grp	CsGrp	TeGrp	BaGrp	NMtlS	CeGrp	LaGrp	SrGrp
0.00056	1786	446	17.9	17.9	17.9	17.9	17.9	17.9	17.9
720	0	0	0	0	0	0	0	0	0

Release to Sump

Time	N_Gas	I_Grp	CsGrp	TeGrp	BaGrp	NMtlS	CeGrp	LaGrp	SrGrp
0.00056	0	446	0	0	0	0	0	0	0
720	0	0	0	0	0	0	0	0	0

Note that the release to the sump is included. If Engineered Safety Feature (ESF) leakage outside containment were to be considered (not currently part of the model) the organic and particulate fractions would be filtered completely and the elemental iodine would be filtered

assuming an efficiency of 89%. This assumption would be equivalent to a 10% release of the iodine in the sump water but all as elemental. Note that in order to model a 50% release of iodine to the sump water (a typical assumption for ESF leakage modeling), the I_Grp release rate to the sump would have to be increased by a factor of two to 892 per hour.

Activity Removal Rates

In the PC, elemental iodine is removed at a rate of 20 per hour and the particulate is removed at a rate of 0.45 per hour. Those rates are applied from $t = 1$ minute to $t = 14.8$ minutes when a DF of 100 is reached for the elemental iodine.

Filtration of Activity in Release Pathways

The following is the equivalent filtration of releases via the Auxiliary Building (0.1% per day of the containment volume through the building filters and 0.01% per day bypassing the building filters, both leak rates reduced by a factor of two at $t = 24$ hours).

Elemental:

$$\text{Eq. Eff.} = \frac{.9 \times .1\%/ \text{day}}{.11\%/ \text{day}} = .818$$

Organic:

$$\text{Eq. Eff.} = \frac{.7 \times .1\%/ \text{day}}{.11\%/ \text{day}} = .636$$

Particulate:

$$\text{Eq. Eff.} = \frac{.99 \times .1\%/ \text{day}}{.11\%/ \text{day}} = .90$$

0.14% per day of the containment volume is leaked to the Shield Building (reduced by a factor two at $t = 24$ hours). The filter efficiency for the Shield Building exhaust path and for the Shield Building recirculation path is 90% for elemental iodine, 70% for organic iodine, and 99% for particulate. The time-dependent flows are as follows:

Time Period	Shield Building Exhaust (CFM)	Shield Building Exhaust (HR-1)*	Shield Building Leakage (CFM)	Shield Building Leakage (HR-1)*	Shield Building Recirc. (CFM)	Shield Building Recirc. (HR-1)*
0 - 36 Sec.	0	0.0000	1558.3	0.5000	0	0.0000
36 Sec. - 4.5 Min.	6000	1.9251	1558.3	0.5000	0	0.0000
4.5 - 10 Min.	3000	0.9626	0	0.0000	0	0.0000
10 - 20 Min.	1300	0.4171	0	0.0000	0	0.0000
20 Min. - 30 Days	1000	0.3209	0	0.0000	4000	1.2834

*Leak Rate, 1/HR, based on a Shield Building Volume of 3.74×10^4 Cu. Ft. and a Participation Factor of 0.5

STARDOSE Library File

The LIBFILE1.TXT file used in the analysis is presented in Appendix Aa for the OFA fuel and Appendix Ab for the HB fuel.

Performance of STARDOSE Runs.

The INPUT.DAT file is presented in Appendix B. Excerpts of the output files for both the OFA fuel case and the HB fuel case are presented in Appendix C.

Performance of MicroShield Runs.

The use of STARGATE [8] to extract $t = 0$ “waterborne” (i.e., non-NG) source activities from the STARDOSE RESULTS.OUT files and the use of those activities in MicroShield [9] to obtain long-term dose rates is described in Appendix D.

Results

Table 5 – Results Summary – Dose Index

	Thyroid Index	WB Index	WB w/o NG	TEDE Index	NG + I TEDE
OFA Two-Hour EAB	4.15E+13	2.70E+11	1.60E+11	9.85E+12	1.57E+12
OFA Thirty-Day LPZ	4.01E+15	2.88E+12	2.30E+12	3.01E+15	N/A
HB Two-Hour EAB	4.05E+13	2.65E+11	1.56E+11	1.07E+13	1.53E+12
HB Thirty-Day LPZ	3.91E+15	2.84E+12	2.26E+12	3.32E+15	N/A
OFA/HB Two Hour	1.025	1.019	1.026	0.921	1.026
OFA/HB Thirty Day	1.026	1.014	1.018	0.901	N/A

Table 6 – Results Summary – STARDOSE (Doses in Rem)

	Thyroid Dose	WB Dose	TEDE Dose
OFA Two-Hour EAB	1.06E+001	1.26E+000	8.00E+000
OFA Thirty-Day LPZ	2.43E+000	1.88E-001	2.23E+000
HB Two-Hour EAB	1.04E+001	1.24E+000	8.66E+000
HB Thirty-Day LPZ	2.37E+000	1.86E-001	2.44E+000
OFA/HB Two Hour	1.019	1.016	0.924
OFA/HB Thirty Day	1.025	1.011	0.914

Table 7 – Comparison of Activity (Ci) Released to Environment –
STARDOSE OFA Fuel Case vs. Item 2.1 (Attachment 3) of Reference [7]

	Core (OFA)	Core (Item 2.1)	2-Hour (OFA)	2-Hour (Item 2.1)	30-Day (OFA)	30-Day (Item 2.1)
Kr85m	1.06E+07	1.1E+07	1.11E+03	1.15E+03	5.75E+03	5.86E+03
Kr85	6.23E+05	6.9E+05	7.64E+01	8.62E+01	2.35E+04	2.61E+04
Kr87	2.08E+07	2.1E+07	1.50E+03	1.51E+03	2.59E+03	2.61E+03
Kr88	2.77E+07	2.9E+07	2.64E+03	2.76E+03	8.94E+03	9.22E+03
Xe131m	4.97E+05	3.2E+05	6.08E+01	3.92E+01	9.22E+03	5.92E+03
Xe133m	2.81E+06	1.3E+07	3.40E+02	1.57E+03	1.37E+04	6.52E+04
Xe133	8.99E+07	9.2E+07	1.10E+04	1.12E+04	9.21E+05	9.48E+05
Xe135m	1.92E+07	1.9E+07	3.75E+02	3.80E+02	3.77E+02	3.82E+02
Xe135	1.82E+07	1.9E+07	2.07E+03	2.15E+03	2.06E+04	2.14E+04
Xe137	8.09E+07	8.1E+07	3.83E+02	3.78E+02	3.83E+02	3.78E+02
Xe138	7.59E+07	7.3E+07	1.65E+03	1.65E+03	1.67E+03	1.67E+03
I131	4.43E+07	4.6E+07	3.13E+01	3.26E+01	1.78E+03	1.84E+03
I132	6.41E+07	6.6E+07	3.85E+01	3.72E+01	4.23E+02	7.06E+01
I133	8.97E+07	9.2E+07	6.19E+01	6.35E+01	6.11E+02	6.16E+02
I134	1.01E+08	9.9E+07	4.26E+01	4.16E+01	5.00E+01	4.88E+01
I135	8.57E+07	8.5E+07	5.60E+01	5.56E+01	2.37E+02	2.37E+02

With the exception of I-132 30-day releases, the agreement is good in light of differences in core inventory for Xe-131m and Xe-133m. The problem with I-132 at 30 days may be that STARDOSE has daughter in growth from Te-132 that may not have been included in the methodology of Item 2.1 of reference [7].

Conclusions

Both the dose index spreadsheet and the confirming STARDOSE run produce essentially the same results. The OFA fuel produces higher thyroid and whole body doses than the HB fuel over the 30-day dose interval for the MHA dose calculation, although while the OFA fuel thyroid dose margin is increasing with time, the whole body dose margin is decreasing, both with and without noble gases included. This decreasing whole body dose margin for the OFA fuel suggests that for EQ purposes, the potential exists for the HB fuel external exposure dose rates to eventually exceed those for the OFA fuel. This potential has been confirmed by the MicroShield analysis presented in Appendix D. However, the external exposure dose rate becomes only marginally higher for the HB fuel than for the OFA fuel (see Appendix D); and given the margin that exists in the whole body dose at 30 days, it is unlikely that the external exposure (i.e., EQ) doses would become greater for the HB fuel than for the OFA fuel beyond 30 days.

The TEDE dose indices for the two cases indicate that HB fuel may be limiting for situations in which TEDE must be reported except for Fuel Handling Accident (FHA) which is dominated by noble gas and iodine. TEDE is not reported for dose analyses performed in accordance with reference [1]; and, except for FHA, this observation is made here for information only.

LIBFILE1.TXT - OFA

n_isotopes	77	n_isotope_groups	11											
Kr85m N_Gas	NONE	NONE	1.06E+074.30E-05 0	2.77E-02 0	0	0	0	0	0	0	0	0	0	0
Kr85 N_Gas	NONE	NONE	6.23E+052.05E-09 0	4.40E-04 0	0	0	0	0	0	0	0	0	0	0
Kr87 N_Gas	NONE	NONE	2.08E+071.51E-04 0	1.52E-01 0	0	0	0	0	0	0	0	0	0	0
Kr88 N_Gas	NONE	Rb88	2.77E+076.78E-05 0	3.77E-01 0	0	0	0	0	0	0	0	0	0	0
Xe131m N_Gas	NONE	NONE	4.97E+056.74E-07 0	1.44E-03 0	0	0	0	0	0	0	0	0	0	0
Xe133m N_Gas	NONE	NONE	2.81E+063.67E-06 0	5.07E-03 0	0	0	0	0	0	0	0	0	0	0
Xe133 N_Gas	I133Elem	NONE	8.99E+071.53E-06 0	5.77E-03 0	0	0	0	0	0	0	0	0	0	0
Xe135m N_Gas	NONE	NONE	1.92E+077.56E-04 0	7.55E-02 0	0	0	0	0	0	0	0	0	0	0
Xe135 N_Gas	I135Elem	NONE	1.82E+072.12E-05 0	4.40E-02 0	0	0	0	0	0	0	0	0	0	0
Xe137 N_Gas	NONE	Cs137	8.09E+072.96E-03 0	3.03E-02 0	0	0	0	0	0	0	0	0	0	0
Xe138 N_Gas	NONE	Cs138	7.59E+076.80E-04 0	2.13E-01 0	0	0	0	0	0	0	0	0	0	0
I130Org Org_I	NONE	NONE	1.43E+061.56E-05 7.36E+043.85E-01 0		0	0	2.64E+030	0	0	0	0	0	0	0
I131Org Org_I	NONE	NONE	4.43E+079.98E-07 1.07E+066.73E-02 0		0	0	3.29E+040	0	0	0	0	0	0	0
I132Org Org_I	NONE	NONE	6.41E+078.37E-05 6.29E+034.14E-01 0		0	0	3.81E+020	0	0	0	0	0	0	0
I133Org Org_I	NONE	NONE	8.97E+079.26E-06 1.81E+051.09E-01 0		0	0	5.85E+030	0	0	0	0	0	0	0
I134Org Org_I	NONE	NONE	1.01E+082.20E-04 1.07E+034.81E-01 0		0	0	1.31E+020	0	0	0	0	0	0	0
I135Org Org_I	NONE	NONE	8.57E+072.91E-05 3.14E+043.07E-01 0		0	0	1.23E+030	0	0	0	0	0	0	0
I130Elem Elm_I	NONE	NONE	1.43E+061.56E-05 7.36E+043.85E-01 0		0	0	2.64E+030	0	0	0	0	0	0	0
I131Elem Elm_I	Te131m	NONE	4.43E+079.98E-07 1.07E+066.73E-02 0		0	0	3.29E+040	0	0	0	0	0	0	0
I132Elem Elm_I	Te132	NONE	6.41E+078.37E-05 6.29E+034.14E-01 0		0	0	3.81E+020	0	0	0	0	0	0	0
I133Elem Elm_I	NONE	Xe133	8.97E+079.26E-06 1.81E+051.09E-01 0		0	0	5.85E+030	0	0	0	0	0	0	0
I134Elem Elm_I	NONE	NONE	1.01E+082.20E-04 1.07E+034.81E-01 0		0	0	1.31E+020	0	0	0	0	0	0	0
I135Elem Elm_I	NONE	Xe135	8.57E+072.91E-05 3.14E+043.07E-01 0		0	0	1.23E+030	0	0	0	0	0	0	0
I130Part Prt_I	NONE	NONE	1.43E+061.56E-05 7.36E+043.85E-01 0		0	0	2.64E+030	0	0	0	0	0	0	0
I131Part Prt_I	NONE	NONE	4.43E+079.98E-07 1.07E+066.73E-02 0		0	0	3.29E+040	0	0	0	0	0	0	0
I132Part Prt_I	NONE	NONE	6.41E+078.37E-05 6.29E+034.14E-01 0		0	0	3.81E+020	0	0	0	0	0	0	0
I133Part Prt_I	NONE	NONE	8.97E+079.26E-06 1.81E+051.09E-01 0		0	0	5.85E+030	0	0	0	0	0	0	0
I134Part Prt_I	NONE	NONE	1.01E+082.20E-04 1.07E+034.81E-01 0		0	0	1.31E+020	0	0	0	0	0	0	0
I135Part Prt_I	NONE	NONE	8.57E+072.91E-05 3.14E+043.07E-01 0		0	0	1.23E+030	0	0	0	0	0	0	0
Rb86 CsGrp	NONE	NONE	1.29E+054.30E-07 0	1.78E-02 0	0	0	6.62E+030	0	0	0	0	0	0	0
Rb88 CsGrp	Kr88	NONE	2.83E+076.49E-04 0	1.24E-01 0	0	0	8.36E+010	0	0	0	0	0	0	0
Cs134 CsGrp	NONE	NONE	1.33E+071.07E-08 0	2.80E-01 0	0	0	4.63E+040	0	0	0	0	0	0	0
Cs136 CsGrp	NONE	NONE	2.91E+066.12E-07 0	3.92E-01 0	0	0	7.33E+030	0	0	0	0	0	0	0
Cs137 CsGrp	Xe137	NONE	6.80E+067.32E-10 0	1.01E-01 0	0	0	3.19E+040	0	0	0	0	0	0	0
Cs138 CsGrp	Xe138	NONE	8.31E+073.59E-04 0	4.48E-01 0	0	0	1.01E+020	0	0	0	0	0	0	0
Sb127 TeGrp	NONE	Te127	4.19E+062.08E-06 0	1.23E-01 0	0	0	6.03E+030	0	0	0	0	0	0	0
Sb129 TeGrp	NONE	NONE	1.28E+074.46E-05 0	2.64E-01 0	0	0	6.44E+020	0	0	0	0	0	0	0

Te127m	TeGrp	NONE	NONE	7.11E+057.36E-08 0	5.44E-04 0	0	0	2.15E+040	0	0	0	0	0
Te127	TeGrp	Sb127	NONE	4.13E+062.06E-05 0	8.95E-04 0	0	0	3.18E+020	0	0	0	0	0
Te129m	TeGrp	NONE	NONE	2.31E+062.39E-07 0	1.23E-02 0	0	0	2.40E+040	0	0	0	0	0
Te131m	TeGrp	NONE	I131Elem	8.75E+066.42E-06 0	2.76E-01 0	0	0	6.50E+030	0	0	0	0	0
Te132	TeGrp	NONE	I132Elem	6.25E+072.46E-06 0	3.81E-02 0	0	0	9.44E+030	0	0	0	0	0
Ba139	BaGrp	NONE	NONE	7.92E+071.40E-04 0	8.03E-03 0	0	0	1.72E+020	0	0	0	0	0
Ba140	BaGrp	NONE	La140	7.61E+076.30E-07 0	3.17E-02 0	0	0	3.74E+030	0	0	0	0	0
Mo99	NMtlis	NONE	Tc99m	8.17E+072.92E-06 0	2.69E-02 0	0	0	3.96E+030	0	0	0	0	0
Tc99m	NMtlis	Mo99	NONE	7.19E+073.20E-05 0	2.18E-02 0	0	0	3.26E+010	0	0	0	0	0
Ru103	NMtlis	NONE	NONE	7.29E+072.04E-07 0	8.33E-02 0	0	0	8.96E+030	0	0	0	0	0
Ru105	NMtlis	NONE	Rh105	5.18E+074.34E-05 0	1.41E-01 0	0	0	4.55E+020	0	0	0	0	0
Ru106	NMtlis	NONE	NONE	2.85E+072.18E-08 0	3.85E-02 0	0	0	4.77E+050	0	0	0	0	0
Rh105	NMtlis	Ru105	NONE	4.83E+075.45E-06 0	1.38E-02 0	0	0	9.55E+020	0	0	0	0	0
Y90	LaGrp	Sr90	NONE	5.20E+063.01E-06 0	7.03E-04 0	0	0	8.44E+030	0	0	0	0	0
Y91	LaGrp	Sr91	NONE	5.24E+071.37E-07 0	9.62E-04 0	0	0	4.88E+040	0	0	0	0	0
Y92	LaGrp	Sr92	NONE	5.39E+075.44E-05 0	4.81E-02 0	0	0	7.81E+020	0	0	0	0	0
Y93	LaGrp	NONE	NONE	6.17E+071.91E-05 0	1.78E-02 0	0	0	2.15E+030	0	0	0	0	0
Zr95	LaGrp	NONE	Nb95	7.35E+071.25E-07 0	1.33E-01 0	0	0	2.36E+040	0	0	0	0	0
Zr97	LaGrp	NONE	NONE	7.36E+071.14E-05 0	1.64E-01 0	0	0	4.33E+030	0	0	0	0	0
Nb95	LaGrp	Zr95	NONE	7.48E+072.28E-07 0	1.38E-01 0	0	0	5.81E+030	0	0	0	0	0
La140	LaGrp	Ba140	NONE	8.01E+074.78E-06 0	4.33E-01 0	0	0	4.85E+030	0	0	0	0	0
La141	LaGrp	NONE	Ce141	7.13E+074.90E-05 0	8.84E-03 0	0	0	5.81E+020	0	0	0	0	0
La142	LaGrp	NONE	NONE	6.87E+071.25E-04 0	5.33E-01 0	0	0	2.53E+020	0	0	0	0	0
Pr143	LaGrp	Ce143	NONE	6.60E+075.92E-07 0	7.77E-05 0	0	0	8.10E+030	0	0	0	0	0
Nd147	LaGrp	NONE	NONE	2.83E+077.31E-07 0	2.29E-02 0	0	0	6.85E+030	0	0	0	0	0
Am241	LaGrp	NONE	NONE	4.98E+035.08E-11 0	3.03E-03 0	0	0	4.44E+080	0	0	0	0	0
Cm242	LaGrp	NONE	NONE	2.37E+064.93E-08 0	2.11E-05 0	0	0	1.73E+070	0	0	0	0	0
Cm244	LaGrp	NONE	NONE	5.29E+051.21E-09 0	1.82E-05 0	0	0	2.48E+080	0	0	0	0	0
Ce141	CeGrp	La141	NONE	7.26E+072.47E-07 0	1.27E-02 0	0	0	8.95E+030	0	0	0	0	0
Ce143	CeGrp	NONE	Pr143	6.64E+075.83E-06 0	4.77E-02 0	0	0	3.39E+030	0	0	0	0	0
Ce144	CeGrp	NONE	NONE	5.92E+072.82E-08 0	1.03E-02 0	0	0	3.74E+050	0	0	0	0	0
Np239	CeGrp	NONE	NONE	8.95E+083.41E-06 0	2.85E-02 0	0	0	2.51E+030	0	0	0	0	0
Pu238	CeGrp	NONE	NONE	2.10E+052.50E-10 0	1.81E-05 0	0	0	2.88E+080	0	0	0	0	0
Pu239	CeGrp	NONE	NONE	1.24E+049.13E-13 0	1.57E-05 0	0	0	3.08E+080	0	0	0	0	0
Pu240	CeGrp	NONE	NONE	2.00E+043.36E-12 0	1.76E-05 0	0	0	3.08E+080	0	0	0	0	0
Pu241	CeGrp	NONE	NONE	5.44E+061.53E-09 0	2.68E-07 0	0	0	4.96E+060	0	0	0	0	0
Sr89	SrGrp	NONE	NONE	3.95E+071.59E-07 0	2.86E-04 0	0	0	4.14E+040	0	0	0	0	0
Sr90	SrGrp	NONE	Y90	4.93E+067.54E-10 0	2.79E-05 0	0	0	1.30E+060	0	0	0	0	0
Sr91	SrGrp	NONE	Y91	4.93E+072.03E-05 0	1.82E-01 0	0	0	1.68E+030	0	0	0	0	0
Sr92	SrGrp	NONE	Y92	5.33E+077.10E-05 0	2.51E-01 0	0	0	8.07E+020	0	0	0	0	0

LIBFILE1.TXT - HB

n_isotopes	77	n_isotope_groups	11											
Kr85m N_Gas	NONE	NONE	1.04E+074.30E-05 0	2.77E-02 0	0	0	0	0	0	0	0	0	0	0
Kr85 N_Gas	NONE	NONE	6.88E+052.05E-09 0	4.40E-04 0	0	0	0	0	0	0	0	0	0	0
Kr87 N_Gas	NONE	NONE	2.03E+071.51E-04 0	1.52E-01 0	0	0	0	0	0	0	0	0	0	0
Kr88 N_Gas	NONE	Rb88	2.72E+076.78E-05 0	3.77E-01 0	0	0	0	0	0	0	0	0	0	0
Xe131m N_Gas	NONE	NONE	4.86E+056.74E-07 0	1.44E-03 0	0	0	0	0	0	0	0	0	0	0
Xe133m N_Gas	NONE	NONE	2.75E+063.67E-06 0	5.07E-03 0	0	0	0	0	0	0	0	0	0	0
Xe133 N_Gas	I133Elem	NONE	8.80E+071.53E-06 0	5.77E-03 0	0	0	0	0	0	0	0	0	0	0
Xe135m N_Gas	NONE	NONE	1.87E+077.56E-04 0	7.55E-02 0	0	0	0	0	0	0	0	0	0	0
Xe135 N_Gas	I135Elem	NONE	1.99E+072.12E-05 0	4.40E-02 0	0	0	0	0	0	0	0	0	0	0
Xe137 N_Gas	NONE	Cs137	7.91E+072.96E-03 0	3.03E-02 0	0	0	0	0	0	0	0	0	0	0
Xe138 N_Gas	NONE	Cs138	7.42E+076.80E-04 0	2.13E-01 0	0	0	0	0	0	0	0	0	0	0
I130Org Org_I	NONE	NONE	1.40E+061.56E-05 7.36E+043.85E-01 0		0	0	2.64E+030	0	0	0	0	0	0	0
I131Org Org_I	NONE	NONE	4.33E+079.98E-07 1.07E+066.73E-02 0		0	0	3.29E+040	0	0	0	0	0	0	0
I132Org Org_I	NONE	NONE	6.26E+078.37E-05 6.29E+034.14E-01 0		0	0	3.81E+020	0	0	0	0	0	0	0
I133Org Org_I	NONE	NONE	8.78E+079.26E-06 1.81E+051.09E-01 0		0	0	5.85E+030	0	0	0	0	0	0	0
I134Org Org_I	NONE	NONE	9.83E+072.20E-04 1.07E+034.81E-01 0		0	0	1.31E+020	0	0	0	0	0	0	0
I135Org Org_I	NONE	NONE	8.38E+072.91E-05 3.14E+043.07E-01 0		0	0	1.23E+030	0	0	0	0	0	0	0
I130Elem Elm_I	NONE	NONE	1.40E+061.56E-05 7.36E+043.85E-01 0		0	0	2.64E+030	0	0	0	0	0	0	0
I131Elem Elm_I	Te131m	NONE	4.33E+079.98E-07 1.07E+066.73E-02 0		0	0	3.29E+040	0	0	0	0	0	0	0
I132Elem Elm_I	Te132	NONE	6.26E+078.37E-05 6.29E+034.14E-01 0		0	0	3.81E+020	0	0	0	0	0	0	0
I133Elem Elm_I	NONE	Xe133	8.78E+079.26E-06 1.81E+051.09E-01 0		0	0	5.85E+030	0	0	0	0	0	0	0
I134Elem Elm_I	NONE	NONE	9.83E+072.20E-04 1.07E+034.81E-01 0		0	0	1.31E+020	0	0	0	0	0	0	0
I135Elem Elm_I	NONE	Xe135	8.38E+072.91E-05 3.14E+043.07E-01 0		0	0	1.23E+030	0	0	0	0	0	0	0
I130Part Prt_I	NONE	NONE	1.40E+061.56E-05 7.36E+043.85E-01 0		0	0	2.64E+030	0	0	0	0	0	0	0
I131Part Prt_I	NONE	NONE	4.33E+079.98E-07 1.07E+066.73E-02 0		0	0	3.29E+040	0	0	0	0	0	0	0
I132Part Prt_I	NONE	NONE	6.26E+078.37E-05 6.29E+034.14E-01 0		0	0	3.81E+020	0	0	0	0	0	0	0
I133Part Prt_I	NONE	NONE	8.78E+079.26E-06 1.81E+051.09E-01 0		0	0	5.85E+030	0	0	0	0	0	0	0
I134Part Prt_I	NONE	NONE	9.83E+072.20E-04 1.07E+034.81E-01 0		0	0	1.31E+020	0	0	0	0	0	0	0
I135Part Prt_I	NONE	NONE	8.38E+072.91E-05 3.14E+043.07E-01 0		0	0	1.23E+030	0	0	0	0	0	0	0
Rb86 CsGrp	NONE	NONE	1.27E+054.30E-07 0	1.78E-02 0	0	0	6.62E+030	0	0	0	0	0	0	0
Rb88 CsGrp	Kr88	NONE	2.77E+076.49E-04 0	1.24E-01 0	0	0	8.36E+010	0	0	0	0	0	0	0
Cs134 CsGrp	NONE	NONE	1.43E+071.07E-08 0	2.80E-01 0	0	0	4.63E+040	0	0	0	0	0	0	0
Cs136 CsGrp	NONE	NONE	3.00E+066.12E-07 0	3.92E-01 0	0	0	7.33E+030	0	0	0	0	0	0	0
Cs137 CsGrp	Xe137	NONE	7.58E+067.32E-10 0	1.01E-01 0	0	0	3.19E+040	0	0	0	0	0	0	0
Cs138 CsGrp	Xe138	NONE	8.13E+073.59E-04 0	4.48E-01 0	0	0	1.01E+020	0	0	0	0	0	0	0
Sb127 TeGrp	NONE	Te127	4.09E+062.08E-06 0	1.23E-01 0	0	0	6.03E+030	0	0	0	0	0	0	0
Sb129 TeGrp	NONE	NONE	1.25E+074.46E-05 0	2.64E-01 0	0	0	6.44E+020	0	0	0	0	0	0	0

Te127m	TeGrp	NONE	NONE	7.08E+057.36E-08 0	5.44E-04 0	0	0	2.15E+040	0	0	0	0	0
Te127	TeGrp	Sb127	NONE	4.05E+062.06E-05 0	8.95E-04 0	0	0	3.18E+020	0	0	0	0	0
Te129m	TeGrp	NONE	NONE	2.26E+062.39E-07 0	1.23E-02 0	0	0	2.40E+040	0	0	0	0	0
Te131m	TeGrp	NONE	I131Elem	8.56E+066.42E-06 0	2.76E-01 0	0	0	6.50E+030	0	0	0	0	0
Te132	TeGrp	NONE	I132Elem	6.11E+072.46E-06 0	3.81E-02 0	0	0	9.44E+030	0	0	0	0	0
Ba139	BaGrp	NONE	NONE	7.75E+071.40E-04 0	8.03E-03 0	0	0	1.72E+020	0	0	0	0	0
Ba140	BaGrp	NONE	La140	7.43E+076.30E-07 0	3.17E-02 0	0	0	3.74E+030	0	0	0	0	0
Mo99	NMtlis	NONE	Tc99m	7.99E+072.92E-06 0	2.69E-02 0	0	0	3.96E+030	0	0	0	0	0
Tc99m	NMtlis	Mo99	NONE	7.03E+073.20E-05 0	2.18E-02 0	0	0	3.26E+010	0	0	0	0	0
Ru103	NMtlis	NONE	NONE	7.12E+072.04E-07 0	8.33E-02 0	0	0	8.96E+030	0	0	0	0	0
Ru105	NMtlis	NONE	Rh105	5.05E+074.34E-05 0	1.41E-01 0	0	0	4.55E+020	0	0	0	0	0
Ru106	NMtlis	NONE	NONE	2.96E+072.18E-08 0	3.85E-02 0	0	0	4.77E+050	0	0	0	0	0
Rh105	NMtlis	Ru105	NONE	4.75E+075.45E-06 0	1.38E-02 0	0	0	9.55E+020	0	0	0	0	0
Y90	LaGrp	Sr90	NONE	5.76E+063.01E-06 0	7.03E-04 0	0	0	8.44E+030	0	0	0	0	0
Y91	LaGrp	Sr91	NONE	5.13E+071.37E-07 0	9.62E-04 0	0	0	4.88E+040	0	0	0	0	0
Y92	LaGrp	Sr92	NONE	5.28E+075.44E-05 0	4.81E-02 0	0	0	7.81E+020	0	0	0	0	0
Y93	LaGrp	NONE	NONE	6.04E+071.91E-05 0	1.78E-02 0	0	0	2.15E+030	0	0	0	0	0
Zr95	LaGrp	NONE	Nb95	7.22E+071.25E-07 0	1.33E-01 0	0	0	2.36E+040	0	0	0	0	0
Zr97	LaGrp	NONE	NONE	7.20E+071.14E-05 0	1.64E-01 0	0	0	4.33E+030	0	0	0	0	0
Nb95	LaGrp	Zr95	NONE	7.35E+072.28E-07 0	1.38E-01 0	0	0	5.81E+030	0	0	0	0	0
La140	LaGrp	Ba140	NONE	7.82E+074.78E-06 0	4.33E-01 0	0	0	4.85E+030	0	0	0	0	0
La141	LaGrp	NONE	Ce141	6.98E+074.90E-05 0	8.84E-03 0	0	0	5.81E+020	0	0	0	0	0
La142	LaGrp	NONE	NONE	6.72E+071.25E-04 0	5.33E-01 0	0	0	2.53E+020	0	0	0	0	0
Pr143	LaGrp	Ce143	NONE	6.46E+075.92E-07 0	7.77E-05 0	0	0	8.10E+030	0	0	0	0	0
Nd147	LaGrp	NONE	NONE	2.78E+077.31E-07 0	2.29E-02 0	0	0	6.85E+030	0	0	0	0	0
Am241	LaGrp	NONE	NONE	6.29E+035.08E-11 0	3.03E-03 0	0	0	4.44E+080	0	0	0	0	0
Cm242	LaGrp	NONE	NONE	2.68E+064.93E-08 0	2.11E-05 0	0	0	1.73E+070	0	0	0	0	0
Cm244	LaGrp	NONE	NONE	5.89E+051.21E-09 0	1.82E-05 0	0	0	2.48E+080	0	0	0	0	0
Ce141	CeGrp	La141	NONE	7.11E+072.47E-07 0	1.27E-02 0	0	0	8.95E+030	0	0	0	0	0
Ce143	CeGrp	NONE	Pr143	6.50E+075.83E-06 0	4.77E-02 0	0	0	3.39E+030	0	0	0	0	0
Ce144	CeGrp	NONE	NONE	6.01E+072.82E-08 0	1.03E-02 0	0	0	3.74E+050	0	0	0	0	0
Np239	CeGrp	NONE	NONE	8.73E+083.41E-06 0	2.85E-02 0	0	0	2.51E+030	0	0	0	0	0
Pu238	CeGrp	NONE	NONE	2.39E+052.50E-10 0	1.81E-05 0	0	0	2.88E+080	0	0	0	0	0
Pu239	CeGrp	NONE	NONE	1.39E+049.13E-13 0	1.57E-05 0	0	0	3.08E+080	0	0	0	0	0
Pu240	CeGrp	NONE	NONE	2.24E+043.36E-12 0	1.76E-05 0	0	0	3.08E+080	0	0	0	0	0
Pu241	CeGrp	NONE	NONE	6.07E+061.53E-09 0	2.68E-07 0	0	0	4.96E+060	0	0	0	0	0
Sr89	SrGrp	NONE	NONE	3.83E+071.59E-07 0	2.86E-04 0	0	0	4.14E+040	0	0	0	0	0
Sr90	SrGrp	NONE	Y90	5.49E+067.54E-10 0	2.79E-05 0	0	0	1.30E+060	0	0	0	0	0
Sr91	SrGrp	NONE	Y91	4.82E+072.03E-05 0	1.82E-01 0	0	0	1.68E+030	0	0	0	0	0
Sr92	SrGrp	NONE	Y92	5.22E+077.10E-05 0	2.51E-01 0	0	0	8.07E+020	0	0	0	0	0

INPUT.DAT for Prairie Island Nuclear Generating Plant

```

edit_time
0      0.00056 0.01    0.0167 0.075  0.167  0.247  0.333  2      8      24      96      720
end_edit_time

```

```

participating_isotopes
Kr85m Kr85  Kr87  Kr88
Xe131m Xe133m Xe133  Xe135m Xe135  Xe137  Xe138
I130Org I130Elem  I130Part
I131Org I131Elem  I131Part
I132Org I132Elem  I132Part
I133Org I133Elem  I133Part
I135Org I135Elem  I135Part
I134Org I134Elem  I134Part
Rb86   Rb88   Cs134  Cs136  Cs137  Cs138
Sb127  Sb129  Te127m Te127  Te129m Te131m Te132
Ba139  Ba140
Mo99   Tc99m  Ru103  Ru105  Ru106  Rh105
Y90    Y91    Y92    Y93  Zr95  Zr97  Nb95
La140  La141  La142  Pr143  Nd147  Am241  Cm242  Cm244
Ce141  Ce143  Ce144  Np239  Pu238  Pu239  Pu240  Pu241
Sr89   Sr90   Sr91   Sr92
end_participating_isotopes

```

```

core
thermal_power      1
elemental_iodine_frac 0.91
organic_iodine_frac 0.04
particulate_iodine_frac 0.05
release_frac
to_control_volume  PC
Time  N_Gas  I_Grp  CsGrp  TeGrp  BaGrp  NMtIs  CeGrp  LaGrp  SrGrp
0.00056 1786  446  17.9  17.9  17.9  17.9  17.9  17.9  17.9
720    0      0    0      0      0      0      0      0      0
end_to_control_volume
to_control_volume  Sump
Time  N_Gas  I_Grp  CsGrp  TeGrp  BaGrp  NMtIs  CeGrp  LaGrp  SrGrp
0.00056 0      446  0      0      0      0      0      0      0
720    0      0    0      0      0      0      0      0      0
end_to_control_volume
end_release_frac
end_core

```

```

control_volume
obj_type      OBJ_CV
name          PC
air_volume    1.32e6
water_volume  2.67e4
surface_area  0
has_recirc_filter false
removal_rate_to_waterpool
Time  NobleGas  ElemIodine  OrgIodine  PartIodine  Solubles  Insolubles
0.017  0          0           0           0           0          0
0.247  0          20          0           0.45        0.45       0.45
720.0  0          0           0           0           0          0

```

```

end_removal_rate_to_waterpool
frac_4_daughter_resusp_from_water
Time    NobleGas    ElemIodine    OrgIodine    PartIodine    Solubles    Insolubles
720      0              0              0              0              0              0
end_frac_4_daughter_resusp_from_water
end_control_volume

```

```

control_volume
obj_type      OBJ_CV
name          Sump
air_volume    2.67e4
water_volume  0
surface_area  0
has_recirc_filter  false
end_control_volume

```

```

control_volume
obj_type      OBJ_CV
name          SC
air_volume    1.87e5
water_volume  0
surface_area  0
has_recirc_filter  true
recirc_flowrate
Time    (hr)    Value    (cfm)
0.333      0
720        4000
end_recirc_flowrate
recirc_filter_efficiency
Time    NobleGas    ElemIodine    OrgIodine    PartIodine    Solubles    Insolubles
720      0              0.9              0.7              0.99              0.99              0.99
end_recirc_filter_efficiency
frac_4_daughter_resusp_from_recirc_filter
Time    NobleGas    ElemIodine    OrgIodine    PartIodine    Solubles    Insolubles
720      0              0              0              0              0              0
end_frac_4_daughter_resusp_from_recirc_filter
end_control_volume

```

```

junction
junction_type      AIR_JUNCTION
downstream_location  AIR_SPACE
upstream           CORE
downstream         PC
has_filter         false
flow_rate
Time    (hr)    Value    (cfm)
720      1
end_flow_rate
end_junction

```

```

junction
junction_type      AIR_JUNCTION
downstream_location  AIR_SPACE
upstream           CORE
downstream         Sump
has_filter         false

```

```

flow_rate
Time    (hr)    Value    (cfm)
720          1
end_flow_rate
end_junction

```

```

junction
junction_type      AIR_JUNCTION
downstream_location AIR_SPACE
upstream           PC
downstream         environment
has_filter         true

```

```

flow_rate
Time    (hr)    Value    (cfm)
0.00056      0
24          1.008
720         0.504

```

```

end_flow_rate
filter_efficiency
Time    NobleGas    ElemIodine    OrgIodine    PartIodine    Solubles    Insolubles
720      0          0.818        0.636        0.9           0.9         0.9

```

```

end_filter_efficiency
frac_4_daughter_resusp
Time    NobleGas    ElemIodine    OrgIodine    PartIodine    Solubles    Insolubles
720      0          0            0            0            0           0

```

```

end_frac_4_daughter_resusp
X_over_Q_4_site_boundary
Time    (hr)    Value    (s/m*3)
2          6.49e-4
720        0

```

```

end_X_over_Q_4_site_boundary
X_over_Q_4_low_population_zone
Time    (hr)    Value    (s/m*3)
8          3.71E-05
24         6.27E-06
96         1.09E-06
720        1.52E-07

```

```

end_X_over_Q_4_low_population_zone
X_over_Q_4_ctrl_room
Time    (hr)    Value    (s/m*3)
720        0
end_X_over_Q_4_ctrl_room
end_junction

```

```

junction
junction_type      AIR_JUNCTION
downstream_location AIR_SPACE
upstream           PC
downstream         SC
has_filter         false

```

```

flow_rate
Time    (hr)    Value    (cfm)
24          1.28
720         0.64

```

```

end_flow_rate
end_junction

```

```

junction
junction_type          AIR_JUNCTION
downstream_location    AIR_SPACE
upstream               SC
downstream             environment
has_filter             true
flow_rate
Time   (hr)   Value   (cfm)
0.01      1558.3
0.075     7558.3
0.167     3000
0.333     1300
720       1000
end_flow_rate
filter_efficiency
Time   NobleGas   ElemIodine   OrgIodine   PartIodine   Solubles   Insolubles
0.01   0           0            0           0            0          0
0.075  0           0.714       0.556      0.786        0.786      0.786
720    0           0.9         0.7        0.99         0.99       0.99
end_filter_efficiency
frac_4_daughter_resusp
Time   NobleGas   ElemIodine   OrgIodine   PartIodine   Solubles   Insolubles
720    0           0            0           0            0          0
end_frac_4_daughter_resusp
X_over_Q_4_site_boundary
Time   (hr)   Value   (s/m*3)
2      6.49e-4
720    0
end_X_over_Q_4_site_boundary
X_over_Q_4_low_population_zone
Time   (hr)   Value   (s/m*3)
8      3.71E-05
24     6.27E-06
96     1.09E-06
720    1.52E-07
end_X_over_Q_4_low_population_zone
X_over_Q_4_ctrl_room
Time   (hr)   Value   (s/m*3)
720    0
end_X_over_Q_4_ctrl_room
end_junction

```

```

junction
junction_type          AIR_JUNCTION
downstream_location    AIR_SPACE
upstream               Sump
downstream             Environment
has_filter             true
flow_rate
Time   (hr)   Value   (cfm)
720    0
end_flow_rate
filter_efficiency
Time   NobleGas   ElemIodine   OrgIodine   PartIodine   Solubles   Insolubles
720    0           0.89         1           1            1          1

```

end_filter_efficiency

frac_4_daughter_resusp

Time	NobleGas	ElemIodine
720	0	0

OrgIodine
0

PartIodine
0

Solubles
0

Insolubles
0

720

end_frac_4_daughter_resusp

end_junction

environment

breathing_rate_sb

Time (hr)	Value (cms)
8	0.00035
720	0.0

8

0.00035

720

0.0

end_breathing_rate_sb

breathing_rate_lpz

Time (hr)	Value (cms)
8	0.00035
24	0.00018
720	0.00023

8

0.00035

24

0.00018

720

0.00023

end_breathing_rate_lpz

end_environment

Excerpts of RESULTS.OUT files for STARDOSE Analyses

2 Hours – OFA

environment

	thyroid	wbody	skin	CEDE
EAB dose:	1.06E+001	1.26E+000	0.00E+000	6.74E+000
LPZ dose:	6.05E-001	7.20E-002	0.00E+000	3.85E-001

	thyrd_eab	wbody_eab	skin_eab	CEDE_eab	thyrd_lpz	wbody_lpz	skin_lpz	CEDE_lpz
Noble gas	0.00E+000	1.16E+000	0.00E+000	0.00E+000	0.00E+000	6.64E-002	0.00E+000	0.00E+000
Org iodine	5.93E+000	2.04E-002	0.00E+000	1.88E-001	3.39E-001	1.17E-003	0.00E+000	1.07E-002
Elem iodine	3.06E+000	1.42E-002	0.00E+000	9.73E-002	1.75E-001	8.10E-004	0.00E+000	5.56E-003
Part iodine	1.60E+000	5.59E-003	0.00E+000	5.06E-002	9.14E-002	3.19E-004	0.00E+000	2.89E-003
Cesium	0.00E+000	4.93E-002	0.00E+000	2.27E-002	0.00E+000	2.82E-003	0.00E+000	1.30E-003
Tellurium	0.00E+000	4.53E-004	0.00E+000	1.45E-002	0.00E+000	2.59E-005	0.00E+000	8.30E-004
Barium	0.00E+000	1.56E-004	0.00E+000	5.70E-003	0.00E+000	8.93E-006	0.00E+000	3.26E-004
Noble metal	0.00E+000	9.94E-004	0.00E+000	2.85E-001	0.00E+000	5.68E-005	0.00E+000	1.63E-002
Lanthanides	0.00E+000	5.29E-003	0.00E+000	3.53E+000	0.00E+000	3.03E-004	0.00E+000	2.02E-001
Cerium	0.00E+000	1.66E-003	0.00E+000	2.39E+000	0.00E+000	9.50E-005	0.00E+000	1.37E-001
Strontinum	0.00E+000	1.04E-003	0.00E+000	1.59E-001	0.00E+000	5.97E-005	0.00E+000	9.09E-003

	air_space	thyrd_eab	wbody_eab	skin_eab	CEDE_eab	thyrd_lpz	wbody_lpz	skin_lpz
CEDE_lpz								
Kr85m	1.11E+003	0.00E+000	2.00E-002	0.00E+000	0.00E+000	0.00E+000	1.14E-003	0.00E+000
0.00E+000								
Kr85	7.64E+001	0.00E+000	2.25E-005	0.00E+000	0.00E+000	0.00E+000	1.29E-006	0.00E+000
0.00E+000								
Kr87	1.50E+003	0.00E+000	1.45E-001	0.00E+000	0.00E+000	0.00E+000	8.31E-003	0.00E+000
0.00E+000								
Kr88	2.64E+003	0.00E+000	6.46E-001	0.00E+000	0.00E+000	0.00E+000	3.69E-002	0.00E+000
0.00E+000								
Xe131m	6.08E+001	0.00E+000	5.85E-005	0.00E+000	0.00E+000	0.00E+000	3.35E-006	0.00E+000
0.00E+000								
Xe133m	3.40E+002	0.00E+000	1.15E-003	0.00E+000	0.00E+000	0.00E+000	6.57E-005	0.00E+000
0.00E+000								
Xe133	1.10E+004	0.00E+000	4.14E-002	0.00E+000	0.00E+000	0.00E+000	2.36E-003	0.00E+000
0.00E+000								
Xe135m	3.75E+002	0.00E+000	1.77E-002	0.00E+000	0.00E+000	0.00E+000	1.01E-003	0.00E+000
0.00E+000								
Xe135	2.07E+003	0.00E+000	5.95E-002	0.00E+000	0.00E+000	0.00E+000	3.40E-003	0.00E+000
0.00E+000								
Xe137	3.83E+002	0.00E+000	7.24E-003	0.00E+000	0.00E+000	0.00E+000	4.14E-004	0.00E+000
0.00E+000								
Xe138	1.65E+003	0.00E+000	2.22E-001	0.00E+000	0.00E+000	0.00E+000	1.27E-002	0.00E+000
0.00E+000								
I130Org	5.33E-001	8.94E-003	1.34E-004	0.00E+000	3.21E-004	5.11E-004	7.64E-006	0.00E+000
1.83E-005								
I131Org	1.74E+001	4.26E+000	7.65E-004	0.00E+000	1.31E-001	2.43E-001	4.37E-005	0.00E+000
7.48E-003								
I132Org	1.89E+001	2.67E-002	5.03E-003	0.00E+000	1.62E-003	1.53E-003	2.87E-004	0.00E+000
9.26E-005								
I133Org	3.42E+001	1.41E+000	2.43E-003	0.00E+000	4.57E-002	8.07E-002	1.39E-004	0.00E+000
2.61E-003								
I134Org	1.96E+001	4.68E-003	6.01E-003	0.00E+000	5.73E-004	2.67E-004	3.44E-004	0.00E+000
3.27E-005								
I135Org	3.05E+001	2.17E-001	6.07E-003	0.00E+000	8.51E-003	1.24E-002	3.47E-004	0.00E+000
4.86E-004								
I130Elem	2.91E-001	4.74E-003	7.09E-005	0.00E+000	1.70E-004	2.71E-004	4.05E-006	0.00E+000
9.72E-006								
I131Elem	9.17E+000	2.17E+000	3.90E-004	0.00E+000	6.68E-002	1.24E-001	2.23E-005	0.00E+000
3.82E-003								
I132Elem	1.44E+001	2.02E-002	3.81E-003	0.00E+000	1.23E-003	1.16E-003	2.18E-004	0.00E+000
7.01E-005								
I133Elem	1.84E+001	7.39E-001	1.27E-003	0.00E+000	2.39E-002	4.22E-002	7.27E-005	0.00E+000
1.37E-003								
I134Elem	1.75E+001	4.11E-003	5.29E-003	0.00E+000	5.04E-004	2.35E-004	3.02E-004	0.00E+000
2.88E-005								

I135Elem	1.72E+001	1.20E-001	3.35E-003	0.00E+000	4.70E-003	6.85E-003	1.91E-004	0.00E+000
2.68E-004								
I130Part	1.45E-001	2.41E-003	3.61E-005	0.00E+000	8.66E-005	1.38E-004	2.06E-006	0.00E+000
4.95E-006								
I131Part	4.72E+000	1.15E+000	2.06E-004	0.00E+000	3.53E-002	6.56E-002	1.18E-005	0.00E+000
2.02E-003								
I132Part	5.17E+000	7.30E-003	1.37E-003	0.00E+000	4.42E-004	4.17E-004	7.85E-005	0.00E+000
2.53E-005								
I133Part	9.28E+000	3.81E-001	6.56E-004	0.00E+000	1.23E-002	2.18E-002	3.75E-005	0.00E+000
7.04E-004								
I134Part	5.48E+000	1.30E-003	1.67E-003	0.00E+000	1.60E-004	7.45E-005	9.57E-005	0.00E+000
9.13E-006								
I135Part	8.27E+000	5.88E-002	1.64E-003	0.00E+000	2.30E-003	3.36E-003	9.39E-005	0.00E+000
1.32E-004								
Rb86	1.10E-002	0.00E+000	1.28E-007	0.00E+000	1.66E-005	0.00E+000	7.30E-009	0.00E+000
9.51E-007								
Rb88	1.68E+002	0.00E+000	1.36E-002	0.00E+000	3.21E-003	0.00E+000	7.77E-004	0.00E+000
1.83E-004								
Cs134	1.14E+000	0.00E+000	2.08E-004	0.00E+000	1.20E-002	0.00E+000	1.19E-005	0.00E+000
6.87E-004								
Cs136	2.49E-001	0.00E+000	6.34E-005	0.00E+000	4.15E-004	0.00E+000	3.63E-006	0.00E+000
2.37E-005								
Cs137	5.83E-001	0.00E+000	3.83E-005	0.00E+000	4.23E-003	0.00E+000	2.19E-006	0.00E+000
2.42E-004								
Cs138	1.23E+002	0.00E+000	3.54E-002	0.00E+000	2.79E-003	0.00E+000	2.02E-003	0.00E+000
1.59E-004								
Sb127	3.57E-001	0.00E+000	2.85E-005	0.00E+000	4.89E-004	0.00E+000	1.63E-006	0.00E+000
2.80E-005								
Sb129	9.41E-001	0.00E+000	1.60E-004	0.00E+000	1.37E-004	0.00E+000	9.16E-006	0.00E+000
7.82E-006								
Te127m	6.10E-002	0.00E+000	2.16E-008	0.00E+000	2.98E-004	0.00E+000	1.23E-009	0.00E+000
1.70E-005								
Te127	3.54E-001	0.00E+000	2.06E-007	0.00E+000	2.56E-005	0.00E+000	1.18E-008	0.00E+000
1.47E-006								
Te129m	1.98E-001	0.00E+000	1.58E-006	0.00E+000	1.08E-003	0.00E+000	9.04E-008	0.00E+000
6.18E-005								
Te131m	7.34E-001	0.00E+000	1.31E-004	0.00E+000	1.08E-003	0.00E+000	7.51E-006	0.00E+000
6.19E-005								
Te132	5.31E+000	0.00E+000	1.31E-004	0.00E+000	1.14E-002	0.00E+000	7.52E-006	0.00E+000
6.52E-004								
Ba139	4.31E+000	0.00E+000	2.21E-005	0.00E+000	1.66E-004	0.00E+000	1.26E-006	0.00E+000
9.47E-006								
Ba140	6.51E+000	0.00E+000	1.34E-004	0.00E+000	5.54E-003	0.00E+000	7.67E-006	0.00E+000
3.17E-004								
Mo99	6.94E+000	0.00E+000	1.21E-004	0.00E+000	6.24E-003	0.00E+000	6.93E-006	0.00E+000
3.57E-004								
Tc99m	6.25E+000	0.00E+000	8.86E-005	0.00E+000	4.64E-005	0.00E+000	5.06E-006	0.00E+000
2.65E-006								
Ru103	6.25E+000	0.00E+000	3.38E-004	0.00E+000	1.27E-002	0.00E+000	1.93E-005	0.00E+000
7.28E-004								
Ru105	3.82E+000	0.00E+000	3.48E-004	0.00E+000	3.93E-004	0.00E+000	1.99E-005	0.00E+000
2.25E-005								
Ru106	2.44E+000	0.00E+000	6.12E-005	0.00E+000	2.65E-001	0.00E+000	3.50E-006	0.00E+000
1.52E-002								
Rh105	4.14E+000	0.00E+000	3.71E-005	0.00E+000	8.99E-004	0.00E+000	2.12E-006	0.00E+000
5.14E-005								
Y90	4.46E-001	0.00E+000	2.04E-007	0.00E+000	8.56E-004	0.00E+000	1.16E-008	0.00E+000
4.89E-005								
Y91	4.49E+000	0.00E+000	2.81E-006	0.00E+000	4.99E-002	0.00E+000	1.61E-007	0.00E+000
2.85E-003								
Y92	4.49E+000	0.00E+000	1.40E-004	0.00E+000	7.96E-004	0.00E+000	8.01E-006	0.00E+000
4.55E-005								
Y93	4.95E+000	0.00E+000	5.70E-005	0.00E+000	2.41E-003	0.00E+000	3.26E-006	0.00E+000
1.38E-004								
Zr95	6.30E+000	0.00E+000	5.45E-004	0.00E+000	3.38E-002	0.00E+000	3.11E-005	0.00E+000
1.93E-003								
Zr97	6.06E+000	0.00E+000	6.45E-004	0.00E+000	5.96E-003	0.00E+000	3.69E-005	0.00E+000
3.41E-004								
Nb95	6.42E+000	0.00E+000	5.75E-004	0.00E+000	8.48E-003	0.00E+000	3.29E-005	0.00E+000
4.85E-004								

Lal140	6.86E+000	0.00E+000	1.93E-003	0.00E+000	7.57E-003	0.00E+000	1.10E-004	0.00E+000
4.33E-004								
Lal141	5.17E+000	0.00E+000	2.94E-005	0.00E+000	6.77E-004	0.00E+000	1.68E-006	0.00E+000
3.87E-005								
Lal142	3.91E+000	0.00E+000	1.33E-003	0.00E+000	2.21E-004	0.00E+000	7.62E-005	0.00E+000
1.27E-005								
Pr143	5.66E+000	0.00E+000	2.86E-007	0.00E+000	1.04E-002	0.00E+000	1.63E-008	0.00E+000
5.96E-004								
Nd147	2.42E+000	0.00E+000	3.60E-005	0.00E+000	3.77E-003	0.00E+000	2.06E-006	0.00E+000
2.16E-004								
Am241	4.27E-004	0.00E+000	8.41E-010	0.00E+000	4.31E-002	0.00E+000	4.81E-011	0.00E+000
2.47E-003								
Cm242	2.03E-001	0.00E+000	2.79E-009	0.00E+000	8.00E-001	0.00E+000	1.59E-010	0.00E+000
4.57E-002								
Cm244	4.54E-002	0.00E+000	5.37E-010	0.00E+000	2.56E+000	0.00E+000	3.07E-011	0.00E+000
1.46E-001								
Ce141	6.23E+000	0.00E+000	5.14E-005	0.00E+000	1.27E-002	0.00E+000	2.94E-006	0.00E+000
7.24E-004								
Ce143	5.58E+000	0.00E+000	1.73E-004	0.00E+000	4.30E-003	0.00E+000	9.87E-006	0.00E+000
2.46E-004								
Ce144	5.08E+000	0.00E+000	3.40E-005	0.00E+000	4.32E-001	0.00E+000	1.94E-006	0.00E+000
2.47E-002								
Np239	7.58E+001	0.00E+000	1.40E-003	0.00E+000	4.33E-002	0.00E+000	8.02E-005	0.00E+000
2.47E-003								
Pu238	1.80E-002	0.00E+000	2.12E-010	0.00E+000	1.18E+000	0.00E+000	1.21E-011	0.00E+000
6.74E-002								
Pu239	1.06E-003	0.00E+000	1.09E-011	0.00E+000	7.45E-002	0.00E+000	6.20E-013	0.00E+000
4.26E-003								
Pu240	1.72E-003	0.00E+000	1.96E-011	0.00E+000	1.20E-001	0.00E+000	1.12E-012	0.00E+000
6.87E-003								
Pu241	4.67E-001	0.00E+000	8.13E-011	0.00E+000	5.26E-001	0.00E+000	4.65E-012	0.00E+000
3.01E-002								
Sr89	3.39E+000	0.00E+000	6.29E-007	0.00E+000	3.19E-002	0.00E+000	3.60E-008	0.00E+000
1.82E-003								
Sr90	4.23E-001	0.00E+000	7.67E-009	0.00E+000	1.25E-001	0.00E+000	4.38E-010	0.00E+000
7.15E-003								
Sr91	3.94E+000	0.00E+000	4.64E-004	0.00E+000	1.50E-003	0.00E+000	2.65E-005	0.00E+000
8.57E-005								
Sr92	3.59E+000	0.00E+000	5.80E-004	0.00E+000	6.52E-004	0.00E+000	3.31E-005	0.00E+000
3.73E-005								

720 Hours - OFA

environment

	thyroid	wbody	skin	CEDE				
EAB dose:	1.06E+001	1.26E+000	0.00E+000	6.74E+000				
LPZ dose:	2.43E+000	1.88E-001	0.00E+000	2.04E+000				
	thyrd_eab	wbody_eab	skin_eab	CEDE_eab	thyrd_lpz	wbody_lpz	skin_lpz	CEDE_lpz
Noble gas	0.00E+000	1.16E+000	0.00E+000	0.00E+000	0.00E+000	1.75E-001	0.00E+000	0.00E+000
Org iodine	5.93E+000	2.04E-002	0.00E+000	1.88E-001	1.68E+000	3.19E-003	0.00E+000	5.27E-002
Elem iodine	3.06E+000	1.42E-002	0.00E+000	9.73E-002	3.21E-001	1.64E-003	0.00E+000	1.02E-002
Part iodine	1.60E+000	5.59E-003	0.00E+000	5.06E-002	4.25E-001	8.24E-004	0.00E+000	1.33E-002
Cesium	0.00E+000	4.93E-002	0.00E+000	2.27E-002	0.00E+000	4.65E-003	0.00E+000	5.83E-003
Tellurium	0.00E+000	4.53E-004	0.00E+000	1.45E-002	0.00E+000	1.11E-004	0.00E+000	3.90E-003
Barium	0.00E+000	1.56E-004	0.00E+000	5.70E-003	0.00E+000	4.75E-005	0.00E+000	1.62E-003
Noble metal	0.00E+000	9.94E-004	0.00E+000	2.85E-001	0.00E+000	2.75E-004	0.00E+000	8.74E-002
Lanthanides	0.00E+000	5.29E-003	0.00E+000	3.53E+000	0.00E+000	1.41E-003	0.00E+000	1.09E+000
Cerium	0.00E+000	1.66E-003	0.00E+000	2.39E+000	0.00E+000	4.95E-004	0.00E+000	7.36E-001
Strontinum	0.00E+000	1.04E-003	0.00E+000	1.59E-001	0.00E+000	1.70E-004	0.00E+000	4.86E-002
	air_space	thyrd_eab	wbody_eab	skin_eab	CEDE_eab	thyrd_lpz	wbody_lpz	skin_lpz
CEDE_lpz								
Kr85m	5.75E+003	0.00E+000	2.00E-002	0.00E+000	0.00E+000	0.00E+000	4.16E-003	0.00E+000
0.00E+000								
Kr85	2.35E+004	0.00E+000	2.25E-005	0.00E+000	0.00E+000	0.00E+000	1.22E-005	0.00E+000
0.00E+000								

Kr87	2.59E+003	0.00E+000	1.45E-001	0.00E+000	0.00E+000	0.00E+000	1.39E-002	0.00E+000
0.00E+000								
Kr88	8.94E+003	0.00E+000	6.46E-001	0.00E+000	0.00E+000	0.00E+000	1.06E-001	0.00E+000
0.00E+000								
Xe131m	9.22E+003	0.00E+000	5.85E-005	0.00E+000	0.00E+000	0.00E+000	2.88E-005	0.00E+000
0.00E+000								
Xe133m	1.37E+004	0.00E+000	1.15E-003	0.00E+000	0.00E+000	0.00E+000	4.84E-004	0.00E+000
0.00E+000								
Xe133	9.21E+005	0.00E+000	4.14E-002	0.00E+000	0.00E+000	0.00E+000	1.94E-002	0.00E+000
0.00E+000								
Xe135m	3.77E+002	0.00E+000	1.77E-002	0.00E+000	0.00E+000	0.00E+000	1.02E-003	0.00E+000
0.00E+000								
Xe135	2.06E+004	0.00E+000	5.95E-002	0.00E+000	0.00E+000	0.00E+000	1.71E-002	0.00E+000
0.00E+000								
Xe137	3.83E+002	0.00E+000	7.24E-003	0.00E+000	0.00E+000	0.00E+000	4.14E-004	0.00E+000
0.00E+000								
Xe138	1.67E+003	0.00E+000	2.22E-001	0.00E+000	0.00E+000	0.00E+000	1.28E-002	0.00E+000
0.00E+000								
I130Org	4.66E+000	8.94E-003	1.34E-004	0.00E+000	3.21E-004	1.99E-003	3.21E-005	0.00E+000
7.14E-005								
I131Org	1.30E+003	4.26E+000	7.65E-004	0.00E+000	1.31E-001	1.29E+000	2.70E-004	0.00E+000
3.95E-002								
I132Org	4.35E+001	2.67E-002	5.03E-003	0.00E+000	1.62E-003	3.17E-003	6.01E-004	0.00E+000
1.92E-004								
I133Org	4.40E+002	1.41E+000	2.43E-003	0.00E+000	4.57E-002	3.47E-001	6.60E-004	0.00E+000
1.12E-002								
I134Org	2.51E+001	4.68E-003	6.01E-003	0.00E+000	5.73E-004	3.39E-004	4.36E-004	0.00E+000
4.15E-005								
I135Org	1.64E+002	2.17E-001	6.07E-003	0.00E+000	8.51E-003	4.08E-002	1.19E-003	0.00E+000
1.60E-003								
I130Elem	7.21E-001	4.74E-003	7.09E-005	0.00E+000	1.70E-004	4.27E-004	6.62E-006	0.00E+000
1.53E-005								
I131Elem	1.58E+002	2.17E+000	3.90E-004	0.00E+000	6.68E-002	2.36E-001	4.66E-005	0.00E+000
7.26E-003								
I132Elem	3.68E+002	2.02E-002	3.81E-003	0.00E+000	1.23E-003	3.99E-003	8.68E-004	0.00E+000
2.42E-004								
I133Elem	6.06E+001	7.39E-001	1.27E-003	0.00E+000	2.39E-002	7.03E-002	1.28E-004	0.00E+000
2.27E-003								
I134Elem	1.80E+001	4.11E-003	5.29E-003	0.00E+000	5.04E-004	2.43E-004	3.12E-004	0.00E+000
2.98E-005								
I135Elem	3.12E+001	1.20E-001	3.35E-003	0.00E+000	4.70E-003	9.85E-003	2.81E-004	0.00E+000
3.86E-004								
I130Part	1.17E+000	2.41E-003	3.61E-005	0.00E+000	8.66E-005	5.07E-004	8.17E-006	0.00E+000
1.82E-005								
I131Part	3.25E+002	1.15E+000	2.06E-004	0.00E+000	3.53E-002	3.25E-001	6.81E-005	0.00E+000
1.00E-002								
I132Part	1.13E+001	7.30E-003	1.37E-003	0.00E+000	4.42E-004	8.28E-004	1.57E-004	0.00E+000
5.01E-005								
I133Part	1.10E+002	3.81E-001	6.56E-004	0.00E+000	1.23E-002	8.83E-002	1.67E-004	0.00E+000
2.85E-003								
I134Part	6.86E+000	1.30E-003	1.67E-003	0.00E+000	1.60E-004	9.25E-005	1.19E-004	0.00E+000
1.13E-005								
I135Part	4.16E+001	5.88E-002	1.64E-003	0.00E+000	2.30E-003	1.04E-002	3.05E-004	0.00E+000
4.09E-004								
Rb86	1.23E+000	0.00E+000	1.28E-007	0.00E+000	1.66E-005	0.00E+000	4.43E-008	0.00E+000
4.90E-006								
Rb88	5.46E+002	0.00E+000	1.36E-002	0.00E+000	3.21E-003	0.00E+000	2.17E-003	0.00E+000
5.04E-004								
Cs134	2.03E+002	0.00E+000	2.08E-004	0.00E+000	1.20E-002	0.00E+000	7.63E-005	0.00E+000
3.70E-003								
Cs136	2.34E+001	0.00E+000	6.34E-005	0.00E+000	4.15E-004	0.00E+000	2.16E-005	0.00E+000
1.21E-004								
Cs137	1.05E+002	0.00E+000	3.83E-005	0.00E+000	4.23E-003	0.00E+000	1.41E-005	0.00E+000
1.31E-003								
Cs138	1.45E+002	0.00E+000	3.54E-002	0.00E+000	2.79E-003	0.00E+000	2.37E-003	0.00E+000
1.87E-004								
Sb127	1.37E+001	0.00E+000	2.85E-005	0.00E+000	4.89E-004	0.00E+000	8.89E-006	0.00E+000
1.33E-004								
Sb129	3.36E+000	0.00E+000	1.60E-004	0.00E+000	1.37E-004	0.00E+000	2.50E-005	0.00E+000
2.08E-005								

Te127m	1.01E+001	0.00E+000	2.16E-008	0.00E+000	2.98E-004	0.00E+000	7.84E-009	0.00E+000
9.11E-005								
Te127	1.50E+001	0.00E+000	2.06E-007	0.00E+000	2.56E-005	0.00E+000	6.69E-008	0.00E+000
7.19E-006								
Te129m	2.70E+001	0.00E+000	1.58E-006	0.00E+000	1.08E-003	0.00E+000	5.61E-007	0.00E+000
3.24E-004								
Te131m	1.14E+001	0.00E+000	1.31E-004	0.00E+000	1.08E-003	0.00E+000	3.59E-005	0.00E+000
2.65E-004								
Te132	1.77E+002	0.00E+000	1.31E-004	0.00E+000	1.14E-002	0.00E+000	4.05E-005	0.00E+000
3.06E-003								
Ba139	6.74E+000	0.00E+000	2.21E-005	0.00E+000	1.66E-004	0.00E+000	1.92E-006	0.00E+000
1.44E-005								
Ba140	6.03E+002	0.00E+000	1.34E-004	0.00E+000	5.54E-003	0.00E+000	4.56E-005	0.00E+000
1.61E-003								
Mo99	2.01E+002	0.00E+000	1.21E-004	0.00E+000	6.24E-003	0.00E+000	3.66E-005	0.00E+000
1.65E-003								
Tc99m	2.15E+002	0.00E+000	8.86E-005	0.00E+000	4.64E-005	0.00E+000	2.92E-005	0.00E+000
1.32E-005								
Ru103	8.87E+002	0.00E+000	3.38E-004	0.00E+000	1.27E-002	0.00E+000	1.21E-004	0.00E+000
3.83E-003								
Ru105	1.40E+001	0.00E+000	3.48E-004	0.00E+000	3.93E-004	0.00E+000	5.49E-005	0.00E+000
6.03E-005								
Ru106	4.30E+002	0.00E+000	6.12E-005	0.00E+000	2.65E-001	0.00E+000	2.24E-005	0.00E+000
8.16E-002								
Rh105	8.08E+001	0.00E+000	3.71E-005	0.00E+000	8.99E-004	0.00E+000	1.10E-005	0.00E+000
2.36E-004								
Y90	7.70E+001	0.00E+000	2.04E-007	0.00E+000	8.56E-004	0.00E+000	7.43E-008	0.00E+000
2.62E-004								
Y91	6.93E+002	0.00E+000	2.81E-006	0.00E+000	4.99E-002	0.00E+000	1.01E-006	0.00E+000
1.52E-002								
Y92	2.04E+001	0.00E+000	1.40E-004	0.00E+000	7.96E-004	0.00E+000	2.64E-005	0.00E+000
1.45E-004								
Y93	3.45E+001	0.00E+000	5.70E-005	0.00E+000	2.41E-003	0.00E+000	1.22E-005	0.00E+000
4.83E-004								
Zr95	9.79E+002	0.00E+000	5.45E-004	0.00E+000	3.38E-002	0.00E+000	1.96E-004	0.00E+000
1.03E-002								
Zr97	6.19E+001	0.00E+000	6.45E-004	0.00E+000	5.96E-003	0.00E+000	1.58E-004	0.00E+000
1.33E-003								
Nb95	1.13E+003	0.00E+000	5.75E-004	0.00E+000	8.48E-003	0.00E+000	2.11E-004	0.00E+000
2.61E-003								
La140	6.82E+002	0.00E+000	1.93E-003	0.00E+000	7.57E-003	0.00E+000	6.66E-004	0.00E+000
2.22E-003								
La141	1.71E+001	0.00E+000	2.94E-005	0.00E+000	6.77E-004	0.00E+000	4.40E-006	0.00E+000
9.88E-005								
La142	6.54E+000	0.00E+000	1.33E-003	0.00E+000	2.21E-004	0.00E+000	1.23E-004	0.00E+000
2.04E-005								
Pr143	5.92E+002	0.00E+000	2.86E-007	0.00E+000	1.04E-002	0.00E+000	9.95E-008	0.00E+000
3.08E-003								
Nd147	2.05E+002	0.00E+000	3.60E-005	0.00E+000	3.77E-003	0.00E+000	1.21E-005	0.00E+000
1.09E-003								
Am241	7.72E-002	0.00E+000	8.41E-010	0.00E+000	4.31E-002	0.00E+000	3.10E-010	0.00E+000
1.33E-002								
Cm242	3.46E+001	0.00E+000	2.79E-009	0.00E+000	8.00E-001	0.00E+000	1.02E-009	0.00E+000
2.45E-001								
Cm244	8.19E+000	0.00E+000	5.37E-010	0.00E+000	2.56E+000	0.00E+000	1.98E-010	0.00E+000
7.90E-001								
Ce141	8.46E+002	0.00E+000	5.14E-005	0.00E+000	1.27E-002	0.00E+000	1.83E-005	0.00E+000
3.81E-003								
Ce143	9.36E+001	0.00E+000	1.73E-004	0.00E+000	4.30E-003	0.00E+000	4.78E-005	0.00E+000
1.06E-003								
Ce144	8.86E+002	0.00E+000	3.40E-005	0.00E+000	4.32E-001	0.00E+000	1.24E-005	0.00E+000
1.33E-001								
Np239	1.94E+003	0.00E+000	1.40E-003	0.00E+000	4.33E-002	0.00E+000	4.16E-004	0.00E+000
1.13E-002								
Pu238	3.25E+000	0.00E+000	2.12E-010	0.00E+000	1.18E+000	0.00E+000	7.80E-011	0.00E+000
3.64E-001								
Pu239	1.92E-001	0.00E+000	1.09E-011	0.00E+000	7.45E-002	0.00E+000	3.99E-012	0.00E+000
2.30E-002								
Pu240	3.10E-001	0.00E+000	1.96E-011	0.00E+000	1.20E-001	0.00E+000	7.22E-012	0.00E+000
3.71E-002								

	air_space	thyrd_eab	wbody_eab	skin_eab	CEDE_eab	thyrd_lpz	wbody_lpz	skin_lpz
CEDE_lpz								
Kr85m	1.08E+003	0.00E+000	1.96E-002	0.00E+000	0.00E+000	0.00E+000	1.12E-003	0.00E+000
0.00E+000								
Kr85	8.43E+001	0.00E+000	2.48E-005	0.00E+000	0.00E+000	0.00E+000	1.42E-006	0.00E+000
0.00E+000								
Kr87	1.46E+003	0.00E+000	1.42E-001	0.00E+000	0.00E+000	0.00E+000	8.11E-003	0.00E+000
0.00E+000								
Kr88	2.59E+003	0.00E+000	6.35E-001	0.00E+000	0.00E+000	0.00E+000	3.63E-002	0.00E+000
0.00E+000								
Xe131m	5.94E+001	0.00E+000	5.72E-005	0.00E+000	0.00E+000	0.00E+000	3.27E-006	0.00E+000
0.00E+000								
Xe133m	3.32E+002	0.00E+000	1.12E-003	0.00E+000	0.00E+000	0.00E+000	6.43E-005	0.00E+000
0.00E+000								
Xe133	1.07E+004	0.00E+000	4.05E-002	0.00E+000	0.00E+000	0.00E+000	2.31E-003	0.00E+000
0.00E+000								
Xe135m	3.65E+002	0.00E+000	1.73E-002	0.00E+000	0.00E+000	0.00E+000	9.88E-004	0.00E+000
0.00E+000								
Xe135	2.26E+003	0.00E+000	6.50E-002	0.00E+000	0.00E+000	0.00E+000	3.71E-003	0.00E+000
0.00E+000								
Xe137	3.74E+002	0.00E+000	7.08E-003	0.00E+000	0.00E+000	0.00E+000	4.05E-004	0.00E+000
0.00E+000								
Xe138	1.62E+003	0.00E+000	2.17E-001	0.00E+000	0.00E+000	0.00E+000	1.24E-002	0.00E+000
0.00E+000								
I130Org	5.22E-001	8.75E-003	1.31E-004	0.00E+000	3.14E-004	5.00E-004	7.48E-006	0.00E+000
1.79E-005								
I131Org	1.70E+001	4.16E+000	7.48E-004	0.00E+000	1.28E-001	2.38E-001	4.28E-005	0.00E+000
7.32E-003								
I132Org	1.84E+001	2.61E-002	4.91E-003	0.00E+000	1.58E-003	1.49E-003	2.81E-004	0.00E+000
9.04E-005								
I133Org	3.35E+001	1.38E+000	2.38E-003	0.00E+000	4.47E-002	7.90E-002	1.36E-004	0.00E+000
2.55E-003								

I134Org	1.91E+001	4.55E-003	5.85E-003	0.00E+000	5.57E-004	2.60E-004	3.34E-004	0.00E+000
3.19E-005								
I135Org	2.98E+001	2.12E-001	5.93E-003	0.00E+000	8.32E-003	1.21E-002	3.39E-004	0.00E+000
4.75E-004								
I130Elem	2.85E-001	4.64E-003	6.94E-005	0.00E+000	1.66E-004	2.65E-004	3.97E-006	0.00E+000
9.52E-006								
I131Elem	8.96E+000	2.12E+000	3.81E-004	0.00E+000	6.53E-002	1.21E-001	2.18E-005	0.00E+000
3.73E-003								
I132Elem	1.41E+001	1.98E-002	3.72E-003	0.00E+000	1.20E-003	1.13E-003	2.13E-004	0.00E+000
6.85E-005								
I133Elem	1.80E+001	7.23E-001	1.24E-003	0.00E+000	2.34E-002	4.14E-002	7.12E-005	0.00E+000
1.34E-003								
I134Elem	1.70E+001	4.00E-003	5.14E-003	0.00E+000	4.90E-004	2.29E-004	2.94E-004	0.00E+000
2.80E-005								
I135Elem	1.68E+001	1.17E-001	3.28E-003	0.00E+000	4.59E-003	6.70E-003	1.87E-004	0.00E+000
2.63E-004								
I130Part	1.42E-001	2.36E-003	3.53E-005	0.00E+000	8.48E-005	1.35E-004	2.02E-006	0.00E+000
4.85E-006								
I131Part	4.61E+000	1.12E+000	2.02E-004	0.00E+000	3.45E-002	6.41E-002	1.15E-005	0.00E+000
1.97E-003								
I132Part	5.04E+000	7.13E-003	1.34E-003	0.00E+000	4.32E-004	4.08E-004	7.66E-005	0.00E+000
2.47E-005								
I133Part	9.08E+000	3.73E-001	6.42E-004	0.00E+000	1.21E-002	2.13E-002	3.67E-005	0.00E+000
6.89E-004								
I134Part	5.33E+000	1.27E-003	1.63E-003	0.00E+000	1.55E-004	7.25E-005	9.32E-005	0.00E+000
8.88E-006								
I135Part	8.09E+000	5.75E-002	1.61E-003	0.00E+000	2.25E-003	3.29E-003	9.18E-005	0.00E+000
1.29E-004								
Rb86	1.09E-002	0.00E+000	1.26E-007	0.00E+000	1.64E-005	0.00E+000	7.19E-009	0.00E+000
9.36E-007								
Rb88	1.65E+002	0.00E+000	1.33E-002	0.00E+000	3.15E-003	0.00E+000	7.63E-004	0.00E+000
1.80E-004								
Cs134	1.23E+000	0.00E+000	2.23E-004	0.00E+000	1.29E-002	0.00E+000	1.28E-005	0.00E+000
7.38E-004								
Cs136	2.57E-001	0.00E+000	6.54E-005	0.00E+000	4.28E-004	0.00E+000	3.74E-006	0.00E+000
2.45E-005								
Cs137	6.50E-001	0.00E+000	4.27E-005	0.00E+000	4.72E-003	0.00E+000	2.44E-006	0.00E+000
2.70E-004								
Cs138	1.20E+002	0.00E+000	3.46E-002	0.00E+000	2.73E-003	0.00E+000	1.98E-003	0.00E+000
1.56E-004								
Sb127	3.48E-001	0.00E+000	2.78E-005	0.00E+000	4.77E-004	0.00E+000	1.59E-006	0.00E+000
2.73E-005								
Sb129	9.19E-001	0.00E+000	1.57E-004	0.00E+000	1.34E-004	0.00E+000	8.95E-006	0.00E+000
7.64E-006								
Te127m	6.07E-002	0.00E+000	2.15E-008	0.00E+000	2.97E-004	0.00E+000	1.23E-009	0.00E+000
1.70E-005								
Te127	3.48E-001	0.00E+000	2.02E-007	0.00E+000	2.51E-005	0.00E+000	1.16E-008	0.00E+000
1.44E-006								
Te129m	1.94E-001	0.00E+000	1.55E-006	0.00E+000	1.06E-003	0.00E+000	8.85E-008	0.00E+000
6.04E-005								
Te131m	7.18E-001	0.00E+000	1.29E-004	0.00E+000	1.06E-003	0.00E+000	7.35E-006	0.00E+000
6.06E-005								
Te132	5.20E+000	0.00E+000	1.29E-004	0.00E+000	1.11E-002	0.00E+000	7.35E-006	0.00E+000
6.37E-004								
Ba139	4.22E+000	0.00E+000	2.16E-005	0.00E+000	1.62E-004	0.00E+000	1.24E-006	0.00E+000
9.27E-006								
Ba140	6.36E+000	0.00E+000	1.31E-004	0.00E+000	5.41E-003	0.00E+000	7.49E-006	0.00E+000
3.09E-004								
Mo99	6.78E+000	0.00E+000	1.18E-004	0.00E+000	6.11E-003	0.00E+000	6.77E-006	0.00E+000
3.49E-004								
Tc99m	6.11E+000	0.00E+000	8.66E-005	0.00E+000	4.53E-005	0.00E+000	4.95E-006	0.00E+000
2.59E-006								
Ru103	6.10E+000	0.00E+000	3.30E-004	0.00E+000	1.24E-002	0.00E+000	1.89E-005	0.00E+000
7.11E-004								
Ru105	3.73E+000	0.00E+000	3.39E-004	0.00E+000	3.83E-004	0.00E+000	1.94E-005	0.00E+000
2.19E-005								
Ru106	2.54E+000	0.00E+000	6.35E-005	0.00E+000	2.75E-001	0.00E+000	3.63E-006	0.00E+000
1.57E-002								
Rh105	4.07E+000	0.00E+000	3.65E-005	0.00E+000	8.84E-004	0.00E+000	2.09E-006	0.00E+000
5.05E-005								

Y90	4.94E-001	0.00E+000	2.26E-007	0.00E+000	9.48E-004	0.00E+000	1.29E-008	0.00E+000
5.42E-005								
Y91	4.40E+000	0.00E+000	2.75E-006	0.00E+000	4.88E-002	0.00E+000	1.57E-007	0.00E+000
2.79E-003								
Y92	4.40E+000	0.00E+000	1.37E-004	0.00E+000	7.80E-004	0.00E+000	7.85E-006	0.00E+000
4.46E-005								
Y93	4.84E+000	0.00E+000	5.58E-005	0.00E+000	2.36E-003	0.00E+000	3.19E-006	0.00E+000
1.35E-004								
Zr95	6.19E+000	0.00E+000	5.35E-004	0.00E+000	3.32E-002	0.00E+000	3.06E-005	0.00E+000
1.90E-003								
Zr97	5.93E+000	0.00E+000	6.31E-004	0.00E+000	5.83E-003	0.00E+000	3.61E-005	0.00E+000
3.33E-004								
Nb95	6.30E+000	0.00E+000	5.65E-004	0.00E+000	8.33E-003	0.00E+000	3.23E-005	0.00E+000
4.76E-004								
La140	6.70E+000	0.00E+000	1.89E-003	0.00E+000	7.39E-003	0.00E+000	1.08E-004	0.00E+000
4.23E-004								
La141	5.06E+000	0.00E+000	2.88E-005	0.00E+000	6.63E-004	0.00E+000	1.65E-006	0.00E+000
3.79E-005								
La142	3.82E+000	0.00E+000	1.30E-003	0.00E+000	2.16E-004	0.00E+000	7.45E-005	0.00E+000
1.24E-005								
Pr143	5.54E+000	0.00E+000	2.80E-007	0.00E+000	1.02E-002	0.00E+000	1.60E-008	0.00E+000
5.83E-004								
Nd147	2.38E+000	0.00E+000	3.54E-005	0.00E+000	3.70E-003	0.00E+000	2.02E-006	0.00E+000
2.12E-004								
Am241	5.40E-004	0.00E+000	1.06E-009	0.00E+000	5.45E-002	0.00E+000	6.07E-011	0.00E+000
3.11E-003								
Cm242	2.30E-001	0.00E+000	3.15E-009	0.00E+000	9.04E-001	0.00E+000	1.80E-010	0.00E+000
5.17E-002								
Cm244	5.05E-002	0.00E+000	5.97E-010	0.00E+000	2.85E+000	0.00E+000	3.42E-011	0.00E+000
1.63E-001								
Ce141	6.10E+000	0.00E+000	5.03E-005	0.00E+000	1.24E-002	0.00E+000	2.88E-006	0.00E+000
7.09E-004								
Ce143	5.46E+000	0.00E+000	1.69E-004	0.00E+000	4.21E-003	0.00E+000	9.67E-006	0.00E+000
2.40E-004								
Ce144	5.15E+000	0.00E+000	3.45E-005	0.00E+000	4.38E-001	0.00E+000	1.97E-006	0.00E+000
2.51E-002								
Np239	7.40E+001	0.00E+000	1.37E-003	0.00E+000	4.22E-002	0.00E+000	7.83E-005	0.00E+000
2.41E-003								
Pu238	2.05E-002	0.00E+000	2.41E-010	0.00E+000	1.34E+000	0.00E+000	1.38E-011	0.00E+000
7.68E-002								
Pu239	1.19E-003	0.00E+000	1.22E-011	0.00E+000	8.35E-002	0.00E+000	6.95E-013	0.00E+000
4.77E-003								
Pu240	1.92E-003	0.00E+000	2.20E-011	0.00E+000	1.35E-001	0.00E+000	1.26E-012	0.00E+000
7.69E-003								
Pu241	5.21E-001	0.00E+000	9.07E-011	0.00E+000	5.87E-001	0.00E+000	5.18E-012	0.00E+000
3.36E-002								
Sr89	3.28E+000	0.00E+000	6.10E-007	0.00E+000	3.09E-002	0.00E+000	3.49E-008	0.00E+000
1.77E-003								
Sr90	4.71E-001	0.00E+000	8.54E-009	0.00E+000	1.39E-001	0.00E+000	4.88E-010	0.00E+000
7.96E-003								
Sr91	3.85E+000	0.00E+000	4.54E-004	0.00E+000	1.47E-003	0.00E+000	2.59E-005	0.00E+000
8.38E-005								
Sr92	3.52E+000	0.00E+000	5.68E-004	0.00E+000	6.39E-004	0.00E+000	3.24E-005	0.00E+000
3.65E-005								

720 Hours - HB

environment

	thyroid	wbody	skin	CEDE
EAB dose:	1.04E+001	1.24E+000	0.00E+000	7.42E+000
LPZ dose:	2.37E+000	1.86E-001	0.00E+000	2.25E+000

	thyrd_eab	wbody_eab	skin_eab	CEDE_eab	thyrd_lpz	wbody_lpz	skin_lpz	CEDE_lpz
Noble gas	0.00E+000	1.14E+000	0.00E+000	0.00E+000	0.00E+000	1.74E-001	0.00E+000	0.00E+000
Org iodine	5.80E+000	1.99E-002	0.00E+000	1.83E-001	1.64E+000	3.12E-003	0.00E+000	5.15E-002
Elem iodine	2.99E+000	1.38E-002	0.00E+000	9.51E-002	3.14E-001	1.60E-003	0.00E+000	9.97E-003
Part iodine	1.56E+000	5.46E-003	0.00E+000	4.95E-002	4.16E-001	8.05E-004	0.00E+000	1.30E-002
Cesium	0.00E+000	4.82E-002	0.00E+000	2.40E-002	0.00E+000	4.57E-003	0.00E+000	6.24E-003

Tellurium	0.00E+000	4.43E-004	0.00E+000	1.42E-002	0.00E+000	1.08E-004	0.00E+000	3.82E-003
Barium	0.00E+000	1.53E-004	0.00E+000	5.57E-003	0.00E+000	4.64E-005	0.00E+000	1.58E-003
Noble metal	0.00E+000	9.75E-004	0.00E+000	2.95E-001	0.00E+000	2.70E-004	0.00E+000	9.04E-002
Lanthanides	0.00E+000	5.18E-003	0.00E+000	3.93E+000	0.00E+000	1.38E-003	0.00E+000	1.21E+000
Cerium	0.00E+000	1.62E-003	0.00E+000	2.65E+000	0.00E+000	4.83E-004	0.00E+000	8.14E-001
Strontinum	0.00E+000	1.02E-003	0.00E+000	1.72E-001	0.00E+000	1.66E-004	0.00E+000	5.27E-002
	air_space	thyrd_eab	wbody_eab	skin_eab	CEDE_eab	thyrd_lpz	wbody_lpz	skin_lpz
CEDE_lpz								
Kr85m	5.65E+003	0.00E+000	1.96E-002	0.00E+000	0.00E+000	0.00E+000	4.08E-003	0.00E+000
0.00E+000								
Kr85	2.60E+004	0.00E+000	2.48E-005	0.00E+000	0.00E+000	0.00E+000	1.34E-005	0.00E+000
0.00E+000								
Kr87	2.53E+003	0.00E+000	1.42E-001	0.00E+000	0.00E+000	0.00E+000	1.36E-002	0.00E+000
0.00E+000								
Kr88	8.78E+003	0.00E+000	6.35E-001	0.00E+000	0.00E+000	0.00E+000	1.04E-001	0.00E+000
0.00E+000								
Xe131m	9.02E+003	0.00E+000	5.72E-005	0.00E+000	0.00E+000	0.00E+000	2.81E-005	0.00E+000
0.00E+000								
Xe133m	1.34E+004	0.00E+000	1.12E-003	0.00E+000	0.00E+000	0.00E+000	4.73E-004	0.00E+000
0.00E+000								
Xe133	9.02E+005	0.00E+000	4.05E-002	0.00E+000	0.00E+000	0.00E+000	1.90E-002	0.00E+000
0.00E+000								
Xe135m	3.67E+002	0.00E+000	1.73E-002	0.00E+000	0.00E+000	0.00E+000	9.94E-004	0.00E+000
0.00E+000								
Xe135	2.25E+004	0.00E+000	6.50E-002	0.00E+000	0.00E+000	0.00E+000	1.86E-002	0.00E+000
0.00E+000								
Xe137	3.74E+002	0.00E+000	7.08E-003	0.00E+000	0.00E+000	0.00E+000	4.05E-004	0.00E+000
0.00E+000								
Xe138	1.64E+003	0.00E+000	2.17E-001	0.00E+000	0.00E+000	0.00E+000	1.26E-002	0.00E+000
0.00E+000								
I130Org	4.57E+000	8.75E-003	1.31E-004	0.00E+000	3.14E-004	1.95E-003	3.15E-005	0.00E+000
6.99E-005								
I131Org	1.27E+003	4.16E+000	7.48E-004	0.00E+000	1.28E-001	1.26E+000	2.64E-004	0.00E+000
3.86E-002								
I132Org	4.25E+001	2.61E-002	4.91E-003	0.00E+000	1.58E-003	3.10E-003	5.87E-004	0.00E+000
1.88E-004								
I133Org	4.31E+002	1.38E+000	2.38E-003	0.00E+000	4.47E-002	3.40E-001	6.46E-004	0.00E+000
1.10E-002								
I134Org	2.45E+001	4.55E-003	5.85E-003	0.00E+000	5.57E-004	3.30E-004	4.24E-004	0.00E+000
4.04E-005								
I135Org	1.61E+002	2.12E-001	5.93E-003	0.00E+000	8.32E-003	3.99E-002	1.17E-003	0.00E+000
1.56E-003								
I130Elem	7.06E-001	4.64E-003	6.94E-005	0.00E+000	1.66E-004	4.18E-004	6.48E-006	0.00E+000
1.50E-005								
I131Elem	1.54E+002	2.12E+000	3.81E-004	0.00E+000	6.53E-002	2.31E-001	4.56E-005	0.00E+000
7.09E-003								
I132Elem	3.60E+002	1.98E-002	3.72E-003	0.00E+000	1.20E-003	3.90E-003	8.48E-004	0.00E+000
2.36E-004								
I133Elem	5.93E+001	7.23E-001	1.24E-003	0.00E+000	2.34E-002	6.88E-002	1.25E-004	0.00E+000
2.22E-003								
I134Elem	1.76E+001	4.00E-003	5.14E-003	0.00E+000	4.90E-004	2.37E-004	3.04E-004	0.00E+000
2.90E-005								
I135Elem	3.05E+001	1.17E-001	3.28E-003	0.00E+000	4.59E-003	9.63E-003	2.75E-004	0.00E+000
3.77E-004								
I130Part	1.15E+000	2.36E-003	3.53E-005	0.00E+000	8.48E-005	4.96E-004	8.00E-006	0.00E+000
1.78E-005								
I131Part	3.18E+002	1.12E+000	2.02E-004	0.00E+000	3.45E-002	3.18E-001	6.65E-005	0.00E+000
9.78E-003								
I132Part	1.11E+001	7.13E-003	1.34E-003	0.00E+000	4.32E-004	8.08E-004	1.53E-004	0.00E+000
4.90E-005								
I133Part	1.08E+002	3.73E-001	6.42E-004	0.00E+000	1.21E-002	8.64E-002	1.64E-004	0.00E+000
2.79E-003								
I134Part	6.68E+000	1.27E-003	1.63E-003	0.00E+000	1.55E-004	9.00E-005	1.16E-004	0.00E+000
1.10E-005								
I135Part	4.07E+001	5.75E-002	1.61E-003	0.00E+000	2.25E-003	1.02E-002	2.98E-004	0.00E+000
4.00E-004								
Rb86	1.22E+000	0.00E+000	1.26E-007	0.00E+000	1.64E-005	0.00E+000	4.36E-008	0.00E+000
4.82E-006								
Rb88	5.36E+002	0.00E+000	1.33E-002	0.00E+000	3.15E-003	0.00E+000	2.13E-003	0.00E+000
4.95E-004								

Cs134	2.19E+002	0.00E+000	2.23E-004	0.00E+000	1.29E-002	0.00E+000	8.20E-005	0.00E+000
3.98E-003								
Cs136	2.41E+001	0.00E+000	6.54E-005	0.00E+000	4.28E-004	0.00E+000	2.23E-005	0.00E+000
1.24E-004								
Cs137	1.17E+002	0.00E+000	4.27E-005	0.00E+000	4.72E-003	0.00E+000	1.57E-005	0.00E+000
1.46E-003								
Cs138	1.41E+002	0.00E+000	3.46E-002	0.00E+000	2.73E-003	0.00E+000	2.32E-003	0.00E+000
1.83E-004								
Sb127	1.34E+001	0.00E+000	2.78E-005	0.00E+000	4.77E-004	0.00E+000	8.68E-006	0.00E+000
1.30E-004								
Sb129	3.28E+000	0.00E+000	1.57E-004	0.00E+000	1.34E-004	0.00E+000	2.44E-005	0.00E+000
2.03E-005								
Te127m	1.00E+001	0.00E+000	2.15E-008	0.00E+000	2.97E-004	0.00E+000	7.80E-009	0.00E+000
9.08E-005								
Te127	1.46E+001	0.00E+000	2.02E-007	0.00E+000	2.51E-005	0.00E+000	6.55E-008	0.00E+000
7.04E-006								
Te129m	2.64E+001	0.00E+000	1.55E-006	0.00E+000	1.06E-003	0.00E+000	5.49E-007	0.00E+000
3.17E-004								
Te131m	1.12E+001	0.00E+000	1.29E-004	0.00E+000	1.06E-003	0.00E+000	3.51E-005	0.00E+000
2.59E-004								
Te132	1.73E+002	0.00E+000	1.29E-004	0.00E+000	1.11E-002	0.00E+000	3.96E-005	0.00E+000
2.99E-003								
Ba139	6.60E+000	0.00E+000	2.16E-005	0.00E+000	1.62E-004	0.00E+000	1.88E-006	0.00E+000
1.41E-005								
Ba140	5.88E+002	0.00E+000	1.31E-004	0.00E+000	5.41E-003	0.00E+000	4.45E-005	0.00E+000
1.57E-003								
Mo99	1.96E+002	0.00E+000	1.18E-004	0.00E+000	6.11E-003	0.00E+000	3.58E-005	0.00E+000
1.62E-003								
Tc99m	2.10E+002	0.00E+000	8.66E-005	0.00E+000	4.53E-005	0.00E+000	2.85E-005	0.00E+000
1.29E-005								
Ru103	8.66E+002	0.00E+000	3.30E-004	0.00E+000	1.24E-002	0.00E+000	1.18E-004	0.00E+000
3.74E-003								
Ru105	1.36E+001	0.00E+000	3.39E-004	0.00E+000	3.83E-004	0.00E+000	5.35E-005	0.00E+000
5.88E-005								
Ru106	4.47E+002	0.00E+000	6.35E-005	0.00E+000	2.75E-001	0.00E+000	2.33E-005	0.00E+000
8.48E-002								
Rh105	7.94E+001	0.00E+000	3.65E-005	0.00E+000	8.84E-004	0.00E+000	1.08E-005	0.00E+000
2.32E-004								
Y90	8.57E+001	0.00E+000	2.26E-007	0.00E+000	9.48E-004	0.00E+000	8.23E-008	0.00E+000
2.91E-004								
Y91	6.78E+002	0.00E+000	2.75E-006	0.00E+000	4.88E-002	0.00E+000	9.93E-007	0.00E+000
1.48E-002								
Y92	2.00E+001	0.00E+000	1.37E-004	0.00E+000	7.80E-004	0.00E+000	2.59E-005	0.00E+000
1.42E-004								
Y93	3.37E+001	0.00E+000	5.58E-005	0.00E+000	2.36E-003	0.00E+000	1.19E-005	0.00E+000
4.73E-004								
Zr95	9.62E+002	0.00E+000	5.35E-004	0.00E+000	3.32E-002	0.00E+000	1.93E-004	0.00E+000
1.01E-002								
Zr97	6.06E+001	0.00E+000	6.31E-004	0.00E+000	5.83E-003	0.00E+000	1.54E-004	0.00E+000
1.30E-003								
Nb95	1.11E+003	0.00E+000	5.65E-004	0.00E+000	8.33E-003	0.00E+000	2.07E-004	0.00E+000
2.56E-003								
La140	6.66E+002	0.00E+000	1.89E-003	0.00E+000	7.39E-003	0.00E+000	6.50E-004	0.00E+000
2.17E-003								
La141	1.67E+001	0.00E+000	2.88E-005	0.00E+000	6.63E-004	0.00E+000	4.30E-006	0.00E+000
9.67E-005								
La142	6.40E+000	0.00E+000	1.30E-003	0.00E+000	2.16E-004	0.00E+000	1.20E-004	0.00E+000
1.99E-005								
Pr143	5.79E+002	0.00E+000	2.80E-007	0.00E+000	1.02E-002	0.00E+000	9.74E-008	0.00E+000
3.02E-003								
Nd147	2.02E+002	0.00E+000	3.54E-005	0.00E+000	3.70E-003	0.00E+000	1.19E-005	0.00E+000
1.07E-003								
Am241	9.75E-002	0.00E+000	1.06E-009	0.00E+000	5.45E-002	0.00E+000	3.91E-010	0.00E+000
1.68E-002								
Cm242	3.91E+001	0.00E+000	3.15E-009	0.00E+000	9.04E-001	0.00E+000	1.15E-009	0.00E+000
2.77E-001								
Cm244	9.12E+000	0.00E+000	5.97E-010	0.00E+000	2.85E+000	0.00E+000	2.20E-010	0.00E+000
8.80E-001								
Ce141	8.29E+002	0.00E+000	5.03E-005	0.00E+000	1.24E-002	0.00E+000	1.79E-005	0.00E+000
3.73E-003								

Ce143 1.04E-003	9.16E+001	0.00E+000	1.69E-004	0.00E+000	4.21E-003	0.00E+000	4.67E-005	0.00E+000
Ce144 1.35E-001	9.00E+002	0.00E+000	3.45E-005	0.00E+000	4.38E-001	0.00E+000	1.26E-005	0.00E+000
Np239 1.10E-002	1.89E+003	0.00E+000	1.37E-003	0.00E+000	4.22E-002	0.00E+000	4.06E-004	0.00E+000
Pu238 4.15E-001	3.70E+000	0.00E+000	2.41E-010	0.00E+000	1.34E+000	0.00E+000	8.88E-011	0.00E+000
Pu239 2.58E-002	2.15E-001	0.00E+000	1.22E-011	0.00E+000	8.35E-002	0.00E+000	4.48E-012	0.00E+000
Pu240 4.16E-002	3.47E-001	0.00E+000	2.20E-011	0.00E+000	1.35E-001	0.00E+000	8.09E-012	0.00E+000
Pu241 1.81E-001	9.39E+001	0.00E+000	9.07E-011	0.00E+000	5.87E-001	0.00E+000	3.34E-011	0.00E+000
Sr89 9.35E-003	4.91E+002	0.00E+000	6.10E-007	0.00E+000	3.09E-002	0.00E+000	2.19E-007	0.00E+000
Sr90 4.30E-002	8.50E+001	0.00E+000	8.54E-009	0.00E+000	1.39E-001	0.00E+000	3.14E-009	0.00E+000
Sr91 2.89E-004	2.56E+001	0.00E+000	4.54E-004	0.00E+000	1.47E-003	0.00E+000	9.52E-005	0.00E+000
Sr92 7.86E-005	8.71E+000	0.00E+000	5.68E-004	0.00E+000	6.39E-004	0.00E+000	7.06E-005	0.00E+000

STARDOSE 1.01 (c) 1996-2002 Polestar Applied Technology, Inc.
Tue Apr 29 08:53:47 2008

Total elapsed hours: 0, mins: 0, secs: 3

MicroShield Analysis for Long-Term EQ Dose Rates

Introduction

This appendix presents the MicroShield analyses performed to project the external exposure dose rates beyond the 30-day dose integration of the STARDOSE analysis. In these analyses, the STARDOSE output at $t = 0.00056$ hours (two seconds) for the two cases presented in Appendix C are used as input to STARGATE (reference [D1]) to extract relevant activity information for the containment. The .MX7 (external source) files created by STARGATE are read by MicroShield (reference [D2]) as input to a shine analysis, but no shine analysis is actually conducted. Rather, the source is decayed for 90 days and 180 days (after the noble gas radionuclides have been deleted) to provide the long-term waterborne gamma radiation source term consistent with the release to containment. There is a question regarding whether the iodine contribution to the waterborne source term should have been increased by a factor of two (to account for 50% iodine release rather than 25% iodine release); but even the relatively long-lived I-131 will have gone through 11.2 half-lives by 90 days, so the contribution of another 25% of iodine at $t = 90$ days (or $t = 180$ days) should have a negligible effect, and this has been confirmed.

.MX7 Files

The two $t = 0$.MX7 files prepared by STARGATE after the noble gas has been removed are as follows (first for OFA fuel):

7.02 MS source file created: Wed Apr 30 06:52:59 2008 for edit time= .000560 (hr) from results-ofa.out

```

1
1 : Indicator for Ci or Photons/sec
1 : Geometry factor (point, cm, cm^2, or cm^3)
54 : Number of nuclides in file.
Nuclide Index      Ci      Nuclide Name
332      1.29E+003      Rb-86
334      3.01E+005      Rb-88
115      1.33E+005      Cs-134
118      2.92E+004      Cs-136
119      6.82E+004      Cs-137
120      8.60E+005      Cs-138
365      4.20E+004      Sb-127
366      1.28E+005      Sb-129
416      7.13E+003      Te-127m
415      4.14E+004      Te-127
418      2.32E+004      Te-129m
420      8.77E+004      Te-131m
421      6.26E+005      Te-132
41      7.94E+005      Ba-139
42      7.63E+005      Ba-140
224      8.19E+005      Mo-99
408      7.21E+005      Tc-99m
355      7.31E+005      Ru-103
356      5.19E+005      Ru-105
357      2.86E+005      Ru-106
347      4.84E+005      Rh-105
480      5.21E+004      Y-90
482      5.25E+005      Y-91
484      5.40E+005      Y-92
485      6.18E+005      Y-93
496      7.37E+005      Zr-95
497      7.38E+005      Zr-97

```

238	7.50E+005	Nb-95	
209	8.03E+005	La-140	
210	7.15E+005	La-141	
211	6.88E+005	La-142	
302	6.62E+005	Pr-143	
243	2.84E+005	Nd-147	
13	4.99E+001	Am-241	
93	2.38E+004	Cm-242	
95	5.30E+003	Cm-244	
81	7.28E+005	Ce-141	
82	6.66E+005	Ce-143	
83	5.93E+005	Ce-144	
255	8.97E+006	Np-239	
313	2.11E+003	Pu-238	
314	1.24E+002	Pu-239	
315	2.00E+002	Pu-240	
316	5.45E+004	Pu-241	
391	3.96E+005	Sr-89	
392	4.94E+004	Sr-90	
393	4.94E+005	Sr-91	
394	5.34E+005	Sr-92	
174	3.57E+005	I-130	
175	1.11E+007	I-131	
176	1.60E+007	I-132	
177	2.24E+007	I-133	
178	2.52E+007	I-134	
179	2.14E+007	I-135	
Energy	Activity (Photons/sec)		
0	0	Energy #	1
0	0	Energy #	2
0	0	Energy #	3
0	0	Energy #	4
0	0	Energy #	5
0	0	Energy #	6
0	0	Energy #	7
0	0	Energy #	8
0	0	Energy #	9
0	0	Energy #	10
0	0	Energy #	11
0	0	Energy #	12
0	0	Energy #	13
0	0	Energy #	14
0	0	Energy #	15
0	0	Energy #	16
0	0	Energy #	17
0	0	Energy #	18
0	0	Energy #	19
0	0	Energy #	20
0	0	Energy #	21
0	0	Energy #	22
0	0	Energy #	23
0	0	Energy #	24
0	0	Energy #	25

And for HB fuel:

7.02 MS source file created: Wed Apr 30 06:58:45 2008 for edit time= .000560 (hr) from results-HB.out

```

1
1 : Indicator for Ci or Photons/sec
1 : Geometry factor (point, cm, cm^2, or cm^3)
54 : Number of nuclides in file.
Nuclide Index      Ci      Nuclide Name
332      1.27E+003      Rb-86
334      2.95E+005      Rb-88
115      1.43E+005      Cs-134
118      3.01E+004      Cs-136
119      7.60E+004      Cs-137
120      8.41E+005      Cs-138

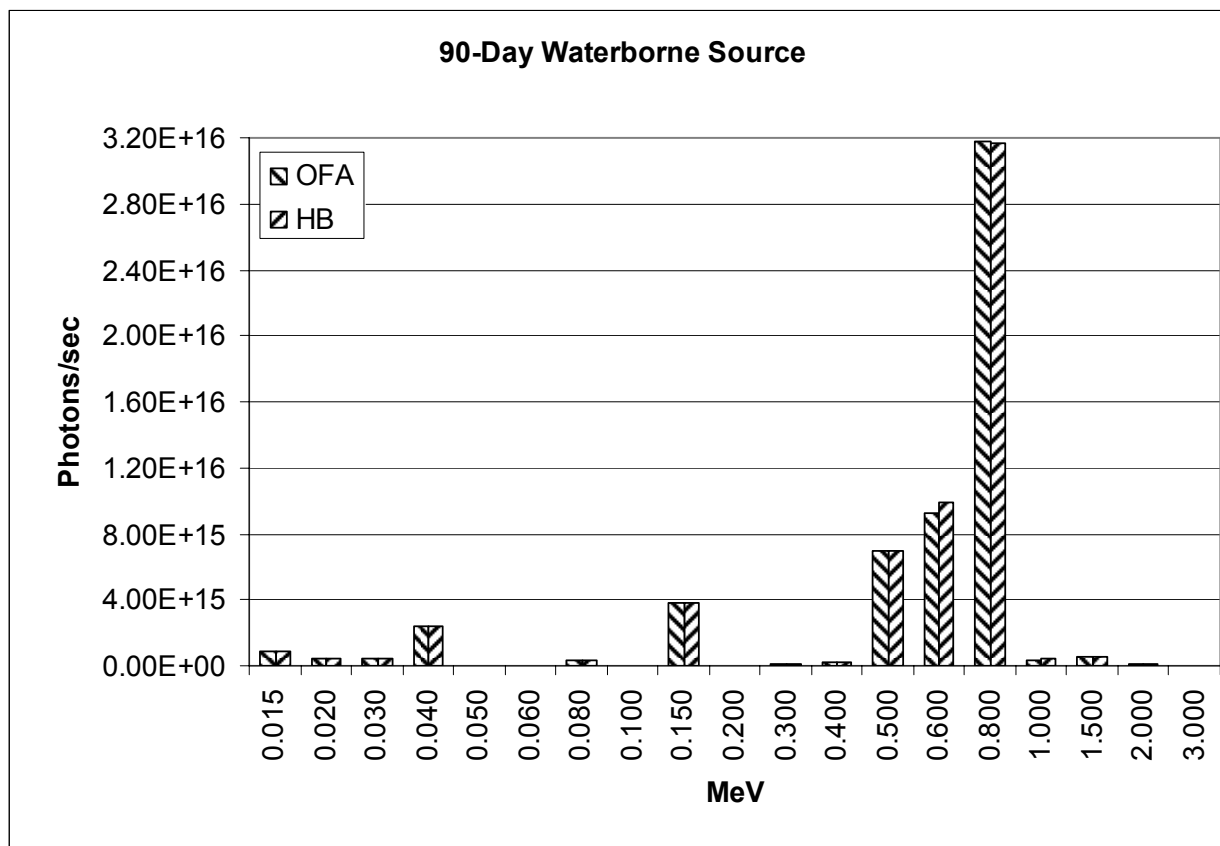
```

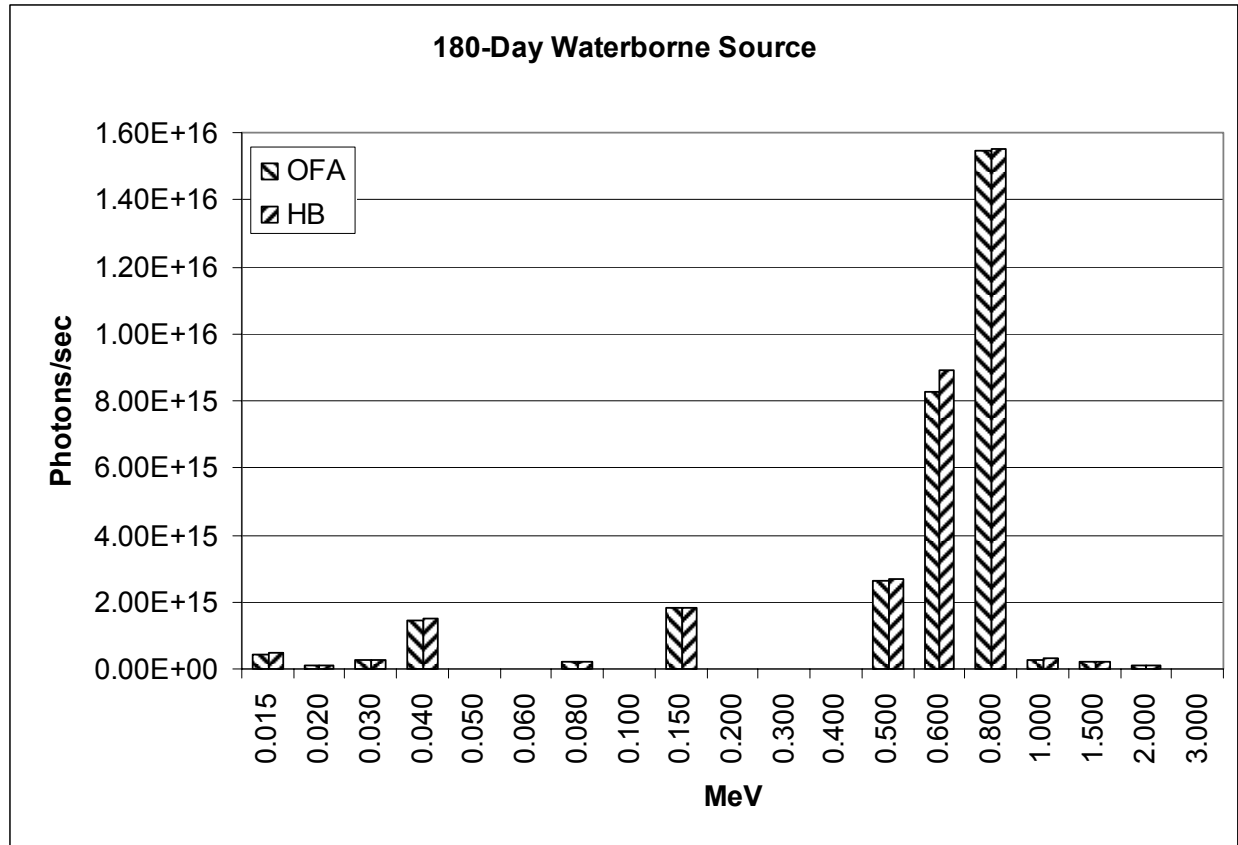
365	4.10E+004	Sb-127	
366	1.25E+005	Sb-129	
416	7.10E+003	Te-127m	
415	4.06E+004	Te-127	
418	2.27E+004	Te-129m	
420	8.58E+004	Te-131m	
421	6.12E+005	Te-132	
41	7.77E+005	Ba-139	
42	7.45E+005	Ba-140	
224	8.01E+005	Mo-99	
408	7.05E+005	Tc-99m	
355	7.14E+005	Ru-103	
356	5.06E+005	Ru-105	
357	2.97E+005	Ru-106	
347	4.76E+005	Rh-105	
480	5.77E+004	Y-90	
482	5.14E+005	Y-91	
484	5.29E+005	Y-92	
485	6.05E+005	Y-93	
496	7.24E+005	Zr-95	
497	7.22E+005	Zr-97	
238	7.37E+005	Nb-95	
209	7.84E+005	La-140	
210	7.00E+005	La-141	
211	6.73E+005	La-142	
302	6.48E+005	Pr-143	
243	2.79E+005	Nd-147	
13	6.31E+001	Am-241	
93	2.69E+004	Cm-242	
95	5.90E+003	Cm-244	
81	7.13E+005	Ce-141	
82	6.52E+005	Ce-143	
83	6.02E+005	Ce-144	
255	8.75E+006	Np-239	
313	2.40E+003	Pu-238	
314	1.39E+002	Pu-239	
315	2.25E+002	Pu-240	
316	6.08E+004	Pu-241	
391	3.84E+005	Sr-89	
392	5.50E+004	Sr-90	
393	4.83E+005	Sr-91	
394	5.23E+005	Sr-92	
174	3.50E+005	I-130	
175	1.08E+007	I-131	
176	1.56E+007	I-132	
177	2.20E+007	I-133	
178	2.45E+007	I-134	
179	2.09E+007	I-135	
Energy	Activity (Photons/sec)		
0	0	Energy #	1
0	0	Energy #	2
0	0	Energy #	3
0	0	Energy #	4
0	0	Energy #	5
0	0	Energy #	6
0	0	Energy #	7
0	0	Energy #	8
0	0	Energy #	9
0	0	Energy #	10
0	0	Energy #	11
0	0	Energy #	12
0	0	Energy #	13
0	0	Energy #	14
0	0	Energy #	15
0	0	Energy #	16
0	0	Energy #	17
0	0	Energy #	18
0	0	Energy #	19
0	0	Energy #	20
0	0	Energy #	21
0	0	Energy #	22

0	0	Energy #	23
0	0	Energy #	24
0	0	Energy #	25

Results

Graphically, the dose rates are as follows;





As is evident from these plots, the EQ dose rates due to waterborne sources at $t = 90$ days would be about the same for the two core inventories (the HB fuel being only 1% higher in terms of total photons/sec and actually less than the OFA fuel for the dominant 0.8 MeV group), and at $t = 180$ days, the HB fuel being only 3% greater. The late contribution (30 to 180 days) will be comparable to that for the first 30 days in spite of the time duration being five times greater. If one assumes the average MeV/sec over the 150 day interval from 30 to 180 days is that equal to the point value at $t = 90$ days ($\sim 3.7\text{E}16$ MeV/sec, a reasonable assumption given that the point value at $t = 180$ days is $\sim 55\%$ of that at $t = 90$ days), the rem- m^3 from $t = 30$ days to $t = 180$ days would be approximately $(0.25 \text{ rem-}\text{m}^3\text{-disintegration/Ci-sec-MeV from RG 1.4}) / (3.7\text{E}10 \text{ disintegrations/sec-Ci}) \cdot 3.7\text{E}16 \text{ MeV/sec} \cdot 1.3\text{E}7 \text{ seconds} = 3.25\text{E}12 \text{ rem-}\text{m}^3$. For the HB fuel, the rem- m^3 value might be of the order of 1% greater than that for the OFA fuel; i.e., $\sim 3\text{E}10 \text{ rem-}\text{m}^3$ greater. The margin at $t = 30$ days (OFA minus HB) is $\sim 4\text{E}10 \text{ rem-}\text{m}^3$. Therefore, the OFA fuel would be expected to be bounding even at $t = 180$ days.

References

- D1.PSAT CI18.QA.07, "STARGATE Programming Report" and PSAT CI18.QA.03, "Dedication of MicroShield and STARGATE"
- D2.PSAT CI18.QA.04, "MicroShield User's Manual, Version 7," October, 2006, Grove Software, Inc. and PSAT CI18.QA.03, "Dedication of MicroShield and STARGATE"