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GE-Hitachi As-Run Neutronics ECAR-4740

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Title: AS-RUN NEUTRONICS EVALUATION FOR THE GE HITACHI EXPERIMENT IN THE ATR

ECAR NO.: 4740 REV. NO.: 0 PROJECT NO.: 32535 Date: 12/02/2019

1.	Does this ECAR involve a Safety SSC?	No	**Professional Engineer's Stamp** N/A See LWP-10010 for requirements
2.	Safety SSC Determination Document ID	N/A	
3.	Engineering Job (EJ) No.	NA	
4.	SSC ID	N/A	
5.	Building	TRA-670	
6.	Site Area	ATR Complex	

7. Objective/Purpose:

This Engineering Calculations and Analysis Report (ECAR) documents the results of the Advanced Test Reactor (ATR) detailed Monte Carlo N-Particle (MCNP) code full-core model as-run physics analysis performed to support shipping and PIE for the GE-Hitachi static drop-in experiment in the B-11 position (see Appendix A).

The purpose of this analysis is to calculate the following:

- The heat-generation rates of the test specimens and associated components.
- The DPA for each capsule as a result of irradiation for the currently planned cycles.
- Decay heat (watts/cc) at shutdown and after 30 minutes, 5 hours, 1 day, 7 days, 14 days, 30 days, 60 days, 90 days, 120 days, and 360 days of cooling for each material.
- Source terms (curies) at shutdown and after 30 minutes, 5 hours, 1 day, 7 days, 14 days, 30 days, 60 days, 90 days, 120 days, and 360 days of cooling for the experiment.

These calculations were performed using the computer codes MCNP and ORIGEN2. The neutronics model description, analysis details, and results are presented in the attached report.

8.	If revision, please state the reason and list sections or pages being affected:
9.	Conclusions/Recommendations: Results are shown for the heating rates (see Table 6 and Table 7), DPA (see Table 13), decay heat (see Table 15), and radionuclide concentrations (see Table 16) in this report. Heating rates were generated assuming nominal core power configurations for each cycle, see Table 5. The DPA was calculated for each material. The following, Table 1, displays the calculated DPA range for each capsule target.

Table 1. Calculated DPA Range.

	EFPD	Minimum DPA	Maximum DPA	Average DPA
SS316L	219	0.74	0.86	0.92
Inconel 718		0.86	1.00	1.07

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PROJECT ROLES AND RESPONSIBILITIES

Project Role	Name (Typed)	Organization	Pages Covered (if applicable)
Performer(s)	Jill Mitchell	C-130	All
Checker[a]	Brian Gross	C-130	All
Independent Reviewer[b]	N/A	--	--
CUI Reviewer[c]	Matthew Arrowood	C-601	All
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Requestor[e]	Matthew Arrowood	C-601	All
Nuclear Safety[e]	N/A	--	--
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Responsibilities:

a. Confirmation of completeness, mathematical accuracy, and correctness of data and appropriateness of assumptions.
b. Concurrence of method or approach. See definition, LWP-10106.
c. Concurrence with the document's markings in accordance with LWP-11202.
d. Concurrence of procedure compliance. Concurrence with method/approach and conclusion.
e. Concurrence with the document's assumptions and input information. See definition of Acceptance, LWP-10200.

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1. SCOPE AND BRIEF DESCRIPTION

This engineering calculations and analysis report (ECAR) documents the results of the Advanced Test Reactor (ATR) as-run physics analysis performed to support shipping and PIE of the GE Hitachi static drop-in experiment in the B-11 position located in the south region of the ATR. The purpose of this analysis is to calculate the following:

- The as-run neutron and gamma heat rates for the GE Hitachi experiment;
- The DPA for each capsule as a result of irradiation;
- Decay heat (watts) at shutdown and after 30 minutes, 5 hours, 1 day, 7 days, 14 days, 30 days, 60 days, and 360 days of cooling for each material;
- Source term (curies) at shutdown and after 30 minutes, 5 hours, 1 day, 7 days, 14 days, 30 days, 60 days, and 360 days of cooling for the experiment.

2. DESIGN AND TECHNICAL PARAMETER INPUT AND SOURCES

The GE Hitachi experiment was irradiated in the B-11 position in the ATR, shown in Figure 1. The experiment specimens consisted of twelve rounded, compact tension (CT) specimens, six composed of SS316L and six of Inconel 718, and eight ASTM standard sub-size tensile specimens, four composed of SS316L and four Inconel 718, packaged inside three specimen holders centered about the ATR core midplane and were “clocked” to ensure the tension specimens were oriented facing the ATR core center and the tensile specimens. To ensure proper tensile specimen vertical alignment within each holder, a sleeve surrounds the smaller diameter portion of each tensile specimen. ECAR-3569 [[14]] contains a detailed description of the GE-Hitachi experiment model. Figure 2 shows an axial view of the MCNP model of the experiment assembly.

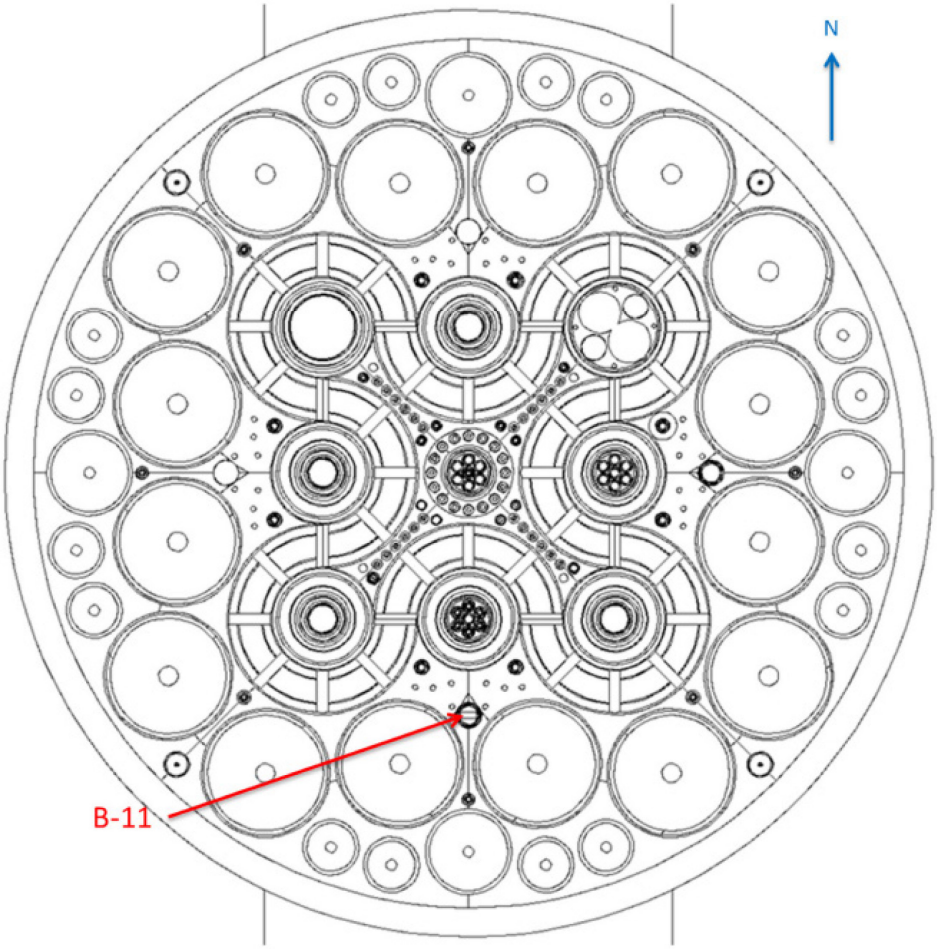

Figure 1. Radial cross section view of the ATR core, B-11 irradiation test position.

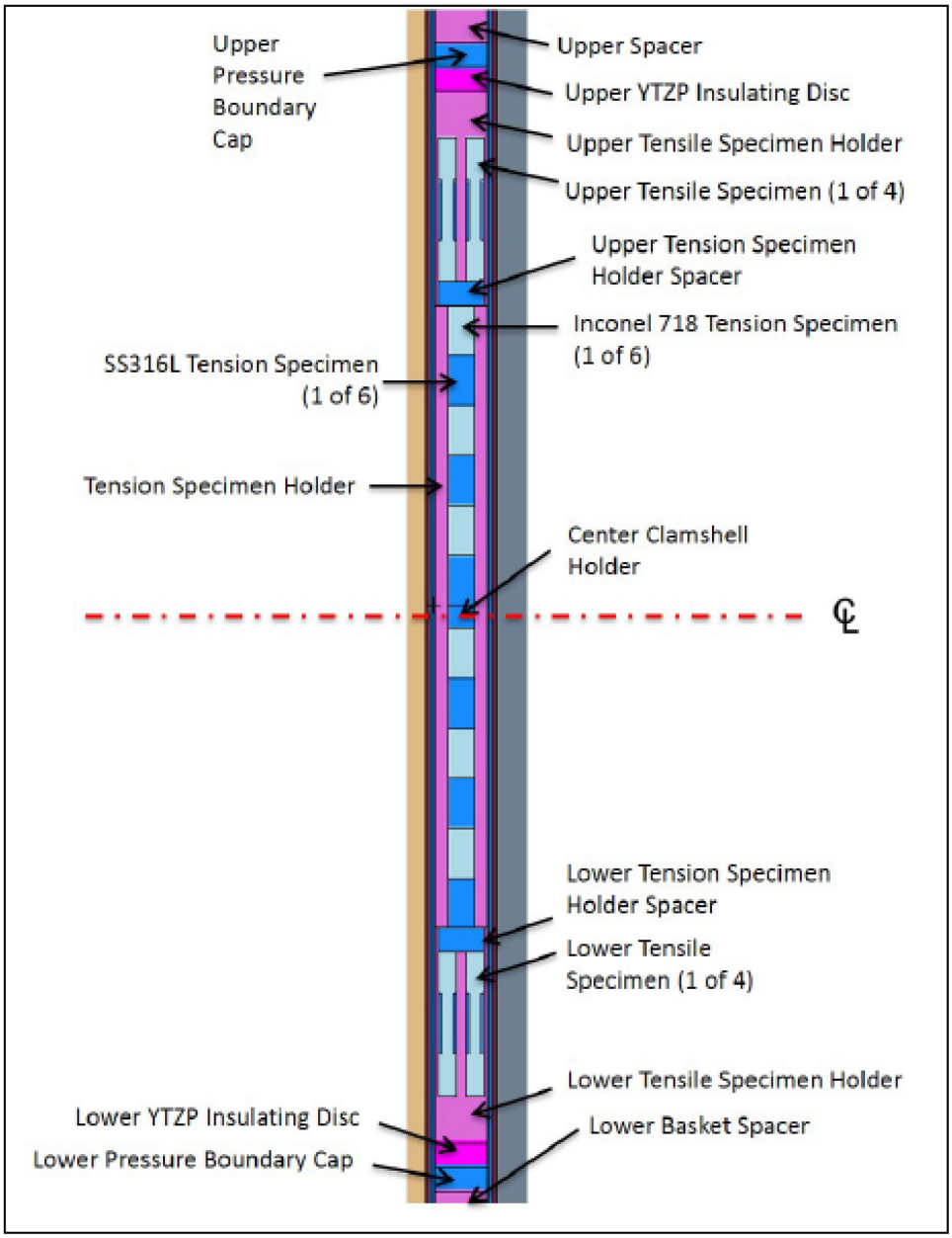

Figure 2. Axial View of MCNP Model of GE Hitachi Experiment Assembly.

3. RESULTS OF LITERATURE SEARCHES AND OTHER BACKGROUND DATA

The general purpose Monte Carlo N-Particle transport code, MCNP [4][5], was used to model and evaluate the GE-HITACHI experiment. ORIGEN2 [6] was used to calculate the source term for the experiment.

The model for the GE-HITACHI experiment is based on the drawings listed in Table 2. Nominal dimensions for the specimen, holders, and capsules are used in the model.

Table 2. List of drawings for GE-HITACHI experiment.

INL Drawing	Rev.	Drawing Title
605754	1	ATR GE HITACHI (GEH) CAPSULE DETAILS AND ASSEMBLY
605755	1	ATR GE HITACHI (GEH) ADDITIVELY MANUFACTURED (AM) ROUND TENSILE SPECIMEN DETAIL
605756	1	ATR GE HITACHI (GEH) ADDITIVEVLY MANUFACTURED (AM) COMPACT TENSILE SPECIMEN DETAIL
605757	2	ATR GE HITCAHI (GEH) FINAL ASSMBLY
605758	1	ATR GE HITACHI (GEH) BASKET DETAILS AND ASSEMBLY
605759	2	ATR GE HITACHI (GEH) PRESSURE BOUNDARY AND SPACERS DETAILS
605760	0	ATR GE HITACHI (GEH) IN-VESSEL INSTALLATION

The files used for this analysis are located on the Irradiation Testing server [Z:\IRRADIATION TESTING\C660 Analysts\Jill Mitchell files\Projects\2019\GE-HIT AsRun\cksum_final_files\New_final]. The following checksum results are provided for the supporting documents:

3819434261 1802 316SS_long.inp
908377615 1789944 316SS_long.out
2416965142 2002 Al_6061.inp
2438781775 85472 Al_6061.out
4114281713 1291360 Cycle162A.xlsx
2470164183 1421 Fe_long.inp
2052588175 1691250 Fe_long.out
3450685755 453236 GE_AsRun_JRM1.xlsx
3117161257 1192473 ged
1237472001 1192202 ged1
2081978239 7778763 ged1.o
1503290156 7778761 ged.o
2186552041 1198601 gedpa
1178662459 14005626 gedpa.o
982957008 1209226 geh1
3187985869 1209497 geh1 (2)
1648079297 14207487 geh1 (2).o
123181859 14207487 geh1.o
2777823801 1198872 grdpa
1989005037 14005626 grdpa.o

1364922650 2215 Inconel_718.inp
1736015861 101340 Inconel_718.out
1616816814 2058 incon_long.inp
951933670 1830072 incon_long.out
1840308986 1421 Nb_long.inp
3895938005 1690690 Nb_long.out
577040119 2031 SS316L.inp
1856543422 93075 SS316L.out
1090761148 1421 Ti_long.inp
2629022030 1697148 Ti_long.out
1458566354 3749
Total_experiment_assembly.inp
572013508 118681
Total_experiment_assembly.out
2723465091 1849 YTZP_zirconia.inp
2400910794 300126 YTZP_zirconia.out

4. ASSUMPTIONS

The following assumptions were used in this analysis:

1. The as-run analysis was performed based on nominal lobe powers provided in Appendix B for 162A through 164B.

2. An increase in lobe power for any lobe affecting the south region of the reactor will result in a change in test heating. Therefore, any power changes must be accounted for as a function of the ratio of the actual south lobe power to the analyzed south lobe source power.

3. The south lobe power is defined by the average of the SW, SE, and C lobe powers; S=(SW+SE+C)/3.

4. Heating rate values reported for GE-HITACHI include energy deposition from prompt neutrons, prompt gammas, and delayed fission product gammas.

5. Contributions to heat and radionuclide source term from the flux wires, melt wires, and quartz tubes are negligible.

6. The radionuclide source term was calculated using the maximum neutron flux seen by the experiment which was scaled to the maximum south source power of 26.4 MW assumed for cycle 162A [14]. The historical 8.5% instrumentation uncertainty and OSCC multiplier of 1.2 for the large-B positions were added to the calculation.

7. No credit is given to radioactive decay between cycles when calculating the radionuclide source term and decay heat.

8. YTZP ceramic material contains 3 wt% HfO2 which represents the maximum Hf impurity content instead of the average of 2 wt% as reported by the manufacturer.

5. COMPUTER CODE VALIDATION

The computer code MCNP is listed in the INL Enterprise Architecture (EA) Repository and is accepted as a qualified scientific and engineering analysis software. Table 3 lists the version and EA identification (ID) for the computer code used to perform the calculations and analyses documented by this ECAR.

Table 3. INL qualified analysis software, version, and EA ID.

Code Name	Version	V&V Tracking Number
MCNP	5 (Release 1.60)	234728 [7]
ORIGEN2	2.2	201298 [12]

MCNP Version 5, Release 1.60 and ORIGEN2 have been verified and validated (V&V'd) for use at INL, as documented by TEV-2944 [15]. The computer configurations listed in Table 4 were used to perform the MCNP5 and ORIGEN2 calculations reported in this ECAR.

Table 4. Computer configurations for INL-qualified MCNP5 and ORIGEN2 installations.

Computer	Processor	Operating System

34,992 core
 	
SGI ICE X distributed memory cluster
 	
(a.k.a. falcon computer system)
	2 Login Nodes
	falcon1, falcon2
	• 2 Intel Xeon E5-2695 v4 CPUs
	  ○ Broadwell chipset
	  ○ 18 cores per CPU
	  ○ 2.10 GHz
	• 128GB of RAM
	• FDR InfiniBand Interconnect
	972 Compute Nodes with:
	• 2 Intel Xeon E5-2695 v4 CPUs
	  ○ Broadwell chipset
	  ○ 18 cores per CPU
	  ○ 2.10 GHz
	• 128GB of RAM
	• FDR InfiniBand Interconnect
		SUSE Linux Enterprise Server 12 SP4

5.1. Data Libraries

The standard MCNP cross-section data libraries [4][5] were used to calculate the heating rates, neutron flux, and DPA for the GE-HITACHI experiment. The ENDF/B-VII library was used in the MCNP models. The ATRXS library [11] was used in the ORIGEN2 calculations.

5.2. Power Data

The analysis was performed using nominal lobe powers for each of the cycles. Table 5 gives a summary of the cycle data.

Table 5. Power splits and EFPDs.

	NW (MW)	NE (MW)	C (MW)	SW (MW)	SE (MW)	Total (MW)	S (MW)	EFPD
162A	20.1	17.9	22.8	24.0	26.2	111.0	24.3	61.9
162B	20.0	14.5	19.2	23.9	23.0	100.6	22.0	38.5
164A	20.0	16.0	19.4	22.4	25.7	103.5	22.5	54.9
164B	19.5	16.4	19.7	23.1	25.1	103.8	22.6	64.1
							Total EFPDs:	219.4

6. DISCUSSION / ANALYSIS

MCNP is used to calculate the heating rates, flux, and DPA for GE-HITACHI. ORIGEN2 was used to calculate the decay heat, radionuclide inventory, and radionuclide source term versus cooling time for GE-HITACHI.

6.1. Neutron/Prompt Gamma Heating and Delayed Fission Product Gamma Heating Normalization Factors

MCNP reports tally results normalized per source particle. The MCNP Type 6 energy deposition tally results or Type 7 fission energy deposition tally results are used to calculate HGRs. The MCNP Tally Type 6 has units of MeV/g per source particle (fission neutron for prompt neutron, gamma heating, and fission heating). The heating normalization factor (HNF) is defined by Equation (1).

$$HNF = \left(\frac{2.43\ fission\ neutrons}{fission}\right)\left(\frac{fission}{200\ MeV}\right)\left(\frac{1\times 10^{6}\ W}{1\ MW}\right)$$

$$HNF = 1.215\times 10^{4}\frac{fission\ neutrons\cdot W}{MW\cdot MeV} \quad (1)$$

The HGR values are calculated using the MCNP Tally Type 6 results, the HNF, and the ATR core power. Prompt neutron and gamma heating rates (PHRs) are calculated using Equation (2).

$$PHR = \left(type\ 6\ tally\frac{MeV}{g\cdot fission\ neutron}\right)\left(1.215 \times 10^{4}\frac{fission\ neutrons\cdot W}{MW\cdot MeV}\right)(Core\ Power\ MW)$$

$$PHR = (f6)(HNF)(Core\ Power)\frac{W}{g} \quad (2)$$

MCNP reports tally results normalized per source particle. The heating tallies have units of MeV/g per fission neutron. The MCNP Type 6 energy deposition tally results are used to calculate delayed gamma HGRs. The MCNP Tally Type 6 has units of MeV/g per source particle (per delayed fission product gamma for delayed fission product gamma heating). The delayed gamma heating normalization factor (DNF) is defined by Equation (3) using 8.9603 delayed fission photons per fission.

$$DFN = \left(\frac{8.9603\ delayed\ photons}{fission}\right)\left(\frac{fission}{200\ MeV}\right)\left(\frac{1 \times 10^6\ W}{MW}\right)$$

$$DFN = 4.480 \times 10^4 \frac{delayed\ photons \cdot W}{MW_{core\ power} \cdot MeV} \quad (3)$$

The HGR values are calculated using the MCNP Tally Type 6 or Type 7 results, the HNF, and the ATR core power. The delayed fission product heating rate (DHR) is calculated using Equation (4).

$$DHR = \left(type\ 6\ tally \frac{MeV}{g \cdot source\ photon}\right)\left(4.480 \times 10^4 \frac{delayed\ photons \cdot W}{MW \cdot MeV}\right)(Core\ Power\ MW)$$

$$DHR = (f6)(DNF)(Core\ Power)\frac{W}{g} \quad (4)$$

6.2. Neutron Flux Normalization Factor

MCNP reports tally results normalized per source particle. The MCNP Type 4 flux tally results are used to generate neutron flux input values for the ORIGEN2 activation calculations. The MCNP Tally Type 4 (for neutrons) has units of neutrons/cm^2 per source neutron. The neutron flux conversion factor (NFCF) is defined by Equation (5).

$$NFCF = \left(\frac{2.43\ fission\ neutrons}{fission}\right)\left(\frac{fission}{200\ MeV}\right)\left(\frac{6.24151 \times 10^{18}\ MeV}{MW_{Core\ Power} \cdot s}\right)$$

$$NFCF = 7.583 \times 10^{16} \frac{fission\ neutrons}{MW_{Core\ Power} \cdot s} \quad (5)$$

The neutron flux values are calculated using the MCNP tally type 4 results, the NFCF, and the ATR core power. The neutron flux is calculated using Equation (6).

$$\phi_{\text{neutron}} = \left(\text{type 4 tally}\frac{\text{neutrons}}{\text{cm}^2 - \text{fission neutron}}\right)\left(7.583 \times 10^{16}\frac{\text{fission neutrons}}{\text{MW}_{\text{core power}} - \text{s}}\right)(\text{Core Power MW})$$

$$\phi_{\text{neutron}} = (\text{f4})(7.583 \times 10^{16})(\text{Core Power})\frac{\text{neutrons}}{\text{cm}^2 - \text{s}} \quad (6)$$

6.3.MCNP DPA Calculations

The DPA rate in a material is estimated by using a tally multiplier card with a standard flux tally in MCNP. The tally multiplier card applied to a flux tally calculates the reaction rate, which is defined as the quantity:

$$C\int \Phi(E)R_m(E)dE \quad (7)$$

Where,

C	=	multiplicative constant
Φ(E)	=	energy dependent flux
$R_m(E)$	=	energy dependent reaction rate of interest (ENDF/B-VII damage cross-section)

The quantity defined in Equation 12 is the total damage energy rate for the material. Assigning the quantity $\eta/2E_d$ to the constant C in Equation (7) results in:

$$\text{DPA rate} = C\int \Phi(E)R_m(E)dE \quad (8)$$

Where,

$C = \eta/2Ed$

$\int\Phi(E)\, Rm(E)dE$ = total damage energy.

The DPA cross section would be calculated by:

$$\sigma_{DPA} = \frac{\int \Phi(E)R_m(E)dE}{\int \Phi(E)dE} \quad (9)$$

The resulting cross section has units of MeV-barns per atom.

Therefore, using the MCNP tallies, the DPA rate is calculated by converting the flux multiplier result to units of MeV-cm^2 per atom, then multiplying by the efficiency (η) and dividing by 2 times the cutoff energy (E_d) then using the standard tally conversion factors:

$$DPA\ rate = FMn \times \frac{\eta}{2E_d} \times Flux\ Normalization\ Factor \times Core\ Power \quad (10)$$

7. RESULTS

7.1. Heating Results

Heating rates were generated assuming nominal core power configurations for cycle 162A through 164B [1]. The source power is assumed to be scaled to a nominal south power of 24.3 MW, 22.0 MW, 22.5 MW, and 22.6 MW, for ATR cycle 162A, 162B, 164A, and 164B, respectively. The heating results include prompt neutron and gamma heating, as well as delayed gamma heating. Delayed gamma heating was explicitly calculated using a separate MCNP model. The results for the heat generation rate calculations are presented in Table 6 - Table 7.

Table 6. Pressure Boundary Internal Component, End Cap, and Spacer Heat Generation Rates.

Component	162A	162B	164A	164B
	W/g	W/g	W/g	W/g
Upper Al spacer	1.6	1.5	1.5	1.5
Upper Pressure Boundary Cap	3.2	2.9	3.0	3.0
Upper YTZP Insulating Disc	3.5	3.1	3.2	3.2
NE Upper 316 Tensile specimen	4.0	3.9	3.7	4.0
NE Upper Tensile sleeve	4.0	3.7	3.7	3.8
SW Upper 316 Tensile specimen	3.3	3.2	3.1	3.3
SW Upper Tensile sleeve	3.3	3.1	3.1	3.2
NW Upper 718 Tensile specimen	4.3	3.6	4.0	3.7
NW Upper Tensile sleeve	4.0	3.6	3.7	3.7
SE Upper 718 Tensile specimen	3.6	3.0	3.3	3.1
SE Upper Tensile sleeve	3.4	3.1	3.1	3.2
Upper Tensile specimen holder annulus	3.0	2.8	2.8	2.9
Upper Flux Monitor	3.3	3.1	3.1	3.2
Upper SS316 CT spacer	3.8	3.5	3.5	3.6
CT 718 specimen 12	4.2	3.8	3.9	3.9
CT 316 specimen 11	4.1	3.6	3.8	3.7
CT 718 specimen 10	4.4	4.1	4.1	4.2
CT 316 specimen 9	4.2	3.7	3.9	3.8
CT 718 specimen 8	4.6	4.1	4.3	4.2
CT 316 specimen 7	4.2	3.9	3.9	4.0
SS Center clamshell	4.2	3.9	3.9	4.0
Center Flux Monitor	3.6	3.2	3.3	3.3
CT 718 specimen 6	4.6	4.2	4.3	4.3
CT 316 specimen 5	4.3	3.9	4.0	4.0
CT 718 specimen 4	4.5	4.1	4.2	4.2
CT 316 specimen 3	4.2	3.9	3.9	4.0
CT 718 specimen 2	4.5	4.1	4.2	4.2
CT 316 specimen 1	4.1	3.7	3.8	3.8
Lower SS316 CT spacer	3.9	3.5	3.6	3.6
Lower Tensile specimen holder annulus	3.2	2.9	3.0	3.0
Lower Flux Monitor	3.7	3.3	3.4	3.4
NE Lower 316 Tensile specimen	4.1	4.0	3.8	4.1
NE Lower Tensile sleeve	4.2	3.8	3.9	3.9
SW Lower 316 Tensile specimen	3.5	3.3	3.2	3.4
SW Lower Tensile sleeve	3.5	3.2	3.2	3.3
NW Lower 718 Tensile specimen	4.5	3.8	4.2	3.9
NW Lower Tensile sleeve	4.1	3.7	3.8	3.8

Component	162A	162B	164A	164B
	W/g	W/g	W/g	W/g
SE Lower 718 Tensile specimen	3.8	3.2	3.5	3.3
SE Lower Tensile sleeve	3.6	3.2	3.3	3.3
Lower YTZP insulating disc	3.7	3.3	3.4	3.4
Lower Pressure Boundary Cap	3.3	3.0	3.1	3.1
Lower Al spacer	2.0	1.7	1.8	1.7

Table 7. Beryllium Surrounding B-11 Position Heat Generation Rates.

Component	162A	162B	164A	164B	Upper Elevation	Lower Elevation
	W/g	W/g	W/g	W/g	cm	cm
Segment of Beryllium around B-11	1.0	0.9	0.9	0.9	2.54	-2.54
Segment of Beryllium around B-11	1.3	1.2	1.2	1.2	7.62	2.54
Segment of Beryllium around B-11	1.7	1.5	1.6	1.5	12.70	7.62
Segment of Beryllium around B-11	2.0	1.8	1.8	1.8	17.78	12.70
Segment of Beryllium around B-11	2.3	2.1	2.1	2.2	22.86	17.78
Segment of Beryllium around B-11	2.6	2.3	2.4	2.4	27.94	22.86
Segment of Beryllium around B-11	2.8	2.5	2.6	2.6	33.02	27.94
Segment of Beryllium around B-11	3.0	2.8	2.8	2.9	38.10	33.02
Segment of Beryllium around B-11	3.2	2.9	3.0	3.0	43.18	38.10
Segment of Beryllium around B-11	3.4	3.0	3.1	3.1	48.26	43.18
Segment of Beryllium around B-11	3.5	3.2	3.2	3.3	53.34	48.26
Segment of Beryllium around B-11	3.5	3.2	3.2	3.3	58.42	53.34
Segment of Beryllium around B-11	3.5	3.2	3.2	3.3	63.50	58.42
Segment of Beryllium around B-11	3.5	3.1	3.2	3.2	68.58	63.50
Segment of Beryllium around B-11	3.4	3.0	3.1	3.1	73.66	68.58
Segment of Beryllium around B-11	3.3	2.9	3.1	3.0	78.74	73.66
Segment of Beryllium around B-11	3.0	2.8	2.8	2.9	83.82	78.74
Segment of Beryllium around B-11	2.9	2.7	2.7	2.8	88.90	83.82
Segment of Beryllium around B-11	2.6	2.4	2.4	2.5	93.98	88.90
Segment of Beryllium around B-11	2.3	2.1	2.1	2.2	99.06	93.98
Segment of Beryllium around B-11	2.1	1.8	1.9	1.8	104.14	99.06
Segment of Beryllium around B-11	1.7	1.6	1.6	1.6	109.22	104.14
Segment of Beryllium around B-11	1.3	1.2	1.2	1.2	114.30	109.22
Segment of Beryllium around B-11	1.1	1.0	1.0	1.0	119.38	114.30
Segment of Beryllium around B-11	0.7	0.6	0.6	0.6	127.00	119.38

Table 8. Water Annulus Outside Basket Heat Generation Rates.

Component	162A	162B	164A	164B	Upper Elevation	Lower Elevation
	W/g	W/g	W/g	W/g	cm	cm
Segment of Water annulus outside basket	1.5	1.4	1.4	1.4	2.54	-2.54
Segment of Water annulus outside basket	2.2	2.0	2.0	2.1	7.62	2.54
Segment of Water annulus outside basket	2.8	2.5	2.6	2.6	12.70	7.62
Segment of Water annulus outside basket	3.3	3.0	3.1	3.1	17.78	12.70
Segment of Water annulus outside basket	3.9	3.6	3.6	3.7	22.86	17.78
Segment of Water annulus outside basket	4.3	3.9	4.0	4.0	27.94	22.86
Segment of Water annulus outside basket	4.8	4.4	4.4	4.5	33.02	27.94
Segment of Water annulus outside basket	5.2	4.7	4.8	4.8	38.10	33.02
Segment of Water annulus outside basket	5.4	4.9	5.0	5.0	43.18	38.10
Segment of Water annulus outside basket	5.7	5.2	5.3	5.3	48.26	43.18
Segment of Water annulus outside basket	5.9	5.3	5.5	5.4	53.34	48.26
Segment of Water annulus outside basket	6.0	5.4	5.5	5.5	58.42	53.34
Segment of Water annulus outside basket	5.9	5.4	5.5	5.5	63.50	58.42
Segment of Water annulus outside basket	5.9	5.4	5.5	5.5	68.58	63.50
Segment of Water annulus outside basket	5.8	5.2	5.4	5.3	73.66	68.58
Segment of Water annulus outside basket	5.5	4.9	5.1	5.0	78.74	73.66
Segment of Water annulus outside basket	5.2	4.7	4.8	4.8	83.82	78.74
Segment of Water annulus outside basket	4.8	4.4	4.4	4.5	88.90	83.82
Segment of Water annulus outside basket	4.4	4.0	4.1	4.1	93.98	88.90
Segment of Water annulus outside basket	3.9	3.6	3.6	3.7	99.06	93.98
Segment of Water annulus outside basket	3.5	3.1	3.2	3.2	104.14	99.06
Segment of Water annulus outside basket	2.9	2.7	2.7	2.8	109.22	104.14
Segment of Water annulus outside basket	2.3	2.1	2.1	2.2	114.30	109.22
Segment of Water annulus outside basket	1.7	1.6	1.6	1.6	119.38	114.30
Segment of Water annulus outside basket	1.0	0.9	0.9	0.9	127.00	119.38

Table 9. Basket Heat Generation Rates.

Component	162A	162B	164A	164B	Upper Elevation	Lower Elevation
	W/g	W/g	W/g	W/g	cm	cm
Segment of Al basket	1.1	1.0	1.0	1.0	2.54	-2.54
Segment of Al basket	1.5	1.3	1.4	1.3	7.62	2.54
Segment of Al basket	1.8	1.6	1.7	1.6	12.70	7.62
Segment of Al basket	2.1	2.0	1.9	2.1	17.78	12.70
Segment of Al basket	2.5	2.3	2.3	2.4	22.86	17.78
Segment of Al basket	2.8	2.5	2.6	2.6	27.94	22.86

Component	162A	162B	164A	164B	Upper Elevation	Lower Elevation
	W/g	W/g	W/g	W/g	cm	cm
Segment of Al basket	3.1	2.7	2.9	2.8	33.02	27.94
Segment of Al basket	3.3	3.0	3.1	3.1	38.10	33.02
Segment of Al basket	3.5	3.1	3.2	3.2	43.18	38.10
Segment of Al basket	3.6	3.2	3.3	3.3	48.26	43.18
Segment of Al basket	3.7	3.4	3.4	3.5	53.34	48.26
Segment of Al basket	3.8	3.5	3.5	3.6	58.42	53.34
Segment of Al basket	3.8	3.5	3.5	3.6	63.50	58.42
Segment of Al basket	3.7	3.4	3.4	3.5	68.58	63.50
Segment of Al basket	3.6	3.4	3.3	3.5	73.66	68.58
Segment of Al basket	3.5	3.1	3.2	3.2	78.74	73.66
Segment of Al basket	3.3	3.0	3.1	3.1	83.82	78.74
Segment of Al basket	3.1	2.9	2.9	3.0	88.90	83.82
Segment of Al basket	2.9	2.6	2.7	2.7	93.98	88.90
Segment of Al basket	2.5	2.4	2.3	2.5	99.06	93.98
Segment of Al basket	2.2	2.0	2.0	2.1	104.14	99.06
Segment of Al basket	1.9	1.7	1.8	1.7	109.22	104.14
Segment of Al basket	1.5	1.4	1.4	1.4	114.30	109.22
Segment of Al basket	1.1	1.0	1.0	1.0	119.38	114.30
Segment of Al basket	0.7	0.6	0.6	0.6	127.00	119.38

Table 10. Water Annulus Inside Basket Heat Generation Rates.

Component	162A	162B	164A	164B	Upper Elevation	Lower Elevation
	W/g	W/g	W/g	W/g	cm	cm
Segment of Water annulus inside basket	1.5	1.4	1.4	1.4	2.54	-2.54
Segment of Water annulus inside basket	2.2	2.0	2.0	2.1	7.62	2.54
Segment of Water annulus inside basket	2.8	2.5	2.6	2.6	12.70	7.62
Segment of Water annulus inside basket	3.3	3.0	3.1	3.1	17.78	12.70
Segment of Water annulus inside basket	3.9	3.6	3.6	3.7	22.86	17.78
Segment of Water annulus inside basket	4.4	3.9	4.1	4.0	27.94	22.86
Segment of Water annulus inside basket	4.8	4.3	4.4	4.4	33.02	27.94
Segment of Water annulus inside basket	5.1	4.7	4.7	4.8	38.10	33.02
Segment of Water annulus inside basket	5.4	4.9	5.0	5.0	43.18	38.10
Segment of Water annulus inside basket	5.7	5.1	5.3	5.2	48.26	43.18
Segment of Water annulus inside basket	5.8	5.3	5.4	5.4	53.34	48.26
Segment of Water annulus inside basket	5.9	5.4	5.5	5.5	58.42	53.34
Segment of Water annulus inside basket	6.0	5.4	5.5	5.5	63.50	58.42

Component	162A	162B	164A	164B	Upper Elevation	Lower Elevation
	W/g	W/g	W/g	W/g	cm	cm
Segment of Water annulus inside basket	5.8	5.4	5.4	5.5	68.58	63.50
Segment of Water annulus inside basket	5.7	5.2	5.3	5.3	73.66	68.58
Segment of Water annulus inside basket	5.5	4.9	5.1	5.0	78.74	73.66
Segment of Water annulus inside basket	5.2	4.7	4.8	4.8	83.82	78.74
Segment of Water annulus inside basket	4.8	4.4	4.4	4.5	88.90	83.82
Segment of Water annulus inside basket	4.4	4.0	4.1	4.1	93.98	88.90
Segment of Water annulus inside basket	4.0	3.6	3.7	3.7	99.06	93.98
Segment of Water annulus inside basket	3.4	3.1	3.1	3.2	104.14	99.06
Segment of Water annulus inside basket	2.9	2.6	2.7	2.7	109.22	104.14
Segment of Water annulus inside basket	2.3	2.1	2.1	2.2	114.30	109.22
Segment of Water annulus inside basket	1.7	1.5	1.6	1.5	119.38	114.30
Segment of Water annulus inside basket	1.0	0.9	0.9	0.9	127.00	119.38

Table 11. Pressure Boundary Heat Generation rates.

Component	162A	162B	164A	164B	Upper Elevation	Lower Elevation
	W/g	W/g	W/g	W/g	cm	cm
Segment of pressure boundary	1.5	1.4	1.4	1.4	2.54	-2.54
Segment of pressure boundary	1.9	1.7	1.8	1.7	7.62	2.54
Segment of pressure boundary	2.3	2.2	2.1	2.3	12.70	7.62
Segment of pressure boundary	2.8	2.5	2.6	2.6	17.78	12.70
Segment of pressure boundary	3.2	2.9	3.0	3.0	22.86	17.78
Segment of pressure boundary	3.6	3.2	3.3	3.3	27.94	22.86
Segment of pressure boundary	3.8	3.4	3.5	3.5	33.02	27.94
Segment of pressure boundary	4.2	3.8	3.9	3.9	38.10	33.02
Segment of pressure boundary	4.3	3.9	4.0	4.0	43.18	38.10
Segment of pressure boundary	4.5	4.2	4.2	4.3	48.26	43.18
Segment of pressure boundary	4.7	4.3	4.3	4.4	53.34	48.26
Segment of pressure boundary	4.8	4.3	4.4	4.4	58.42	53.34
Segment of pressure boundary	4.8	4.3	4.4	4.4	63.50	58.42
Segment of pressure boundary	4.7	4.3	4.3	4.4	68.58	63.50
Segment of pressure boundary	4.6	4.2	4.3	4.3	73.66	68.58
Segment of pressure boundary	4.4	3.9	4.1	4.0	78.74	73.66
Segment of pressure boundary	4.2	3.8	3.9	3.9	83.82	78.74
Segment of pressure boundary	3.9	3.6	3.6	3.7	88.90	83.82
Segment of pressure boundary	3.5	3.2	3.2	3.3	93.98	88.90
Segment of pressure boundary	3.3	3.0	3.1	3.1	99.06	93.98

Component	162A	162B	164A	164B	Upper Elevation	Lower Elevation
	W/g	W/g	W/g	W/g	cm	cm
Segment of pressure boundary	2.8	2.6	2.6	2.7	104.14	99.06
Segment of pressure boundary	2.4	2.2	2.2	2.3	109.22	104.14
Segment of pressure boundary	1.9	1.7	1.8	1.7	114.30	109.22
Segment of pressure boundary	1.4	1.3	1.3	1.3	119.38	114.30
Segment of pressure boundary	0.9	0.9	0.8	0.9	127.00	119.38

Table 12. CT Specimen Holder Heat Generation Rates.

Component	162A	162B	164A	164B	Upper Elevation	Lower Elevation
	W/g	W/g	W/g	W/g	cm	cm
Segment of CT specimen holder	3.4	3.2	3.1	3.3	47.12	44.48
Segment of CT specimen holder	3.5	3.2	3.2	3.3	49.76	47.12
Segment of CT specimen holder	3.6	3.2	3.3	3.3	52.40	49.76
Segment of CT specimen holder	3.6	3.2	3.3	3.3	55.04	52.40
Segment of CT specimen holder	3.6	3.3	3.3	3.4	57.68	55.04
Segment of CT specimen holder	3.6	3.3	3.3	3.4	60.33	57.68
Segment of CT specimen holder	3.5	3.3	3.2	3.4	61.60	60.33
Segment of CT specimen holder	3.5	3.2	3.2	3.3	64.24	61.60
Segment of CT specimen holder	3.5	3.3	3.2	3.4	66.88	64.24
Segment of CT specimen holder	3.5	3.2	3.2	3.3	69.52	66.88
Segment of CT specimen holder	3.5	3.1	3.2	3.2	72.16	69.52
Segment of CT specimen holder	3.5	3.1	3.2	3.2	74.80	72.16
Segment of CT specimen holder	3.3	3.0	3.1	3.1	77.44	74.80

7.2. DPA Results

The projected cumulative DPA was calculated for the GE-HITACHI sample specimen. The efficiency was assumed to be 80%. The cutoff energy for 316 stainless steel and Inconel-718 used in the DPA calculation was 4.02×10^{-5} MeV and 4.02×10^{-5} MeV, respectively (see ECAR-3569 [14]). Table 13 reports the projected DPA for the GE-HITACHI experiment after four ATR cycles of irradiation, 219 EFPDs.

Table 13. DPA for GE-HITACHI Samples.

Material	Cycle:	162A	162B	164A	164B	Total
	EFPDs:	**61.90**	**38.51**	**54.91**	**64.06**	**219.38**
SS316L Samples	N Tensile Specimen	0.22	0.13	0.18	0.22	0.74
	S Tensile Specimen	0.25	0.14	0.21	0.25	0.85
	CT Specimen 11 - 316L	0.26	0.15	0.21	0.25	0.87
	CT Specimen 9 - 316L	0.26	0.15	0.22	0.25	0.89
	CT Specimen 7 - 316L	0.27	0.15	0.23	0.26	0.92
	CT Specimen 5 - 316L	0.27	0.15	0.22	0.26	0.91
	CT Specimen 3 - 316L	0.27	0.15	0.22	0.26	0.90
	CT Specimen 1 - 316L	0.26	0.14	0.21	0.25	0.85
	NE Tensile Specimen	0.26	0.15	0.22	0.25	0.88
	SW Tensile Specimen	0.23	0.13	0.19	0.22	0.78
Inconel-718 Samples	E Tensile Specimen	0.29	0.17	0.24	0.29	0.99
	W Tensile Specimen	0.26	0.14	0.21	0.25	0.86
	CT Specimen 12 - 718	0.30	0.17	0.24	0.29	0.99
	CT Specimen 10 - 718	0.30	0.17	0.25	0.29	1.01
	CT Specimen 8 - 718	0.31	0.18	0.26	0.30	1.05
	CT Specimen 6 - 718	0.32	0.18	0.26	0.31	1.07
	CT Specimen 4 - 718	0.32	0.18	0.26	0.30	1.06
	CT Specimen 2 - 718	0.31	0.17	0.25	0.29	1.02
	NW Tensile Specimen	0.31	0.17	0.25	0.30	1.03
	SE Tensile Specimen	0.27	0.15	0.22	0.26	0.90

Table 14. DPA for all SS316L and Inconel 718 Specimens after four cycles of irradiation.

Material	Total EFPD	min	average	max
SS316L	219	0.74	0.86	0.92
Inconel 718		0.86	1.00	1.07

7.3. Decay Heat

The decay heat from the as run radionuclide inventory was calculated for the GE HITACHI experiment using ORIGEN2. The peak neutron flux, irradiation time of 219 EFPDs, and experiment component compositional data were used to calculate the as-run volumetric decay heat for each material and the results are reported in Table 15.

Table 15. Volumetric Decay Heat for Experiment Materials.

	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
Material	W/cc	W/cc	W/cc	W/cc	W/cc	W/cc	W/cc	W/cc	W/cc	W/cc
SS316L	0.61	0.53	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00
Inconel 718	0.28	0.24	0.12	0.11	0.09	0.08	0.08	0.07	0.07	0.06
Aluminum	0.37	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
YTZP Zirconia	0.24	0.09	0.06	0.04	0.02	0.02	0.01	0.01	0.00	0.00

7.4. Radionuclide Source Term

The source term for the GE-HITACHI experiment was evaluated using the neutron flux for the experiment in the B-11 position. The peak MCNP calculated neutron flux for the entire experiment irradiation was $5.28 \times 10^{14} n/cm^2 \cdot s$. This flux value was used to calculate all radiological source terms and the decay heat generation rates for the GE-HITACHI experiment.

Table 16 provides the summary of the radionuclide activity (in Curies) for the entire GE-HITACHI experiment immediately after shutdown and for an additional 360 days after.

Table 16. Radionuclide source term for the GE-HITACHI experiment after 219 days of irradiation (Ci).

Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci	Ci	Ci	Ci	Ci	Ci	Ci	Ci	Ci	Ci
H 3	3.38E-07	3.38E-07	3.38E-07	3.37E-07	3.36E-07	3.35E-07	3.33E-07	3.32E-07	3.28E-07	3.20E-07
H 4	3.42E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HE 6	8.77E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LI 8	1.37E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BE 8	1.39E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B 12	9.56E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C 14	1.24E-02	1.24E-02	1.24E-02	1.24E-02	1.24E-02	1.24E-02	1.24E-02	1.24E-02	1.24E-02	1.24E-02
C 15	8.47E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
N 16	4.99E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
O 19	6.06E-04	1.25E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NE 23	1.18E+00	3.33E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NA 24	1.71E+02	1.67E+02	5.64E+01	7.30E-02	6.10E-13	2.17E-27	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NA 24M	4.52E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NA 25	7.14E-01	5.79E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MG 27	8.04E+02	8.93E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AL 28	1.92E+04	1.78E+00	5.78E-07	4.89E-09	5.53E-17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AL 29	4.18E-01	1.72E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AL 30	4.04E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SI 31	5.78E+00	5.06E+00	1.02E-02	2.97E-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
P 32	6.00E+00	5.99E+00	5.71E+00	4.27E+00	1.40E+00	3.27E-01	7.64E-02	1.79E-02	3.70E-04	1.60E-07
P 33	2.06E-04	2.06E-04	2.01E-04	1.70E-04	8.99E-05	3.91E-05	1.70E-05	7.41E-06	8.06E-07	9.55E-09
P 34	1.16E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
S 35	1.09E-01	1.09E-01	1.08E-01	1.03E-01	8.61E-02	6.80E-02	5.37E-02	4.24E-02	2.26E-02	6.40E-03
S 37	3.35E-04	5.49E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CA 45	3.77E-03	3.77E-03	3.75E-03	3.66E-03	3.31E-03	2.92E-03	2.57E-03	2.26E-03	1.61E-03	8.14E-04
CA 47	3.70E-05	3.69E-05	3.17E-05	1.27E-05	3.78E-07	3.85E-09	3.94E-11	4.02E-13	1.97E-18	4.74E-29
SC 46	6.58E-01	6.58E-01	6.53E-01	6.21E-01	5.14E-01	4.01E-01	3.13E-01	2.44E-01	1.26E-01	3.35E-02

Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci	Ci	Ci	Ci	Ci	Ci	Ci	Ci	Ci	Ci
SC 46M	1.88E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SC 47	1.22E+00	1.22E+00	9.93E-01	2.87E-01	2.47E-03	4.98E-06	1.02E-08	2.17E-11	8.85E-18	0.00E+00
SC 48	1.14E-01	1.14E-01	7.83E-02	8.02E-03	1.29E-06	1.46E-11	1.64E-16	1.85E-21	0.00E+00	0.00E+00
SC 49	1.01E-01	7.07E-02	2.93E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SC 50	1.94E-03	1.00E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TI 51	2.23E+00	6.02E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 52	4.05E+01	1.58E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 53	1.86E-01	4.57E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 54	1.96E-03	2.76E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CR 51	4.01E+03	4.01E+03	3.91E+03	3.37E+03	1.89E+03	8.94E+02	4.22E+02	1.99E+02	2.69E+01	4.92E-01
CR 55	5.58E+01	1.60E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 54	7.14E+01	7.14E+01	7.13E+01	7.03E+01	6.68E+01	6.25E+01	5.85E+01	5.47E+01	4.58E+01	3.21E+01
MN 56	8.89E+03	7.77E+03	1.40E+01	2.17E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 57	4.66E-01	1.15E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 58	1.44E-03	7.26E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE 55	2.97E+02	2.97E+02	2.97E+02	2.96E+02	2.91E+02	2.84E+02	2.78E+02	2.72E+02	2.57E+02	2.28E+02
FE 59	5.53E+01	5.53E+01	5.44E+01	4.96E+01	3.48E+01	2.19E+01	1.38E+01	8.71E+00	2.54E+00	2.16E-01
CO 58	3.90E+02	3.90E+02	3.86E+02	3.64E+02	2.91E+02	2.17E+02	1.61E+02	1.20E+02	5.50E+01	1.15E+01
CO 60	2.42E+02	2.42E+02	2.42E+02	2.42E+02	2.40E+02	2.37E+02	2.34E+02	2.32E+02	2.25E+02	2.13E+02
CO 60M	1.69E+03	2.32E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO 61	8.65E+00	7.01E+00	3.62E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO 62	9.70E-02	9.25E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI 59	1.12E-01	1.12E-01	1.12E-01	1.12E-01	1.12E-01	1.12E-01	1.12E-01	1.12E-01	1.12E-01	1.12E-01
NI 63	1.44E+01	1.44E+01	1.44E+01	1.44E+01	1.44E+01	1.44E+01	1.44E+01	1.44E+01	1.44E+01	1.43E+01
NI 65	9.27E+01	8.07E+01	1.26E-01	7.90E-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI 66	1.41E-03	1.40E-03	1.04E-03	1.68E-04	1.52E-07	1.63E-11	1.75E-15	1.88E-19	4.91E-30	0.00E+00
CU 64	5.28E+02	5.13E+02	1.42E+02	5.50E-02	4.53E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CU 66	1.14E+02	1.94E+00	1.04E-03	1.68E-04	1.52E-07	1.63E-11	1.76E-15	1.89E-19	0.00E+00	0.00E+00

Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci	Ci	Ci	Ci	Ci	Ci	Ci	Ci	Ci	Ci
CU 67	3.31E-04	3.29E-04	2.53E-04	5.03E-05	1.04E-07	3.26E-11	1.02E-14	3.20E-18	1.45E-27	0.00E+00
ZN 65	1.99E+01	1.99E+01	1.98E+01	1.95E+01	1.83E+01	1.68E+01	1.54E+01	1.42E+01	1.13E+01	7.15E+00
ZN 69	2.85E+01	2.04E+01	6.14E-01	4.35E-04	3.65E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN 69M	1.92E+00	1.87E+00	5.72E-01	4.05E-04	3.40E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN 71	4.27E-02	9.45E-06	3.25E-08	2.84E-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN 71M	4.48E-03	4.10E-03	6.43E-05	5.62E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GA 70	1.48E-01	5.52E-02	4.22E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GA 72	5.47E-04	5.34E-04	1.68E-04	1.42E-07	2.32E-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GA 72M	1.69E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GE 71	2.13E-04	2.13E-04	2.01E-04	1.41E-04	3.66E-05	6.29E-06	1.08E-06	1.85E-07	1.69E-09	1.40E-13
GE 71M	2.03E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR 89	1.57E-02	1.57E-02	1.55E-02	1.42E-02	1.04E-02	6.88E-03	4.56E-03	3.02E-03	1.01E-03	1.12E-04
SR 90	7.15E-08	7.15E-08	7.15E-08	7.15E-08	7.14E-08	7.13E-08	7.11E-08	7.10E-08	7.06E-08	6.99E-08
SR 91	3.17E-03	3.06E-03	5.50E-04	1.51E-08	4.85E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR 93	1.09E-05	6.83E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y 89M	7.77E-03	7.74E-03	6.29E-03	1.76E-03	1.34E-05	2.32E-08	4.01E-11	6.95E-14	2.98E-21	0.00E+00
Y 90	3.42E+01	3.40E+01	2.64E+01	5.55E+00	1.40E-02	5.83E-06	7.35E-08	7.10E-08	7.06E-08	6.99E-08
Y 90M	2.52E-02	2.26E-02	1.18E-04	1.23E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y 91	4.13E-02	4.13E-02	4.08E-02	3.80E-02	2.89E-02	2.03E-02	1.42E-02	9.96E-03	3.86E-03	5.80E-04
Y 92	3.57E-02	3.24E-02	3.25E-04	1.83E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y 93	1.09E-05	1.07E-05	2.13E-06	1.09E-10	3.84E-27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y 94	2.27E-03	7.64E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y 96	1.46E-05	1.72E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZR 89	7.79E-03	7.75E-03	6.30E-03	1.76E-03	1.34E-05	2.33E-08	4.02E-11	6.96E-14	2.98E-21	0.00E+00
ZR 93	1.08E-05	1.08E-05	1.08E-05	1.08E-05	1.08E-05	1.08E-05	1.08E-05	1.08E-05	1.08E-05	1.08E-05
ZR 95	1.31E+01	1.30E+01	1.29E+01	1.21E+01	9.43E+00	6.81E+00	4.92E+00	3.56E+00	1.49E+00	2.64E-01
ZR 97	2.10E+01	2.06E+01	7.85E+00	2.14E-02	3.14E-12	4.70E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 92	1.55E+00	1.55E+00	1.45E+00	9.61E-01	2.00E-01	2.59E-02	3.34E-03	4.31E-04	1.84E-06	3.34E-11

Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci	Ci	Ci	Ci	Ci	Ci	Ci	Ci	Ci	Ci
NB 93M	1.56E-07	1.56E-07	1.58E-07	1.66E-07	1.98E-07	2.41E-07	2.83E-07	3.24E-07	4.35E-07	6.53E-07
NB 94	1.92E-02	1.92E-02	1.92E-02	1.92E-02	1.92E-02	1.92E-02	1.92E-02	1.92E-02	1.92E-02	1.92E-02
NB 95	4.28E+01	4.28E+01	4.22E+01	3.89E+01	2.86E+01	1.94E+01	1.33E+01	9.19E+00	3.59E+00	5.97E-01
NB 95M	9.08E-02	9.08E-02	9.08E-02	8.81E-02	6.99E-02	5.05E-02	3.65E-02	2.64E-02	1.11E-02	1.96E-03
NB 96	1.39E-01	1.37E-01	6.82E-02	9.49E-04	7.26E-11	3.79E-20	1.98E-29	0.00E+00	0.00E+00	0.00E+00
NB 97	2.10E+01	2.09E+01	7.89E+00	2.15E-02	3.39E-12	4.80E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 97M	1.99E+01	1.95E+01	7.43E+00	2.02E-02	2.98E-12	4.45E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 98	3.26E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB100	1.62E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO 93M	4.50E-01	4.28E-01	3.97E-02	1.86E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO 93	1.65E-03	1.65E-03	1.65E-03	1.65E-03	1.65E-03	1.65E-03	1.65E-03	1.65E-03	1.65E-03	1.65E-03
MO 99	3.15E+02	3.13E+02	2.45E+02	5.40E+01	1.64E-01	8.52E-05	4.43E-08	2.31E-11	4.03E-20	0.00E+00
MO101	7.83E+01	1.89E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TC 99	7.20E-05	7.20E-05	7.23E-05	7.31E-05	7.34E-05	7.34E-05	7.34E-05	7.34E-05	7.34E-05	7.34E-05
TC100	3.37E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TC101	7.83E+01	4.52E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU103	1.84E-03	1.84E-03	1.81E-03	1.63E-03	1.09E-03	6.39E-04	3.77E-04	2.22E-04	5.41E-05	3.21E-06
RH104	1.91E-05	1.37E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LU176M	4.07E-01	3.70E-01	4.48E-03	8.02E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LU177	8.02E-02	8.00E-02	7.23E-02	3.89E-02	3.63E-03	1.76E-04	1.85E-05	1.01E-05	6.82E-06	3.33E-06
LU177M	7.25E-05	7.25E-05	7.22E-05	7.03E-05	6.34E-05	5.54E-05	4.85E-05	4.24E-05	2.96E-05	1.45E-05
HF175	3.55E+00	3.55E+00	3.51E+00	3.31E+00	2.64E+00	1.96E+00	1.46E+00	1.08E+00	4.90E-01	1.00E-01
HF178M	1.30E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HF179M	7.19E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HF180M	2.85E+00	2.68E+00	1.38E-01	1.82E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HF181	5.75E+01	5.75E+01	5.66E+01	5.13E+01	3.52E+01	2.16E+01	1.32E+01	8.09E+00	2.19E+00	1.60E-01
TA182	2.95E+01	2.95E+01	2.93E+01	2.83E+01	2.46E+01	2.06E+01	1.72E+01	1.43E+01	8.84E+00	3.37E+00
TA182M	8.84E-02	2.51E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci	Ci	Ci	Ci	Ci	Ci	Ci	Ci	Ci	Ci
TA183	1.55E+02	1.54E+02	1.35E+02	5.97E+01	2.62E+00	4.44E-02	7.53E-04	1.28E-05	2.42E-10	8.71E-20
W183M	1.17E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W185	1.11E-02	1.11E-02	1.10E-02	1.04E-02	8.41E-03	6.38E-03	4.84E-03	3.67E-03	1.75E-03	4.00E-04
W185M	3.02E-05	1.18E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W187	2.00E-06	1.98E-06	9.99E-07	1.53E-08	1.71E-15	1.46E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE186	1.14E-03	1.13E-03	9.47E-04	3.15E-04	4.62E-06	1.88E-08	7.63E-11	3.10E-13	1.30E-19	0.00E+00
SUMTOT	3.83E+04	1.48E+04	5.79E+03	4.68E+03	2.96E+03	1.82E+03	1.25E+03	9.52E+02	6.55E+02	5.12E+02
0TOTAL	3.83E+04	1.48E+04	5.79E+03	4.68E+03	2.96E+03	1.82E+03	1.25E+03	9.52E+02	6.55E+02	5.12E+02

8. REFERENCES

[1] N. H. Manwaring Letter to R. R. Little, Advanced Test Reactor Power History Through Cycle 164B-1, January 21, 2019, RE-03-19 (see Appendix B).

[2] Tim Goorley, Jeffrey S. Bull, Forrest B. Brown, et. al., "Release of MCNP5_RSICC_1.30," Trans. Am. Nucl. Soc., Vol. 91, 693-694 (2004).

[3] X-5 Monte Carlo Team, "MCNP – A General Monte Carlo N-Particle Transport Code, Version 5," Volume I, LA-UR-03-1987, Los Alamos National Laboratory, April 24, 2003 (Revised /30/2004) and Volume II, LA-CP-0245, Los Alamos National Laboratory, April 24, 2003 (Revise 6/30/2004) (Vol. II is available with a licensed copy of MCNP).

[4] A. G. Croff, ORIGEN2: A Versatile Computer code for Calculating the Nuclide Compositions and Characteristics of Nuclear Materials, Nuclear Technology, Vol. 62, pp. 335-352, (1983).

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[6] B. G. Schnitzler, "Origen2 Cross Section Library Assessment for ATR Applications," BGS-6-91, Idaho National Laboratory, April 1991.

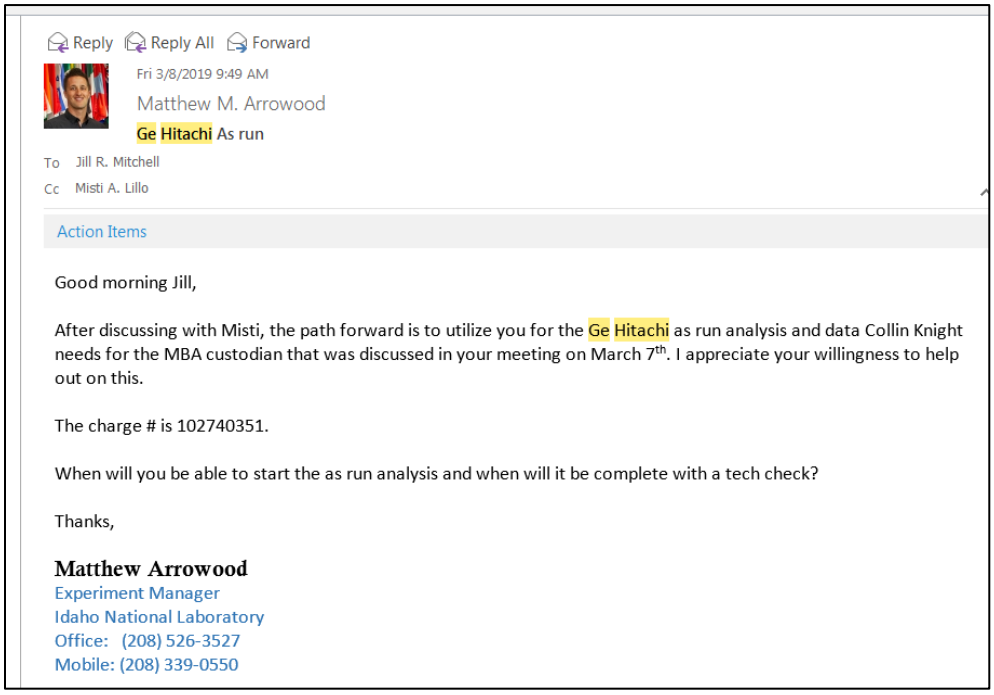
[7] J.R. Mitchell, J.W. Nielsen, "Software Management ORIGEN2 Version 2.2," PLN-3710, Revision 0, October 2011, INL Record Number 3818329, January 25, 2012 (EA ID 201298).

[8] T.A. Tomberlin, "Advanced Test Reactor Critical Facility Measurements in Support of Advanced Test Reactor Experiments," TRA-ATRC-1546, Rev. 0, March 2000.

[9] ECAR-3569, "Physics Analysis of the GE Hitachi Experiment," Rev. 2, B. J. Gross, May 23, 2017.

[10] TEV-2944, "Verification and Validation Testing of MCNP and ORIGEN2 Computer Codes for Idaho National Laboratory (INL) High Performance Computing (HPC) Systems," Rev. 4, J. W. Nielsen, July 16, 2019.

APPENDIX A "PYHSICS ANALYSIS REQUEST FORM"



Reply Reply All Forward

Fri 3/8/2019 9:49 AM

Matthew M. Arrowood

Ge Hitachi As run

To Jill R. Mitchell

Cc Misti A. Lillo

Action Items

Good morning Jill,

After discussing with Misti, the path forward is to utilize you for the Ge Hitachi as run analysis and data Collin Knight needs for the MBA custodian that was discussed in your meeting on March 7th. I appreciate your willingness to help out on this.

The charge # is 102740351.

When will you be able to start the as run analysis and when will it be complete with a tech check?

Thanks,

Matthew Arrowood
Experiment Manager
Idaho National Laboratory
Office: (208) 526-3527
Mobile: (208) 339-0550

APPENDIX B "POWER HISTORY LETTER"

INTEROFFICE MEMORANDUM

Idaho National Laboratory INL

Date: January 21, 2019

To: R. R. Little, Reactor and Nuclear Safety Engineering Manager, Advanced Test Reactor Programs

From: Reactor Engineering, Advanced Test Reactor Programs

Subject: Advanced Test Reactor Power History Through Cycle 164B-1

References:
(a) A. V. Briscoe letter to J. L. Durney, ATR Power History Through Cycle 34C-1, June 7, 1977, AVB-9-77
(b) C. C. Swanson letter to J. L. Durney, ATR Power History Through Cycle 72A-1, February 3, 1986, CAS-05-86
(c) L. S. Loret letter to E. C. Anderson, Sr., ATR Power History Through Cycle 102B-1, February 28, 1994, LSL-11-94
(d) D. E. Hale letter to J. C. Chapman, ATR Power History Through Cycle 133B-1, August 18, 2004, DEH-05-04

Table 1 lists the Advanced Test Reactor (ATR) N-16 constrained power history data since the Beryllium VI Core Internals Changeout (CIC) Cycle 134A-1 through Cycle 164B-1.

Table 2 lists the accumulated N-16 lobe and total core exposure, as obtained from the ATR Data Acquisition System (RDAS) for Cycles 134A-1 through 164B-1.

The ATR power history prior to Cycle 134A-1 is presented in the references.

Table 1. Summary of ATR Power History by Cycle

	Average Lobe Power (MW)					Cycle Exposure (MWd)						Length
	NW	NE	C	SW	SE	NW	NE	C	SW	SE	Total	(EFPD)
134A-1	-	-	-	-	-	-	-	-	-	-	-	-
134A-2	-	-	-	-	-	0.21	0.30	0.39	0.36	0.36	1.62	-
134B-1	18.0	18.0	24.5	23.0	25.0	452.82	452.24	615.47	578.48	628.58	2,727.59	25.10
134B-2	18.0	18.0	25.8	23.0	25.0	385.62	385.80	553.50	493.24	536.07	2,354.23	21.40
135A-1	18.0	18.0	29.8	28.1	35.4	236.16	235.99	391.07	368.63	463.98	1,695.83	13.10
135B-1	18.0	18.0	24.8	23.0	25.0	458.28	458.35	630.79	585.27	636.51	2,769.20	25.50
135B-2	18.0	18.0	25.2	23.0	25.0	405.02	405.70	567.38	517.82	562.99	2,458.91	22.50
135C-1	18.0	18.0	25.0	23.0	25.0	729.91	729.70	1,013.45	933.00	1,013.86	4,419.92	40.60
136A-1	18.0	18.0	24.0	23.0	23.0	916.18	916.39	1,218.91	1,169.47	1,170.17	5,391.12	50.90
136B-1	18.0	18.0	23.9	23.0	23.0	701.94	702.32	931.19	896.93	896.97	4,129.35	39.00
137A-1	18.0	18.0	24.7	20.0	25.0	975.35	974.76	1,336.16	1,083.20	1,353.31	5,722.78	54.10
137B-1	20.0	17.9	35.5	56.6	30.4	241.97	217.01	429.62	685.38	367.63	1,941.61	12.10
138A-1	18.0	18.0	23.6	23.0	25.0	1,046.87	1,047.69	1,370.69	1,336.39	1,453.47	6,255.11	58.10
138B-1	18.0	18.0	23.3	23.0	25.0	838.54	839.62	1,084.79	1,070.94	1,164.64	4,998.53	46.60
139A-1	18.0	18.0	23.9	23.0	25.0	928.73	929.09	1,231.07	1,186.27	1,289.47	5,564.63	51.60

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Table 1. Summary of ATR Power History by Cycle

	Average Lobe Power (MW)					Cycle Exposure (MWd)						Length
	NW	NE	C	SW	SE	NW	NE	C	SW	SE	Total	(EFPD)
139B-1	18.0	18.0	23.2	23.0	23.0	919.70	919.66	1,187.49	1,174.88	1,175.03	5,376.76	51.10
140A-1	18.0	18.0	21.8	23.0	23.0	836.99	837.18	1,012.89	1,069.69	1,069.39	4,826.14	46.50
140B-1	18.0	17.7	21.8	23.6	23.0	641.72	629.49	777.20	842.86	820.00	3,711.27	35.70
141A-1	18.0	18.0	23.4	23.0	23.0	583.25	583.08	756.83	745.05	745.45	3,413.66	32.40
142A-1	23.0	18.0	24.7	24.8	23.0	1,104.91	864.75	1,186.04	1,192.49	1,104.04	5,452.23	48.00
142B-1	23.0	18.0	25.4	25.4	25.0	1,196.93	936.68	1,323.41	1,322.45	1,298.70	6,078.17	52.00
143A-1/2	18.0	18.0	24.3	26.9	25.0	879.98	882.52	1,187.67	1,315.44	1,223.08	5,488.69	48.90
143B-1	18.0	18.0	24.9	27.0	25.1	1,032.06	1,032.58	1,423.53	1,543.74	1,435.01	6,466.92	57.30
144A-1	18.0	18.0	23.1	23.0	25.1	786.97	787.02	1,006.67	1,004.53	1,093.44	4,678.63	43.70
144B-1	18.0	18.1	22.4	23.0	23.0	932.25	933.43	1,155.74	1,190.72	1,190.89	5,403.03	51.70
145A-1	18.0	17.9	23.2	23.8	25.7	982.97	980.89	1,267.34	1,299.49	1,407.75	5,938.44	54.70
145B-1	17.8	17.8	23.0	24.6	25.8	1,020.46	1,019.96	1,321.43	1,407.79	1,478.25	6,247.89	57.30
146A-1	18.0	18.0	24.3	25.8	26.0	906.76	906.80	1,225.74	1,300.02	1,312.55	5,651.87	50.50
146B-1	23.0	18.0	26.0	23.0	26.0	903.68	707.11	1,021.59	903.85	1,020.96	4,557.19	39.20
147A-1	23.0	18.0	24.1	20.9	23.0	1,156.86	904.42	1,208.41	1,049.42	1,155.15	5,474.26	50.20
148A-1	18.0	18.0	23.6	22.0	23.0	855.97	855.75	1,121.43	1,043.79	1,093.64	4,970.58	47.50
148B-1	18.0	18.0	23.0	23.8	23.0	927.50	926.72	1,181.60	1,223.98	1,185.03	5,444.83	51.50
149A-1	18.0	18.0	24.2	24.0	23.0	662.45	662.65	891.28	883.28	846.80	3,946.46	36.80
149B-1	18.0	18.0	24.2	23.0	23.0	964.38	964.45	1,297.77	1,231.63	1,230.78	5,689.01	53.60
150A-1	18.9	18.0	30.5	37.5	35.1	233.41	221.60	375.93	462.71	432.58	1,726.23	12.32
150B-1	19.9	18.0	24.2	23.0	23.1	832.84	754.72	1,014.58	964.86	966.00	4,533.00	41.87
151A-1	18.9	14.2	22.0	23.6	23.0	1,058.63	799.95	1,237.01	1,324.39	1,289.04	5,709.02	56.14
151B-1/2	18.9	14.5	22.1	23.0	23.0	971.41	741.75	1,134.87	1,181.94	1,179.97	5,209.94	51.30
152A-1/6	-	-	-	-	-	0.30	0.30	0.50	0.40	0.50	2.00	-
152B-1	18.9	15.9	22.4	23.0	23.0	966.42	813.00	1,141.28	1,172.08	1,173.57	5,266.35	51.02
153B-1	19.7	19.7	30.8	35.4	44.0	265.20	265.35	414.47	476.12	591.42	2,012.56	13.45
154A-1	20.0	16.0	20.5	20.5	23.0	1,048.12	838.60	1,069.38	1,071.42	1,204.22	5,231.74	52.28
154B-1	20.0	17.9	21.6	22.8	23.9	1,066.60	958.47	1,156.40	1,220.49	1,275.27	5,677.23	53.44
155A-1	17.5	18.0	21.2	24.9	23.0	964.46	992.05	1,169.64	1,373.15	1,269.33	5,768.63	55.14
155B-1	18.0	18.7	22.0	22.9	23.0	896.41	933.78	1,097.45	1,145.28	1,146.21	5,219.13	49.92
156A-1	18.0	18.1	34.4	47.6	47.3	258.99	260.10	495.95	685.85	681.77	2,382.66	14.40
157A-1	18.0	16.9	20.1	19.9	24.0	674.80	636.93	755.89	749.37	900.30	3,717.29	37.58
157C-1	18.0	17.0	21.1	20.1	25.0	96.61	91.47	113.15	107.90	134.07	543.20	5.37
157D-1	18.0	17.0	21.6	20.9	25.0	1,072.06	1,012.51	1,288.16	1,247.14	1,490.31	6,110.18	59.71
158A-1	18.0	19.0	21.3	20.0	27.0	941.32	994.16	1,112.08	1,044.16	1,410.05	5,501.77	52.23
158B-1	18.0	19.0	19.0	22.7	23.0	924.85	977.00	974.33	1,165.25	1,183.34	5,224.77	51.36
159A-1	22.1	22.9	29.1	37.4	35.0	68.55	71.08	90.14	116.01	108.61	454.39	3.10
160A-1	17.5	21.1	19.8	20.0	26.1	924.07	1,115.94	1,050.71	1,057.87	1,380.71	5,529.30	52.94
160B-1	18.0	21.0	20.9	23.0	25.6	1,080.05	1,259.85	1,252.55	1,380.11	1,537.65	6,510.21	60.06
161A-1	18.0	20.9	30.6	42.7	41.5	230.21	268.17	392.91	547.87	532.53	1,971.69	12.82
162A-1	20.1	17.9	22.8	24.0	26.2	1,244.31	1,105.06	1,410.78	1,486.12	1,621.56	6,867.83	61.90
162B-1	20.0	14.5	19.2	23.9	23.0	769.04	560.05	738.98	918.84	884.90	3,871.81	38.51
163A-1	21.0	20.5	28.3	40.8	31.8	62.84	61.22	84.68	121.93	95.13	425.80	2.99
164A-1	20.0	16.0	19.4	22.4	25.7	1,099.06	879.28	1,067.84	1,230.00	1,410.51	5,686.69	54.91
164B-1	19.5	16.4	19.7	23.1	25.1	1,246.27	1,051.72	1,261.58	1,477.80	1,607.82	6,645.19	64.06

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Table 2. Cumulative Exposure

	Cumulative Exposure (MWd)					
	NW	NE	C	SW	SE	Total
134A-1	-	-	-	-	-	-
134A-2	0.21	0.30	0.39	0.36	0.36	1.62
134B-1	453.03	452.54	615.86	578.84	628.94	2,729.21
134B-2	838.65	838.34	1,169.36	1,072.08	1,165.01	5,083.44
135A-1	1,074.81	1,074.33	1,560.43	1,440.71	1,628.99	6,779.27
135B-1	1,533.09	1,532.68	2,191.22	2,025.98	2,265.50	9,548.47
135B-2	1,938.11	1,938.38	2,758.60	2,543.80	2,828.49	12,007.38
135C-1	2,668.02	2,668.08	3,772.05	3,476.80	3,842.35	16,427.30
136A-1	3,584.20	3,584.47	4,990.96	4,646.27	5,012.52	21,818.42
136B-1	4,286.14	4,286.79	5,922.15	5,543.20	5,909.49	25,947.77
137A-1	5,261.49	5,261.55	7,258.31	6,626.40	7,262.80	31,670.55
137B-1	5,503.46	5,478.56	7,687.93	7,311.78	7,630.43	33,612.16
138A-1	6,550.33	6,526.25	9,058.62	8,648.17	9,083.90	39,867.27
138B-1	7,388.87	7,365.87	10,143.41	9,719.11	10,248.54	44,865.80
139A-1	8,317.60	8,294.96	11,374.48	10,905.38	11,538.01	50,430.43
139B-1	9,237.30	9,214.62	12,561.97	12,080.26	12,713.04	55,807.19
140A-1	10,074.29	10,051.80	13,574.86	13,149.95	13,782.43	60,633.33
140B-1	10,716.01	10,681.29	14,352.06	13,992.81	14,602.43	64,344.60
141A-1	11,299.26	11,264.37	15,108.89	14,737.86	15,347.88	67,758.26
142A-1	12,404.17	12,129.12	16,294.93	15,930.35	16,451.92	73,210.49
142B-1	13,601.10	13,065.80	17,618.34	17,252.80	17,750.62	79,288.66
143A-1/2	14,481.08	13,948.32	18,806.01	18,568.24	18,973.70	84,777.35
143B-1	15,513.14	14,980.90	20,229.54	20,111.98	20,408.71	91,244.27
144A-1	16,300.11	15,767.92	21,236.21	21,116.51	21,502.15	95,922.90
144B-1	17,232.36	16,701.35	22,391.95	22,307.23	22,693.04	101,325.93
145A-1	18,215.33	17,682.24	23,659.29	23,606.72	24,100.79	107,264.37
145B-1	19,235.79	18,702.20	24,980.72	25,014.51	25,579.04	113,512.26
146A-1	20,142.55	19,609.00	26,206.46	26,314.53	26,891.59	119,164.13
146B-1	21,046.23	20,316.11	27,228.05	27,218.38	27,912.55	123,721.32
147A-1	22,203.09	21,220.53	28,436.46	28,267.80	29,067.70	129,195.58
148A-1	23,059.06	22,076.28	29,557.89	29,311.59	30,161.34	134,166.16
148B-1	23,986.56	23,003.00	30,739.49	30,535.57	31,346.37	139,610.99
149A-1	24,649.01	23,665.65	31,630.77	31,418.85	32,193.17	143,557.45
149B-1	25,613.39	24,630.10	32,928.54	32,650.48	33,423.95	149,246.46
150A-1	25,846.80	24,851.70	33,304.47	33,113.19	33,856.53	150,972.69
150B-1	26,679.64	25,606.42	34,319.05	34,078.05	34,822.53	155,505.69
151A-1	27,738.27	26,406.37	35,556.06	35,402.44	36,111.57	161,214.71
151B-1/2	28,709.68	27,148.12	36,690.93	36,584.38	37,291.54	166,424.65
152A-1/6	28,709.98	27,148.42	36,691.43	36,584.78	37,292.04	166,426.65
152B-1	29,676.40	27,961.42	37,832.71	37,756.86	38,465.61	171,693.00
153B-1	29,941.60	28,226.77	38,247.18	38,232.98	39,057.03	173,705.56
154A-1	30,989.72	29,065.37	39,316.56	39,304.40	40,261.25	178,937.30
154B-1	32,056.32	30,023.84	40,472.96	40,524.89	41,536.52	184,614.53
155A-1	33,020.78	31,015.89	41,642.60	41,898.04	42,805.85	190,383.16
155B-1	33,917.19	31,949.67	42,740.05	43,043.32	43,952.06	195,602.29
156A-1	34,176.18	32,209.77	43,236.00	43,729.17	44,633.83	197,984.95
157A-1	34,850.98	32,846.70	43,991.89	44,478.54	45,534.13	201,702.24
157C-1	34,947.59	32,938.17	44,105.04	44,586.44	45,668.20	202,245.44

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Table 2. Cumulative Exposure

	Cumulative Exposure (MWd)					
	NW	NE	C	SW	SE	Total
157D-1	36,019.65	33,950.68	45,393.20	45,833.58	47,158.51	208,355.62
158A-1	36,960.97	34,944.84	46,505.28	46,877.74	48,568.56	213,857.39
158B-1	37,885.82	35,921.84	47,479.61	48,042.99	49,751.90	219,082.16
159A-1	37,954.37	35,992.92	47,569.75	48,159.00	49,860.51	219,536.55
160A-1	38,878.44	37,108.86	48,620.46	49,216.87	51,241.22	225,065.85
160B-1	39,958.49	38,368.71	49,873.01	50,596.98	52,778.87	231,576.06
161A-1	40,188.70	38,636.88	50,265.92	51,144.85	53,311.40	233,547.75
162A-1	41,433.01	39,741.94	51,676.70	52,630.97	54,932.96	240,415.58
162B-1	42,202.05	40,301.99	52,415.68	53,549.81	55,817.86	244,287.39
163A-1	42,264.89	40,363.21	52,500.36	53,671.74	55,912.99	244,713.19
164A-1	43,363.95	41,242.49	53,568.20	54,901.74	57,323.5	250,399.88
164B-1	44,610.22	42,294.21	54,829.78	56,379.54	58,931.32	257,045.07

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APPENDIX C "ADDITIONAL SOURCE TERM"

The GE-HITACHI consisted of two sample materials. To support disassembly and future PIE of the GE-HITACHI-10584 experiment the source term for 1 gram of each material scaled to the maximum experiment flux was calculated. This conservative source term can be scaled to the total mass for each sample geometry located in each capsule.

Table 17. Ci/1g of incon

1g of Inconel										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon
H 3	3.24E-10	3.24E-10	3.24E-10	3.24E-10	3.23E-10	3.21E-10	3.20E-10	3.18E-10	3.14E-10	3.07E-10
H 4	7.42E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
HE 6	8.44E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LI 8	2.98E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BE 8	3.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BE 10	2.83E-12	2.83E-12	2.83E-12	2.83E-12	2.83E-12	2.83E-12	2.83E-12	2.83E-12	2.83E-12	2.83E-12
BE 11	1.00E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B 12	2.05E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C 14	4.85E-11	4.85E-11	4.85E-11	4.85E-11	4.85E-11	4.85E-11	4.85E-11	4.85E-11	4.85E-11	4.85E-11
NE 23	9.05E-10	2.55E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NA 24	5.07E-04	4.95E-04	1.67E-04	2.15E-07	1.80E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NA 24M	1.73E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NA 25	1.37E-09	1.11E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MG 27	2.42E-03	2.69E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MG 28	3.85E-12	3.79E-12	1.74E-12	1.47E-14	1.66E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AL 28	5.93E-02	5.51E-06	1.74E-12	1.47E-14	1.67E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AL 29	4.16E-05	1.71E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AL 30	4.02E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SI 31	7.71E-04	6.76E-04	1.35E-06	3.95E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SI 32	1.57E-13	1.57E-13	1.57E-13	1.57E-13	1.57E-13	1.57E-13	1.57E-13	1.57E-13	1.57E-13	1.57E-13
P 32	1.39E-03	1.39E-03	1.33E-03	9.91E-04	3.25E-04	7.59E-05	1.77E-05	4.14E-06	8.57E-08	3.69E-11
P 33	5.82E-08	5.82E-08	5.66E-08	4.79E-08	2.53E-08	1.10E-08	4.80E-09	2.09E-09	2.27E-10	2.69E-12
P 34	3.27E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Title: AS-RUN NEUTRONICS EVALUATION FOR THE GE HITACHI EXPERIMENT IN THE ATR

ECAR NO.: 4740 REV. NO.: 0 PROJECT NO.: 32535 Date: 12/02/2019

1g of Inconel										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon
S 35	3.08E-05	3.08E-05	3.05E-05	2.91E-05	2.43E-05	1.92E-05	1.51E-05	1.20E-05	6.36E-06	1.81E-06
S 37	9.43E-08	1.55E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CL 36	3.92E-13	3.92E-13	3.92E-13	3.92E-13	3.92E-13	3.92E-13	3.92E-13	3.92E-13	3.92E-13	3.92E-13
CL 38	4.02E-11	2.30E-11	9.05E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CL 38M	4.79E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AR 41	2.81E-11	2.33E-11	3.12E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
K 42	2.29E-13	2.22E-13	5.95E-14	1.86E-17	3.58E-20	3.58E-20	3.58E-20	3.58E-20	3.58E-20	3.58E-20
K 43	3.57E-10	3.51E-10	1.71E-10	2.06E-12	9.16E-20	2.35E-29	0.00E+00	0.00E+00	0.00E+00	0.00E+00
K 44	6.36E-11	2.47E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CA 45	3.20E-06	3.20E-06	3.19E-06	3.11E-06	2.82E-06	2.48E-06	2.18E-06	1.92E-06	1.37E-06	6.92E-07
CA 47	3.14E-08	3.13E-08	2.70E-08	1.08E-08	3.21E-10	3.28E-12	3.34E-14	3.42E-16	1.68E-21	0.00E+00
SC 46	5.60E-04	5.59E-04	5.55E-04	5.28E-04	4.37E-04	3.41E-04	2.66E-04	2.07E-04	1.07E-04	2.85E-05
SC 46M	1.59E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SC 47	1.04E-03	1.03E-03	8.44E-04	2.44E-04	2.10E-06	4.24E-09	8.68E-12	1.86E-14	7.55E-21	0.00E+00
SC 48	9.72E-05	9.65E-05	6.65E-05	6.81E-06	1.10E-09	1.24E-14	1.39E-19	1.57E-24	0.00E+00	0.00E+00
SC 49	8.62E-05	6.01E-05	2.49E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SC 50	1.65E-06	8.53E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TI 51	1.88E-03	5.10E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 52	2.20E-02	8.61E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 53	1.02E-04	2.50E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 54	1.07E-06	1.51E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CR 51	2.19E+00	2.19E+00	2.14E+00	1.84E+00	1.03E+00	4.88E-01	2.30E-01	1.09E-01	1.47E-02	2.69E-04
CR 55	2.96E-02	8.45E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 54	7.71E-03	7.71E-03	7.69E-03	7.59E-03	7.21E-03	6.75E-03	6.31E-03	5.90E-03	4.94E-03	3.47E-03
MN 56	9.51E-01	8.32E-01	1.50E-03	2.32E-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 57	5.03E-05	1.24E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 58	1.66E-07	8.36E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE 55	4.22E-02	4.22E-02	4.21E-02	4.19E-02	4.12E-02	4.03E-02	3.95E-02	3.86E-02	3.64E-02	3.24E-02
FE 59	6.42E-03	6.41E-03	6.32E-03	5.76E-03	4.04E-03	2.55E-03	1.60E-03	1.01E-03	2.95E-04	2.51E-05
CO 58	4.57E-01	4.57E-01	4.53E-01	4.27E-01	3.41E-01	2.54E-01	1.89E-01	1.41E-01	6.45E-02	1.35E-02
CO 60	5.25E-01	5.25E-01	5.25E-01	5.23E-01	5.19E-01	5.14E-01	5.08E-01	5.03E-01	4.88E-01	4.61E-01
CO 60M	3.65E+00	5.02E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO 61	1.83E-02	1.49E-02	7.66E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO 62	9.33E-05	8.90E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI 59	1.31E-04	1.31E-04	1.31E-04	1.31E-04	1.31E-04	1.31E-04	1.31E-04	1.31E-04	1.31E-04	1.31E-04
NI 63	1.69E-02	1.69E-02	1.69E-02	1.69E-02	1.69E-02	1.69E-02	1.69E-02	1.69E-02	1.68E-02	1.68E-02
NI 65	1.08E-01	9.43E-02	1.47E-04	9.25E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Title: AS-RUN NEUTRONICS EVALUATION FOR THE GE HITACHI EXPERIMENT IN THE ATR

ECAR NO.: 4740 REV. NO.: 0 PROJECT NO.: 32535 Date: 12/02/2019

1g of Inconel										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon
NI 66	1.65E-06	1.64E-06	1.22E-06	1.96E-07	1.77E-10	1.91E-14	2.05E-18	2.20E-22	0.00E+00	0.00E+00
CU 64	1.36E-01	1.32E-01	3.66E-02	1.41E-05	1.16E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CU 66	2.95E-02	5.02E-04	1.22E-06	1.96E-07	1.78E-10	1.91E-14	2.05E-18	2.20E-22	0.00E+00	0.00E+00
CU 67	8.55E-08	8.50E-08	6.53E-08	1.30E-08	2.67E-11	8.37E-15	2.63E-18	8.23E-22	0.00E+00	0.00E+00
ZN 65	1.26E-05	1.26E-05	1.26E-05	1.24E-05	1.16E-05	1.06E-05	9.75E-06	8.96E-06	7.13E-06	4.53E-06
ZN 69	7.72E-11	5.51E-11	1.66E-12	1.18E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZN 69M	5.19E-12	5.06E-12	1.55E-12	1.10E-15	9.22E-28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GA 70	1.01E-13	3.82E-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR 89	1.99E-10	1.99E-10	1.96E-10	1.81E-10	1.32E-10	8.72E-11	5.78E-11	3.83E-11	1.28E-11	1.42E-12
SR 90	1.02E-12	1.02E-12	1.02E-12	1.02E-12	1.01E-12	1.01E-12	1.01E-12	1.01E-12	1.00E-12	9.92E-13
SR 91	5.14E-12	4.95E-12	8.92E-13	2.44E-17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y 89M	4.17E-06	4.15E-06	3.37E-06	9.45E-07	7.20E-09	1.24E-11	2.14E-14	3.89E-17	1.67E-24	0.00E+00
Y 90	9.40E-05	9.35E-05	7.25E-05	1.52E-05	3.86E-08	1.68E-11	1.02E-12	1.01E-12	1.00E-12	9.92E-13
Y 90M	4.10E-12	3.66E-12	1.92E-14	2.00E-28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y 91	6.54E-09	6.53E-09	6.46E-09	6.02E-09	4.58E-09	3.21E-09	2.25E-09	1.58E-09	6.11E-10	9.18E-11
Y 92	6.42E-10	5.82E-10	5.84E-12	3.29E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y 94	3.63E-12	1.22E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZR 89	4.18E-06	4.16E-06	3.38E-06	9.47E-07	7.21E-09	1.24E-11	2.14E-14	3.90E-17	1.67E-24	0.00E+00
ZR 93	2.53E-10	2.53E-10	2.53E-10	2.53E-10	2.53E-10	2.53E-10	2.53E-10	2.53E-10	2.53E-10	2.53E-10
ZR 95	1.31E-05	1.31E-05	1.29E-05	1.21E-05	9.45E-06	6.83E-06	4.94E-06	3.57E-06	1.50E-06	2.65E-07
ZR 97	3.30E-07	3.24E-07	1.23E-07	3.37E-10	4.95E-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 92	8.31E-04	8.30E-04	7.77E-04	5.16E-04	1.07E-04	1.39E-05	1.79E-06	2.31E-07	9.86E-10	1.79E-14
NB 93M	3.64E-12	3.64E-12	3.68E-12	3.87E-12	4.63E-12	5.61E-12	6.59E-12	7.57E-12	1.01E-11	1.52E-11
NB 94	4.18E-05	4.18E-05	4.18E-05	4.18E-05	4.18E-05	4.18E-05	4.18E-05	4.18E-05	4.18E-05	4.18E-05
NB 95	6.77E-02	6.76E-02	6.64E-02	5.90E-02	3.75E-02	2.07E-02	1.15E-02	6.35E-03	1.31E-03	5.65E-05
NB 95M	9.10E-08	9.10E-08	9.10E-08	8.84E-08	7.01E-08	5.07E-08	3.66E-08	2.65E-08	1.11E-08	1.97E-09
NB 96	1.62E-04	1.60E-04	7.94E-05	1.11E-06	8.46E-14	4.41E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 97	1.17E-05	8.86E-06	1.24E-07	3.38E-10	5.33E-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 97M	3.13E-07	3.06E-07	1.17E-07	3.19E-10	4.69E-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 98	1.75E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB100	8.67E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO 93M	2.41E-04	2.30E-04	2.13E-05	1.00E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO 93	8.84E-07	8.84E-07	8.84E-07	8.84E-07	8.84E-07	8.84E-07	8.84E-07	8.84E-07	8.84E-07	8.84E-07
MO 99	1.69E-01	1.68E-01	1.31E-01	2.90E-02	8.79E-05	4.57E-08	2.38E-11	1.24E-14	2.16E-23	0.00E+00
MO101	4.20E-02	1.01E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TC 99	3.86E-08	3.86E-08	3.88E-08	3.92E-08	3.94E-08	3.94E-08	3.94E-08	3.94E-08	3.94E-08	3.94E-08
TC100	1.81E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

1g of Inconel										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon	Ci/1g of incon
TC101	4.20E-02	2.43E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU103	9.89E-07	9.89E-07	9.72E-07	8.74E-07	5.83E-07	3.43E-07	2.02E-07	1.19E-07	2.90E-08	1.72E-09
RU105	5.13E-12	4.75E-12	1.21E-13	2.08E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RH104	1.02E-08	7.34E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RH104M	7.42E-10	6.16E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RH105	4.20E-12	4.21E-12	3.07E-12	1.83E-13	3.67E-18	2.72E-24	2.02E-30	0.00E+00	0.00E+00	0.00E+00
RH105M	1.44E-12	1.33E-12	3.40E-14	5.83E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RH106	4.15E-13	1.41E-18	1.41E-18	1.41E-18	1.35E-18	1.27E-18	1.20E-18	1.13E-18	9.74E-19	7.16E-19
RH106M	2.02E-13	1.73E-13	1.05E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TA182	6.20E-02	6.20E-02	6.16E-02	5.94E-02	5.17E-02	4.32E-02	3.60E-02	3.01E-02	1.86E-02	7.08E-03
TA182M	1.84E-04	5.22E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TA183	3.25E-01	3.24E-01	2.84E-01	1.26E-01	5.51E-03	9.34E-05	1.58E-06	2.68E-08	5.09E-13	1.83E-22
W183M	2.52E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W185	2.40E-05	2.40E-05	2.38E-05	2.25E-05	1.82E-05	1.38E-05	1.05E-05	7.93E-06	3.79E-06	8.65E-07
W185M	6.52E-08	2.55E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W187	4.35E-09	4.28E-09	2.17E-09	3.33E-11	3.71E-18	3.17E-27	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W188	5.50E-12	5.50E-12	5.45E-12	5.13E-12	4.08E-12	3.02E-12	2.24E-12	1.66E-12	7.47E-13	1.51E-13
RE186	2.47E-06	2.46E-06	2.05E-06	6.82E-07	1.00E-08	4.07E-11	1.65E-13	6.69E-16	2.81E-22	0.00E+00
RE188	9.23E-11	9.17E-11	3.87E-11	5.28E-12	4.12E-12	3.05E-12	2.26E-12	1.68E-12	7.54E-13	1.53E-13
RE188M	8.79E-11	2.89E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SUMTOT	8.97E+00	5.48E+00	3.77E+00	3.14E+00	2.06E+00	1.39E+00	1.04E+00	8.52E-01	6.46E-01	5.35E-01
0TOTAL	8.97E+00	5.48E+00	3.77E+00	3.14E+00	2.06E+00	1.39E+00	1.04E+00	8.52E-01	6.46E-01	5.35E-01

Table 18. g/1g of incon

1g of Inconel										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon
H 1	1.45E-06	1.45E-06	1.45E-06	1.45E-06	1.45E-06	1.45E-06	1.45E-06	1.45E-06	1.45E-06	1.45E-06
H 2	5.05E-10	5.05E-10	5.05E-10	5.05E-10	5.05E-10	5.05E-10	5.05E-10	5.05E-10	5.05E-10	5.05E-10
H 3	3.36E-14	3.36E-14	3.36E-14	3.35E-14	3.34E-14	3.33E-14	3.31E-14	3.30E-14	3.26E-14	3.18E-14
HE 3	1.30E-16	1.30E-16	1.35E-16	1.66E-16	2.84E-16	4.38E-16	5.91E-16	7.43E-16	1.15E-15	1.94E-15
HE 4	5.96E-06	5.96E-06	5.96E-06	5.96E-06	5.96E-06	5.96E-06	5.96E-06	5.96E-06	5.96E-06	5.96E-06
LI 6	2.28E-13	2.28E-13	2.28E-13	2.28E-13	2.28E-13	2.28E-13	2.28E-13	2.28E-13	2.28E-13	2.28E-13
LI 7	7.64E-06	7.64E-06	7.64E-06	7.64E-06	7.64E-06	7.64E-06	7.64E-06	7.64E-06	7.64E-06	7.64E-06

Title: AS-RUN NEUTRONICS EVALUATION FOR THE GE HITACHI EXPERIMENT IN THE ATR

ECAR NO.: 4740 REV. NO.: 0 PROJECT NO.: 32535 Date: 12/02/2019

1g of Inconel										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon
BE 9	2.31E-09	2.31E-09	2.31E-09	2.31E-09	2.31E-09	2.31E-09	2.31E-09	2.31E-09	2.31E-09	2.31E-09
BE 10	1.26E-10	1.26E-10	1.26E-10	1.26E-10	1.26E-10	1.26E-10	1.26E-10	1.26E-10	1.26E-10	1.26E-10
B 10	1.99E-07	1.99E-07	1.99E-07	1.99E-07	1.99E-07	1.99E-07	1.99E-07	1.99E-07	1.99E-07	1.99E-07
B 11	4.89E-05	4.89E-05	4.89E-05	4.89E-05	4.89E-05	4.89E-05	4.89E-05	4.89E-05	4.89E-05	4.89E-05
C 12	7.90E-04	7.90E-04	7.90E-04	7.90E-04	7.90E-04	7.90E-04	7.90E-04	7.90E-04	7.90E-04	7.90E-04
C 13	9.61E-06	9.61E-06	9.61E-06	9.61E-06	9.61E-06	9.61E-06	9.61E-06	9.61E-06	9.61E-06	9.61E-06
C 14	1.09E-11	1.09E-11	1.09E-11	1.09E-11	1.09E-11	1.09E-11	1.09E-11	1.09E-11	1.09E-11	1.09E-11
N 14	3.95E-16	3.95E-16	3.98E-16	4.20E-16	5.03E-16	6.11E-16	7.19E-16	8.27E-16	1.11E-15	1.69E-15
NE 21	2.84E-14	2.84E-14	2.84E-14	2.84E-14	2.84E-14	2.84E-14	2.84E-14	2.84E-14	2.84E-14	2.84E-14
NE 22	1.50E-13	1.50E-13	1.50E-13	1.50E-13	1.50E-13	1.50E-13	1.50E-13	1.50E-13	1.50E-13	1.50E-13
NA 23	1.21E-14	1.21E-14	1.21E-14	1.21E-14	1.21E-14	1.21E-14	1.21E-14	1.21E-14	1.21E-14	1.21E-14
NA 24	5.82E-11	5.69E-11	1.92E-11	2.47E-14	2.06E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MG 24	1.41E-08	1.41E-08	1.41E-08	1.42E-08	1.42E-08	1.42E-08	1.42E-08	1.42E-08	1.42E-08	1.42E-08
MG 25	6.52E-09	6.52E-09	6.52E-09	6.52E-09	6.52E-09	6.52E-09	6.52E-09	6.52E-09	6.52E-09	6.52E-09
MG 26	2.97E-09	2.97E-09	2.97E-09	2.97E-09	2.97E-09	2.97E-09	2.97E-09	2.97E-09	2.97E-09	2.97E-09
MG 27	3.29E-12	3.66E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AL 27	8.00E-03	8.00E-03	8.00E-03	8.00E-03	8.00E-03	8.00E-03	8.00E-03	8.00E-03	8.00E-03	8.00E-03
AL 28	1.98E-11	1.84E-15	5.81E-22	4.91E-24	5.56E-32	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AL 29	4.18E-14	1.72E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SI 28	3.22E-03	3.22E-03	3.22E-03	3.22E-03	3.22E-03	3.22E-03	3.22E-03	3.22E-03	3.22E-03	3.22E-03
SI 29	1.69E-04	1.69E-04	1.69E-04	1.69E-04	1.69E-04	1.69E-04	1.69E-04	1.69E-04	1.69E-04	1.69E-04
SI 30	1.16E-04	1.16E-04	1.16E-04	1.16E-04	1.16E-04	1.16E-04	1.16E-04	1.16E-04	1.16E-04	1.16E-04
SI 31	2.00E-11	1.75E-11	3.51E-14	1.02E-30	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SI 32	9.11E-15	9.11E-15	9.11E-15	9.11E-15	9.11E-15	9.11E-15	9.11E-15	9.11E-15	9.11E-15	9.11E-15
P 31	1.50E-04	1.50E-04	1.50E-04	1.50E-04	1.50E-04	1.50E-04	1.50E-04	1.50E-04	1.50E-04	1.50E-04
P 32	4.87E-09	4.87E-09	4.64E-09	3.47E-09	1.14E-09	2.66E-10	6.21E-11	1.45E-11	3.00E-13	1.29E-16
P 33	3.68E-13	3.67E-13	3.58E-13	3.03E-13	1.60E-13	6.96E-14	3.03E-14	1.32E-14	1.44E-15	1.70E-17
S 32	1.42E-04	1.42E-04	1.42E-04	1.42E-04	1.42E-04	1.42E-04	1.42E-04	1.42E-04	1.42E-04	1.42E-04
S 33	1.23E-06	1.23E-06	1.23E-06	1.23E-06	1.23E-06	1.23E-06	1.23E-06	1.23E-06	1.23E-06	1.23E-06
S 34	6.69E-06	6.69E-06	6.69E-06	6.69E-06	6.69E-06	6.69E-06	6.69E-06	6.69E-06	6.69E-06	6.69E-06
S 35	7.25E-10	7.25E-10	7.19E-10	6.86E-10	5.72E-10	4.52E-10	3.57E-10	2.82E-10	1.50E-10	4.26E-11
S 36	2.86E-08	2.86E-08	2.86E-08	2.86E-08	2.86E-08	2.86E-08	2.86E-08	2.86E-08	2.86E-08	2.86E-08
CL 35	7.87E-10	7.87E-10	7.93E-10	8.26E-10	9.39E-10	1.06E-09	1.16E-09	1.23E-09	1.36E-09	1.47E-09
CL 36	1.19E-11	1.19E-11	1.19E-11	1.19E-11	1.19E-11	1.19E-11	1.19E-11	1.19E-11	1.19E-11	1.19E-11
CL 37	4.09E-12	4.09E-12	4.09E-12	4.09E-12	4.09E-12	4.09E-12	4.09E-12	4.09E-12	4.09E-12	4.09E-12
AR 40	2.07E-14	2.07E-14	2.07E-14	2.07E-14	2.07E-14	2.07E-14	2.07E-14	2.07E-14	2.07E-14	2.07E-14
CA 43	1.72E-09	1.72E-09	1.72E-09	1.72E-09	1.72E-09	1.72E-09	1.72E-09	1.72E-09	1.72E-09	1.72E-09

Title: AS-RUN NEUTRONICS EVALUATION FOR THE GE HITACHI EXPERIMENT IN THE ATR

ECAR NO.: 4740 REV. NO.: 0 PROJECT NO.: 32535 Date: 12/02/2019

1g of Inconel										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon
CA 44	1.33E-08	1.33E-08	1.33E-08	1.33E-08	1.33E-08	1.33E-08	1.33E-08	1.33E-08	1.33E-08	1.33E-08
CA 45	1.80E-10	1.80E-10	1.79E-10	1.74E-10	1.58E-10	1.39E-10	1.23E-10	1.08E-10	7.67E-11	3.89E-11
CA 46	1.55E-09	1.55E-09	1.55E-09	1.55E-09	1.55E-09	1.55E-09	1.55E-09	1.55E-09	1.55E-09	1.55E-09
CA 47	5.13E-14	5.11E-14	4.40E-14	1.76E-14	5.24E-16	5.35E-18	5.46E-20	5.59E-22	2.74E-27	0.00E+00
SC 45	9.50E-11	9.50E-11	9.58E-11	1.00E-10	1.17E-10	1.36E-10	1.52E-10	1.67E-10	1.98E-10	2.36E-10
SC 46	1.65E-08	1.65E-08	1.64E-08	1.56E-08	1.29E-08	1.01E-08	7.84E-09	6.12E-09	3.16E-09	8.40E-10
SC 47	1.25E-09	1.25E-09	1.02E-09	2.94E-10	2.53E-12	5.11E-15	1.05E-17	2.24E-20	9.10E-27	0.00E+00
SC 48	6.52E-11	6.47E-11	4.46E-11	4.57E-12	7.35E-16	8.29E-21	9.35E-26	1.06E-30	0.00E+00	0.00E+00
SC 49	1.29E-12	8.99E-13	3.73E-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TI 46	9.10E-04	9.10E-04	9.10E-04	9.10E-04	9.10E-04	9.10E-04	9.10E-04	9.10E-04	9.10E-04	9.10E-04
TI 47	8.39E-04	8.39E-04	8.39E-04	8.39E-04	8.39E-04	8.39E-04	8.39E-04	8.39E-04	8.39E-04	8.39E-04
TI 48	8.43E-03	8.43E-03	8.43E-03	8.43E-03	8.43E-03	8.43E-03	8.43E-03	8.43E-03	8.43E-03	8.43E-03
TI 49	6.96E-04	6.96E-04	6.96E-04	6.96E-04	6.96E-04	6.96E-04	6.96E-04	6.96E-04	6.96E-04	6.96E-04
TI 50	6.26E-04	6.26E-04	6.26E-04	6.26E-04	6.26E-04	6.26E-04	6.26E-04	6.26E-04	6.26E-04	6.26E-04
TI 51	2.94E-12	7.96E-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 50	6.54E-07	6.54E-07	6.54E-07	6.54E-07	6.54E-07	6.54E-07	6.54E-07	6.54E-07	6.54E-07	6.54E-07
V 51	1.07E-04	1.07E-04	1.08E-04	1.11E-04	1.20E-04	1.26E-04	1.29E-04	1.30E-04	1.31E-04	1.31E-04
V 52	2.28E-11	8.92E-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 53	4.60E-14	1.13E-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CR 50	8.65E-03	8.65E-03	8.65E-03	8.65E-03	8.65E-03	8.65E-03	8.65E-03	8.65E-03	8.65E-03	8.65E-03
CR 51	2.37E-05	2.37E-05	2.31E-05	1.99E-05	1.12E-05	5.28E-06	2.49E-06	1.18E-06	1.59E-07	2.91E-09
CR 52	1.75E-01	1.75E-01	1.75E-01	1.75E-01	1.75E-01	1.75E-01	1.75E-01	1.75E-01	1.75E-01	1.75E-01
CR 53	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02
CR 54	5.49E-03	5.49E-03	5.49E-03	5.49E-03	5.49E-03	5.49E-03	5.49E-03	5.49E-03	5.49E-03	5.49E-03
CR 55	3.07E-11	8.77E-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 54	9.95E-07	9.95E-07	9.93E-07	9.80E-07	9.31E-07	8.71E-07	8.15E-07	7.63E-07	6.39E-07	4.48E-07
MN 55	3.45E-03	3.45E-03	3.45E-03	3.45E-03	3.45E-03	3.45E-03	3.45E-03	3.45E-03	3.45E-03	3.45E-03
MN 56	4.38E-08	3.83E-08	6.90E-11	1.07E-27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 57	2.45E-14	6.03E-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE 54	6.21E-03	6.21E-03	6.21E-03	6.21E-03	6.21E-03	6.21E-03	6.21E-03	6.21E-03	6.21E-03	6.21E-03
FE 55	1.69E-05	1.69E-05	1.68E-05	1.68E-05	1.65E-05	1.61E-05	1.58E-05	1.54E-05	1.46E-05	1.30E-05
FE 56	1.02E-01	1.02E-01	1.02E-01	1.02E-01	1.02E-01	1.02E-01	1.02E-01	1.02E-01	1.02E-01	1.02E-01
FE 57	2.71E-03	2.71E-03	2.71E-03	2.71E-03	2.71E-03	2.71E-03	2.71E-03	2.71E-03	2.71E-03	2.71E-03
FE 58	3.65E-04	3.65E-04	3.65E-04	3.66E-04	3.69E-04	3.72E-04	3.74E-04	3.75E-04	3.78E-04	3.79E-04
FE 59	1.30E-07	1.30E-07	1.28E-07	1.17E-07	8.22E-08	5.18E-08	3.26E-08	2.05E-08	5.99E-09	5.09E-10
CO 58	1.44E-05	1.44E-05	1.42E-05	1.34E-05	1.07E-05	7.99E-06	5.95E-06	4.44E-06	2.03E-06	4.23E-07
CO 59	9.56E-03	9.56E-03	9.56E-03	9.56E-03	9.56E-03	9.56E-03	9.56E-03	9.56E-03	9.56E-03	9.56E-03

Title: AS-RUN NEUTRONICS EVALUATION FOR THE GE HITACHI EXPERIMENT IN THE ATR

ECAR NO.: 4740 REV. NO.: 0 PROJECT NO.: 32535 Date: 12/02/2019

1g of Inconel										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon
CO 60	4.64E-04	4.64E-04	4.64E-04	4.63E-04	4.59E-04	4.54E-04	4.49E-04	4.44E-04	4.32E-04	4.08E-04
CO 60M	1.22E-08	1.68E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO 61	5.88E-10	4.77E-10	2.46E-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO 62	4.61E-14	4.40E-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI 58	3.69E-01	3.69E-01	3.69E-01	3.69E-01	3.69E-01	3.69E-01	3.69E-01	3.69E-01	3.69E-01	3.69E-01
NI 59	1.73E-03	1.73E-03	1.73E-03	1.73E-03	1.73E-03	1.73E-03	1.73E-03	1.73E-03	1.73E-03	1.73E-03
NI 60	1.46E-01	1.46E-01	1.46E-01	1.46E-01	1.46E-01	1.46E-01	1.46E-01	1.46E-01	1.46E-01	1.46E-01
NI 61	6.83E-03	6.83E-03	6.83E-03	6.83E-03	6.83E-03	6.83E-03	6.83E-03	6.83E-03	6.83E-03	6.83E-03
NI 62	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02
NI 63	2.74E-04	2.74E-04	2.74E-04	2.74E-04	2.74E-04	2.74E-04	2.73E-04	2.73E-04	2.73E-04	2.72E-04
NI 64	5.45E-03	5.45E-03	5.45E-03	5.45E-03	5.45E-03	5.45E-03	5.45E-03	5.45E-03	5.45E-03	5.45E-03
NI 65	5.65E-09	4.93E-09	7.69E-12	4.83E-29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI 66	1.90E-12	1.89E-12	1.40E-12	2.25E-13	2.04E-16	2.19E-20	2.35E-24	2.53E-28	0.00E+00	0.00E+00
CU 63	2.05E-03	2.05E-03	2.05E-03	2.05E-03	2.05E-03	2.05E-03	2.05E-03	2.05E-03	2.05E-03	2.05E-03
CU 64	3.51E-08	3.42E-08	9.48E-09	3.66E-12	3.02E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CU 65	9.50E-04	9.50E-04	9.50E-04	9.50E-04	9.50E-04	9.50E-04	9.50E-04	9.50E-04	9.50E-04	9.50E-04
CU 66	5.28E-11	8.98E-13	2.18E-15	3.51E-16	3.18E-19	3.42E-23	3.67E-27	3.94E-31	0.00E+00	0.00E+00
CU 67	1.13E-13	1.12E-13	8.63E-14	1.72E-14	3.53E-17	1.11E-20	3.47E-24	1.09E-27	0.00E+00	0.00E+00
ZN 64	3.75E-06	3.75E-06	3.76E-06	3.76E-06	3.76E-06	3.76E-06	3.76E-06	3.76E-06	3.76E-06	3.76E-06
ZN 65	1.53E-09	1.53E-09	1.52E-09	1.50E-09	1.40E-09	1.29E-09	1.18E-09	1.09E-09	8.66E-10	5.49E-10
ZN 66	2.26E-06	2.26E-06	2.26E-06	2.26E-06	2.26E-06	2.26E-06	2.26E-06	2.26E-06	2.26E-06	2.26E-06
ZN 67	1.02E-09	1.02E-09	1.02E-09	1.02E-09	1.02E-09	1.02E-09	1.02E-09	1.02E-09	1.02E-09	1.02E-09
ZN 68	3.63E-12	3.63E-12	3.63E-12	3.63E-12	3.63E-12	3.63E-12	3.63E-12	3.63E-12	3.63E-12	3.63E-12
GA 69	1.55E-15	1.55E-15	1.55E-15	1.56E-15	1.56E-15	1.56E-15	1.56E-15	1.56E-15	1.56E-15	1.56E-15
SR 88	1.31E-14	1.31E-14	1.31E-14	1.31E-14	1.31E-14	1.31E-14	1.31E-14	1.31E-14	1.31E-14	1.31E-14
SR 89	6.84E-15	6.83E-15	6.74E-15	6.21E-15	4.53E-15	3.00E-15	1.99E-15	1.32E-15	4.39E-16	4.88E-17
SR 90	7.44E-15	7.44E-15	7.44E-15	7.44E-15	7.42E-15	7.41E-15	7.40E-15	7.38E-15	7.34E-15	7.27E-15
Y 89	4.23E-10	4.23E-10	4.25E-10	4.31E-10	4.33E-10	4.33E-10	4.33E-10	4.33E-10	4.33E-10	4.33E-10
Y 90	1.73E-10	1.72E-10	1.33E-10	2.80E-11	7.08E-14	3.09E-17	1.87E-18	1.85E-18	1.84E-18	1.82E-18
Y 91	2.66E-13	2.66E-13	2.63E-13	2.45E-13	1.87E-13	1.31E-13	9.17E-14	6.43E-14	2.49E-14	3.74E-15
ZR 89	9.30E-12	9.26E-12	7.52E-12	2.11E-12	1.61E-14	2.77E-17	4.77E-20	8.68E-23	3.72E-30	0.00E+00
ZR 90	9.70E-09	9.70E-09	9.74E-09	9.84E-09	9.87E-09	9.87E-09	9.87E-09	9.87E-09	9.87E-09	9.87E-09
ZR 91	5.89E-09	5.89E-09	5.89E-09	5.89E-09	5.89E-09	5.89E-09	5.89E-09	5.89E-09	5.89E-09	5.89E-09
ZR 92	1.39E-07	1.39E-07	1.39E-07	1.41E-07	1.44E-07	1.45E-07	1.45E-07	1.45E-07	1.45E-07	1.45E-07
ZR 93	1.01E-07	1.01E-07	1.01E-07	1.01E-07	1.01E-07	1.01E-07	1.01E-07	1.01E-07	1.01E-07	1.01E-07
ZR 94	1.29E-08	1.29E-08	1.29E-08	1.29E-08	1.29E-08	1.29E-08	1.29E-08	1.29E-08	1.29E-08	1.29E-08
ZR 95	6.09E-10	6.09E-10	6.02E-10	5.64E-10	4.40E-10	3.18E-10	2.30E-10	1.66E-10	6.98E-11	1.23E-11

Title: AS-RUN NEUTRONICS EVALUATION FOR THE GE HITACHI EXPERIMENT IN THE ATR

ECAR NO.: 4740 REV. NO.: 0 PROJECT NO.: 32535 Date: 12/02/2019

1g of Inconel										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon
ZR 96	9.76E-13	9.76E-13	9.76E-13	9.76E-13	9.76E-13	9.76E-13	9.76E-13	9.76E-13	9.76E-13	9.76E-13
ZR 97	1.73E-13	1.69E-13	6.45E-14	1.76E-16	2.59E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 92	5.95E-09	5.94E-09	5.56E-09	3.69E-09	7.68E-10	9.92E-11	1.28E-11	1.66E-12	7.06E-15	1.28E-19
NB 93	5.47E-02	5.47E-02	5.47E-02	5.47E-02	5.47E-02	5.47E-02	5.47E-02	5.47E-02	5.47E-02	5.47E-02
NB 93M	1.29E-14	1.29E-14	1.30E-14	1.37E-14	1.64E-14	1.99E-14	2.33E-14	2.68E-14	3.59E-14	5.38E-14
NB 94	2.23E-04	2.23E-04	2.23E-04	2.23E-04	2.23E-04	2.23E-04	2.23E-04	2.23E-04	2.23E-04	2.23E-04
NB 95	1.73E-06	1.73E-06	1.70E-06	1.51E-06	9.58E-07	5.30E-07	2.93E-07	1.62E-07	3.36E-08	1.44E-09
NB 95M	2.39E-13	2.39E-13	2.39E-13	2.32E-13	1.84E-13	1.33E-13	9.61E-14	6.94E-14	2.92E-14	5.16E-15
NB 96	1.16E-10	1.14E-10	5.68E-11	7.90E-13	6.05E-20	3.16E-29	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 97	4.35E-13	3.29E-13	4.61E-15	1.26E-17	1.98E-27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO 92	4.68E-03	4.68E-03	4.68E-03	4.68E-03	4.68E-03	4.68E-03	4.68E-03	4.68E-03	4.68E-03	4.68E-03
MO 93M	4.91E-11	4.66E-11	4.33E-12	2.03E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO 93	8.04E-07	8.04E-07	8.05E-07	8.05E-07	8.04E-07	8.04E-07	8.04E-07	8.04E-07	8.04E-07	8.04E-07
MO 94	3.00E-03	3.00E-03	3.00E-03	3.00E-03	3.00E-03	3.00E-03	3.00E-03	3.00E-03	3.00E-03	3.00E-03
MO 95	4.98E-03	4.98E-03	4.98E-03	4.98E-03	4.98E-03	4.98E-03	4.98E-03	4.98E-03	4.98E-03	4.98E-03
MO 96	5.69E-03	5.69E-03	5.69E-03	5.69E-03	5.69E-03	5.69E-03	5.69E-03	5.69E-03	5.69E-03	5.69E-03
MO 97	3.22E-03	3.22E-03	3.22E-03	3.22E-03	3.22E-03	3.22E-03	3.22E-03	3.22E-03	3.22E-03	3.22E-03
MO 98	8.12E-03	8.12E-03	8.12E-03	8.12E-03	8.12E-03	8.12E-03	8.12E-03	8.12E-03	8.12E-03	8.12E-03
MO 99	3.52E-07	3.50E-07	2.74E-07	6.03E-08	1.83E-10	9.53E-14	4.96E-17	2.58E-20	4.51E-29	0.00E+00
MO100	3.29E-03	3.29E-03	3.29E-03	3.29E-03	3.29E-03	3.29E-03	3.29E-03	3.29E-03	3.29E-03	3.29E-03
MO101	3.30E-10	7.96E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TC 99	2.28E-06	2.28E-06	2.29E-06	2.31E-06	2.32E-06	2.32E-06	2.32E-06	2.32E-06	2.32E-06	2.32E-06
TC100	2.53E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TC101	3.21E-10	1.85E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU 99	2.19E-12	2.19E-12	2.21E-12	2.33E-12	2.81E-12	3.43E-12	4.05E-12	4.67E-12	6.32E-12	9.63E-12
RU100	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
RU101	4.87E-06	4.87E-06	4.87E-06	4.87E-06	4.87E-06	4.87E-06	4.87E-06	4.87E-06	4.87E-06	4.87E-06
RU102	7.30E-08	7.30E-08	7.30E-08	7.30E-08	7.30E-08	7.30E-08	7.30E-08	7.30E-08	7.30E-08	7.30E-08
RU103	3.06E-11	3.06E-11	3.01E-11	2.71E-11	1.80E-11	1.06E-11	6.26E-12	3.69E-12	8.99E-13	5.34E-14
RU104	2.37E-13	2.37E-13	2.37E-13	2.37E-13	2.37E-13	2.37E-13	2.37E-13	2.37E-13	2.37E-13	2.37E-13
RH103	3.09E-12	3.09E-12	3.14E-12	3.44E-12	4.34E-12	5.08E-12	5.51E-12	5.77E-12	6.05E-12	6.13E-12
PD104	2.74E-13	2.74E-13	2.74E-13	2.74E-13	2.74E-13	2.74E-13	2.74E-13	2.74E-13	2.74E-13	2.74E-13
TA180	2.92E-08	2.92E-08	2.92E-08	2.92E-08	2.92E-08	2.92E-08	2.92E-08	2.92E-08	2.92E-08	2.92E-08
TA181	4.13E-04	4.13E-04	4.13E-04	4.13E-04	4.13E-04	4.13E-04	4.13E-04	4.13E-04	4.13E-04	4.13E-04
TA182	9.93E-06	9.93E-06	9.87E-06	9.52E-06	8.29E-06	6.92E-06	5.77E-06	4.82E-06	2.97E-06	1.13E-06
TA182M	2.94E-12	8.34E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TA183	2.32E-06	2.32E-06	2.03E-06	8.97E-07	3.94E-08	6.67E-10	1.13E-11	1.92E-13	3.64E-18	1.31E-27

1g of Inconel										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon	g/1g of incon
W182	1.17E-05	1.17E-05	1.17E-05	1.21E-05	1.33E-05	1.47E-05	1.58E-05	1.68E-05	1.86E-05	2.04E-05
W183M	2.12E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W183	6.17E-05	6.17E-05	6.20E-05	6.31E-05	6.40E-05	6.40E-05	6.40E-05	6.40E-05	6.40E-05	6.40E-05
W184	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06
W185	2.55E-09	2.55E-09	2.53E-09	2.39E-09	1.94E-09	1.47E-09	1.11E-09	8.43E-10	4.03E-10	9.20E-11
W186	6.36E-12	6.36E-12	6.50E-12	6.98E-12	7.22E-12	7.22E-12	7.22E-12	7.22E-12	7.22E-12	7.22E-12
W187	6.20E-15	6.11E-15	3.09E-15	4.74E-17	5.29E-24	4.52E-33	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE185	1.13E-09	1.13E-09	1.16E-09	1.29E-09	1.75E-09	2.22E-09	2.57E-09	2.84E-09	3.28E-09	3.59E-09
RE186	1.33E-11	1.32E-11	1.10E-11	3.67E-12	5.39E-14	2.19E-16	8.89E-19	3.60E-21	1.51E-27	0.00E+00
RE187	1.46E-13	1.46E-13	1.49E-13	1.52E-13	1.52E-13	1.52E-13	1.52E-13	1.52E-13	1.52E-13	1.52E-13
OS186	9.36E-11	9.37E-11	9.57E-11	1.03E-10	1.06E-10	1.06E-10	1.06E-10	1.06E-10	1.06E-10	1.06E-10
OS188	2.75E-15	2.75E-15	2.81E-15	2.87E-15	2.98E-15	3.09E-15	3.17E-15	3.22E-15	3.32E-15	3.38E-15
SUMTOT	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
0TOTAL	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00

Table 19. Ci/1g of 316SS

1g of 316SS										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS
H 3	1.22E-10	1.22E-10	1.22E-10	1.22E-10	1.21E-10	1.21E-10	1.20E-10	1.20E-10	1.18E-10	1.15E-10
HE 6	3.17E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
LI 8	4.44E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BE 8	5.50E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BE 10	4.95E-13	4.95E-13	4.95E-13	4.95E-13	4.95E-13	4.95E-13	4.95E-13	4.95E-13	4.95E-13	4.95E-13
BE 11	1.75E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B 12	9.53E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C 14	8.05E-06	8.05E-06	8.05E-06	8.05E-06	8.05E-06	8.05E-06	8.05E-06	8.05E-06	8.05E-06	8.05E-06
C 15	1.47E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
N 16	5.06E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NE 23	1.94E-09	5.46E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NA 24	5.21E-12	5.09E-12	1.72E-12	2.21E-15	1.85E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NA 24M	3.70E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NA 25	2.94E-09	2.38E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MG 27	2.19E-06	2.43E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Title: AS-RUN NEUTRONICS EVALUATION FOR THE GE HITACHI EXPERIMENT IN THE ATR

ECAR NO.: 4740 REV. NO.: 0 PROJECT NO.: 32535 Date: 12/02/2019

1g of 316SS										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS
AL 28	2.65E-03	2.46E-07	1.58E-15	1.33E-17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AL 29	8.91E-05	3.67E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AL 30	8.62E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SI 31	1.99E-03	1.75E-03	3.49E-06	1.02E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SI 32	4.05E-13	4.05E-13	4.05E-13	4.05E-13	4.05E-13	4.05E-13	4.05E-13	4.05E-13	4.05E-13	4.04E-13
P 32	3.47E-03	3.47E-03	3.31E-03	2.47E-03	8.10E-04	1.89E-04	4.42E-05	1.03E-05	2.14E-07	9.20E-11
P 33	1.16E-07	1.16E-07	1.13E-07	9.59E-08	5.07E-08	2.21E-08	9.60E-09	4.18E-09	4.55E-10	5.39E-12
P 34	6.53E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
S 35	6.15E-05	6.15E-05	6.10E-05	5.82E-05	4.86E-05	3.83E-05	3.03E-05	2.39E-05	1.27E-05	3.61E-06
S 37	1.89E-07	3.10E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CL 36	7.84E-13	7.84E-13	7.84E-13	7.84E-13	7.84E-13	7.84E-13	7.84E-13	7.84E-13	7.84E-13	7.84E-13
CL 38	8.04E-11	4.60E-11	1.81E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CL 38M	9.57E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CA 45	5.16E-13	5.16E-13	5.14E-13	5.01E-13	4.54E-13	4.00E-13	3.52E-13	3.10E-13	2.21E-13	1.12E-13
CA 47	3.65E-12	3.64E-12	3.13E-12	1.25E-12	3.72E-14	3.81E-16	5.76E-18	2.01E-18	9.86E-24	0.00E+00
SC 46	9.19E-16	9.19E-16	9.12E-16	8.68E-16	7.17E-16	5.59E-16	4.36E-16	3.40E-16	1.76E-16	4.67E-17
SC 47	1.69E-08	1.68E-08	1.37E-08	3.97E-09	3.42E-11	7.02E-14	1.53E-16	0.00E+00	3.73E-23	0.00E+00
SC 48	1.66E-08	1.65E-08	1.14E-08	1.17E-09	1.88E-13	2.11E-18	2.38E-23	2.69E-28	0.00E+00	0.00E+00
SC 49	4.71E-09	3.28E-09	1.36E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SC 50	4.02E-10	2.08E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TI 51	1.15E-05	3.11E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 52	1.90E-02	7.41E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 53	8.70E-05	2.14E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 54	9.20E-07	1.29E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CR 51	1.88E+00	1.88E+00	1.83E+00	1.58E+00	8.88E-01	4.19E-01	1.98E-01	9.34E-02	1.26E-02	2.31E-04
CR 55	2.63E-02	7.52E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 54	4.30E-02	4.30E-02	4.29E-02	4.24E-02	4.03E-02	3.77E-02	3.53E-02	3.30E-02	2.76E-02	1.94E-02
MN 56	4.84E+00	4.23E+00	7.65E-03	1.18E-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 57	2.81E-04	6.91E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 58	8.65E-07	4.36E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE 55	1.76E-01	1.76E-01	1.76E-01	1.75E-01	1.72E-01	1.69E-01	1.65E-01	1.61E-01	1.52E-01	1.35E-01
FE 59	3.32E-02	3.32E-02	3.27E-02	2.98E-02	2.09E-02	1.32E-02	8.30E-03	5.23E-03	1.52E-03	1.30E-04
CO 58	1.16E-01	1.16E-01	1.15E-01	1.09E-01	8.68E-02	6.47E-02	4.82E-02	3.59E-02	1.64E-02	3.43E-03
CO 60	5.11E-04	5.11E-04	5.11E-04	5.10E-04	5.05E-04	5.00E-04	4.95E-04	4.89E-04	4.75E-04	4.49E-04
CO 60M	4.31E-03	5.91E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO 61	1.45E-04	1.18E-04	6.07E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO 62	2.23E-05	2.13E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Title: AS-RUN NEUTRONICS EVALUATION FOR THE GE HITACHI EXPERIMENT IN THE ATR

ECAR NO.: 4740 REV. NO.: 0 PROJECT NO.: 32535 Date: 12/02/2019

1g of 316SS										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS
NI 59	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05
NI 63	4.30E-03	4.30E-03	4.30E-03	4.30E-03	4.30E-03	4.30E-03	4.29E-03	4.29E-03	4.28E-03	4.27E-03
NI 65	2.75E-02	2.40E-02	3.75E-05	2.36E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI 66	4.20E-07	4.17E-07	3.10E-07	4.98E-08	4.51E-11	4.85E-15	5.21E-19	5.59E-23	0.00E+00	0.00E+00
CU 64	1.06E-05	1.03E-05	2.85E-06	1.10E-09	9.06E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CU 66	6.50E-05	1.51E-06	3.10E-07	4.98E-08	4.52E-11	4.85E-15	5.21E-19	5.60E-23	0.00E+00	0.00E+00
CU 67	1.86E-10	1.85E-10	1.42E-10	2.83E-11	5.82E-14	1.82E-17	5.72E-21	1.79E-24	0.00E+00	0.00E+00
ZN 65	1.79E-10	1.79E-10	1.78E-10	1.75E-10	1.64E-10	1.51E-10	1.38E-10	1.27E-10	1.01E-10	6.42E-11
ZN 69	4.37E-14	3.15E-14	9.41E-16	6.59E-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR 89	1.81E-10	1.81E-10	1.78E-10	1.64E-10	1.20E-10	7.93E-11	5.25E-11	3.48E-11	1.16E-11	1.29E-12
SR 90	4.58E-14	4.58E-14	4.58E-14	4.58E-14	4.57E-14	4.56E-14	4.55E-14	4.54E-14	4.52E-14	4.47E-14
SR 91	4.44E-12	4.28E-12	7.71E-13	2.11E-17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y 89M	3.79E-06	3.78E-06	3.07E-06	8.59E-07	6.54E-09	1.13E-11	1.95E-14	3.54E-17	1.52E-24	0.00E+00
Y 90	4.89E-09	4.86E-09	3.77E-09	7.92E-10	2.05E-12	4.64E-14	4.55E-14	4.54E-14	4.52E-14	4.47E-14
Y 90M	3.72E-12	3.33E-12	1.75E-14	1.82E-28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y 91	2.93E-11	2.93E-11	2.90E-11	2.70E-11	2.06E-11	1.44E-11	1.01E-11	7.08E-12	2.74E-12	4.12E-13
Y 92	5.80E-10	5.26E-10	5.27E-12	2.97E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y 94	3.17E-12	1.07E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZR 89	3.80E-06	3.78E-06	3.07E-06	8.61E-07	6.55E-09	1.13E-11	1.95E-14	3.55E-17	1.52E-24	0.00E+00
ZR 93	1.14E-11	1.14E-11	1.14E-11	1.14E-11	1.14E-11	1.14E-11	1.14E-11	1.14E-11	1.14E-11	1.14E-11
ZR 95	1.19E-05	1.19E-05	1.18E-05	1.10E-05	8.60E-06	6.21E-06	4.49E-06	3.24E-06	1.36E-06	2.41E-07
ZR 97	3.00E-07	2.94E-07	1.12E-07	3.06E-10	4.50E-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 92	7.56E-04	7.55E-04	7.06E-04	4.69E-04	9.76E-05	1.26E-05	1.63E-06	2.10E-07	8.97E-10	1.63E-14
NB 93M	1.64E-13	1.64E-13	1.65E-13	1.74E-13	2.08E-13	2.53E-13	2.97E-13	3.41E-13	4.58E-13	6.88E-13
NB 94	1.28E-09	1.28E-09	1.28E-09	1.28E-09	1.28E-09	1.28E-09	1.28E-09	1.28E-09	1.28E-09	1.28E-09
NB 95	2.89E-05	2.89E-05	2.86E-05	2.67E-05	2.05E-05	1.46E-05	1.04E-05	7.43E-06	3.07E-06	5.36E-07
NB 95M	8.28E-08	8.28E-08	8.28E-08	8.04E-08	6.37E-08	4.61E-08	3.33E-08	2.41E-08	1.01E-08	1.79E-09
NB 96	2.71E-05	2.67E-05	1.33E-05	1.85E-07	1.41E-14	7.37E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 97	1.06E-05	8.05E-06	1.13E-07	3.08E-10	4.85E-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 97M	2.84E-07	2.79E-07	1.06E-07	2.90E-10	4.26E-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 98	1.59E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB100	7.89E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO 93M	2.20E-04	2.09E-04	1.94E-05	9.09E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO 93	8.04E-07	8.04E-07	8.04E-07	8.04E-07	8.04E-07	8.04E-07	8.04E-07	8.04E-07	8.04E-07	8.04E-07
MO 99	1.54E-01	1.53E-01	1.19E-01	2.63E-02	7.99E-05	4.15E-08	2.16E-11	1.12E-14	1.97E-23	0.00E+00
MO101	3.82E-02	9.22E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TC 99	3.51E-08	3.51E-08	3.53E-08	3.57E-08	3.58E-08	3.58E-08	3.58E-08	3.58E-08	3.58E-08	3.58E-08

Title: AS-RUN NEUTRONICS EVALUATION FOR THE GE HITACHI EXPERIMENT IN THE ATR

ECAR NO.: 4740 REV. NO.: 0 PROJECT NO.: 32535 Date: 12/02/2019

1g of 316SS										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS	Ci/1g of 316SS
TC100	1.64E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TC101	3.82E-02	2.21E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU103	8.99E-07	8.99E-07	8.83E-07	7.95E-07	5.30E-07	3.12E-07	1.84E-07	1.08E-07	2.64E-08	1.57E-09
RU105	4.67E-12	4.32E-12	1.10E-13	1.89E-23	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RH104	9.31E-09	6.68E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RH104M	6.74E-10	5.60E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RH105	3.82E-12	3.83E-12	2.79E-12	1.67E-13	3.33E-18	2.47E-24	1.84E-30	0.00E+00	0.00E+00	0.00E+00
RH105M	1.31E-12	1.21E-12	3.09E-14	5.30E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RH106	3.77E-13	1.28E-18	1.28E-18	1.28E-18	1.23E-18	1.16E-18	1.09E-18	1.03E-18	8.86E-19	6.51E-19
RH106M	1.84E-13	1.57E-13	9.57E-17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SUMTOT	7.41E+00	6.70E+00	2.34E+00	1.97E+00	1.21E+00	7.08E-01	4.60E-01	3.34E-01	2.15E-01	1.63E-01
0TOTAL	7.41E+00	6.70E+00	2.34E+00	1.97E+00	1.21E+00	7.08E-01	4.60E-01	3.34E-01	2.15E-01	1.63E-01

Table 20. g/1g of 316SS

1g of 316SS										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS
H 1	8.08E-07	8.08E-07	8.08E-07	8.08E-07	8.08E-07	8.08E-07	8.08E-07	8.08E-07	8.08E-07	8.08E-07
H 2	2.82E-10	2.82E-10	2.82E-10	2.82E-10	2.82E-10	2.82E-10	2.82E-10	2.82E-10	2.82E-10	2.82E-10
H 3	1.26E-14	1.26E-14	1.26E-14	1.26E-14	1.26E-14	1.25E-14	1.24E-14	1.24E-14	1.22E-14	1.19E-14
HE 4	4.36E-07	4.36E-07	4.36E-07	4.36E-07	4.36E-07	4.36E-07	4.36E-07	4.36E-07	4.36E-07	4.36E-07
LI 6	8.54E-14	8.54E-14	8.54E-14	8.54E-14	8.54E-14	8.54E-14	8.54E-14	8.54E-14	8.54E-14	8.54E-14
BE 9	8.66E-10	8.66E-10	8.66E-10	8.66E-10	8.66E-10	8.66E-10	8.66E-10	8.66E-10	8.66E-10	8.66E-10
BE 10	2.21E-11	2.21E-11	2.21E-11	2.21E-11	2.21E-11	2.21E-11	2.21E-11	2.21E-11	2.21E-11	2.21E-11
B 11	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07	2.06E-07
C 12	2.96E-04	2.96E-04	2.96E-04	2.96E-04	2.96E-04	2.96E-04	2.96E-04	2.96E-04	2.96E-04	2.96E-04
C 13	3.61E-06	3.61E-06	3.61E-06	3.61E-06	3.61E-06	3.61E-06	3.61E-06	3.61E-06	3.61E-06	3.61E-06
C 14	1.81E-06	1.81E-06	1.81E-06	1.81E-06	1.81E-06	1.81E-06	1.81E-06	1.81E-06	1.81E-06	1.81E-06
N 14	9.94E-04	9.94E-04	9.94E-04	9.94E-04	9.94E-04	9.94E-04	9.94E-04	9.94E-04	9.94E-04	9.94E-04

Title: AS-RUN NEUTRONICS EVALUATION FOR THE GE HITACHI EXPERIMENT IN THE ATR

ECAR NO.: 4740 REV. NO.: 0 PROJECT NO.: 32535 Date: 12/02/2019

1g of 316SS										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS
N 15	3.99E-06	3.99E-06	3.99E-06	3.99E-06	3.99E-06	3.99E-06	3.99E-06	3.99E-06	3.99E-06	3.99E-06
O 16	9.33E-14	9.33E-14	9.33E-14	9.33E-14	9.33E-14	9.33E-14	9.33E-14	9.33E-14	9.33E-14	9.33E-14
NE 22	3.21E-13	3.21E-13	3.21E-13	3.21E-13	3.21E-13	3.21E-13	3.21E-13	3.21E-13	3.21E-13	3.21E-13
NA 23	2.60E-14	2.60E-14	2.60E-14	2.60E-14	2.60E-14	2.60E-14	2.60E-14	2.60E-14	2.60E-14	2.60E-14
MG 25	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08
MG 26	6.37E-09	6.37E-09	6.37E-09	6.37E-09	6.37E-09	6.37E-09	6.37E-09	6.37E-09	6.37E-09	6.37E-09
MG 27	2.97E-15	3.30E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AL 27	6.87E-11	6.87E-11	6.87E-11	6.87E-11	6.87E-11	6.87E-11	6.87E-11	6.87E-11	6.87E-11	6.87E-11
AL 28	8.82E-13	8.20E-17	5.26E-25	4.45E-27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AL 29	8.95E-14	3.69E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SI 28	6.89E-03	6.89E-03	6.89E-03	6.89E-03	6.89E-03	6.89E-03	6.89E-03	6.89E-03	6.89E-03	6.89E-03
SI 29	3.62E-04	3.62E-04	3.62E-04	3.62E-04	3.62E-04	3.62E-04	3.62E-04	3.62E-04	3.62E-04	3.62E-04
SI 30	2.48E-04	2.48E-04	2.48E-04	2.48E-04	2.48E-04	2.48E-04	2.48E-04	2.48E-04	2.48E-04	2.48E-04
SI 31	5.16E-11	4.52E-11	9.05E-14	2.64E-30	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SI 32	2.35E-14	2.35E-14	2.35E-14	2.35E-14	2.35E-14	2.35E-14	2.35E-14	2.35E-14	2.35E-14	2.35E-14
P 31	4.50E-04	4.50E-04	4.50E-04	4.50E-04	4.50E-04	4.50E-04	4.50E-04	4.50E-04	4.50E-04	4.50E-04
P 32	1.22E-08	1.21E-08	1.16E-08	8.66E-09	2.84E-09	6.63E-10	1.55E-10	3.62E-11	7.49E-13	3.22E-16
P 33	7.35E-13	7.35E-13	7.15E-13	6.06E-13	3.20E-13	1.39E-13	6.06E-14	2.64E-14	2.87E-15	3.40E-17
S 32	2.84E-04	2.84E-04	2.84E-04	2.84E-04	2.84E-04	2.84E-04	2.84E-04	2.84E-04	2.84E-04	2.84E-04
S 33	2.46E-06	2.46E-06	2.46E-06	2.46E-06	2.46E-06	2.46E-06	2.46E-06	2.46E-06	2.46E-06	2.46E-06
S 34	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05	1.34E-05
S 35	1.45E-09	1.45E-09	1.44E-09	1.37E-09	1.15E-09	9.04E-10	7.14E-10	5.64E-10	3.00E-10	8.51E-11
S 36	5.72E-08	5.72E-08	5.72E-08	5.72E-08	5.72E-08	5.72E-08	5.72E-08	5.72E-08	5.72E-08	5.72E-08
CL 35	1.57E-09	1.57E-09	1.59E-09	1.65E-09	1.88E-09	2.12E-09	2.31E-09	2.46E-09	2.72E-09	2.94E-09
CL 36	2.38E-11	2.38E-11	2.38E-11	2.38E-11	2.38E-11	2.38E-11	2.38E-11	2.38E-11	2.38E-11	2.38E-11
CL 37	8.19E-12	8.19E-12	8.19E-12	8.19E-12	8.19E-12	8.19E-12	8.19E-12	8.19E-12	8.19E-12	8.19E-12
AR 38	1.77E-15	1.77E-15	1.77E-15	1.77E-15	1.77E-15	1.77E-15	1.77E-15	1.77E-15	1.77E-15	1.77E-15
CA 44	1.11E-13	1.11E-13	1.11E-13	1.11E-13	1.11E-13	1.11E-13	1.11E-13	1.11E-13	1.11E-13	1.11E-13
CA 46	4.44E-14	4.44E-14	4.44E-14	4.44E-14	4.44E-14	4.44E-14	4.44E-14	4.44E-14	4.44E-14	4.44E-14
SC 47	2.04E-14	2.03E-14	1.66E-14	4.79E-15	4.12E-17	8.46E-20	1.85E-22	0.00E+00	4.49E-29	0.00E+00
SC 48	1.12E-14	1.11E-14	7.63E-15	7.81E-16	1.26E-19	1.42E-24	1.60E-29	1.80E-34	0.00E+00	0.00E+00
TI 47	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08	1.40E-08
TI 48	1.34E-11	1.34E-11	1.34E-11	1.34E-11	1.34E-11	1.34E-11	1.34E-11	1.34E-11	1.34E-11	1.34E-11
TI 49	3.81E-08	3.81E-08	3.81E-08	3.81E-08	3.81E-08	3.81E-08	3.81E-08	3.81E-08	3.81E-08	3.81E-08
TI 50	1.52E-07	1.52E-07	1.52E-07	1.52E-07	1.52E-07	1.52E-07	1.52E-07	1.52E-07	1.52E-07	1.52E-07
TI 51	1.80E-14	4.86E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 50	5.60E-07	5.60E-07	5.60E-07	5.60E-07	5.60E-07	5.60E-07	5.60E-07	5.60E-07	5.60E-07	5.60E-07

Title: AS-RUN NEUTRONICS EVALUATION FOR THE GE HITACHI EXPERIMENT IN THE ATR

ECAR NO.: 4740 REV. NO.: 0 PROJECT NO.: 32535 Date: 12/02/2019

1g of 316SS										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS
V 51	9.21E-05	9.21E-05	9.26E-05	9.54E-05	1.03E-04	1.08E-04	1.10E-04	1.12E-04	1.12E-04	1.13E-04
V 52	1.97E-11	7.68E-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 53	3.95E-14	9.70E-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CR 50	7.41E-03	7.41E-03	7.41E-03	7.41E-03	7.41E-03	7.41E-03	7.41E-03	7.41E-03	7.41E-03	7.41E-03
CR 51	2.03E-05	2.03E-05	1.98E-05	1.71E-05	9.60E-06	4.53E-06	2.14E-06	1.01E-06	1.37E-07	2.50E-09
CR 52	1.50E-01	1.50E-01	1.50E-01	1.50E-01	1.50E-01	1.50E-01	1.50E-01	1.50E-01	1.50E-01	1.50E-01
CR 53	1.76E-02	1.76E-02	1.76E-02	1.76E-02	1.76E-02	1.76E-02	1.76E-02	1.76E-02	1.76E-02	1.76E-02
CR 54	4.71E-03	4.71E-03	4.71E-03	4.71E-03	4.71E-03	4.71E-03	4.71E-03	4.71E-03	4.71E-03	4.71E-03
CR 55	2.73E-11	7.80E-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 54	5.56E-06	5.56E-06	5.55E-06	5.47E-06	5.20E-06	4.87E-06	4.55E-06	4.26E-06	3.57E-06	2.50E-06
MN 55	1.97E-02	1.97E-02	1.97E-02	1.97E-02	1.97E-02	1.97E-02	1.97E-02	1.97E-02	1.97E-02	1.97E-02
MN 56	2.23E-07	1.95E-07	3.53E-10	5.45E-27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 57	1.37E-13	3.37E-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE 54	3.47E-02	3.47E-02	3.47E-02	3.47E-02	3.47E-02	3.47E-02	3.47E-02	3.47E-02	3.47E-02	3.47E-02
FE 55	7.04E-05	7.04E-05	7.04E-05	7.01E-05	6.89E-05	6.74E-05	6.59E-05	6.45E-05	6.09E-05	5.41E-05
FE 56	5.69E-01	5.69E-01	5.69E-01	5.69E-01	5.69E-01	5.69E-01	5.69E-01	5.69E-01	5.69E-01	5.69E-01
FE 57	1.51E-02	1.51E-02	1.51E-02	1.51E-02	1.51E-02	1.51E-02	1.51E-02	1.51E-02	1.51E-02	1.51E-02
FE 58	1.90E-03	1.90E-03	1.90E-03	1.90E-03	1.90E-03	1.91E-03	1.91E-03	1.91E-03	1.91E-03	1.91E-03
FE 59	6.75E-07	6.74E-07	6.64E-07	6.06E-07	4.25E-07	2.68E-07	1.69E-07	1.06E-07	3.10E-08	2.64E-09
CO 58	3.66E-06	3.66E-06	3.62E-06	3.42E-06	2.73E-06	2.03E-06	1.52E-06	1.13E-06	5.16E-07	1.08E-07
CO 59	1.13E-05	1.13E-05	1.13E-05	1.13E-05	1.15E-05	1.17E-05	1.18E-05	1.18E-05	1.19E-05	1.19E-05
CO 60	4.52E-07	4.52E-07	4.51E-07	4.50E-07	4.47E-07	4.42E-07	4.37E-07	4.32E-07	4.20E-07	3.97E-07
CO 60M	1.44E-11	1.97E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO 61	4.66E-12	3.78E-12	1.95E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO 62	1.10E-14	1.05E-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI 58	9.39E-02	9.39E-02	9.39E-02	9.39E-02	9.39E-02	9.39E-02	9.39E-02	9.39E-02	9.39E-02	9.39E-02
NI 59	4.40E-04	4.40E-04	4.40E-04	4.40E-04	4.40E-04	4.40E-04	4.40E-04	4.40E-04	4.40E-04	4.40E-04
NI 60	3.72E-02	3.72E-02	3.72E-02	3.72E-02	3.72E-02	3.72E-02	3.72E-02	3.72E-02	3.72E-02	3.72E-02
NI 61	1.74E-03	1.74E-03	1.74E-03	1.74E-03	1.74E-03	1.74E-03	1.74E-03	1.74E-03	1.74E-03	1.74E-03
NI 62	5.24E-03	5.24E-03	5.24E-03	5.24E-03	5.24E-03	5.24E-03	5.24E-03	5.24E-03	5.24E-03	5.24E-03
NI 63	6.97E-05	6.97E-05	6.97E-05	6.97E-05	6.97E-05	6.96E-05	6.96E-05	6.95E-05	6.94E-05	6.92E-05
NI 64	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03	1.39E-03
NI 65	1.44E-09	1.25E-09	1.96E-12	1.23E-29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI 66	4.83E-13	4.80E-13	3.56E-13	5.72E-14	5.19E-17	5.57E-21	5.99E-25	6.43E-29	0.00E+00	0.00E+00
CU 63	1.59E-07	1.59E-07	1.60E-07	1.69E-07	2.02E-07	2.45E-07	2.88E-07	3.31E-07	4.45E-07	6.74E-07
CU 64	2.74E-12	2.66E-12	7.38E-13	2.85E-16	2.35E-29	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CU 65	2.08E-06	2.08E-06	2.08E-06	2.08E-06	2.08E-06	2.08E-06	2.08E-06	2.08E-06	2.08E-06	2.08E-06

Title: AS-RUN NEUTRONICS EVALUATION FOR THE GE HITACHI EXPERIMENT IN THE ATR

ECAR NO.: 4740 REV. NO.: 0 PROJECT NO.: 32535 Date: 12/02/2019

1g of 316SS										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS
CU 66	1.16E-13	2.71E-15	5.55E-16	8.92E-17	8.08E-20	8.68E-24	9.33E-28	1.00E-31	0.00E+00	0.00E+00
ZN 64	9.76E-11	9.76E-11	9.83E-11	9.86E-11	9.86E-11	9.86E-11	9.86E-11	9.86E-11	9.86E-11	9.86E-11
ZN 65	2.17E-14	2.17E-14	2.16E-14	2.12E-14	1.99E-14	1.83E-14	1.68E-14	1.54E-14	1.23E-14	7.79E-15
ZN 66	2.51E-09	2.51E-09	2.51E-09	2.51E-09	2.51E-09	2.51E-09	2.51E-09	2.51E-09	2.51E-09	2.51E-09
ZN 67	7.63E-13	7.63E-13	7.63E-13	7.63E-13	7.64E-13	7.64E-13	7.64E-13	7.64E-13	7.64E-13	7.64E-13
ZN 68	2.06E-15	2.06E-15	2.06E-15	2.06E-15	2.06E-15	2.06E-15	2.06E-15	2.06E-15	2.06E-15	2.06E-15
SR 88	1.19E-14	1.19E-14	1.19E-14	1.19E-14	1.19E-14	1.19E-14	1.19E-14	1.19E-14	1.19E-14	1.19E-14
SR 89	6.21E-15	6.21E-15	6.13E-15	5.65E-15	4.12E-15	2.73E-15	1.81E-15	1.20E-15	3.99E-16	4.44E-17
Y 89	3.85E-10	3.85E-10	3.86E-10	3.91E-10	3.93E-10	3.93E-10	3.93E-10	3.93E-10	3.93E-10	3.93E-10
Y 90	8.98E-15	8.93E-15	6.92E-15	1.46E-15	3.77E-18	8.53E-20	8.37E-20	8.35E-20	8.30E-20	8.22E-20
Y 91	1.20E-15	1.20E-15	1.18E-15	1.10E-15	8.38E-16	5.87E-16	4.12E-16	2.89E-16	1.12E-16	1.68E-17
ZR 89	8.46E-12	8.42E-12	6.84E-12	1.92E-12	1.46E-14	2.52E-17	4.35E-20	7.90E-23	3.39E-30	0.00E+00
ZR 90	2.50E-13	2.50E-13	2.52E-13	2.57E-13	2.59E-13	2.59E-13	2.59E-13	2.59E-13	2.59E-13	2.59E-13
ZR 91	5.35E-09	5.35E-09	5.35E-09	5.35E-09	5.35E-09	5.35E-09	5.35E-09	5.35E-09	5.35E-09	5.35E-09
ZR 92	1.26E-07	1.26E-07	1.27E-07	1.28E-07	1.31E-07	1.32E-07	1.32E-07	1.32E-07	1.32E-07	1.32E-07
ZR 93	4.55E-09	4.55E-09	4.55E-09	4.55E-09	4.55E-09	4.55E-09	4.55E-09	4.55E-09	4.55E-09	4.55E-09
ZR 94	1.13E-08	1.13E-08	1.13E-08	1.13E-08	1.13E-08	1.13E-08	1.13E-08	1.13E-08	1.13E-08	1.13E-08
ZR 95	5.54E-10	5.53E-10	5.48E-10	5.13E-10	4.00E-10	2.89E-10	2.09E-10	1.51E-10	6.34E-11	1.12E-11
ZR 96	8.87E-13	8.87E-13	8.87E-13	8.87E-13	8.87E-13	8.87E-13	8.87E-13	8.87E-13	8.87E-13	8.87E-13
ZR 97	1.57E-13	1.54E-13	5.87E-14	1.60E-16	2.35E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 92	5.41E-09	5.40E-09	5.05E-09	3.35E-09	6.99E-10	9.02E-11	1.17E-11	1.51E-12	6.42E-15	1.17E-19
NB 93	4.35E-11	4.35E-11	4.38E-11	4.62E-11	5.54E-11	6.73E-11	7.92E-11	9.11E-11	1.23E-10	1.86E-10
NB 93M	5.79E-16	5.79E-16	5.84E-16	6.16E-16	7.37E-16	8.94E-16	1.05E-15	1.21E-15	1.62E-15	2.43E-15
NB 94	6.81E-09	6.81E-09	6.81E-09	6.81E-09	6.81E-09	6.81E-09	6.81E-09	6.81E-09	6.81E-09	6.81E-09
NB 95	7.39E-10	7.39E-10	7.31E-10	6.82E-10	5.23E-10	3.72E-10	2.66E-10	1.90E-10	7.86E-11	1.37E-11
NB 95M	2.17E-13	2.17E-13	2.17E-13	2.11E-13	1.67E-13	1.21E-13	8.74E-14	6.31E-14	2.65E-14	4.69E-15
NB 96	1.94E-11	1.91E-11	9.49E-12	1.32E-13	1.01E-20	5.27E-30	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 97	3.96E-13	2.99E-13	4.19E-15	1.14E-17	1.80E-27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO 92	4.25E-03	4.25E-03	4.25E-03	4.25E-03	4.25E-03	4.25E-03	4.25E-03	4.25E-03	4.25E-03	4.25E-03
MO 93M	4.46E-11	4.24E-11	3.93E-12	1.85E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO 93	7.31E-07	7.31E-07	7.31E-07	7.31E-07	7.31E-07	7.31E-07	7.31E-07	7.31E-07	7.31E-07	7.31E-07
MO 94	2.73E-03	2.73E-03	2.73E-03	2.73E-03	2.73E-03	2.73E-03	2.73E-03	2.73E-03	2.73E-03	2.73E-03
MO 95	4.53E-03	4.53E-03	4.53E-03	4.53E-03	4.53E-03	4.53E-03	4.53E-03	4.53E-03	4.53E-03	4.53E-03
MO 96	5.17E-03	5.17E-03	5.17E-03	5.17E-03	5.17E-03	5.17E-03	5.17E-03	5.17E-03	5.17E-03	5.17E-03
MO 97	2.92E-03	2.92E-03	2.92E-03	2.92E-03	2.92E-03	2.92E-03	2.92E-03	2.92E-03	2.92E-03	2.92E-03
MO 98	7.38E-03	7.38E-03	7.38E-03	7.38E-03	7.38E-03	7.38E-03	7.38E-03	7.38E-03	7.38E-03	7.38E-03
MO 99	3.20E-07	3.19E-07	2.49E-07	5.48E-08	1.67E-10	8.66E-14	4.50E-17	2.34E-20	4.10E-29	0.00E+00

1g of 316SS										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS	g/1g of 316SS
MO100	3.00E-03	3.00E-03	3.00E-03	3.00E-03	3.00E-03	3.00E-03	3.00E-03	3.00E-03	3.00E-03	3.00E-03
MO101	3.00E-10	7.23E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TC 99	2.07E-06	2.07E-06	2.08E-06	2.10E-06	2.11E-06	2.11E-06	2.11E-06	2.11E-06	2.11E-06	2.11E-06
TC100	2.30E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TC101	2.91E-10	1.68E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RU 99	1.99E-12	1.99E-12	2.01E-12	2.12E-12	2.55E-12	3.11E-12	3.68E-12	4.24E-12	5.75E-12	8.75E-12
RU100	9.51E-08	9.51E-08	9.51E-08	9.51E-08	9.51E-08	9.51E-08	9.51E-08	9.51E-08	9.51E-08	9.51E-08
RU101	4.43E-06	4.43E-06	4.43E-06	4.43E-06	4.43E-06	4.43E-06	4.43E-06	4.43E-06	4.43E-06	4.43E-06
RU102	6.64E-08	6.64E-08	6.64E-08	6.64E-08	6.64E-08	6.64E-08	6.64E-08	6.64E-08	6.64E-08	6.64E-08
RU103	2.79E-11	2.78E-11	2.74E-11	2.46E-11	1.64E-11	9.66E-12	5.69E-12	3.35E-12	8.17E-13	4.85E-14
RU104	2.15E-13	2.15E-13	2.15E-13	2.15E-13	2.15E-13	2.15E-13	2.15E-13	2.15E-13	2.15E-13	2.15E-13
RH103	2.81E-12	2.81E-12	2.86E-12	3.13E-12	3.95E-12	4.62E-12	5.01E-12	5.24E-12	5.50E-12	5.57E-12
PD104	2.49E-13	2.49E-13	2.49E-13	2.49E-13	2.49E-13	2.49E-13	2.49E-13	2.49E-13	2.49E-13	2.49E-13
SUMTOT	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
0TOTAL	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00

Table 21. g/1g of Ti

1g of Ti										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of Ti	g/1g of Ti	g/1g of Ti	g/1g of Ti	g/1g of Ti	g/1g of Ti	g/1g of Ti	g/1g of Ti	g/1g of Ti	g/1g of Ti
H 1	1.91E-07	1.91E-07	1.91E-07	1.91E-07	1.91E-07	1.91E-07	1.91E-07	1.91E-07	1.91E-07	1.91E-07
H 2	6.65E-11	6.65E-11	6.65E-11	6.65E-11	6.65E-11	6.65E-11	6.65E-11	6.65E-11	6.65E-11	6.65E-11
HE 4	1.33E-07	1.33E-07	1.33E-07	1.33E-07	1.33E-07	1.33E-07	1.33E-07	1.33E-07	1.33E-07	1.33E-07
AR 40	1.80E-12	1.80E-12	1.80E-12	1.80E-12	1.80E-12	1.80E-12	1.80E-12	1.80E-12	1.80E-12	1.80E-12
K 41	5.81E-14	5.81E-14	5.82E-14	5.82E-14	5.82E-14	5.82E-14	5.82E-14	5.82E-14	5.82E-14	5.82E-14
K 43	9.61E-15	9.47E-15	4.60E-15	5.56E-17	2.47E-24	6.34E-34	1.81E-43	0.00E+00	0.00E+00	0.00E+00
CA 43	1.50E-07	1.50E-07	1.50E-07	1.50E-07	1.50E-07	1.50E-07	1.50E-07	1.50E-07	1.50E-07	1.50E-07
CA 44	1.16E-06	1.16E-06	1.16E-06	1.16E-06	1.16E-06	1.16E-06	1.16E-06	1.16E-06	1.16E-06	1.16E-06
CA 45	1.56E-08	1.56E-08	1.56E-08	1.52E-08	1.38E-08	1.21E-08	1.07E-08	9.38E-09	6.67E-09	3.38E-09
CA 46	1.35E-07	1.35E-07	1.35E-07	1.35E-07	1.35E-07	1.35E-07	1.35E-07	1.35E-07	1.35E-07	1.35E-07
CA 47	4.46E-12	4.45E-12	3.83E-12	1.53E-12	4.55E-14	4.65E-16	4.75E-18	4.84E-20	2.38E-25	5.72E-36
SC 45	8.26E-09	8.26E-09	8.33E-09	8.72E-09	1.01E-08	1.18E-08	1.32E-08	1.45E-08	1.72E-08	2.05E-08
SC 46	1.44E-06	1.44E-06	1.42E-06	1.36E-06	1.12E-06	8.74E-07	6.82E-07	5.32E-07	2.75E-07	7.31E-08
SC 47	1.09E-07	1.08E-07	8.85E-08	2.56E-08	2.20E-10	4.45E-13	9.06E-16	1.94E-18	7.89E-25	1.62E-35

1g of Ti										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of Ti	g/1g of Ti	g/1g of Ti	g/1g of Ti	g/1g of Ti	g/1g of Ti	g/1g of Ti	g/1g of Ti	g/1g of Ti	g/1g of Ti
SC 48	5.67E-09	5.63E-09	3.88E-09	3.97E-10	6.39E-14	7.21E-19	8.13E-24	9.17E-29	5.85E-42	0.00E+00
SC 49	1.12E-10	7.82E-11	3.25E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SC 50	6.51E-14	3.37E-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TI 46	7.92E-02	7.92E-02	7.92E-02	7.92E-02	7.92E-02	7.92E-02	7.92E-02	7.92E-02	7.92E-02	7.92E-02
TI 47	7.30E-02	7.30E-02	7.30E-02	7.30E-02	7.30E-02	7.30E-02	7.30E-02	7.30E-02	7.30E-02	7.30E-02
TI 48	7.33E-01	7.33E-01	7.33E-01	7.33E-01	7.33E-01	7.33E-01	7.33E-01	7.33E-01	7.33E-01	7.33E-01
TI 49	6.05E-02	6.05E-02	6.05E-02	6.05E-02	6.05E-02	6.05E-02	6.05E-02	6.05E-02	6.05E-02	6.05E-02
TI 50	5.44E-02	5.44E-02	5.44E-02	5.44E-02	5.44E-02	5.44E-02	5.44E-02	5.44E-02	5.44E-02	5.44E-02
TI 51	2.54E-10	6.87E-12	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 51	9.62E-06	9.62E-06	9.62E-06	9.62E-06	9.62E-06	9.62E-06	9.62E-06	9.62E-06	9.62E-06	9.62E-06
V 52	7.76E-13	3.03E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CR 52	2.26E-08	2.27E-08	2.27E-08	2.27E-08	2.27E-08	2.27E-08	2.27E-08	2.27E-08	2.27E-08	2.27E-08
CR 53	2.57E-11	2.57E-11	2.57E-11	2.57E-11	2.57E-11	2.57E-11	2.57E-11	2.57E-11	2.57E-11	2.57E-11
CR 54	1.11E-13	1.11E-13	1.11E-13	1.11E-13	1.11E-13	1.11E-13	1.11E-13	1.11E-13	1.11E-13	1.11E-13
SUMTOT	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
0TOTAL	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00

Table 22. Ci/1g of Ti

1g of Ti										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti
H 3	1.56E-13	1.56E-13	1.56E-13	1.56E-13	1.55E-13	1.55E-13	1.54E-13	1.53E-13	1.51E-13	1.48E-13
S 37	2.24E-11	3.69E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CL 38	3.16E-15	1.40E-15	5.50E-27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AR 41	2.45E-09	2.02E-09	2.71E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AR 42	3.53E-18	3.53E-18	3.53E-18	3.53E-18	3.52E-18	3.52E-18	3.51E-18	3.50E-18	3.49E-18	3.46E-18
K 42	1.99E-11	1.93E-11	5.18E-12	1.62E-15	3.52E-18	3.52E-18	3.51E-18	3.50E-18	3.49E-18	3.46E-18
K 43	3.10E-08	3.05E-08	1.49E-08	1.79E-10	7.96E-18	2.05E-27	0.00E+00	0.00E+00	0.00E+00	0.00E+00
K 44	5.53E-09	2.15E-09	1.09E-28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CA 45	2.78E-04	2.78E-04	2.77E-04	2.70E-04	2.45E-04	2.16E-04	1.90E-04	1.67E-04	1.19E-04	6.02E-05
CA 47	2.73E-06	2.72E-06	2.35E-06	9.38E-07	2.79E-08	2.85E-10	2.91E-12	2.97E-14	1.46E-19	3.51E-30
SC 46	4.87E-02	4.86E-02	4.83E-02	4.59E-02	3.80E-02	2.96E-02	2.31E-02	1.80E-02	9.30E-03	2.48E-03

1g of Ti										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti	Ci/1g of Ti
SC 46M	1.39E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SC 47	9.03E-02	8.99E-02	7.34E-02	2.12E-02	1.82E-04	3.69E-07	7.52E-10	1.61E-12	6.54E-19	1.35E-29
SC 48	8.45E-03	8.39E-03	5.78E-03	5.92E-04	9.53E-08	1.08E-12	1.21E-17	1.37E-22	0.00E+00	0.00E+00
SC 49	7.50E-03	5.22E-03	2.17E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SC 50	1.43E-04	7.41E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TI 51	1.63E-01	4.40E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 52	7.49E-04	2.92E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 53	1.27E-13	3.12E-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CR 51	7.87E-11	7.87E-11	7.68E-11	6.61E-11	3.72E-11	1.76E-11	8.29E-12	3.91E-12	5.29E-13	9.66E-15
CR 55	5.93E-13	3.15E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 56	1.81E-15	1.56E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SUMTOT	3.19E-01	1.57E-01	1.28E-01	6.80E-02	3.84E-02	2.98E-02	2.33E-02	1.82E-02	9.42E-03	2.54E-03
0TOTAL	3.19E-01	1.57E-01	1.28E-01	6.80E-02	3.84E-02	2.98E-02	2.33E-02	1.82E-02	9.42E-03	2.54E-03

Table 23. g/1g of Nb

1g of Nb										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of Nb	g/1g of Nb	g/1g of Nb	g/1g of Nb	g/1g of Nb	g/1g of Nb	g/1g of Nb	g/1g of Nb	g/1g of Nb	g/1g of Nb
H 1	1.88E-08	1.88E-08	1.88E-08	1.88E-08	1.88E-08	1.88E-08	1.88E-08	1.88E-08	1.88E-08	1.88E-08
H 2	6.53E-12	6.53E-12	6.53E-12	6.53E-12	6.53E-12	6.53E-12	6.53E-12	6.53E-12	6.53E-12	6.53E-12
HE 4	7.98E-09	7.98E-09	7.98E-09	7.98E-09	7.98E-09	7.98E-09	7.98E-09	7.98E-09	7.98E-09	7.98E-09
SR 90	1.29E-13	1.29E-13	1.29E-13	1.29E-13	1.28E-13	1.28E-13	1.28E-13	1.28E-13	1.27E-13	1.26E-13
Y 90	3.14E-09	3.12E-09	2.42E-09	5.09E-10	1.29E-12	5.61E-16	3.23E-17	3.20E-17	3.18E-17	3.15E-17
Y 91	4.82E-12	4.82E-12	4.76E-12	4.44E-12	3.38E-12	2.37E-12	1.66E-12	1.16E-12	4.51E-13	6.77E-14
ZR 90	1.76E-07	1.76E-07	1.77E-07	1.79E-07	1.79E-07	1.79E-07	1.79E-07	1.79E-07	1.79E-07	1.79E-07
ZR 91	3.12E-11	3.12E-11	3.13E-11	3.16E-11	3.27E-11	3.37E-11	3.44E-11	3.49E-11	3.56E-11	3.60E-11
ZR 92	1.79E-10	1.79E-10	1.79E-10	1.79E-10	1.79E-10	1.79E-10	1.79E-10	1.79E-10	1.79E-10	1.79E-10
ZR 93	1.74E-06	1.74E-06	1.74E-06	1.74E-06	1.74E-06	1.74E-06	1.74E-06	1.74E-06	1.74E-06	1.74E-06
ZR 94	9.06E-09	9.06E-09	9.06E-09	9.06E-09	9.06E-09	9.06E-09	9.06E-09	9.06E-09	9.06E-09	9.06E-09
ZR 95	3.60E-13	3.60E-13	3.56E-13	3.34E-13	2.60E-13	1.88E-13	1.36E-13	9.81E-14	4.12E-14	7.29E-15
NB 93	9.95E-01	9.95E-01	9.95E-01	9.95E-01	9.95E-01	9.95E-01	9.95E-01	9.95E-01	9.95E-01	9.95E-01
NB 93M	2.23E-13	2.23E-13	2.25E-13	2.37E-13	2.83E-13	3.43E-13	4.03E-13	4.62E-13	6.20E-13	9.30E-13
NB 94	4.05E-03	4.05E-03	4.05E-03	4.05E-03	4.05E-03	4.05E-03	4.05E-03	4.05E-03	4.05E-03	4.05E-03
NB 95	3.14E-05	3.14E-05	3.08E-05	2.74E-05	1.74E-05	9.63E-06	5.33E-06	2.95E-06	6.09E-07	2.60E-08

1g of Nb										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of Nb	g/1g of Nb	g/1g of Nb	g/1g of Nb	g/1g of Nb	g/1g of Nb	g/1g of Nb	g/1g of Nb	g/1g of Nb	g/1g of Nb
NB 96	1.72E-09	1.69E-09	8.43E-10	1.17E-11	8.97E-19	4.68E-28	2.45E-37	0.00E+00	0.00E+00	0.00E+00
MO 94	4.19E-08	4.19E-08	4.23E-08	4.45E-08	5.32E-08	6.46E-08	7.60E-08	8.73E-08	1.18E-07	1.78E-07
MO 95	5.63E-05	5.64E-05	5.70E-05	6.04E-05	7.04E-05	7.82E-05	8.25E-05	8.48E-05	8.72E-05	8.78E-05
MO 96	8.08E-07	8.08E-07	8.09E-07	8.10E-07	8.10E-07	8.10E-07	8.10E-07	8.10E-07	8.10E-07	8.10E-07
MO 97	1.29E-09	1.29E-09	1.29E-09	1.29E-09	1.29E-09	1.29E-09	1.29E-09	1.29E-09	1.29E-09	1.29E-09
MO 98	1.70E-12	1.70E-12	1.70E-12	1.70E-12	1.70E-12	1.70E-12	1.70E-12	1.70E-12	1.70E-12	1.70E-12
SUMTOT	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01
0TOTAL	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01

Table 24. Ci/1g of Nb

1g of Nb										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb
H 3	1.53E-14	1.53E-14	1.53E-14	1.53E-14	1.53E-14	1.52E-14	1.51E-14	1.51E-14	1.49E-14	1.45E-14
SR 89	1.60E-13	1.60E-13	1.58E-13	1.46E-13	1.06E-13	7.03E-14	4.66E-14	3.09E-14	1.03E-14	1.15E-15
SR 90	1.75E-11	1.75E-11	1.75E-11	1.75E-11	1.75E-11	1.75E-11	1.74E-11	1.74E-11	1.73E-11	1.71E-11
SR 91	4.63E-12	4.47E-12	8.04E-13	2.20E-17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y 90	1.71E-03	1.70E-03	1.32E-03	2.77E-04	7.01E-07	3.05E-10	1.76E-11	1.74E-11	1.73E-11	1.71E-11
Y 91	1.18E-07	1.18E-07	1.17E-07	1.09E-07	8.29E-08	5.81E-08	4.07E-08	2.85E-08	1.11E-08	1.66E-09
Y 92	7.62E-11	6.91E-11	6.93E-13	3.90E-25	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Y 94	2.55E-12	8.58E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ZR 93	4.36E-09	4.36E-09	4.36E-09	4.36E-09	4.36E-09	4.36E-09	4.36E-09	4.36E-09	4.36E-09	4.36E-09
ZR 95	7.74E-09	7.73E-09	7.65E-09	7.17E-09	5.59E-09	4.04E-09	2.92E-09	2.11E-09	8.86E-10	1.57E-10
ZR 97	3.62E-15	3.54E-15	1.35E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 93M	6.30E-11	6.30E-11	6.35E-11	6.69E-11	8.00E-11	9.70E-11	1.14E-10	1.31E-10	1.75E-10	2.63E-10
NB 94	7.59E-04	7.59E-04	7.59E-04	7.59E-04	7.59E-04	7.59E-04	7.59E-04	7.59E-04	7.59E-04	7.59E-04
NB 95	1.23E+00	1.23E+00	1.21E+00	1.07E+00	6.81E-01	3.77E-01	2.09E-01	1.15E-01	2.38E-02	1.02E-03
NB 95M	5.10E-11	5.10E-11	5.15E-11	5.15E-11	4.14E-11	3.00E-11	2.16E-11	1.56E-11	6.57E-12	1.16E-12
NB 96	2.40E-03	2.37E-03	1.18E-03	1.64E-05	1.26E-12	6.55E-22	3.42E-31	0.00E+00	0.00E+00	0.00E+00
NB 97	4.58E-12	3.44E-12	1.36E-15	3.69E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NB 97M	3.42E-15	3.36E-15	1.28E-15	3.47E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MO 99	3.21E-11	3.20E-11	2.50E-11	5.50E-12	1.67E-14	8.69E-18	4.52E-21	2.35E-24	0.00E+00	0.00E+00
TC100	5.59E-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SUMTOT	1.24E+00	1.23E+00	1.21E+00	1.07E+00	6.81E-01	3.78E-01	2.09E-01	1.16E-01	2.46E-02	1.78E-03

1g of Nb										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb	Ci/1g of Nb
0TOTAL	1.24E+00	1.23E+00	1.21E+00	1.07E+00	6.81E-01	3.78E-01	2.09E-01	1.16E-01	2.46E-02	1.78E-03

Table 25. g/1g of Fe

1g of Fe										
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of Fe	g/1g of Fe	g/1g of Fe	g/1g of Fe	g/1g of Fe	g/1g of Fe	g/1g of Fe	g/1g of Fe	g/1g of Fe	g/1g of Fe
H 1	4.85E-07	4.85E-07	4.85E-07	4.85E-07	4.85E-07	4.85E-07	4.85E-07	4.85E-07	4.85E-07	4.85E-07
H 2	1.69E-10	1.69E-10	1.69E-10	1.69E-10	1.69E-10	1.69E-10	1.69E-10	1.69E-10	1.69E-10	1.69E-10
HE 4	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07
TI 48	1.37E-15	1.37E-15	1.39E-15	1.41E-15	1.41E-15	1.41E-15	1.41E-15	1.41E-15	1.41E-15	1.41E-15
TI 50	3.32E-12	3.32E-12	3.32E-12	3.32E-12	3.32E-12	3.32E-12	3.32E-12	3.32E-12	3.32E-12	3.32E-12
V 51	3.18E-07	3.18E-07	3.20E-07	3.30E-07	3.56E-07	3.73E-07	3.81E-07	3.85E-07	3.88E-07	3.89E-07
V 52	2.57E-14	1.00E-16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CR 51	7.06E-08	7.06E-08	6.89E-08	5.93E-08	3.33E-08	1.57E-08	7.43E-09	3.51E-09	4.74E-10	8.67E-12
CR 52	6.87E-10	6.87E-10	6.87E-10	6.87E-10	6.87E-10	6.87E-10	6.87E-10	6.87E-10	6.87E-10	6.87E-10
CR 53	7.62E-07	7.62E-07	7.62E-07	7.62E-07	7.62E-07	7.62E-07	7.62E-07	7.62E-07	7.62E-07	7.62E-07
CR 54	2.60E-06	2.61E-06	2.62E-06	2.74E-06	3.18E-06	3.72E-06	4.23E-06	4.70E-06	5.82E-06	7.54E-06
CR 55	1.65E-14	4.69E-17	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 54	8.97E-06	8.97E-06	8.95E-06	8.83E-06	8.39E-06	7.85E-06	7.34E-06	6.87E-06	5.75E-06	4.04E-06
MN 55	9.19E-06	9.19E-06	9.27E-06	9.76E-06	1.16E-05	1.40E-05	1.63E-05	1.86E-05	2.44E-05	3.50E-05
MN 56	1.09E-08	9.56E-09	1.72E-11	2.67E-28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 57	2.21E-13	5.43E-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE 54	5.60E-02	5.60E-02	5.60E-02	5.60E-02	5.60E-02	5.60E-02	5.60E-02	5.60E-02	5.60E-02	5.60E-02
FE 55	1.12E-04	1.12E-04	1.12E-04	1.11E-04	1.09E-04	1.07E-04	1.05E-04	1.02E-04	9.66E-05	8.59E-05
FE 56	9.17E-01	9.17E-01	9.17E-01	9.17E-01	9.17E-01	9.17E-01	9.17E-01	9.17E-01	9.17E-01	9.17E-01
FE 57	2.44E-02	2.44E-02	2.44E-02	2.44E-02	2.44E-02	2.44E-02	2.44E-02	2.44E-02	2.44E-02	2.44E-02
FE 58	3.06E-03	3.06E-03	3.06E-03	3.06E-03	3.06E-03	3.06E-03	3.06E-03	3.06E-03	3.06E-03	3.06E-03
FE 59	1.09E-06	1.08E-06	1.07E-06	9.74E-07	6.83E-07	4.31E-07	2.71E-07	1.71E-07	4.98E-08	4.24E-09
CO 59	2.64E-06	2.64E-06	2.66E-06	2.75E-06	3.04E-06	3.30E-06	3.46E-06	3.56E-06	3.68E-06	3.72E-06
CO 60	5.17E-08	5.17E-08	5.17E-08	5.16E-08	5.12E-08	5.06E-08	5.01E-08	4.95E-08	4.81E-08	4.54E-08
CO 60M	3.37E-12	4.63E-13	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO 61	6.39E-14	5.18E-14	2.67E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI 60	1.23E-09	1.23E-09	1.25E-09	1.36E-09	1.79E-09	2.34E-09	2.88E-09	3.42E-09	4.82E-09	7.52E-09
NI 61	4.08E-11	4.08E-11	4.08E-11	4.08E-11	4.08E-11	4.08E-11	4.08E-11	4.08E-11	4.08E-11	4.08E-11

	1g of Fe									
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	g/1g of Fe	g/1g of Fe	g/1g of Fe	g/1g of Fe	g/1g of Fe	g/1g of Fe	g/1g of Fe	g/1g of Fe	g/1g of Fe	g/1g of Fe
NI 62	2.18E-14	2.18E-14	2.18E-14	2.18E-14	2.18E-14	2.18E-14	2.18E-14	2.18E-14	2.18E-14	2.18E-14
SUMTOT	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
0TOTAL	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00

Table 26. Ci/1g of Fe

	1g of Fe									
Isotope	EOI	30.0MI	1.0D	7.0D	30.0D	60.0D	90.0D	120.0D	200.0D	360.0D
	Ci/1g of Fe	Ci/1g of Fe	Ci/1g of Fe	Ci/1g of Fe	Ci/1g of Fe	Ci/1g of Fe	Ci/1g of Fe	Ci/1g of Fe	Ci/1g of Fe	Ci/1g of Fe
H 3	3.96E-13	3.96E-13	3.96E-13	3.96E-13	3.95E-13	3.93E-13	3.91E-13	3.89E-13	3.84E-13	3.75E-13
SC 48	5.74E-11	5.70E-11	3.93E-11	4.03E-12	6.48E-16	7.30E-21	8.24E-26	9.36E-31	0.00E+00	0.00E+00
SC 50	8.76E-15	4.53E-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TI 51	7.51E-09	2.03E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 52	2.48E-05	9.69E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 53	3.76E-09	9.25E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V 54	5.09E-10	7.16E-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CR 51	6.53E-03	6.53E-03	6.37E-03	5.48E-03	3.08E-03	1.46E-03	6.87E-04	3.24E-04	4.39E-05	8.01E-07
CR 55	1.58E-05	4.52E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 54	6.94E-02	6.94E-02	6.93E-02	6.83E-02	6.50E-02	6.08E-02	5.69E-02	5.32E-02	4.45E-02	3.12E-02
MN 56	2.37E-01	2.08E-01	3.74E-04	5.79E-21	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 57	4.53E-04	1.11E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MN 58	1.39E-06	7.01E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE 55	2.80E-01	2.80E-01	2.79E-01	2.78E-01	2.73E-01	2.68E-01	2.62E-01	2.56E-01	2.42E-01	2.15E-01
FE 59	5.34E-02	5.34E-02	5.26E-02	4.79E-02	3.36E-02	2.12E-02	1.33E-02	8.41E-03	2.45E-03	2.09E-04
CO 60	5.85E-05	5.85E-05	5.85E-05	5.84E-05	5.79E-05	5.73E-05	5.66E-05	5.60E-05	5.44E-05	5.14E-05
CO 60M	1.01E-03	1.39E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO 61	1.99E-06	1.61E-06	8.32E-11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI 63	3.18E-15	3.18E-15	3.18E-15	3.18E-15	3.18E-15	3.18E-15	3.17E-15	3.17E-15	3.17E-15	3.16E-15
SUMTOT	6.48E-01	6.17E-01	4.08E-01	4.00E-01	3.75E-01	3.51E-01	3.33E-01	3.18E-01	2.89E-01	2.46E-01
0TOTAL	6.48E-01	6.17E-01	4.08E-01	4.00E-01	3.75E-01	3.51E-01	3.33E-01	3.18E-01	2.89E-01	2.46E-01