Design Analysis Cover Sheet

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2. DESIGN ANALYSIS	TITLE	
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Design Analysis

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1. Purpose

This study is prepared by the Mined Geologic Disposal System (MGDS) Waste Package Development Department (WPDD) to provide input to a separate evaluation on the probability of criticality in the far-field environment. These calculations are performed in sufficient detail to provide conservatively bounding configurations to support separate probabilistic analyses. The objective of this evaluation is to provide input to a risk analysis which will show that criticalities involving commercial spent nuclear fuel (SNF) are not credible, or indicate additional measures that are required for the Engineered Barrier Segment (EBS) to make such events incredible. Minimum critical volumes and masses of $UO_2/H_2O/tuff$ mixtures are determined without application of regulatory safety limits. This study does not address or demonstrate compliance with regulatory limits.

2. Quality Assurance

The work performed for this analysis is covered by a Waste Package Development (WPD) Quality Assurance Procedure (QAP)-2-0 work control Activity Evaluation entitled "Perform Criticality, Thermal, Structural, and Shielding Analyses" (Ref. 5.1). The QAP-2-0 evaluation determined that such activities are subject to Quality Assurance Requirements and Description (QARD) (Ref. 5.2) controls. Applicable procedural controls are listed in the activity evaluation. The waste package is on the Q-List (Ref. 5.3) by direct inclusion by the Department of Energy (DOE) as are the natural barriers of the. Topopah Spring Welded (TSw) Hydrogeologic Unit, the Calico Hills Nonwelded (CHn) Hydrogeologic Unit, and the Saturated Zone (SZ) barrier; a QAP-2-3 evaluation has yet to be conducted.

The work reported in this document is part of the neutronic analysis for the preliminary design; thus, design inputs include unqualified data and unconfirmed assumptions. These design inputs will require subsequent qualification (or superseding inputs) as the waste package design proceeds. This document will not directly support any construction, fabrication, or procurement activity and, therefore, does not require initiation of a TBV (to be verified) number for tracking purposes. However, use of any data or output from this analysis for input into documents supporting procurement, fabrication, or construction is required to be controlled as TBV in accordance with appropriate procedures.

3. Method

The SAS2H sequence in SCALE 4.3 (Ref. 5.4) is used to calculate the isotopic composition, as a function of time, for the pressurized water reactor (PWR) criticality design basis fuel assembly. The prime module of this sequence is the ORIGEN-S code. This code does a point depletion of a selected fuel type with user specified irradiation conditions. At the completion of the depletion calculation, decay of the irradiated fuel with user specified time intervals is computed.

Number densities for subsequent MCNP cases are calculated using LOTUS 1-2-3 spreadsheets using the ORIGEN-S output.

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The multiplication factor (k_{eff}) of the fissile material accumulations is determined using the Monte Carlo neutron transport technique implemented in the MCNP (Ref. 5.5) computer program. The resulting k_{eff} values for a variety of configurations are then provided for subsequent evaluation of the criticality potential of the disposal package and the acceptablility of the design in meeting design requirements and criteria using probabilistic methods.

4. Design Inputs

The design inputs identified in this document are for preliminary design and shall be treated as unqualified data; these design input will require subsequent qualification (or superseding inputs) as the waste package design proceeds. This document will not directly support any construction, fabrication, or procurement activity and therefore is not required to be procedurally controlled as TBV.

The dimensions listed in this section and throughout this analysis are in the metric units used directly in the neutronics codes to facilitate checking and preclude errors in input.

4.1 Design Parameters

The composition and characteristics of the far-field tuff are shown in Table 4.1-1 (Ref. 5.7, p. 16 unless otherwise noted).

Table 4.1-1 CALICO HILLS/PROW PASS NONW	ELDED-ZEULITIC TUP
Parameter	Value
Mean Density 198 samples	1.746 g/cm ³ *
Mean Porosity 127 samples (Max = 0.470)	0.306*
SiO ₂ Wtfrac.	69.1
TiO_2 Wtfrac.	0.11
Al_2O_3 Wtfrac.	13.4
Fe_2O_3 Wtfrac.	1.13
MnO Wtfrac.	0.05
MgO Wtfrac.	0.94
CaO Wtfrac.	3.22
Na ₂ O Wtfrac.	1.23
K_2O Wtfrac.	2.64
P_2O_5 Wtfrac.	0.01
LOI (volatile) Wtfrac.	8.90
Total Wtfrac.	100.7
* Dof 56 - 7 11	

Table 4.1-1 CALICO HILLS/PROW PASS NONWELDED-ZEOLITIC TUFF

* Ref. 5.6, p. 7-11

In addition to the above major-element concentrations, 25 trace-element concentrations were identified by parts per million by weight (Ref. 5.7, Appendix C). Some of these trace elements have high absorption cross sections, for example, Eu, Hf, Sm, etc. The impact of these trace elements were evaluated for possible incorporation into the Tuff concentrations. As noted in Section 7.3.3, it was

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judged that no element contained sufficient concentrations with an adequate confidence in the nominal value to be included.

The atomic weights of isotopes used are listed in Table 4.1-2 (Ref 5.8, pp. 941-978).

			(Ref 5.8)	, pp. 941-978)	
Ζ	Element	<u>Symbol</u>	Isotope	MCNP ID	Atomic Weight
1	Hydrogen	Н	H-1	1001.50C	1.00782519
		D	H-2	1002.55C	2.01410222
		Т	H-3	1003.50C	3.01604971
6	Carbon	С	natural	6000.50C	12.01115
		С	C-12	6012.50C	12.0000
8	Oxygen	0	O-16	8016.50C	15.994915
8	Oxygen	0	natural		15.999325*
11	Sodium	Na	Na-23	11023.50C	22.9897707
12	Magnesium •	Mg	natural	12000.50C	24.312
13	Aluminum	Al	Al-27	13027.50C	26.9815389
14	Silicon	Si	natural	14000.50C	28.086
19	Potassium	К	natural	19000.50C	39.102
20	Calcium	Ca	natural	20000.50C	40.08
22	Titanium	Ti	natural	22000.50C	47.9
25	Manganese	Mn	Mn-55	25055.50C	54.9380503
26	Iron	Fe	natural	26000.55C	55.847
92	Uranium	U	U-233	92233.50C	233.039522
		U	U-234	92234.50C	234.040904
		U	U-235	92235.50C	235.043915
		U	U-236	92236.50C	236.045637
		U	U-238	92238.50C	238.05077
93	Neptunium	Np	Np-237	93237.55C	237.048056
94	Plutonium	Pu	Pu-238	94238.50C	238.049511
		Pu	Pu-239	94239.55C	239.052146
		Pu	Pu-240	94240.50C	240.053882
		Pu	Pu-241	94241.50C	241.056737
		Pu	Pu-242	94242.50C	242.058725
		Pu	Pu-243	94243.35C	243.061972
95	Americium	Am	Am-241	95241.50C	241.056714
		Am	Am-242m	95242.50C	242.059502
		Am	Am-243	95243.50C	243.061367
96	Curium	Cm	Cm-243	96243.35C	243.06137
		Cm	Cm-245	96245.35C	245.065371
		Cm	Cm-248	96248.35C	248.0722

Table 4.1-2 List of Isotope Atomic Weights

* Calculated from atomic weights and abundances shown below.

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In addition, the atomic weights of O-17 and O-18 are 16.9991314 and 17.999160, respectively (Ref. 5.9). The atom percent abundances of O-16, O-17 and O-18 are 99.76, 0.04 and 0.20, respectively (Ref. 5.9).

The atomic weight data listed above comes from handbooks and textbooks (Ref. 5.8, Ref. 5.9) that are utilized industry-wide. The data is taken to be established fact that requires no additional qualification.

The theoretical density of UO₂ is 10.96 g/cm³ (Ref. 5.4, Table M8.2.1).

Avogadro's Number $[N_A] = 0.602252 \text{ (g-mol)}^{-1} \times 10^{24} \text{ (Ref. 5.8, p. 933)}$. A physical constant is taken to be established fact that requires no additional qualification.

4.2 Criteria

This design analysis provides input for consequence analyses which evaluate whether waste package designs meet the repository criticality control design criteria from requirement documents. The *Engineered Barrier Design Requirements Document* (EBDRD, Ref. 5.10) has requirements which pertain to criticality analyses. These requirements apply to accumulations of fissile material in the far-field because far-field consequences can have an impact on the WP design. The WP is the source for material in the far-field and mitigation of significant consequences in the far-field may require some modification of the WP (Engineered Barrier) design. The requirements cited in Reference 5.10 that have bearing on this analysis include the following:

4.2.1 From the EBDRD (Ref. 5.10); "3.2.2.6 CRITICALITY PROTECTION

- A. The Engineered Barrier Segment shall be designed to ensure that a nuclear criticality accident is not possible unless at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. Each system shall be designed for criticality safety under normal and accident conditions. The calculated effective multiplication factor must be sufficiently below unity to show at least a five percent margin, after allowance for the bias in the method of calculation and the uncertainty in the experiments used to validate the methods of calculation. [MGDS-RD 3.2.2.6.A][10CFR60.131(b)(7)]
- B. To mitigate the potential for nuclear criticality, the Engineering Barrier Segment shall be designed and constructed to comply with the nuclear criticality requirements specified by DOE order 6430.1A, 1300-4.

[MGDS-RD 3.2.2.6.B] [DOE Order 6430.1A, 1300-4]"

The present DOE and Civilian Radioactive Waste Management System (CRWMS) Management and Operating Contractor (M&O) management position is that the requirements cited in the above criteria based on 10CFR60.131(b)7, being primarily of a deterministic nature, is not appropriate for postclosure

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disposal criticality analysis. Instead, the probability or risk based approach has been recommended to the U.S. Nuclear Regulatory Commission (NRC) in the following two letters:

4.2.2 From Ronald A. Milner, Director, Office of Program Management and Integration, Office of Civilian Radioactive Waste Management (OCRWM), to the NRC, Docketing and Service Branch, dated June 16, 1995 (Ref. 5.11), which included the specific recommendation to apply the above requirements only to preclosure, and create the following new requirement for postclosure criticality:

"Postclosure criticality safety. The engineered barrier system shall be designed such that the probability and consequences of nuclear criticality provide reasonable assurance that the performance objective of §60.112 is met." (Ref. 5.11)

4.2.3 From Stephan J. Brocoum, Assistant Manager for Suitability and Licensing, OCRWM, to Michael J. Bell, Chief, Engineering and Geosciences Branch, Division of Waste Management, Office of Nuclear Material Safety and Safeguards, NRC (Ref. 5.18), which referred to the above referenced letter, and specifically commented as follows:

"The DOE, therefore, requests that consideration be given to the DOE's proposed revision to 10CFR60.131(b)7 that would allow disposal criticality to be evaluated with risk-based methods." (Ref. 5.18)

The analyses in this document are intended to provide input to consequence analyses whose output will be used as part of TSPA-VA to demonstrate compliance with the performance objective of §60.112. This study focuses on supporting a probabilistic analysis which will evaluate the probability of criticality of these accumulations rather than conformance with regulatory limits. Therefore, no regulatory safety margins are applied in calculating critical parameters in this study. This document will not directly support any construction, fabrication, or procurement activity.

4.3 Assumptions

- 4.3.1 Principal Isotope (PI) burnup credit is an acceptable criticality control mechanism for the waste package. (CDA Key 009) (Ref. 5.12). This assumption is used throughout Section 7.
- 4.3.2 Water infiltration has provided the mechanism for waste package and SNF degradation, as well as the mechanism for actinide transport to the far-field environment. This assumption is used throughout Section 7.
- 4.3.3 Only uranium and neptunium oxide accumulations are investigated. The transport of material from the waste package will likely occur over hundreds of thousands of years in which time the plutonium would have decayed to uranium or neptunium and an unknown fraction of the fission products would have been stripped away. This assumption is used throughout Section 7.
- 4.3.4 The fresh fuel bias and uncertainty for MCNP is approximately 0.015. This uncertainty was used in a prior unqualified analysis (Ref. 5.13, p. 6-221) and is appropriate for application to accumulations of $U(Np)O_2$. This assumption is used throughout Section 7.4.

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- 4.3.5 The material compositions for tuff in the far-field is assumed to be represented by the major constituents of Calico Hills/Prow Pass nonwelded-zeolitic tuff taken from References 5.6 and 5.7. Portions of these formations fall within the saturated zone. This assumption is used throughout Section 7.
- 4.3.6 The accumulation of UO_2 in saturated tuff is assumed to be represented by a spherical homogeneous mixture of UO_2 /tuff/water. This is a reasonable geometry given that fracture distributions and densities in the tuff, size and density of potential uranium deposits, and presence and composition of reducing zones within the tuff are unknown. This assumption is used throughout Section 7.
- 4.3.7 The U(Np)O₂ is accumulated at the theoretical maximum density of UO₂ (natural U) of 10.96 g/cm³ (Ref. 5.4, Table M8.2.1). This is conservative because the least amount of other material is displaced. This assumption is used throughout Section 7.

4.4 Codes and Standards

American National Standard on "Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors", ANSI/ANS-8.17, 1984.

5. References

- 5.1 "Perform Criticality, Thermal, Structural, and Shielding Analyses," Document Identifier (DI) #: BB0000000-01717-2200-00025 REV 02, Civilian Radioactive Waste Management System (CRWMS) Management and Operating Contractor (M&O).
- 5.2 "Quality Assurance Requirements and Description (QARD)," DOE/RW-0333P Rev 5, U. S. Department of Energy (USDOE) Office of Civilian Radioactive Waste Management (OCRWM).
- 5.3 "Yucca Mountain Site Characterization Project Q-List," YMP/90-55Q, REV 3, Yucca Mountain Site Characterization Project.
- 5.4 <u>SCALE 4.3</u>, RSIC Computer Code Collection, CCC-545, Oak Ridge National Laboratory, October 1995.
- 5.5 <u>MCNP 4A Monte Carlo N-Particle Transport Code System</u>, RSIC Computer Code Collection, CCC-200, Oak Ridge National Laboratory, February 1994.
- 5.6 "Total-System Performance Assessment for Yucca Mountain SNL Second Iteration (TSPA-1993)", Volume 1, Michael L. Wilson, et al., SAND93-2675, April 1994, pp. 7-11.
- 5.7 "Chemistry of Diagenetically Altered Tuffs at a Potential Nuclear Waste Repository, Yucca Mountain, Nye County, Nevada", David E. Broxton, et al., LA-10802-MS, October 1986, pp. 16, 52.

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- 5.8 <u>Nuclear Chemical Engineering</u>, 2nd Edition, Manson Benedict, Thomas H. Pigford, and Hans W. Levi, McGraw-Hill Book Company, New York NY, 1981.
- 5.9 <u>Nuclides and Isotopes</u>, Fourteenth Edition, GE Nuclear Energy, 1989.
- 5.10 Engineered Barrier Design Requirements Document, YMP/CM-0024, REV 0, ICN 1, Yucca Mountain Site Characterization Project.
- 5.11 Letter, R.A. Milner to Secretary, U.S. NRC Docketing and Service Branch, Transmitting DOE comments regarding NRC-proposed revisions to 10 CFR Part 60 Regulations for Design Basis Events, June 16, 1995.
- 5.12 "Controlled Design Assumptions (CDA) Document," DI#: B0000000-01717-4600-00032 REV 03, CRWMS M&O.
- 5.13 "Initial Summary Report for Repository/Waste Package Advanced Conceptual Design," DI#: B00000000-01717-5705-00015 REV 00, CRWMS M&O, p. 6-221.
- 5.14 "SCALE4.3 and MCNP4A Installation," Interoffice Correspondence LV.WP.JWD.06/96.135, J. Wesley Davis, June 11, 1996, CRWMS M&O
- 5.15 American National Standard on "Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors", ANSI/ANS-8.17, 1984.
- 5.16 "SAS2H Generated Isotopic Concentrations for B&W 15x15 PWR Assembly," DI#: BBA000000-01717-0200-00012 REV 00, CRWMS M&O.
- 5.17 "Probabilistic External Criticality Evaluation," DI#: BB0000000-01717-0200-00037 REV 00, CRWMS M&O.
- 5.18 Letter, S.J. Brocoum to M.J. Bell, Providing DOE acknowledgment of receipt of NRC comments on the Annotated Outline for the Disposal Criticality Analysis Topical Report, April 12, 1996.

6. Use of Computer Software

6.1 Scientific and Engineering Software

SCALE 4.3 has not been qualified according to QA procedures. The results of this analysis, therefore, shall be treated as unqualified data. SCALE 4.3 was run on HP Series 735 Workstations.

SCALE 4.3 is an appropriate tool to be utilized to determine the composition and characteristics of PWR spent fuel and has been demonstrated to run correctly on the HP 735 Workstations (Ref. 5.14).

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MCNP4A was not qualified when this analysis began but was in the process of being qualified. The results from MCNP4A shall be treated as unqualified data. MCNP4A was run on HP 735 Workstations.

MCNP4A is utilized to determine the criticality potential of fissile material accumulations in the farfield environment external to the repository and is an appropriate tool for this purpose (Ref. 5.14).

There are biases and uncertainties associated with a criticality calculation. How these biases and uncertainties are treated in criticality calculations is covered in the American National Standard on "Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors" (Ref. 5.15). The fresh fuel bias and uncertainty for MCNP is approximately 0.015. The fresh fuel bias and uncertainty is appropriate for application to the external accumulations of fissile material investigated in this analysis.

6.2 Computational Support Software

LOTUS 1-2-3, Release 4.01 for Windows was used to calculate the isotopic number densities for the tuff/water/UO₂ mixtures investigated. Details of the equations used in the spreadsheet are provided in Section 7.3.3.

SLIDEWRIGHT PLUS V. 3.0 for WINDOWS was used for plotting the results. The plots with curvefitting are included in this report.

7. Design Analysis

This study was performed to determine the critical masses and concentrations of actinides released from breached waste packages in the far-field environment. This study will provide input to a risk analysis which will show to what extent the SNF waste package concept, in conjunction with the rest of the Engineered Barrier Segment (EBS), meets the regulatory requirements or indicate additional measures that are required for the EBS.

7.1 Background

The modeling of the SNF for evaluations of criticality and reactivity in the far-field is integrated with the scenarios for transport and deposit. The scenarios for SNF transport and deposit begin with the parameter of time. For SNF transport, the WP and fuel cladding must be breached and the fuel released from the repository with the transport mechanism. As noted in the assumptions, the time frame for the analysis is 100,000 years or more, after closure of the repository. In the 100,000 year period, it is assumed (Assumption 4.3.2) that water in some form has completely degraded the fuel container and degraded the fuel into elemental (molecular) forms. The water that causes the degradation of the container is assumed to be the transport mechanism that carries the fuel to the far-field. The water is also assumed to provide the mechanism for separating the actinides (uranium and neptunium) from the stable fission products and daughters of fission product decay.

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7.2 Evaluation Procedure

The evaluation procedure is broken into two major tasks, with subtasks in each. The general procedure is as follows:

1) Material Composition Generation

- a) SAS2H Cases
- b) U(Np)O₂ isotopic composition calculation
- c) Number density calculations for Tuff/Water/UO₂ mixtures using spreadsheet

2) MCNP Criticality Cases

- a) k_{∞} cases for various burnup/enrichment pairs in various Tuff/Water/UO₂ mixtures which are plotted to identify the optimum (highest k_{∞}) mixtures.
- b) k_{eff} cases for optimum mixtures identified in previous subtask which are plotted to identify minimum critical sizes and masses of mixtures
- c) k_{eff} cases for nominal mixtures identified in previous subtask which are plotted to identify nominal critical sizes and masses of mixtures
- d) k_{∞} and k_{eff} cases for highest porosity tuff which are plotted to identify optimum moderator volume fractions and indicate magnitude of any positive effects due to reducing water volume fraction
- e) k_{∞} and k_{eff} cases specifically requested to support a separate probabilistic analysis

The results of task 1 and task 2 are listed in Sections 7.3 and 7.4, respectively.

7.3 Material Composition Generation

SAS2H calculations were first run on six fuel burnup/enrichment pairs to generate compositions in the form of grams/assembly. The six burnup/enrichment pairs were chosen to provide an indication of the effect of reduced effective enrichment on the critical masses to be calculated in this study. The actinides from the SAS2H calculations were then converted to the uranium or Np-237 isotopes into which they decay and number densities for the resulting oxide were calculated. These fuel number densities along with the compositions for tuff and water were then entered into a spreadsheet which was used to calculate homogenized number densities for the water/tuff/UO₂ mixtures to be investigated.

7.3.1 SAS2H Calculations

The base input for the SAS2H cases was taken from a previous QAP-3-9 analysis (Ref. 5.16) for a B&W 15x15 fuel assembly with 3% enrichment and 20 GWd/MTU burnup. The burnup conditions used are the most stressing in order to produce the most reactive burned fuel. Only the minor changes to the base model will be discussed in the current calculation.

In order to cover a wide range of the SNF inventory, six different burnup/enrichment pairs (five different enrichments) were run. The isotopic distribution of the uranium is determined by the given initial

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enrichment and the following empirical relationship (Ref. 5.16):

 $wt\%_{234} = 0.007731(wt\%_{235})^{1.0837},$ $wt\%_{236} = 0.0046wt\%_{235},$ $wt\%_{238} = 100\% - wt\%_{234} - wt\%_{235} - wt\%_{236}$

Using this formulation, the fresh fuel isotopics for selected U_{235} enrichments were calculated as shown in Table 7.3.1-1.

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U-235 Enrichment	3.0%	3.5%	4.0%	4.2%	4.5%
. ISOTOPE			WT%		
U-234	2.54E-2*	· 3.00E-2	3.47E-2	3.66E-2	3.95E-2
U-236	1.38E-2	1.61E-2	1.84E-2	1.93E-2	2.07E-2
U-238	96.9608*	96.4539	95.9469	95.7441	95.4398

Table 7.3.1-1 Isotopic Makeup of Uranium of Selected U-235 Enrichments

* The base case in Ref. 5.16 had a minor error in the U-234 and U-238 wt% calculations - actual values used in Ref. 5.16 and this analysis for consistency are 2.40E-2 and 96.9622 for U-234 and U-238, respectively.

Block 4 of the input has Zircaloy-4 entered as an arbitrary material rather than using the predefined zircaloy as listed in Reference 5.16 because the 44-group cross sections used with SCALE4.3 does not support this predefined material.

The EFPD entered in data block 8 (burn=) of the input is a function of burnup as indicated by the following equation:

From Reference 5.16, the MTU/Assembly is 0.464 and the MW/Assembly is 7.25. The EFPD calculated for each burnup is shown in Table 7.3.1-2. All other input is the same as that developed in Reference 5.16.

The input and relevant output from each of the six burnup/enrichment pair SAS2H cases are listed in Attachments II-VII.

		Table 7.3.1-21	Sumup and As	Socialed EFFD	
BURNUP GWd/MTU	20	30	40	45	53
EFPD	1280	1920	2560	2880	3392

Table 7.3.1-2 Burnup and Associated EFPD

A simplistic identification of the fuel characteristics is expressed by the weight fractions of U-235 and Pu-239 relative to the total amount of metal (versus oxide) fuel material. The expression for determining the weight fraction of an isotope (I) of the metal fuel is:

Weight Fraction(I) = Atom Fraction(I) * Atomic Weight(Aⁱ) / Metal Atomic Weight

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Table 7.3.1-3 below gives the weight fractions of U-235, Pu-239 and (U-235 + Pu-239) after 1826.25 days of decay for three of the six SNF fuel burnup/enrichment pairs. The atom fractions are calculated by dividing the "gm-atoms" for a given isotope by the total "gm-atoms" from the SAS2H output included in Attachments II-VII.

Table 7.3.1-3	U-235 and Pu-2	239 Weight Fra	actions	
	Weight Fraction in		Fuel Metal	
Fuel Characteristics 1826.25 Day (5 Year) Decay 3.0 Initial U-235	_U-235	Pu-239	U-235 + Pu-239	
20 GWd Burnup	0.01397	0.00541	0.01938	
3.5 Initial U-235 30 GWd Burnup	0.01242	0.00631	0.01873	
4.0 Initial U-235 40 GWd Burnup	0.01122	0.00699	0.01821	

7.3.2 U(Np)O₂ Isotopic Compositions

The uranium and neptunium isotopic compositions in the far-field originate with the six fuel burnup/enrichment pairs that are described above in Section 7.3.1. Attachments II-VII give the SAS2H results for the actinide isotopic fractions after decaying for 1826.25 days (5 years). For time periods of 100,000 years, the actinides decay to the asymptotic daughter products as shown below in Table 7.3.2-1. The decay chains shown in Table 7.3.2-1 were constructed from data in Reference 5.9. Atomic weights are not required in construction of the decay chains so isotopes may appear in Table 7.3.2-1 which are not listed in Table 4.1-2.

The resulting atom fractions of U-234, U-235, U-236, U-238 and Np-237 for each fuel-burnup type are applied to the constant atomic concentration of cubic crystalline UO_2 to determine the appropriate number density for each fuel isotope as shown in Table 7.3.2-2. The atom fractions are calculated by dividing the "gm-atoms" for a given isotope by the total "gm-atoms" for 5 years decay from the SAS2H output included in Attachments II-VII. These calculations are shown in the spreadsheet included in Attachment I.

The fuel characteristics when deposited in the far-field are modeled as a cubic crystalline UO_2 -NpO₂ structure at 100% UO_2 density (10.96 g/cm³) in solid solution (molecular mixture) with the tuff material. Only the uranium and neptunium are included in the transport modeling. This provides a simplistic and more reactive fuel material but eliminates the complexity and the requirements to develop the model and probabilities that various amounts of other materials will be transported with the fuel. The reactivity of the fuel material is limited by the assumptions that (1) the fuel is a molecular mixture (homogeneous mixture, Assumption 4.3.6) with the tuff and not a particulate mixture, and (2) it does not contain water

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in any physical or chemical form, only the tuff contains water (Assumption 4.3.7).

Table 7.3.2-1 Actinide Transmutation Chains

The density of the fuel deposited in the far-field is bounded by the maximum cubic crystalline density of UO_2 , 10.96 g/cm³ for natural uranium concentrations. Lower fuel densities are assumed not to have any open porosity. Therefore, the modeling parameter for fuel density is simply fixed at 100% theoretical for cubic crystalline UO_2 . Under these conditions, lower density fuel only includes voided space which decreases reactivity for finite systems and has no effect on infinite systems.

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Fuel Type		Asymptotic Transmutations (≈ 100,000 Years) Cubic Crystalline Concentrations			
	U-234	U-235	U-236	U-238	Np-237
3.0E-20GWd Atom Fraction Number Density (atoms/barn-cm)	.00024 5.868062 - 6	.01956 4.781608 - 4	.00468 1.144148 - 4	.97440 2.381875 - 2	.00112 2.728657 - 5
3.5E-30GWd Atom Fraction Number Density	.00036 8.691609 - 6	.01893 4.628167 - 4	.00653 1.597173 - 4	.97239 2.376949 - 2	.00179 4.376500 - 5
4.0E-40GWd Atom Fraction Number Density	.00051 1.246889 - 5	.01847 4.515723 - 4	.00825 2.017600 - 4	.97035 2.371969 - 2	.00241 5.898417 - 5
4.2E-45GWd Atom Fraction Number Density	.00060 1.463431 - 5	.01791 4.378063 - 4	.00902 2.204533 - 4	.96977 2.370558 - 2	.00270 6.599715 - 5
4.0E-45GWd Atom Fraction Number Density	.00059 1.444231 - 5	.01676 4.097444 - 4	.00881 2.153653 - 4	.97114 2.373895 - 2	.00270 6.597651 - 5
4.5E-53GWd Atom Fraction Number Density	.00076 1.865720 - 5	.01704 4.164425 - 4	.01012 2.473902 - 4	.96895 2.368540 - 2	.00313 7.658723 - 5

Table 7.3.2-2 Isotopic Concentrations In The Far-Field

Note that the number densities were calculated with the spreadsheet values (no roundoff) for atom fractions.

The cubic structure of UO_2 results in the atomic concentration (atom / barn-cm) being a constant with the maximum value for 100% theoretical density. The 100% theoretical density and atom fractions of natural UO_2 are used to determine the maximum (constant) atomic concentrations as follows:

Natural UO_2 (100% Theoretical Density = 10.96 gm/cm³)

Atom Fractions	Atomic Weights (g/mole)
U-234 = 0.000055	$A^{234} = 234.040904$
U-235 = 0.0072	$A^{235} = 235.043915$
U-238 = 0.992745	$A^{238} = 238.05077$

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The molecular weight for UO_2 is calculated from the atomic weights of U and O (x 2).

Molecules	<u>Atomic Weights (g/mole)</u>
U = 1.0	$A^{U} = 238.028900$
O = 2.0	$A^{o} = 15.999325$
$UO_2 = 1.0$	$A^{UO_2} = 270.02755$

Maximum Number Density UO_2 {ND (UO_2)} = $\frac{10.96g/cm^3 * 0.602252 \text{ molecules/mole}}{270.02755 \text{ g/mole}}$

 $Maximum ND (UO_2) = .0244444758 molecules/b-cm$ ND (O) = .04888895 atoms/b-cm

ND(U-234 + U-235 + U-236 + U-238 + Np-237) = .0244444758 atoms/b-cm

The UO₂ number density (ND) and atomic weight are used in Attachment I calculations.

7.3.3 Tuff/Water/UO₂ Mixture Number Densities

As discussed above in Section 7.3.2, the composition of the fuel is uranium dioxide and neptunium dioxide. This composition does not exist as an independent material in the far-field but as a solid solution (molecular mixture) with the tuff.

The far-field characteristics that involve increasing reactivity as fuel is deposited in with the tuff are (1) the composition of the tuff, and (2) the open porosity for water saturation. The far-field is composed of Prow Pass nonwelded-zeolitic tuff from the Crater Flat group of the Calico Hills formation (Ref. 5.6 and 5.7). The average density and porosity of the tuff along with the weight percent of the compounds are listed in Table 4.1-1. In addition to the average porosity of 30.6%, upper bounds of 47% (which may be anomalous datum) and 40% porosity are included as modeling parameters for the tuff. These increases in porosity are modeled with the appropriate reductions in density. The water that could saturate the tuff has a maximum density of H_2O (1.0 g/cm³) and is modeled to fill the 47% and 40% of the open porosity in the upper bounding porosity models. The nominal porosity is modeled to be saturated with 30% of the total volume filled with water (0.6% left void). Evaluations of tuff dry-out were evaluated with 20% of the total volume filled with water (10.6% left void) in the nominal model, and a range of water from 47% to 15% in the bounding porosity model.

The atomic concentrations of hydrogen and oxygen in the water are determined as follows.

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Molecules	Atomic Weights (g/mole)
H = 2.0	$A^{H} = 1.00782519$
O = 1.0	$A^{o} = 15.999325$
$H_2O = 1.0$	$A^{H_2O} = 18.014975$
Number Density $H_2O\{ND(H_2O)\}=$	1.00 g/cm ³ * .602252 molecules/mole 18.014975 g/mole
<i>ND</i> (<i>H</i>)	= 6.686126 - 2
. ND (O)	= 3.343063 - 2

The nominal density and porosity of the tuff in the far-field are shown in Table 7.3.3-1 along with the weight fractions (Wt.-frac.) of the major constituents. The weight fractions of the constituents were converted from Table 4.1-1 by eliminating minor and volitile constituents and renormalizing. This conversion was performed in the spreadsheet included in Attachment I.

Table 7.3.3-1 Far-Field Dry Tuff Model

Pa	rameter	Value
Mean D	ensity (Dry)	1.746 g/cm ³
Porosity	(Mean)	0.306
SiO ₂	(Wtfrac.)	0.754
Al_2O_3	(Wtfrac.)	0.146
Fe_2O_3	(Wtfrac.)	0.012
MgO	(Wtfrac.)	0.010
CaO	(Wtfrac.)	0.035
Na ₂ O	(Wtfrac.)	0.013
K ₂ O	(Wtfrac.)	<u>0.029</u>
Total W	tfrac.	0.999

The number densities for the isotopic concentrations of the dry tuff were performed in the spreadsheet included in Attachment I and are evaluated as follows:

Number Density x {ND (x)} =
$$\frac{1.746 * Wt. - frac.^{x} * .602252}{Atomic Weight (A^{x})}$$

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Number Der	<u>usity (atoms/b-cm)</u>	<u>Atomic</u>	Wei	ghts (atoms/mole)
ND(O)	= 2.638683 <i>E</i> -2	AO	=	15.999325
ND (Si)	= 1.319341 <i>E</i> -2	A ^{Si}	=	28.086
$ND(SiO_2)$	= 1.319341 <i>E</i> -2	A^{SiO_2}	=	60.08465
-				
ND(O)	= 4.523081 <i>E</i> -3	A ⁰	=	15.999325
ND (Al)	= 3.015387 <i>E</i> -3	A Al	=	26.9815389
$ND(Al_2O_3)$	= 1.507694 <i>E</i> -3	$A^{Al_2O_3}$	=	101.9610528
ND(O)	= 2.435338 <i>E</i> -4	A ^o	=	15.999325
ND (Fe)	= 1.623559 <i>E</i> -4	A Fe	=	55.847
$ND(Fe_2O_3)$	= 8.117793 <i>E</i> -5	$A^{Fe_2O_3}$	=	159.691975
ND (0)	= 2.675121 <i>E</i> -4	A ⁰	=	15.999325
ND (Mg)	= 2.675121 <i>E</i> -4	A ^{Mg}	=	24.312
ND(MgO)	= 2.675121 <i>E</i> -4	A ^{MgO}	=	40.311325
ND(O)	= 6.587122 <i>E</i> -4	A ⁰	=	15.999325
ND (Ca)	= 6.587122 <i>E</i> -4	A ^{Ca}	=	40.08
ND (CaO)	= 6.587122E - 4	A ^{CaO}	=	56.079325
ND(O)	= 2.276691 <i>E</i> -4	A ^O	=	15.999325
ND (Na)	= 4.553382 <i>E</i> -4	A ^{Na}	=	22.9897707
$ND(Na_2O)$	= 2.276691 <i>E</i> -4	A ^{Na2O}	=	61.9788664
ND(O)	= 3.214995 <i>E</i> -4	A ⁰	=	15.999325
ND (K)	= 6.429990 <i>E</i> -4	A ^K	=	39.102
$ND(K_2O)$	= 3.214995 <i>E</i> -4	A^{K_2O}	=	94.203325

In addition to the above major constituents, trace elements of thorium, samarium, europium, et cetera, were noted to also be constituents of the tuff. These trace elements would reduce the reactivity of the tuff. However, evaluating the effects of 20 parts-per-million (ppm) of thorium and 5 ppm of samarium with engineering judgement indicated that the negative reactivity effects were too small to accurately quantify. Therefore, the trace elements were not included in the tuff model.

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When the porosity of the tuff is increased to 40% or 47%, the density is reduced. For example, with a density of 1.746 g/cm^3 and a porosity of 0.306 for nominal tuff, a porosity of 0.47 has a density of

Density (.47 porosity tuff) = $\frac{1.746 \text{ gm}/\text{cm}^3}{1.0 - .306} * (1.0 - .47)$

Density (.47 porosity tuff) = $1.3334 \text{ gm}/\text{cm}^3$

The (heterogeneous) isotopic concentrations computed above for the tuff, water and fuel (Section 7.3.2) are for each material as if it existed separately in the far-field. The $UO_2 - NpO_2$ fuel however is deposited with some resulting (molecular) mixture volume fraction with the tuff-water. The (homogeneous) isotopic concentrations for the mixture of far-field fuel and tuff-water are determined using a LOTUS 1-2-3 spreadsheet (Attachment VIII). An example of the spread sheet expression to compute the isotopic concentrations follows assuming (a) a fuel volume fraction of 0.185, (b) with a complementary tuff-water volume fraction of (1.0 - 0.185 =) 0.815, and (c) a tuff porosity of 0.47 that is completely saturated with water.

Far - Field ND $(UO_2 - NpO_2)_{Homogeneous}$	=	.18	5 *	Ň	$D(UO_2 - NpO_2)_{Heterogeneous}$
Far – Field ND (Tuff Materials) _{Homogeneous}	=	.81:	5 *	N	D (Tuff Materials) _{Heterogeneous}
Far - Field ND (Water) _{Homogeneous} =	.81	5 *	.4	7,	* ND (Water) _{Heterogeneous}

The spreadsheet listing all of the mixtures analyzed is included in Attachment VIII.

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7.4 MCNP Criticality Cases

The analytical modeling of SNF in the far-field has the objective of determining the reactivity and the minimum critical mass. To determine the most reactive conditions and the configurations with the minimal critical mass, the analytical modeling employed separation of spatial and spectral variables. MCNP was used to determine the most reactive fuel and water-tuff conditions for the various fuel-burnup types in an infinite configuration. These optimal conditions of fuel-tuff-water were modeled in various MCNP configurations to determine the minimum critical mass.

The results from MCNP cases are reported as $k_{eff} \pm 2\sigma$. k_{eff} is the final estimated combined collision/absorption/track-length k_{eff} reported in MCNP. 2σ is twice the standard deviation of the calculated value and approximately represents the 95% confidence interval of the result.

All material fractions or percents reported in this Section are by volume unless otherwise noted.

7.4.1 Optimum Mixtures of Tuff/Water/UO₂

Optimum mixtures of tuff/water/UO₂ for various burnup/enrichment pairs are identified by running k_{∞} cases (reflected sphere) for the mixtures and plotting the results. A curve is fit to the points and the peak is identified from the curve.

Four water volume variations as described in Section 7.3.3 were run in the MCNP model for the 3.00% enrichment/20 GWd/MTU fuel form. The case inputs and relevant outputs are included in Attachments IX-XXXIII. These case descriptions and results are listed in Table 7.4.1-1. The results are plotted in Figure 7.4.1-1. Three cases for an additional mixture of 30% water and 35% C (50% of tuff replaced by C) were run to demonstrate the reactivity effect of the C. The results for the three additional cases are included in Table 7.4.1-1 and on Figure 7.4.1-1.

The optimum UO_2 volume percent for each of the four water volume variations was determined by reading off the UO_2 volume percent corresponding to the peak k_w value from the curves on Figure 7.4.1-1. The optimum UO_2 volume percents are 18.5, 17.0, 15.0, and 11.6 for 47%, 40%, 30%, and 20% water in tuff, respectively.

Nine additional cases were run to identify the minimum water volume fraction required for criticality to occur. Criticality was defined as follows:

$$CRITICAL = 1 - 0.015 - 2\sigma$$

Three cases each for 12%, 10%, and 8% UO_2 in a Tuff/Water mixture were run with the results listed in Table 7.4.1-2 and shown Figure 7.4.1-2. In the lower water volume fraction range the 10.0% UO_2 case has the highest values of k_{∞} . Using the relation listed above to define criticality and reading off Figure 7.4.1-2, 16.4% water is identified as the lowest volume percent for criticality for 30.6% porosity tuff.

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, ,	47%	Water	40	% Water	30)% Water		20% Water		30	30% Water/ 35% C		
UO ₂ %	Att. #	k_ ± 2σ	Att. #	k_ ± 2σ	Att. #	k_±2σ	UO ₂	Att. #	k_ ± 2σ	UO2 %	Att. #	k_ ± 2σ	
5	IX	0.8805 ± .0025	xv	0.8932 ± .0026	XXI	0.9072 ± .0017	5	XXVI	0.9285 ± .0019	3.6	XXXI	0.8970 ± .0022	
8	x	1.0096 ± .0023	XVI	1.0155 ± .0027	-	-	8	XXVII	0.9950 ± .0031	5	XXXII	0.9848 ± .0028	
10	XI	1.0559 ± .0029	XVII	1.0580 ± .0029	XXII	1.0371 ± .0021	10	XXVIII	1.0057 ± .0029	8	XXXIII	1.0704 ± .0035	
15	XII	1.1070 ± .0036	хүш	1.0902 ± .0033	XXIII	1.05465 ± .0023	11.6	XXIX	1.0090 ± .0041	-	-	-	
20	хш	1.1112 ± .0029	XIX	1.0893 ± .0034	XXIV	1.0393 ± .0024	15	xxx	0.9965 ± .0030	-	-	-	
25	XIV	1.0988 ± .0039	xx	1.0694 ± .0028	xxv	1.0073 ± .0024	-	-	-	-	-	-	

Table 7.4.1-1 Results of 3.00% Enrichment/	20 GWd/MTU Fuel Form Mixture	Variation k _w Cases
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Table 7.4.1-2 3.00% Enrichment 20 GWd/MTU Minimum Water Volume Fraction For Criticality (k_w) in Tuff with 30.6% Porosity

20% Water			18%	Water	16% Water		
UO ₂ %	Att. #	k_ ± 2σ	Att. #	k_ ± 2σ	Att. #	k_ ± 2σ	
8	XXXIV	0.9960 ± .0021	XXXVII	0.9904 ± .0022	XL	0.9777 ± .0020	
10	XXXV	1.0078 ± .0022	XXXVIII	0.9948 ± .0022	XLI	0.9803 ± .0023	
12	XXXVI	1.0089 ± .0023	XXXIX	0.9931 ± .0023	XLII	0.9729 ± .0023	

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Optimum mixtures of tuff/water/UO₂ were identified using the method described above for:

3.5% enrichment, 30 GWd/MTU, for 30% and 20% water;

4.0% enrichment, 40 GWd/MTU, for 30% water;

and 4.2% enrichment, 45 GWd/MTU, for 30% water.

The remaining burnup/enrichment pairs discussed in Section 7.3.1 were not run because these cases were sufficient to establish the reactivity trend of these results and the trend indicated that the last two pairs would be subcritical at all UO_2 volume percents at the nominal water concentration of 30%. The case inputs and relevant outputs are included in Attachments XLIII-LXI. These case descriptions and results are listed in Table 7.4.1-3. The results are plotted in Figure 7.4.1-3.

The optimum UO_2 volume percent for each of the four burnup/enrichment/water volume variations was determined by reading off the UO_2 volume percent corresponding to the peak k_{∞} value from the curves on Figure 7.4.1-3. The optimum UO_2 volume percents are 14.0, 12.0, 15.0, and 15.0 for 3.5% enrichment, 30 GWd/MTU, 30% water in tuff; 3.5% enrichment, 30 GWd/MTU, 20% water in tuff; 4.0% enrichment, 40 GWd/MTU, 30% water in tuff; and 4.2% enrichment, 45 GWd/MTU, 30% water in tuff; nu tuff; respectively.

3.59	6 U-235/ 30%	30 GWd/MTU Water	3.5%	U-235 20%	/ 30 GWd/MTU 6 Water	MTU 4.0% U-235/ 40 GWd/MTU 30% Water			4.2% U-235/ 45 GWd/MTU 30% Water		
UO ₂ #	Att. #	k ± 2σ	UO2 %	Att. #	k_ ± 2σ	UO2 %	Att. #	k_ ± 2σ	UO ₂ %	Att. #	k_ ± 2σ
5	XLIII	0.8872 ± .0033	5	IL	0.9065 ± .0026	5	LIII	0.8689 ± .0023	10	LIX	0.9809 ± .0023
8.8	XLIV	0.9990 ± .0034	10	L	0.9794 ± .0031	10	LIV	0.9966 ± .0027	15	LX	0.9935 ± .0026
10	XLV	1.0125 ± .0040	12	LI	0.9861 ± .0040	12	LV	1.0058 ± .0030	20	LXI	0.9744 ± .0022
14	XLVI	1.0316 ± .0037	14	LII	0.9804 ± .0032	14	LVI	1.0091 ± .0035	-	-	-
15	XLVII	1.0309 ± .0031	-	-	-	16	LVII	1.0092 ± .0025	-	-	-
16	XLVIII	1.0268 ± .0037	-	-	•	18	LVIII	1.0034 ± .0029	-	-	•

Table 7.4.1-3 Results of Lower Reactivity Fuel Form Mixture Variation k_w Cases



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7.4.2 Optimum Critical Sizes and Masses

Multiple k_{eff} cases were run for each of the optimum UO₂ volume percents identified for the four water volume variations of the 3.00% enrichment/20 GWd/MTU fuel form. These cases were run in order to identify the minimum sphere radius (and corresponding mass) at which these mixtures would be critical. These cases were modeled with an inner spherical region containing the tuff/water/UO₂ mixture and an outer reflector region of at least 60 cm thick containing a tuff/water mixture. The results for these cases are shown in Table 7.4.2-1. The source distribution for these cases (large thermal systems) take a large number of cycles to reach equilibrium. As a result, most of the cases were run two or more times using the SRCTP file from the prior run until the statistical check in the output indicated the source distribution had reached equilibrium. The initial run of most of these cases used a starting source distribution from a SRCTP file for a case of similar size.

The minimum radius and associated minimum UO_2 mass are determined by plotting the results and fitting a second order polynomial to the results as shown in Figure 7.4.5-1 through 7.4.5-4. The critical radius value is then determined by identifying the point on the curve that meets the following relation:

$$CRITICAL = 1 - 0.015 - 2\sigma$$

The corresponding critical mass is calculated by multiplying the volume of the critical sphere $(4/3\pi r^3)$ by the density of UO₂ (10.96 g/cm³) and the volume percent of UO₂ in the mixture. The critical radii and UO₂ masses are shown in Table 7.4.2-2.

47% Water / 18.5% UO ₂ 47% Porosity			4(40% Water / 17% UO ₂ 40% Porosity		30% Water / 15% UO ₂ 30.6% Porosity			20% Water / 11.6% UO ₂ 30.6% Porosity		
r (cm)	Att. #	$k_{eff} \pm 2\sigma$	r (cm)	Att. #	$k_{eff} \pm 2\sigma$	r (cm)	Att. #	$k_{eff} \pm 2\sigma$	r (cm)	Att. #	k _{eff} ± 2σ
57 ·	LXII	0.9787 ± .0029	60	LXVI	0.9578 ± .0014	59	LXXII	0.8980 ± .0018	180	LXXVIII	0.9755 ± .0019
61	LXIII	0.9950 ± .0027	65	LXVII	0.9747 ± .0014	97.86	LXXIII	0.9846 ± .0018	220	LXXIX	0.9849 ± .0017
70	LXIV	1.0202 ± .0032	70	LXVIII	0.9873 ± .0015	103	LXXIV	0.9893 ± .0027	250	LXXX	0.9887 ± .0019
77	LXV	1.0290 ± .0024	75	LXIX	0.9986 ± .0014	113.15	LXXV	0.9985 ± .0024	300	LXXXI	0.9952 ± .0019
-	-	-	80	LXX	1.0100 ± .0014	114.51	LXXVI	0.9993 ± .0025	325	LXXXII	0.9975 ± .0019
-	-	-	85	LXXI	1.0158 ± .0014	123.15	LXXVII	1.0088 ± .0023	345	LXXXIII	1.0004 ± .0017
-	-	-	1	-	-	-	-	-	365	LXXXIV	0.9987 ± .0020
-	-	-	-	_	-	-	-	_	385	LXXXV	1.0020 ± .0018

Table 7.4.2-1 Results of 3.00% Enrichment/20 GWd/MTU Fuel Form Optimum Mixture k_{eff} Cases

Far-Field External Criticality Analysis 3.0% Enriched, 20 GWd/MTU, 18.5 vol% UQ

+ 47% Water in Tuff



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86 85 84 Far-Field External Criticality Analysis 3.0% Enriched, 20 GWd/MTU, 17 vol% UQ 83 82 81 80 79 72 73 74 75 76 77 78 Sphere Radius (cm) FIGURE 7.4.2-2 111 111 111 111 71 111 40% Water in Tuff 2 111 69 68 67 99 65 +8 0.975 1.010 0.995 0.985 0.970 1.030 1.015 1.005 1.000 0.990 0.980 1.025 1.020 k_{eff} (2 σ indicated by error bars)

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Far-Field External Criticality Analysis 3.0% Enriched, 20 GWd/MTU, 15 vol% UO₂ 30% Water in Tuff

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3.0% Enriched, 20 GWd/MTU, 11.6 vol% UQ Far-Field External Criticality Analysis 20% Water in Tuff

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Critical Parameter	47% Water / 18.5% UO ₂ 47% Porosity	40% Water / 17% UO ₂ 40% Porosity	30% Water / 15% UO ₂ 30.6% Porosity	20% Water / 11.6% UO ₂ 30.6% Porosity
Radius (cm)	57.4	68.5	98	218
Mass (MT)	1.6	2.5	6.5	55.2

Table 7.4.2-2 Critical Parameters for 3.00% Enrichment/20 GWd/MTU Optimum Mixtures

In order to demonstrate that the optimum compositions identified in Section 7.4.1 are applicable to the current calculations, two additional cases were run for the 61 cm radius sphere containing 47% water with 15% and 20% UO₂. The results are shown in the Table 7.4.2-3 with those for the optimum case at 18.5% UO₂. These results indicate that the optimum UO₂ volume fraction identified in the infinite calculations is applicable to the finite calculations.

Table 7.4.2-3 Confirmation of Optimum UO₂ Volume Percent for k_{eff} Cases

47% Water / R=61 cm 47% Porosity 3.00% Enrichment/20 GWd/MTU							
$\begin{array}{c c} UO_2 & Att. & k_{eff} \pm 2\sigma \\ Vol\% & \# \end{array}$							
15	LXXXVI	0.9879 ± .0030					
18.5	LXIII	0.9950 ± .0027					
20	LXXXVII	0.9925 ± .0031					

Multiple k_{eff} cases were also run for each of the optimum UO₂ volume percents for the following burnup/enrichment pair and water volume percent cases to demonstrate increasing critical mass requirements:

3.5% enrichment, 30 GWd/MTU, for 30% water;

4.0% enrichment, 40 GWd/MTU, for 30% water.

The results for these cases are listed in Table 7.4.2-4 and the results are plotted in Figures 7.4.2-5 and 7.4.2-6. The method described above was used to determine the critical radius and calculate the critical mass. The critical parameters are listed in Table 7.4.2-5.

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	3.5% U-235/ 30 (30% Water/ 14 30.6% Pore	GWd/MTU 4% UO ₂ osity	4.	0% U-235/ 40 0 30% Water/ 15 30.6% Porc	GWd/MTU 5% UO ₂ Disity
r (cm)	Att. #	$k_{eff} \pm 2\sigma$	r (cm)	Att. #	$k_{eff} \pm 2\sigma$
120	LXXXVIII	0.9821 ± .0029	160	XCVII	0.9806 ± .0018
130	LXXXIX	0.9877 ± .0021	187	хсуш	0.9873 ± .0017
134	XC	0.9901 ± .0025	219.08	IC	0.9943 ± .0019
140	XCI	0.9946 ± .0026	275.35	С	0.9987 ± .0019
150	XCII	0.9971 ± .0030	280	CI	0.9989 ± .0018
151	ХСШ	0.9970 ± .0041	284.32	CII	0.9993 ± .0019
152	XCIV	0.9955 ± .0034	293.22	CIII	1.0012 ± .0020
153	XCV	0.9994 ± .0037	310	CIV	1.0017 ± .0017
154.9	XCVI	1.0013 ± .0040	-	_	_

Table 7.4.2-4 Results of Lower Reactivity	y Fuel Form Op	timum Mixture k _{eff} Cases

Table 7.4.2-5 Critical Parameters for Lower Reactivity Fuel Form Optimum Mixtures

Critical Parameter	3.5% U-235/ 30 GWd/MTU 30% Water/ 14% UO ₂ 30.6% Porosity	4.0% U-235/ 40 GWd/MTU 30% Water/ 15% UO ₂ 30.6% Porosity
Radius (cm)	120	165
Mass (MT)	11.1	30.9

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Far-Field External Criticality Analysis 3.5% Enriched, 30 GWd/MTU, 14 vol% UO2

+ 30% Water in Tuff



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7.4.3 Nominal Critical Sizes and Masses

The optimum UO_2 volume fractions identified previously are much higher than could likely be achieved by natural processes. In order to demonstrate the effect of less conservative assumptions, lower volume percent UO_2 cases (nominal) were run for the tuff/water mixtures run for the 3.0% enrichment/20 GWd/MTU fuel form. Multiple k_{eff} cases were run for each mixture to demonstrate increasing critical mass requirements from the optimum mixture results.

The results for these cases are listed in Table 7.4.3-1 and the results are plotted in Figures 7.4.3-1 through 7.4.3-4. The method described in Section 7.4.2 was used to determine the critical radius and calculate the critical mass. The critical parameters are listed in Table 7.4.3-2.

47% Water / 8% UO ₂ 47% Porosity			40% Water / 8% UO ₂ 40% Porosity		30% Water / 10% UO ₂ 30.6% Porosity			30% Water / 8% UO ₂ 30.6% Porosity			
r (cm)	Att. #	$k_{eff} \pm 2\sigma$	r (cm)	Att. #	$k_{eff} \pm 2\sigma$	r (cm)	Att. #	$k_{eff} \pm 2\sigma$	r (cm)	Att. #	k _{eff} ± 2σ
115	cv	0.9684 ± .0022	140	CXIII	0.9819 ± .0016	115	CXXI	0.9791 ± .0032	180	CXXVI	0.9833 ± .0020
150	CVI	0.9855 ± .0021	150	CXIV	0.9867 ± .0015	125	CXXII	0.9909 ± .0035	220	CXXVII	0.9905 ± .0022
160	CVII	0.9908 ± .0020	160	cxv	0.9892 ± .0016	140	CXXIII	0.9997 ± .0029	280	CXXVIII	0.9963 ± .0022
175	CVIII	0.9915 ± .0018	175	CXVI	0.9901 ± .0017	155	CXXIV	1.0046 ± .0028	300	CXXIX	0.9978 ± .0021
190	CIX	0.9967 ± .0017	190	схуп	0.9976 ± .0013	170	CXXV	1.0096 ± .0031	335	CXXX	0.9995 ± .0028
205	сх	0.9979 ± .0023	205	схуш	0.9960 ± .0018	-	- 1	-	345	CXXXI	0.9981 ± .0029
220	схі	0.9974 ± .0015	220	CXIX	0.9991 ± .0014	-	-	-	355	CXXXII	1.0020 ± .0020
235	CXII	1.0020 ± .0022	235	CXX	1.0035 ± .0016	-	-	-	365	CXXXIII	1.0021 ± .0028

Table 7.4.3-1 Results of 3.00% Enrichment/20 GWd/MTU Fuel Form Nominal Mixture keff Cases

Table 7.4.3-2 Critical Parameters for 3.00% Enrichment/20 GWd/MTU Nominal Mixture Cases

Critical Parameter	47% Water / 8% UO ₂ 47% Porosity	40% Water / 8% UO2 40% Porosity	30% Water / 10% UO ₂ 30.6% Porosity	30% Water / 8% UO ₂ 30.6% Porosity	
Radius (cm)	140	140	117	170	
Mass (MT)	10.1	10.1	7.4	18.0	

Far-Field External Criticality Analysis 3.0% Enriched, 20 GWd/MTU, 8 vol% UO₂ 47% Water in Tuff

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Far-Field External Criticality Analysis 3.0% Enriched, 20 GWd/MTU, 8 vol% UO2



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Far-Field External Criticality Analysis 3.0% Enriched, 20 GWd/MTU, 10 vol% UO2





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7.4.4 Moderator Volume Fraction Effects

The results shown in Table 7.4.2-1 indicate that there are various far-field combinations of (a) asymptotically transmuted SNF without fission products or fission product daughters, and (b) tuff with water that would be critical. In addition, the results shown in Table 7.4.1-1 indicate that there is a reactivity dependency on the water moderation. Depending on the volume fraction of UO_2 -NpO₂ that is assumed to be deposited in a combined mass of fuel and tuff with water, increasing the water volume fraction in the open porosity of the tuff can both increase and decrease reactivity. Consequently, it is feasible that a positive moderator void coefficient would exist in a subcritical mass of UO_2 -NpO₂ fuel. The evaluations performed to determine the combinations of fuel, tuff and water necessary to have a positive moderator void coefficient are explained in this section. The conclusions are that (1) the nominal tuff with 30.6% porosity will not have a positive void coefficient, (2) the most porous tuff (47%) could possibly have a positive coefficient, and (3) the effects of the positive coefficient could hypothetically produce a dynamic fissioning system and a limited neutron - thermal transient. The consequences of the hypothetical transient and dynamic system are not addressed in this document.

Figure 7.4.4-1 and Table 7.4.4-1 summarize results which show that large configurations (infinite) have a very positive moderator void coefficient if the tuff contains the maximum porosity (47%) that has been observed, and the open porosity is completely saturated. The magnitude of the moderator void coefficient is increased by having both the greatest amount of water, and the least amount of UO_2 -NpO₂ in the fuel-tuff-water mixture.

3.00 Wt. % Initial Enrichment 20 GWd/MTU Burnup 8% UO ₂ - NpO ₂ 92% Tuff-Water 47% Tuff Porosity							
Water %	Att. #	$K_{\infty} \pm 2\sigma$	Att. #	$K_{eff} \pm 2\sigma$			
47	CXXXIV	$1.01025 \pm .0018$	CXLI	.98706 ± .0013			
40	CXXXV	$1.02854 \pm .0018$	CXLII	.99684 ± .0014			
35	CXXXVI	1.03566 ± .0019	CXLIII	$1.00242 \pm .0015$			
30	CXXXVII	1.04272 ± .0019	CXLIV	$1.00163 \pm .0016$			
25	CXXXVIII	$1.04320 \pm .0020$	CXLV	.99189 ± .0016			
20	CXXXIX	1.03318 ± .0022	CXLVI	.97117 ± .0016			
15	CXL	$1.00676 \pm .0022$	CXLVII	.93067 ± .0018			

 Table 7.4.4-1
 Positive Reactivity From Moderator Voids

Figures 7.4.1-1 and 7.4.3-1 indicate that 8% UO_2 -NpO₂ by volume with the 47% saturated tuff would be around the lowest practical amount of fuel. The reactivity (ρ) increase with these optimal conditions

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of maximum water and minimum fuel is 0.0025 $\Delta \rho$ per percent void in an infinite configuration. Consequently, only 2% to 3% voiding would result in a prompt critical system.

For configurations with the minimum size, and minimum amount of fuel that would achieve criticality in the far-field, the leakage effects on reactivity produce a large reduction in the positive moderator void coefficient. A 150 cm radius sphere was found to have a leakage of 2.35% in reactivity. The k_{eff} for this high leakage configuration is 0.987 as shown in Figure 7.4.4-1 and Table 7.4.4-1. The leakage effects reduce the positive void coefficient to 0.0014 $\Delta \rho$ per percent void. While this is a significant reduction from 0.0025 $\Delta \rho / \%$ Void the positive void coefficient still needs to be addressed in the future because 4% to 5% voiding could create a prompt critical system, although the magnitude of a power transient would be extremely limited in the unlikely event that one started in the first place. It should be noted that for a finite system the k_{eff} drops sharply from the peak of the curve as the water volume fraction is reduced. This would tend to quickly shutdown any transients which may be started.

In order for a significant increase in power to occur, a mechanism for introducing the reactivity increase (moderator volume percent decrease) instantaneously would be required. If the reactivity is inserted (water removed) over a time scale of seconds or greater then the temperature feedback effects of increasing power would likely compensate and keep the system relatively stable and at low power.

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7.4.5 Additional Cases

Several cases were specifically requested to support separate probabilistic analyses. These cases are documented in this section. All cases in this section are based on the 3.0% enrichment/ 20 GWd/MTU actinide isotopics. These cases include:

2 fuel zone cases to demonstrate the effect of reduced density UO_2 in second zone, cylindrical configuration (log simulation).

Two sets of cases were requested to demonstrate the reactivity effect of a secondary fuel shell around the primary sphere in support of methodology development for probabilistic analyses (Ref. 5.17). The primary fuel zone contains 18.5 volume percent UO₂ based on the 3.0% enrichment/ 20 GWd/MTU pair. The tuff porosity is 47% and is assumed completely filled with water. The secondary shell is twice the radius of the primary sphere. The average (two region) UO₂ volume fraction specified for the two sets of cases is 9.2% and 4.6% with corresponding volume fractions in the outer shell of 7.87% and 2.61%, respectively. The volume fractions in the secondary shell correspond to approximately 3/7 and 1/7 of the primary sphere volume fraction, respectively. The mixture number densities are calculated in a spreadsheet as described in Section 7.3.3 and included in Attachment VIII. Multiple k_{eff} cases were run for each of these two mixtures in order to identify the minimum sphere radius (and corresponding mass) at which these mixtures would be critical. The results for these cases are shown in Table 7.4.5-1. The minimum radius and associated minimum UO₂ mass are determined by plotting the results as shown in Figures 7.4.5-1 and 7.4.5-2 and performing the operations previously described in Section 7.4.2. The critical radii and UO₂ masses for the inner spherical fuel zone are 39.4 cm (0.52 MT) and 54.2 cm (1.4 MT) for 9.2 % and 4.6% UO₂, respectively. The total critical mass for the primary and secondary zones is 2.1 MT and 2.7 MT for 9.2% and 4.6% UO₂, respectively. The minimum critical mass for the single fuel zone case calculated in Section 7.4.2 is 1.6 MT.

9.2 Ave	erage Volume	% for UO ₂	4.6 Average Volume % for UO ₂			
Inner Radius (cm)	Attachment #	k _{eff} ± 2σ	Inner Radius (cm)	Attachment #	k _{eff} ± 2σ	
40	CXLVIII	0.9847 ± .0018	53	CLI	0.9762 ± .0017	
50	CIL	1.0140 ± .0018	55	CLII	0.9870 ± .0018	
57.4	CL	1.0301 ± .0019	57.4	CLIII	0.9939 ± .0018	

Table 7.4.5-1 Results for 2 Fuel Zone Cases to Determine Critical Radii

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3.0% Enriched, 20 GWd/MTU, 47 vol% Water in Tuff Far-Field External Criticality Analysis 2 Zones, 18.5 vol% UO_{2} Center / 9.2 Vol% Average



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3.0% Enriched, 20 GWd/MTU, 47 vol% Water in Tuff Far-Field External Criticality Analysis 2 Zones, 18.5 vol% UO₂ Center / 4.6 Vol% Average



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The highest local uranium ore concentrations in the United States are found in the Uravan Mineral Belt in southwestern Colorado and southeastern Utah. These are up to $21.5\% U_3O_8$ by weight and are found in fossilized logs along pre-historic riverbeds (Ref. 5.17, Attachment II). The maximum values of log parameters were determined to be:

radius=61 cm, length= 24.4 m (80 ft), UO_2 weight fraction= 0.215 (4.6 volume %).

These parameters (Ref. 5.17) were used for a 40% volume percent water in tuff mixture to demonstrate a low k_{eff} for this configuration (infinite length). This resulting k_{eff} for this case is 0.7926 ± .0015. The input and relevant output for this case is included in Attachment CLIV.

8. Conclusions

The results of this study should be treated as unqualified data and not be used for procurement, fabrication, or construction unless properly identified, tracked as TBV, and controlled by the appropriate procedures.

The major results are summarized below:

CRITICALITY DEFINED as $k_{eff} = \{1.0 - .015 \text{ (bias and uncertainty)} - 2\sigma\}$ from Curves

The water volume percents quoted throughout this report have been the volume percent water in a tuff/water mixture. The UO₂ volume percent quoted displaces the tuff/water mixture such that the water volume fraction in the tuff/water/UO₂ mixture is reduced by the factor (1-UO₂ volume fraction). The volume fraction of water in the tuff/water/UO₂ mixture is reported next to the UO₂ volume fraction in the mixture.

3.0% Enrichment/ 20 GWd/MTU

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47% water in Tuff
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Minimum critical radius/mass at 18.5 vol% UO₂ / 38.3 vol% water - R=57.4 cm, UO₂ mass=1.6 MT, UO₂ ρ =2.028 g/cm³

8 vol% UO₂ / 43.2 vol% water - R=140 cm, UO₂ mass=10.1, UO₂ ρ =0.877 g/cm³ Minimum UO₂ vol%/density for criticality (k_w =.982) - 7.2 vol% / 0.789 g/cm³

40% water in Tuff

Minimum critical radius/mass at 17 vol% UO₂ / 33.2 vol% water - R=68.5 cm, UO₂ mass=2.5 MT, UO₂ ρ =1.863 g/cm³

8 vol% UO₂ / 36.8 vol% water - R=140 cm, UO₂ mass=10.1, UO₂ ρ =0.877 g/cm³ Minimum UO₂ vol%/density for criticality (k_w =.982) - 7.1 vol% / 0.778 g/cm³

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30% water in Tuff Minimum critical radius/mass at 15 vol% UO₂ / 25.5 vol% water - R=98 cm, UO₂ mass=6.5 MT, UO₂ ρ =1.644 g/cm³ 10 vol% UO₂ / 27.0 vol% water - R=117 cm, UO₂ mass=7.4 MT, UO₂ ρ =1.096 g/cm³ 8 vol% UO₂ / 27.6 vol% water - R=170 cm, UO₂ mass=18.0 MT, UO₂ ρ =0.877 g/cm³ Minimum UO₂ vol%/density for criticality (k_∞ =.982) - 7.0 vol% / 0.767 g/cm³

20% water in Tuff

Minimum critical radius/mass at 11.6 vol% UO₂ / 17.7 vol% water - R=218 cm, UO₂ mass=55.2 MT, UO₂ ρ =1.271 g/cm³ Minimum UO₂ vol%/density for criticality (k_w =.982) - 7.2 vol% / 0.789 g/cm³

≤16.4% water in Tuff - subcritical

3.5% Enrichment/ 30 GWd/ MTU

30% water in Tuff

Minimum critical radius/mass at 14 vol% UO₂ / 25.8 vol% water - R=120 cm, UO₂ mass=11.1MT, UO₂ ρ =1.534 g/cm³

Minimum UO₂ vol%/density for criticality (k_{∞} =.982) - 7.6 vol% / 0.833 g/cm³

≤20% water in Tuff - subcritical

4.0% Enrichment/ 40 GWd/ MTU

30% water in Tuff

Minimum critical radius/mass at 15 vol% UO₂ / 25.5 vol% water - R=165 cm, UO₂ mass=30.9 MT, UO₂ ρ =1.644 g/cm³ Minimum UO₂ vol%/density for criticality (k_w =.982) - 8.6 vol% / 0.943 g/cm³

≤20% water in Tuff - subcritical

3.0% Enrichment/ 20 GWd/ MTU, 47% Porosity, 8.0 volume% UO₂

Peak $k_{\infty} = 1.044$ at 27 volume% water, Δk from 47% water = 0.034

Peak $k_{eff} = 1.003$ at 33 volume% water for 150 cm sphere, Δk from 47% water = 0.017

The evaluations performed to determine the combinations of fuel, tuff and water necessary to have a positive moderator void coefficient provide the following conclusions: (1) the nominal tuff with 30.6% porosity will not have a positive void coefficient, (2) the most porous tuff (47%) could possibly have a positive coefficient, and (3) the effects of the positive coefficient could hypothetically produce a dynamic fissioning system and a limited neutron-thermal transient. The consequences of the hypothetical transient and dynamic system are not addressed in this document.

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9. Attachments

The following Attachments are case output files as listed. The name of the file is listed in parenthesis.

I. LOTUS 1-2-3 Spreadsheet for Base number densities (atomden.wk3 sheet A), 9/3/96, 2 pages

Cases for Section 7.3.1

II. SAS2H Case - 3.0% Enrichment, 20 GWd/MTU (03020.res), 4/5/96, 6 pages

III. SAS2H Case - 3.5% Enrichment, 30 GWd/MTU (03530.res), 4/5/96, 5 pages

IV. SAS2H Case - 4.0% Enrichment, 40 GWd/MTU (04040.res), 4/8/96, 6 pages

V. SAS2H Case - 4.0% Enrichment, 45 GWd/MTU (04045.res), 4/5/96, 6 pages

VI. SAS2H Case - 4.2% Enrichment, 45 GWd/MTU (04245.res), 4/5/96, 6 pages

VII. SAS2H Case - 4.5% Enrichment, 53 GWd/MTU (04553.res), 4/5/96, 6 pages

VIII. LOTUS 1-2-3 Spreadsheet for Mixture number densities (lespher2.wk4 sheet B), 8/27/96, 11 pages

Cases for Section 7.4.1

- IX. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 47% Water, 5% UO₂ (i3020md.sum), 6/5/96, 1 page
- X. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 47% Water, 8% UO₂ (i3020mf.sum), 5/21/96, 1 page
- XI. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 47% Water, 10% UO₂ (i3020me.sum), 5/21/96, 1 page
- XII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 47% Water, 15% UO₂ (i3020ma.sum), 5/21/96, 1 page
- XIII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 47% Water, 20% UO₂ (i3020mb.sum), 5/21/96, 1 page
- XIV. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 47% Water, 25% UO₂ (i3020mc.sum), 5/21/96, 1 page
- XV. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 40% Water, 5% UO₂ (i3020oa.sum), 5/21/96, 1 page
- XVI. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 40% Water, 8% UO₂ (i3020ob.sum), 5/21/96, 1 page
- XVII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 40% Water, 10% UO₂ (i3020oc.sum), 5/21/96, 1 page
- XVIII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 40% Water, 15% UO₂ (i3020od.sum), 5/21/96, 1 page
- XIX. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 40% Water, 20% UO₂ (i3020oe.sum), 5/21/96, 1 page
- XX. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 40% Water, 25% UO₂ (i3020of.sum), 5/21/96, 1 page
- XXI. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 30% Water, 5% UO₂ (I1-3.0E-20GWd-30W05U), 5/20/96, 2 pages
- XXII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 30% Water, 10% UO₂

5/22/96, 1 page

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- XLV. MCNP Case 3.5% Enrichment, 30 GWd/MTU, 30% Water, 10% UO₂ (i3530d.sum), 5/21/96, 1 page
- XLVI. MCNP Case 3.5% Enrichment, 30 GWd/MTU, 30% Water, 14% UO₂ (i3530c.sum), 5/21/96, 1 page
- XLVII. MCNP Case 3.5% Enrichment, 30 GWd/MTU, 30% Water, 15% UO₂ (i3530a.sum), 5/21/96, 1 page
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- LIII. MCNP Case 4.0% Enrichment, 30 GWd/MTU, 20% Water, 5% UO₂ (i4040f.sum), 5/22/96, 1 page
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- LV. MCNP Case 4.0% Enrichment, 30 GWd/MTU, 20% Water, 12% UO₂ (i4040b.sum), 5/22/96, 1 page
- LVI. MCNP Case 4.0% Enrichment, 30 GWd/MTU, 20% Water, 14% UO₂ (i4040a.sum), 5/22/96, 1 page
- LVII. MCNP Case 4.0% Enrichment, 30 GWd/MTU, 20% Water, 16% UO₂ (i4040c.sum), 5/22/96, 1 page
- LVIII. MCNP Case 4.0% Enrichment, 30 GWd/MTU, 20% Water, 18% UO₂ (i4040e.sum), 5/22/96, 1 page
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- LX. MCNP Case 4.2% Enrichment, 45 GWd/MTU, 30% Water, 15% UO₂ (i4245b.sum), 8/27/96, 1 pages
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- LXII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 47% Water, 18.5% UO₂, r=57 (s3020me.sum), 5/23/96, 2 pages
- LXIII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 47% Water, 18.5% UO₂, r=61 (s3020md.sum), 5/23/96, 2 pages
- LXIV. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 47% Water, 18.5% UO₂, r=70 (s3020mb.sum), 5/23/96, 2 pages

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- LXV. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 47% Water, 18.5% UO₂, r=77 (s3020ma.sum), 5/23/96, 2 pages
- LXVI. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 40% Water, 17% UO₂, r=60 (s30200a.sum), 5/23/96, 2 pages
- LXVII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 40% Water, 17% UO₂, r=65 (s3020ob.sum), 5/23/96, 2 pages
- LXVIII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 40% Water, 17% UO₂, r=70 (s3020oc.sum), 5/23/96, 2 pages
- LXIX. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 40% Water, 17% UO₂, r=75 (s3020od.sum), 5/23/96, 2 pages
- LXX. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 40% Water, 17% UO₂, r=80 (s30200e.sum), 5/23/96, 2 pages
- LXXI. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 40% Water, 17% UO₂, r=85 (s3020of.sum), 5/23/96, 2 pages
- LXXII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 30% Water, 15% UO₂, r=59 (C1-3.0E-20GWd-30W15U), 5/20/96, 2 pages
- LXXIII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 30% Water, 15% UO₂, r=97.86 (C2-3.0E-20GWd-30W15U), 5/17/96, 2 pages
- LXXIV. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 30% Water, 15% UO₂, r=103 (S3020a.sum), 6/10/96, 2 pages
- LXXV. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 30% Water, 15% UO₂, r=113.15 (C4-3.0E-20GWd-30W15U), 5/20/96, 2 pages
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- LXXVII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 30% Water, 15% UO₂, r=123.15 (C6-3.0E-20GWd-30W15U), 5/20/96, 2 pages
- LXXVIII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 20% Water, 11.6% UO₂, r=180 (s30e12h.sum), 6/7/96, 2 pages
- LXXIX. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 20% Water, 11.6% UO₂, r=220 (s30e12g.sum), 6/7/96, 2 pages
- LXXX. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 20% Water, 11.6% UO₂, r=250 (s30e12f.sum), 6/7/96, 2 pages
- LXXXI. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 20% Water, 11.6% UO₂, r=300 (s30e12e.sum), 6/7/96, 2 pages
- LXXXII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 20% Water, 11.6% UO₂, r=325 (s30e12b.sum), 6/7/96, 2 pages
- LXXXIII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 20% Water, 11.6% UO₂, r=345 (s30e12a.sum), 6/7/96, 2 pages
- LXXXIV. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 20% Water, 11.6% UO₂, r=365 (s30e12c.sum), 6/7/96, 2 pages
- LXXXV. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 20% Water, 11.6% UO₂, r=385 (s30e12d.sum), 6/7/96, 2 pages
- LXXXVI. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 47% Water, 15% UO₂, r=61

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- CLI. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 47% Water, 2 Zone 4.6% Average UO₂, r=53(106) (s3020ms.sum), 6/7/96, 2 pages
- CLII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 47% Water, 2 Zone 4.6% Average UO₂, r=55(110) (s3020mr.sum), 6/7/96, 2 pages
- CLIII. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 47% Water, 2 Zone 4.6% Average UO₂, r=57.4(114.8) (s3020mq.sum), 6/7/96, 2 pages
- CLIV. MCNP Case 3.0% Enrichment, 20 GWd/MTU, 40% Water, Cylinder, 4.6% UO₂, r=61, (c3020nb.sum), 6/7/96, 2 pages

c

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isotopic	c concentrations	in gm-atoms for each enrich./bi	umup pair			
isotope	3/20	3.5/30	4/40	4/45	4.2/45	4.5/53
he 4	3.650000E-02	1.080000E-01	2.290000E-01	3.230000E-01	3.110000E-01	4.720000E-01
th230	7.520000E-06	9,200000E-06	1.020000E-05	9.670000E-06	1.040000E-05	1.060000E-05
th232	1.250000E-06	1,980000E-06	2.820000E-06	3.140000E-06	3.260000E-06	3.980000E-06
pa231	1.300000E-06	2.600000E-06	4.080000E-06	4.480000E-06	4.780000E-06	5.840000E-06
u232		1.760000E-06	3.560000E-06	4.650000E-06	4.710000E-06	6.840000E-06
u233	4.140000E-06	6.420000E-06	8.600000E-06	9.090000E-06	9.570000E-06	1.110000E-05
u234	3.430000E-01	3.800000E-01	3.990000E-01	3.770000E-01	4.020000E-01	4.080000E-01
u235	2.700000E+01	2.380000E+01	2.120000E+01	1.750000E+01	1.960000E+01	1.700000E+01
u236	5.980000E+00	8.230000E+00	1.030000E+01	1.070000E+01	1.120000E+01	1.240000E+01
u238	1.860000E+03	1.840000E+03	1.810000E+03	1.800000E+03	1.800000E+03	1.780000E+03
np236		1.120000E-06	2.320000E-06	3.140000E-06	3.110000E-06	4.670000E-06
np237	4.840000E-01	8.390000E-01	1.220000E+00	1.390000E+00	1.410000E+00	1.710000E+00
pu236			6.380000E-07	8.250000E-07	8.200000E-07	1.150000E-06
pu238	1.140000E-01	2.900000E-01	5.480000E-01	7.130000E-01	7.040000E-01	9.880000E-01
pu239	1.030000E+01	1.190000E+01	1.300000E+01	1.320000E+01	1.330000E+01	1.380000E+01
pu240	2.950000E+00	4.110000E+00	5.030000E+00	5.520000E+00	5.440000E+00	6.020000E+00
pu241	1.240000E+00	1.890000E+00	2.400000E+00	2.630000E+00	2.620000E+00	2.920000E+00
pu242	3.330000E-01	7.080000E-01	1.130000E+00	1.430000E+00	1.360000E+00	1.740000E+00
am241	4.070000E-01	6.590000E-01	8.800000E-01	9.800000E-01	9.790000E-01	1.120000E+00
am242m	1.310000E-03	3.060000E-03	5.040000E-03	5.920000E-03	6.010000E-03	7.450000E-03
am243	4.600000E-02	1.400000E-01	2.790000E-01	3.920000E-01	3.670000E-01	5.250000E-01
cm242	7.590000E-06	1 790000E-05	2.930000E-05	3.540000E-05	3 510000E-05	4 390000E-05
cm243	1 480000E-04	5 070000E-04	1.050000E-03	1.450000E-03	1.390000E-03	1 970000E-03
cm244	6 220000E-03	2 850000E-02	7.550000E-02	1.230000E-01	1 120000E-01	1 900000E-01
cm245	1.830000E-04	1 160000E-03	3.770000E-03	6 630000E-03	6 050000E-03	1.130000E-02
cm246	1 230000E-05	1 140000E-04	4.890000E-04	1.030000E-03	8 920000E-04	2 010000E-03
cm247	1.2000002-00	1 7700005-06	9 900000E-06	2 360000E-05	2 010000E-05	5 260000E-05
cm248			1.050000E-06	2.000000E-06	2.460000E-06	7 830000E-00
total	1 910000E+03	1.890000E+03	1 870000E+03	1 860000E+03	1.860000E+03	1 840000E+03
gm atoms at approx. 100,000 yrs		calculated by summing compo	onents of chains listed in	n Table 7.3.2-1		
U234	4.583176E-01	6.730779E-01	9.520693E-01	1.095955E+00	1.112045E+00	1.403494E+00
U235	3.734615E+01	3.584051E+01	3.448006E+01	3.109347E+01	3.326841E+01	3.132702E+01
U236	8.936220E+00	1.236850E+01	1.540550E+01	1.634300E+01	1.675200E+01	1.861001E+01
U238	1.860333E+03	1.840708E+03	1.811130E+03	1.801431E+03	1.801361E+03	1.781742E+03
No237	2.131183E+00	3.389160E+00	4.503770E+00	5.006630E+00	5.015050E+00	5.761300E+00
TOTAL	1.909205E+03	1.892979E+03	1.866472E+03	1.854970E+03	1.857508E+03	1.838844E+03
atom fractions at approx 100 000 ver		Calculated by dividing on-ato	me ahova hv total am a	tome		
	•	Calculated by entering gritate	ine above by total gri-a	toma		
U234	2.400568E-04	3.555654E-04	5.100904E-04	5.908211E-04	5.986757E-04	7.632480E-04
U235	1.956110E-02	1.893339E-02	1.847339E-02	1.676225E-02	1.791023E-02	1.703626E-02
U236	4.680598E-03	6.533880E-03	8.253808E-03	8.810386E-03	9.018534E-03	1.012049E-02
U238	9.744020E-01	9.723868E-01	9.703497E-01	9.711375E-01	9.697727E-01	9.689469E-01
Np237	1.116267E-03	1.790384E-03	2.412986E-03	2.699035E-03	2.699880E-03	3.133110E-03
Density of UO2 (g/cc)	10.96	= p				
Atomic Wt UO2	270.02755	= A				
Number densities in atoms/barn-cm		N=(atom frac.*p*0.602252)/A				
U234	5.868062E-06	8.691609E-06	1.246889E-05	1.444231E-05	1.463431E-05	1.865720E-05
U235	4.781608E-04	4.628167E-04	4.515723E-04	4.097444E-04	4.378063E-04	4.164425E-04
U236	1.144148E-04	1.597173E-04	2.017600E-04	2.153653E-04	2.204533E-04	2.473902E-04
U238	2.381875E-02	2.376949E-02	2.371969E-02	2.373895E-02	2.370558E-02	2.368540F-02
Np237	2.728657E-05	4,376500E-05	5.898417E-05	6.597651E-05	6.599715E-05	7.658723E-05
0	2.444448E-02	2.44448E-02	2.44448E-02	2.44448E-02	2.44448E-02	2.444448E-02

	Nominal				
Tuff Density (g/cc)	1.746				
Tuff Porosity	0.306		Renormalized		
Tuff Composition	Weight fractions	Minerals used	Wt. Fractions		Atomic Wts (g/mole)
SiO2	0.691	0.69	0.75387	3 0.490017455814968	60.08465
TiO2	0.0011				
AI2O3	0.134	0.13	0.14619	2 0.095025092734017	101.9610528
Fe2O3	0.0113	. 0.011	0.01232	8 0.008013310058913	159.691975
MnO	0.0005				
MgO	0.0094	0.009	0.01025	5 0.006665939341043	40.311325
CaO	0.0322	0.0323	0.03513	0 0.022834387955488	56.079325
Na2O	0.0123	0.012	0.01341	9 0.008722452542003	61.9788664
к20	0.0264	0.026	0.02880	2 0.018721361553568	94.20332500000001
P2O5	0.0001				

atomden.wk3 sheet A 9/3/96

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External Criticality Number Densities BBA000000-01717-0200-00016 REV 00

Attachment 1 Page 2

LOI	0.089			0.25	10 01115	
C	1.0073	0.9166	1.000	0.35	12.01115	
Number densities	atom/bam-cm Normal	(tuff density*normalized min. wt	. frac.*0.602252)/min. atomic w	r t .		
SiO2	1.31934127E-02	8.57571828E-03				
AI2O3	1.50769372E-03	9.80000915E-04				
Fe2O3	8.11779330E-05	5.27656564E-05				
MgO	2.67512092E-04	1.73882860E-04				
CaO	6.58712237E-04	4.28162954E-04				
Na2O	2.27669115E-04	1.47984925E-04				
K2O	3.21499523E-04	2.08974690E-04				
Si	1.319341274E-02					
AI	3.015387431E-03					
Fe	1.623558660E-04					
Mg	2.675120920E-04					
Ca	6.587122370E-04					
Na	4.553382308E-04					
к	6.429990451E-04					
0	3.262883339E-02					

```
parm='halt8, skipcellwt, skipshipdata'
=sas2h
SAS2H: Babcock Wilcox 15x15, 3.00wt%, 20gwd/mtu burn High Temp
44group
            latticecell
.
   mixtures of fuel-pin-unit-cell:
 \begin{array}{c} \begin{array}{c} & \text{den=mass } 102/ \text{ Volume assembly = } 526377.3 \text{ g/5.157524E4} \\ \text{uo2} \underline{1} \text{ den=} \underline{10.2060} \underline{1.975} \text{ 92235} 3.00 \text{ 92234} 0.0240 \text{ 92236} 0.0138 \text{ 92238} 96.9622 \text{ end} \end{array} 
kr-83
           1 0 1-20 975 end
kr-85
           1 0 1-20 975 end
sr-90
           1 0 1-20 975 end
           1 0 1-20 975 end
y-89
mo-95
           1 0 1-20 975 end
           1 0 1-20 975 end
zr-93
zr-94
           1 0 1-20 975 end
           1 0 1-20 975 end
zr-95
            1 0 1-20 975 end
nb-94
           1 0 1-20 975 end
tc-99
           1 0 1-20 975 end
rh-103
rh-105
           1 0 1-20 975 end
ru-101
           1 0 1-20 975 end
ru-106
           1 0 1-20 975 end
pd-105
           1 0 1-20 975 end
           1 0 1-20 975 end
pd-108
ag-109
           1 0 1-20 975 end
sb-124
           1 0 1-20 975 end
           1 0 1-20 975 end
xe-131
            1 0 1-20 975 end
xe-132
           1 0 1-20 975 end
xe-135
           1 0 1-20 975 end
xe-136
cs-134
           1 0 1-20 975 end
cs-135
           1 0 1-20 975 end
           1 0 1-20 975 end
cs-137
           1 0 1-20 975 end
ba-136
           1 0 1-20 975 end
la-139
pr-141
           1 0 1-20 975 end
pr-143
           1 0 1-20 975 end
           1 0 1-20 975 end
ce-144
nd-143
           1 0 1-20 975 end
nd-145
           1 0 1-20 975 end
pm-147
           1 0 1-20 975 end
pm-148
           1 0 1-20 975 end
           1 0 1-20 975 end
nd-147
           1 0 1-20 975 end
sm-147
           1 0 1-20 975 end
sm-149
           1 0 1-20 975 end
sm-150
           1 0 1-20 975 end
sm-151
           1 0 1-20 975 end
sm-152
           1 0 1-20 975 end
gd-155
           1 0 1-20 975 end
ēu-153
eu-154
           1 0 1-20 975 end
eu-155
           1 0 1-20 975 end
           3 den=0.6272 1 607.6 end
h2o
arbm-bormod 0.6272 1 1 0 0 5000 100 3 552.6e-6 607.6 end
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
                             40000 98.18 2 1.0 650.0 end
```

1050 ppm boron

end comp

Apr 05 08:29 1996 File Name: /users/hassler/wells/scale/o3020.res BBA000000-01717-0200-00016 REV. 00 ATTACHMENT II - Page 2

1 -. . . . 1 fuel-pin-cell geometry: . squarepitch 1.44272 0.936244 1 3 1.0922 2 0.95758 0 end / assembly and cycle parameters: npin/assm=208 fuelngth=360.172 ncycles=1 nlib/cyc=8 printlevel=5 inplevel=2 numztotal=4 end 3 0.63246_2 0.67310_3 0.814_500_2.961 power=7.25 burn=1280 down=1826.25 end end

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•						A	
sas2h:	babcock W1	LCOX 15X15	. 5.00Wt%,	20gwa/mtu	i durn nign E±17n/om##	temp	
power=	7.23MW,	anunnab=	ilou.mwa,		concentrat	ione arem	atome
				haeie =	concentrat	ctor accemb	าเง
	chacae	60 0 d	B0 0 d	120 0 4	160 0 d	160 0 d	~ ,
he 4		1 386-06	5 446-06	1.235-05	2.24F-05	2.246-05	
+6226	005+00	2 835-21	8 376-21	1 49F-20	2.22F-20	2.22F-20	
th227	005+00	6.59F-18	4.59F-17	1.38E-16	2.99E-16	2.99E-16	
th228	.00F+00	8.49E-13	3.41E-12	7.75E-12	1.40E-11	1.40E-11	
th229	00E+00	4.18E-14	1.68E-13	3.82E-13	6.84E-13	6.84E-13	
th230	.00E+00	1.45E-07	2.84E-07	4.20E-07	5.51E-07	5.51E-07	
th231	.00E+00	3.64E-10	4.77E-10	5.84E-10	6.87E-10	6.85E-10	
th232	.00E+00	1.32E-09	3.52E-09	6.55E-09	1.04E-08	1.04E-08	
th233	.00E+00	1.09E-15	2.87E-15	5.30E-15	8.34E-15	6.26E-15	
th234	.00E+00	1.91E-08	2.51E-08	2.70E-08	2.76E-08	2.76E-08	
pa231	.00E+00	7.58E-09	1.83E-08	3.16E-08	4.74E-08	4.75E-08	
pa232	.00E+00	5.90E-12	1.41E-11	2.42E-11	3.61E-11	3.60E-11	
pa233	.00E+00	4.87E-11	2.00E-10	4.13E-10	6.68E-10	6.68E-10	
pa234m	.00E+00	6.43E-13	8.46E-13	9.10E-13	9.30E-13	9.30E-13	
pa234	.00E+00	2.90E-13	3.90E-13	4.32E-13	4.57E-13	4.00E-13	
pa235	.00E+00	.00E+00	.00E+00	.UUE+UU	.UUE+UU	.UUE+UU	
u230	.00E+00	2.74E-18	8.11E-18	1.476-1/	2.10E-1/ 5.995-14	2.10E-17 E 995-14	
u231	.00E+00	1.245-10	2./2E-10	4.23E-10 5 1/5-00	7 10E-00	7 105-00	
U232	.002+00	1.000-09	3.296-09	J. 146-09	4 38E-07	4 295-07	
u233	.002+00 4 745-01	6 715-01	J.J(E-0/	4.036-07	6.20E-07	6.20E-07	
u234	5 025+01	4./1E-01 5 79E+01	4.00E-01	5 50E+01	5 365+01	5 366+01	
1236	2 716-01	5 458-01	8 NOF-01	1 06F+00	1.31E+00	1.31F+00	
1237	006+00	1.49E-03	1.77E-03	2.02E-03	2.25E-03	2.25E-03	
u238	1.89E+03	1.89E+03	1.89E+03	1.89E+03	1.89E+03	1.89E+03	
u239	.00E+00	4.78E-04	4.74E-04	4.70E-04	4.67E-04	3.55E-04	
u240	.00E+00	.00E+00	1.51E-38	1.15E-36	2.50E-35	2.50E-35	
u241	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	
np235	.00E+00	3.56E-12	1.82E-11	4.55E-11	8.60E-11	8.60E-11	
np236m	.00E+00	2.28E-11	5.65E-11	9.44E-11	1.36E-10	1.36E-10	·
np236	.00E+00	9.59E-11	5.02E-10	1.28E-09	2.47E-09	2.47E-09	
np237	.00E+00	4.40E-03	1.10E-02	1.85E-02	2.68E-02	2.68E-02	
np238	.00E+00	5.87E-06	1.45E-05	2.43E-05	3.50E-05	3.50E-05	

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np239	.00E+00	6.91E-02	6.84E-02	6.78E-02	6.74E-02	6.74E-02
np240m	.00E+00	.00E+00	1.29E-40	9.85E-39	2.14E-37	2.14E-37
np240	.00E+00	1.16E-06	1.14E-06	1.12E-06	1.11E-06	9.99E-07
np241	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00
pu236	.00E+00	1.26E-10	6.65E-10	1.69E-09	3.24E-09	3.24E-09
pu237	.00E+00	2.30E-10	8.10E-10	1.59E-09	2.50È-09	2.50E-09
pu238	.00E+00	2.88E-05	1.55E-04	3.99E-04	7.72E-04	7.72E-04
pu239	.00E+00	7.13E-01	1.43E+00	2.08E+00	2.67E+00	2.67E+00
pu240	.00E+00	1.15E-02	4.35E-02	9.15E-02	1.52E-01	1.52E-01
pu241	.00E+00	4.47E-04	3.28E-03	1.02E-02	2.25E-02	2.25E-02
pu242	.00E+00	2.40E-06	3.46E-05	1.63E-04	4.79E-04	4.79E-04
pu243	.00E+00	3.08E-10	4.40E-09	2.05E-08	6.00E-08	5.87E-08
pu244	.00E+00	4.39E-31	7.51E-28	5.75E-26	1.25E-24	1.25E-24
pu245	.00E+00	3.32E-37	5.63E-34	4.28E-32	9.22E-31	9.13E-31
bu246	.00E+00	2.78E-40	7.94E-37	7.83E-35	1.98E-33	1.98E-33
am239	.00E+00	2.33E-17	3.33E-16	1.55E-15	4.53E-15	4.49E-15
am240	.00E+00	8.14E-15	1.16E-13	5.41E-13	1.58E-12	1.58E-12

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sas2h: babcock wilcox 15x15, 3.00wt%, 20gwd/mtu burn high temp power= 7.25mw, burnup= 1160.mwd, flux= 1.76E+13n/cm**2-sec nuclide concentrations, gram atoms

				basis =	single rea	ctor assemb	ιty
	charge	40.0 d	~80.0 d	120.0 d	160.0 d	160.0 d	-
am241	.00E+00	6.09E-07	8.77E-06	4.11E-05	1.21E-04	1.21E-04	
am242m	00F+00	1.085-09	2.90F-08	1.935-07	7.20F-07	7.20F-07	
am242	005+00	6 00F-10	0 94F-00	4 58E-08	1 346-07	1 336-07	
000243	005+00	8 405-00	2 405-07	1 405-04	A 445.04	A 445-04	
am243	.000+00	0.475-07	005-00	005+00	0.000-00	0.000-00	
802440	.002700		.002700	.002400	.002700	. UUETUU	
8M244	.UUE+UU	3.3/E-12	y.426-11	0.00E-10	2.30E-09	2.302-09	
am245	.00E+00	3.12E-35	5.23E-32	3.92E-30	8.34E-29	8.34E-29	
am246	.00E+00	.00E+00	1.98E-39	1.96E-37	4.95E-36	4.95E-36	
cm241	.00E+00	1.83E-17	9.05E-16	8.46E-15	3.96E-14	3.96E-14	
cm242	-00E+00	4.67E-09	1.29E-07	8.87E-07	3.41E-06	3.41E-06	
cm243	.00E+00	2.14E-12	1.17E-10	1.20E-09	6.13E-09	6.13E-09	
cm244	00F+00	3.76F-11	2.10F-09	2.22F-08	1.17E-07	1.175-07	
cm245	005+00	3 186-14	3 40F-12	5 44F-11	3 776-10	3 776-10	
0=244	005+00	5 795-17	1 245.14	2 025-13	2 40E-12	2 405-12	
CIII240	.002+00	1 745 20	7 400 10	2.725 13	7 405 45	7 105 15	
Cm247	.002700	1./05-20	1.000-10	2.012-10	3. 10E-12	3.102.12	
cm248	.00E+00	2.30E-23	1.9/E-20	1.00E-18	1.63E-1/	1.63E-1/	
cm249	.00E+00	1.41E-28	1.19E-25	6.04E-24	9.75E-23	8.82E-23	
cm250	.00E+00	1.10E-33	1.85E-30	1.39E-28	2.99E-27	2.99E-27	
cm251	.00E+00	2.85E-41	4.62E-38	3.46E-36	7.37E-35	5.03E-35	
totals	1.95E+03	1.95E+03	1.95E+03	1.95E+03	1.94E+03	1.94E+03	
flux		1.78E+13	1.77E+13	1.75E+13	1.74E+13	1.748-02	

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sas2h:	babcock W	ilcox 15x1	5, 3.00wt%, 0280 mud	, 20gwd/mti fluvn 1 70	u burn high tem NE+13p/cm##2-ce	ip .
power -	· · · · · · · · · · · · · · · · · · ·	bai nap-	7200. MWG,	nuclide	concentrations	. gram atoms
•				basis =	single reactor	assembly
	charge	1160.2 d	1200.2 d	1240.2 d	1280.2 d	-
he 4	9.34E-03	1.07E-02	1.22E-02	1.39E-02	1.57E-02	
ob206	4.08E-16	4.77E-16	5.54E-16	6.40E-16	7.37E-16	
66207	5.81E-13	6.61E-13	7.48E-13	8.43E-13	9.46E-13	
bb208	5.09E-10	5.84E-10	6.67E-10	7.60E-10	8.62E-10	
66209	1.74E-17	1.94E-17	2.17E-17	2.42E-17	2.69E-17	

actinides

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actinides

power=	1.20mW,	purnup=	726U. MW ₫,	TUX= 1.70	ETIJN/CM""2"88C
sas2h:	babcock wi	Lcox 15x15	3.00wt%,	20gwd/mtu	burn high temp
np240	6.63E-07	1.38E-06	1.39E-06	1.40E-06	1.41E-U6
np240m	1.87E-28	2.68E-28	3.77E-28	5.24E-28	7.22E-28
np239	7.40E-02	7.49E-02	7.51E-02	7.54E-02	7.56E-02
np238	5.32E-04	5.65E-04	5.94E-04	6.23E-04	6.52E-04
np236	2.91E-07	5.18E-07	5.4/E-0/ 4 345-01	3./0E-U/ 4 54E-01	4.002-07
np236m	2.44E-09	2.67E-09	2.81E-09	2.94E-09	3.088-09
np235	6.89E-09	7.42E-09	7.97E-09	8.54E-09	9.12E-09
u241	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00
U239 U240	7.04E-UD 2 20F-26	3.10E-04 3.13E-24	J.201-04	5.22E-04	3.292-04 8.46F-26
u238	1.86E+03	1.86E+03	1.86E+03	1.86E+03	1.862+03
u237	6.42E-03	6.50E-03	6.64E-03	6.78E-03	6.91E-03
u236	5.51E+00	5.63E+00	5.75E+00	5.86E+00	5.97E+00
u235	2.99E+01	2.91E+01	2.84E+01	2.77E+01	2.70E+01
u255	5.05E-06 3.54E-01	3.09E-06 3.50E-01	3.15E-06 3 44E-01	3.20E-06-	3.232-00 3 396-01
u232	2.51E-07	2.73E-07	2.97E-07	3.22E-07	3.48E-07
u231	1.98E-14	2.17E-14	2.37E-14	2.57E-14	2.78E-14
.u230	1.04E-15	1.14E-15	1.24E-15	1.35E-15	1.47E-15
pa235	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00
pa234M	9.20t-15 1 255-12	9.31E-13	9.30E-13 1 45E-12	9.30E-13	9.30E-13
pa233	1.34E-08	1.40E-08	1.47E-08	1.54E-08	1.61E-08
pa232	7.77E-10	8.41E-10	8.86E-10	9.32E-10	9.79E-10
pa231	9.60E-07	1.01E-06	1.06E-06	1.11E-06	1.16E-06
th234	2.75E-08	2.75E-08	2.75E-08	2.75E-08	2.75E-08
th233	2.090-07	2.775-13	2.05F-13	3.13F-13	3.316-13
th231	2.50E-09	2.62E-09	2.66E-09	2./1E-09	2.758-09
th230	2.55E-06	2.59E-06	2.64E-06	2.67E-06	2.71E-06
th229	6.77E-11	7.58E-11	8.47E-11	9.45E-11	1.05E-10
th228	1.80E-09	2.00E-09	2.22E-09	2.46E-09	2.71E-09
th227	5.25E-14	5.74E-14	6.26E-14	6.80E-14	7.37E-14
F8220 +6226	1.401-1/	1.012-1/	1.726-17	1.912-17	2.0/2-1/
ra226	4.26E-11	4.52E-11	4.78E-11	5.05E-11	5.52E-11 2.07E-17
ra225	1.87E-15	2.10E-15	2.35E-15	2.61E-15	2.90E-15
ra224	9.48E-12	1.05E-11	1.17E-11	1.29E-11	1.43E-11
ra223	3.13E-14	3.43E-14	3.75E-14	4.08E-14	4.42E-14
ra222	2.20E-20	2.41E-20	2.63E-20	2.86E-20	3.11E-20
pb212	1.15E-12	1.286-12	1.426-12	1.5/E-12 1 415-19	1.735-12
pb211	6.87E-17	7.53E-17	8.22E-17	8.94E-17	9.70E-17
pb210	3.09E-14	3.43E-14	3.8 0E-14	4.19E-14	4.61E-14

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np241 pu236

pu237 pu238 pu239

pu240 pu241 pu242 pu243

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charge 1160.2 d 1200.2 d 1240.2 d 1280.2 d .00E+00 .00 ons, gram atoms 3.24E-07 3.52E-07 3.81E-07 4.11E-07 4.42E-07 1.01E-07 1.11E-07 1.21E-07 7.80E-02 8.50E-02 9.23E-02 1.31E-07 1.41E-07 1.00E-01 1.08E-01 9.81E+00 9.93E+00 1.01E+01 1.02E+01 1.03E+01 2.55E+00 2.65E+00 2.76E+00 2.86E+00 2.95E+00 1.32E+00 1.39E+00 1.45E+00 1.51E+00 1.58E+00 2.38E-01 2.60E-01 2.83E-01 3.07E-01 3.33E-01 2.82E-05 3.55E-05 3.88E-05 4.23E-05 4.59E-05

actinides

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	pu244	1.09E-15	1.56E-15	2.20E-15	3.06E-15	4.21E-15
	pu245	7.52E-22	1.16E-21	1.64E-21	2.30E-21	3.17E-21
	pu246	3.29E-24	4.79E-24	6.84E-24	9.63E-24	1.34E-23
	am239	2.30E-12	2.69E-12	2.91E-12	3.14E-12	3.37E-12
	am240	8.37E-10	9.31E-10	1.01E-09	1.09E-09	1.17E-09
	am241	5.19E-02	5.62E-02	6.06E-02	6.51E-02	6.97È-02
	am242m	9.67E-04	1.06E-03	1.15E-03	1.24E-03	1.34E-03
	am242	5.21E-05	5.89E-05	6.38E-05	6.88E-05	7.39E-05
	am243	2.86E-02	3.24E-02	3.66E-02	4.11E-02	4.60E-02
	am244m	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00
	am244	1.03E-05	1.25E-05	1.41E-05	1.59E-05	1.79E-05
	am245	6.20E-20	8.78E-20	1.23E-19	1.69E-19	2.31E-19
	am246	8.24E-27	1.20E-26	1.71E-26	2.41E-26	3.35E-26
	cm241	2.20E-10	2.47E-10	2.75E-10	3.05E-10	3.35E-10
	cm242	6.74E-03	7.45E-03	8.20E-03	8.98E-03	9.80E-03
	cm243	9.98E-05	1.15E-04	1.31E-04	1.48E-04	1.67E-04
	cm244	4.01E-03	4.74E-03	5.55E-03	6.48E-03	7.51E-03
	cm245	8.72E-05	1.06E-04	1.28E-04	1.54E-04	1.83E-04
	cm246	4.97E-06	6.33E-06	7.97E-06	9.96E-06	1.23E-05
	cm247	4.56E-08	6.01E-08	7.85E-08	1.01E-07	1.30E-07
	cm248	1.93E-09	2.66E-09	3.61E-09	4.85E-09	6.46E-09
	cm249	6.55E-15	1.82E-14	2.48E-14	3.34E-14	4.46E-14
	cm250	2.93E-18	4.22E-18	5.99E-18	8.40E-18	1.16E-17
	cm251	5.01E-27	1.05E-25	1.49E-25	2.10E-25	2.93E-25
	bk249	1.60E-11	2.26E-11	3.16E-11	4.36E-11	5.96E-11
	bk250	4.44E-15	7.98E-15	1.12E-14	1.55E-14	2.13E-14
	bk251	3.73E-20	1.18E-19	1.66E-19	2.31E-19	3.17E-19
-	totals	1.91E+03	1.91E+03	1.91E+03	1.91E+03	1.91E+03
0	flux		1.73E+13	1.73E+13	1.74E+13	1.75E+13

	sas2h:	babcock wi	lcox 15x15	, 3.00wt%,	20gwd/mtu	u burn higi	n temp				actinides	pag
	decay, fol	lowing read	tor irradi:	ation iden	tified by:	; power≖ _	7.25mw, b	urnup≖	9280.mwd,	flux= 1.7	70E+13n/cm**2-sec	• •
0)	-			nuclidé	concentral	tions, gra	m atoms	-			
					basis =	single rea	actor asse	mbly				
		initial	304.4 d	608.8 d	913.1 d	1217.5 d	1521.9 d	1826.3 d	1			
	he 4	1.57E-02	2.45E-02	2.82E-02	3.05E-02	3.25E-02	3.45E-02	3.65E-C)2			
	th230	2.71E-06	3.51E-06	4.31E-06	5.11E-06	5.91E-06	6.72E-06	7.52E-0)6			
	th232	3.62E-07	5.09E-07	6.57E-07	8.04E-07	9.51E-07	1.10E-06	1.25E-0)6			
	pa231	1.16E-06	1.19E-06	1.21E-06	1.23E-06	1.25E-06	1.28E-06	1.30E-0)6			
	u233	3.25E-06	3.40E-06	3.55E-06	3.69E-06	3.84E-06	3.99E-06	4.14E-0)6			
	u234	3.39E-01	3.39E-01	3.40E-01	3.41E-01	3.42E-01	3.43E-01	3.43E-0	01			
	u235	2.70E+01	2.70E+01	2.70E+01	2.70E+01	2.70E+01	2.70E+01	2.70E+()1			
	u236	5.97E+00	5.97E+00	5.97E+00	5.98E+00	5.98E+00	5.98E+00	5.98E+0	00			
	u238	1.86E+03	1.86E+03	1.86E+03	1.86E+03	1.86E+03	1.86E+03	1.86E+0)3			
	np237	4.75E-01	4.83E-01	4.83E-01	4.83E-01	4.83E-01	4.84E-01	4.84E-0	01			
	pu238	1.08E-01	1.15E-01	1.16E-01	1.16E-01	1.16E-01	1.15E-01	1.14E-0)1			
	pu239	1.03E+01	1.03E+01	1.03E+01	1.03E+01	1.03E+01	1.03E+01	1.03E+0)1			
	pu240	2.95E+00	2.95E+00	2.95E+00	2.95E+00	2,95E+00	2.95E+00	2.95E+(00			
	pu241	1.58E+00	1.52E+00	1.46E+00	1.40E+00	1.35E+00	1.29E+00	1.24E+0	00			
	pu242	3.33E-01	3.33E-01	3.33E-01	3.33E-01	3.33E-01	3.33E-01	3.33E-0)1			
	am241	6.97E-02	1.32E-01	1.92E-01	2.49E-01	3.04E-01	3.56E-01	4.07E-0	01			
	am242m	1.34E-03	1.34E-03	1.33E-03	1.33E-03	1.32E-03	1.32E-03	1.31E-0)3			
	am243	4.60E-02	4.60E-02	4.60E-02	4.60E-02	4.60E-02	4.60E-02	4.60E-0)2			
	cm242	9.80E-03	2.71E-03	7.44E-04	2.06E-04	5.90E-05	1.87E-05	7.59E-0)6			
	cm2/3	1 676-04	1 666-06	1 616-04	1 576-04	1 546-04	1 516-04	1 486-1	14			

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cm244	7.51E-03	7.30E-03	7.07E-03	6.84E-03	6.63E-03	6.42E-03	6.22E-03	
cm245	1.83E-04							
cm246	1.23E-05							
total	1.91E+03							

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=sas2h p	parm=′ha	lt8,s	kipcellwt,s	kipshipd	ata'	115 mb 7 m		
SASZH: BADCO	DCK Wild	OX 15	x15, 5.50wt	x, sugwa	/mtu burn	High len	ip .	
44group	latticed	ell						
I mixturer	of fuel		unit-colle					
		olume	accembly =	526377	3 a/5 157	574F4		
uo2 1 den=1(2060 1	075	02235 3 50	92234 0	0300 9223	6 0.0161	92238 96 453	P end
kr-83 1	0 1-20	975	and	/2204 01		• • • • • • • •	/	
kr-85 1	0 1-20	975	nd					
sr-90 1	0 1-20	975 e	end					
y-89 1	0 1-20	975 e	end					
mo-95 1	0 1-20	975 e	end					
zr-93 1	0 1-20	975 e	end					
zr-94 1	0 1-20	<u>975</u> e	end					
zr-95 1	0 1-20	975 e	end					
nb-94 1	0 1-20	975 e	end .					
tc-99 1	0 1-20	975 e	ena					
n=105 1	0 1-20	7/3 C	and					
ru-101 1	0 1-20	075	and					
cu-106 1	0 1-20	075	and					
pd-105 1	0 1-20	975 e	end					
pd-108 1	0 1-20	975 e	end					
ag-109 1	0 1-20	975 e	end					
sb-124 1	0 1-20	<u>975</u> e	end					
xe-131 1	0 1-20	975 e	end					
xe-132 1	0 1-20	975 e	end					
Xe-135 1	0 1-20	975 C	ena					
Xe*130	0 1-20	975 e	ena und					
ce-135 1	0 1-20	075	and					
cs-137 1	0 1-20	975 e	end					
ba-136 1	0 1-20	975 e	end					
la-139 1	0 1-20	975 e	end					
pr-141 1	0 1-20	975 e	end					
pr-143 1	0 1-20	975 e	end					
ce-144 1	0 1-20	975 e	end					
nd-145 1	0 1-20	975 E	ena					
na-143 1	0 1-20	975 e	na					
pm-148 1	0 1-20	075	and					
nd-147 1	ŏ 1-2ŏ	975 e	end					
sm-147 1	0 1-20	975 e	end					
sm-149 1	0 1-20	975 e	end					
sm-150 1	0 1-20	975 e	end					
sm-151 1	0 1-20	975 e	end					
sm-152 1	0 1-20	975 e	end					
ga-155 1	0 1-20	975 e	ena					
eu-155 1	0 1-20	975 4	ena und					
eu-155 1	0 1-20	975	nd					
h2o 3	den=0.6	272 1	607.6 end					
arbm-bormod	0.6272	1 1 0	0 5000 100	3 552.6	e-6_607.6	end		
arbm-zirc4	6.56 5	000	8016 0.12	24000 0.	10 26000	0.20 5000	0 1.40	
			40000 98.1	821.0	650.0 e	nd		
1 1050								
	DOLOU							

end comp

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. / fuel-pin-cell geometry: , squarepitch 1.44272 0.936244 1 3 1.0922 2 0.95758 0 end / assembly and cycle parameters: npin/assm=208 fuelngth=360.172 ncycles=1 nlib/cyc=8 printlevel=5 inplevel=2 numztotal=4 end 3 0.63246 2 0.67310 3 0.814 500 2.961 power=7.25 burn=1920 down=1826.25 end

end

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sas2h: babcock wilcox 15x15, 3.50wt%, 30gwd/mtu burn high	temp
power= 7.25mW, burnup= 1740.mWd, Ttux=1.5TET15T/CHI***	
nuclide concentrat	ions, gram atoms
Dasis = single real	CTOP assembly
charge 60.0 d 120.0 d 180.0 d 240.0 d	240.0 0
ne 4 .00E+00 2.94E-06 1.17E-05 2.69E-05 5.03E-05	5.052-05
Th226 .UUE+00 6.43E-21 1.77E-20 3.10E-20 4.66E-20	4.00E-20
TN227 .UUE+UU 2.43E-17 1.04E-10 4.08E-10 1.03E-13	1.025-12
Th228 .00E+00 2.33E-12 9.41E-12 2.16E-11 3.96E-11	3. YOE - 11
Th229 .00E+00 1.12E-13 4.53E-13 1.03E-12 1.83E-12	1.025-12
th230 .00E+00 2.89E-07 5.26E-07 7.71E-07 1.00E-06	1.001-06
(1231) $(100+00)$ $(100+10)$ $(100+10)$ $(100+10)$ $(100+10)$	1.072-09
	2.105-00
Th233 .00E+00 2.00E-15 5.50E-15 1.04E-14 1.67E-14	1.001-14
Th234 .0UE+00 2.28E-08 2.09E-08 2.76E-08 2.77E-08	2.772-08
pa251 .0UE+UU 1.49E-US 5.77E-US 6.75E-US 1.04E-UT	1.046-07
	1.245"[]
	1.272-09
DE234M .UUE+UU (.09E-13 9.09E-13 9.29E-13 9.35E-13	Y.332-13
DE234 .UUE+UU 3.3UE-13 4.29E-13 4.03E-13 4.72E-13	4.91E-13
$p_{2,2,3}$.002+000 .002+0000 .002+0000 .002+000 .002+0000 .002+000 .002+00000 .002+0000000000	. UUETUU 4 535-17
	4.725-17
U231 .000000 2.010 10 3.320 10 0.320 10 1.170 13	1.1/6-13
U232 .000+00 2.92009 0.22209 1.00000 1.430000	1.475-00
U233 . $UUE+UU 3. UIE-U/ 3.01E-U/ 0.44E-U/ 1.09E-00$	5 415-01
$(234 - 3.975^{-}01 - 3.005^{-}01 - 3.095^{-}01 - 3.095^{-}01 - 3.015^{-}01 - 0.015^{$	
(233) 0.7 [270] 0.09 [270] 0.40 [270] 0.2 [270] 0.00 [270]	1 905+00
1230 3.10001 1.37001 1.14000 1.32000 1.09000	2 405-03
1237 . 100000 1.03000 2.01000 2.30000 2.70000	1 876+03
1230 $1.000+0.0$ ($25-0.000+0.0$ $1.000+0.0$ $1.000+0.0$ $1.000+0.0$	2 005-04
1237 . $1000000 4.47200 4.42004 4.37004 4.3$	R 04E-34
	005+00
	2 056-10
nn234m 00F+00 3 82F-11 9 25F-11 1 56F-10 2.0JE-10	2.265-10
np236 00F+00 2 49F-10 1 25F-09 3 17F-09 6 14F-09	L . LVL IV
	6.14F-09
NN237 NAF+AA 7 53F-A3 1 84F-A2 3 12F-A2 4 59F-A2	6.14E-09 4.59E-02

actinides

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np239	.00E+00	6.45E-02	6.39E-02	6.34E-02	6.31E-02	6.31E-02
np240m	.00E+00	2.63E-42	4.62E-39	3.54E-37	7.65E-36	7.65E-36
np240	.00E+00	1.03E-06	1.01E-06	9.93E-07	9.8 4E-07	8.42E-07
np241	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00
pu236	.00E+00	3.30E-10	1.65E-09	4.15E-09	7.95E-09	7.95E-09
pu237	.00E+00	4.48E-10	1.47E-09	2.79E-09	4.32E-09	4.32E-09
pu238	.00E+00	7.16E-05	3.66E-04	9.28E-04	1.80E-03	1.80E-03
pu239	.00E+00	1.02E+00	1.98E+00	2.83E+00	3.60E+00	3.60E+00
pu240	.00E+00	2.08E-02	7.64E-02	1.57E-01	2.56E-01	2.56E-01
pu241	.00E+00	1.11E-03	7.97E-03	2.43E-02	5.23E-02	5.23E-02
pu242	.00E+00	7.72E-06	1.10E-04	5.05E-04	1.46E-03	1.46E-03
pu243	.00E+00	9.40E-10	1.32E-08	6.06E-08	1.75E-07	1.69E-07
pu244	.00E+00	1.56E-29	2.69E-26	2.07E-24	4.46E-23	4.46E-23
pu245	.00E+00	9.90E-36	1.69E-32	1.29E-30	2.77E-29	2.73E-29
pu246	.00E+00	1.00E-38	2.73E-35	2.60E-33	6.38E-32	6.38E-32
am239	.00E+00	8.47E-17	1.19E-15	5.41E-15	1.55E-14	1.53E-14
am240	.00E+00	2.95E-14	4.15E-13	1.89E-12	5.41E-12	5.40E-12

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	sas2h:	babcock wi	ilcox 15x1	5, 3.50wt%,	, 30gwd/mtw	u burn high temp	
	power=	7.25mw.	burnup= '	13920.mwd,	flux= 1.5	1E+13n/cm**2-sec	
0	F	•	•	•	nuclide	concentrations, gram atom	S
					basis =	single reactor assembly	
		charge	1740.3 d	1800.3 d	1860.3 d	1920.3 d	
	he 4	3.70E-02	4.21E-02	4.76E-02	5.36E-02	6.00E-02	
	pb206	2.99E-15	3.48E-15	4.03E-15	4.64E-15	5.32E-15	
	pb207	3.09E-12	3.51E-12	3.96E-12	4.44E-12	4.97E-12	
	pb208	2.91E-09	3.35E-09	3.85E-09	4.40E-09	5.01E-09	
	pb209	6.48E-17	7.30E-17	8.21E-17	9.20E-17	1.03E-16	
	pb210	1.25E-13	1.39E-13	1.54E-13	1.70E-13	1.87E-13	
	pb211	2.38E-16	2.60E-16	2.82E-16	3.06E-16	3.30E-16	
	pb212	4.52E-12	5.04E-12	5.60E-12	6.19E-12	6.83E-12	
	pb214	3.22E-18	3.51E-18	3.70E-18	3.88E-18	4.07E-18	
	ra222	7.08E-20	7.74E-20	8.48E-20	9.27E-20	1.01E-19	
	ra223	1.09E-13	1.18E-13	1.29E-13	1.39E-13	1.50E-13	
	ra224	3.73E-11	4.16E-11	4.62E-11	5.11E-11	5.64E-11	
	ra225	7.05E-15	8.01E-15	9.01E-15	1.01E-14	1.12E-14	
	ra226	1.05E-10	1.10E-10	1.16E-10	1.22E-10	1.28E-10	
	ra228	4.50E-17	4.928-17	5.36E-17	5.82E-17	6.30E-17	
	ac225	4.75E-15	5.38E-15	6.06E-15	6.79E-15	7.58E-15	
	ac227	8.04E-11	8.74E-11	9.47E-11	1.02E-10	1.10E-10	
	ac228	5.49E-21	6.00E-21	6.54E-21	7.10E-21	7.69E-21	
	th226	3.44E-18	3.78E-18	4.14E-18	4.52E-18	4.93E-18	
	th227	1.80E-13	1.96E-13	2.12E-13	2.30E-13	2.48E-13	
	th228	7.09E-09	7.91E-09	8.78E-09	9.71E-09	1.07E-08	
	th229	2.82E-10	3.21E-10	3.65E-10	4.13E-10	4.67E-10	
	th230	3.82E-06	3.85E-06	3.88E-06	3.90E-06	3.92E-06	
	th231	3.73E-09	3.93E-09	3.98E-09	4.02E-09	4.002-09	
	th232	6.15E-07	6.51E-07	6.888-07	(.25E-0/	1.03E-U/	
	th233	2.78E-14	5.99E-13	6.3/E-13	6.77E-13	7.1/E-13	
	th234	2.728-08	2.72E-08	2.72E-08	2.71E-08	2./12-08	
	pa231	2.10E-06	2.20E-06	2.29E-00	2.391-00	2.485-00	
	pa232	1.0/E-09	1.02E-UY	1.91E-09	2.UUE-U9	2.075.09	
	pa233	2.40E-08	2.322-08	2.035-00	0 215-17	0.216-17	
	pa234m	9.1/E-13	9.22E-13	9.22E-13	7.212-13	7.615-13	
	pazsa	1.0/2-12	2.22t-12	2.32E-12	2.415-12	2.315-12	

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actinides

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na235	005+00	005+00	006+00	006+00	00F+00	•
1.230	7 7/6-15	2 446-15	4 015-15	/ 785.15	4 775-15	
u230	3.346-13	J. DOE - 15	4.012-13	4.305-13	4.775-13	
u231	0.17E-14	0.032-14	7.47E-14	0.145°14	0.045-14	
u232	7.60E-07	8.28E-07	9.00E-07	9.75E-07	1.05E-06	
u233	4.66E-06	4.72E-06	4.78E-06	4.84E-06	4.90E-06	
u234	3.92E-01	3.86E-01	3.80E-01	3.74E-01	3.69E-01	
1235	2 75 =+01	2 655+01	2 565+01	2 47E+01	2 38F+01	
11274	7 495-00	7 975+00	7 076+00	9 105-00	8 335400	
u230	7.00ETUU	1.032400	7.776700	0. IUE + UU		,
u <u>237</u>	8.102-03	0.2/2-03	0.40E-US	8.04E-U3	8.81E-U3	
u238	1.84E+05	1.84E+03	1.84E+03	1.84E+03	1.84E+U3	
u239	2.96E-05	5.19E-04	5.22E-04	5.25E-04	5.29E-04	
u240	7.20E-25	1.02E-24	1.43E-24	1.99E-24	2.72E-24	
u241	005+00	00F+00	00E+00	00F+00	00F+00	
	1 585-08	1 705-08	1 825-08	1 0/5-08	2 045-08	
	4 455-00	4 0/5-00	5 205-00	5 /55-00	5 715-00	
npzzom	4.432-07	4.745-07	3.202-09	3.4JE-UF	J./1E-07	
np <u>cso</u>	8.01E-07	8.70E-U/	9.33E-0/	1.04E-00	1.128-00	
np237	6.99E-01	7.31E-01	7.63E-01	7.95E-01	8.27E-01	
np238	9.02E-04	9.64E-04	1.01E-03	1.06E-03	1.11E-03	
•						
sas2h:	babcock H	ilcox 15x15	i. 3.50wt%.	30awd/mti	u burn high temp	
DOMACE	7 25mu	buchun= 1	3020 mud	flux= 1 51	E+130/cm**2-sec	
power -	1.1.5.2.1004	bui nup-	3720. mwa,			arem stome
				nuctiae	concentracions,	gram acoms
				Dasis =	single reactor a	assemoly
	charge	1740.5 d	1800.5 d	1860.5 d	1920.5 0	
np239	7.36E-02	7.49E-02	7.54E-02	7.59E-02	7.63E-02	
np240m	6.19E-27	8.73E-27	1.22E-26	1.70E-26	2.33E-26	
np240	4.71E-07	1.40E-06	1.42E-06	1.44E-06	1.46E-06	
nn241	005+00	00F+00	00F+00	00F+00	00E+00	
01236	8 21E-07	R ROF-07	9 60F-07	1 036-06	1 11E-06	
pu230	2 445-07	2 015-07	3 195-07	7 475-07	3 746-07	
pu237	2.045-01	2.710-07	3.10E-07	3.545-01	3 775-01	
pu230	2.002-01	2.100-01	4.470.04	2.300-01	4 495+01	
puzay	1.152401	1.102701	1.1/2401	1.102701	1.102701	
pu240	3.60E+00	5.74E+UU	3.8/E+UU	3.99E+UU	4.11E+UU	
pu241	2.09E+00	2.16E+00	2.24E+00	2.32E+00	2.4UE+UU	
pu242	5.21E-01	5.66E-01	6.12E-01	6.59E-01	7.08E-01	
pu243	5.62E-05	7.47E-05	8.14E-05	8.83E-05	9.55E-05	
bu244	3.59E-14	5.10E-14	7.15E-14	9.90E-14	1.36E-13	
pu245	2.16E-20	3.47E-20	4.91E-20	6.85E-20	9.45E-20	
DU246	9.71F-23	1.42F-22	2.038-22	2.86F-22	3.98E-22	
am230	5 265-12	6 25F-12	A 70F-12	7 146-12	7 60F-12	
am2/0	1 045-00	2 145-00	2 325-00	2 475-00	2 435-00	
am240	1 148-01	1 3/5-01	1 736-01	1 705-01	1 475-01	
811241	2 / 25 07	1.24E-01	7 776 07	1.37E-01	7 4/8-07	
81124211	2.420-03	2.395-03	2.775-03	2.752-03	3.146-03	
amz4z	1.07E-04	1.236-04	1.31E-04	1.40E-04	1.49E-04	
am243	9.09E-02	1.02E-01	1.14E-01	1.2/E-01	1.4UE-UT	
am244m	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	
am244	3.09E-05	3.83E-05	4.31E-05	4.83E-05	5.39E-05	
am245	1.83E-18	2.57E-18	3.56E-18	4.89E-18	6.64E-18	
am246	2.43F-25	3-55F-25	5.07E-25	7.14F-25	9.95E-25	
cm241	A 17E-10	A 825-10	7 475-10	8 156-10	8 856-10	
	1 705-02	1 955-02	2 005-02	2 146-02	2 125-02	
CM242	1.105-02	1.032-02	2.000-02	E 145 0/	E 728-0/	
rm/43	1 1/P-0/		a.n. P - 116	3.10E-U4	J./2E-U4	
	3.66E-04	9.132-04	3 EOF 43	7 005 00	7 /82.03	
cm244	3.66E-04 1.91E-02	2.23E-02	2.59E-02	3.00E-02	3.45E-02	
cm244 cm245	3.66E-04 1.91E-02 5.77E-04	4.13E-04 2.23E-02 6.94E-04	2.59E-02 8.29E-04	3.00E-02 9.83E-04	3.45E-02 1.16E-03	
cm244 cm245 cm246	3.66E-04 1.91E-02 5.77E-04 4.73E-05	4.152-04 2.23E-02 6.94E-04 5.97E-05	2.59E-02 8.29E-04 7.47E-05	3.00E-02 9.83E-04 9.27E-05	3.45E-02 1.16E-03 1.14E-04	
cm244 cm245 cm246 cm247	3.66E-04 1.91E-02 5.77E-04 4.73E-05 6.40E-07	4.152-04 2.23E-02 6.94E-04 5.97E-05 8.38E-07	2.59E-02 8.29E-04 7.47E-05 1.09E-06	3.00E-02 9.83E-04 9.27E-05 1.39E-06	3.45E-02 1.16E-03 1.14E-04 1.77E-06	
cm244 cm245 cm246 cm247 cm248	3.66E-04 1.91E-02 5.77E-04 4.73E-05 6.40E-07 4.18E-08	4.15E-04 2.23E-02 6.94E-04 5.97E-05 8.38E-07 5.71E-08	2.59E-02 8.29E-04 7.47E-05 1.09E-06 7.72E-08	3.00E-02 9.83E-04 9.27E-05 1.39E-06 1.03E-07	3.45E-02 1.16E-03 1.14E-04 1.77E-06 1.37E-07	
cm244 cm245 cm245 cm247 cm248 cm248 cm249	3.66E-04 1.91E-02 5.77E-04 4.73E-05 6.40E-07 4.18E-08 1.03E-13	4.132-04 2.23E-02 6.94E-04 5.97E-05 8.38E-07 5.71E-08 4.02E-13	2.59E-02 8.29E-04 7.47E-05 1.09E-06 7.72E-08 5.47E-13	3.00E-02 9.83E-04 9.27E-05 1.39E-06 1.03E-07 7.37E-13	3.45E-02 1.16E-03 1.14E-04 1.77E-06 1.37E-07 9.83E-13	
cm244 cm245 cm246 cm246 cm247 cm248 cm249 cm250	3.66E-04 1.91E-02 5.77E-04 4.73E-05 6.40E-07 4.18E-08 1.03E-13 8.90E-17	4.13E-04 2.23E-02 6.94E-04 5.97E-05 8.38E-07 5.38E-07 5.71E-08 4.02E-13 1.28E-16	2.59E-02 8.29E-04 7.47E-05 1.09E-06 7.72E-08 5.47E-13 1.82E-16	3.00E-02 9.83E-04 9.27E-05 1.39E-06 1.03E-07 7.37E-13 2.56E-16	3.45E-02 1.16E-03 1.14E-04 1.77E-06 1.37E-07 9.83E-13 3.55E-16	

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4.71E-10	6.61E-10	9.17E-10	1.26E-09	1.71E-09	
1.12E-13	2.25E-13	3.14E-13	4.34E-13	5.94E-13	
6.50E-19	3.03E-18	4.27E-18	5.95E-18	8.19E-18	
1.08E-10	1.55E-10	2.20E-10	3.08E-10	4.26E-10	
5.76E-11	8.27E-11	1.17E-10	1.64E-10	2.26E-10	
3.23E-11	4.72E-11	6.81E-11	9.68E-11	1.36E-10	
1.17E-11	1.79E-11	2.69E-11	3.98E-11	5.80E-11	
1.01E-14	1.57E-14	2.39E-14	3.578-14	5.28E-14	
4.20E-18	6.67E-18	1.04E-17	1.59E-17	2.39E-17	
1.93E-22	6.45E-22	1.01E-21	1.56E-21	2.36E-21	
1.90E+03	1.89E+03	1.89E+03	1.89E+03	1.89E+03	
	1.60E+13	1.61E+13	1.62E+13	1.63E+13	
	4.71E-10 1.12E-13 6.50E-19 1.08E-10 5.76E-11 3.23E-11 1.17E-11 1.01E-14 4.20E-18 1.93E-22 1.90E+03	4.71E-10 6.61E-10 1.12E-13 2.25E-13 6.50E-19 3.03E-18 1.08E-10 1.55E-10 5.76E-11 8.27E-11 3.23E-11 4.72E-11 1.17E-11 1.79E-11 1.01E-14 1.57E-14 4.20E-18 6.67E-18 1.93E-22 6.45E-22 1.90E+03 1.89E+03 1.60E+13	4.71E-10 6.61E-10 9.17E-10 1.12E-13 2.25E-13 3.14E-13 6.50E-19 3.03E-18 4.27E-18 1.08E-10 1.55E-10 2.20E-10 5.76E-11 8.27E-11 1.17E-10 3.23E-11 4.72E-11 6.81E-11 1.17E-11 1.79E-11 2.69E-11 1.01E-14 1.57E-14 2.39E-14 4.20E-18 6.67E-18 1.04E-17 1.93E-22 6.45E-22 1.01E-21 1.90E+03 1.89E+03 1.89E+03 1.60E+13 1.61E+13	4.71E-10 6.61E-10 9.17E-10 1.26E-09 1.12E-13 2.25E-13 3.14E-13 4.34E-13 6.50E-19 3.03E-18 4.27E-18 5.95E-18 1.08E-10 1.55E-10 2.20E-10 3.08E-10 5.76E-11 8.27E-11 1.17E-10 1.64E-10 3.23E-11 4.72E-11 6.81E-11 9.68E-11 1.01E-14 1.57E-14 2.39E-14 3.57E-14 4.20E-18 6.67E-18 1.04E-17 1.59E-17 1.93E-22 6.45E-22 1.01E-21 1.56E-21 1.90E+03 1.89E+03 1.89E+03 1.60E+13 1.61E+13 1.62E+13	4.71E-10 6.61E-10 9.17E-10 1.26E-09 1.71E-09 1.12E-13 2.25E-13 3.14E-13 4.34E-13 5.94E-13 6.50E-19 3.03E-18 4.27E-18 5.95E-18 8.19E-18 1.08E-10 1.55E-10 2.20E-10 3.08E-10 4.26E-10 5.76E-11 8.27E-11 1.17E-10 1.64E-10 2.26E-10 3.23E-11 4.72E-11 6.81E-11 9.68E-11 1.36E-10 1.17E-11 1.79E-11 2.69E-11 3.98E-11 5.80E-11 1.01E-14 1.57E-14 2.39E-14 3.57E-14 5.28E-14 4.20E-18 6.67E-18 1.04E-17 1.59E-17 2.39E-17 1.93E-22 6.45E-22 1.01E-21 1.56E-21 2.36E-21 1.90E+03 1.89E+03 1.89E+03 1.89E+03 1.60E+13 1.61E+13 1.62E+13 1.63E+13

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sas2h: babcock wilcox 15x15, 3.50wt%, 30gwd/mtu burn high temp decay, following reactor irradiation identified by: power= 7.25mw, burnup= 13920.mwd, flux= 1.51E+13n/cm**2-sec 0 nuclide concentrations, gram atoms

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				basis =	single rea	ctor assem	bly
	initial	304.4 d	608.8 d	913.1 d	1217.5 d	1521.9 d	1826.3 d
he 4	6.00E-02	8.09E-02	8.96E-02	9.50E-02	9.96E-02	1.04E-01	1.08E-01
th230	3.92F-06	4.79E-06	5.66E-06	6.54E-06	7.42E-06	8.31E-06	9.20E-06
th232	7.63E-07	9.66F-07	1.17E-06	1.37E-06	1.57E-06	1.78E-06	1.98E-06
08231	2.48E-06	2.50F-06	2.52F-06	2.54F-06	2.56E-06	2.58F-06	2.60E-06
1232	1 055-06	1 255-06	1 405-06	1.526-06	1.62E-06	1.70E-06	1.76F-06
1233	4 Q0E-06	5 156-06	5 405-06	5.665-06	5 01F-06	6 17E-06	6.42E-06
1234	3 A0E-01	3 715-01	3 726-01	3 74F-01	3 76F-01	3 78E-01	3.806-01
1235	2 385+01	2 385+01	2 386+01	2 385+01	2 38F+01	2 385+01	2.38E+01
1236	8 236+01	8 235+00	8 235+00	8 23E+00	8 23F+00	8 235+00	8 23E+00
1238	1 8/6+03	1 846+03	1 845+03	1 84F+03	1 846+03	1 846+03	1 846+03
	1 125-04	1 125-04	1 125-04	1 125-06	1 125-04	1 125-06	1 125-06
np230	9 375-01	9 745-01	9 745-00	9 376-01	8 185-01	8 385.01	8 305-01
npzar	3 775-01	2 075-01	2 055-01	2 955-01	2 075-01	2 015-01	2 005-01
puzzo	2.//2-01	1 105+01	1 105+01	1 105+01	1 105+01	1 105+01	1 105+01
pu239	1.10ETU1	6 115+00	4 11E+00	4 11E+00	4 115+00	4 115+00	4 11E+00
pu240	4.11ETUU	3 715+00	3 22E+00	3 175+00	4.11E+00 2.05E+00	4.112700	1 905+00
pu241	2.4UE+UU	2.312400	2.225700	2.136700	2.036700	7.005.01	7 095 01
pu242	1.08E-01	7.UOE-01	7.000-01	1.000-01	7.00E-01	7.00E-01	6 50F 01
am241	1.4/E-01	2.42E-01	3.32E-01	4.196-01	5.05E-01	2.83E-01	0.39E-U1
am242m	3.14E-03	5.12E-05	3.11E-05	3.10E-03	3.09E-03	3.0/E-U3	3.U0E-U3
am243	1.40E-01	1.40E-01	1.40E-01	1.40E-01	1.40E-01	1.40E-01	1.40E-01
cm242	2.32E-02	6.40E-03	1.76E-03	4.88E-04	1.40E-04	4.40E-05	1.79E-05
cm243	5.72E-04	5.61E-04	5.49E-04	5.38E-04	5.28E-04	5.17E-04	5.07E-04
cm244	3.45E-02	3.35E-02	3.24E-02	3.14E-02	3.04E-02	2.95E-02	2.85E-02
cm245	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03	1.16E-03
cm246	1.14E-04	1. <u>14</u> E-04	1. <u>14</u> E-04	1. <u>14</u> E-04	1.14E-04	1. <u>14E-04</u>	1.14E-04
cm247	1.77E-06	1.77E-06	1.77E-06	1.77E-06	1.77E-06	1.77E-06	1.77E-D6
total	1.89E+03	1.89E+03	1.89E+03	1.89E+03	1.89E+03	1.89E+03	1.89E+03

Apr 08 12:17 1996 File Name: /users/hassler/wells/scale/o4040.res BBA000000-01717-0200-00016 REV. 00 ATTACHMENT IV - Page 1

=sas2h parm='halt8,skipcellwt,skipshipdata' SAS2H: Babcock Wilcox 15x15, 4.00wt%, 40gwd/mtu burn High Temp 44group latticecell	
/ / mixtures of fuel-pin-unit-cell: / den=mass U02/ Volume assembly = 526377.3 g/5.157524E4	
uo2 1 den=10.2060 1 975 92235 4.00 92234 0.0347 92236 0.0184 92238 95.	9469 end
Kr-85 1 U 1-2U 9/5 end kn-95 1 0 1-20 975 and	
RF-02 1 0 1-20 975 end	
y-89 1 0 1-20 975 end	
mo-95 1 0 1-20 975 end	
zr-93 1 0 1-20 975 end	
ZF-94 1 U 1-2U 9/3 End	
nb-94 1 0 1-20 975 end	
tc-99 1 0 1-20 975 end	
rh-103 1 0 1-20 975 end	
rh-105 1 0 1-20 975 end	
ru - 101 = 1 = 0 - 1 - 20 - 975 end	
Dd-105 1 0 1-20 975 end	
pd-108 1 0 1-20 975 end	
ag-109 1 0 1-20 975 end	
sb-124 1 0 1-20 975 end	
xe-131 1 0 1-20 975 end	
xe-135 1 0 1-20 975 end	
xe-136 1 0 1-20 975 end	
cs-134 1 0 1-20 975 end	
cs-135 1 0 1-20 975 end	
CS-137 I U 1-20 973 Eng	
la-139 1 0 1-20 975 end	
pr-141 1 0 1-20 975 end	
pr-143 1 0 1-20 975 end	
ce-144 1 U 1-2U 9/5 end	
nd-145 1 0 1-20 975 end	
pm-147 1 0 1-20 975 end	
pm-148 1 0 1-20 975 end	
nd-147 1 0 1-20 975 end	
SM-14/ 1 U 1-2U 9/3 ENG sm-14/ 1 0 1-2U 9/3 end	
sm 150 1 0 1-20 975 end 3	
sm-151 1 0 1-20 975 end	
sm-152 1 0 1-20 975 end	
gd-155 1 0 1-20 975 end	
eu-153 1 0 1-20 975 end	
eu-155 1 0 1-20 975 end	
h2o 3 den=0.6272 1 607.6 end	
arbm-bormod 0.6272 1 1 0 0 5000 100 3 552.6e-6 607.6 end	• .
arbm-zirc4 6.56 5 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40 40000 98.18 2 1.0 650.0 end	
(1050 mm basan	

end comp

Apr 08 12:17 1996 File Name: /users/hassler/wells/scale/o4040.res BBA000000-01717-0200-00016 REV. 00 ATTACHNENT IV - Page 2

fuel-pin-cell geometry: squarepitch 1.44272 0.936244 1 3 1.0922 2 0.95758 0 end / assembly and cycle parameters: npin/assm=208 fuelngth=360.172 ncycles=1 nlib/cyc=8 printlevel=5 inplevel=2 numztotal=4 end 3 0.63246 2 0.67310 3 0.814 500 2.961 power=7.25 burn=2560 down=1826.25 end end 1 sas2h: babcock wilcox 15x15, 4.00wt%, 40gwd/mtu burn high temp power= 7.25mw, burnup= 2320.mwd, flux= 1.32E+13n/cm**2-sec ۵ nuclide concentrations, gram atoms basis = single reactor assembly charge 80.0 d 160.0 d 240.0 d 320.0 d 320.0 d .00E+00 4.98E-06 2.00E-05 4.74E-05 9.25E-05 9.25E-05 .00E+00 1.11E-20 2.93E-20 5.17E-20 7.97E-20 7.96E-20 .00E+00 6.16E-17 4.05E-16 1.20E-15 2.59E-15 2.59E-15 .00E+00 4.70E-12 1.92E-11 4.47E-11 8.33E-11 8.33E-11 he 4 th226 th227 th228 2.25E-13 9.10E-13 4.12E-07 8.01E-07 .00E+00 2.08E-12 3.75E-12 3.75E-12 th229 1.17E-06 1.51E-06 1.51E-06 th230 .00E+00 .00E+00 4.12E-07 8.01E-07 1.7E-08 1.31E-08 1.31E-08 .00E+00 6.47E-10 9.43E-10 1.22E-09 1.48E-09 1.47E-09 .00E+00 4.21E-09 1.20E-08 2.32E-08 3.77E-08 3.77E-08 .00E+00 3.14E-15 8.89E-15 1.71E-14 2.77E-14 1.56E-14 .00E+00 2.48E-08 2.73E-08 2.75E-08 2.75E-08 2.75E-08 .00E+00 2.47E-08 6.47E-08 1.18E-07 1.84E-07 1.84E-07 .00E+00 1.65E-11 4.29E-11 7.81E-11 1.21E-10 1.21E-10 .00E+00 2.05E-09 2.05E-09 2.05E-09 2.05E-09 th231 th232 th233 th234 pa231 1.21E-10 1.21E-10 2.05E-09 2.05E-09 9.28E-13 9.28E-13 pa232 .00E+00 2.14E-10 6.96E-10 .00E+00 8.37E-13 9.21E-13 .00E+00 3.86E-13 4.51E-13 1.32E-09 9.28E-13 pa233 pa234m 4.90E-13 5.32E-13 5.29E-13 pa234 .00E+00 .00E+00 pa235 .00E+00 .00E+00 .00E+00 .00E+00 .00E+00 1.07E-17 2.84E-17 .00E+00 3.88E-16 8.10E-16 u230 5.01E-17 7.72E-17 7.72E-17 1.30E-15 1.89E-15 1.89E-15 u231 .00E+00 4.53E-09 9.78E-09 .00E+00 4.50E-07 8.65E-07 1.63E-08 2.44E-08 2.44E-08 1.25E-06 1.60E-06 1.60E-06 u232 u233 u234 6.88E-01 6.76E-01 6.64E-01 6.52E-01 6.40E-01 6.40E-01 u235 7.90E+01 7.60E+01 7.32E+01 7.05E+01 6.79E+01 6.79E+01 9.34E-01 1.48E+00 1.82E-03 2.29E-03 1.87E+03 1.87E+03 u236 3.62E-01 .00E+00 1.99E+00 2.48E+00 2.74E-03 3.18E-03 2.48E+00 3.17E-03 u237 u238 1.87E+03 1.87E+03 1.86E+03 1.86E+03 .00E+00 4.22E-04 4.18E-04 4.16E-04 4.15E-04 2.40E-04 u239 .00E+00 3.49E-39 6.05E-36 u240 4.65E-34 1.00E-32 1.00E-32 .00E+00 .00E+00 .00E+00 .00E+00 .00E+00 .00E+00 u241 .00E+00 1.96E-11 8.89E-11 2.13E-10 3.97E-10 3.97E-10 .00E+00 5.50E-11 1.33E-10 2.27E-10 3.36E-10 3.33E-10 np235 np236m .00E+00 5.42E-10 2.56E-09 6.39E-09 1.24E-08 1.24E-08 np236 1.11E-02 2.71E-02 4.64E-02 6.87E-02 6.87E-02 1.25E-05 3.03E-05 5.16E-05 7.63E-05 7.60E-05 np237 .00E+00 np238 .00E+00 .00E+00 6.09E-02 6.04E-02 6.00E-02 5.99E-02 5.98E-02 nb239

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np240m	.00E+00	2.98E-41	5.16E-38	3.96E-36	8.56E-35	8.56E-35	
np240	.00E+00	9.24E-07	9.09E-07	9.00E-07	8.96E-07	7.28E-07	
np241	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	
pu236	.00E+00	7.17E-10	3.36E-09	8.27E-09	1.58E-08	1.58E-08	
pu237	.00E+00	7.02E-10	2.21E-09	4.14E-09	6.47E-09	6.47E-09	
pu238	.00E+00	1.49E-04	7.08E-04	1.77E-03	3.41E-03	3.41E-03	
pu239	.00E+00	1.29E+00	2.46E+00	3.49E+00	4.39E+00	4.39E+00	
pu240	.00E+00	3.06E-02	1.10E-01	2.22E-01	3.55E-01	3.55E-01	
pu241	.00E+00	2.03E-03	1.42E-02	4.27E-02	9.03E-02	9.03E-02	
pu242	.00E+00	1.64E-05	2.31E-04	1.05E-03	3.00E-03	3.00E-03	
pu243	.00E+00	1.91E-09	2.67E-08	1.21E-07	3.45E-07	3.30E-07	
pu244	.00E+00	1.74E-28	3.01E-25	2.31E-23	5.00E-22	5.00E-22	
pu245	.00E+00	9.41E-35	1.62E-31	1.24E-29	2.67E-28	2.61E-28	
pu246	.00E+00	1.05E-37	2.76E-34	2.57E-32	6.19E-31	6.19E-31	
am239	.00E+00	2.00E-16	2.78E-15	1.25E-14	3.52E-14	3.46E-14	
am240	.00E+00	6.99E-14	9.69E-13	4.35E-12	1.23E-11	1.22E-11	

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sas2h:	babcock wi	ilcox 15x1	5, 4.00wt%,	, 40gwd/mtu	u burn high te	emp –
power=	7.25mw,	burnup= '	18560.mwd,	flux= 1.38	8E+13n/cm**2-s	sec .
				nuclide	concentration	ns, gram atoms
				basis =	single reacto	or assembly
	charge	2320.4 d	2400.4 d	2480.4 d	2560.4 d	
he 4	9.08E-02	1.03E-01	1.15E-01	1.29E-01	1.43E-01	
pb206	1.16E-14	-1.35E-14	1.56E-14	1.79E-14	2.05E-14	
pb207	9.81E-12	1.11E-11	1.25E-11	1.39E-11	1.55E-11	
pb208	1.01E-08	1.16E-08	1.33E-08	1.52E-08	1.73E-08	
pb209	1.66E-16	1.87E-16	2.11E-16	2.37E-16	2.65E-16	
bb210	3.33E-13	3.70E-13	4.10E-13	4.52E-13	4.98E-13	
bb211	5.50E-16	5.97E-16	6.45E-16	6.95E-16	7.46E-16	
bb212	1.18E-11	1.31E-11	1.45E-11	1.60E-11	1.75E-11	
pb214	5.84E-18	6.33E-18	6.63E-18	6.93E-18	7.23E-18	
Fa222	1.60E-19	1.74E-19	1.91E-19	2.08E-19	2.27E-19	
ra223	2.51E-13	2.72E-13	2.94E-13	3.17E-13	3.40E-13	
ra224	9.70E-11	1.08E-10	1.19E-10	1.32E-10	1.45E-10	
ra225	1.81E-14	2.07E-14	2.33E-14	2.61E-14	2.92E-14	
ra226	1.89E-10	1.99E-10	2.08E-10	2.18E-10	2.27E-10	
ra228	9.92E-17	1.08E-16	1.18E-16	1.27E-16	1.38E-16	
ac225	1.21E-14	1.38E-14	1.56E-14	1.75E-14	1.95E-14	
ac227	1.82E-10	1.97E-10	2.13E-10	2.29E-10	2.46E-10	
ac228	1.21E-20	1.32E-20	1.43E-20	1.55E-20	1.68E-20	
th226	7.79F-18	8.50E-18	9.31E-18	1.02E-17	1.11E-17	
th227	4.12E-13	4-47E-13	4.82E-13	5.19E-13	5.57E-13	
th228	1.84E-08	2.05E-08	2.27E-08	2.50E-08	2.75E-08	
th229	8.19E-10	9.42E-10	1.08E-09	1.23E-09	1.40E-09	
th230	4.75E-06	4.75E-06	4.74E-06	4.72E-06	4.70E-06	
th231	4.68E-09	4.92E-09	4.96E-09	4.99E-09	5.01E-09	
th232	1.05E-06	1.11E-06	1.18E-06	1.24E-06	1.30E-06	
th233	2.74E-14	1.04E-12	1.11E-12	1.18E-12	1.25E-12	
th234	2.69E-08	2.69E-08	2.68E-08	2.68E-08	2.68E-08	
pa231	3.47E-06	3.60E-06	3.73E-06	3.85E-06	3.97E-06	
pa232	2.74E-09	2.98E-09	3.12E-09	3.25E-09	3.38E-09	
pa233	3.62E-08	3.78E-08	3.94E-08	4.10E-08	4.26E-08	
pa234m	9.07E-13	9.14E-13	9.13E-13	9.13E-13	9.12E-13	
pa234	2.58E-12	3.18E-12	3.33E-12	3.47E-12	3.62E-12	

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375	005.00	005.00	005.00	005+00	005+00	
pa233	.UUETUU	- UUE+UU	0.075-15	0 945-15	1 075-14	
u230	1.346-13	0.245-13	9.032-13	7,002-13	1.076-14	
u231	1.375-13	1.795.04	1.075-04	2 005-04	2 245-04	
u232	1.040-00	1./05-00	4 395-00	4 775-04	2.24E-00 4 795-04	
u233	0.100-00	0.22E-UD	7 025 01	0.33E-00	7 775-01	
U234	4.072-01	3.99E-01	3.922-01	3.04E-UI	3.175-01	
u235	2.205+01	2.44E+U1	2.336+01	2.23E+U1	2.122701	
U230	9.74E+UU	9.89E+00	1.000+01	1.020+01	1.032701	
u237	9.//E-U3	9.04E-U3	1.012-02	1.036-02	1.035-02	
u230	1.022403	1.022+03	1.022703	1.01ETU3	1.012703	
u239	1./3E-U5	5.2UE-U4	2.23E-04	3.30E-04	2.34E-U4 2.025-27	
u240	1.37E-24	1.0/2-23	1.302-23	2.U/E-23	2.025-23	
U241	.UUE+UU	.002+00	.002+00	7 770 00	.002700	
np235	2.70E-08	2.90E-00	3.1/E-00	3.3/E-UO	3.305-00	
np230m	0.002-09	7.0UE-UY	1.99E-09	0.302-09	0./0E*U9 2.725-04	
np230	1.002-00	1.012-00	1.976-00	2.142-00	2.322-00	
npzar	1.032400	1.000+00	1.122700	1.1007	1.418-07	
npzsö	1.30E-03	1.406-03	1.4/2-05	1.346-03	1.012-03	
ese2h.	hebcock u	ilcov 15×1	5 4 004+%	60 aud/mts	u hurn high tem	סו
5032H.		hurnung	18560 mud	fluve 1 3	RF+13n/cm**2-se	ν Γ
power-	r - c 7000 j	bui nup-	10500.1880,	nuclide	concentrations	. gram atoms
				hasis =	single reactor	assembly
	charge	2320.4 d	2400.4 d	2480.4 d	2560.4 d	
np239	7.36E-02	7.51E-02	7.58E-02	7.65E-02	7.71E-02	
np240m	6.51E-26	9.15E-26	1.28E-25	1.77E-25	2.41E-25	
np240	3.91E-07	1.43E-06	1.46E-06	1.48E-06	1.51E-06	
np241	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	
pu236	1.57E-06	1.70E-06	1.83E-06	1.96E-06	2.10E-06	
pu237	5.33E-07	5.86E-07	6.41E-07	6.99E-07	7.59E-07	
pu238	3.88E-01	4.21E-01	4.56E-01	4.92E-01	5.29E-01	
pu239	1.27E+01	1.28E+01	1.28E+01	1.29E+01	1.29E+01	
pu240	4.45E+00	4.61E+00	4.75E+00	4.89E+00	5.01E+00	
pu241	2.73E+00	2.80E+00	2.88E+00	2.97E+00	3.06E+00	
pu242	8.46E-01	9.14E-01	9.84E-01	1.05E+00	1.13E+00	
pu243	8.53E-05	1.16E-04	1.27E-04	1.37E-04	1.48E-04	
pu244	3.77E-13	5.34E-13	7.46E-13	1.03E-12	1.41E-12	
pu245	2.09E-19	3.42E-19	4.83E-19	6.74E-19	9.29E-19	
pu246	9.42E-22	1.39E-21	1.98E-21	2.79E-21	3.90E-21	
am239	8.79E-12	1.05E-11	1.12E-11	1.18E-11	1.25E-11	
am240	5.51E-09	3.63E-09	3.86E-09	4.08E-09	4.30E-09	
am241	1.88E-01	1.99E-01	2.09E-01	2.19E-01	2.29E-01	
am242m	4.20E-05	4.43E-05	4.68E-U3	4.92E-U3	2.10E-U3	
80242	1.07t-04	1.90E-04	2.022-04	2.145-04	2.232-04	
8月1243 8月1243	1.0/6-01	2.000-01	2.302-01	2.742-01	005+00	
802448	4 155-05	7 405-05	8 415-05	0 505-05	1 075-04	
am244	1 755-17	2 446-17	3 346-17	6 505-17	A 20E-17	
am245	2 365-26	3 446-24	4 05E-24	A 085-24	0 735-24	
cm241	1 146-09	1 24F-00	1 346-09	1 456-09	1.56F-09	
cm242	2.925-02	3.14F-02	3.365-02	3.58E-02	3.81E-02	
cm243	8.04E-04	8.94E-04	9.89E-04	1.09E-03	1.19E-03	
cm244	5.19E-02	6.03E-02	6.96E-02	7.99E-02	9.13E-02	
cm245	1.95E-03	2.32E-03	2.75E-03	3.23E-03	3.77E-03	
cm246	2.08E-04	2.61E-04	3.24E-04	4.00E-04	4.89E-04	
cm247	3.66E-06	4.76E-06	6.14E-06	7.83E-06	9.90E-06	
cm248	3.27E-07	4.44E-07	5.98E-07	7.97E-07	1.05E-06	
cm249	6.78E-13	3.20E-12	4.36E-12	5.87E-12	7.82E-12	
cm250	8.89E-16	1.28E-15	1.82E-15	2.57E-15	3.57E-15	
cm251	1.61E-25	Z.74E-23	3.94E-23	5.6UE-23	7.86E-25	

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DK249	4.50E-09	6.2/E-09	8.66E-UY	1.18E-08	1.60E-08	
bk250	9.80E-13	2.09E-12	2.918-12	4.02E-12	5.48E-12	
bk251	4.54E-18	2.65E-17	3.74E-17	5.21E-17	7.17E-17	
cf249	1.25E-09	1.79E-09	2.51E-09	3.48E-09	4.78E-09	
cf250	6.01E-10	8.59E-10	1.21E-09	1.67E-09	2.29E-09	
cf251	3.91E-10	5.66E-10	8.08E-10	1.14E-09	1.58E-09	
cf252	1.80E-10	2.72E-10	4.06E-10	5.96E-10	8.63E-10	
cf253	1.62E-13	2.49E-13	3.77E-13	5.61E-13	8.23E-13	
cf254	7.00E-17	1.11E-16	1.71E-16	2.60E-16	3.89E-16	
cf255	2.86E-21	1.10E-20	1.71E-20	2.63E-20	3.97E-20	
otals	1.88E+03	1.88E+03	1.87E+03	1.87E+03	1.87E+03	
flux		1.52E+13	1.53E+13	1.55E+13	1.56E+13	
	bk249 bk250 cf251 cf250 cf251 cf252 cf253 cf254 cf255 cf255 cotals flux	bk249 4.50E-09 bk250 9.80E-13 bk251 4.54E-18 cf249 1.25E-09 cf250 6.01E-10 cf251 3.91E-10 cf252 1.80E-10 cf253 1.62E-13 cf254 7.00E-17 cf255 2.86E-21 cotals 1.88E+03 flux	bk249 4.50E-09 6.27E-09 bk250 9.80E-13 2.09E-12 bk251 4.54E-18 2.65E-17 cf249 1.25E-09 1.79E-09 cf250 6.01E-10 8.59E-10 cf251 3.91E-10 5.66E-10 cf252 1.80E-10 2.72E-10 cf253 1.62E-13 2.49E-13 cf254 7.00E-17 1.11E-16 cf255 2.86E-21 1.10E-20 cotals 1.88E+03 1.88E+03 flux 1.52E+13	bk249 4.50E-09 6.27E-09 8.66E-09 bk250 9.80E-13 2.09E-12 2.91E-12 bk251 4.54E-18 2.65E-17 3.74E-17 cf249 1.25E-09 1.79E-09 2.51E-09 cf250 6.01E-10 8.59E-10 1.21E-09 cf251 3.91E-10 5.66E-10 8.08E-10 cf252 1.80E-10 2.72E-10 4.06E-10 cf253 1.62E-13 2.49E-13 3.77E-13 cf254 7.00E-17 1.11E-16 1.71E-16 cf255 2.86E-21 1.10E-20 1.71E-20 cotals 1.88E+03 1.88E+03 1.87E+03 flux 1.52E+13 1.53E+13 1.53E+13	bk249 4.50E-09 6.27E-09 8.66E-09 1.18E-08 bk250 9.80E-13 2.09E-12 2.91E-12 4.02E-12 bk251 4.54E-18 2.65E-17 3.74E-17 5.21E-17 cf249 1.25E-09 1.79E-09 2.51E-09 3.48E-09 cf250 6.01E-10 8.59E-10 1.21E-09 1.67E-09 cf251 3.91E-10 5.66E-10 8.08E-10 1.14E-09 cf252 1.80E-10 2.72E-10 4.06E-10 5.96E-10 cf253 1.62E-13 2.49E-13 3.77E-13 5.61E-13 cf254 7.00E-17 1.11E-16 1.71E-16 2.60E-16 cf255 2.86E-21 1.10E-20 1.71E-20 2.63E-20 cotals 1.88E+03 1.87E+03 1.87E+03 1.55E+13	bk249 4.50E-09 6.27E-09 8.66E-09 1.18E-08 1.60E-08 bk250 9.80E-13 2.09E-12 2.91E-12 4.02E-12 5.48E-12 bk251 4.54E-18 2.65E-17 3.74E-17 5.21E-17 7.17E-17 cf249 1.25E-09 1.79E-09 2.51E-09 3.48E-09 4.78E-09 cf250 6.01E-10 8.59E-10 1.21E-09 1.67E-09 2.29E-09 cf251 3.91E-10 5.66E-10 8.08E-10 1.41E-09 1.58E-09 cf252 1.80E-10 2.72E-10 4.06E-10 5.96E-10 8.63E-10 cf253 1.62E-13 2.49E-13 3.77E-13 5.61E-13 8.23E-13 cf254 7.00E-17 1.11E-16 1.71E-16 2.60E-16 3.89E-16 cf255 2.86E-21 1.0E-20 1.71E-20 2.63E-20 3.97E-20 cotals 1.88E+03 1.87E+03 1.87E+03 1.87E+03 flux 1.52E+13 1.53E+13 1.55E+13 1.55E+13

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sas2h: babcock wilcox 15x15, 4.00wt%, 40gwd/mtu burn high temp decay, following reactor irradiation identified by: power= 7.25mw, burnup= 18560.mwd, flux= 1.38E+13n/cm**2-sec nuclide concentrations, grams basis =single reactor assembly initial 304.4 d 608.8 d 913.1 d 1217.5 d 1521.9 d 1826.3 d he 4 5.73E-01 7.15E-01 7.77E-01 8.17E-01 8.51E-01 8.83E-01 9.16E-01 page 49 0

pb208	3.60E-06	5.65E-06	8.34E-06	1.16E-05	1.55E-05	1.98E-05	2.45E-05
th228	6.27E-06	8.61E-06	1.09E-05	1.30E-05	1.48E-05	1.65E-05	1.79E-05
th230	1.08E-03	1.29E-03	1.49E-03	1.70E-03	1.91E-03	2.12E-03	2.34E-03
th232	3.01E-04	3.60E-04	4.19E-04	4.78E-04	5.37E-04	5.96E-04	6.55E-04
th234	6.26E-06	6.26E-06	6.26E-06	6.26E-06	6.26E-06	6.26E-06	6.26E-06
Da231	9.16E-04	9.22E-04	9.26F-04	9.30E-04	9.34E-04	9.38E-04	9.42E-04
De233	9.92E-06	9.81E-06	9.81F-06	9-82E-06	9.82E-06	9.83E-06	9-84E-06
u232	5.21E-04	6.05E-04	6.72E-04	7.25E-04	7.68E-04	8.01E-04	8.27E-04
u233	1.49E-03	1.57E-03	1.66E-03	1.75E-03	1.83E-03	1.928-03	2.00E-03
u234	8.82E+01	8.90E+01	8.99E+01	9.07E+01	9.16E+01	9.24E+01	9.33E+01
u235	4.99E+03	4.99E+03	4.99E+03	4.99E+03	4.99E+03	4.99E+03	4.99E+03
u236	2.43E+03	2.43E+03	2.43E+03	2.43E+03	2.43E+03	2.43E+03	2.43E+03
u237	2.49E+00	2.15E-05	2.06E-05	1.98E-05	1.908-05	1.83E-05	1.75E-05
u238	4.31E+05	4.31E+05	4.31E+05	4.31E+05	4.31E+05	4.31E+05	4.31E+05
np236	5.48E-04	5.48E-04	5.48E-04	5.48E-04	5.48E-04	5.48E-04	5.48E-04
np237	2.86E+02	2.89E+02	2.89E+02	2.89E+02	2.89E+02	2.89E+02	2.90E+02
np239	1.84E+01	5.84E-05	5.84E-05	5.84E-05	5.84E-05	5.84E-05	5.84E-05
pu236	4.96E-04	4.07E-04	3.34E-04	2.73E-04	2.24E-04	1.84E-04	1.50E-04
pu238	1.26E+02	1.32E+02	1.33E+02	1.33E+02	1.32E+02	1.31E+02	1.30E+02
pu239	3.08E+03	3.10E+03	3.10E+03	3.10E+03	3.10E+03	3.10E+03	3.10E+03
pu240	1.20E+03	1.20E+03	1.20E+03	1.20E+03	1.21E+03	1.21E+03	1.21E+03
pu241	7.37E+02	7.08E+02	6.80E+02	6.53E+02	6.27E+02	6.03E+02	5.79E+02
pu242	2.73E+02	2.73E+02	2.73E+02	2.73E+02	2.73E+02	2.73E+02	2.73E+02
am241	5.51E+01	8.41E+01	1.12E+02	1.39E+02	1.64E+02	1.89E+02	2.12E+02
am242m	1.25E+00	1.24E+00	1.24E+00	1.23E+00	1.23E+00	1.22E+00	1.22E+00
am242	5.45E-02	1.61E-05	1.60E-05	1.59E-05	1.59E-05	1.58E-05	1.57E-05
am243	6.79E+01	6.79E+01	6.79E+01	6.79E+01	6.79E+01	6.79E+01	6.79E+01
cm242	9.22E+00	2.54E+00	6.99E-01	1.94E-01	5.54E-02	1.75E-02	7.10E-03
cm243	2.89E-01	2.83E-01	2.78E-01	2.72E-01	2.67E-01	2.61E-01	2.56E-01
cm244	2.23E+01	2.16E+01	2.09E+01	2.03E+01	1.96E+01	1.90E+01	1.84E+01
cm245	9.23E-01	9.23E-01	9.23E-01	9.23E-01	9.23E-01	9.23E-01	9.23E-01
cm246	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01
cm247	2.45E-03	2.45E-03	2.45E-03	2.45E-03	2.45E-03	2.45E-03	2.45E-03
cm248	2.61E-04	2.61E-04	2.61E-04	2.61E-04	2.61E-04	2.61E-04	2.61E-04
cf249	1.19E-06	3.11E-06	4.10E-06	4.60E-06	4.86E-06	4.99E-06	5.05E-06
total	4.45E+05	4.45E+05	4.45E+05	4.45E+05	4.45E+05	4.45E+05	4.45E+05

·=sas2h SAS2H: Babco 44group /	parm='halt8 ock Wilcox latticecell	,skipcellwt,skips 15x15, 4.00wt%, 4	hipdata' 5gwd/mtu burn H	ligh Temp	
/ mixtures / den=mas: uo2 1 den=10 kr-83 1 kr-85 1	of fuel-pin s U02/ Volu 0.2060 1 97 0 1-20 975 0 1-20 975	n-unit-cell: me assembly = 526 5 92235 4.00 9223 end end	377.3 g/5.15752 4 0.0347 92236	4E4 0.0184 92238 9	5.9469 end
sr-90 1 y-89 1 mo-95 1 zr-93 1	0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975	end end end			
zr-94 i zr-95 1 nb-94 1 tc-99 1 cb-103 1	0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975	end end end end			
rh-105 1 ru-101 1 ru-106 1 pd-105 1	0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975	end end end end			
pd-108 1 ag-109 1 sb-124 1 xe-131 1	0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975	end end end end			
xe-132 1 xe-135 1 xe-136 1 cs-134 1 cs-135 1	0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975	end end end end			
cs-137 1 ba-136 1 la-139 1 pr-141 1	0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975	end end end end			
pr-143 1 ce-144 1 nd-143 1 nd-145 1	0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975	end end end end			
pm-148 1 nd-147 1 sm-147 1 sm-147 1	0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975	end end end end			
sm-150 1 sm-151 1 sm-152 1 gd-155 1	0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975 0 1-20 975	end end end			
eu-153 1 eu-154 1 eu-155 1 h2o 3 esta-borrad	u 1-20 975 0 1-20 975 0 1-20 975 den=0.6272 0 6272 1 1	end end end 1 607.6 end 0 0 5000 100 3 5	52 Ke-6 607 K e	nd	
arbm-zirc4	6.56 5 0 0	0 8016 0.12 2400 40000 98.18 2	0 0.10 26000 0. 1.0 650.0 end	20 50000 1.40 I	•

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end comp

Apr 05 10:13 1996 File Name: /users/hassler/wells/scale/o4045.res BBA000000-01717-0200-00016 REV. 00 ATTACHMENT V - Page 2

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. . **. . . .** 1 - - -- --1 fuel-pin-cell geometry:

squarepitch 1.44272 0.936244 1 3 1.0922 2 0.95758 0 end

/ assembly and cycle parameters:

npin/assm=208 fuelngth=360.172 ncycles=1 nlib/cyc=8 printlevel=5 inplevel=2 numztotal=4 end 3 0.63246 2 0.67310 3 0.814 500 2.961 power=7.25 burn=2880 down=1826.25 end

end

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0

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sas2h:	babcock w	ilcox 15x15	5, 4.00wt%,	, 45gwd/mti	u burn high	temp	
power=	7.25mW,	burnup≖	2010. mwa ,	TLUX= 1.3	264130/00**	2-sec	
				nuclide	concentrat	ions, gram	atoms
				basis ≖	single rea	ctor assemb	ily –
	charge	90.0 d	180.0 d	270.0 d	360.0 d	360.0 d	
he 4	.00E+00	6.30E-06	2.56E-05	6.19E-05	1.25E-04	1.25E-04	
th226	.00E+00	1.33E-20	3.48E-20	6.20E-20	9.72E-20	9.72E-20	
th227	.00E+00	8.52E-17	5.56E-16	1.65E-15	3.55E-15	3.55E-15	
th228	.00E+00	5.99E-12	2.46E-11	5.78E-11	1.09E-10	1.09E-10	
th229	.00E+00	2.87E-13	1.16E-12	2.66E-12	4.82E-12	4.82E-12	
th230	00F+00	4.62E-07	8.94E-07	1.30E-06	1.67E-06	1.67E-06	
th231	00E+00	6.86E-10	1.02E-09	1.32E-09	1.61E-09	1.60E-09	
th232	00F+00	4.99E-09	1.45E-08	2.83E-08	4.61E-08	4.61E-08	
th233	.00E+00	3.74E-15	1.08E-14	2.09E-14	3.40E-14	1.78E-14	
th234	00F+00	2.55E-08	2.74E-08	2.75E-08	2.75E-08	2.75E-08	
na231	.00E+00	2.89E-08	7.718-08	1.42E-07	2.22E-07	2.22E-07	
pa232	.00F+00	1.93F-11	5.11E-11	9.38E-11	1.46E-10	1.458-10	
08233	_00F+00	2.64E-10	8.40E-10	1.58E-09	2.46E-09	2.46E-09	
na234m	00F+00	8.61F-13	9.24F-13	9.29E-13	9.28F-13	9.28F-13	
na234	00F+00	4.00E-13	4.62E-13	5.06E-13	5.56E-13	5.51E-13	
na235	005+00	.00E+00	00F+00	.00F+00	.00F+00	00F+00	
1230	00F+00	1.29F-17	3.37F-17	6.01E-17	9.42E-17	9.42F-17	
1231	005+00	4 43E-16	9 35F-16	1.52E-15	2.26F-15	2 25F-15	
1232	00F+00	5.16F-09	1.13F-08	1.92F-08	2.94F-08	2.94F-08	
1233	005+00	5-07E-07	9.69F-07	1.39E-06	1.78F-06	1.78E-06	
1234	A 88E-01	6 74E-01	6 61F-01	6.48E-01	6.35E-01	6 35F-01	
1235	7 905+01	7.57F+01	7.25F+01	6.95E+01	6.66E+01	6.66E+01	
1236	3.625-01	1.00F+00	1.61E+00	2.18E+00	2.72E+00	2.72F+00	
1237	005+00	1.88F-03	2.41E-03	2.91F-03	3.39F-03	3.386-03	
1238	1 87F+03	1.87F+03	1.87F+03	1.86E+03	1.86E+03	1.86F+03	
1230	005+00	4.23F-04	4.19F-04	4.17E-04	4.16F-04	2.25F-04	
1240	005+00	1.25F-38	2.16F-35	1.65E-33	3.54E-32	3.54F-32	
11241	005+00	.00E+00	.00F+00	.00E+00	.00E+00	.00F+00	
np235	00F+00	2.56F-11	1.16F-10	2.77E-10	5.16E-10	5.16F-10	
nn236m	005+00	6-45E-11	1.57F-10	2.69F-10	3.99F-10	3.95F-10	
np236	00E+00	7.128-10	3.36E-09	8.43E-09	1.64E-08	1.64E-08	
np237	00F+00	1.29F-02	3.17E-02	5.45E-02	8.11E-02	8.11F-02	
np238	005+00	1.46E-05	3.54E-05	6.07E-05	9.01E-05	8.97E-05	

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np239	.00E+00	6.11E-02	6.05E-02	6.02E-02	6.00E-02	5.99E-02	
np240m	.00E+00	1.07E-40	1.84E-37	1.41E-35	3.02E-34	3.02E-34	
np240	.00E+00	9.29E-07	9.12E-07	9.04E-07	9.00E-07	7.14E-07	
np241	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	
pu236	.00E+00	9.42E-10	4.40E-09	1.08E-08	2.07E-08	2.07E-08	
ou237	00E+00	8-69E-10	2.68E-09	5.01E-09	7.87E-09	7.87E-09	
01238	00E+00	1.95E-04	9.26F-04	2.32F-03	4.48E-03	4.48E-03	
nu239	.00F+00	1.45F+00	2.74F+00	3.86E+00	4.82E+00	4.82E+00	
01240	005+00	3 82F-02	1 35E-01	2.70E-01	4.28F-01	4.28F-01	
DU241	005+00	2 826-03	1 05E-02	5 78F-02	1.21F-01	1.21F-01	
pu247	005-00	2 545-05	3 545-04	1 605-03	4 54F-03	4 54F-03	
pu242	005+00	3 005-00	6 135-08	1 856-07	5 236-07	4 98F-07	
puzas	.000000	J.UUE-U7	4.136-00	1.0JE-07	1 7/F 34	4 745 34	
puz44	.UUE+UU	D.232-20	1.0/6-24	0.22E-23	1.702-21	1./DE-21	
pu245	.00E+00	3.37E-34	5.76E-31	4.38E-29	9.39E-28	9.18E-28	
pu246	.00E+00	4.08E-37	1.05E-33	9.55E-32	2.27E-30	2.27E-30	
am239	.00E+00	3.15E-16	4.31E-15	1.91E-14	5.33E-14	5.23E-14	
em240	005+00	1 105-13	1 506-12	6 67E-12	1 86F-11	1.85F-11	
			I SAVE IE	VIVIL IL			

sas2h: power=	babcock w ^a 7,25mw.	ilcox 15x15 burnup= 2	, 4.00wt%, 0880.mwd.	, 45gwd/mtu flux= 1.40	u burn high tei DE+13n/cm**2-si	np ec
P •				nuclide	concentration	s. gram atoms
				hasis =	single reactor	rassembly
	charge	2610.4 d	2700.4 d	2790.4 d	2880_4 d	
he 4	1.365-01	1.53F-01	1.72E-01	1.91F-01	2.11E-01	•
pb206	1 92F-14	2.23F-14	2.57F-14	2.96E-14	3.38E-14	•
pb207	1.47E-11	1.66F-11	1.86F-11	2.08E-11	2.31E-11	
pb208	1.63E-08	1.88E-08	2.15E-08	2.45E-08	2.78E-08	
bb209	2.51E-16	2.84E-16	3.20E-16	3.59E-16	4.00E-16	
bb210	4.76E-13	5.29E-13	5.86E-13	6.47E-13	7.11E-13	
bb211	7.21E-16	7.80E-16	8.40E-16	9.02E-16	9.65E-16	
66212	1.68E-11	1.86E-11	2.05E-11	2.26E-11	2.47E-11	
bb214	6.86E-18	7.41E-18	7.75E-18	8.08E-18	8.41E-18	
ra222	2.20E-19	2.39E-19	2.61E-19	2.85E-19	3.09E-19	
ra223	3.29E-13	3.56E-13	3.83E-13	4.11E-13	4.40E-13	
ra224	1.38E-10	1.54E-10	1.70E-10	1.86E-10	2.04E-10	
ra225	2.75E-14	3.14E-14	3.53E-14	3.96E-14	4.42E-14	
ra226	2.22E-10	2.33E-10	2.43E-10	2.54E-10	2.64E-10	
ra228	1.32E-16	1.44E-16	1.56E-16	1.69E-16	1.82E-16	
ac225	1.84E-14	2.10E-14	2.36E-14	2.65E-14	2.95E-14	
ac227	2.38E-10	2.56E-10	2.76E-10	2.95E-10	3.16E-10	
ac228	1.62E-20	1.76E-20	1.91E-20	2.06E-20	2.23E-20	
th226	1.07E-17	1.17E-17	1.28E-17	1.39E-17	1.51E-17	
th227	5.39E-13	5.82E-13	6.26E-13	6.72E-13	7.19E-13	
th228	2.63E-08	2.92E-08	3.22E-08	3.54E-08	3.88E-08	
th229	1.31E-09	1.51E-09	1.73E-09	1.98E-09	2.26E-09	
th230	4.70E-06	4.67E-06	4.64E-06	4.60E-06	4.55E-06	
th231	4.76E-09	4.98E-09	5.00E-09	5.00E-09	5.00E-09	
th232	1.27E-06	1.34E-06	1.41E-06	1.48E-06	1.55E-06	
th233	3.40E-14	1.29E-12	1.38E-12	1.46E-12	1.55E-12	
th234	2.68E-08	2.67E-08	2.67E-08	2.67E-08	2.66E-08	
pa231	3.92E-06	4.04E-06	4.17E-06	4.28E-06	4.39E-06	
pa232	3.19E-09	3.46E-09	3.60E-09	3.74E-09	3.88E-09	
pa233	4.19E-08	4.37E-08	4.54E-08	4.72E-08	4.89E-08	

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pa234m pa235 u230 u231 u232 u233 u234 u235 u236 u237 u238 u239 u240 u241 np235 np236m np236m	9.03E-13 3.00E-12 .00E+00 1.04E-14 1.87E-13 2.17E-06 6.38E-06 3.80E-01 2.18E+01 1.02E+01 1.02E+01 1.02E+01 3.50E-08 8.16E-09 2.25E-06 1.54E-03	9.12E-13 3.71E-12 .00E+00 1.13E-14 2.05E-36 6.43E-06 3.72E-01 2.06E+01 1.04E+01 1.04E+01 1.05E-02 1.81E+03 5.35E-04 3.47E-23 .09E+00 3.74E-08 9.09E-09 2.45E-06 1.24E+00 1.65E-03	9.11E-13 3.88E-12 .00E+00 1.24E-14 2.54E-06 3.64E-01 1.96E+01 1.96E+01 1.05E+01 1.05E+01 1.05E+01 3.64E-04 4.82E-23 .00E+00 3.97E-08 9.55E-09 2.67E-06 1.28E+00 1.73E-03	9.11E-13 4.05E-12 .00E+00 1.35E-14 2.44E-13 2.74E-06 3.56E-01 1.85E+01 1.06E+01 1.06E+01 1.06E+01 5.46E-03 5.46E-04 6.64E-23 .00E+00 4.21E-08 1.00E-08 2.90E-06 1.33E+00 1.81E-03	9.10E-13 4.22E-12 .00E+00 1.46E-14 2.65E-13 2.94E-06 6.55E-06 3.49E-01 1.75E+01 1.75E+01 1.1E-02 1.80E+03 5.51E-04 9.02E-23 .00E+00 4.46E-08 1.05E-08 3.14E-06 1.38E+00 1.89E-03	•
npzoo	1.246703	1.075-03	1.732-03	1.012-05	1.072-03	
sas2h: power≖	babcock w 7.25mw,	ilcox 15x1 burnup=	5, 4.00wt% 20880.mwd,	, 45gwd/mtu flux= 1.40 nuclide	u burn high ter DE+13n/cm**2-se concentration	np ec s, gram atoms
	charge	2610.4 d	2700.4 d	2790.4 d	2880.4 d	r assembly
np239	7.58E-02	7.73E-02	7.81E-02	7.89E-02	7.96E-02	
np240m	2.11E-25	2.96E-25	4.12E-25	5.66E-25	7.70E-25	
np240	4.156-07	1.526-00	1.336-00	1.386-00	1.012-00	
nu236	2.05E-06	2.218-06	2.37E-06	2.54E-06	2.72E-06	
bu237	7.35E-07	8.06E-07	8.81E-07	9.59E-07	1.04E-06	
pu238	5.13E-01	5.56E-01	6.00E-01	6.46E-01	6.93E-01	
pu239	1.30E+01	1.30E+01	1.30E+01	1.31E+01	1.31E+01	
pu240	4.93E+00	5.10E+00	5.24E+00	5.58E+00	5.50E+00 7 75E+00	
pu241	3.04E+00	1.175+00	1.26E+00	1.34F+00	1.43E+00	
pu243	1.10E-04	1.49E-04	1.61E-04	1.74E-04	1.87E-04	
pu244	1.22E-12	1.73E-12	2.40E-12	3.30E-12	4.49E-12	
pu245	7.01E-19	1.15E-18	1.62E-18	2.25E-18	3.09E-18	
pu246	3.29E-21	4.848-21	6.91E-21	9.72E-21	1.358-20	
8M239	4 125-00	4.485-09	4.74F-09	4.98F-09	5.228-09	
am241	2.25E-01	2.36E-01	2.46E-01	2.56E-01	2.66E-01	
am242m	5.10E-03	5.33E-03	5.58E-03	5.828-03	6.06E-03	
am242	2.03E-04	2.31E-04	2.44E-04	2.57E-04	2.69E-04	
am243	2.688-01	2.96E-01	3.26E-01	3.58E-U1	5.928-01	
am244m	8.98E-05	1.11F-04	1.24F-04	1.38E-04	1.52E-04	
am245	5.46E-17	7.57E-17	1.04E-16	1.41E-16	1.90E-16	
am246	8.24E-24	1.21E-23	1.73E-23	2.43E-23	3.38E-23	
cm241	1.528-09	1.64E-09	1.77E-09	1.90E-09	2.03E-09	
CM242	3./12*02	3.90E-U2 1 26E-03	4.20E-02	4.47E-02	4.702-02	
cm244	8.62E-02	9.95E-02	1.14E-01	1.31E-01	1.48E-01	
cm245	3.54E-03	4.18E-03	4.91E-03	5.72E-03	6.64E-03	
cm246	4.46E-04	5.58E-04	6.90E-04	8.46E-04	1.03E-03	
CM24/	0.93E-00	1.156-05	1.40E-05	1.0/E-U5 2 245.04	2.302-U3 2 055.06	
cm249	2.00E-12	9.39E-12	1.27E-11	1.71E-11	2.27E-11	

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actinides

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cm250	3.07E-15	4.41E-15	6.27E-15	8.80E-15	1.22E-14
cm251	5.73E-25	9.78E-23	1.41E-22	1.99E-22	2.80E-22
bk249	1.41E-08	1.95E-08	2.68E-08	3.64E-08	4.89E-08
bk250	3.17E-12	6.72E-12	9.33E-12	1.28E-11	1.74E-11
bk251	1.52E-17	8.85E-17	1.24E-16	1.73E-16	2.37E-16
cf249	4.17E-09	5.91E-09	8.24E-09	1.13E-08	1.55E-08
cf250	1.99E-09	2.83E-09	3.95E-09	5.44E-09	7.41E-09
cf251	1.37E-09	1.97E-09	2.79E-09	3.89E-09	5.37E-09
cf252	7.30E-10	1.10E-09	1.63E-09	2.37E-09	3.41E-09
cf253	6.90E-13	1.05E-12	1.58E-12	2.34E-12	3.41E-12
cf254	3.20E-16	5.03E-16	7.73E-16	1.17E-15	1.74E-15
cf255	1.35E-20	5.14E-20	8.00E-20	1.22E-19	1.83E-19
totals	1.87E+03	1.87E+03	1.86E+03	1.86E+03	1.86E+03
flux		1.57E+13	1.59E+13	1.60E+13	1.62E+13

1	sas2h: decay, foll	babcock wi owing reac	lcox 15x15 tor irradi	, 4.00wt%, ation iden	45gwd/mtu tified by:	burn high	temp 7.25mw, bu	irnup= 2088	0.mwd, flux	actinides = 1.40E+13n/cm**2-sec
ų	•				haeie z	eingle res	ctor aggem	hlv		
		initial	304 4 4	608 8 d	913 1 d	1217.5 d	1521.9 d	1826.3 d		
	he 4	8.46F-01	1.03E+00	1.11E+00	1.16E+00	1.21E+00	1.25E+00	1.29E+00		
	nb208	5.79F-06	8.62F-06	1.23E-05	1.66E-05	2.17E-05	2.74E-05	3.37E-05		
	th228	8.85E-06	1.17E-05	1.468-05	1.72E-05	1.96E-05	2.17E-05	2.35E-05		
	th230	1.05E-03	1.24E-03	1.43E-03	1.62E-03	1.82E-03	2.02E-03	2.22E-03		
	th232	3.60E-04	4.22E-04	4.83E-04	5.44E-04	6.06E-04	6.67E-04	7.29E-04		
	th234	6.23E-06	6.23E-06	6.23E-06	6.23E-06	6.23E-06	6.23E-06	6.23E-06		
	pa231	1.01E-03	1.02E-03	1.02E-03	1.03E-03	1.03E-03	1.03E-03	1.04E-03		
	pa233	1.14E-05	1.12E-05	1.12E-05	1.12E-05	1.12E-05	1.12E-05	1.12E-05		
	u232	6.83E-04	7.91E-04	8.78 E-04	9.47E-04	1.00E-03	1.04E-03	1.08E-03		
	u233	1.53E-03	1.62E-03	1.72E-03	1.82E-03	1.92E-03	2.02E-03	2.12E-03		
	u234	8.16E+01	8.27E+01	8.38E+01	8.50E+01	8.61E+01	8.72E+01	8.83E+01		
	u235	4.12E+03	4.12E+03	4.12E+03	4.12E+03	4.12E+03	4.12E+03	4.12E+03		
	u236	2.53E+03	2.53E+03	2.53E+03	2.53E+03	2.53E+03	2.53E+05	2.53E+03		
	u237	2.64E+00	2.35E-05	2.26E-05	2.17E-05	2.09E-05	2.00E-05	1.92E-05		
	u238	4.29E+05	4.29E+05	4.292+05	4.29E+U5	4.292+05	4.29E+U5	4.292+05		
	np235	1.05E-05	6.15E-06	3.61E-06	2.12E-00	1.24E-UO	7.316-07	4.29E-U/		
	np230	7.40E-04	7.40E-04	7.40E-04	7.405-04	7.402-04	7.405-04	7.9UE-04 7.70E+03		
	np237	J.20E+U2	3.29ETU2 8 10E-05	3.29ETU2 8 10E-05	3.27ETU2 8 105-05	9.105-05	9 10c-05	9 10E-05		
	np239	4 425-04	0.17E-07 5 37E-04	6.175-03	3 545-05	2 005-04	2 375-04	1 055-04		
	pu230	1 455-04	1 725+02	4.325-04	1 736-09	1 725+02	1 715+07	1 705+02		
	pu230	3 126+02	3 145+03	3 145+03	3 146+03	3 14F+03	3 146+03	3 14F+03		
	pu240	1 326+03	1 326+03	1 325+03	1.32E+03	1.32F+03	1.326+03	1.33E+03		
	pu241	8.08E+02	7.76F+02	7.465+02	7.16E+02	6.88E+02	6.61E+02	6.35E+02		
	pu242	3.46E+02	3.46E+02	3.46E+02	3.46E+02	3.46E+02	3.46E+02	3.46E+02	•	
	am241	6.40E+01	9.58E+01	1.26E+02	1.56E+02	1.84E+02	2.10E+02	2.36E+02		
	am242m	1.47E+00	1.46E+00	1.46E+00	1.45E+00	1.44E+00	1.44E+00	1.43E+00		
	am242	6.51E-02	1.89E-05	1.88E-05	1.87E-05	1.86E-05	1.86E-05	1.85E-05		
	am243	9.51E+01	9.52E+01	9.52E+01	9.52E+01	9.52E+01	9.51E+01	9.51E+01		
	cm242	1.14E+01	3.14E+00	8.62E-01	2.39E-01	6.82E-02	2.14E-02	8.57E-03		
	cm243	3.98E-01	3.90E-01	3.82E-01	3.74E-01	3.67E-01	3.59E-01	3.52E-01		
	cm244	3.62E+01	3.51E+01	3.40E+01	3.29E+01	3.19E+01	3.09E+01	2:99E+01		
	cm245	1.63E+00	1.63E+00	1.63E+00	1.63E+00	1.63E+00	1.63E+00	1.62E+00		
	cm246	2.53E-01	2.53E-01	2.53E-01	2.55E-01	2.55E-01	2.55E-01	Z.55E-01		
	Cm247	5.82E-03	5.82E-03	5.82E-03	5.82E-05	3.82E-US	3.82E-U3	5.828-05		

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cm248	7.31E-04	7.31E-04	7.31E-04	7.32E-04	7.32E-04	7.32E-04	7.32E-04	
cf249	3.85E-06	9.72E-06	1.27E-05	1.43E-05	1.51E-05	1.55E-05	1.57E-05	
cf250	1.85E-06	1.78E-06	1.70E-06	1.63E-06	1.56E-06	1.49E-06	1.42E-06	
cf251	1.35E-06	1.35E-06	1.35E-06	1.35E-06	1.35E-06	1.34E-06	1.34E-06	
total	4.42E+05	4.42E+05	4.42E+05	4.42E+05	4.42E+05	4.42E+05	4.42E+05	

Apr 05 10:26 1996 File Name: /users/hassler/wells/scale/o4245.res BBA000000-01717-0200-00016 REV. 00 ATTACHMENT VI - Page 1

=sas2h parm=/halt8,skipcellwt,skipshipdata/	
SAS2H: BADCOCK WILCOX IDXID, 4.20WT%, 40gWd/mtu burn mign iemp Afgroup latticecali	
/ mixtures of fuel-pin-unit-cell:	
<pre>/ den=mass U02/ Volume assembly = 526377.3 g/5.157524E4</pre>	
uo2 1 den=10.2060 1 975 92235 4.20 92234 0.0366 92236 0.0193 92238 95.7441 e	nd
kr-83 1 0 1-20 975 end	
kr-85 1 0 1-20 975 end	
sr-90 1 0 1-20 9/5 end	
y-cy 101-2097 end	
77-93 1 0 1-20 975 end	
zr-94 1 0 1-20 975 end	
zr-95 1 0 1-20 975 end	
nb- <u>94</u> 1 0 1-20 975 end	
tc-99 1 0 1-20 975 end	
rn-103 1 0 1-20 975 end	
ru-103 1 0 1-20 973 end	
ru-106 1 0 1-20 975 end	
pd-105 1 0 1-20 975 end	
pd-108 1 0 1-20 975 end	
ag-109 1 0 1-20 975 end	
sb-124 1 0 1-20 975 end	
Xe-151 1 U 1-2U 9/5 end	
xe-125 1 0 1-20 975 end	
xe-136 1 0 1-20 975 end	
cs-134 1 0 1-20 975 end	
cs-135 1 0 1-20 975 end	
cs-137 1 0 1-20 975 end	
ba-136 1 U 1-2U 9/5 end	
La-139 1 U 1-2U 9/3 end	
pr-141 1 0 1-20 975 end	
ce-144 1 0 1-20 975 end	
nd-143 1 0 1-20 975 end	
nd-145 1 0 1-20 975 end	
pm-147 1 0 1-20 975 end	
pm-148 1 U 1-2U 9/3 end =	
sm-147 1 0 1-20 975 end	
sm-149 1 0 1-20 975 end	
sm-150 1 0 1-20 975 end	
sm-151 1 0 1-20 975 end	
sm-152 1 0 1-20 975 end	
ga-155 1 0 1-20 9/5 end	
eu-155 1 0 1-20 975 end	
eu-155 1 0 1-20 975 end	
h2o 3 den=0.6272 1 607.6 end	
arbm-bormod 0.6272 1 1 0 0 5000 100 3 552.6e-6 607.6 end	•
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40	
40000 90.10 2 1.0 000.0 end	
1050 ppm boron	

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squarepitch 1.44272 0.936244 1 3 1.0922 2 0.95758 0 end

/ assembly and cycle parameters:

.

npin/assm=208 fuelngth=360.172 ncycles=1 nlib/cyc=8 printlevel=5 inplevel=2 numztotal=4 end 3 0.63246 2 0.67310 3 0.814 500 2.961 power=7.25 burn=2880 down=1826.25 end

end

1

0

.

1 - -

sas2h:	babcock wi	ilcox 15x15	, 4.20wt%,	45gwd/mtu	, burn high	temp	
power=	7.25mw,	burnup=	2610.mwd,	flux= 1.26	5E+13n/cm**	2-sec	
				nuclide	concentrat	ions, gram	atoms
				basis =	single rea	ctor assemb	ly
	charge	90.0 d	180.0 d	270.0 d	360.0 d	360.0 d	
he 4	.00E+00	6.20E-06	2.51E-05	6.03E-05	1.21E-04	1.21E-04	
th226	.00E+00	1.37E-20	3.58E-20	6.38E-20	9.98E-20	9.98E-20	
th227	.00E+00	8.93E-17	5.83E-16	1.72E-15	3.72E-15	3.72E-15	
th228	.00E+00	6.24E-12	2.56E-11	6.01E-11	1.13E-10	1.13E-10	
th229	.00E+00	2.98E-13	1.21E-12	2.76E-12	5.00E-12	5.00E-12	
th230	.00E+00	4.88E-07	9.44E-07	1.37E-06	1.77E-06	1.77E-06	
th231	.00E+00	7.18E-10	1.06E-09	1.38E-09	1.68E-09	1.67E-09	
th232	.00E+00	5.14E-09	1.49E-08	2.89E-08	4.70E-08	4.70E-08	
th233	.00E+00	3.78E-15	1.08E-14	2.10E-14	3.41E-14	1.79E-14	
th234	.00E+00	2.55E-08	⁻ 2.74E-08	2.75E-08	2.75E-08	2.75E-08	
pa231	.00E+00	3.03E-08	8.07E-08	1.49E-07	2.33E-07	2.33E-07	
pa232	_00E+00	1.97E-11	5.22E-11	9.59E-11	1.50E-10	1.49E-10	
pa233	.00E+00	2.63E-10	8.37E-10	1.58E-09	2.45E-09	2.45E-09	
pa234m	.00E+00	8.59E-13	9.23E-13	9.27E-13	9.26E-13	9.26E-13	
pa234	.00E+00	3.99E-13	4.60E-13	5.04E-13	5.53E-13	5.48E-13	
pa235	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	
. u230	.00E+00	1.32E-17	3.47E-17	6.18E-17	9.68E-17	9.67E-17	
u231	.00E+00	4.56E-16	9.63E-16	1.57E-15	2.32E-15	2.31E-15	
u232	.00E+00	5.38E-09	1.18E-08	1.99E-08	3.04E-08	3.04E-08	
u233	.00E+00	5.28E-07	1.01E-06	1.46E-06	1.87E-06	1.87E-06	
u234	7.26E-01	7.11E-01	6.98E-01	6.84E-01	6.71E-01	6.71E-01	
u235	8.29E+01	7.96E+01	7.64E+01	7.34E+01	7.05E+01	7.05E+01	
u236	3.79E-01	1.03E+00	1.64E+00	2.22E+00	2.77E+00	2.77E+00	
u237	-00E+00	1.87E-03	2.40E-03	2.90E-03	3.38E-03	3.38E-03	
u238	1.87E+03	1.86E+03	1.86E+03	1.86E+03	1.86E+03	1.86E+03	
u239	.00E+00	4.13E-04	4.10E-04	4.08E-04	4.07E-04	2.21E-04	
u240	.00E+00	9.65E-39	1.67E-35	1.29E-33	2.78E-32	2.78E-32	
u241	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	
np235	.00E+00	2.52E-11	1.14E-10	2.74E-10	5.09E-10	5.09E-10	
np236m	.00E+00	6.35E-11	1.55E-10	2.65E-10	3.94E-10	3.90E-10	
np236	.00E+00	7.01E-10	3.31E-09	8.31E-09	1.61E-08	1.61E-08	
np237	.00E+00	1.29E-02	3.16E-02	5.44E-02	8.09E-02	8.09E-02	

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np238	.00E+00	1.41E-05	3.43E-05	5.89E-05	8.76E-05	8.72E-05	
np239	.00E+00	5.97E-02	5.92E-02	5.89E-02	5.88E-02	5.87E-02	
np240m	.00E+00	8.23E-41	1.43E-37	1.10E-35	2.37E-34	2.37E-34	
np240	.00E+00	8.92E-07	8.77E-07	8.70E-07	8.68E-07	6.88E-07	
no241	.00E+00	-00E+00	.00E+00	.00E+00	.00E+00	.00E+00	
pu236	.00E+00	9.27E-10	4.33E-09	1.07E-08	2.05E-08	2.05E-08	
pu237	.00E+00	8.40E-10	2.60E-09	4.87E-09	7.65E-09	7.65E-09	
pu238	.00E+00	1.89E-04	8.98E-04	2.25E-03	4.36E-03	4.36E-03	
pu239	.00E+00	1.42E+00	2.70E+00	3.80E+00	4.77E+00	4.77E+00	
pu240	.00E+00	3.60E-02	1.28E-01	2.56E-01	4.07E-01	4.07E-01	٠
pu241	.00F+00	2.60E-03	1.81E-02	5.39E-02	1.13E-01	1.13E-01	
bu242	.00E+00	2.26E-05	3.16E-04	1.43E-03	4.06E-03	4.06E-03	
04243	00F+00	2.60F-09	3.60E-08	1.62E-07	4.61E-07	4.39F-07	
01244	00F+00	4.81F-28	8.33F-25	6.41F-23	1.38F-21	1.38F-21	
01245	00E+00	2 45E-34	4 22E-31	3 235-20	6 97E-28	6 82F-28	
01246	005+00	2 846-37	7 386-34	A 78E-32	1 675-30	1 626-30	
m230	005+00	2 RRE-16	3 06F-15	1 766-14	4 95E-14	4 85E-14	
	.00E+00	1 005-17	1 795.10	4 44E-12	1 776-14	4 725.44	
20240	.005700	1.005-13	1.305-16	0,105-12	1.135-11	1.166-11	

sas2h:	babcock wi	LCOX 15x1	5, 4.20wt%,	, 45gwd/mtu	u burn high ter	np
power=	7.25mw,	burnup≖ 3	20880.mwd,	flux= 1.34	4E+13n/cm**2-se	2C
				nuclide	concentrations	s, gram atoms
				basis =	single reactor	assembly
	charge	2610.4 d	2700.4 d	2790.4 d	2880.4 d	
he 4	1.30E-01	1.47E-01	1.64E-01	1.83E-01	2.03E-01	
pb206	1.99E-14	2.32E-14	2.67E-14	3.07E-14	3.51E-14	
pb207	1.55E-11	1.75E-11	1.96E-11	2.19E-11	2.44E-11	
ob208	1.67E-08	1.92E-08	2.20E-08	2.51E-08	2.85E-08	
bb209	2.45E-16	2.77E-16	3.13E-16	3.51E-16	3.91E-16	
pb210	4.94E-13	5.49E-13	6.07E-13	-6.70E-13	7.36E-13	
pb211	7.61E-16	8.24E-16	8.88E-16	9.54E-16	1.02E-15	
pb212	1.72E-11	1.90E-11	2.10E-11	2.31E-11	2.53E-11	
pb214	7.32E-18	7.91E-18	8.27E-18	8.63E-18	8.98E-18	
ra222	2.22E-19	2.41E-19	2.64E-19	2.88E-19	3.13E-19	
ra223	3.47E-13	3.76E-13	4.05E-13	4.35E-13	4.66E-13	
ra224	1.42E-10	1.57E-10	1.74E-10	1.91E-10	2.09E-10	
ra225	2.68E-14	3.07E-14	3.45E-14	3.87E-14	4.32E-14	
ra226	2.37E-10	2.48E-10	2.60E-10	2.71E-10	2.82E-10	
ra228	1.36E-16	1.48E-16	1.61E-16	1.74E-16	1.88E-16	
ac225	1.79E-14	2.05E-14	2.31E-14	2.59E-14	2.89E-14	
ac227	2.51E-10	2.71E-10	2.91E-10	3.13E-10	3.34E-10	
ac228	1.66E-20	1.81E-20	1.96E-20	2.12E-20	2.29E-20	
th226	1.08E-17	1.18E-17	1.29E-17	1.40E-17	1.53E-17	
th227	5.69E-13	6.15E-13	6.62E-13	7.11E-13	7.61E-13	
th228	2.69E-08	2.99E-08	3.30E-08	3.63E-08	3.97E-08	
th229	1.28E-09	1.48E-09	1.70E-09	1.95E-09	2.22E-09	
th230	5.05E-06	5.02E-06	4.99E-06	4.95E-06	4.91E-06	
th231	5.05E-09	5.28E-09	5.30E-09	5.31E-09	5.32E-09	
th232	1.31E-06	1.38E-06	1.45E-06	1.53E-06	1.60E-06	
th233	3.44E-14	1.31E-12	1.39E-12	1.48E-12	1.57E-12	
th234	2.67E-08	2.67E-08	2.67E-08	2.66E-08	2.66E-08	
pa231	4.16E-06	4.30E-06	4.43E-06	4.56E-06	4.68E-06	
pa232	3.31E-09	3.59E-09	3.74E-09	3.89E-09	4.04E-09	
pa233	4.24E-08	4.42E-08	4.60E-08	4.78E-08	4.96E-08	
pa234m	9.02E-13	9.10E-13	9.10E-13	9.09E-13	9.09E-13	

actinides

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pa234 pa235 u230 u232 u233 u234 u235 u236 u237 u238 u239 u240 u241 np235 np236m np236m np237	2.99E-12 .00E+00 1.05E-14 1.89E-13 2.22E-06 6.81E-06 4.07E-01 2.41E+01 1.06E+01 1.06E+01 1.05E-02 1.81E+03 2.02E-23 .00E+00 3.47E-08 8.11E-09 2.22E-06	3.69E-12 .00E+00 1.14E-14 2.07E-13 2.41E-06 6.86E-06 3.99E-01 1.08E+01 1.08E+01 1.05E-02 1.81E+03 5.24E-04 2.85E-23 .00E+00 3.71E-08 9.04E-09 2.45E-06 1.25E+00	3.87E-12 .00E+00 1.25E-14 2.27E-13 2.60E-06 3.90E-01 2.17E+01 1.09E+01 1.09E+01 1.08E-02 1.81E+03 5.30E-04 3.94E-08 9.51E-09 2.65E-06 1.30E+00	4.04E-12 .00E+00 1.36E-14 2.47E-13 2.81E-06 6.96E-06 3.82E-01 1.11E+01 1.11E+01 1.10E-02 1.80E+03 5.35E-04 5.48E-23 .00E+00 4.19E-08 9.97E-09 2.87E-09 1.35E+00	4.22E-12 .00E+00 1.48E-14 2.68E-13 3.01E-06 7.00E-06 3.74E-01 1.96E+01 1.12E+01 1.12E+01 1.12E+02 1.80E+03 5.40E-04 7.47E-23 .00E+00 4.43E-08 1.04E-08 3.11E-06 1.40E+00	
np238 sas2h: power=	1.52E-03 babcock w 7.25mw,	1.62E-03 ilcox 15x1! burnup=	1.71E-03 5, 4.20wt%, 20880.mwd,	1.79E-03 , 45gwd/mtu flux= 1.34	1.87E-03 J burn high tem E+13n/cm**2-se	
np239 np240 np240 np240 np241 pu236 pu237 pu238 pu243 pu242 pu2441 pu242 pu2443 pu2445 pu2445 pu2445 pu2445 am2242 am2243 am2244 am2245 cm2243 cm2243 cm2246 cm2243 cm2246 cm2245 cm2246 cm2245 cm2246 cm2245 cm2246 cm2245 cm2246 cm2245 cm2246 cm2245 cm2250	charge 7.42E-02 1.74E-25 3.99E-07 .00E+00 2.03E-06 7.11E-07 5.05E-01 1.31E+01 1.31E+01 1.03E+00 1.03E+00 1.03E+00 1.03E+00 1.03E+00 1.03E+01 5.48E-19 2.48E-19 2.48E-19 2.48E-19 2.48E-11 5.14E-03 1.97E-04 2.25E-01 5.14E-03 1.97E-04 2.25E-01 5.14E-03 1.97E-04 8.20E-05 4.46E-17 3.59E-02 1.09E-03 3.84E-04 7.55E-06 7.70E-07 1.63E-12 2.36E-15	2610.4 d 7.56E-02 2.43E-25 1.46E-06 .00E+00 2.19E-06 7.81E-07 5.47E-01 1.32E+01 1.32E+01 1.32E+01 3.08E+00 1.11E+00 1.39E-04 2.37E-01 5.38E-03 2.25E-04 2.37E-01 5.38E-03 2.25E-04 2.37E-01 5.38E-03 2.25E-04 6.20E-17 9.14E-24 1.56E-09 3.83E-02 1.20E-03 4.80E-04 9.78E-03 4.80E-04 9.78E-03 4.80E-04 9.78E-03 4.80E-04 9.78E-03 4.80E-04 9.78E-03 4.80E-04 9.78E-03 4.80E-04 9.78E-03 4.80E-04 9.78E-03 4.80E-04 9.78E-03 4.80E-04 9.78E-03 4.80E-04 9.78E-03 4.80E-04 9.78E-03 4.80E-04 9.78E-03 4.80E-04 9.78E-03 4.80E-04 9.78E-03 4.80E-04 9.78E-05 1.04E-0	2700.4 d 7.64E-02 3.39E-25 1.49E-06 .00E+00 2.36E-06 8.54E-07 5.92E-01 1.32E+01 1.32E+01 1.32E+01 1.51E-04 1.51E-04 1.51E-04 3.23E-01 5.64E-03 2.38E-04 1.42E-03 2.38E-04 1.42E-03 1.32E-03 1.62E-05 1.42E-03 5.96E-04 1.26E-05 1.40E-0	nuclide basis = 2790.4 d 7.72E-02 4.68E-25 1.52E-06 .00E+00 2.53E-06 9.31E-07 6.37E-01 1.32E+01 5.29E+00 3.25E+00 1.27E+00 1.27E+00 1.63E-04 2.73E-12 1.77E-18 7.38E-21 1.43E-11 4.93E-09 2.58E-01 5.90E-03 2.50E-04 1.68E-23 1.81E-09 4.33E-02 1.44E-03 5.20E-03 7.32E-04 1.60E-05 1.87E-06 1.40E-11 6.82E-15	concentrations single reactor 2880.4 d 7.79E-02 6.37E-25 1.55E-06 1.01E-06 6.85E-01 1.33E+00 1.36E+00 1.36E+00 1.36E+00 1.76E-04 3.34E+00 1.36E+00 1.76E-04 3.72E-12 2.44E-18 1.03E-20 1.50E-11 5.17E-09 2.63E-01 6.16E-03 2.63E-01 6.16E-03 2.63E-01 6.16E-03 2.63E-01 6.16E-03 2.63E-01 6.257E-23 1.94E-09 4.58E-02 1.57E-03 8.92E-04 2.01E-05 2.46E-06 1.86E-11 9.48E-15	, gram atoms assembly

actinides .

cm251	4.20E-25	7.19E-23	1.04E-22	1.47E-22	2.07E-22	
bk249	1.15E-08	1.60E-08	2.20E-08	2.99E-08	4.03E-08	
bk250	2.51E-12	5.32E-12	7.41E-12	1.02E-11	1.39E-11	
bk251	1.14E-17	6.68E-17	9.41E-17	1.31E-16	1.80E-16	
cf249	3.44E-09	4.88E-09	6.83E-09	9.42E-09	1.29E-08	
cf250	1.59E-09	2.27E-09	3.17E-09	4.38E-09	5.98E-09	
cf251	1.10E-09	1.57E-09	2.24E-09	3.14E-09	4.34E-09	
cf252	5.59E-10	8.44E-10	1.25E-09	1.83E-09	2.64E-09	
cf253	5.16E-13	7.89E-13	1.19E-12	1.76E-12	2.58E-12	
cf254	2.28E-16	3.59E-16	5.54E-16	8.39E-16	1.25E-15	
cf255	9.46E-21	3.61E-20	5.64E-20	8.64E-20	1.30E-19	
totals	1.87E+03	1.87E+03	1.86E+03	1.86E+03	1.86E+03	
flux		1.50E+13	1.52E+13	1.54E+13	1.55E+13	

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sas2h: babcock wilcox 15x15, 4.20wt%, 45gwd/mtu burn high temp decay, following reactor irradiation identified by: power= 7.25mw, burnup= 20880.mwd, flux= 1.34E+13n/cm**2-sec 0 nuclide concentrations, grams

				nuctiae	concentra	cions, gra	M S
				Dasis =	single rea	ctor assem	bly
	initial	304.4 d	608.8 d	913.1 d	1217.5 d	1521.9 d	1826.3 d
he 4	8.11E-01	9.85E-01	1.06E+00	1.12E+00	1.16E+00	1.20E+00	1.24E+00
pb208	5.92E-06	8.83E-06	1.25E-05	1.70E-05	2.22E-05	2.80E-05	3.43E-05
th228	9.06E-06	1.20E-05	1.49E-05	1.75E-05	1.99E-05	2.20E-05	2.38E-05
th230	1.13E-03	1.33E-03	1.54E-03	1.75E-03	1.96E-03	2.17E-03	2.39E-03
+6232	3.726-04	4.36F-04	5.00F-04	5.64E-04	6.28E-04	6.92E-04	7.56E-04
+6234	6 235-06	6.22E-06	6 22E-06	6.22F-06	6.22E-06	6.22F-06	6.22E-06
n=231	1 086-03	1 09F-03	1 005-03	1.09F-03	1 106-03	1 10F-03	1.105-03
2233	1 146-05	1 135-05	1 135-05	1 136-05	1 146-05	1 146-05	1 145-05
pa233	4 00E-04	8 075-04	8 036-04	0 626-04	1 026-03	1 046-03	1 005-03
1272	1 475-04	1 735-03	1 935-03	1 075.07	2 035-03	2 135-03	2 235-03
u233	1.03E*03 € 75E±01	8 845+01	9 075-01	0 085-01	0 105+01	0 305-01	0 /15-01
U234	0./JETUI	6.0000101	6 405+07	4 40E+07	4 40E+07	4 40E+07	6 40E+07
u235	9.00ETU3	4.002703	4.0UETUJ	4.00E+03	4.0UETUJ	4.00ETUJ	9.00ETUJ
U230	2.042403	2.042703	2.045703	2.045-05	2.042703	2.046703	2.046-05
u237	2.002+00	2.346-05	2.232-03	2.100-03	2.002-00	1.996-03	1.912-05
u238	4.29E+03	4.292+03	4.29E+U3	4.2YETU3	4.292+03	4.292+03	4.292703
npzaż	1.04E-07	9.11E-00	3.345.00	2.115-00	1.245-00	7.202-07	4.205-0/
npzso	7.34E-04	7.34E-U4	7.34E-04	7.346-04	7.342-04	7.34E-04	7.346-04
np237	3.31E+U2	3.34E+U2	3.34E+U2	3.34E+U2	3.34E+U2	3.34E+U2	3.332+02
np239	1.86E+U1	(.00E-U)	1.0/2-05	1.0/E-U2	1.0/E-03	(.0/E-U)	1.0/E-U)
pu236	6.38E-04	5.24E-U4	4.29E-04	3.52E-04	2.08E-04	2.30E-U4	1.941-04
pu238	1.63E+02	1.70E+02	1./1E+02	1./16+02	1.70E+02	1.69E+U2	1.08E+U2
pu239	3.17E+03	3.19E+03	3.19E+03	3.19E+03	3.19E+03	3.19E+05	5.19E+05
pu240	1.30E+03	1.30E+03	1.30E+03	1.50E+03	1.30E+03	1.30E+03	1.51E+U5
pu241	8.04E+02	7.73E+02	7.42E+02	7.13E+02	6.85E+02	6.58E+02	6.32E+02
pu242	3.29E+02	3.29E+02	3.29E+02	3.29E+02	3.29E+02	3.29E+02	3.29E+02
am241	6.45E+01	9.62E+01	1.27E+02	1.56E+02	1.84E+02	2.10E+02	2.36E+02
am242m	1.49E+00	1.48E+00	1.48E+00	1.47E+00	1.47E+00	1.46E+00	1.45E+00
am242	6.36E-02	1.92E-05	1.91E-05	1.90E-05	1.89E-05	1.88E-05	1.88E-05
am243	8.92E+01	8.92E+01	8.92E+01	8.92E+01	8.92E+01	8.92E+01	8.92E+01
cm242	1.11E+01	3.05E+00	8.39E-01	2.33E-01	6.65E-02	2.10E-02	8.50E-03
cm243	3.81E-01	3.74E-01	3.66E-01	3.59E-01	3.51E-01	3.44E-01	3.38E-01
cm244	3.30E+01	3.20E+01	3.10E+01	3.01E+01	2.91E+01	2.82E+01	2.73E+01
cm245	1.48E+00	1.48E+00	1.48E+00	1.48E+00	1.48E+00	1.48E+00	1.48E+00
cm246	2.20E-01	2.20E-01	2.19E-01	2.19E-01	2.19E-01	2.19E-01	2.19E-01
cm247	4.97E-03	4.97E-03	4.97E-03	4.97E-03	4.97E-03	4.97E-03	4.97E-03
cm248	6.09E-04	6.09E-04	6.09E-04	6.09E-04	6.09E-04	6.09E-04	6.09E-04
cf249	3.20E-06	8.04E-06	1.05E-05	1.18E-05	1.25E-05	1.28E-05	1.29E-05

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cf250 1.49E-06 1.43E-06 1.37E-06 1.31E-06 1.26E-06 1.20E-06 1.15E-06 cf251 1.09E-06 1.09E-06 1.09E-06 1.09E-06 1.09E-06 1.09E-06 total 4.42E+05 4.42E+05 4.42E+05 4.42E+05 4.42E+05 4.42E+05 4.42E+05

=sas2h pa \$AS2H: Babco 44group /	arm='halt8,s ock Wilcox f latticecelt	skipcellwt,skipshipdata′ 5x15, 4.50wt%, 53gwd/mtu burn High Temp
' mixtures ' den=mass uo2 1 den=10 kr-83 1 kr-85 1	of fuel-pir s UO2/ Volum 0.2060 1 975 0 1-20 975	n-unit-cell: ne assembly = 526377.3 g/5.157524E4 5 92235 4.50 92234 0.0395 92236 0.0207 92238 95.4398 end end end
sr-90 1	0 1-20 975	end
mo-95 1	0 1-20 975	end
zr-93 1	0 1-20 975	end
zr-94 1	0 1-20 975	end
zr-95 1	0 1-20 975	end
nb-94 1	0 1-20 975	end
tc-99 1	0 1-20 975	end
rh-105 1	0 1-20 975	end
ru-101 1	0 1-20 975	end
ru-106 1	0 1-20 975	end
pd-105 1	0 1-20 975	end
pd-108 1	0 1-20 975	end
ag-109 1 eb-126 1	0 1-20 975	end
xe-131 1	0 1-20 975	end
xe-132 1	0 1-20 975	end
xe-135 1	0 1-20 975	end
xe-136 1	0 1-20 975	end
cs-134 1	0 1-20 975	end
CS-137 1	0 1-20 9/5	end
ba-136 1	0 1-20 975	end
la-139 1	0 1-20 975	end
pr-141 1	0 1-20 975	end
pr-143 1	0 1-20 975	end
ce-144 1	0 1-20 9/5	end
ng-145 1	0 1-20 975	end
pm-147 1	0 1-20 975	end
pm-148 1	0 1-20 975	end
nd-147 1	0 1-20 975	end
sm-147 1	0 1-20 975	end
SM-149 1	0 1-20 975	end
sm=150 i	0 1-20 975	end
sm-152 1	0 1-20 975	end
gd-155 1	0 1-20 975	end
eu-153 1	0 1-20 975	end
eu-154 1	0 1-20 975	end
eu-122. 1 h2o 3	U 1-20 9/3	t 607 6 end
arbm-bormod	0.6272 1 1	0 0 5000 100 3 552.6e-6 607.6 end
arbm-zirc4	6.56 5 0 0	0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
_		40000 98.18 2 1.0 650.0 end
,		

/ 1050 ppm boron

end comp

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actinides

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page

fuel-pin-cell geometry: squarepitch 1.44272 0.936244 1 3 1.0922 2 0.95758 0 end / assembly and cycle parameters: npin/assm=208 fuelngth=360.172 ncycles=1 nlib/cyc=8 printlevel=5 inplevel=2 numztotal=4 end 3 0.63246 2 0.67310 3 0.814 500 2.961 power=7.25 burn=3392 down=1826.25 end end

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sas2h: babcock wilcox 15x15, 4.50wt%, 53gwd/mtu burn high temp
power= 7.25mw, burnup= 3074.mwd, flux= 1.18E+13n/cm**2-sec nuclide concentrations, gram atoms basis = single reactor assembly charge 106.0 d 212.0 d 318.0 d 424.0 d 424.0 d .00E+00 8.39E-06 3.44E-05 8.52E-05 1.79E-04 1.79E-04 he 4 .00E+00 1.83E-20 4.76E-20 8.63E-20 1.39E-19 1.38E-19 .00E+00 1.49E-16 9.66E-16 2.86E-15 6.16E-15 6.16E-15 .00E+00 9.28E-12 3.84E-11 9.14E-11 1.75E-10 1.75E-10 .00E+00 4.42E-13 1.79E-12 4.10E-12 7.46E-12 7.46E-12 th226 th227 th228 th229 2.20E-06 2.20E-06 2.02E-09 2.00E-09 6.17E-07 1.19E-06 1.72E-06 _00E+00 th230 8.36E-10 1.26E-09 1.66E-09 th231 .00E+00 6.83E-09 2.01E-08 4.92E-15 1.43E-14 6.42E-08 6.42E-08 3.93E-08 th232 .00E+00 2.80E-14 2.74E-08 2.05E-07 4.58E-14 2.14E-14 2.74E-08 2.74E-08 3.23E-07 3.23E-07 th233 .00E+00 2.61E-08 2.74E-08 4.05E-08 1.10E-07 th234 .00E+00 .00E+00 pa231 2.02E-10 2.00E-10 3.15E-09 3.15E-09 2.55E-11 6.90E-11 3.48E-10 1.08E-09 .00E+00 pa232 1.28E-10 .00E+00 pa233 2.02E-09 8.82E-13 9.23E-13 4.13E-13 4.73E-13 9.24E-13 5.26E-13 9.23E-13 9.22E-13 pa234m .00E+00 5.89E-13 5.82E-13 ba234 .00E+00 .00E+00 .00E+00 .00E+00 .00E+00 pa235 .00E+00 .00E+00 1.77E-17 u230 .00E+00 4.61E-17 8.37E-17 1.34E-16 1.34E-16 u231 .00E+00 5.74E-16 1.23E-15 2.06E-15 3.12E-15 3.12E-15 u232 .00E+00 6.86E-09 1.54E-08 2.67E-08 4.19E-08 4.19E-08 6.61E-07 1.26E-06 7.66E-01 7.49E-01 1.81E-06 2.31E-06 2.31E-06 7.32E-01 7.16E-01 7.16E-01 u233 .00E+00 7.83E-01 u234 7.76E+01 7.42E+01 7.42E+01 2.59E+00 3.24E+00 3.24E+00 3.15E-03 3.70E-03 3.70E-03 1.85E+03 1.85E+03 1.85E+03 u235 8.88E+01 8.49E+01 8.12E+01 1.18E+00 1.90E+00 4.07E-01 u236 .00E+00 1.96E-03 2.57E-03 .86E+03 1.86E+03 1.86E+03 u237 u238 1.86E+03 4.02E-04 3.99E-04 3.97E-04 3.97E-04 1.93E-04 u239 .00E+00 u240 3.93E-38 6.83E-35 5.25E-33 1.13E-31 1.13E-31 .00E+00 u241 .00E+00 .00E+00 .00E+00 .00E+00 .00E+00 .00E+00 .00E+00 3.57E-11 1.61E-10 7.21E-10 7.21E-10 3.87E-10 np235 .00E+00 7.76E-11 1.90E-10 4.94E-10 4.88E-10 3.30E-10 nb236m .00E+00 1.00E-09 4.75E-09 1.20E-08 2.35E-08 2.35E-08 .00E+00 1.59E-02 3.92E-02 6.80E-02 1.02E-01 1.02E-01 np236 np237 np238 .00E+00 1.67E-05 4.09E-05 7.09E-05 1.06E-04 1.06E-04

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np239	.00E+00	5.80E-02	5.76E-02	5.74E-02	5.74E-02	5.73E-02	
np240m	.00E+00	3.35E-40	5.83E-37	4.48E-35	9.66E-34	9.66E-34	
np240	.00E+00	8.48E-07	8.36E-07	8.32E-07	8.32E-07	6.33E-07	
np241	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	.00E+00	
pu236	.00E+00	1.32E-09	6.18E-09	1.53E-08	2.95E-08	2.95E-08	
pu237	.00E+00	1.07E-09	3.25E-09	6.11E-09	9.75E-09	9.74E-09	
pu238	.00E+00	2.62E-04	1.25E-03	3.15E-03	6.15E-03	6.15E-03	
pu239	.00E+00	1.62E+00	3.06E+00	4.28E+00	5.33E+00	5.33E+00	
pu240	.00E+00	4.49E-02	1.58E-01	3.12E-01	4.90E-01	4.90E-01	
pu241	.00E+00	3.67E-03	2.52E-02	7.42E-02	1.54E-01	1.54E-01	
pu242	.00E+00	3.51E-05	4.86E-04	2.18E-03	6.14E-03	6.14E-03	4
pu243	.00E+00	3.94E-09	5.42E-08	2.42E-07	6.83E-07	6.46E-07	
pu244	.00E+00	1.96E-27	3.40E-24	2.61E-22	5.64E-21	5.64E-21	
pu245	.00E+00	9.20E-34	1.59E-30	1.22E-28	2.63E-27	2.56E-27	
pu246	.00E+00	1.13E-36	2.84E-33	2.57E-31	6.11E-30	6.11E-30	
am239	.00E+00	4.73E-16	6.44E-15	2.84E-14	7.89E-14	7.70E-14	
am240	.00F+00	1.65E-13	2.25E-12	9.92E-12	2.76E-11	2.74E-11	

ower≖	7.25mW,	burnup=	24592.mwd,	tlux= 1.29	YE+13N/CM**2-Sec
				nuclide	concentrations, gram atom
			-		single reactor assembly
	charge	30/4.4 d	5180.4 d	3280.4 C	3372.4 G
e 4	2.11E-01	2.37E-01	2.64E-01	2.92E-01	3.23E-01
b206	4.22E-14	4.90E-14	2.65E-14	0.48E-14	7.4UE-14
6207	2.91E-11	3.27E-11	5.66E-11	4.07E-11	4.51E-11
6208	3.33E-08	3.83E-08	4.38E-08	4.98E-08	5.64E-08
6209	4.33E-10	4.91E-16	5.53E-16	6.19E-16	0.9UE-10
6210	8.51E-13	9.45E-13	1.04E-12	1.15E-12	1.201-12
D211	1.18E-15	1.2/E-15	1.36E-15	1.40E-15	1.556-15
b212	2.87E-11	3.17E-11	3.48E-11	3.81E-11	4.10E-11
D214	9.92E-18	1.0/E-1/	1.11E-17	1.10E-1/	1.20E-17
8222	3.4/E-19	5.75E-19	4.09E-19	4.42E-19	4.832-19
a223	5.39E-13	5.80E-13	0.22E-13	0.07E-13	7.096-13
8224	2.3/E-10	2.02E-10	2.88E-10	3.15E-10	3.436-10
8222	4.01E-14	2.20E-14	2.946-14	0.07E-14	7.412-14
8220	3.212-10	3.35E-10	3.49E-10	3.03E-10	3.//E-10 3.045.44
8220	2.09E-10	2.20E-10	2.4/E-10	2.00E-10	2.00E-10 E.00E-1/
CZZ2	5.18E-14	3.03E-14	4.U8E-14	4.3/E-14	5.09E-14 5.055.10
C221	3.80E-10	4.15E-10	4.43E-10	4.732-10	5.05E-10 7.505 30
C220	2.30E-20	2./0E-2U	3.01E-20	3.236-20	3,302-20
	1.0YE-1/	1.03E-1/	2.00E-17	2.1/E-1/	
	0.00E-13	9.4/E-13	1.02E-12	1.UOL-12	1.105°12 4.535-09
220	4.302-08	4.9/E-UO	7 775.00	7.405-00	6.325-00
227	5 795-04	5 725-04	5 255-04	5 176-04	5.005-06
6221	5.302-00	5 716-00	5 716.00	5.172-00	5.092-00
6222	1 755-04	1 955-04	1 055-04	2 045-04	2 1/5-04
h277	6 40E-16	1 705.12	1 015-12	2 035-12	2 155-12
h233	2 455-08	2 455-08	2 646-08	2 645-08	2 435-08
-231	5 245-04	5 405-04	5 525-06	5 645-06	5 756-06
232	4.24F-00	4.57F-00	4.75F-00	4.91F-00	5.07E-09
233	5.25E-08	5.46F-08	5.67F-08	5.87E-08	6-08E-08
a234m	8.94F-13	9.05F-13	9-04F-13	9.04E-13	9.03E-13

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pa234 3.68E-11	2 4.56E-12 4.77E-12	4.99E-12 5.21E-12
pa235 .00E+00	0 .00E+00 .00E+00	.00E+00 .00E+00
u230 1.64E-1	4 1.77E-14 1.94E-14	2.11E-14 2.28E-14
u231 2.93E-1	3 3.20E-13 3.49E-13	3.80E-13 4.11E-13
u232 3.35E-0	6 3.62E-06 3.90E-06	4.18E-06 4.47E-06
u233 7.78E-0	6 7.82E-06 7.86E-06	7.90E-06 7.93E-06
u234 4.05E-0	1 3.95E-01 3.86E-01	3.77E-01 3.68E-01
u235 2.17E+0	1 2.05E+01 1.93E+01	1.81E+01 1.70E+01
u236 1.20E+0	1 1.21E+01 1.22E+01	1.23E+01 1.24E+01
u237 1.15E-0	2 1.16E-02 1.18E-02	1.21E-02 1.23E-02
u238 1.79E+0	3 1.79E+03 1.79E+03	1.79E+03 1.78E+03
u239 1.75E-0	5 5.31E-04 5.37E-04	5.43F-04 5.49F-04
u240 7.77E-2	3 1.09E-22 1.52E-22	2.09E-22 2.84E-22
u241 .00E+00	0 .00E+00 .00E+00	.00E+00 .00E+00
np235 4.68E-00	8 4.98E-08 5.29E-08	5.60E-08 5.91E-08
np236m 1.03E-00	8 1.15E-08 1.21E-08	1.26E-08 1.32E-08
np236 3.34E-00	6 3.65E-06 3.97E-06	4.31E-06 4.67E-06
np237 1.48E+00	0 1.53E+00 1.59E+00	1.64E+00 1.69E+00
np238 1.87E-0	3 2.00E-03 2.10E-03	2.20E-03 2.29E-03
sas2h: babcock	wilcox 15x15,_4.50wt%	, 53gwd/mtu burn high temp
sas2h: babcock i power= 7.25mw rp239 7.52E-00 np240m 6.68E-22 np240 4.12E-0 np240 4.12E-0 np240 2.89E-00 pu236 2.89E-00 pu237 1.06E-00 pu238 7.23E-0 pu239 1.37E+0 pu240 5.41E+00 pu241 3.41E+00 pu241 3.41E+00 pu242 1.34E+00 pu242 3.41E+00 pu243 1.31E-00 pu244 3.87E-11 pu245 2.08E-11 am240 5.27E-00 am244 3.87E-12 pu246 9.51E-22 am239 1.40E-11 am240 5.27E-00 am241 2.82E-00 am242 2.45E-00 am244 1.20E-00 am245 1.61E-11 am246 2.38E-22 cm241 1.96E-00 cm242 4.65E-00 cm244 1.35E-0 cm244 1.35E-0	<pre>wilcox 15x15, 4.50wt% , burnup= 24592.mwd,</pre>	<pre>, 53gwd/mtu burn high temp flux= 1.29E+13n/cm**2-sec nuclide concentrations, gram atoms basis = single reactor assembly 3286.4 d 3392.4 d 7.85E-02 7.93E-02 1.78E-24 2.42E-24 1.58E-06 1.62E-06 .00E+00 .00E+00 3.57E-06 3.80E-06 1.38E-06 1.49E-06 9.04E-01 9.67E-01 1.37E+01 1.37E+01 5.86E+00 5.99E+00 3.64E+00 3.72E+00 1.64E+00 3.72E+00 2.06E-04 2.21E-04 1.04E-11 1.41E-11 6.70E-18 9.21E-18 2.83E-20 3.94E-20 1.82E-11 1.90E-11 6.27E-09 6.54E-09 3.15E-01 3.25E-01 7.38E-03 7.63E-03 3.06E-04 3.19E-04 4.82E-01 5.25E-01 .00E+00 .00E+00 1.83E-04 2.02E-04 4.13E-16 5.54E-16 7.07E-23 9.85E-23 2.41E-09 2.56E-09 5.48E-02 5.75E-02 2.07E-03 2.23E-03 2.02E-01 2.29E-01 9.82E-03 1.13E-02</pre>

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cm251	1.59E-24	2.75E-22	3.97E-22	5.66E-22	7.96E-22
bk249	4.15E-08	5.73E-08	7.84E-08	1.06E-07	1.43E-07
Ьk250	9.09E-12	1.92E-11	2.67E-11	3.66E-11	4.98E-11
bk251	4.09E-17	2.39E-16	3.36E-16	4.67E-16	6.42E-16
cf249	1.36E-08	1.92E-08	2.66E-08	3.64E-08	4.93E-08
cf250	6.02E-09	8.52E-09	1.18E-08	1.63E-08	2.21E-08
cf251	4.45E-09	6.34E-09	8.94E-09	1.24E-08	1.71E-08
cf252	2.64E-09	3.96E-09	5.84E-09	8.49E-09	1.22E-08
cf253	2.52E-12	3.82E-12	5.73E-12	8.46E-12	1.23E-11
cf254	1.15E-15	1.80E-15	2.77E-15	4.17E-15	6.18E-15
cf255	4.88E-20	1.86E-19	2.89E-19	4.42E-19	6.63E-19
totals	1.86E+03	1.85E+03	1.85E+03	1.85E+03	1.84E+03
flux		1.49E+13	1.51E+13	1.53E+13	1.55E+13

sas2h: babcock wilcox 15x15, 4.50wt%, 53gwd/mtu burn high temp decay, following reactor irradiation identified by: power= 7.25mw, burnup= 24592.mwd, flux= 1.29E+13n/cm**2-sec nuclide concentrations, grams

				indefinde	- concentra	icional Aid	
				basis =	single rea	ctor assem	bly
	initial	304.4 d	608.8 d	913.1 d	1217.5 d	1521.9 d	1826.3 d
he 4	1 20E+00	1 52F+00	1.63E+00	1.70E+00	1.77E+00	1.83E+00	1.89F+00
mb208	1 176-05	1 445-05	2 215-05	2 805-05	3 445-05	4 525-05	5 445-05
PD200		1.045-05	2.216-05	2.075-05	3.000-01	7 3/2 05	7 545 05
11220	1.496-02	1.0YE-U2	2.20E-UD	2.046-02	2.9/2-03	3.20E-U2	3.215-02
th229	9.62E-07	9.69E-07	9.76E-07	9.84E-07	9.92E-07	1.00E-06	1.01E-06
th230	1.17E-03	1.37E-03	1.58E-03	1.78E-03	1.99E-03	2.21E-03	2.43E-03
th232	4.96E-04	5.68E-04	6.39E-04	7.10E-04	7.81E-04	8.52E-04	9.24E-04
th234	6.17E-06	6.16E-06	6.16E-06	6.16F-06	6.16E-06	6.16F-06	6.16F-06
na231	1 336-03	1 336-03	1 34F-03	1.34F-03	1.34F-03	1.356-03	1 356-03
227	1 425-05	1 395-05	1 795-05	1 395-05	1 395-05	1 395-05	1 395-05
pa233	1.425-03	1.305-03	1.305-03	1.300-03	1 /95-07	1.500-05	1.500-03
u232	1.046-03	1.192-03	1.312-03	1.410-03	1.405-03	1.342-03	1.576-03
u233	1.85E-03	1.97E-03	2.09E-03	2.21E-05	2.33E-03	2.43E-03	2.38E-03
u234	8.62E+01	8.77E+01	8.92E+01	9.08E+01	9.23E+01	9.39E+01	9.54E+01
u235	3:99E+03	3.99E+03	3.99E+03	3.99E+03	3.99E+03	3.99E+03	3.99E+03
u236	2.94E+03	2.94E+03	2.94E+03	2.94E+03	2.94E+03	2.94E+03	2.94E+03
u237	2-92F+00	2.61E-05	2.51F-05	2.41E-05	2.31E-05	2.22E-05	2.13E-05
1238	4 24F+05	4 24F+05	4 24F+05	4.24F+05	4.24F+05	4.24F+05	4.24F+05
	1 705-05	9 155-04	4 705-04	2 816-04	1 455-04	0 405-07	5 405-07
10233	1 105 07	4 105-07	4.772-00	1 105-07	1 105-07	1 105-07	1 105-07
npzso	1.10E-03	1.102-03	1.102-03	1.102-03	1.100-03	1.102-03	1.100-03
np237	4.02E+02	4.05E+02	4.05E+02	4.03E+02	4.052+02	4.U0E+U2	4.U0E+U2
np239	1.89E+01	1.10E-04	1.10E-04	1.1UE-04	1.10E-04	1.10E-04	1.10E-04
pu236	8.98E-04	7.37E-04	6.04E-04	4.95E-04	4.05E-04	3.32E-04	2.72E-04
bu238	2.30E+02	2.39E+02	2.40E+02	2.39E+02	2.38E+02	2.37E+02	2.35E+02
pu239	3.28E+03	3.30E+03	3.30E+03	3.30E+03	3.30E+03	3.30E+03	3.30E+03
5u240	1 445+03	1 44F+03	1.44F+03	1.44F+03	1.44E+03	1.44F+03	1.45F+03
51241	8 075+02	8 416+02	8 276+02	7 955+02	7 635+02	7 335+02	7 045+02
puc+1	6 215+02	6 215+02	4 215-02	6 216+02	6 21E+02	6 218+02	6 216+02
pu242	7 870.01	4.215+02	4.616+02	1 905+02	7 115+02	3 (15+02	3 405+02
80241	7.83E+U1	1.14E+U2	1.4/2702	1.000402	2.112702	2.412702	2.092402
amzązm	1.856+00	1.84E+00	1.832+00	1.026+00	1.02E+UU	1.01E+UU	1.002+00
am242	7.73E-02	2.37E-05	2.36E-05	2.35E-05	2.34E-05	2.34E-05	2.33E-05
an243	1.28E+02	1.28E+02	1.28E+02	1.28E+02	1.28E+02	1.28E+02	1.28E+02
cm242	1.39E+01	3.83E+00	1.05E+00	2.92E-01	8.35E-02	2.63E-02	1.06E-02
cm243	5.41E-01	5.30E-01	5.20E-01	5.09E-01	4.99E-01	4.89E-01	4.79E-01
cm244	5-60E+01	5.43E+01	5.26E+01	5.09E+01	4.93E+01	4.78E+01	4.63E+01
cm245	2.78F+00	2.78E+00	2.78E+00	2.78E+00	2.78E+00	2.78E+00	2.78E+00
c=246	A 045-01	1 04E-01	A 04E-01	4 96F-01	4 04F-01	4 94F-01	4 95E-01
	1 305-03	4 305-07	1 205-02	1 305-02	1 305-02	1 305-02	1 305-02
C/#24/	1.302-02	1.302-02	1.305-02	1.305-02	1.305-02	1.305-02	1.302-02

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Apr 05 10:24 1996 File Name: /users/hassler/wells/scale/o4553.res BBA000000-01717-0200-00016 REV. 00 ATTACHMENT VII - Page 6

cm248	1.94E-03						
bk249	3.55E-05	1.84E-05	9.50E-06	4.92E-06	2.54E-06	1.31E-06	6.80E-07
cf249	1.23E-05	2.94E-05	3.82E-05	4.27E-05	4.50E-05	4.62E-05	4.67E-05
cf250	5.51E-06	5.29E-06	5.06E-06	4.84E-06	4.63E-06	4.43E-06	4.24E-06
cf251	4.29E-06	4.28E-06	4.28E-06	4.28E-06	4.28E-06	4.27E-06	4.27E-06
cf252	3.06E-06	2.46E-06	1.98E-06	1.59E-06	1.28E-06	1.03E-06	8.26E-07
total	4.38E+05						

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Far-Field External Criticality Analysis

Avogadro's 0.602252

	Vol Den tuff
Calico Hills Tuff - Nominal Porosity .306 / density=1.746 g/cc	6.9400E-01

	Number D	ensity Calculations								
		····, ····	3.0% / 20 GW	D/mt	3.0% / 20 GWD	/mt	3.0% / 20 GWD	Vmt	3.0% / 20 GWD	/mt
	3.0% / 20	GWD/mt	water vol frac	3.000000E-01	water voi frac	3.00000E-01	water vol frac	3.000000E-01	water vol frac	3.000000E-01
		Full Density	UO2 vol frac	1.500000E-01	UO2 vol frac	5.00000E-02	UO2 vol frac	1.000000E-01	UO2 vol frac	2.000000E-01
UO2	0	4.8888950E-02	0	7.333343E-03	0	2.44448E-03	0	4.888895E-03	0	9.777790E-03
	U-234	5.8680620E-06	U-234	8.802093E-07	U-234	2.934031E-07	U-234	5.868062E-07	U-234	1.173612E-06
	U-235	4.7816080E-04	U-235	7.172412E-05	U-235	2.390804E-05	U-235	4.781608E-05	U-235	9.563216E-05
	U-236	1 1441480E-04	U-236	1.716222E-05	U-236	5.720740E-06	U-236	1.144148E-05	U-236	2.288296E-05
	11-238	2 3818750E-02	U-238	3.572813E-03	U-238	1.190938E-03	U-238	2.381875E-03	U-238	4.763750E-03
	No-237	2 7286570E-05	Np-237	4.092986E-06	Np-237	1.364329E-06	Np-237	2.728657E-06	Np-237	5.457314E-06
420	H	6 6861260E-02	H	1.704962E-02	H	1.905546E-02	H	1.805254E-02	н	1.604670E-02
1120	ä	3 3430630E-02	ö	8 524811E-03	ö	9 527730E-03	Ö	9.026270E-03	0	8.023351E-03
Tuff	L L	0.0000000000000000000000000000000000000	н	0.000000E+00	н	0.000000E+00	Ĥ	0.000000E+00	Ĥ	0.000000E+00
1411	~	2 2628820E 02	ä	2 7724515-02	Ö	3 099739E-02	ö	2 936595E-02	Ö	2.610306E-02
	U No	A 6522020E 04	Na	2.7734312-02	Na	4 325713E-04	Na	4 098044E-04	Ňa	3.642706E-04
	Na Na	4.00000000	i va Ma	2 2729525 04	Ma	2 5413655-04	Ma	2 407609E-04	Ma	2 140097E-04
	Mg	2.0751210E-04	NIG AL	2.2730335-04		2.0410000-04	AL	2 7138495-03	· AI	2 412310E-03
	AI O:	3.0153870E-03	AI Ci	2.0030/9E-03		1 2622745 02		1 1974075-02	Si	1.055473E-02
	SI	1.3193410E-02	51	1.121440E-02	51	1.2000000 00	0	0.0000000000000000000000000000000000000	0	0.0000000000000000000000000000000000000
•	Р	0.000000E+00	P	0.00000E+00	P	0.0000002+00	F	5 796004E 04	r v	5 142002E 04
	к	6.4299900E-04	ĸ	5.465492E-04	ĸ	6.1084912-04	n	5.7609912-04	к С-	5.143552E-04
	Ca	6.5871220E-04	Ca	5.599054E-04	Ca	6.257766E-04	Ca	5.9284102-04		0.2090905-04
	Ti	0.000000E+00	Ti	0.000000E+00	Ti	0.00000E+00	11	0.00000E+00	11	0.0000000000000000000000000000000000000
	Mn	0.000000E+00	Mn	0.000000E+00	Mn	0.00000E+00	Mn	0.00000E+00	Mn	0.000000E+00
	Fe	1.6235590E-04	Fe	1.380025E-04	Fe	1.542381E-04	Fe	1.461203E-04	Fe	1.298847E-04
			Total	7.994531E-02	Total	8.072318E-02	Total	8.033424E-02	Total	7.955638E-02
			Total O	4.359266E-02	Total O	4.296957E-02	Total O	4.328111E-02	Total O	4.390421E-02
			Total H	1.704962E-02	Total H	1.905546E-02	Total H	1.805254E-02	Total H	1.604670E-02
			3.5% / 30 GW	D/mt	3.5% / 30 GWD	/mt	3.5% / 30 GWD	Vmt	3.5% / 30 GWD	/mt
	3.5% / 30	GWD/mt	water vol frac	3.000000E-01	water vol frac	3.000000E-01	water vol frac	3.000000E-01	water vol frac	3.000000E-01
		Full Density	UO2 vol frac	1.500000E-01	UO2 vol frac	1.600000E-01	UO2 vol frac	1.400000E-01	UO2 vol frac	1.000000E-01
1102	0	4 8888950E-02	0	7.333343E-03	0	7.822232E-03	0	6.844453E-03	0	4.888895E-03
001	1.234	0.00400005.00		1 303741E-06	11.224	1 390657E-06	U-234	1.216825E-06	U-234	8 691609E-07
		8 69 10090 F-00	0-234	1.0007 12.00	V-2.34		v = • ·			0.0010000 07
	11-235	4 6281670E-04	U-234 (J-235	6 942251E-05	U-235	7.405067E-05	U-235	6.479434E-05	U-235	4.628167E-05
	U-235	4.6281670E-04	U-234 U-235	6.942251E-05 2.395760E-05	U-235	7.405067E-05 2.555477E-05	U-235 U-236	6.479434E-05 2.236042E-05	U-235 U-236	4.628167E-05 1.597173E-05
	U-235 U-236	8.6916090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02	U-234 U-235 U-236 11-238	6.942251E-05 2.395760E-05 3.565424E-03	U-235 U-236	7.405067E-05 2.555477E-05 3.803118E-03	U-235 U-236 U-238	6.479434E-05 2.236042E-05 3.327729E-03	U-235 U-236 U-238	4.628167E-05 1.597173E-05 2.376949E-03
	U-235 U-236 U-238	8.6916090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05	U-234 U-235 U-236 U-238 No.237	6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06	U-234 U-235 U-236 U-238 Nn-237	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06	U-235 U-236 U-238 Np-237	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06	U-235 U-236 U-238 No-237	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06
420	U-235 U-236 U-238 Np-237	8.6916090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6961260E-02	U-234 U-235 U-236 U-238 Np-237	6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02	U-234 U-235 U-236 U-238 Np-237 H	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02	U-235 U-236 U-238 Np-237 H	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02	U-235 U-236 U-238 Np-237 H	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06 1.805254E-02
H2O	U-235 U-236 U-238 Np-237 H	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02	U-234 U-235 U-236 U-238 Np-237 H	6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02	U-235 U-236 U-238 U-238 Np-237 H	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.424519E-03	U-235 U-236 U-238 Np-237 H	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03	U-235 U-236 U-238 Np-237 H O	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06 1.805254E-02 9.026270E-03
H2O	U-235 U-236 U-238 Np-237 H O	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02 3.3430630E-02	U-234 U-235 U-236 U-238 Np-237 H O	6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02 8.524811E-03 0.00000E+00	U-235 U-236 U-238 Np-237 H O	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.4245199E-03 0.00000E+00	U-235 U-236 U-238 Np-237 H O H	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03 0.000000E+00	U-235 U-236 U-238 Np-237 H O H	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06 1.805254E-02 9.026270E-03 0.000000E+00
H2O Tuff	U-235 U-236 U-238 Np-237 H O H	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02 3.3430630E-02 0.0000000E+00	U-234 U-235 U-236 U-238 Np-237 H O O H	6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02 8.524811E-03 0.000000E+00	U-235 U-236 U-238 Np-237 H O H	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.424519E-05 0.000000E+00 2.740827E-02	U-235 U-236 U-238 Np-237 H O H	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03 0.000000E+00 2.806079E-02	U-235 U-236 U-238 Np-237 H O H O	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06 1.805254E-02 9.026270E-03 0.000000E+00 2.936595E-02
H2O Tuff	U-235 U-236 U-238 Np-237 H O H O	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02 3.3430630E-02 0.0000000E+00 3.2628830E-02	U-234 U-235 U-236 U-238 Np-237 H O H O H	6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02 8.524811E-03 0.000000E+00 2.773451E-02	U-235 U-236 U-238 Np-237 H O H O No	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.424519E-03 0.000000E+00 2.740822E-02 2.82441E.04	U-235 U-236 U-238 Np-237 H O H O Na	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03 0.000000E+00 2.806079E-02 3.915909E-04	U-235 U-236 U-238 Np-237 H O H O Na	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06 1.805254E-02 9.026270E-03 0.000000E+00 2.936595E-02 4.098044E-04
H2O Tuff	U-235 U-236 U-238 Np-237 H O H O Na	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02 3.3430630E-02 0.0000000E+00 3.2628830E-02 4.5533820E-04	U-234 U-235 U-236 U-238 Np-237 H O H O Na	6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02 8.524811E-03 0.000000E+00 2.773451E-02 3.870375E-04	U-235 U-236 U-238 Np-237 H O H O Na	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.424519E-03 0.000000E+00 2.740822E-02 3.824841E-04 2.347103E-04	U-235 U-236 U-238 Np-237 H O H O Na	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03 0.000000E+00 2.806079E-02 3.915909E-04 2.30604E-04	U-235 U-236 Np-237 H O H O Na	4.628167E-05 1.597173E-05 2.376549E-03 4.376500E-06 1.805254E-02 9.026270E-03 0.000000E+00 2.936595E-02 4.098044E-04 2.036595E-02
H2O Tuff	U-235 U-236 U-238 Np-237 H O H O Na Mg	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02 3.3430630E-02 0.0000000E+00 3.2628830E-02 4.5533820E-04 2.6751210E-04	U-234 U-235 U-236 U-238 Np-237 H O H O Na Mg	6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02 8.524811E-03 0.00000E+00 2.773451E-02 3.870375E-04 2.273853E-04	U-235 U-236 U-236 U-238 Np-237 H O H O Na Na	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.424519E-05 0.000000E+00 2.740822E-02 3.824841E-04 2.247102E-04 2.5205E-03	U-235 U-236 U-238 Np-237 H O H O Na Mg	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03 0.000000E+00 2.806079E-02 3.915909E-04 2.300604E-04 2.50032E-03	U-235 U-236 U-238 Np-237 H O H O Na Mg Al	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06 1.805254E-02 9.026270E-03 0.000000E+00 2.936595E-02 4.098044E-04 2.403695E-02 4.038044E-04 2.403686E-03
H2O Tuff	0-235 U-236 U-238 U-238 Np-237 H O H O Na Mg Al	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02 3.3430630E-02 0.0000000E+00 3.2628830E-02 4.5533820E-04 2.6751210E-04 3.0153870E-03	U-234 U-235 U-236 U-238 Np-237 H O H O Na Mg Al	6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02 8.524811E-03 0.000000E+00 2.773451E-02 3.870375E-04 2.273853E-04 2.563079E-03	U-235 U-236 U-238 Np-237 H O H O Na Mg Al	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.424519E-03 0.000000E+00 2.740822E-02 3.824841E-04 2.247102E-04 2.532925E-03	U-235 U-236 U-238 Np-237 H O H O Na Mg AJ	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03 0.000000E+00 2.806079E-02 3.915309E-04 2.300604E-04 2.593233E-03	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si	4.628167E-05 1.597173E-05 2.376549E-03 4.376500E-06 1.805254E-02 9.026270E-03 0.00000C+00 2.936595E-02 4.098044E-04 2.407609E-04 2.713848E-03 1.9726-02
H2O Tuff	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02 3.3430630E-02 0.0000000E+00 3.2628830E-02 4.5533820E-04 2.6751210E-04 3.0153870E-03 1.3193410E-02	U-234 U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si	6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02 8.524811E-03 0.000000E+00 2.773451E-02 3.870375E-04 2.273853E-04 2.273853E-04 2.563079E-03 1.121440E-02	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.424519E-03 0.000000E+00 2.740822E-02 3.824841E-04 2.247102E-04 2.532925E-03 1.108246E-02	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si Si	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03 0.000000E+00 2.806079E-02 3.915909E-04 2.300604E-04 2.593233E-03 1.134633E-02 0.00000E-02	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si Si	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06 1.805254E-02 9.026270E-03 0.000000E+00 2.936595E-02 4.098044E-04 2.407609E-04 2.713848E-03 1.187407E-02 0.00000E+00
H2O Tuff	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02 3.3430630E-02 0.000000E+00 3.2628830E-02 4.5533820E-04 2.6751210E-04 3.0153870E-03 1.3193410E-02 0.0000000E+00	U-234 U-235 U-236 U-238 Np-237 H O H O Na A Mg AI Si Si	6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02 8.524811E-03 0.000000E+00 2.773451E-02 3.870375E-04 2.273853E-04 2.273853E-04 2.273853E-04 2.563079E-03 1.121440E-02 0.000000E+00	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.424519E-03 0.000000E+00 2.740822E-02 3.824841E-04 2.247102E-04 2.532925E-03 1.108246E-02 0.000000E+00	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03 0.000000E+00 2.806079E-02 3.915909E-04 2.593233E-03 1.134633E-02 0.000000E+00 6.52070E-04	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P P	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06 1.805254E-02 9.026270E-03 0.000000E+00 2.936595E-02 4.098044E-04 2.47384E-03 1.187407E-02 0.000000E+00 5.786707E-02 0.00000E+00 5.786707E-02 0.00000E+00 5.786707E-02 0.00000E+00 5.786707E-02 0.00000E+00 5.786707E-02 0.00000E+00 5.786707E-02 0.00000E+00 5.786707E-02 0.00000E+00 5.786707E-02 0.00000E+00 5.786707E-02 0.00000E+00 5.786707E-02 0.00000E+00 5.786707E-02 0.00000E+00 5.786707E-02 0.00000E+00 5.786707E-02 0.000000E+00 5.786707E-02 0.000000E+00 5.786707E-02 0.00000E+00 5.786707E-02 5.78777E-02 5.78777E-02 5.78777E-02 5.787777E-02 5.787777E-02 5.78777777E-02 5.7877777777777777777777777777777777777
H2O Tuff	U-235 U-236 U-238 Np-237 H O H O Na Mg AJ Si Si K	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02 3.3430630E-02 0.0000000E+00 3.2628830E-02 4.5533820E-04 2.6751210E-04 3.0153870E-03 1.3193410E-02 0.0000000E+00 6.4299900E-04	U-234 U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K	6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02 8.524811E-03 0.000000E+00 2.773451E-02 3.870375E-04 2.273853E-04 2.273853E-04 2.563079E-03 1.121440E-02 0.000000E+00 5.465492E-04	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.424519E-05 0.000000E+00 2.740822E-02 3.824841E-04 2.247102E-04 2.532925E-03 1.108246E-02 0.000000E+00 5.401192E-04	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03 0.000000E+00 2.806079E-02 3.915909E-04 2.300604E-04 2.300604E-04 2.593233E-03 1.134633E-02 0.000000E+00 5.529791E-04	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K C	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06 1.805554E-02 9.026270E-03 0.000000E+00 2.936595E-02 4.098044E-04 2.407609E-04 2.407609E-04 2.407609E-04 1.187407E-02 0.000000E+00 5.786991E-04
H2O Tuff	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02 3.3430630E-02 0.0000000E+00 3.2628830E-02 4.5533820E-04 2.6751210E-04 3.0153870E-03 1.3193410E-02 0.000000E+00 6.4299900E-04 6.5871220E-04	U-234 U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca	6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02 8.524811E-03 0.000000E+00 2.773451E-02 3.870375E-04 2.273853E-04 2.563079E-03 1.121440E-02 0.000000E+00 5.466492E-04 5.599054E-04	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si Si P K Ca	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.424519E-03 0.000000E+00 2.740822E-02 3.824841E-04 2.247102E-04 2.532925E-03 1.108246E-02 0.000000E+00 5.401192E-04 5.533182E-04	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si Si F K Ca	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03 0.000000E+00 2.806079E-02 3.915509E-04 2.300604E-04 2.593233E-03 1.134633E-02 0.000000E+00 5.529791E-04 5.664925E-04	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si Si F K Ca	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06 1.805254E-02 9.026270E-03 0.000000E+00 2.936595E-02 4.098044E-04 2.407609E-04 2.713848E-03 1.187407E-02 0.000000E+00 5.786991E-04 5.928410E-04
H2O Tuff	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02 3.3430630E-02 0.000000E+00 3.2628830E-02 4.5533820E-04 2.6751210E-04 3.0153870E-03 1.3193410E-02 0.0000000E+00 6.4299900E-04 6.5871220E-04 0.0000000E+00	U-234 U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti	1.50171E-05 6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02 8.524811E-03 0.000000E+00 2.773451E-02 3.870375E-04 2.273853E-04 2.563079E-03 1.121440E-02 0.000000E+00 5.465492E-04 5.599054E-04 0.000000E+00	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.424519E-03 0.000000E+00 2.740822E-02 3.824841E-04 2.53292E-03 1.108246E-02 0.000000E+00 5.401192E-04 5.533182E-04 0.000000E+00	U-235 U-236 U-238 Np-237 H O H O Na Mg AJ Si P K Ca Ti	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03 0.000000E+00 2.806079E-02 3.915909E-04 2.300604E-04 2.593233E-03 1.134633E-02 0.000000E+00 5.529791E-04 5.664925E-04 0.000000E+00	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06 1.805254E-02 9.026270E-03 0.000000E+00 2.936595E-02 4.098044E-04 2.4713848E-03 1.187407E-02 0.000000E+00 5.786991E-04 5.928410E-04 0.000000E+00
H2O Tuff	U-235 U-236 U-238 Np-237 H O H O Na Mg AJ Si P K Ca Ti Mn	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02 3.3430630E-02 0.0000000E+00 3.2628830E-02 4.5533820E-04 2.6751210E-04 3.0153870E-03 1.3193410E-02 0.0000000E+00 6.4299900E-04 6.5871220E-04 0.0000000E+00 0.0000000E+00	U-234 U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti K	1.50171E 6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02 8.524811E-03 0.000000E+00 2.773451E-02 3.870375E-04 2.273853E-04 2.273853E-04 2.563079E-03 1.121440E-02 0.000000E+00 5.465492E-04 5.599054E-04 0.000000E+00 0.000000E+00	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti Mn	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.424519E-05 0.000000E+00 2.740822E-02 3.824841E-04 2.247102E-04 2.532925E-03 1.108246E-02 0.000000E+00 5.401192E-04 5.533182E-04 0.000000E+00	U-235 U-235 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti Mn	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03 0.000000E+00 2.806079E-02 3.915909E-04 2.300604E-04 2.593233E-03 1.134633E-02 0.000000E+00 5.564925E-04 0.000000E+00 0.000000E+00	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti Ti Mn	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06 1.805254E-02 9.026270E-03 0.000000E+00 2.936595E-02 4.098044E-04 2.407609E-04 2.407609E-04 2.407609E-04 0.000000E+00 5.786991E-04 5.928410E-04 0.000000E+00 0.000000E+00 0.000000E+00 0.000000E+00 0.000000E+00 0.000000E+00 0.000000E+00 0.00000E+00 0.00000E+00 0.000000E+00 0.0000E+00 0.0000E+00 0.00000E+00 0.0000E+00
H2O Tuff	U-235 U-236 U-238 Np-237 H O H O Na Mg AJ Si P K Ca Ti Mn Fe	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02 3.3430630E-02 0.0000000E+00 3.2628830E-02 4.5533820E-04 2.6751210E-04 3.0153870E-03 1.3193410E-02 0.0000000E+00 6.4299900E-04 6.5871220E-04 0.0000000E+00 0.000000E+00 1.6235590E-04	U-234 U-235 U-236 U-238 Np-237 H O H O Na Mg AI Si P K Ca Ti K Ca Ti Mn Fe	1.30171E 0.942251E 2.395760E 3.565424E 0.3565424E 1.704962E 8.524811E 0.000000E 2.773451E 3.870375E 2.273853E 0.00000E 1.121440E 0.000000E 5.465492E 0.000000E 0.000000E 1.121440E 0.000000E 0.000000E 1.45492E 0.000000E 1.380025E	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si Si P K Ca Ti Mn Fe	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.424519E-05 0.000000E+00 2.740822E-02 3.824841E-04 2.53292E-03 1.108246E-02 0.000000E+00 5.401192E-04 5.533182E-04 0.000000E+00 1.363790E-04	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti Mn Fe	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03 0.000000E+00 2.806079E-02 3.915909E-04 2.300604E-04 2.300604E-04 2.593233E-03 1.134633E-02 0.000000E+00 5.529791E-04 5.664925E-04 0.000000E+00 1.396261E-04	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti Mn Fe	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06 1.805254E-02 9.026270E-03 0.00000E+00 2.936595E-02 4.098044E-04 2.407609E-04 2.407609E-04 2.113448E-03 1.187407E-02 0.000000E+00 5.786991E-04 5.928410E-04 0.000000E+00 0.000000E+00 1.461203E-04 4.02020E+00 1.461202E+00 1.461202E+00 1.461202E+00 1.461202E+00 1.461202E+00 1.461202E+00 1.461202E+00 1.46120E
H2O Tuff	U-235 U-236 U-238 V-238 H O H O Na Mg Al Si P K Ca Ti Ti Mn Fe	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02 3.3430630E-02 0.0000000E+00 3.2628830E-02 4.5533820E-04 2.6751210E-04 3.0153870E-03 1.3193410E-02 0.0000000E+00 6.4299900E-04 6.5871220E-04 0.0000000E+00 0.0000000E+00 1.6235590E-04	U-234 U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si Si Si Si Si Ca Ti K Ca Ti Fe Total	1.50171E-05 6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02 8.524811E-03 0.000000E+00 2.773451E-02 3.870375E-04 2.273853E-04 2.563079E-03 1.121440E-02 0.000000E+00 5.465492E-04 5.599054E-04 0.000000E+00 1.380025E-04 7.994531E-02	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si Si P K Ca Ti Mn Fe Total	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.424519E-03 0.000000E+00 2.740822E-02 3.824841E-04 2.532925E-03 1.108246E-02 0.000000E+00 5.401192E-04 5.533182E-04 0.000000E+00 0.363790E-04 7.986752E-02	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti K Ca Ti Fe Total	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03 0.000000E+00 2.806079E-02 3.915909E-04 2.300604E-04 2.593233E-03 1.134633E-02 0.00000E+00 5.529791E-04 5.664925E-04 0.000000E+00 1.396261E-04 8.002310E-02	U-235 U-236 U-238 Np-237 H O Na Mg Al Si P K Ca Ti K Ca Ti Fe Total	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06 1.805254E-02 9.026270E-03 0.000000E+00 2.936595E-02 4.098044E-04 2.407609E-04 2.713848E-03 1.87407E-02 0.000000E+00 5.786991E-04 5.928410E-04 0.000000E+00 1.461203E-04 8.033424E-02
H2O Tuff	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti Mn Fe	8.6910090E-06 4.6281670E-04 1.5971730E-04 2.3769490E-02 4.3765000E-05 6.6861260E-02 3.3430630E-02 0.000000E+00 3.2628830E-02 4.5533820E-04 2.6751210E-04 3.0153870E-03 1.3193410E-02 0.0000000E+00 6.4299900E-04 6.5871220E-04 0.0000000E+00 1.6235590E-04	U-234 U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti K Ca Ti Mn Fe Total Total O	1.03171E-05 6.942251E-05 2.395760E-05 3.565424E-03 6.564750E-06 1.704962E-02 8.524811E-03 0.000000E+00 2.773451E-02 3.870375E-04 2.273853E-04 2.273853E-04 2.563079E-03 1.121440E-02 0.000000E+00 5.465492E-04 5.599054E-04 0.000000E+00 1.380025E-04 7.994531E-02 4.359266E-02	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti K Ca Ti Mn Fe Total Total O	7.405067E-05 2.555477E-05 3.803118E-03 7.002400E-06 1.684904E-02 8.424519E-03 0.00000E+00 2.740822E-02 3.824841E-04 2.247102E-04 2.532925E-03 1.108246E-02 0.000000E+00 5.401192E-04 5.533182E-04 0.000000E+00 0.000000E+00 0.363790E-04 7.966752E-02 4.365497E-02	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti K Ca Ti Total Total O	6.479434E-05 2.236042E-05 3.327729E-03 6.127100E-06 1.725021E-02 8.625103E-03 0.000000E+00 2.806079E-02 3.915909E-04 2.300604E-04 2.59323E-03 1.134633E-02 0.000000E+00 5.529791E-04 5.664925E-04 0.000000E+00 1.396261E-04 8.002310E-02 4.353035E-02	U-235 U-236 U-238 Np-237 H O H O Na Mg Al Si P K Ca Ti K Ca Ti Mn Fe Total Total O	4.628167E-05 1.597173E-05 2.376949E-03 4.376500E-06 1.805254E-02 9.026270E-03 0.000000E+00 2.936595E-02 4.098044E-04 2.407609E-04 2.407609E-04 2.713848E-03 1.187407E-02 0.000000E+00 0.5786991E-04 5.928410E-04 0.000000E+00 0.000000E+00 0.000000E+00 0.461203E-04 8.033424E-02 4.338111E-02

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				.47 Porosity		.47 Porosity		.47 Porosity	
3.0% / 20 GWD	D/mt	3.0% / 20 GWI	D/mt	3.0% / 20 GWD	/mt	3.0% / 20 GWI	D/mt	3.0% / 20 GWD	/mt
water vol frac	3.000000E-01	water vol frac	3.000000E-01	water vol frac	4.700000E-01	water vol frac	4.700000E-01	water vol frac	4.700000E-01
UO2 vol frac	8.000000E-02	UO2 vol frac	0.000000E+00	UO2 vol frac	1.500000E-01	UO2 vol frac	0.000000E+00	UO2 vol frac	2.000000E-01
0	3.911116E-03	0	0.000000E+00	0	7.333343E-03	0	0.000000E+00	0	9.777790E-03
U-234	4.694450E-07	U-234	0.000000E+00	U-234	8.802093E-07	U-234	0.000000E+00	U-234	1.173612E-06
U-235	3.825286E-05	U-235	0.000000E+00	U-235	7.172412E-05	U-235	0.000000E+00	U-235	9.563216E-05
U-236	9.153184E-06	U-236	0.000000E+00	U-236	1.716222E-05	U-236	0.000000E+00	U-236	2.288296E-05
U-238	1.905500E-03	U-238	0.000000E+00	U-238	3.572813E-03	U-238	0.000000E+00	U-238	4.763750E-03
Np-237	2 182926E-06	No-237	0.000000E+00	Np-237	4.092986E-06	Np-237	0.000000E+00	Np-237	5.457314E-06
н	1 845371E-02	H	2.005838E-02	H	2.671107E-02	н	3.142479E-02	н	2.513983E-02
0	9 226854E-03	ö	1 002919E-02	ö	1.335554E-02	Ö	1.571240E-02	0	1.256992E-02
й	0.000000E+00	н [°]	0.000000E+00	Ĥ	0 000000E+00	Ĥ	0.000000E+00	Ĥ	0.000000E+00
0	3.001852E-02	ö	3 262883E-02	ö	2 118053E-02	ö	2.491827E-02	ö	1.993462E-02
Na	4 190111E-04	Na	4 5533825-04	Na	2 955762E-04	Na	3 477367E-04	Na	2.781893E-04
Ma	2 4611112-04	Ma	2 675121E-04	Ma	1 7365165-04	Ma	2 042960E-04	Ma	1 634368E-04
Mg	2.4011112-04	Nig Al	2.0751212-04	ΔI	1 9573955-03	ΔI	2 302817E-03	Al	1 842254E-03
	2.7741502-03		1 240241E 02		8 564310E-03	Ci	1 007566E-02	Si	8 060527E-03
31	1.213/94E-02	51	1.3193412-02	31 D	0.0000005+00	D	0.000000E+00	D	0.00000E+00
P	0.000000E+00	P V	0.000000000000	P K	4 1720245 04	F V		r V	3 0284005-04
к,	5.915591E-04	ĸ	0.429990E-04	N CO	4.1739346-04	N	5 020511E-04	Č.	4 024400E 04
Ca	6.060152E-04	Ca	6.58/122E-04	Ca	4.2/3934E-04	Ca Ti	0.000000E+00		4.024409E+04
11	0.00000E+00	11	0.00000E+00		0.0000000000000000000000000000000000000	11	0.0000002+00	1	0.0000000000000000000000000000000000000
Mn	0.00000E+00	Mn	0.00000E+00	Mn	0.000000E+00	Mn	0.0000002+00	MO	0.0000000000000000000000000000000000000
Fe	1.493674E-04	Fe	1.623559E-04	Fe	1.053910E-04	Fe .	1.239894E-04	re Tatal	9.919100E-00
Total	8.048982E-02	Total	8.111211E-02	lotal	8.41884/E-02	Iotal	8.610406E-02	l otal	8.334993E-02
Total O	4.315649E-02	Total O	4.265802E-02	Total O	4.186941E-02	Total O	4.063067E-02		4.228232E-02
Total H	1.845371E-02	Total H	2.005838E-02	lotal H	2.6/110/E-02	Total H	3.142479E-02	I OTAL PI	2.5139836-02
0.5% (00.0%)		0.5% / 00.0%	∼ ∕_∕	2 58/ / 20 (140)		2 EV / 20 CM	7/mt	2 5% / 20 CM	Int
3.5% / 30 GWL	J/mt	3.5% / 30 GWL		3.5% / 30 GWD	2 0000005 01	3.3767 30 9991	2 000000E 01	3.3 /6 / SU GVVD	2 000000E 01
water vol trac	3.000000E-01	water vol mac	3.0000002-01	Water voi frac	4.000000E-01		1 400000E-01	HO2 vol fron	1 0000000000000000000000000000000000000
UU2 vol frac	2.500000E-01		8.800000E-02	UU2 voi mac	1.20000E-01		1.400000E-01		4 9999055 02
0	1.222224E-02	0	4.302228E-03	0	5.8000/4E-03	0	0.044403E-03	11 224	4.0000902-03
U-234	2.172902E-06	U-234	7.648616E-07	0-234	1.042993E-06	0-234	1.210823E-00	0-234	0.091009E-07
U-235	1.157042E-04	U-235	4.072787E-05	0-235	5.553800E-05	0-235	6.4/9434E-05	0-235	4.02010/E-03
U-236	3.992933E-05	U-236	1.405512E-05	0-236	1.916608E-05	0-236	2.236042E-05	0-230	1.09/1/3E-00
U-238	5.942373E-03	U-238	2.091715E-03	0-238	2.852339E-03	0-238	3.327729E-03	0-238	2.376949E-03
Np-237	1.094125E-05	Np-237	3.851320E-06	Np-237	5.251800E-06	Np-237	6.12/100E-06	Np-237	4.376500E-00
н	1.504378E-02	н	1.829324E-02	н	1.176758E-02	н	1.150014E-02	н	1.203503E-02
0	7.521892E-03	0	9.146620E-03	0	5.883791E-03	0	5.750068E-03	0	6.01/513E-03
н	0.000000E+00	н	0.000000E+00	н	0.000000E+00	н	0.000000E+00	н	0.000000E+00
0	2.447162E-02	0	2.975749E-02	0	2.871337E-02	0	2.806079E-02	0	2.936595E-02
Na	3.415037E-04	Na	4.152684E-04	Na	4.006976E-04	Na	3.915909E-04	Na	4.098044E-04
Mg	2.006341E-04	Mg	2.439710E-04	Mg	2.354106E-04	Mg	2.300604E-04	Mg	2.407609E-04
Aľ	2.261540E-03	Aľ	2.750033E-03	Al	2.653541E-03	AI	2.593233E-03	AI	2.713848E-03
Si	9.895058E-03	Si	1.203239E-02	Si	1.161020E-02	Si	1.134633E-02	Si	1.187407E-02
Р	0.000000E+00	P	0.000000E+00	P	0.000000E+00	► P	0.000000E+00	P	0.000000E+00
к	4.822493E-04	к	5.864151E-04	к	5.658391E-04	ĸ	5.529791E-04	к	5.786991E-04
Ca	4.940342E-04	Ca	6.007455E-04	Ca	5.796667E-04	Ca	5.664925E-04	Ca	5.928410E-04
Ti	0.000000E+00	Ti	0.000000E+00	Π	0.000000E+00	Ti	0.000000E+00	Ti	0.000000E+00
Mn	0.000000E+00	Mn	0.000000E+00	Mn	0.000000E+00	Mn	0.000000E+00	Mn	0.000000E+00
Fe	1.217669E-04	Fe	1.480686E-04	Fe	1.428732E-04	Fe	1.396261E-04	Fe	1.461203E-04
Total	7.916744E-02	Total	8.042759E-02	Total	7.135298E-02	Total	7.139799E-02	Total	7.130797E-02
Total O	4.421575E-02	Total O	4.320634E-02	Total O	4.046384E-02	Total O	4.065532E-02	Total O	4.027236E-02
Total H	1.504378E-02	Total H	1.829324E-02	Total H	1.176758E-02	Total H	1.150014E-02	Total H	1.203503E-02

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3.0% / 20 GWD/ml		3.0% / 20 GWD/mt		3.0% / 20 GWD/ml		3.0% / 20 GWD/	'nt	3.0% / 20 GWD/r	nt
water vol frac	4.700000E-01	water vol frac	4.700000E-01	water vol frac	4.700000E-01	water vol frac	4.700000E-01	water vol frac	4.700000E-01
UO2 vol frac	2.500000E-01	UO2 vol frac	5.000000E-02	UO2 vol frac	1.000000E-01	UO2 vol frac	1.850000E-01	UO2 vol frac	8.000000E-02
0	1.222224E-02	0	2.444448E-03	0	4.888895E-03	0	9.044456E-03	0	3.911116E-03
U-234	1.467016E-06	U-234	2.934031E-07	U-234	5.868062E-07	U-234	1.085591E-06	U-234	4.694450E-07
U-235	1 195402E-04	U-235	2.390804E-05	U-235	4.781608E-05	U-235	8.845975E-05	U-235	3.825286E-05
U-236	2 860370E-05	U-236	5.720740E-06	U-236	1.144148E-05	U-236	2.116674E-05	U-236	9.153184E-06
11-238	5 954688E-03	U-238	1.190938E-03	U-238	2.381875E-03	U-238	4.406469E-03	U-238	1.905500E-03
No-237	6 821643E-06	Nn-237	1 364329E-06	Np-237	2.728657E-06	Np-237	5.048015E-06	Np-237	2.182926E-06
H	2 356859E-02	H	2 985355E-02	Н	2.828231E-02	H	2.561121E-02	н	2.891081E-02
0	1 178430E-02	ö	1 492678E-02	0	1.414116E-02	0	1.280560E-02	0	1.445540E-02
й Н	0.000000E+00	н́ ·	0.000000E+00	Ĥ	0.00000E+00	Ĥ	0.00000E+00	Ĥ	0.000000E+00
ö	1 868870E-02	0	2 367236E-02	Ö	2.242644E-02	0	2.030839E-02	0	2.292481E-02
Na	2 608025E-04	Na	3 303498E-04	Na	3.129630E-04	Na	2.834054E-04	Na	3.199177E-04
Ma	1 532220E-04	Ma	1 9408125-04	Ma	1 838664E-04	Ma	1.665012E-04	Ma	1.879523E-04
ΔI	1 727113E-03	ΔΙ	2 1876765-03	AI	2 072535E-03	Al	1.876796E-03	Al	2.118592E-03
Ci Ci	7 556744E-03	Si	9 571876E-03	Si	9 068093E-03	Si	8.211662E-03	Si	9.269606E-03
D	0.000000E+00		0.000000E+00	P	0.000000E+00	P	0.000000E+00	P	0.000000E+00
ĸ	3 6928835-04	ĸ	4 664986E-04	ĸ	4 419460E-04	ĸ	4.002067E-04	ĸ	4.517670E-04
C.	3 7728835-04	Ca	4 778985E-04	Ca	4 527460E-04	Ca	4 099866E-04	Ca	4.628070E-04
Ti Ca	0.000000E+00	Ti	0.00000E+00	Ti	0.000000E+00	Ti	0.000000E+00	Ti	0.000000E+00
Mo	0.000000E+00	Mo	0.000000E+00	Mn	0.000000E+00	Mn	0 000000E+00	Mn	0.000000E+00
Eo	9 200203E-05	Fo	1 177899E-04	Fe	1 115904E-04	Fe	1 010513E-04	Fe	1.140702E-04
Totol	9 201140E 02	Total	8 546553E-02	Total	8 482700E-02	Total	8 374149E-02	Total	8 508241E-02
Total O	4 260524E 02	Total O	4 104358E-02	Total O	4 145650E-02	Total O	4 215845E-02	Total O	4 129133E-02
Total U	2 255250E-02	Total H	2 9853555-02	Total H	2 828231E-02	Total H	2 561121E-02	Total H	2.891081E-02
rutar m	2.3300332-02		2.5000302-02		L.VLVLVIL VL				

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3.5% / 30 GWD	/mt	3.5% / 30 GWD/m	nt
water vol frac	2.000000E-01	water vol frac	3.000000E-01
UO2 vol frac	5.00000E-02	UO2 vol frac	5.000000E-02
0	2.44448E-03	0	2.444448E-03
U-234	4.345805E-07	U-234	4.345805E-07
U-235	2.314084E-05	U-235	2.314084E-05
U-236	7.985865E-06	U-236	7.985865E-06
U-238	1.188475E-03	U-238	1.188475E-03
Np-237	2.188250E-06	Np-237	2.188250E-06
н	1.270364E-02	н	1.905546E-02
0	6.351820E-03	0	9.527730E-03
н	0.000000E+00	н	0.000000E+00
0	3.099739E-02	0	3.099739E-02
Na	4.325713E-04	Na	4.325713E-04
Mg	2.541365E-04	Mg	2.541365E-04
Aľ	2.864618E-03	Ai	2.864618E-03
Si	1.253374E-02	Si	1.253374E-02
Р	0.00000E+00	Р	0.000000E+00
К	6.108491E-04	к	6.108491E-04
Ca	6.257766E-04	Ca	6.257766E-04
Ti	0.000000E+00	Ti	0.000000E+00
Mn	0.00000E+00	Mn	0.000000E+00
Fe	1.542381E-04	Fe	1.542381E-04
Total	7.119545E-02	Total	8.072318E-02
Total O	3.979366E-02	Total O	4.296957E-02
Total H	1.270364E-02	Total H	1.905546E-02

Attachment VIII Page 4

		log model		log model					
3.0% / 20 GW	D/mt	3.0% / 20 GWD	D/mt	3.0% / 20 GWD	Vmt	3.0% / 20 GWD	/mt	3.0% / 20 GWI	D/mt
water vol frac	4.700000E-01	water vol frac	3.000000E-01	water vol frac	3.000000E-01	water vol frac	3.000000E-01	water vol frac	1.000000E-01
UO2 vol frac	5.000000E-02	UO2 vol frac	3.600000E-02	UO2 voi frac	8.00000E-02	UO2 vol frac	5.000000E-02	UO2 vol frac	8.000000E-02
0	2.444448E-03	0	1.760002E-03	0	3.911116E-03	0	2.44448E-03	0	3.911116E-03
U-234	2.934031E-07	U-234	2.112502E-07	U-234	4.694450E-07	U-234	2.934031E-07	U-234	4.694450E-07
U-235	2.390804E-05	U-235	1.721379E-05	U-235	3.825286E-05	U-235	2.390804E-05	U-235	3.825286E-05
U-236	5.720740E-06	U-236	4.118933E-06	U-236	9.153184E-06	U-236	5.720740E-06	U-236	9.153184E-06
U-238	1.190938E-03	U-238	8.574750E-04	U-238	1.905500E-03	U-238	1.190938E-03	U-238	1.905500E-03
Np-237	1.364329E-06	Np-237	9.823165E-07	Np-237	2.182926E-06	Np-237	1.364329E-06	Np-237	2.182926E-06
H	2.985355E-02	H	1.933628E-02	H	1.845371E-02	H	1.905546E-02	н	6.151236E-03
0	1.492678E-02	0	9.668138E-03	0	9.226854E-03	0	9.527730E-03	0	3.075618E-03
н	0.000000E+00	H	0.000000E+00	΄ Η	0.000000E+00	н	0.000000E+00	н	0.000000E+00
0	2.367236E-02	0	1.572710E-02	0	1.500926E-02	0	1.549869E-02	0	1.500926E-02
Na	3.303498E-04	Na	2.194730E-04	Na	2.094556E-04	Na	2.162856E-04	Na	2.094556E-04
Ma	1.940812E-04	Ma	1.289408E-04	Ma	1.230556E-04	Ma	1.270682E-04	Ma	1.230556E-04
AŬ	2.187676E-03	Aľ	1.453417E-03	Aľ	1.387078E-03	AŬ	1.432309E-03	Aľ	1.387078E-03
Si	9.571876E-03	Si	6.359224E-03	Si	6.068969E-03	Si	6.266870E-03	Si	6.068969E-03
P	0.000000E+00								
к	4.664986E-04	ĸ	3.099255E-04	ĸ	2.957795E-04	ĸ	3.054245E-04	ĸ	2.957795E-04
Ca	4.778985E-04	Ca	3.174993E-04	Ca	3.030076E-04	Ca	3.128883E-04	Ca	3.030076E-04
Ti	0.000000E+00	Ti	0.000000E+00	Ti	0.000000E+00	Ti	0.000000E+00	· Ti	0.000000E+00
Mn	0.000000E+00								
Fe	1.177899E-04	Fe	7.825554E-05	Fe	7.468371E-05	Fe	7.711905E-05	Fe	7.468371E-05
Total	8.546553E-02	C	2,706816E-02	C	2.583268E-02	C	2.667505E-02	C	2.583268E-02
Total O	4.104358E-02	Total	8.330641E-02	Total	8.285121E-02	Total	8.316157E-02	Total	6.439750E-02
Total H	2.985355E-02	Total O	2.715524E-02	Total O	2.814723E-02	Total O	2.747087E-02	Total O	2.199600E-02
		Total H	1.933628E-02	Total H	1.845371E-02	Total H	1.905546E-02	Total H	6.151236E-03

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Additional Case Soddyite/water in Tuff Additional Cas Soddvite/water in Tuff

3.0% / 20 GW	D/mt
water vol frac	1.570000E-01
UO2 vol frac	7.400000E-02
0	3.617782E-03
U-234	4.342366E-07
U-235	3.538390E-05
U-236	8.466695E-06
U-238	1.762588E-03
Np-237	2.019206E-06
ี ค่	1.049722E-02

3.0% / 20 GWD/r	nt	3.0% / 20 GWD/r	nt	3.0% / 20 GWI	D/mt	3.0% / 20 GWD/	rnt	3.0% / 20 GWI	D/mt
water vol frac	2.000000E-01	water vol frac	2.500000E-01	water vol frac	2.700000E-01	water vol frac	1.210000E-01	water vol frac	1.570000E-01
UO2 vol frac	8.000000E-02	UO2 vol frac	8.000000E-02	UO2 vol frac	8.000000E-02	UO2 vol frac	9.100000E-02	UO2 vol frac	7.400000E-02
0	3.911116E-03	0	3.911116E-03	0	3.911116E-03	0	4.448894E-03	0	3.617782E-03
U-234	4.694450E-07	U-234	4.694450E-07	U-234	4.694450E-07	U-234	5.339936E-07	U-234	4.342366E-07
U-235	3.825286E-05	U-235	3.825286E-05	U-235	3.825286E-05	U-235	4.351263E-05	U-235	3.538390E-05
U-236	9.153184E-06	U-236	9.153184E-06	U-236	9.153184E-06	U-236	1.041175E-05	U-236	8.466695E-06
U-238	1.905500E-03	U-238	1.905500E-03	U-238	1.905500E-03	U-238	2.167506E-03	U-238	1.762588E-03
Np-237	2.182926E-06	Np-237	2.182926E-06	Np-237	2.182926E-06	Np-237	2.483078E-06	Np-237	2.019206E-06
н	1.230247E-02	н	1.537809E-02	H	1.660834E-02	н	8.090212E-03	н	1.049722E-02
0	6.151236E-03	0	7.689045E-03	0	8.304168E-03	0	4.045106E-03	0	5.248609E-03
н	0.000000E+00	Н, 1	0.000000E+00	н	0.00000E+00	н :	0.000000E+00	н	0.000000E+00
0	1.500926E-02	0	1.500926E-02	0	1.500926E-02	0	3.262883E-02	0	3.262883E-02
Na	2.094556E-04	Na	2.094556E-04	Na	2.094556E-04	Na	4.553382E-04	Na	4.553382E-04
Mg	1.230556E-04	Mg	1.230556E-04	Mg	1.230556E-04	Mg	2.675121E-04	Mg	2.675121E-04
Al	1.387078E-03	AI	1.387078E-03	AI	1.387078E-03	AI	3.015387E-03	AI	3.015387E-03
Si	6.068969E-03	Si	6.068969E-03	Si	6.068969E-03	Si	1.319341E-02	Si	1.319341E-02
P	0.000000E+00	Р	0.000000E+00	Р	0.00000E+00	Р	0.000000E+00	P	0.000000E+00
к	2.957795E-04	к	2.957795E-04	ĸ	2.957795E-04	к	6.429990E-04	к	6.429990E-04
Ca	3.030076E-04	Ca	3.030076E-04	Ca	3.030076E-04	Ca	6.587122E-04	Ca	6.587122E-04
Ti	0.000000E+00	Ti	0.000000E+00	Ti	0.00000E+00	Ti	0.000000E+00	Ti	0.000000E+00
Mn	0.000000E+00	Mn	0.000000E+00	Mn	0.00000E+00	Mn	0.000000E+00	Mn	0.000000E+00
Fe	7.468371E-05	Fe	7.468371E-05	Fe	7.468371E-05	Fe	1.623559E-04	Fe	1.623559E-04
C	2.583268E-02	C	2.583268E-02	С	2.583268E-02	С	0.000000E+00	С	0.000000E+00
Total	7.362436E-02	Total	7.823778E-02	Total	8.008315E-02	Total	6.983321E-02	Total	7.219704E-02
Total O	2.507161E-02	Total O	2.660942E-02	Total O	2.722455E-02	Total O	4.112283E-02	Total O	4.149522E-02
Total H	1.230247E-02	Total H	1.537809E-02	Total H	1.660834E-02	Total H	8.090212E-03	Total H	1.049722E-02

								40 Porosity		.40 Porosity
Additional C	Soddyite/water in Tuff	Additional Cas	s Soddyite/water in Tuff	Additional Cas	s Soddyite/water in Tuff	Additional Case	Soddyite/water in Tuff	-		•
3 0% / 20 0	MD/mt	3.0% / 20.014	D/mt	3.0% / 20.00	D/mt	3.0% / 20. CMD	/mt	3 0% / 20 (2)4/0	Int	3.0% / 20.0%
3.0% / 20 G	1 020000E 01	3.0 /6 / 20 GW	1 470000E 01	3.0% / 20 GW	2 1000005 01	3.0767 20 GWD	2 0000005 01	S.0 /6 / 20 GVVD	A 000000E 01	S.0 /8 / 20 GVV
	5 5000005 02		1.470000E-01	Water vor nac	4 200000E-01		2.500000E-01		5 000000E-01	
	3.500000E-02	OUZ VOLITAC	1.00000E-01		1.2900000-01	OO2 VOI Trac	9.2000002-02		3.000000E-02	
0	2.000092E-03	U 224	0.0000772-03	0	7.5000/0E-03	0	4.4977032-03	U 124	2.4444402-03	U 224
0-234	3.22/434E-0/	0-234	9.682302E-07	0-234	7.309800E-07	0-234	5.39801/E-0/	0-234	2.934031E-07	0-234
U-235	2.629884E-05	0-235	7.889653E-05	0-235	6.1682/4E-05	0-235	4.399079E-05	0-235	2.390804E-05	0-235
0-236	6.292814E-06	0-236	1.867844E-05	0-236	1.4/5951E-05	0-236	1.052616E-05	U-236	5./20/40E-06	0-236
0-238	1.310031E-03	U-238	3.930094E-03	U-238	3.072619E-03	0-238	2.191325E-03	U-238	1.190938E-03	0-238
Np-237	1.500761E-06	Np-237	4.502284E-06	Np-237	3.519968E-06	Np-237	2.510364E-06	Np-237	1.364329E-06	Np-237
н	1.283736E-02	н	9.828605E-03	н	1.464262E-02	Н	1.938977E-02	н	2.540728E-02	н
0	6.418681E-03	0	4.914303E-03	0	7.321308E-03	0	9.694883E-03	0	1.270364E-02	0
н	0.000000E+00	н	0.000000E+00	н	0.000000E+00	н	0.000000E+00	н	0.000000E+00	н
0	3.262883E-02	0	2.470469E-02	0	2.470469E-02	0	2.470469E-02	ο.	2.679889E-02	0
Na	4.553382E-04	Na	3.447561E-04	Na	3.447561E-04	Na	3.447561E-04	Na	3.739809E-04	Na
Mg	2.675121E-04	Mg	2.025449E-04	Mg	2.025449E-04	Mg	2.025449E-04	Mg	2.197145E-04	Mg
AI	3.015387E-03	Al	2.283079E-03	Al	2.283079E-03	Ai	2.283079E-03	Ai	2.476615E-03	AI
Si	1.319341E-02	Si	9.989296E-03	Si	9.989296E-03	Si	9.989296E-03	Si	1.083609E-02	Si
Р	0.000000E+00	Р	0.000000E+00	Р	0.000000E+00	Р	0.000000E+00	Р	0.000000E+00	P
к	6.429990E-04	к	4.868421E-04	к	4.868421E-04	κ	4.868421E-04	К	5.281116E-04	к
Ca	6.587122E-04	Ca	4.987392E-04	Ca	4.987392E-04	Ca	4.987392E-04	Ca	5.410172E-04	Ca
Ti	0.000000E+00	Ti	0.000000E+00	Ti	0.000000E+00	Ti	0.000000E+00	Ti	0.000000E+00	Ti
Mn	0.000000E+00	Mn	0.000000E+00	Mn	0.000000E+00	Mn	0.000000E+00	Mn	0.000000E+00	Mn
Fe	1.623559E-04	Fe	1.229266E-04	Fe	1.229266E-04	Fe	1.229266E-04	Fe	1.333471E-04	Fe
c	0.000000E+00	Ċ	0.000000E+00	C	0.000000E+00	Ċ	0.00000E+00	Total	8.368536E-02	Total
Total	7 431393E-02	Total	6 547579E-02	Total	7 005681E-02	Total	7.446419E-02	Total O	4.194698E-02	Total O
Total O	4 173640E-02	Total O	3 768566E-02	Total O	3 833267E-02	Total O	3 889735E-02	Total H	2 540728E-02	Total H
Total H	1 283736E-02	Total H	9 828605E-03	Total H	1 464262E-02	Total H	1 938977E-02			
10(2) 11	1.2001002 02	1010111	5.0200002 00	10(0.11)		30 Porosity			30	Porosity
					30 Porosity	3.0% / 20 GWD	/mt	3.0% / 20.GWD	/mt	3.0% / 20.GW
						water vol frac	2 000000E-01	water vol frac	2 000000E-01	water vol frac
						UO2 vol frac	0.000000E+00	UO2 voi frac	5.000000E-02	LIO2 vol frac
						0	0.000000E+00	0	2 4444485-03	0
						11-234	0.00000000000	11.234	2 0340315-07	11.234
						11.235	0.000000E+00	11-235	2.3040312-07	11.235
						11-236	0.000000E+00	11-236	5 720740E-06	11-236
						11 220	0.000000E+00	11 229	1 1000295 02	11 229
						No 227	0.000000E+00	No 227	1 264220E 06	No 227
						ц	1 3372255-02	нф-257 Ш	1.2703845-02	цр-237 Ц
							E 6961265 02		5 261920E 02	0
						U U	0.000120E+00	ŭ	0.331020E-03	ŭ
						п О	3 2628925 02	0	2.0007205.02	п
						U Na	3.202003E-02	U No	3.0997392-02	U No
						Na Ma	4.003382E-04	ina M-	4.323/13E-04	Na Ma
						мg	2.0/3121E-04	Mg	2.0413005-04	Mg
						Al	3.01538/E-03	Al O	2.864618E-03	AJ
						SI	1.319341E-02	SI	1.2533/4E-02	51
						Р И	0.00000E+00	P	0.000000E+00	P
						ĸ	6.429990E-04	ĸ	6.108491E-04	ĸ
						Ca	6.587122E-04	Ca	6.257766E-04	Ca
						11	0.000000E+00	11	0.000000E+00	TI
						Mn	0.000000E+00	Mn	0.000000E+00	Mn
						Fe	1.623559E-04	Fe	1.542381E-04	Fe
						Total	7.108292E-02	Total	7.119545E-02	Total
						Total O	3.931496E-02	Total O	3.979366E-02	Total O

	.40 Porosity									
/mt	3.0% / 20 GWD	/mt	3.0% / 20 GW	D/mt	3.0% / 20 GWI	D/mt	3.0% / 20 GW	D/mt	3.0% / 20 GWD/r	nt
4.000000E-01	water vol frac	4.000000E-01								
8.00000E-02	UO2 vol frac	1.000000E-01	UO2 vol frac	1.500000E-01	UO2 vol frac	2.000000E-01	UO2 vol frac	2.500000E-01	UO2 vol frac	1.700000E-01
3.911116E-03	0	4.888895E-03	0	7.333343E-03	0	9.777790E-03	0	1.222224E-02	0	8.311122E-03
4.694450E-07	U-234	5.868062E-07	U-234	8.802093E-07	U-234	1.173612E-06	U-234	1.467016E-06	U-234	9.975705E-07
3.825286E-05	U-235	4.781608E-05	U-235	7.172412E-05	U-235	9.563216E-05	U-235	1.195402E-04	U-235	8.128734E-05
9.153184E-06	U-236	1.144148E-05	U-236	1.716222E-05	U-236	2.288296E-05	U-236	2.860370E-05	U-236	1.945052E-05
1.905500E-03	U-238	2.381875E-03	U-238	3.572813E-03	U-238	4.763750E-03	U-238	5.954688E-03	U-238	4.049188E-03
2.182926E-06	Np-237	2.728657E-06	Np-237	4.092986E-06	Np-237	5.45/314E-06	Np-237	6.821643E-06	Np-237	4.638/1/E-06
2.460494E-02	н	2.407005E-02	н	2.273283E-02	н	2.139560E-02	н	2.005838E-02	н	2.219/94E-02
1.230247E-02	0	1.203503E-02	0	1.136641E-02	0	1.069780E-02	0	1.002919E-02	0	1.109897E-02
0.000000E+00	н	0.000000E+00	н	0.000000E+00	н	0.00000E+00	н	0.000000E+00	н	0.00000E+00
2.595261E-02	0	2.538843E-02	U	2.397796E-02	0	2.200749E-02	0	2.115/02E-02	0	2.3413/7E-02
3.621/10E-04	Na	3.542977E-04	Na	3.346145E-04	Na	3.1493135-04	Na	2.9524812-04	Na M-	3.20/412E-04
2.127702E-04	Mg	2.081500E-04	Mg	1.903807E-04	Mg	1.6502282-04	Mg	1.734369E-04	Mg	1.9190116-04
2.398400E-03	AI Ci	2.340207E-03	Al Ci	2.215918E-03	AI	2.085570E-03	AI Di	1.9002222-03	AI	2.103//9E-03
1.049389E-02	51	1.020577E-02	51	9.695445E-03	31	9.125125E-03	51	8.554805E-03	51	9.40/31/2-03
0.000000E+00	P V	0.00000E+00	Р И	4.725200E-04	Р И	0.0000000000000000000000000000000000000	P	0.00000E+00	P V	0.00000E+00
5.1143448-04	n Ca	5.003102E-04	N Ca	4.72020912-04	N. ()	4.4472002-04	<u> </u>	4.109302E-04	N	4.0140276-04
5.239325E-04		0.120420E-04	Ca	4.04000012-04		4.555935E-04	Ca Ti	4.2/11896-04		9.720702E-04
0.000000E+00	ll Ma	0.000000E+00	II M-	0.000000E+00	1 Ma	0.000000000000	11 Mar	0.0000000000000000000000000000000000000		0.0000000000000000000000000000000000000
1 2012615 04	Min Ee	1 2622995 04	Min Fe	1 1021055 04		1 1220225 04	Mn Ee	1.0527405.04	ivin Fe	1 1650225 04
9 2259455 02	Total	1.203200E-04 B 214052E 03	Tetel	9 2505695 02	re Totol	9.205094E.02	Total	R 150600E 02	Total	9 2277745-02
0.333043E-02	Total O	0.314032E-02	Total O	0.239300E-U2 A 267772E 02	Total O	0.200004E-02	Total O	6.100000E-02	Total O	4 2922065-02
4.210020E-02	Total U	4.231233E-02	Total U	9.2011122-02	Total U	2 1205605 02	Total H	2 0059295 02	Total H	4.202300E-02
2.400494E-02		2.4070032-02	TOTAL	2.2132832-02	rutar m	2.1333002-02	i utari n	2.0030382-02		2.213/346-02
		.30 Poros	sity			.30 Por	osity	_		
/mt	3.0% / 20 GWD	/mt	3.0% / 20 GW	D/mt	3.0% / 20 GWI	D/mt	3.0% / 20 GW	D/mt	3.0% / 20 GWD/r	nt
2.00000E-01	water vol frac	2.000000E-01	water vol frac	2.00000E-01	water vol frac	2.000000E-01	water vol frac	2.000000E-01	water vol frac	1.800000E-01
8.000000E-02	UO2 vol frac	1.00000E-01	UO2 vol frac	1.160000E-01	UO2 vol frac	1.200000E-01	UO2 vol frac	1.500000E-01	UO2 vol frac	8.000000E-02
3.911116E-03	0	4.888895E-03	0	5.671118E-03	0	5.866674E-03	0	7.333343E-03	0	3.911116E-03
4.694450E-07	U-234	5.868062E-07	U-234	6.806952E-07	U-234	7.041674E-07	U-234	8.802093E-07	U-234	4.694450E-07
3.825286E-05	0-235	4.781608E-05	0-235	5.546665E-05	U-235	5.737930E-05	0-235	7.1/2412E-05	0-235	3.825286E-05
9.153184E-06	0-236	1.144148E-05	0-236	1.327212E-05	U-236	1.3/29/8E-05	U-236	1.716222E-05	0-236	9.153184E-06
1.905500E-03	U-238	2.381875E-03	U-238	2.762975E-03	U-238	2.858250E-03	U-238	3.572813E-03	U-238	1.905500E-03
2.182926E-06	Np-237	2.728657E-06	Np-237	3.165242E-06	Np-237	3.274388E-06	Np-237	4.092986E-06	Np-237	2.182926E-00
1.230247E-02	н	1.203503E-02	н	1.18210/E-02	н	1.1/6/58E-02	н	1.136641E-02	н	1.10/222E-02
6.151236E-03	0	6.017513E-03	0	5.910535E-03	0	5.883/91E-03	0	5.683207E-03	0	5.536112E-03
0.00000E+00	н	0.00000E+00	н	0.000000E+00	н	0.000000E+00	Н	0.000000E+00	H	0.000002+00
3.001852E-02	0	2.936595E-02	0	2.884389E-02	0	2.8/133/E-02	0	2.773451E-02	0	3.001852E-02
4.189111E-04	Na	4.098044E-04	Na	4.025190E-04	Na	4.006976E-04	Na	3.870375E-04	Na	4.189111E-04
2.461111E-04	Mg	2.40/609E-04	Mg	2.3048072-04	Mg	2.3041005-04	Mg	2.2/30532-04	Mg	2.401111E-04
2.774150E-03	AI	2.713848E-03	Al Si	2.000002E-03	Al Ci	2.003041E-03	Al	2.5030/9E-03		2.774100E-U3
1.213/94E-02	51	0.0000005+00	31 D	1.100297E-02	0	1.1010206-02	21	0.0000005+00	31	1.213/99E-02
5 015501E 04	r k	5 786001E 04	r K	5 694111E 04	r K	5 6593015-04	F	5 465402E 04	r K	5.015501E-04
6 060152E 04	Г. С.а.	5.700991E-04	<u> </u>	5 922016E 04	Г. Са	5.00000010-04	ľ,	5.5000545 04	Г. С.	8 0601525-04
0.0001022-04	ti .	0.8204102-04	Ua Ti	0.0000005400	ua Ti	0.1 50007 E-04	Ca Ti	0.0000000000	0a Ti	0.0001022-04
0.0000000000000000000000000000000000000	Mo	0.0000000000000000000000000000000000000	Mo	0.0000000000000000000000000000000000000	Mo	0.0000000000000000000000000000000000000	Ma	0.0000000000000000000000000000000000000	Mo	0.0000000000000000000000000000000000000
1 403674E-04	Fe	1 4612035-04	Fo	1 4352285-04	Fo	1 4287325-04	Ee	1 3800255-04	Fe	1 4036745-04
7 1262065-02	Total	7 1307075-09	Total	7 1343985-02	Total	7 1357086-07	Total	7 1420505-04	Total	6 0417505-07
A 0080885-02	Total O	4 027236E_02	Total O	A 042554E-02	Total O	A MAG384E-02	Total O	4 0751065-02	Total O	3 9465755-02
1 230247E-02	Total H	1.203503E-02	Total H	1 182107E-02	Total H	1.176758E-02	Total H	1.136641E-02	Total H	1.107222F-02

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	.40 Porosity		.30 Porosity		.47 Porosity					
	3.0% / 20 GWI)/mt	3.0% / 20 GWI	D/mt	3.0% / 20 GWD	/mt	3.0% / 20 GWI	D/mt	3.0% / 20 GW	D/mt
	water vol frac	4.000000E-01	water vol frac	3.000000E-01	water vol frac	4.700000E-01	water vol frac	4.700000E-01	water vol frac	4.700000E-01
	UO2 vol frac	0.000000E+00	UO2 vol frac	2.500000E-01	UO2 vol frac	7.870000E-02	UO2 vol frac	2.614300E-02	UO2 vol frac	4.700000E-02
	0	0.000000E+00	0	1.222224E-02	0	3.847560E-03	0	1.278104E-03	0	2.297781E-03
	U-234	0.000000E+00	11-234	1 467016E-06	<u>U-234</u>	4.618165E-07	U-234	1.534087E-07	U-234	2.757989E-07
	11-235	0.000000E+00	11-235	1 195402E-04	11-235	3 763125E-05	11-235	1 250056E-05	11-235	2 247356E-05
	11-236	0.000000E+00	11.236	2 860370E-05	1-236	9 004445E-06	U-236	2 991146E-06	U-236	5.377496E-06
	11-238	0.0000000000000000000000000000000000000	11.238	5 054688E-03	11-238	1 874536E-03	11.238	6 226936E-04	11-238	1 119481E-03
	No. 237	0.0000000000000000000000000000000000000	No-237	6 821643E-06	No.237	2 147453E-06	Nn-237	7 133528E-07	Nn-237	1 282469E-06
	14p-2.57	2 6744605 02	мр-237 Ц	1 5042795 02	14p-201	2 8951665-02	нр-201	3 060325E-02	н 101	2 004783E-02
	n	1 2272255 02	0	7 5219025 02	0	1 4475935-02	ö	1 530163E-02	0	1 407301F-02
	U	1.337223E-02		1,021092E-03	ŭ	0.000000E+00	ы. 	0.000000E+00	ŭ	0.0000005+00
	н	0.0000000000000000000000000000000000000	п О	0.0000000000000000000000000000000000000	н	0.000002700		0.000002+00		2 274714E 02
	0	2.820930E-02	0	2.44/ 1020-02	0	2.295/202-02	U Na	2.420003E-02	No.	2.3/4/11E-02
	Na	3.936641E-04	Na	3.41503/E-04	Na	3.2030988-04	Na	3.300430E-04	INB.	3.313930E-04
	мg	2.312785E-04	Mg	2.006341E-04	Mg	1.8821/9E-04	Mg	1.969331E-04	Mg	1.940941E-04
	AI	2.606963E-03	Al	2.261540E-03	Ar	2.121585E-03	AI	2.242615E-03	AI	2.194080E-03
	Si	1.140641E-02	Si	9.895058E-03	SI	9.282705E-03	SI	9.812251E-03	SI	9.602103E-03
	Р	0.000000E+00	P	0.000000E+00	Р	0.000000E+00	P	0.000000E+00	P	0.00000E+00
	к.	5.559069E-04	ĸ	4.822493E-04	к	4.524054E-04	к	4.782136E-04	ĸ	4.679717E-04
	Ca	5.694918E-04	Ca	4.940342E-04	Ca	4.634610E-04	Ca	4.898998E-04	Ca	4.794077E-04
	π	0.000000E+00	Ti	0.000000E+00	Ti	0.000000E+00	Ti	0.000000E+00	Ti	0.000000E+00
	Mn	0.000000E+00	Mn	0.000000E+00	Mn	0.00000E+00	Mn	0.000000E+00	Mn	0.000000E+00
	Fe	1.403653E-04	Fe	1.217669E-04	Fe	1.142314E-04	Fe	1.207479E-04	Fe	1.181619E-04
	Total	8.423019E-02	Total	7.916744E-02	Total	8.509901E-02	Total	8.577020E-02	Total	8.550384E-02
	Total O	4.158162E-02	Total O	4.421575E-02	Total O	4.128059E-02	Total O	4.084656E-02	Total O	4.101881E-02
	Total H	2.674450E-02	Total H	1.504378E-02	Total H	2.895166E-02	Total H	3.060325E-02	Total H	2.994783E-02
.30 Poros	sity			.30	Porosity			.301	Porosity	.
	3.0% / 20 GWI)/mt	3.0% / 20 GWI	D/mt	3.0% / 20 GWD	/mt	3.0% / 20 GWI)/mt	3.0% / 20 GW	D/mt
	water vol frac	1.800000E-01	water vol frac	1.800000E-01	water vol frac	1.600000E-01	water vol frac	1.600000E-01	water vol frac	1.600000E-01
	UO2 vol frac	1.000000E-01	UO2 vol frac	1.200000E-01	UO2 vol frac	8.000000E-02	UO2 vol frac	1.00000E-01	UO2 vol frac	1.200000E-01
	0	4.888895E-03	0	5.866674E-03	Ō	3.911116E-03	0	4.888895E-03	0	5.866674E-03
	U-234	5.868062E-07	U-234	7.041674E-07	U-234	4.694450E-07	U-234	5.868062E-07	U-234	7.041674E-07
	U-235	4.781608E-05	U-235	5.737930E-05	U-235	3.825286E-05	U-235	4.781608E-05	U-235	5.737930E-05
	U-236	1.144148E-05	U-236	1.372978E-05	U-236	9.153184E-06	U-236	1.144148E-05	U-236	1.372978E-05
	U-238	2.381875E-03	U-238	2.858250E-03	U-238	1.905500E-03	U-238	2.381875E-03	U-238	2.858250E-03
	No-237	2.728657E-06	Np-237	3.274388E-06	Np-237	2.182926E-06	Np-237	2.728657E-06	Np-237	3.274388E-06
	Н	1.083152E-02	H	1.059082E-02	н	9.841977E-03	ี พ่	9.628021E-03	н	9.414065E-03
	0	5.415762E-03	ö	5.295412E-03	Ö	4.920989E-03	0	4.814011E-03	0	4.707033E-03
	й	0 000000E+00	Ĥ	0.000000E+00	Ĥ	0.000000E+00	Ĥ	0.000000E+00	Ĥ	0.00000E+00
	ö	2 936595E-02	ö	2 871337E-02	ö	3 001852E-02	ö	2 936595E-02	ö	2.871337E-02
	Na	4.008044E-04	Na	4 006976E-04	Na	4 189111E-04	Ňa	4 098044E-04	Na	4 006976E-04
	Ma	2 407600E-04	Ma	2 3541065-04	Ma	2461111E-04	Ma	2 407609E-04	Ma	2 354106E-04
	AL	2.4070030-04	AI	2.5541000-04	VI MA	2 7741585-03	ΔI	2 7138485-03	Al	2 653541E-03
		4.4974075.00	~i	1 1610005 00		1 2127045 02	с;	1 1074075 02		1 1610205-02
	0	0.0000005.000	01	0.000000E+00	51	0.0000005+00	5	0.000000E±00	0	0.0000005+00
		0.0000002700	r v		F	6.046504E.04	F V	5 796004E 04	r v	5 659204E 04
	к Са	5./00991E-04	N	5.0003912-04	n Ca	J.910091E-04		5.700331E-04	Г. С.	5 706667E 04
	ua T	5.928410E-04	Ca T	0./9000/E-U4	Ca	0.000152E-04	· Ca	3.9204102-04	Ca To	0./9000/E-04
	11	0.000000E+00	11	0.0000002+00	11	0.00000E+00	II Ma	0.0000000000000000000000000000000000000	ll Ma	0.0000000000000000000000000000000000000
	Mn	0.00000E+00	Mn	0.00000E+00	Mn	0.00000E+00	Mn	0.0000000000000000000000000000000000000	MN F-	0.00000E+00
	Fe	1.461203E-04	Fe	1.428732E-04	Fe .	1.4936/4E-04	Fe .	1.461203E-04	Fe Table	1.428/32E-04
	Total	6.950272E-02	Total	6.958785E-02	Total	6.757222E-02	Total	6./69747E-02	I otal	6./82271E-02
	Total O	3.967060E-02	Total O	3.987546E-02	Total O	3.885063E-02	Total O	3.906885E-02	Total O	3.928708E-02
	Total H	1.083152E-02	Total H	1.059082E-02	Total H	9.841977E-03	Total H	9.628021E-03	Total H	9.414065E-03

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.40 Porosity

3.0% / 20 GW	D/mt	3.0% / 20 GWD	/mt	3.0% / 20 GWD/mt		
water vol frac	4.000000E-01	water vol frac	4.000000E-01	water vol frac	3.200000E-01	
UO2 vol frac	4.300000E-02	UO2 vol frac	4.600000E-02	UO2 vol frac	0.000000E+00	
0	2.102225E-03	0	2.248892E-03	0	0.000000E+00	
U-234	2.523267E-07	U-234	2.699309E-07	U-234	0.000000E+00	
U-235	2.056091E-05	U-235	2.199540E-05	U-235	0.000000E+00	
U-236	4.919836E-06	U-236	5.263081E-06	U-236	0.000000E+00	
U-238	1.024206E-03	U-238	1.095663E-03	U-238	0.000000E+00	
Np-237	1.173323E-06	Np-237	1.255182E-06	Np-237	0.000000E+00	
н	2.559449E-02	н	2.551426E-02	H	2.139560E-02	
0	1.279725E-02	0	1.275713E-02	0	1.069780E-02	
н	0.000000E+00	н	0.000000E+00	н	0.000000E+00	
0	2.699636E-02	0	2.691173E-02	0	3.197061E-02	
Na	3.767366E-04	Na	3.755556E-04	Na	4.461527E-04	
Mg	2.213335E-04	Mg	2.206397E-04	Mg	2.621156E-04	
AŬ	2.494863E-03	Aľ	2.487043E-03	A	2.954558E-03	
Si	1.091593E-02	Si	1.088171E-02	Si	1.292726E-02	
Р	0.000000E+00	P	0.000000E+00	Р	0.000000E+00	
к	5.320029E-04	к	5.303352E-04	к	6.300278E-04	
Ca	5.450037E-04	Ca	5.432952E-04	Ca	6.454241E-04	
Ti	0.00000E+00	Ti	0.000000E+00	Ti	0.000000E+00	
Mn	0.000000E+00	Mn	0.00000E+00	Mn	0.000000E+00	
Fe	1.343296E-04	Fe	1.339085E-04	Fe	1.590807E-04	
Total	8.376163E-02	Total	8.372894E-02	Total	8.208864E-02	
Total O	4.189583E-02	Total O	4.191775E-02	Total O	4.266841E-02	
Total H	2.559449E-02	Total H	2.551426E-02	Total H	2.139560E-02	

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External Criticality Worksheet BBA000000-01717-0200-00016 REV 00

Attachment VIII Page 💋

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			4.0% /40 GWE	D/mt	4.0% /40 GWD/	mt	4.0% /40 GWD	/mt	4.0% /40 GWD/	mt
	4.0% /40	GWD/mt	water vol frac	3.000000E-01						
		Full Density	UO2 vol frac	1.400000E-01	UO2 vol frac	1.200000E-01	UO2 vol frac	1.600000E-01	UO2 vol frac	1.000000E-01
1102	0.	4 8888950E-02	0	6.844453E-03	0	5.866674E-03	0	7.822232E-03	Ó	4.888895E-03
001	1-234	1 2468890E-05	11-234	1 745645E-06	U-234	1.496267E-06	U-234	1.995022E-06	U-234	1.246889E-06
	11-225	4 51572305-04	11.235	6 322012E-05	11-235	5 418868E-05	U-235	7 225157E-05	U-235	4 515723E-05
	0-235	2 01760005 04	U-236	2 8246405-05	11-236	2 421120E-05	11-236	3 228160E-05	U-236	2 017600E-05
	11 220	2.0170000E-04	11 229	2.0240402-00	11-238	2 846363E-03	11-238	3 795150E-03	11-238	2 371969E-03
	0-230	2.37 190902-02	U-230	9 2677945 06	No 237	7 0781005-06	Nn-237	9 437467E-06	No-237	5 898417E-06
	Np-237	5.8984170E-05	Np-237	0.237784E-00	14p-237	1 765127E 02	мр-237 Ц	1 694904E-02	H	1 B05254E-02
H2O	н	6.0801200E-02	H	1.725021E-02		949356965 03	0	9 4045105 02	0	0.026270E.02
	0	3.3430630E-02	0	8.625103E-03	0	8.8230800-03		8.424519E-05	U 1	000000000000
lutt	н	0.000000E+00	н	0.000000E+00	н	0.0000000000000000000000000000000000000	н	0.0000002700		2 0265055 02
	0	3.2628830E-02	0	2.806079E-02	0	2.8/1337E-02	0	2.7408225-02	U No	2.9303936-02
	Na	4.5533820E-04	Na	3.915909E-04	Na	4.006976E-04	Na	3.824841E-04	Na	4.0900446-04
	Mg	2.6751210E-04	Mg	2.300604E-04	Mg	2.354106E-04	мg	2.24/102E-04	Mg	2.40/009E-04
	AI	3.0153870E-03	AI	2.593233E-03	Al	2.653541E-03	AI	2.532925E-03	Al	2./13046E-03
	Si	1.3193410E-02	Si	1.134633E-02	Si	1.161020E-02	Si	1.108246E-02	Si	1.18/40/E-02
	P	0.000000E+00	P	0.000000E+00	Р	0.00000E+00	P	0.00000E+00	P	0.00000E+00
	к	6.4299900E-04	ĸ	5.529791E-04	к	5.658391E-04	ĸ	5.401192E-04	ĸ	5.786991E-04
	Ca	6.5871220E-04	Ca	5.664925E-04	Ca	5.796667E-04	Ca	5.533182E-04	Ca	5.928410E-04
	Ti	0.000000E+00	Ti	0.000000E+00	Ti	0.000000E+00	Ti	0.000000E+00	Ti	0.000000E+00
	Mn	0.000000E+00	Mn	0.000000E+00	Mn	0.000000E+00	Mn	0.000000E+00	Mn	0.000000E+00
	Fe	1.6235590E-04	Fe	1.396261E-04	Fe	1.428732E-04	Fe	1.363790E-04	Fe	1.461203E-04
			Total	8.002310E-02	Total	8.017867E-02	Total	7.986752E-02	Totai	8.033424E-02
			Total O	4.353035E-02	Total O	4.340573E-02	Total O	4.365497E-02	Total O	4.328111E-02
			Total H	1.725021E-02	Total H	1.765137E-02	Total H	1.684904E-02	Total H	1.805254E-02
	A 2% /A5	GWD/mt	4,2% /45 GWI water vol frac	0/mt 3.000000F-01	4.2% /45 GWD/ water vol frac	(mt 3.000000E-01	4.2% /45 GWD water voi frac	/mt 3.000000E-01	4.2% /45 GWD/ water vol frac	/mt 3.000000E-01
	4.2 /0 /45	Full Density	LIO2 vol frac	1.000000E-01	UO2 vol frac	1 200000E-01	UO2 vol frac	1.500000E-01	UO2 vol frac	2.000000E-01
1102	0	4 8888050E-02	0	4 888895E-03	0	5 866674E-03	0	7.333343E-03	0	9.777790E-03
002	11-224	1 4634310E-05	11.234	1 463431E-06	U-234	1 756117E-06	U-234	2.195147E-06	U-234	2.926862E-06
	11.235	4 3780630E-04	11.235	4 378063E-05	U-235	5 253676E-05	U-235	6.567095E-05	U-235	8.756126E-05
	11-236	2 2045330E-04	11.236	2 204533E-05	11-236	2 645440E-05	U-236	3.306800E-05	U-236	4.409066E-05
	11.238	2.204033002-04	11.238	2 370558E-03	11-238	2 844670E-03	U-238	3.555837E-03	U-238	4.741116E-03
	No.237	6 5997150E-05	No.237	6 599715E-06	Nn-237	7 919658E-06	Np-237	9.899573E-06	Np-237	1.319943E-05
L20	LU 140-207	6 6861260E-02	н	1 805254E-02	H	1 765137E-02	H	1.704962E-02	н	1.604670E-02
120	0	3 3430630E-02	ä	9 026270E-02	ö	8 825686E-03	ö	8.524811E-03	Ö	8.023351E-03
Tuff	ŭ	0.0000000E+00	й	0.000000E+00	Ĥ	0.000000E+00	Ĥ	0.000000E+00	Ĥ	0.000000E+00
7011	ö	3 2628830E-02	0	2 936595E-02	ö	2.871337E-02	Ö	2.773451E-02	0	2.610306E-02
	Na	4 5533820E-04	Na	4 098044F-04	Na	4.006976E-04	Na	3.870375E-04	Na	3.642706E-04
	Ma	2 6751210E-04	Ma	2 407609F-04	Ma	2 354106E-04	Ma	2.273853E-04	Ma	2.140097E-04
	M9 A1	2.01512100-04	ΔI	2 7138485-03	At	2 653541E-03	Al	2 563079E-03	Al	2.412310E-03
	Ci Ci	1 21024105 02		1 1874075-02	Si	1 161020E-02	Si	1 121440E-02	Si	1.055473E-02
	5	0.0000005+00	5	0 000000E+00	P	0.000000E+00	P	0.000000E+00	P	0.000000E+00
	F K	6 4200000E 04	r K	5 7860015-04	ĸ	5 658391E-04	ĸ	5 465492E-04	ĸ	5.143992E-04
	<u> </u>	6 58712205-04	n Ce	5 9284105-04	Ca	5 796667E-04	Ċa	5.599054E-04	Ca	5.269698E-04
	Ti	0.000000000000		0.000000E+00	Ť	0.000000E+00	Ti	0.000000E+00	Ti	0.000000E+00
		0.0000000000000000000000000000000000000	11 Mm	0.00000E+00	Mn	0.000000E+00	Mn	0.000000E+00	Mn	0.000000E+00
	Mo									
	Mn	1.6235590E-04	Fe	1 461203E-04	Fe	1 428732E-04	Fe	1.380025E-04	Fe	1.298847E-04
	Mn Fe	1.6235590E-04	Fe	1.461203E-04 8.033424E-02	Fe Total	1.428732E-04 8.017867E-02	Fe Total	1.380025E-04 7.994531E-02	Fe Total	1.298847E-04 7.955637E-02
	Mn Fe	1.6235590E-04	Fe Total Total	1.461203E-04 8.033424E-02 4.328111E-02	Fe Total Total O	1.428732E-04 8.017867E-02 4.340573E-02	Fe Total Total O	1.380025E-04 7.994531E-02 4.359266E-02	Fe Total Total O	1.298847E-04 7.955637E-02 4.390421E-02
	Mn Fe	1.6235590E-04	Fe Total Total O Total H	1.461203E-04 8.033424E-02 4.328111E-02 1.805254E-02	Fe Total Total O Total H	1.428732E-04 8.017867E-02 4.340573E-02 1.765137E-02	Fe Total Total O Total H	1.380025E-04 7.994531E-02 4.359266E-02 1.704962E-02	Fe Total Total O Total H	1.298847E-04 7.955637E-02 4.390421E-02 1.604670E-02

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Attachment VIII Page //

4.0% /40 GWD/mt		4.0% /40 GWD)/mt	4.0% /40 GWD/	4.0% /40 GWD/mt		
water vol frac	3.000000E-01	water vol frac	3.000000E-01	water vol frac	3.00000E-01		
UO2 vol frac	1.800000E-01	UO2 vol frac	1.500000E-01	UO2 vol frac	5.000000E-02		
0	8.800011E-03	0	7.333343E-03	0	2.444448E-03		
U-234	2.244400E-06	U-234	1.870334E-06	U-234	6.234445E-07		
U-235	8.128301E-05	U-235	6.773585E-05	U-235	2.257862E-05		
U-236	3.631680E-05	U-236	3.026400E-05	U-236	1.008800E-05		
U-238	4.269544E-03	U-238	3.557954E-03	U-238	1.185985E-03		
Np-237	1.061715E-05	Np-237	8.847626E-06	Np-237	2.949209E-06		
H	1.644787E-02	н́	1.704962E-02	ี ค่	1.905546E-02		
0	8.223935E-03	0	8.524811E-03	0	9.527730E-03		
н	0.000000E+00	н	0.000000E+00	н	0.000000E+00		
0	2.675564E-02	0	2.773451E-02	0	3.099739E-02		
Na	3.733773E-04	Na	3.870375E-04	Na	4.325713E-04		
Mg	2.193599E-04	Mg	2.273853E-04	Mg	2.541365E-04		
A	2.472617E-03	Aľ	2.563079E-03	Aľ	2.864618E-03		
Si	1.081860E-02	Si	1.121440E-02	Si	1.253374E-02		
P	0.000000E+00	P	0.000000E+00	P	0.000000E+00		
к	5.272592E-04	ĸ	5.465492E-04	к	6.108491E-04		
Ca	5.401440E-04	Ca	5.599054E-04	Ca	6.257766E-04		
Ti	0.000000E+00	Ti	0.000000E+00	Ti	0.000000E+00		
Mn	0.000000E+00	Mn	0.000000E+00	Mn	0.000000E+00		
Fe	1.331318E-04	Fe	1.380025E-04	Fe	1.542381E-04		
Total	7.971195E-02	Total	7.994531E-02	Total	8.072318E-02		
Total O	4.377959E-02	Total O	4.359266E-02	Total O	4.296957E-02		
Total H	1.644787E-02	Total H	1.704962E-02	Total H	1.905546E-02		

May 21 13:48 1996 File Name: i3020md.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT IX - Page 1

04/26/96 14:14:39 1mcnp version 4a ld=10/01/93 ************* probid = 04/26/96 14:14:39 INP=i3020md OUTP=i3020md0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 30% H2O/ 5% UO2 (i3020md) 2-Calico Hills Tuff 1.137 g/cc .470 porosity - reflected sphere C 3-C CELL SPECIFICATIONS 4 -INNER WATER REGION C 5 -1 8.546553-2 -1 IMP:N=1 1 6-7-С OUTSIDE WORLD 2 0 1 IMP:N=0 8-<u>9</u>-C SURFACE SPECIFICATIONS 10-Ĩ* SO 30 **\$** INNER FUEL ZONE 11-12-MODE N 13-KCODE 4000 1. 7 37 14 -KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 5 0 0 -5 -10 0 -10 15 -0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 MATERIAL SPECIFICATIONS 16-С 17-(47 vol% water in calico Hills tuff) x .95 5 vol% UO2 С 18-3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes С 8016.50c 4.104358-2 11023.50c 3.303498-4 13027.50c 2.187676-3 14000.50c 9.571876-3 19-1001.50c 2.985355-2 m1 2Ó-12000.50c 1.940812-4 21-19000.50c 4.664986-4 20000.50c 4.778985-4 26000.55c 1.177899-4 22-92234.50c 2.934031-7 92235.50c 2.390804-5 92236.50c 5.720740-6 23-92238.50c 1.190938-3 93237.50c 1.364329-6 24 mt1 lwtr.01t 25 -PRINT initial source from ksrc card. print table 90 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 30% H2O/ 5% UO2 (i3020md) probid = 04/26/96 14:14:39 the initial fission neutron source distribution used the 14 source points that were input on the ksrc card. the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27591 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120478 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148069 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .88050 with an estimated standard deviation of .00125 the estimated 68, 95, & 99 percent keff confidence intervals are .87923 to .88177, .87794 to .88307, and .87704 to .88397 the estimated collision/absorption neutron removal lifetime = 1.19E-04 seconds with an estimated standard deviation of 4.22E-07

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May 21 13:56 1996 File Name: i3020mf.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT X - Page 1

ld=10/01/93 04/26/96 15:23:19 1mcnp version 4a ************* probid = 04/26/96 15:23:19 inp=i3020mf outp=i3020mf0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 30% H2O/ 8% UO2 (i3020mf) C Calico Hills Tuff 1.137 g/cc .470 porosity - reflected sphere 2-3-C CELL SPECIFICATIONS 4 -C INNER WATER REGION 5 -1 8.508241-2 IMP:N=1 1 6-C OUTSIDE WORLD **7**-2 0 1 IMP:N=0 8-<u>9</u>-SURFACE SPECIFICATIONS С 10-1* SO 30 **\$ INNER FUEL ZONE** 11-12-MODE N 13-KCODE 4000 1. 7 37 KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 5 0 0 -5 -10 0 -10 14-C. 15 -0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C. 16-С MATERIAL SPECIFICATIONS 17-С (47 vol% water in calico Hills tuff) x .90 10 vol% UO2 18-3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes С 19-መ1 1001.50c 2.891081-2 8016.50c 4.129133-2 11023.50c 3.199177-4 12000.50c 1.879523-4 13027.50c 2.118592-3 14000.50c 9.269606-3 19000.50c 4.517670-4 20000.50c 4.628070-4 26000.55c 1.140702-4 92234.50c 4.694450-7 92235.50c 3.825286-5 92236.50c 9.153184-6 20-21-22-23-92236.50c 9.153184-6 92238.50c 1.905500-3 93237.50c 2.182926-6 24 lwtr.01t mt1 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 30% H2O/ 8% UO2 (i3020mf) = bidora 04/26/96 15:23:19 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 28076 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120009 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148085 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.00957 with an estimated standard deviation of .00116 the estimated 68, 95, & 99 percent keff confidence intervals are 1.00840 to 1.01075, 1.00719 to 1.01196, and 1.00635 to 1.01279 the estimated collision/absorption neutron removal lifetime = 8.45E-05 seconds with an estimated standard deviation of 1.95E-07

May 21 13:54 1996 File Name: i3020me.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XI - Page 1

04/26/96 14:50:33 1mcnp version 4a ld=10/01/93 probid = 04/26/96 14:50:33 INP=i3020me OUTP=i3020me0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 30% H2O/ 10% UO2 (i3020me) C Calico Hills Tuff 1.137 g/cc .470 porosity - reflected sphere 1 -2-3-С CELL SPECIFICATIONS 4 -INNER WATER REGION C 5 -1 8.482700-2 -1 IMP:N=1 1 67--99--101--12--145--178-19-C OUTSIDE WORLD 2 0 1 IMP:N=0 SURFACE SPECIFICATIONS С 1* **\$** INNER FUEL ZONE SO 30 MODE N KCODE 4000 1. 7 37 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 5 0 0 -5 -10 0 -10 KSRC 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 С MATERIAL SPECIFICATIONS (47 vol% water in calico Hills tuff) x .90 10 vol% UO2 С 3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes С 1001.50c 2.828231-2 8016.50c 4.145650-2 11023.50c 3.129630-4 m1 20-21-22-12000.50c 1.838664-4 13027.50c 2.072535-3 14000.50c 9.068093-3 19000.50c 4.419460-4 20000.50c 4.527460-4 26000.55c 1.115904-4 92234.50c 5.868062-7 92235.50c 4.781608-5 92236.50c 1.144148-5 23-92238.50c 2.381875-3 93237.50c 2.728657-6 24 mt1 lwtr.01t 25-PRINT initial source from ksrc card. print table 90 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 30% H2O/ 10% UO2 (i3020me) probid = 04/26/96 14:50:33 the initial fission neutron source distribution used the 14 source points that were input on the ksrc card. the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 28111 neutron histories and 30 active cycles with 4000 neutrons per cycle. 119763 neutron histories. this calculation has completed the requested number of keff cycles using a total of 147874 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.05593 with an estimated standard deviation of .00144 the estimated 68, 95, & 99 percent keff confidence intervals are 1.05447 to 1.05739, 1.05297 to 1.05888, and 1.05193 to 1.05992 the estimated collision/absorption neutron removal lifetime = 7.07E-05 seconds with an estimated standard deviation of 1.60E-07
May 21 13:40 1996 File Name: i3020ma.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XII - Page 1

ld=10/01/93 04/26/96 13:13:47 1mcnp version 4a ****** probid = 04/26/96 13:13:47 INP=i3020ma OUTP=i3020ma0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H2O/ 15% UO2 (i3020ma) 1 -Calico Hills Tuff 1.137 g/cc .470 porosity - reflected sphere 2 -C 3ſ CELL SPECIFICATIONS 4 -C INNER WATER REGION 1 8.418847-2 - 1 IMP:N=1 OUTSIDE WORLD C 2 0 1 IMP:N=0 9-10-11-12-13-14-15-16-С SURFACE SPECIFICATIONS 1* SO 30 **\$** INNER FUEL ZONE MODE N KCODE 4000 1. 7 37 KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 5 0 0 -5 -10 0 -10 C 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 MATERIAL SPECIFICATIONS С 17-(47 vol% water in calico Hills tuff) x .85 .15 vol% UO2 С 18-19-20-21-3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes • 1001.50c 2.671107-2 8016.50c 4.186941-2 11023.50c 2.955762-4 12000.50c 1.736516-4 13027.50c 1.957395-3 14000.50c 8.564310-3 19000.50c 4.173934-4 20000.50c 4.275934-4 26000.55c 1.053910-4 92234.50c 8.802093-7 92235.50c 7.172412-5 92236.50c 1.716222-5 m1 22-23-92238.50c 3.572813-3 93237.50c 4.092986-6 24 mt1 lwtr.01t 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H2O/ 15% UO2 (i3020ma) 04/26/96 13:13:47 probid = the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 28394 neutron histories and 30 active cycles with 4000 neutrons per cycle. 119889 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148283 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.10696 with an estimated standard deviation of .00181 the estimated 68, 95, & 99 percent keff confidence intervals are 1.10512 to 1.10879, 1.10324 to 1.11067, and 1.10194 to 1.11197 the estimated collision/absorption neutron removal lifetime = 4.86E-05 seconds with an estimated standard deviation of 1.26E-07

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May 21 13:44 1996 File Name: i3020mb.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XIII - Page 1

1mcnp version 4a ld=10/01/93 04/26/96 13:38:19 probid = 04/26/96 13:38:19 INP=i3020mb OUTP=i3020mb0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H2O/ 20% UO2 (i3020mb) C Calico Hills Tuff 1.137 g/cc .470 porosity - reflected sphere 1 -2-3-С CELL SPECIFICATIONS 4 -INNER WATER REGION С 5-6-7-8-9-10-11-1 8.354993-2 IMP:N=1 - 1 1 C OUTSIDE WORLD 0 1 IMP:N=0 2 SURFACE SPECIFICATIONS С 1* SO 30 **\$** INNER FUEL ZONE 12-13-14-15-16-MODE N KCODE 4000 1. 7 37 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 C 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 С С MATERIAL SPECIFICATIONS 17-(47 vol% water in calico Hills tuff) x .80 20 vol% UO2 С 18-19-3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes 1001.50c 2.513983-2 8016.50c 4.228232-2 11023.50c 2.781893-4 C m1 20-21-22-23-24-12000.50c 1.634368-4 13027.50c 1.842254-3 14000.50c 8.060527-3 19000.50c 3.928409-4 20000.50c 4.024409-4 26000.55c 9.199150-5 92234.50c 1.173612-6 92235.50c 9.563216-5 92236.50c 2.288296-5 92238.50c 4.763750-3 93237.50c 5.457314-6 lwtr.01t mt1 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H2O/ 20% UO2 (i3020mb) probid = 04/26/96 13:38:19 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 28339 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120266 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148605 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.11122 with an estimated standard deviation of .00147 the estimated 68, 95, & 99 percent keff confidence intervals are 1.10973 to 1.11271, 1.10821 to 1.11423, and 1.10715 to 1.11529 the estimated collision/absorption neutron removal lifetime = 3.60E-05 seconds with an estimated standard deviation of 9.38E-08

May 21 13:46 1996 File Name: i3020mc.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XIV - Page 1

1mcnp version 4a ld=10/01/93 04/26/96 13:56:54 ************ probid = 04/26/96 13:56:54 INP=i3020mc OUTP=i3020mc0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H20/ 25% U02 (i3020mc) Calico Hills Tuff 1.137 g/cc .470 porosity - reflected sphere 2-С 3-С CELL SPECIFICATIONS 4-С INNER WATER REGION 5 -1 8.291140-2 -1 IMP:N=1 1 6-OUTSIDE WORLD С 7-0 1 IMP:N=0 2 8-9-SURFACE SPECIFICATIONS C 10-1* SO 30 **\$ INNER FUEL ZONE** 11-12-MODE N KCODE 4000 1. 7 37 13-14-KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 5 0 0 -5 -10 0 -10 15 -0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 . 16-C MATERIAL SPECIFICATIONS 17-(47 vol% water in calico Hills tuff) x .75 25 vol% UO2 С 3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes 18-С 1001.50c 2.356859-2 8016.50c 4.269524-2 11023.50c 2.608025-4 19m1 20-12000.50c 1.532220-4 13027.50c 1.727113-3 14000.50c 7.556744-3 21-22-20000.50c 3.772883-4 26000.55c 9.299203-5 19000.50c 3.682883-4 92235.50c 1.195402-4 92236.50c 2.860370-5 92234.50c 1.467016-6 23-92238.50c 5.954688-3 93237.50c 6.821643-6 24 lwtr.01t mt1 25 -PRINT initial source from ksrc card. print table 90 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H2O/ 25% UO2 (i3020mc) probid = 04/26/96 13:56:54 the initial fission neutron source distribution used the 14 source points that were input on the ksrc card. the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 28583 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120656 neutron histories. this calculation has completed the requested number of keff cycles using a total of 149239 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.09884 with an estimated standard deviation of .00195 the estimated 68, 95, & 99 percent keff confidence intervals are 1.09686 to 1.10082, 1.09484 to 1.10285, and 1.09343 to 1.10425 the estimated collision/absorption neutron removal lifetime = 2.81E-05 seconds with an estimated standard deviation of 8.14E-08

May 21 14:33 1996 File Name: i3020ca.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XV - Page 1

version 4a ld=10/01/93 05/03/96 09:39:29 1mcnp -----*********** probid = 05/03/96 09:39:29 inp=i3020oa outp=i3020oa0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 5% UO2 (i3020ca) C Calico Hills Tuff 1.5095 g/cc .4 porosity - reflected sphere 2-3-CELL SPECIFICATIONS С C INNER WATER REGION 5 -1 1 8.368536-2 IMP:N=1 6-С OUTSIDE WORLD 7-2 0 1 IMP:N=0 8ġ. С SURFACE SPECIFICATIONS 10-1* SO 30 **\$ INNER FUEL ZONE** 11-12-MODE N 13-KCODE 4000 1. 7 37 14-KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 5 0 0 -5 -10 0 -10 С 15 -0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 16-С MATERIAL SPECIFICATIONS 17-С (40 vol% water in calico Hills tuff) x .95 5 vol% UO2 18-3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes С 1001.50c 2.540728-2 8016.50c 4.194698-2 11023.50c 3.739809-4 12000.50c 2.197145-4 13027.50c 2.476615-3 14000.50c 1.083609-2 19000.50c 5.281116-4 20000.50c 5.410172-4 26000.55c 1.333471-4 92234.50c 2.934031-7 92235.50c 2.390804-5 92236.50c 5.720740-6 19m1 20-21-22-23-92238.50c 1.190938-3 93237.50c 1.364329-6 24lwtr.01t mt1 25 PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 5% UO2 (i30200a) probid = 05/03/96 09:39:29 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27616 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120059 neutron histories. this calculation has completed the requested number of keff cycles using a total of 147675 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .89315 with an estimated standard deviation of .00131 the estimated 68, 95, & 99 percent keff confidence intervals are .89182 to .89448, .89046 to .89584, and .88952 to .89678 the estimated collision/absorption neutron removal lifetime = 1.20E-04 seconds with an estimated standard deviation of 3.92E-07

May 21 14:35 1996 File Name: i3020ob.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XVI - Page 1

1mcnp version 4a ld=10/01/93 05/03/96 10:28:15 probid = 05/03/96 10:28:15 inp=i3020ob outp=i3020ob0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H20/ 8% UO2 (i3020ob) 1 -2 -С Calico Hills Tuff 1.5095 g/cc .4 porosity - reflected sphere 3-C CELL SPECIFICATIONS 4 -C INNER WATER REGION 5 -1 8.335845-2 1 -1 IMP:N=1 6-С OUTSIDE WORLD 7-0 1 IMP:N=0 2 8-<u>9</u>-С SURFACE SPECIFICATIONS 10-1* SO 30 **\$** INNER FUEL ZONE 11-12-13-14-MODE N KCODE 4000 1. 7 37 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 С 15-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 16-MATERIAL SPECIFICATIONS С 17-(40 vol% water in calico Hills tuff) x .92 8 vol% UO2 С 18-19-3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes С 1001.50c 2.460494-2 8016.50c 4.216620-2 11023.50c 3.621710-4 m1 20-21-22-23-12000.50c 2.127762-4 13027.50c 2.398406-3 14000.50c 1.049389-2 19000.50c 5.114344-4 20000.50c 5.239325-4 26000.55c 1.291361-4 92234.50c 4.694450-7 92235.50c 3.825286-5 92236.50c 9.153184-6 92238.50c 1.905500-3 93237.50c 2.182926-6 24 -25 mt1 lwtr.01t PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 8% UO2 (i3020ob) probid = 05/03/96 10:28:15 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 28034 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120109 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148143 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.01547 with an estimated standard deviation of .00137 the estimated 68, 95, & 99 percent keff confidence intervals are 1.01408 to 1.01686, 1.01265 to 1.01828, and 1.01167 to 1.01926 the estimated collision/absorption neutron removal lifetime = 8.46E-05 seconds with an estimated standard deviation of 2.56E-07

May 21 14:36 1996 File Name: i3020oc.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XVII - Page 1

version 4a ld=10/01/93 05/03/96 11:44:23 1mcnp ----probid = 05/03/96 11:44:23 inp=i3020oc outp=i3020oc0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 10% UO2 (i3020oc) Calico Hills Tuff 1.5095 g/cc .4 porosity - reflected sphere 2 -С 3-CELL SPECIFICATIONS C 4-С INNER WATER REGION 5-1 8.314052-2 - 1 IMP:N=1 1 6-7-OUTSIDE WORLD С 2 0 1 IMP:N=0 8-<u>9</u>-C SURFACE SPECIFICATIONS 10-1* SO 30 \$ INNER FUEL ZONE 11-12-13-14-15-MODE N KCODE 4000 1. 7 37 KŠŘČ 001 0010 00-20 0029 0205 00-5 -100-10 С 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 16-17-MATERIAL SPECIFICATIONS C (40 vol% water in calico Hills tuff) x .90 10 vol% UO2 C 3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes 1001.50c 2.407005-2 8016.50c 4.231235-2 11023.50c 3.542977-4 12000.50c 2.081506-4 13027.50c 2.346267-3 14000.50c 1.026577-2 18-19-C m1 20-19000.50c 5.003162-4 20000.50c 5.125426-4 26000.55c 1.263288-4 92234.50c 5.868062-7 92235.50c 4.781608-5 92236.50c 1.144148-5 21-22-23-92238.50c 2.381875-3 93237.50c 2.728657-6 24lwtr.01t mt1 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 10% UO2 (i3020oc) probid = 05/03/96 11:44:23 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 28172 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120097 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148269 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. warning. there appears to be decreasing trend in the average col/abs/tl keff estimator over the last 10 active cycles. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 99 percent confidence level, but not at 95 percent the k(absorption) cycle values appear normally distributed at the 95 percent confidence level warning. the k(trk length) cycle values do not appear normally distributed at the 99 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.05803 with an estimated standard deviation of .00143 the estimated 68, 95, & 99 percent keff confidence intervals are 1.05657 to 1.05948, 1.05509 to 1.06097, and 1.05405 to 1.06200 the estimated collision/absorption neutron removal lifetime = 7.04E-05 seconds with an estimated standard deviation of 1.38E-07

May 21 14:39 1996 File Name: i3020od.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XVIII - Page 1

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ld=10/01/93 05/03/96 13:48:52 1mcnp version 4a ********** probid = 05/03/96 13:48:52 inp=i3020od outp=i3020od0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H20/ 15% UO2 (i3020od) Calico Hills Tuff 1.5095 g/cc .4 porosity - reflected sphere 2-С 3-C CELL SPECIFICATIONS C INNER WATER REGION 5-6-7-8-1 8.259568-2 IMP:N=11 C OUTSIDE WORLD 0 1 IMP:N=0 2 9-С SURFACE SPECIFICATIONS 10-1* SO 30 **\$** INNER FUEL ZONE 11-12-13-MODE N KCODE 4000 1. 7 37 14-001 0010 00-20 0029 0205 00-5 -100-10 С KSRC 15-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 16-17-MATERIAL SPECIFICATIONS С (40 vol% water in calico Hills tuff) x .85 15 vol% UO2 С 18-3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes С 19m1 1001.50c 2.273283-2 8016.50c 4.267772-2 11023.50c 3.346145-4 20-12000.50c 1.965867-4 13027.50c 2.215918-3 14000.50c 9.695445-3 21-22-19000.50c 4.725209-4 20000.50c 4.840680-4 92234.50c 8.802093-7 92235.50c 7.172412-5 26000.55c 1.193105-4 92236.50c 1.716222-5 23-92238.50c 3.572813-3 93237.50c 4.092986-6 24 lwtr.01t mt1 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 15% UO2 (i3020od) probid = 05/03/96 13:48:52 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 28106 neutron histories and 30 active cycles with 4000 neutrons per cycle. 119849 neutron histories. this calculation has completed the requested number of keff cycles using a total of 147955 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.09023 with an estimated standard deviation of .00165 the estimated 68, 95, & 99 percent keff confidence intervals are 1.08856 to 1.09190, 1.08685 to 1.09361, and 1.08567 to 1.09479 the estimated collision/absorption neutron removal lifetime = 4.77E-05 seconds with an estimated standard deviation of 1.32E-07

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May 21 14:40 1996 File Name: i3020ce.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XIX - Page 1

ld=10/01/93 1mp version 4a 05/03/96 14:59:14 probid = 05/03/96 14:59:14 inc=i3020ce outc=i3020ce0 Far-Field Criticality Study - 3.0% /20 GwD/mt - 40% H20/ 20% UD2 (i3020ce) 1-Calico Hills Tuff 1.5095 g/cc .4 porosity - reflected sphere 2-С 3-С **CELL SPECIFICATIONS** 4-5-C INNER WATER REGION 1 8.205084-2 -1 IMP:N=1 6 С outside world 7-0 1 IMP:N=0 2 8-9-10-С SURFACE SPECIFICATIONS 1* SO 30 \$ INNER FLEL ZONE 11-12-13-MODE N KOODE 4000 1, 7 37 14-15-16-KSRC 001 0010 00-20 0029 0205 00-5 -100-10 С 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 С MATERIAL SPECIFICATIONS С 17-18-19-20-11-20-(40 vol% water in calico Hills tuff) x .80 20 vol% UD2 C 3.0% Original Enrichment/ 20 GLD/MT decayed to Uranium isotopes С 1001.50c 2.139560-2 8016.50c 4.304308-2 11023.50c 3.149313-4 m1 12000.50c 1.850228-4 13027.50c 2.085570-3 14000.50c 9.125125-3 15000.50c 4.447255-4 2000.50c 4.555955-4 2000.55c 1.122923-4 92234.50c 1.173612-6 92235.50c 9.563216-5 92236.50c 2.288296-5 23-92238.50c 4.763750-3 95237.50c 5.457314-6 24lwtr.01t mt1 PRINT Ъinitial source from file srcto 1keff results for: Far-Field Criticality Study - 3.0% /20 GuD/mt - 40% H2O/ 20% UO2 (i30200e) probid = 05/08/96 14:59:14 the initial fission neutron source distribution was read from the srcto file named srcto the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 28065 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120161 neutron histories. this calculation has completed the requested runber of keff cycles using a total of 148226 fission neutron source histories. all cells with fissionable material were sampled and had fission nutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.08952 with an estimated standard deviation of .00169 the estimated 68, 95, 2 99 percent keff confidence intervels are 1.08761 to 1.09104, 1.08586 to 1.09279, and 1.08464 to 1.09401 the estimated collision/absorption neutron removal lifetime = 3.51E-05 seconds with an estimated standard deviation of 8.83E-08

May 21 14:42 1996 File Name: i3020of.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XX - Page 1

1mcnp version 4a ld=10/01/93 05/03/96 15:25:19 ************** probid = 05/03/96 15:25:19 inp=i3020of outp=i3020of0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 25% UO2 (i3020of) Calico Hills Tuff 1.5095 g/cc .4 porosity - reflected sphere 2-С 3-С CELL SPECIFICATIONS 4-С INNER WATER REGION 5-1 8.150600-2 -1 IMP:N=1 6-С OUTSIDE WORLD 7-2 0 1 IMP:N=0 8-9-С SURFACE SPECIFICATIONS 10-1* SO 30 **\$** INNER FUEL ZONE 11-12-MODE N 13-KCODE 4000 1. 7 37 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 14 -С 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 15 -С MATERIAL SPECIFICATIONS 16-С 17-(40 vol% water in calico Hills tuff) x .75 25 vol% UO2 С 3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes 18-C 1001.50c 2.005838-2 8016.50c 4.340845-2 11023.50c 2.952481-4 12000.50c 1.734589-4 13027.50c 1.955222-3 14000.50c 8.554805-3 19000.50c 4.169302-4 20000.50c 4.271189-4 26000.55c 1.052740-4 92234.50c 1.467016-6 92235.50c 1.195402-4 92236.50c 2.860370-5 19m1 20-21-22-23-92238.50c 5.954688-3 93237.50c 6.821643-6 24lwtr.01t mt1 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 25% UO2 (i3020of) probid = 05/03/96 15:25:19 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 28151 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120514 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148665 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.06938 with an estimated standard deviation of .00142 the estimated 68, 95, & 99 percent keff confidence intervals are 1.06794 to 1.07082, 1.06647 to 1.07230, and 1.06545 to 1.07332 the estimated collision/absorption neutron removal lifetime = 2.71E-05 seconds with an estimated standard deviation of 8.73E-08

May 20 07:40 1996 File Name: 11-3.0E-20GWD-30W050 BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXI - Page 1

1mcnp version 4a ld=10/01/93 04/20/96 22:45:00 ----probid = 04/20/96 22:45:00 INP=3.0E051 OUTP=30E05.IO FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 5% U-Np 02 1-2-3-C k-inf Optimization C 4 -С SPHERE 5 -8.07231773416-2 IMP:N=1 \$ Uranium/Tuff/Water 1 1 - 1 6-8.11121144000-2 1 -2 IMP:N=1 \$ Tuff/Water Reflector С 5 3 7-С 8-С OUTSIDE WORLD 9-C 30 0 2 IMP:N=0 \$ Void 10-30 0 1 IMP:N=0 \$ Void 11-12-C SURFACES 13-1* 0 0 0 10.00 **\$** *Infinite FISSILE SPHERE S 14-С 2 s 0 0 0 174.51 **\$** REFLECTOR 15 warning. this surface has been replaced by a surface of type so 16-17-MODE N KCODE 2000 1 33 158 18-19-0 0 1 0 0 KSRC 0 0 0 - 1 0 0 1 1 0 - 1 0 0 1 0 0 - 1 20-0 0 0 -1 1 1 - 1 0 1 1 1 -1 0 -1 21-0 0 - 1 1 -1 -1 0 -1 1 22-1 n 1 Ω - 1 1 0 1 - 1 0 -1 -1 23-1 -1 -1 1 -1 -1 -1 1 - 1 - 1 24 -25 -26 -27 -M1 92234.50C 2.934031-7 92235.50C 2.390804-5 92236.50C 5.720740-6 \$ Fi 92238.50C 1.190938-3 93237.50c 1.364329-6 8016.50C 4.296957-2 \$ At \$ an 1001.50C 1.905546-2 14000.50C 1.253374-2 13027.50C 2.864618-3 \$ Ca 28-29-26000.55C 1.542381-4 12000.500 2.541365-4 20000.500 6.257766-4 \$ Wi 11023.50C 4.325713-4 19000.50C 6.108491-4 \$ 30 30-MT1 LWTR.01T \$ Wa 31-1001.50C 2.005838-2 14000.50C 1.319341-2 13027.50C 3.015387-3 C M3 32-8016.50C 4.265802-2 С 33-26000.55C 1.623559-4 С 12000.50C 2.675121-4 20000.50C 6.587122-4 34 -11023.50C 4.553382-4 19000.50C 6.429990-4 С 35 -MT3 LWTR.01T С PRINT 36-1 initial source from ksrc card. print table 90 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 5% U-Np 02 probid = 04/20/96 22:45:00 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. the criticality problem was scheduled to skip 33 cycles and run a total of 158 cycles with nominally 2000 neutrons per cycle. this problem has run 33 inactive cycles with 65542 neutron histories and 125 active cycles with 250850 neutron histories. 316392 fission neutron source histories. this calculation has completed the requested number of keff cycles using a total of all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 99 percent confidence level, but not at 95 percent

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the final estimated combined collision/absorption/track-length keff = .90721 with an estimated standard deviation of .00087 the estimated 68, 95, & 99 percent keff confidence intervals are .90634 to .90808, .90548 to .90894, and .90491 to .90950 the estimated collision/absorption neutron removal lifetime = 1.22E-04 seconds with an estimated standard deviation of 2.27E-07 May 20 07:38 1996 File Name: 12-3.0E-20GWD-30W10U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXII - Page 1

version 4a ld=10/01/93 04/20/96 23:50:29 1mcnp probid = 04/20/96 23:50:29 INP=3.0E101 OUTP=30E10.IO FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 10% U-Np 02 1 -2-С k-inf Optimization 3-С 4 -SPHERE С 5-8.03342432832-2 - 1 IMP:N=1 \$ Uranium/Tuff/Water 1 1 6-3 8.11121144000-2 IMP:N=1 \$ Tuff/Water Reflector 5 1 -2 С 7-C 8-C OUTSIDE WORLD <u>9</u>-IMP:N=0 \$ Void С 30 0 2 10-30 0 IMP:N=0 \$ Void 1 11-12-С SURFACES 13-1* S 0 0 0 10.00 \$ *Infinite FISSILE SPHERE 0 0 0 174.51 14-С 2 S \$ REFLECTOR 15 warning. this surface has been replaced by a surface of type so 16-17-MODE N KCODE 2000 1 33 158 18-19-0 Ō 0 KSRC 0 Ω 1 0 - 1 D 0 0 - 1 0 0 1 n 0 - 1 1 n • • 20-- 1 0 0 -1 0 n 1 1 1 1 1 -1 21-Ó -1 0 -1 0 - 1 -1 0 - 1 1 - 1 1 22-23-24-25--1 0 0 -1 -1 0 1 0 1 1 - 1 1 1 -1 -1 1 -1 -1 -1 1 -1 92235.50C 4.781608-5 92234.50C 5.868062-7 92236.50C 1.144148-5 \$ Fi M1 93237.50C 2.728657-6 92238.50C 2.381875-3 8016.50C 4.328111-2 \$ At 26-27-28-29-30-1001.50C 1.805254-2 \$ an 14000.50C 1.187407-2 13027.50C 2.713848-3 \$ Ca 26000.55C 1.461203-4 12000.50C 2.407609-4 20000.50C 5.928410-4 \$ Wi 11023.50C 4.098044-4 19000.50C 5.786991-4 \$ 30 MT1 LWTR.01T \$ Wa 31-32-33-С M3 1001.50C 2.005838-2 14000.50C 1.319341-2 13027.50C 3.015387-3 8016.50C 4.265802-2 26000.55C 1.623559-4 С 12000.50C 2.675121-4 С 20000.50C 6.587122-4 34-11023.50c 4.553382-4 19000.50c 6.429990-4 С 35 -MT3 LWTR.01T C. PRINT 36. initial source from ksrc card. print table 90 1 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 10% U-Np 02 probid = 04/20/96 23:50:29 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. the criticality problem was scheduled to skip 33 cycles and run a total of 158 cycles with nominally 2000 neutrons per cycle. this problem has run 33 inactive cycles with 66233 neutron histories and 125 active cycles with 250174 neutron histories. this calculation has completed the requested number of keff cycles using a total of 316407 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 99 percent confidence level, but not at 95 percent the k(absorption) cycle values appear normally distributed at the 95 percent confidence level

the k(trk length) cycle values appear normally distributed at the 99 percent confidence level, but not at 95 percent

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the final estimated combined collision/absorption/track-length keff = 1.03712 with an estimated standard deviation of .00104 the estimated 68, 95, & 99 percent keff confidence intervals are 1.03608 to 1.03816, 1.03506 to 1.03919, and 1.03438 to 1.03986 the estimated collision/absorption neutron removal lifetime = 6.86E-05 seconds with an estimated standard deviation of 1.27E-07

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May 20 07:30 1996 File Name: 13-3.0E-20GWD-30W15U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXIII - Page 1

04/18/96 11:18:06 1mcnp version 4a ld=10/01/93 probid = 04/18/96 11:18:06 INP=3.0EI OUTP=3.0E.10 1 -Farfield Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 15% U-Np 02 2-С k-inf 3-С 4-С SPHERE 5-7.99453114353-2 1 - 1 IMP:N=1 \$ Uranium/Tuff/Water 8.11121144000-2 6-С 5 3 1 -2 IMP:N=1 \$ Tuff/Water Reflector 7-С 8-С OUTSIDE WORLD 9-IMP:N=0 \$ Void С 30 0 2 10-30 0 1 IMP:N=0 \$ Void 11-С 12-SURFACES 1* 13-S 0 0 0 10. \$ *Infinite FISSILE SPHERE 14 -2 0 0 0 183,15 \$ REFLECTOR С S 15 warning. this surface has been replaced by a surface of type so 16-17-MODE N 18-KCODE 2000 1 13 138 19-KSRC 0 0 0 1 0 0 -1 0 0 0 1 0 0 -1 0 0 0 1 Ō 0 - 1 20-D 1 -1 0 1 0 1 0 -1 1 21-- 1 - 1 -1 0 -1 0 -1 - 1 0 0 1 1 22 -- 1 0 0 -1 -1 0 0 1 - 1 1 1 1 23 -24 -25 --1 -1 -1 1 1 -1 -1 1 1 1 92235.50C 7.172412-5 M1 92234.50C 8.802093-7 92236.50C 1.716222-5 \$ Fi 93237.50C 4.092986-6 92238.50C 3.572813-3 8016.50C 4.359266-2 \$ At 26-27-1001.50C 1.704962-2 \$ an 13027.50c 2.563079-3 14000.50C 1.121440-2 \$ Ca 28-29-12000.500 2.273853-4 26000.55c 1.380025-4 20000.50C 5.599054-4 \$ Wi 11023.50C 3.870375-4 19000.50C 5.465492-4 \$ 30 30-MT1 LWTR.01T \$ Wa 31-M3 1001.50C 2.005838-2 14000.50C 1.319341-2 13027.50C 3.015387-3 С 32-C 8016.50C 4.265802-2 33-С 26000.55C 1.623559-4 12000.50c 2.675121-4 20000.50C 6.587122-4 34 -11023.50C 4.553382-4 19000.50C 6.429990-4 35 -MT3 LWTR.01T C 36-PRINT initial source from ksrc card. print table 90 1 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 15% U-Np 02 probid = 04/18/96 11:18:06 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. the criticality problem was scheduled to skip 13 cycles and run a total of 138 cycles with nominally 2000 neutrons per cycle. 25735 neutron histories and 125 active cycles with this problem has run 13 inactive cycles with 251201 neutron histories. this calculation has completed the requested number of keff cycles using a total of 276936 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points.

the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are:

the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

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the final estimated combined collision/absorption/track-length keff = 1.05465 with an estimated standard deviation of .00113 the estimated 68, 95, & 99 percent keff confidence intervals are 1.05351 to 1.05578, 1.05239 to 1.05691, and 1.05165 to 1.05764 the estimated collision/absorption neutron removal lifetime = 4.56E-05 seconds with an estimated standard deviation of 9.27E-08 May 20 07:27 1996 File Name: I4-3.0E-20GWD-30W20U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXIV - Page 1

04/20/96 22:09:09 ld=10/01/93 1mcnp version 4a _____ ******** probid = 04/20/96 22:09:09 INP=3.0E201 OUTP=30E20.10 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 20% U-Np 02 2 -С k-inf Optimization 3-С 4 -С SPHERE 5 -7.95563751664-2 IMP:N=1 \$ Uranium/Tuff/Water 1 - 1 1 6-7-С 5 3 8.11121144000-2 1 - 2 IMP:N=1 \$ Tuff/Water Reflector С 8-C OUTSIDE WORLD 9-С IMP:N=0 \$ Void 30 0 2 10-30 0 1 IMP:N=0 \$ Void 11-12-С SURFACES 13-1* S 0 0 0 10.00 \$ *Infinite FISSILE SPHERE 14-С 2 S 0 0 0 174.51 \$ REFLECTOR 15 -C warning. this surface has been replaced by a surface of type so 16-17-MODE N 18-KCODE 2000 1 33 158 19-KSRC 0 0 0 1 0 0 - 1 0 0 0 1 0 0 -1 0 0 0 0 0 - 1 1 20-21-22-23-0 1 0 -1 1 0 1 -1 0 1 1 1 0 - 1 - 1 0 - 1 0 1 - 1 0 - 1 - 1 1 0 1 0 - 1 1 0 1 - 1 0 -1 -1 1 -1 -1 1 -1 -1 -1 1 1 1 1 - 1 23-24-25-26-27-28-29-92235.500 9.563216-5 92234.50C 1.173612-6 92236.50C 2.288296-5 \$ Fi M1 92238.50C 4.763750-3 93237.50C 5.457314-6 8016.50C 4.390421-2 \$ At 1001.50c 1.604670-2 \$ an 14000.50C 1.055473-2 13027.50C 2.412310-3 \$ Ca 26000.55C 1.298847-4 12000.50C 2.140097-4 20000.50C 5.269698-4 \$ Wi 11023.50C 3.642706-4 19000.50C 5.143992-4 \$ 30 30-31-MT1 LWTR.01T \$ Wa 1001.50C 2.005838-2 14000.50C 1.319341-2 13027.50C 3.015387-3 С M3 32-8016.500 4.265802-2 С 33-26000.55C 1.623559-4 12000.50C 2.675121-4 20000.50C 6.587122-4 С 34 -11023.50C 4.553382-4 19000.50C 6.429990-4 С 35 -MT3 LWTR.01T C 36-PRINT 1 initial source from ksrc card. print table 90 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 20% U-Np 02 probid = 04/20/96 22:09:09 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. the criticality problem was scheduled to skip 33 cycles and run a total of 158 cycles with nominally this problem has run 33 inactive cycles with 66069 neutron histories and 125 active cycles with 2000 neutrons per cycle. 250814 neutron histories. this calculation has completed the requested number of keff cycles using a total of 316883 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

May 20 07:27 1996 File Name: I4-3.0E-20GWD-30W20U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXIV - Page 2

the final estimated combined collision/absorption/track-length keff = 1.03934 with an estimated standard deviation of .00122 the estimated 68, 95, & 99 percent keff confidence intervals are 1.03812 to 1.04056, 1.03691 to 1.04177, and 1.03612 to 1.04257 the estimated collision/absorption neutron removal lifetime = 3.31E-05 seconds with an estimated standard deviation of 6.79E-08 May 20 07:25 1996 File Name: I5-3.0E-20GWD-30W25U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXV - Page 1 version 4a ld=10/01/93 05/14/96 10:05:12 1mcnp *********** probid = 05/14/96 10:05:12 INP=3E30W251 OUTP=3E3025.0 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 25% U-Np 02 1 -2-С k-inf Optimization 3-C 4 -С SPHERE 7.91674411080-2 \$ Uranium/Tuff/Water 5 -1 - 1 IMP:N=1 Ċ 7.10829224000-2 1 -2 IMP:N=1 \$ Tuff/Water Reflector 6-5 3 7-С 8-С OUTSIDE WORLD 9-С 30 IMP:N=0 \$ Void 0 2 30 10-0 1 IMP:N=0 \$ Void 11-12-C SURFACES 13-1* 0 0 0 10.00 S \$ *Infinite FISSILE SPHERE 14-С 2 S 0 0 0 174.51 \$ REFLECTOR 15 warning. this surface has been replaced by a surface of type so 16-17-MODE N 18-KCODE 250 1 3 1003 19-KSRC 0 0 0 1 0 0 - 1 0 0 0 1 0 0 -1 0 0 0 1 0 0 -1 20-1 0 1 - 1 0 1 0 1 1 0 -1 21 · - 1 -1 -1 ۵ - 1 0 -1 0 -1 1 0 1 22 -23 -24 -25 -0 - 1 0 1 - 1 0 -1 -1 0 1 - 1 -1 -1 -1 -1 1 1 1 -1 -1 1 1 - 1 92235.50C 1.195402-4 92234.50C 1.467016-6 92236.50C 2.860370-5 \$ Fi M1 92238.50C 5.954688-3 93237.50C 6.821643-6 8016.50C 4.421575-2 \$ At 26-27-28-29-30-\$ an 1001.50c 1.504378-2 14000.50C 9.895058-3 13027.50c 2.261540-3 \$ Ca 26000.55C 1.217669-4 12000.50C 2.006341-4 20000.50C 4.940342-4 \$ Vi 11023.50C 3.415037-4 19000.50C 4.822493-4 \$ 30 MT1 LWTR.01T \$ Wa 1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 31-M3 ¢ 32-8016.50C 3.931496-2 C 33-С 26000.55c 1.623559-4 12000.50c 2.675121-4 20000.50c 6.587122-4 34-11023.50C 4.553382-4 19000.50C 6.429990-4 35-MT3 LWTR.01T С 36-PRINT initial source from ksrc card. print table 90 1 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 25% U-Np 02 probid = 05/14/96 10:05:12 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. 250 neutrons per cycle. the criticality problem was scheduled to skip 3 cycles and run a total of 1003 cycles with nominally this problem has run 3 inactive cycles with 711 neutron histories and 1000 active cycles with 251306 neutron histories. this calculation has completed the requested number of keff cycles using a total of 252017 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

May 20 07:25 1996 File Name: I5-3.0E-20GWD-30W25U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXV - Page 2

the final estimated combined collision/absorption/track-length keff = 1.00732 with an estimated standard deviation of .00121 the estimated 68, 95, & 99 percent keff confidence intervals are 1.00611 to 1.00853, 1.00492 to 1.00972, and 1.00414 to 1.01051 the estimated collision/absorption neutron removal lifetime = 2.49E-05 seconds with an estimated standard deviation of 5.37E-08

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May 20 14:01 1996 File Name: I1-3.0E-20GWD-20W05U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXVI - Page 1

Ld=10/01/93 04/30/96 11:58:30 1mcnp version 4a probid = 04/30/96 11:58:30 INP=3E20W05I OUTP=3E2005.0 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 5% U-Np 02 1 -Ź-С k-inf 3-C 4-SPHERE C Ś-7.11954477916-2 IMP:N=1 \$ Uranium/Tuff/Water - 1 1 7.10829224000-2 6-С 5 3 1 -2 IMP:N=1 \$ Tuff/Water Reflector 7-C 8-C OUTSIDE WORLD Q -30 0 IMP:N=0 \$ Void С 2 10-Ō 30 1 IMP:N=0 \$ Void 11-12-C SURFACES 13-1* S 0 0 0 10.00 \$ *Infinite FISSILE SPHERE 14 -С 2 0 0 0 174.51 \$ REFLECTOR 15warning. this surface has been replaced by a surface of type so 16-17-MODE N 18-KCODE 500 1 3 KSRC 0 0 0 503 0 19-1 0 0 - 1 0 Ω 1 0 0 - 1 0 0 0 1 0 0 -1 20-0 0 1 0 - 1 0 1 - 1 1 1 1 21-0 -1 0 -1 - 1 n -1 -1 Ω - 1 1 1 22-23-24-25-26-27-1 - 1 n 0 - 1 Ω 0 -1 -1 1 1 1 - 1 -1 1 1 1 1 1 1 -1 -1 -1 92235.500 2.390804-5 92234.50C 2.934031-7 M1 92236.50C 5.720740-6 \$ Fi 93237.50C 1.364329-6 \$ At 92238.50C 1.190938-3 8016.50C 3.979366-2 \$ an 1001.50C 1.270364-2 14000.500 1.253374-2 13027.50C 2.864618-3 \$ Ca 28-26000.55C 1.542381-4 12000.50C 2.541365-4 20000.50C 6.257766-4 S Wi 29-30-11023.50C 4.325713-4 19000.50C 6.108491-4 \$ 30 MT1 \$ Wa LWTR.01T 31-1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 С МЗ. 32-8016.50C 3.931496-2 С 33-20000.500 6.587122-4 C 26000.550 1.623559-4 12000.50C 2.675121-4 34 -C 11023.50C 4.553382-4 19000.50C 6.429990-4 35-С MT3 LWTR.01T 36-PRINT print table 90 1 initial source from ksrc card. 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 5% U-Np 02 probid = 04/30/96 11:58:30 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. the criticality problem was scheduled to skip 3 cycles and run a total of 503 cycles with nominally this problem has run 3 inactive cycles with 1487 neutron histories and 500 active cycles with 500 neutrons per cycle. 250104 neutron histories. this calculation has completed the requested number of keff cycles using a total of 251591 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are:

the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level May 20 14:01 1996 File Name: I1-3.0E-20GWD-20W05U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXVI - Page 2

the final estimated combined collision/absorption/track-length keff = .92846 with an estimated standard deviation of .00095 the estimated 68, 95, & 99 percent keff confidence intervals are .92751 to .92941, .92657 to .93035, and .92595 to .93096 the estimated collision/absorption neutron removal lifetime = 1.24E-04 seconds with an estimated standard deviation of 2.39E-07 May 20 13:59 1996 File Name: I2-3.0E-20GWD-20W08U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXVII - Page 1

ld=10/01/93 04/23/96 09:19:08 1mcnp version 4a probid = 04/23/96 09:19:08 INP=3.0E081 OUTP=3E08.10 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 8% U-Np 02 1. 2k-inf Optimization C 3-С 4-С SPHERE 7.12629630266-2 IMP:N=1 \$ Uranium/Tuff/Water 1 - 1 1 -2 IMP:N=1 \$ Tuff/Water Reflector C 3 7.10829224000-2 5 С С OUTSIDE WORLD <u>9</u>-С 30 0 2 IMP:N=0 \$ Void 10-30 0 IMP:N=0 \$ Void 1 11-12-С SURFACES 13-1* S 0 0 0 10.00 \$ *Infinite FISSILE SPHERE 14 -2 0 0 0 174.51 С S \$ REFLECTOR 15 -C warning. this surface has been replaced by a surface of type so 16-17-MODE N KCODE 4000 1 13 43 18-19-0 0 KSRC 0 0 1 0 - 1 0 0 0 1 0 0 -1 0 0 0 1 0 0 -1 20-1 0 1 - 1 n 1 0 1 1 0 -1 21-223-234-25-26-278-289-30-- 1 0 -1 -1 0 - 1 0 1 -1 0 -1 1 Ð 0 - 1 0 1 -1 0 -1 -1 1 1 1 1 -1 -1 1 -1 -1 -1 1 1 - 1 1 92235.500 3.825286-5 92236.50C 9.153184-6 M1 92234.50C 4.694450-7 \$ Fi 92238.500 1.905500-3 93237.50C 2.182926-6 8016.50C 4.008088-2 \$ At 1001.50c 1.230247-2 \$ an 14000.50c 1.213793-2 13027.50C 2.774156-3 \$ Ca 26000.55C 1.493674-4 12000.50C 2.461111-4 11023.50C 4.189111-4 19000.50C 5.915591-4 20000.50c 6.060152-4 \$ Wi \$ 30 LWTR.01T MT1 \$ Wa 31-С M3 1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 32-8016.50C 3.931496-2 С 33-С 26000.55C 1.623559-4 12000.50C 2.675121-4 20000.50C 6.587122-4 11023.50C 4.553382-4 19000.50C 6.429990-4 34 -С 35-MT3 LWTR.01T С 36 PRINT initial source from ksrc card. print table 90 1 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 10% U-Np 02 probid = 04/23/96 09:19:08 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. 4000 neutrons per cycle. the criticality problem was scheduled to skip 13 cycles and run a total of 43 cycles with nominally 119742 neutron histories. this problem has run 13 inactive cycles with 51859 neutron histories and 30 active cycles with this calculation has completed the requested number of keff cycles using a total of 171601 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are:

the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level May 20 13:59 1996 File Name: I2-3.0E-20GWD-20W08U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXVII - Page 2

the final estimated combined collision/absorption/track-length keff = .99502 with an estimated standard deviation of .00156 the estimated 68, 95, & 99 percent keff confidence intervals are .99344 to .99660, .99183 to .99821, and .99071 to .99933 the estimated collision/absorption neutron removal lifetime = 8.22E-05 seconds with an estimated standard deviation of 2.19E-07 May 20 07:57 1996 File Name: I3-3.0E-20GWD-20W10U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXVIII - Page 1

ld=10/01/93 1mcnp version 4a 04/22/96 14:38:14 probid = 04/22/96 14:38:14 INP=3.0E101 OUTP=3E10.10 1-FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 10% U-Np 02 2-С k-inf Optimization 3-C 4-C SPHERE 5-7.13079731832-2 IMP:N=1 \$ Uranium/Tuff/Water 1 1 - 1 6-7-C 5 3 7.10829224000-2 1 -2 IMP:N=1 \$ Tuff/Water Reflector С 8-С OUTSIDE WORLD 9-С 30 0 2 IMP:N=0 \$ Void 10-30 0 1 IMP:N=0 \$ Void 11-12-С SURFACES 13-1* 0 0 0 10.00 S \$ *Infinite FISSILE SPHERE 14-2 0 0 0 174.51 С S \$ REFLECTOR 15 warning. this surface has been replaced by a surface of type so 16-17-MODE N KCODE 4000 1 13 43 18-19-0 KSRC 0 0 1 0 0 - 1 0 0 ۵ 0 -1 0 0 1 1 0 0 0 0 - 1 20-1 0 1 -1 0 1 0 1 0 - 1 1 21 -22 -23 -- 1 1 0 -1 -1 0 -1 0 1 -1 0 -1 0 1 1 0 -1 1 0 1 - 1 0 -1 -1 - 1 1 1 1 - 1 1 -1 -1 -1 24 -25 -26 -27 -28 -92234.500 5.868062-7 92235.50C 4.781608-5 M1 92236.50C 1.144148-5 \$ Fi 92238.50C 2.381875-3 93237.50C 2.728657-6 8016.50C 4.027236-2 \$ At 1001.50C 1.203503-2 \$ an 14000.50C 1.187407-2 13027.50C 2.713848-3 \$ Ca 26000.55C 1.461203-4 12000.50C 2.407609-4 20000.50C 5.928410-4 \$ Wi 29-11023.500 4.098044-4 19000.500 5.786991-4 \$ 30 30-31-MT1 LWTR.01T \$ Wa 1001.50C 1.337225-2 8016.50C 3.931496-2 26000.55C 1.623559-4 С M3 14000.50C 1.319341-2 13027.50C 3.015387-3 32-С 33-12000.50C 2.675121-4 20000.50C 6.587122-4 C 34 -С 11023.50c 4.553382-4 19000.50C 6.429990-4 35 -MT3 LWTR.01T С 36-PRINT 1 initial source from ksrc card. print table 90 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 10% U-Np 02 probid = 04/22/96 14:38:14 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. the criticality problem was scheduled to skip 13 cycles and run a total of 43 cycles with nominally this problem has run 13 inactive cycles with 52351 neutron histories and 30 active cycles with 4000 neutrons per cycle. 119304 neutron histories. this calculation has completed the requested number of keff cycles using a total of 171655 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

the final estimated combined collision/absorption/track-length keff = 1.00572 with an estimated standard deviation of .00144 the estimated 68, 95, & 99 percent keff confidence intervals are 1.00426 to 1.00717, 1.00276 to 1.00867, and 1.00173 to 1.00970 the estimated collision/absorption neutron removal lifetime = 6.57E-05 seconds with an estimated standard deviation of 1.80E-07 May 20 07:51 1996 File Name: I4-3.0E-20GWD-20W12U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXIX - Page 1

04/23/96 11:14:58 ld=10/01/93 1mcnp version 4a probid = 04/23/96 11:14:58 INP=3.0E121 OUTP=3E12.IO Farfield Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 2-С k-inf Optimization 3-C 4-С SPHERE 5 -1 7.13439813085-2 - 1 IMP:N=1 \$ Uranium/Tuff/Water 1 6-7-5 7.10829224000-2 1 -2 IMP:N=1 \$ Tuff/Water Reflector С 3 С 8-С OUTSIDE WORLD 9-С 30 0 IMP:N=0 \$ Void 2 10-30 0 IMP:N=0 \$ Void 1 11-12-С SURFACES 13-1* 0 0 0 10.00 **\$** *Infinite FISSILE SPHERE S 0 0 0 174.51 \$ REFLECTOR 14-S С 15 -С warning. this surface has been replaced by a surface of type so 16-17-MODE N 18-KCODE 4000 1 13 43 19-KSRC 0 0 0 1 0 0 0 0 0 1 0 0 -1 0 0 0 1 0 0 - 1 - 1 20-21-22-23-0 -1 0 1 - 1 0 1 ۵ 1 1 -1 - 1 0 -1 0 - 1 0 - 1 - 1 0 1 0 0 -1 -1 0 1 - 1 0 1 - 1 -1 -1 -1 - 1 - 1 1 -1 1 24 -25 -92235.50C 5.546665-5 M1 92234.50C 6.806952-7 92236.50C 1.327212-5 \$ Fi 92238.50C 2.762975-3 93237.50C 3.165242-6 8016.50C 4.042554-2 \$ At 26-27-28-1001.50C 1.182107-2 \$ an 14000.50C 1.166297-2 13027.50C 2.665602-3 \$ Ca 26000.55C 1.435226-4 12000.50C 2.364807-4 \$ Wi 20000.50C 5.823016-4 11023.50C 4.025190-4 19000.50C 5.684111-4 29-\$ 30 30-MT1 LWTR.01T \$ Wa 1001.50C 1.337225-2 31-С М3 14000.50C 1.319341-2 13027.50C 3.015387-3 32-8016.50C 3.931496-2 26000.55C 1.623559-4 С 33-12000.500 2.675121-4 20000.500 6.587122-4 С 34-11023.50C 4.553382-4 19000.50C 6.429990-4 С 35-MT3 LWTR.01T С PRINT 36print table 90 initial source from ksrc card. 1 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 probid = 04/23/96 11:14:58 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. the criticality problem was scheduled to skip 13 cycles and run a total of 43 cycles with nominally this problem has run 13 inactive cycles with 52024 neutron histories and 30 active cycles with 4000 neutrons per cycle. 119849 neutron histories. this calculation has completed the requested number of keff cycles using a total of 171873 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

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May 20 07:51 1996 File Name: I4-3.0E-20GWD-20W12U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXIX - Page 2

the final estimated combined collision/absorption/track-length keff = 1.00904 with an estimated standard deviation of .00204 the estimated 68, 95, & 99 percent keff confidence intervals are 1.00697 to 1.01111, 1.00485 to 1.01323, and 1.00338 to 1.01469 the estimated collision/absorption neutron removal lifetime = 5.67E-05 seconds with an estimated standard deviation of 1.99E-07 May 20 07:48 1996 File Name: I5-3.0E-20GWD-20W15U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXX - Page 1

04/22/96 15:23:31 version 4a ld=10/01/93 1mcnp _____ --------------probid = 04/22/96 15:23:31 INP=3.0E151 OUTP=3E15.IO FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 15% U-Np 02 2-Critical Radius С 3-С 4 -C SPHERE 5. 7.14204985748-2 - 1 'IMP:N=1 \$ Uranium/Tuff/Water 1 1 6-7.10829224000-2 С 5 3 1 - 2 IMP:N=1 \$ Tuff/Water Reflector **7**-С 8-С OUTSIDE WORLD Q -Ċ IMP:N=0 \$ Void 30 0 2 10-30 0 1 1MP:N=0 \$ Void 11-12-С SURFACES 13-1* 0 0 0 10.00 \$ *Infinite FISSILE SPHERE S 14 -С 2 S 0 0 0 174.51 \$ REFLECTOR 15 -C warning. this surface has been replaced by a surface of type so 16-17-MODE N 18-KCODE 4000 1 13 43 19-0 0 0 1 0 0 KSRC 0 - 1 0 0 1 0 0 -1 0 0 0 1 0 0 - 1 20-21-0 0 -1 0 1 - 1 0 1 1 1 - 1 0 -1 - 1 0 - 1 0 1 - 1 0 -1 22-1 Ω 0 -1 0 0 -1 -1 1 1 1 - 1 23 -24 -25 -26 -27 --1 -1 -1 -1 -1 1 1 1 - 1 92234.50C 8.802093-7 92235.50C 7.172412-5 92236.50C 1.716222-5 M1 \$ Fi 92238.50C 3.572813-3 93237.50C 4.092986-6 8016.50C 4.075106-2 \$ At 1001.50C 1.136641-2 \$ an 13027.50C 2.563079-3 14000.50C 1.121440-2 \$ Ca 28-29-26000.55C 1.380025-4 12000.50C 2.273853-4 11023.50C 3.870375-4 19000.50C 5.465492-4 20000.50C 5.599054-4 S ⊌i \$ 30 30-31-32-MT1 LWTR.01T \$ Wa С Μ3 1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 8016.500 3.931496-2 С 33-26000.550 1.623559-4 12000.50C 2.675121-4 С 20000.50C 6.587122-4 34 -11023.50C 4.553382-4 19000.50C 6.429990-4 С 35 -MT3 LWTR.01T C PRINT 36. initial source from ksrc card. 1 print table 90 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 15% U-Np 02 probid = 04/22/96 15:23:31 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. the criticality problem was scheduled to skip 13 cycles and run a total of 43 cycles with nominally this problem has run 13 inactive cycles with 52433 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120237 neutron histories. this calculation has completed the requested number of keff cycles using a total of 172670 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are:

the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

May 20 07:48 1996 File Name: I5-3.0E-20GWD-20W15U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXX - Page 2

the final estimated combined collision/absorption/track-length keff = .99654 with an estimated standard deviation of .00152 the estimated 68, 95, & 99 percent keff confidence intervals are .99499 to .99808, .99341 to .99966, and .99231 to 1.00076 the estimated collision/absorption neutron removal lifetime = 4.23E-05 seconds with an estimated standard deviation of 9.98E-08

Jun 05 15:49 1996 File Name: i30loga.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXXI - Page 1 1mcnp version 4a ld=10/01/93 04/23/96 16:48:09 ************** probid = 04/23/96 16:48:09 INP=i30loga OUTP=i30loga0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 30% H20/ 3.6% UO2 (i30loga) Calico Hills Tuff 0.5685 g/cc .35 vol% C - reflected sphere 2-С 3-CELL SPECIFICATIONS C 4 -C **INNER WATER REGION** 5-1 1 8.330641-2 - 1 IMP:N=1 6-7-С OUTSIDE WORLD 2 0 1 IMP:N=0 8-9-С SURFACE SPECIFICATIONS 10-1* SO 30 **\$** INNER FUEL ZONE 11-12-MODE N 13-KCODE 4000 1. 7 37 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 14-C 15 -0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 С 16-С MATERIAL SPECIFICATIONS 17-С (30 vol% water in calico Hills tuff & C) x .964 3.6 vol% UO2 3.0% Original Enrichment/ 20 GWD/NT decayed to Uranium isotopes 18-C 1001.50c 1.933628-2 8016.50c 2.715524-2 11023.50c 2.194730-4 12000.50c 1.289408-4 13027.50c 1.453417-3 14000.50c 6.359224-3 19m1 20-21-19000.50c 3.099255-4 20000.50c 3.174993-4 26000.55c 7.825554-5 92234.50c 2.112502-7 92235.50c 1.721379-5 92236.50c 4.118933-6 22÷ 23-92238.50c 8.574750-4 93237.50c 9.823165-7 6000.50c 2.706816-2 24lwtr.01t mt1 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 30% H2O/ 3.6% UO2 (i30loga) probid = 04/23/96 16:48:09 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27671 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120210 neutron histories. this calculation has completed the requested number of keff cycles using a total of 147881 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .89704 with an estimated standard deviation of .00111 the estimated 68, 95, £ 99 percent keff confidence intervals are .89592 to .89816, .89477 to .89931, and .89397 to .90011 the estimated collision/absorption neutron removal lifetime = 1.69E-04 seconds with an estimated standard deviation of 4.97E-07

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Jun 05 15:52 1996 File Name: i30logc.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXXII - Page 1

1mcnp ld=10/01/93 04/24/96 07:17:23 version 4a ************ probid = 04/24/96 07:17:23 inp=i30logc outp=i30logc0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 30% H2O/ 5% UO2 (i30logc) 2-Calico Hills Tuff 0.5685 g/cc .35 vol% C - reflected sphere С 3-С CELL SPECIFICATIONS C INNER WATER REGION 5-1 1 8.316157-2 - 1 IMP:N=1 6-С OUTSIDE WORLD 7-2 0 1 IMP:N=0 8-<u>.</u> С SURFACE SPECIFICATIONS 10-1* SO 30 **\$** INNER FUEL ZONE 11-12-13-MODE N KCODE 4000 1. 7 37 14-15-KSRC 001 0010 00-20 0029 0205 00-5 -100-10 С 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 С 16-С MATERIAL SPECIFICATIONS 17-С (30 vol% water in calico Hills tuff & C) x .95 5 vol% UO2 18-3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes С 19-20-21m1 1001.50c 1.905546-2 8016.50c 2.747087-2 11023.50c 2.162856-4 12000.50c 1.270682-4 13027.50c 1.432309-3 14000.50c 6.266870-3 19000.50c 3.054245-4 20000.50c 3.128883-4 26000.55c 7.711905-5 92234.50c 2.934031-7 92235.50c 2.390804-5 92236.50c 5.720740-6 22-23-92238.50c 1.190938-3 93237.50c 1.364329-6 6000.50c 2.667505-2 24 lwtr.01t mt1 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 30% H2O/ 5% UO2 (i30logc) probid = 04/24/96 07:17:23 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27985 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120395 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148380 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .98475 with an estimated standard deviation of .00139the estimated 68, 95, & 99 percent keff confidence intervals are .98333 to .98616, .98189 to .98761, and .98089 to .98861 the estimated collision/absorption neutron removal lifetime = 1.33E-04 seconds with an estimated standard deviation of 3.36E-07

Jun 05 15:51 1996 File Name: i30logb.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXXIII - Page 1

ld=10/01/93 04/23/96 18:14:39 1mcnp version 4a ----probid = 04/23/96 18:14:39 INP=i30logb OUTP=i30logb0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 30% H2O/ 8% UO2 (i30logb) C Calico Hills Tuff 0.5685 g/cc .35 vol% C - reflected sphere 2-3-C CELL SPECIFICATIONS C INNER WATER REGION 4-5-7-8-1 8.285121-2 IMP:N=1 1 - 1 C OUTSIDE WORLD 2 0 1 IMP:N=0 9-C SURFACE SPECIFICATIONS 10-SO 30 1* **\$ INNER FUEL ZONE** 11-12-13-MODE N KCODE 4000 1. 7 37 14 -15 -001 0010 00-20 0029 0205 00-5 -100-10 С KSRC 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 16-17-С MATERIAL SPECIFICATIONS (30 vol% water in calico Hills tuff & C) x .92 8 vol% UO2 С 18-3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes c 19m1 8016.50c 2.814723-2 11023.50c 2.094556-4 1001.50c 1.845371-2 20-12000.50c 1.230556-4 13027.50c 1.387078-3 14000.50c 6.068969-3 21-22-19000.50c 2.957795-4 20000.50c 3.030076-4 26000.55c 7.468371-5 92234.50c 4.694450-7 92235.50c 3.825286-5 92236.50c 9.153184-6 23-92238.50c 1.905500-3 93237.50c 2.182929-6 6000.50c 2.583268-2 24 lwtr.01t mt1 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 30% H2O/ 8% UO2 (i30logb) probid = 04/23/96 18:14:39 the initial fission neutron source distribution was read from the srctp file named srctp 7 cycles and run a total of 37 cycles with nominally 28102 neutron histories and 30 active cycles with the criticality problem was scheduled to skip 4000 neutrons per cycle. this problem has run 7 inactive cycles with 120123 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148225 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.07039 with an estimated standard deviation of .00174 the estimated 68, 95, & 99 percent keff confidence intervals are 1.06863 to 1.07216, 1.06682 to 1.07397, and 1.06557 to 1.07522 the estimated collision/absorption neutron removal lifetime = 8.91E-05 seconds with an estimated standard deviation of 2.66E-07

Jun 07 16:19 1996 File Name: IMW-3.0E-20GWD-20W08U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXXIV - Page 1

ld=10/01/93 05/26/96 00:08:17 1mcnp version 4a ----. probid = 05/26/96 00:08:17 INP=3E20W081 OUTP=320W08.0 1-FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 8% U-Np 02 2 -С k-inf Optimization Minimum Water 3-С 4 -SPHERE С 5 -7.12629630266-2 - 1 IMP:N=1 \$ Uranium/Tuff/Water 1 6-7-3 7.10829224000-2 1 -2 IMP:N=1 \$ Tuff/Water Reflector С 5 С 8-OUTSIDE WORLD С 9-С 30 0 IMP:N=0 \$ Void 2 10-30 Ô 1 IMP:N=0 \$ Void 11-12-С SURFACES 1* 13-0 0 0 10.00 \$ *Infinite FISSILE SPHERE S 14-2 0 0 0 174.51 **\$** REFLECTOR С S 15 warning. this surface has been replaced by a surface of type so 16-17-MODE N 18-KCODE 250 1 3 1003 19-KSRC 0 0 0 0 0 0 0 0 0 - 1 0 0 1 0 -1 - 1 1 0 Ω n 1 20-21-0 1 0 -1 0 1 0 -1 1 1 1 - 1 -1 -1 - 1 0 -1 0 -1 - 1 1 Ω 0 1 22 -23 -24 -25 -26 -27 -28 -28 -29 -30 -0 0 -1 0 1 - 1 0 -1 -1 1 1 1 -1 -1 -1 - 1 - 1 1 1 1 1 1 - 1 92235.50C 3.825286-5 92234.50C 4.694450-7 M1 92236.50C 9.153184-6 \$ Fi 92238.50C 1.905500-3 93237.50C 2.182926-6 8016.500 4.008088-2 \$ At 1001.50C 1.230247-2 \$ an 14000.50C 1.213794-2 13027.50C 2.774156-3 \$ Ca 26000.55C 1.493674-4 12000.50C 2.461111-4 20000.50C 6.060152-4 \$ Wi 11023.50C 4.189111-4 19000.50C 5.915591-4 \$ 30 MT1 LWTR.01T \$ Wa 31-С M3 1001.50c 1.337225-2 14000.50c 1.319341-2 13027.50c 3.015387-3 32-8016.50C 3.931496-2 С 33-26000.55C 1.623559-4 12000.50C 2.675121-4 20000.50C 6.587122-4 С 34 -11023.50c 4.553382-4 19000.50c 6.429990-4 С 35 -MT3 LWTR.01T C PRINT 36 initial source from ksrc card. print table 90 1 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 8% U-Np 02 probid = 05/26/96 00:08:17 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. the criticality problem was scheduled to skip 3 cycles and run a total of 1003 cycles with nominally 250 neutrons per cycle. 716 neutron histories and 1000 active cycles with this problem has run 3 inactive cycles with 249994 neutron histories. this calculation has completed the requested number of keff cycles using a total of 250710 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level

the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level Jun 07 16:19 1996 File Name: IMW-3.0E-20GWD-20W08U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXXIV - Page 2

the final estimated combined collision/absorption/track-length keff = .99598 with an estimated standard deviation of .00106 the estimated 68, 95, & 99 percent keff confidence intervals are .99492 to .99704, .99387 to .99810, and .99318 to .99879 the estimated collision/absorption neutron removal lifetime = 8.22E-05 seconds with an estimated standard deviation of 1.63E-07

Jun 07 16:20 1996 File Name: IMW-3.0E-20GWD-20W10U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXXV - Page 1 ld=10/01/93 05/26/96 00:47:15 1mcnp version 4a ************* probid = 05/26/96 00:47:15 INP=3E20W10I OUTP=320W10.0 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 10% U-Np 02 2-С k-inf Optimization Minimum Water 3-С 4-5-С SPHERE 7.13079731832-2 1 - 1 IMP:N=1 \$ Uranium/Tuff/Water 6-Ċ 7.10829224000-2 5 3 1 -2 IMP:N=1 \$ Tuff/Water Reflector 7-8-С С OUTSIDE WORLD 9-IMP:N=0 \$ Void С 30 0 2 30 Ô. 10-1 IMP:N=0 \$ Void 11-12-С SURFACES 13-1* S 0 0 0 10.00 \$ *Infinite FISSILE SPHERE 14 -2 0 0 0 174.51 \$ REFLECTOR С S 15warning. this surface has been replaced by a surface of type so 16-17-MODE N 18-KCODE 250 1 3 1003 19-KSRC 0 0 0 1 0 0 -1 0 0 0 1 0 0 -1 0 0 0 1 0 0 - 1 20-21-1 0 1 -1 0 1 0 1 0 -1 1 - 1 -1 - 1 0 -1 0 -1 1 0 0 -1 1 22-23-24-25-26-27-28-29-30-0 -1 0 1 - 1 0 0 -1 -1 1 - 1 -1 -1 -1 -1 1 1 1 1 -1 -1 1 92234.50C 5.868062-7 92235.50C 4.781608-5 92236.50C 1.144148-5 M1 \$ Fi 92238.50C 2.381875-3 93237.50C 2.728657-6 8016.50C 4.027236-2 \$ At 1001.50c 1.203503-2 \$ an 14000.50C 1.187407-2 13027.50C 2.713848-3 \$ Ca 26000.55c 1.461203-4 12000.50C 2.407609-4 20000.50C 5.928410-4 \$ Wi 11023.50C 4.098044-4 19000.50C 5.786991-4 \$ 30 MT1 LWTR.01T \$ Va 31-M3 1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 С 32-8016.50C 3.931496-2 С 12000.50C 2.675121-4 33-С 26000.55c 1.623559-4 20000.50C 6.587122-4 34 -С 11023.50c 4.553382-4 19000.50c 6.429990-4 35-MT3 LWTR.01T С PRINT 36-1 initial source from ksrc card. print table 90 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 10% U-Np 02 probid = 05/26/96 00:47:15 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. the criticality problem was scheduled to skip 3 cycles and run a total of 1003 cycles with nominally 250 neutrons per cycle. this problem has run 3 inactive cycles with 730 neutron histories and 1000 active cycles with 251405 neutron histories.

this calculation has completed the requested number of keff cycles using a total of 252135 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points.

the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are:

warning. the k(collision) cycle values do not appear normally distributed at the 99 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 99 percent confidence level, but not at 95 percent Jun 07 16:20 1996 File Name: IMW-3.0E-20GWD-20W10U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXXV - Page 2

the final estimated combined collision/absorption/track-length keff = 1.00783 with an estimated standard deviation of .00112 the estimated 68, 95, & 99 percent keff confidence intervals are 1.00671 to 1.00895, 1.00559 to 1.01007, and 1.00486 to 1.01080 the estimated collision/absorption neutron removal lifetime = 6.57E-05 seconds with an estimated standard deviation of 1.25E-07
Jun 07 16:39 1996 File Name: IMW-3.0E-20GWD-20W12U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXXVI - Page 1

A

1mcnp version 4a ld=10/01/93 05/26/96 01:23:13 ---probid = 05/26/96 01:23:13 INP=3E20W121 OUTP=320W12.0 Farfield Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 12% U-Np 02 2-С k-inf Optimization Minimum Water 3-С 4-С SPHERE 5-7.13529833398-2 -1 IMP:N=1 1 \$ Uranium/Tuff/Water 6-7-C 5 3 7.10829224000-2 1 -2 IMP:N=1 \$ Tuff/Water Reflector C 8-С OUTSIDE WORLD 9-30 C 0 2 IMP:N=0 \$ Void 10-30 0 IMP:N=0 \$ Void 1 11-12-13-С SURFACES 1* 0 0 10.00 S 0 \$ *Infinite FISSILE SPHERE 14-С 2 S 0 0 0 174.51 \$ REFLECTOR 15warning. this surface has been replaced by a surface of type so 16-17-MODE N 18-KCODE 250 1 3 1003 19-0 KSRC 0 n 0 Ω -1 n n 0 0 0 -1 n 0 0 1 Ω 0 -1 1 1 20-21-22-23-1 1 O -1 0 1 0 1 1 0 -1 1 - 1 1 0 - 1 - 1 0 -1 0 1 - 1 0 - 1 0 0 - 1 1 0 1 - 1 0 -1 -1 - 1 -1 -1 -1 1 1 - 1 1 1 - 1 1 24 -25 -92234.500 7.041674-7 92235.50C 5.737930-5 M1 92236.50C 1.372978-5 \$ Fi 92238.50C 2.858250-3 93237.50C 3.274388-6 8016.50C 4.046384-2 \$ At 26-27-1001.50c 1.176758-2 \$ an 14000.50C 1.161020-2 13027.50C 2.673541-3 \$ Ca 28-26000.55C 1.428732-4 12000.50C 2.354106-4 20000.50C 5.796667-4 \$ Wi 29-11023.500 4.006976-4 19000.500 5.658391-4 \$ 30 30-31-MT1 LWTR.01T \$ Va 1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 8016.50C 3.931496-2 26000.55C 1.623559-4 12000.50C 2.675121-4 20000.50C 6.587122-4 M3 C 32-С 33-C 34 -11023.50C 4.553382-4 19000.50C 6.429990-4 C 35 -C MT3 LWTR.01T 36-PRINT 1 initial source from ksrc card. print table 90 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 12% U-Np 02 probid = 05/26/96 01:23:13 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. the criticality problem was scheduled to skip 3 cycles and run a total of 1003 cycles with nominally this problem has run 3 inactive cycles with 711 neutron histories and 1000 active cycles with 25 250 neutrons per cycle. 250794 neutron histories. this calculation has completed the requested number of keff cycles using a total of 251505 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level

the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level Jun 07 16:39 1996 File Name: IMW-3.0E-20GWD-20W12U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXXVI - Page 2

the final estimated combined collision/absorption/track-length keff = 1.00885 with an estimated standard deviation of .00117 the estimated 68, 95, & 99 percent keff confidence intervals are 1.00768 to 1.01002, 1.00652 to 1.01118, and 1.00576 to 1.01194 the estimated collision/absorption neutron removal lifetime = 5.44E-05 seconds with an estimated standard deviation of 1.12E-07 Jun 07 16:12 1996 File Name: IMW-3.0E-20GWD-18W08U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXXVII - Page 1

ld=10/01/93 05/25/96 20:14:43 1mcnp version 4a ************* probid = 05/25/96 20:14:43 INP=3E18W081 OUTP=318W08.0 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 18% Water 8% U-Np 02 1 -2-3-С k-inf Optimization Minimum Water С 4-5-С SPHERE 1 1 6.94175922506-2 - 1 IMP:N=1 \$ Uranium/Tuff/Water 6-С 5 3 7.10829224000-2 1 -2 IMP:N=1 \$ Tuff/Water Reflector 7-С 8-С OUTSIDE WORLD 9-С 30 0 IMP:N=0 \$ Void 2 10-30 0 1 IMP:N=0 \$ Void 11-12-С SURFACES 1* 13-0 0 0 10.00 \$ *Infinite FISSILE SPHERE S 0 0 0 174.51 14-С 2 S \$ REFLECTOR 15-C warning. this surface has been replaced by a surface of type so 16-17-MODE N 18-KCODE 250 1 3 1003 19-KSRC 0 0 0 1 0 0 -1 0 0 0 1 0 0 - 1 0 0 0 1 Ω 0 -1 20-21-22-0 0 1 0 -1 1 1 Ω -1 1 1 - 1 0 -1 -1 0 -1 0 1 -1 0 -1 1 0 1 0 -1 1 0 -1 0 -1 -1 1 23--1 -1 -1 -1 -1 1 1 1 - 1 1 1 - 1 92234.500 4.694450-7 92235.50c 3.825286-5 24 -25 -26 -27 -28 -29 -30 -M1 92236.50C 9.153184-6 \$ Fi 93237.50C 2.182926-6 92238.50C 1.905500-3 8016.50C 3.946575-2 \$ At 1001.50C 1.107222-2 \$ an 14000.50C 1.213794-2 13027.50C 2.774156-3 \$ Ca 26000.55C 1.493674-4 12000.50C 2.461111-4 11023.50C 4.189111-4 19000.50C 5.915591-4 20000.50C 6.060152-4 \$ Wi \$ 30 MT1 LWTR.01T \$ Wa 31-32-1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 С м3 8016.50C 3.931496-2 С 33-26000.55C 1.623559-4 12000.50C 2.675121-4 20000.50C 6.587122-4 C 34 -11023.50C 4.553382-4 19000.50C 6.429990-4 С 35 -C MT3 LWTR.01T 36-PRINT 1 initial source from ksrc card. print table 90 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 18% Water 8% U-Np 02 probid = 05/25/96 20:14:43 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. the criticality problem was scheduled to skip 3 cycles and run a total of 1003 cycles with nominally 250 neutrons per cycle. 722 neutron histories and 1000 active cycles with 251266 neutron histories. this problem has run 3 inactive cycles with this calculation has completed the requested number of keff cycles using a total of 251988 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points.

the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are:

the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 99 percent confidence level, but not at 95 percent the k(trk length) cycle values appear normally distributed at the 95 percent confidence level Jun 07 16:12 1996 File Name: IMW-3.0E-20GWD-18W08U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXXVII. - Page 2

the final estimated combined collision/absorption/track-length keff = .99044 with an estimated standard deviation of .00110 the estimated 68, 95, & 99 percent keff confidence intervals are .98935 to .99154, .98826 to .99263, and .98755 to .99334 the estimated collision/absorption neutron removal lifetime = 8.15E-05 seconds with an estimated standard deviation of 1.66E-07 Jun 07 16:14 1996 File Name: IMW-3.0E-20GWD-18W10U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXXVIII - Page 1

1mcnp ld=10/01/93 05/25/96 22:03:42 version 4a ************* probid = 05/25/96 22:03:42 INP=3E18W10I OUTP=318W10.0 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 18% Water 10% U-Np 02 1 -2 -С k-inf Optimization Minimum Water <u>3</u>-C 4 -С SPHERE 5 -6.95027191632-2 1 1 - 1 IMP:N=1 \$ Uranium/Tuff/Water 7.10829224000-2 1 -2 IMP:N=1 \$ Tuff/Water Reflector 6-С 5 3 7-C 8-OUTSIDE WORLD С 9-30 0 IMP:N=0 \$ Void C 2 30 0 10-IMP:N=0 \$ Void 11-12-С SURFACES 13-1* S 0 0 0 10.00 \$ *Infinite FISSILE SPHERE 14 -C 2 S 0 0 0 174.51 \$ REFLECTOR 15 this surface has been replaced by a surface of type so warning. 16-17-MODE N 18-KCODE 250 1 3 1003 19-KSRC 0 0 0 0 0 -1 0 0 0 1 0 0 -1 0 0 0 1 n 0 -1 1 Ó 20-1 1 0 1 - 1 0 1 1 1 0 - 1 21-0 1 -1 0 -1 0 -1 -1 0 - 1 1 - 1 22-23-24-25-0 0 - 1 0 1 - 1 0 -1 -1 1 1 1 -1 -1 -1 -1 -1 1 1 1 - 1 1 1 1 92235.500 4.781608-5 92234.50C 5.868062-7 92236.50C 1.144148-5 M1 \$ Fi 93237.50C 2.728657-6 92238.50C 2.381875-3 8016.50C 3.967060-2 \$ At 26-\$ an 1001.50C 1.083152-2 27-14000.50C 1.187407-2 13027.50c 2.713848-3 \$ Ca 28-29-26000.550 1.461203-4 12000.50c 2.407609-4 20000.50C 5.928410-4 \$ Wi 11023.50C 4.098044-4 19000.50C 5.786991-4 \$ 30 30-\$ Wa MT1 LWTR.01T 31-C M3 1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 32-С 8016.50C 3.931496-2 33-26000.55C 1.623559-4 12000.50C 2.675121-4 20000.50C 6.587122-4 С 34-11023.50C 4.553382-4 19000.50C 6.429990-4 С 35-C MT3 LWTR.01T 36-PRINT initial source from ksrc card. print table 90 1 probid = 05/25/96 22:03:42 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 18% Water 10% U-Np 02 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. the criticality problem was scheduled to skip 3 cycles and run a total of 1003 cycles with nominally 250 neutrons per cycle. this problem has run 3 inactive cycles with 755 neutron histories and 1000 active cycles with 250120 neutron histories.

this calculation has completed the requested number of keff cycles using a total of 250875 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points.

the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are:

the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level. Jun 07 16:14 1996 File Name: IMW-3.0E-20GWD-18W10U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXXVIII - Page 2

the final estimated combined collision/absorption/track-length keff = .99483 with an estimated standard deviation of .00108 the estimated 68, 95, & 99 percent keff confidence intervals are .99375 to .99592, .99268 to .99699, and .99197 to .99770 the estimated collision/absorption neutron removal lifetime = 6.48E-05 seconds with an estimated standard deviation of 1.31E-07 Jun 07 16:16 1996 File Name: IMW-3.0E-20GWD-18W12U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXXIX - Page 1

1mcnp version 4a ld=10/01/93 05/25/96 23:34:27 **** probid = 05/25/96 23:34:27 INP=3E18W12I OUTP=318W12.0 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 18% Water 12% U-Np 02 1 -2-С k-inf Optimization Minimum Water 3-С 4 -С SPHERE 5 -1 6.95878460758-2 - 1 IMP:N=1 \$ Uranium/Tuff/Water 6-3 7.10829224000-2 C 5 1 -2 IMP:N=1 \$ Tuff/Water Reflector 7-С 8-С OUTSIDE WORLD ō-30 IMP:N=0 \$ Void С 0 2 10-30 Ō IMP:N=0 \$ Void 1 11-12-С SURFACES 1* 13-0 0 0 10.00 \$ *Infinite FISSILE SPHERE S 2 0 0 0 174.51 14 -С S \$ REFLECTOR 15warning. this surface has been replaced by a surface of type so 16-17-MODE N 250 1 3 18-KCODE 1003 19-KSRC 0 0 0 1 0 0 -1 0 n 0 1 0 0 -1 0 0 0 1 0 0 -1 20-1 n - 1 0 1 0 1 0 -1 1 1 - 1 21-22-23-- 1 1 0 -1 -1 0 - 1 0 1 -1 0 -1 0 0 - 1 0 -1 -1 1 1 1 0 1 - 1 1 - 1 1 -1 -1 1 -1 -1 -1 1 - 1 23-24-25-26-27-28-29-M1 92234.500 7.041674-7 92235.50c 5.737930-5 92236.50C 1.372978-5 \$ Fi 93237.50C 3.274388-6 92238.50C 2.858250-3 8016.50C 3.987546-2 \$ At 1001.50c 1.059082-2 \$ an 14000.50c 1.161020-2 13027.50C 2.673541-3 \$ Ca 26000.55c 1.428732-4 12000.50C 2.354106-4 20000.50C 5.796667-4 \$ Wi 11023.50C 4.006976-4 19000.50C 5.658391-4 \$ 30 30-MT1 LWTR.01T \$ Wa 31-С M3 1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 32-8016.50C 3.931496-2 С 33-С 26000.55C 1.623559-4 12000.50C 2.675121-4 20000.50C 6.587122-4 34-11023,50C 4,553382-4 19000,50C 6,429990-4 С 35-С MT3 LWTR.01T 36-PRINT 1 initial source from ksrc card. print table 90 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 18% Water 12% U-Np 02 probid = 05/25/96 23:34:27 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. the criticality problem_was scheduled to skip 3 cycles and run a total of 1003 cycles with nominally 250 neutrons per cycle. this problem has run 3 inactive cycles with 711 neutron histories and 1000 active cycles with 250079 neutron histories. this calculation has completed the requested number of keff cycles using a total of 250790 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level

the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

Jun 07 16:16 1996 File Name: IMW-3.0E-20GWD-18W12U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XXXIX - Page 2

the final estimated combined collision/absorption/track-length keff = .99307 with an estimated standard deviation of .00116 the estimated 68, 95, & 99 percent keff confidence intervals are .99190 to .99423, .99075 to .99538, and .99000 to .99613 the estimated collision/absorption neutron removal lifetime = 5.33E-05 seconds with an estimated standard deviation of 1.11E-07

Jun 07 16:03 1996 File Name: IMW-3.0E-20GWD-16W08U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XL - Page 1 ld=10/01/93 05/25/96 15:08:23 1mcnp version 4a probid = 05/25/96 15:08:23 INP=3E16W08I OUTP=316W08.0 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 16% Water 8% U-Np 02 1 -2-С k-inf Optimization Minimum Water 3-C 4-C SPHERE 5-6.75722214746-2 IMP:N=1 \$ Uranium/Tuff/Water 1 - 1 6-7-3 7.10829224000-2 1 -2 IMP:N=1 \$ Tuff/Water Reflector С 5 С 8-С OUTSIDE WORLD ō-30 IMP:N=0 \$ Void С 0 2 10-30 Ō IMP:N=0 \$ Void 1 11-12-С SURFACES 13-1* 0 0 0 10.00 \$ *Infinite FISSILE SPHERE S 0 0 0 174.51 2 14-С S \$ REFLECTOR 15warning. this surface has been replaced by a surface of type so 16-17-MODE N 18-KCODE 250 1 3 1003 19-0 KSRC 0 0 1 0 0 - 1 0 n Ω 1 0 0 -1 0 0 0 1 0 0 -1 20-1 A 1 - 1 0 1 0 - 1 1 0 -1 1 21-- 1 1 0 -1 -1 0 -1 0 1 -1 0 -1 22-23-24-25-26-27-28-29-0 0 -1 0 -1 -1 1 1 1 0 1 - 1 1 1 1 1 -1 -1 1 -1 -1 -1 1 92234.50C 4.694450-7 92235.500 3.825286-5 92236.50C 9.153184-6 M1 \$ Fi 93237.50C 2.182926-6 92238.50C 1.905500-3 8016.50C 3.885063-2 \$ At 1001.50C 9.841977-3 \$ an 13027.50C 2.774156-3 12000.50C 2.461111-4 14000.50C 1.213794-2 \$ Ca 26000.55C 1.493674-4 20000.50C 6.060152-4 \$ Wi 11023.50C 4.189111-4 19000.50C 5.915591-4 \$ 30 30-MT1 LWTR.01T \$ Va 31-C M3 1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 32-33-8016.50C 3.931496-2 С 20000.50C 6.587122-4 C 26000.55C 1.623559-4 12000.50C 2.675121-4 34-11023.50C 4.553382-4 19000.50C 6.429990-4 C 35-С MT3 LWTR.01T PRINT 36initial source from ksrc card. 1 print table 90 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 16% Water 8% U-Np 02 probid = 05/25/96 15:08:23 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. 250 neutrons per cycle. the criticality problem was scheduled to skip 3 cycles and run a total of 1003 cycles with nominally 729 neutron histories and 1000 active cycles with 250378 neutron histories. this problem has run 3 inactive cycles with this calculation has completed the requested number of keff cycles using a total of 251107 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level

the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

Jun 07 16:03 1996 File Name: IMW-3.0E-20GWD-16W08U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XL - Page 2

the final estimated combined collision/absorption/track-length keff = .97770 with an estimated standard deviation of .00102 the estimated 68, 95, & 99 percent keff confidence intervals are .97668 to .97872, .97566 to .97974, and .97500 to .98040 the estimated collision/absorption neutron removal lifetime = 8.03E-05 seconds with an estimated standard deviation of 1.56E-07

Jun 07 16:07 1996 File Name: IMW-3.0E-20GWD-16W10U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XLI - Page 1 version 4a ld=10/01/93 05/25/96 17:06:59 1mcnp 05/25/96 17:06:59 = bidora INP=3E16W10I OUTP=316W10.0 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 16% Water 10% U-Np 02 2 -С k-inf Optimization Minimum Water 3-C 4 -С SPHERE 5-6.76974651432-2 1 -1 IMP:N=1 \$ Uranium/Tuff/Water 6-3 7.10829224000-2 1 -2 IMP:N=1 \$ Tuff/Water Reflector С 5 7-C 8-С OUTSIDE WORLD 9-IMP:N=0 \$ Void С 30 0 2 10-30 0 1 IMP:N=0 \$ Void 11-12-С SURFACES 13-1* 0 0 0 10.00 \$ *Infinite FISSILE SPHERE S 14 -2 0 0 0 174.51 **\$** REFLECTOR С S 15 this surface has been replaced by a surface of type so warning. 16-17-MODE N 18-KCODE 250 1 3 1003 19-KSRC 0 0 0 0 0 -1 0 0 0 1 0 0 -1 0 0 0 1 0 0 -1 20-21-1 0 1 -1 0 1 0 1 1 0 - 1 1 -1 -1 0 -1 Ó -1 0 -1 - 1 1 n 1 22-23-24-25-26-27-0 -1 0 1 - 1 0 -1 -1 0 1 1 1 -1 -1 1 -1 -1 -1 1 1 1 1 92234.50C 5.868062-7 92235.50C 4.781608-5 92236.50C 1.144148-5 \$ Fi M1 93237.50C 2.728657-6 92238.50C 2.381875-3 8016.500 3.906885-2 \$ At 1001.50C 9.628021-3 \$ an 14000.50C 1.187407-2 13027.50C 2.713848-3 26000.55C 1.461203-4 12000.50C 2.407609-4 11023.50C 4.098044-4 19000.50C 5.786991-4 \$ Ca 28-29-30-31-20000.50C 5.928410-4 \$ ¥i \$ 30 MT1 \$ Wa LWTR.01T M3 1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 С 32-33-8016.50C 3.931496-2 С С 26000.55C 1.623559-4 12000.50C 2.675121-4 20000.50C 6.587122-4 34-C 11023.50C 4.553382-4 19000.50C 6.429990-4 35-MT3 LWTR.01T С PRINT 36print table 90 initial source from ksrc card. 1 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 16% Water 10% U-Np 02 probid = 05/25/96 17:06:59 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. 250 neutrons per cycle. the criticality problem was scheduled to skip 3 cycles and run a total of 1003 cycles with nominally 250152 neutron histories. this problem has run 3 inactive cycles with 713 neutron histories and 1000 active cycles with this calculation has completed the requested number of keff cycles using a total of 250865 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level

the k(trk length) cycle values appear normally distributed at the 95 percent confidence level.

Jun 07 16:07 1996 File Name: IMW-3.0E-20GWD-16W10U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XLI - Page 2

the final estimated combined collision/absorption/track-length keff = .98034 with an estimated standard deviation of .00115 the estimated 68, 95, & 99 percent keff confidence intervals are .97919 to .98149, .97805 to .98263, and .97731 to .98338 the estimated collision/absorption neutron removal lifetime = 6.36E-05 seconds with an estimated standard deviation of 1.31E-07 Jun 07 16:10 1996 File Name: IMW-3.0E-20GWD-16W12U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XLII - Page 1

1mcnp version 4a ld=10/01/93 05/25/96 18:40:56 ********** probid = 05/25/96 18:40:56 INP=3E16W12I OUTP=316W12.0 1-FarField Criticality - Sphere of Transmuted 3.0E 20GWD 16% Water 12% U-Np 02 2 -С k-inf Optimization Minimum Water 3-С 4 -С SPHERE 5 -IMP:N=1 \$ Uranium/Tuff/Water 6.78227088118-2 1 1 -1 6-С 5 3 7.10829224000-2 1 -2 IMP:N=1 \$ Tuff/Water Reflector 7-С 8-OUTSIDE WORLD С 9 -30 IMP:N=0 \$ Void С 0 2 10-30 0 1 IMP:N=0 \$ Void 11-12-С SURFACES 13-1* S 0 0 0 10.00 \$ *Infinite FISSILE SPHERE 14 -C 2 S 0 0 0 174.51 \$ REFLECTOR 15 -C warning. this surface has been replaced by a surface of type so 16-17-MODE N 18-KCODE 250 1 3 1003 19-KSRC 0 0 0 0 1 0 - 1 0 0 0 1 0 0 -1 0 0 0 1 0 0 - 1 20-21-0 1 -1 0 1 0 1 0 -1 1 1 1 - 1 1 0 -1 -1 0 - 1 0 1 -1 0 -1 22-23-0 1 1 0 -1 1 0 1 - 1 0 -1 -1 -1 -1 1 1 1 - 1 1 1 -1 -1 -1 24 -25 -26 -27 -92234.50C 7.041674-7 M1 92235.50c 5.737930-5 92236.50C 1.372978-5 \$ Fi 92238.50C 2.858250-3 93237.50C 3.274388-6 8016.50C 3.928708-2 \$ At 1001.50C 9.414065-3 \$ an 14000.50C 1.161020-2 13027.50C 2.673541-3 \$ Ca 28-29-26000.550 1.428732-4 12000.50C 2.354106-4 20000.50C 5.796667-4 \$ Wi 11023.50C 4.006976-4 19000.50C 5.658391-4 \$ 30 30-MT1 LWTR.01T \$ Wa 31-M3 1001.50c 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 С 32-8016.50C 3.931496-2 С 33-12000.50C 2.675121-4 С 26000.55C 1.623559-4 20000.500 6.587122-4 11023.50C 4.553382-4 19000.50C 6.429990-4 34 -С 35 -С MT3 LWTR.01T PRINT 36-1 initial source from ksrc card. print table 90 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 16% Water 12% U-Np 02 probid = 05/25/96 18:40:56 the initial fission neutron source distribution used the 23 source points that were input on the ksrc card. the criticality problem was scheduled to skip 3 cycles and run a total of 1003 cycles with nominally 250 neutrons per cycle. 694 neutron histories and 1000 active cycles with this problem has run 3 inactive cycles with 251086 neutron histories. this calculation has completed the requested number of keff cycles using a total of 251780 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

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the final estimated combined collision/absorption/track-length keff = .97294 with an estimated standard deviation of .00113 the estimated 68, 95, & 99 percent keff confidence intervals are .97181 to .97406, .97069 to .97518, and .96996 to .97591 the estimated collision/absorption neutron removal lifetime = 5.19E-05 seconds with an estimated standard deviation of 1.11E-07

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May 22 13:11 1996 File Name: i3530f.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XLIII - Page 1

1mcnp version 4a ld=10/01/93 04/30/96 12:14:11 probid = 04/30/96 12:14:11 inp=i3530f outp=i3530f0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 5% UO2 (i3530f) Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere 2 -C 3-C CELL SPECIFICATIONS 4 -C INNER WATER REGION 5-1 8.072318-2 -1 IMP:N=1 1 6-OUTSIDE WORLD С 7. 2 0 1 IMP:N=0 8-<u>9</u>-С SURFACE SPECIFICATIONS 10-1* SO 30 **\$ INNER FUEL ZONE** 11-12-13-14-15-16-17-MODE N KCODE 4000 1. 7 37 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 C 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C MATERIAL SPECIFICATIONS C (30 vol% water in calico Hills tuff) x .95 5 vol% UO2 C 18-3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes 1001.50c 1.905546-2 8016.50c 4.296957-2 11023.50c 4.325713-4 C 19m1 20-12000.50c 2.541365-4 13027.50c 2.864618-3 14000.50c 1.253374-2 21-22-19000.50c 6.108491-4 20000.50c 6.257766-4 26000.55c 1.542381-4 92234.50c 4.345805-7 92235.50c 2.314084-5 92236.50c 7.985865-6 23-92238.50c 1.188475-3 93237.50c 2.188250-6 24mt1 lwtr.01t 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 5% UO2 (i3530f) probid = 04/30/96 12:14:11 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27361 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120254 neutron histories. this calculation has completed the requested number of keff cycles using a total of 147615 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level _____ the final estimated combined collision/absorption/track-length keff = .88719 with an estimated standard deviation of .00164 the estimated 68, 95, & 99 percent keff confidence intervals are .88552 to .88885, .88382 to .89056, and .88264 to .89174 the estimated collision/absorption neutron removal lifetime = 1.23E-04 seconds with an estimated standard deviation of 4.03E-07 _____

May 21 14:45 1996 File Name: i3530e.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XLIV - Page 1

1mcnp version 4a ld=10/01/93 04/17/96 12:22:10 probid = 04/17/96 12:22:10 inp=i3530e outp=i3530e0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H20/ 8.8% UO2 (i3530e) 2-С Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere 3-C CELL SPECIFICATIONS 4 r INNER WATER REGION 5 -1 8.042759-2 -1 IMP:N=1 1 6-7-OUTSIDE WORLD С 2 0 1 IMP:N=0 8-9-C SURFACE SPECIFICATIONS 10-1* SO 30 **\$ INNER FUEL ZONE** 11-12-MODE N 13-KCODE 4000 1. 7 37 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 14-C. 15 -0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 16-MATERIAL SPECIFICATIONS C (30 vol% water in calico Hills tuff) x .912 8.8 vol% UO2 3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes 17-C 18-C 1001.50c 1.829324-2 8016.50c 4.320634-2 11023.50c 4.152684-4 12000.50c 2.439710-4 13027.50c 2.750033-3 14000.50c 1.203239-2 19m1 20-19000.50c 5.864151-4 20000.50c 6.007455-4 26000.55c 1.480686-4 92234.50c 7.648616-7 92235.50c 4.072787-5 92236.50c 1.405512-5 21-22-23-92238.50c 2.091715-3 93237.50c 3.851320-6 24lwtr.01t mt1 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 8.8% UO2 (i3530e) probid = 04/17/96 12:22:10 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27658 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120679 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148337 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 99 percent confidence level, but not at 95 percent the k(trk length) cycle values appear normally distributed at the 95 percent confidence level _____ the final estimated combined collision/absorption/track-length keff = .99900 with an estimated standard deviation of .00171 the estimated 68, 95, & 99 percent keff confidence intervals are .99727 to 1.00073, .99550 to 1.00250, and .99428 to 1.00373 the estimated collision/absorption neutron removal lifetime = 7.79E-05 seconds with an estimated standard deviation of 2.07E-07

May 21 14:04 1996 File Name: i3530d.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XLV - Page 1

version 4a ld=10/01/93 04/16/96 16:30:08 1mcnp probid = 04/16/96 16:30:08 inp=i3530d outp=i3530d0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H20/ 10% U02 (i3530d) 2-С Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere 3-С CELL SPECIFICATIONS 4 -С INNER WATER REGION 5-6-7-1 8.033424-2 -1 IMP:N=11 С OUTSIDE WORLD 2 0 1 IMP:N=0 8-<u>9</u>-С SURFACE SPECIFICATIONS 10-1* SO 30 **\$** INNER FUEL ZONE 11-12-13-14-15-16-MODE N KCODE 4000 1. 7 37 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 С 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C C MATERIAL SPECIFICATIONS 17-(30 vol% water in calico Hills tuff) x .90 .10 vol% UO2 С 3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes 1001.50c 1.805254-2 8016.50c 4.328111-2 11023.50c 4.098044-4 12000.50c 2.407609-4 13027.50c 2.713848-3 14000.50c 1.187407-2 18-C 19**m**1 20-21-22-19000.50c 5.786991-4 20000.50c 5.928410-4 26000.55c 1.461203-4 92234.50c 8.691609-7 92235.50c 4.628167-5 92236.50c 1.597173-5 92238.50c 2.376949-3 93237.50c 4.376500-6 23 -24 mt1 lwtr.01t 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 10% UO2 (i3530d) probid = 04/16/96 16:30:08 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27948 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120460 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148408 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.01253 with an estimated standard deviation of .00199 the estimated 68, 95, & 99 percent keff confidence intervals are 1.01051 to 1.01454, 1.00844 to 1.01661, and 1.00701 to 1.01804 the estimated collision/absorption neutron removal lifetime = 6.91E-05 seconds with an estimated standard deviation of 1.93E-07

May 21 14:02 1996 File Name: i3530c.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XLVI - Page 1 1mcnp version 4a ld=10/01/93 04/16/96 15:57:11 ************* probid = 04/16/96 15:57:11 inp=i3530c outp=i3530c0 1-Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H20/ 14% U02 (i3530c) 2-C Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere 3-C CELL SPECIFICATIONS 4 -С INNER WATER REGION 5 -1 8.002310-2 -1 IMP:N=1 1 6-С OUTSIDE WORLD 7-0 1 IMP:N=0 2 8-9-C SURFACE SPECIFICATIONS 10-1* SO 30 **\$ INNER FUEL ZONE** 11-12-MODE N 13-KCODE 4000 1. 7 37 14-KSRC 001 0010 00-20 0029 0205 00-5 -100-10 C 15 -С 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 16-17-С MATERIAL SPECIFICATIONS (30 vol% water in calico Hills tuff) x .86 .14 vol% UO2 С 3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes 18-С 19-1001.50c 1.725021-2 8016.50c 4.353035-2 11023.50c 3.915909-4 m1 12000.50c 2.300604-4 13027.50c 2.593233-3 14000.50c 1.134633-2 20-21 -22 -23 -24 -19000.50c 5.529791-4 20000.50c 5.664925-4 26000.55c 1.396261-4 92234.50c 1.216825-6 92235.50c 6.479434-5 92236.50c 2.236042-5 92238.50c 3.327729-3 93237.50c 6.127100-6 mt1 lwtr.01t 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (i3530c) probid = 04/16/96 15:57:11the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 28135 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120342 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148477 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.03159 with an estimated standard deviation of .00184 the estimated 68, 95, & 99 percent keff confidence intervals are 1.02972 to 1.03345, 1.02781 to 1.03536, and 1.02649 to 1.03668 the estimated collision/absorption neutron removal lifetime = 4.97E-05 seconds with an estimated standard deviation of 1.25E-07

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May 21 13:59 1996 File Name: i3530a.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XLVII - Page 1

1mcnp version 4a ld=10/01/93 04/16/96 14:56:57 probid = 04/16/96 14:56:57 inp=i3530a outp=i3530a0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 15% UO2 (i3530a) 2 -С Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere 3 -C CELL SPECIFICATIONS 4 -C INNER WATER REGION 1 7.994531-2 5 -IMP:N=1 - 1 6-C OUTSIDE WORLD 7-0 1 IMP:N=0 2 8-9-SURFACE SPECIFICATIONS C 10-1* SO 30 **\$** INNER FUEL ZONE 11-12-13-MODE N KCODE 4000 1. 7 37 14 -15 -0 0 1 0 0 10 0 0 -20 0 0 29 0 20 5 0 0 -5 -10 0 -10 KSRC 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 16-С MATERIAL SPECIFICATIONS 17-(30 vol% water in calico Hills tuff) x .85 .15 vol% UO2 С 18-19-20-21-22-23-3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes C 1001.50c 1.704962-2 8016.50c 4.359266-2 11023.50c 3.870375-4 m1 12000.50c 2.273853-4 13027.50c 2.563079-3 14000.50c 1.121440-2 19000.50c 5.465492-4 20000.50c 5.599054-4 26000.55c 1.380025-4 92234.50c 1.303741-6 92235.50c 6.942251-5 92236.50c 2.395760-5 92238.50c 3.565424-3 93237.50c 6.564750-6 24mt1 lwtr.01t 25 -PRINT initial source from ksrc card. print table 90 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 15% UO2 (i3530a) probid = 04/16/96 14:56:57 the initial fission neutron source distribution used the 14 source points that were input on the ksrc card. the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27946 neutron histories and 30 active cycles with 4000 neutrons per cycle. 119996 neutron histories. this calculation has completed the requested number of keff cycles using a total of 147942 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 99 percent confidence level, but not at 95 percent the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.03087 with an estimated standard deviation of .00154 the estimated 68. 95. & 99 percent keff confidence intervals are 1.02931 to 1.03243. 1.02772 to 1.03402. and 1.02661 to 1.03513 the estimated collision/absorption neutron removal lifetime = 4.62E-05 seconds with an estimated standard deviation of 1.24E-07

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May 21 14:00 1996 File Name: i3530b.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XLVIII - Page 1

1mcnp version 4a ld=10/01/93 04/16/96 15:23:12 ************** probid = 04/16/96 15:23:12 inp=i3530b outp=i3530b0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H20/ 16% U02 (i3530b) 2-Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere C 3-CELL SPECIFICATIONS C 4-C INNER WATER REGION 5-6-7-8-9-1 1 7.986752-2 - 1 IMP:N=1 C OUTSIDE WORLD 2 0 1 IMP:N=0 С SURFACE SPECIFICATIONS 10-1* SO 30 **\$** INNER FUEL ZONE 11-12-13-14-15-MODE N KCODE 4000 1. 5 35 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 C 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 16-MATERIAL SPECIFICATIONS C 17-(30 vol% water in calico Hills tuff) x .84 .16 vol% UO2 C 18-3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes C 19-20-21-22-1001.50c 1.684904-2 8016.50c 4.365497-2 11023.50c 3.824841-4 12000.50c 2.247102-4 13027.50c 2.532925-3 14000.50c 1.108246-2 19000.50c 5.401192-4 20000.50c 5.533182-4 26000.55c 1.363790-4 92234.50c 1.390657-6 92235.50c 7.405067-5 92236.50c 2.555477-5 m1 23-92238.50c 3.803118-3 93237.50c 7.002400-6 24lwtr.01t mt1 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 16% UO2 (i3530b) 04/16/96 15:23:12 probid = the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 5 cycles and run a total of 35 cycles with nominally this problem has run 5 inactive cycles with 19986 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120160 neutron histories. this calculation has completed the requested number of keff cycles using a total of 140146 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are; the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.02680 with an estimated standard deviation of .00183 the estimated 68, 95, & 99 percent keff confidence intervals are 1.02494 to 1.02865, 1.02305 to 1.03054, and 1.02173 to 1.03186 the estimated collision/absorption neutron removal lifetime = 4.26E-05 seconds with an estimated standard deviation of 1.10E-07

May 22 14:00 1996 file Name: i3530j.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT IL - Page 1

1mcnp 04/30/96 12:52:39 version 4a ld=10/01/93 ****** probid = 04/30/96 12:52:39 inp=i3530i outp=i3530i0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 20% H2O/ 5% UO2 (i3530j) C Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere 2-3r CELL SPECIFICATIONS 4 -C INNER WATER REGION <u>5</u>-1 1 7.119545-2 IMP:N=1 6-7-OUTSIDE WORLD С 0 1 IMP:N=0 2 8-9-C SURFACE SPECIFICATIONS 10-1* SO 30 **\$** INNER FUEL ZONE 11-12-MODE N 13-KCODE 4000 1. 7 37 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 14 -C 15-0 -5 -20 -10 0 - 13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 16-С MATERIAL SPECIFICATIONS 17-(20 vol% water in calico Hills tuff) x .95 5 vol% UO2 С 18-3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes C 19m1 1001.50c 1.270364-2 8016.50c 3.979366-2 11023.50c 4.325713-4 20-21-22-23-12000.50c 2.541365-4 13027.50c 2.864618-3 14000.50c 1.253374-2 19000.50c 6.108491-4 20000.50c 6.257766-4 26000.55c 1.542381-4 92234.50c 4.345805-7 92235.50c 2.314084-5 92236.50c 7.985865-6 92238.50c 1.188475-3 93237.50c 2.188250-6 24 lwtr.01t mt1 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 20% H2O/ 5% UO2 (i3530j) 04/30/96 12:52:39 probid = the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27756 neutron histories and 30 active cycles with 4000 neutrons per cycle. 119857 neutron histories. 147613 fission neutron source histories. this calculation has completed the requested number of keff cycles using a total of all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level _____ the final estimated combined collision/absorption/track-length keff = .90652 with an estimated standard deviation of .00130 the estimated 68, 95, & 99 percent keff confidence intervals are .90521 to .90784, .90386 to .90919, and .90292 to .91013 the estimated collision/absorption neutron removal lifetime = 1.25E-04 seconds with an estimated standard deviation of 2.87E-07 _____

May 22 13:18 1996 File Name: i3530i.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT L - Page 1

04/17/96 15:56:27 1mcnp version 4a ld=10/01/93 5---probid = 04/17/96 15:56:27 inp=i3530i outp=i3530i0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 20% H2O/ 10% UO2 (i3530i) C Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere 1 ż-3-CELL SPECIFICATIONS С INNER WATER REGION 4 -C 5 -1 7.130797-2 -1 IMP:N=1 1 6-7-С OUTSIDE WORLD 2 0 1 IMP:N=0 8-<u>9</u>-C SURFACE SPECIFICATIONS 10-1* SO 30 **\$ INNER FUEL ZONE** 11-12-13-MODE N KCODE 4000 1. 7 37 14-KSRC 001 0010 00-20 0029 0205 00-5 -100-10 C 15 -0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 r 16-MATERIAL SPECIFICATIONS С 17-(20 vol% water in calico Hills tuff) x .90 10 vol% UO2 С 18-3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes С 19-8016.50c 4.065532-2 11023.50c 4.098044-4 1001.50c 1.150014-2 m1 12000.50c 2.407609-4 13027.50c 2.713848-3 14000.50c 1.187407-2 20-21-22-23-19000.50c 5.786991-4 20000.50c 5.928410-4 26000.55c 1.461203-4 92235.50c 4.628167-5 92236.50c 1.597173-5 92234.50c 8.691609-7 92238,50c 2.376949-3 93237.50c 4.376500-6 24lwtr.01t mt1 25-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 20% H2O/ 10% UO2 (i3530i) probid = 04/17/96 15:56:27 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27922 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120249 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148171 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .97944 with an estimated standard deviation of .00156 the estimated 68, 95, & 99 percent keff confidence intervals are .97785 to .98102, .97623 to .98264, and .97511 to .98377 the estimated collision/absorption neutron removal lifetime = 6.56E-05 seconds with an estimated standard deviation of 1.84E-07

May 22 13:16 1996 File Name: i3530g.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LI - Page 1 1mcnp version 4a ld=10/01/93 04/17/96 15:03:47 ************ probid = 04/17/96 15:03:47 inp=i3530g outp=i3530g0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 20% H2O/ 12% UO2 (i3530g) 2-С Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere 3-С CELL SPECIFICATIONS 4 -C INNER WATER REGION 5-1 7.135298-2 -1 1 IMP:N=1 OUTSIDE WORLD 6-С 7-0 1 IMP:N=0 2 8-9-С SURFACE SPECIFICATIONS 10-1* SO 30 **\$** INNER FUEL ZONE 11-12-MODE N 13-KCODE 4000 1. 7 37 KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 5 0 0 -5 -10 0 -10 14-C 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 15-С 16-С MATERIAL SPECIFICATIONS (20 vol% water in calico Hills tuff) x .88 12 vol% UO2 3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes 1001.50c 1.176758-2 8016.50c 4.046384-2 11023.50c 4.006976-4 17-C 18-C 19m1 12000.50c 2.354106-4 13027.50c 2.653541-3 14000.50c 1.161020-2 20-19000.50c 5.658391-4 20000.50c 5.796667-4 26000.55c 1.428732-4 92234.50c 1.042993-6 92235.50c 5.553800-5 92236.50c 1.916608-5 21-22-23-92238.50c 2.852339-3 93237.50c 5.251800-6 24mt1 lwtr.01t 25· PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 20% H2O/ 12% UO2 (i3530g) probid = 04/17/96 15:03:47 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27658 neutron histories and 30 active cycles with 4000 neutrons per cycle. 119751 neutron histories. this calculation has completed the requested number of keff cycles using a total of 147409 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 99 percent confidence level, but not at 95 percent the k(trk length) cycle values appear normally distributed at the 95 percent confidence level _____ the final estimated combined collision/absorption/track-length keff = .98612 with an estimated standard deviation of .00200 the estimated 68, 95, £ 99 percent keff confidence intervals are .98409 to .98814, .98202 to .99021, and .98059 to .99165 the estimated collision/absorption neutron removal lifetime = 5.50E-05 seconds with an estimated standard deviation of 2.01E-07 _____

May 22 13:17 1996 File Name: i3530h.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LII - Page 1

1mcnp version 4a ld=10/01/93 04/17/96 15:26:39 ************ probid = 04/17/96 15:26:39 inp=i3530h outp=i3530h0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 20% H2O/ 14% UO2 (i3530h) 2-С Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere 3-С CELL SPECIFICATIONS 4-INNER WATER REGION C <u>5</u>-1 7.139799-2 -1 1 IMP:N=1 6-7-OUTSIDE WORLD С 2 0 1 IMP:N=0 8-**9**-C SURFACE SPECIFICATIONS 10-11-1* SO 30 **\$ INNER FUEL ZONE** 12-13-14-15-16-17-18-19-MODE N KCODE 4000 1. 7 37 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 C 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C MATERIAL SPECIFICATIONS C (20 vol% water in calico Hills tuff) x .86 .14 vol% UO2 3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes 1001.50c 1.150014-2 8016.50c 4.065532-2 11023.50c 3.915909-4 12000.50c 2.300604-4 13027.50c 2.593233-3 14000.50c 1.134633-2 19000.50c 5.529791-4 20000.50c 5.664925-4 26000.55c 1.396261-4 92234.50c 1.216825-6 92235.50c 6.479434-5 92236.50c 2.236042-5 c С m1 żó-21-22-23-92238,50c 3.327729-3 93237.50c 6.127100-6 24 lwtr.01t mt1 25-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 20% H2O/ 14% UO2 (i3530h) probid = 04/17/96 15:26:39 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27868 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120155 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148023 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .98040 with an estimated standard deviation of .00160 the estimated 68, 95, & 99 percent keff confidence intervals are .97877 to .98202, .97711 to .98368, and .97596 to .98483 the estimated collision/absorption neutron removal lifetime = 4.62E-05 seconds with an estimated standard deviation of 1.24E-07

May 22 14:16 1996 File Name: i4040f.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LIII - Page 1

version 4a ld=10/01/93 04/30/96 13:31:56 1mcnp 04/30/96 13:31:56 probid = inp=i4040f outp=i4040f0 Far-Field Criticality Study - 4.0% /40 GWD/mt - 30% H2O/ 5% UO2 (i4040f) 1 -2-С Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere 3-C CELL SPECIFICATIONS 4 -С INNER WATER REGION 5-1 8.072318-2 IMP:N=1 1 -1 OUTSIDE WORLD 6-С 7-2 0 1 IMP:N=0 8-9-С SURFACE SPECIFICATIONS 10-1* SO 30 **\$ INNER FUEL ZONE** 11-MODE N 12-KCODE 4000 1. 7 37 13-KŚRC 001 0010 00-20 0029 0205 00-5 -100-10 14 -С 15-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 16-MATERIAL SPECIFICATIONS С 17-(30 vol% water in calico Hills tuff) x .95 5 vol% UO2 С 18-4.0% Original Enrichment/ 40 GWD/MT decayed to Uranium isotopes Ċ 19-1001.50c 1.905546-2 8016.50c 4.296957-2 11023.50c 4.325731-4 m1 12000.50c 2.541365-4 13027.50c 2.864618-3 14000.50c 1.253374-2 20-21-19000.50c 6.108491-4 20000.50c 6.257766-4 26000.55c 1.542381-4 92234.50c 6.234445-7 92235.50c 2.257862-5 92236.50c 1.008800-5 22-23-92238.50c 1.185985-3 93237.50c 2.949209-6 24lwtr.01t mt1 25-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 4.0% /40 GWD/mt - 30% H2O/ 5% UO2 (i4040f) probid = 04/30/96 13:31:56 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27518 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120246 neutron histories. this calculation has completed the requested number of keff cycles using a total of 147764 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .86893 with an estimated standard deviation of .00117 the estimated 68, 95, & 99 percent keff confidence intervals are .86774 to .87012, .86653 to .87134, and .86568 to .87219 the estimated collision/absorption neutron removal lifetime = 1.23E-04 seconds with an estimated standard deviation of 3.60E-07

1mcnp version 4a ld=10/01/93 04/18/96 07:15:02 probid = 04/18/96 07:15:0 inp=i4040d outp=i4040d0 Far-Field Criticality Study - 4.0% /40 GWD/mt - 30% H2O/ 10% UO2 (i4040d) 1 -2 -С Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere 3-С CELL SPECIFICATIONS 4 -INNER WATER REGION C 5-6-7-8-9-1 8.033424-2 -1 IMP:N=1 1 С OUTSIDE WORLD 2 0 1 IMP:N=0 SURFACE SPECIFICATIONS С 10-1* SO 30 **\$ INNER FUEL ZONE** 11-12-13-14-15-MODE N KCODE 4000 1. 7 37 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 C 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 С 16-17-C MATERIAL SPECIFICATIONS (30 vol% water in calico Hills tuff) x .90 .10 vol% UO2 С 18-4.0% Original Enrichment/ 40 GWD/MT decayed to Uranium isotopes С 19-1001.50c 1.805254-2 8016.50c 4.328111-2 11023.50c 4.098044-4 m1 20-21-22-23-12000.50c 2.407609-4 13027.50c 2.713848-3 14000.50c 1.187407-2 19000.50c 5.786991-4 20000.50c 5.928410-4 26000.55c 1.461203-4 92234.50c 1.246889-6 92235.50c 4.515723-5 92236.50c 2.017600-5 92238.50c 2.371969-3 93237.50c 5.898417-6 24 lwtr.01t mt1 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 4.0% /40 GWD/mt - 30% H2O/ 10% UO2 (i4040d) probid = 04/(8/96) 07:15:02 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27997 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120176 neut on histories. this calculation has completed the requested number of keff cycles using a total of 148173 fission neutron sourcy histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .99662 with an estimated standard deviation of .00134 the estimated 68, 95, & 99 percent keff confidence intervals are .99526 to .99799, .99387 to .99938, and .9929) to 1.00035 the estimated collision/absorption neutron removal lifetime = 6.97E-05 seconds with an estimated standard deviation of 1.33E-07

May 22 14:12 1996 File Name: i4040d.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LIV - Page 1

May 22 14:10 1996 File Name: i4040b.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LV - Page 1

04/17/96 17:11:03 1mcnp version 4a ld=10/01/93 04/17/96 17:11:03 probid = INP=14040b OUTP=14040b0 Far-Field Criticality Study - 4.0% /40 GWD/mt - 30% H20/ 12% U02 (i4040b) 1 -2-3-С Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere С CELL SPECIFICATIONS 4 -INNER WATER REGION C 5 -6 -7 -8 -1 8.017867-2 -1 IMP:N=1 1 C OUTSIDE WORLD 2 0 1 IMP:N=0 <u>9</u>-C SURFACE SPECIFICATIONS 10-1* SO 30 **\$ INNER FUEL ZONE** 11-12-MODE N 13-14-KCODE 4000 1. 7 37 KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 5 0 0 -5 -10 0 -10 С 15-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 С 16-С MATERIAL SPECIFICATIONS 17-(30 vol% water in calico Hills tuff) x .88 12 vol% UO2 С 18-4.0% Original Enrichment/ 40 GWD/MT decayed to Uranium isotopes С 19-1001.50c 1.765137-2 8016.50c 4.340573-2 11023.50c 4.006976-4 m1 20-21-22-23-24-13027.50c 2.653541-3 14000.50c 1.161020-2 12000.50c 2.354106-4 19000.50c 5.658391-4 20000.50c 5.796667-4 26000.55c 1.428732-4 92235.50c 5.418868-5 92236.50c 2.421120-5 92234.50c 1.496267-6 92238.50c 2.846363-3 93237.50c 7.078100-6 mt1 lwtr.01t 25-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 4.0% /40 GWD/mt - 30% H2O/ 12% UO2 (i4040b) probid = 04/17/96 17:11:03 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27978 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120259 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148237 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. warning. there appears to be decreasing trend in the average col/abs/tl keff estimator over the last 10 active cycles. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level k = 1_____ the final estimated combined collision/absorption/track-length keff = 1.00578 with an estimated standard deviation of .00152 the estimated 68, 95, & 99 percent keff confidence intervals are 1.00424 to 1.00732, 1.00267 to 1.00889, and 1.00158 to 1.00998 the estimated collision/absorption neutron removal lifetime = 5.83E-05 seconds with an estimated standard deviation of 1.92E-07 _____

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May 22 14:04 1996 File Name: i4040a0.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LVI - Page 1

1mcnp version 4a Ld=10/01/93 04/17/96 16:37:13 probid = 04/17/96 16:37:13 INP=i4040a OUTP=i4040a0 Far-Field Criticality Study - 4.0% /40 GWD/mt - 30% H20/ 14% U02 (i4040a) 2-Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere C 3-CELL SPECIFICATIONS C INNER WATER REGION 4-5-C 1 8.002310-2 -1 IMP:N=11 6-7-OUTSIDE WORLD С 0 1 IMP:N=0 2 8-9-С SURFACE SPECIFICATIONS 10-1* SO 30 **\$ INNER FUEL ZONE** 11-12-MODE N 13-KCODE 4000 1. 7 37 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 14 -C. 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 15 -С 16-MATERIAL SPECIFICATIONS C 17-(30 vol% water in calico Hills tuff) x .86 .14 vol% UO2 C 4.0% Original Enrichment/ 40 GWD/MT decayed to Uranium isotopes 1001.50c 1.725021-2 8016.50c 4.353035-2 11023.50c 3.915909-4 18-С 19m1 12000.50c 2.300604-4 13027.50c 2.593233-3 14000.50c 1.134633-2 19000.50c 5.529791-4 20000.50c 5.664925-4 26000.55c 1.396261-4 20-21-22-92234.50c 1.745645-6 92235.50c 6.322012-5 92236.50c 2.824640-5 23-92238.50c 3.320757-3 93237.50c 8.257784-6 24mt1 lwtr.01t 25 PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 4.0% /40 GWD/mt - 30% H2O/ 14% UO2 (i4040a) probid = 04/17/96 16:37:13 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 28071 neutron histories and 30 active cycles with 4000 neutrons per cycle. 119929 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148000 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.00910 with an estimated standard deviation of .00174 the estimated 68, 95, & 99 percent keff confidence intervals are 1.00733 to 1.01087, 1.00553 to 1.01267, and 1.00427 to 1.01392 the estimated collision/absorption neutron removal lifetime = 4.97E-05 seconds with an estimated standard deviation of 1.08E-07 _____

1mcnp version 4a ld=10/01/93 04/17/96 17:32:17 probid = 04/17/96 17:32:17 INP=i4040c OUTP=i4040c0 Far-Field Criticality Study - 4.0% /40 GWD/mt - 30% H20/ 16% U02 (i4040c) 2-3-С Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere С CELL SPECIFICATIONS **4** -С INNER WATER REGION 5-6-7-1 7.986752-2 -1 1 IMP:N=1 OUTSIDE WORLD С 0 1 IMP:N=0 2 8-<u>9</u>r SURFACE SPECIFICATIONS 10-1* SO 30 **\$ INNER FUEL ZONE** 11-12-MODE N 13-14-KCODE 4000 1. 5 35 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 C 15 -С 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 16-17-MATERIAL SPECIFICATIONS С (30 vol% water in calico Hills tuff) x .84 .16 vol% UO2 С 4.0% Original Enrichment/ 40 GWD/MT decayed to Uranium isotopes 18-C 19-1001.50c 1.684904-2 8016.50c 4.365497-2 11023.50c 3.824841-4 m1 20-21-22-23-24-12000.50c 2.247102-4 13027.50c 2.532925-3 14000.50c 1.108246-2 19000.50c 5.401192-4 20000.50c 5.533182-4 26000.55c 1.363790-4 92234.50c 1.995022-6 92235.50c 7.225157-5 92236.50c 3.228160-5 92238.50c 3.795150-3 93237.50c 9.437467-6 mt1 lwtr.01t 25 PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 4.0% /40 GWD/mt - 30% H2O/ 16% UO2 (i4040c) probid = 04/17/96 17:32:17 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 5 cycles and run a total of 35 cycles with nominally this problem has run 5 inactive cycles with 20062 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120608 neutron histories. this calculation has completed the requested number of keff cycles using a total of 140670 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.00923 with an estimated standard deviation of .00124 the estimated 68, 95, & 99 percent keff confidence intervals are 1.00798 to 1.01048, 1.00669 to 1.01177, and 1.00580 to 1.01265 the estimated collision/absorption neutron removal lifetime = 4.29E-05 seconds with an estimated standard deviation of 9.74E-08

May 22 14:11 1996 File Name: i4040c.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LVII - Page 1

May 22 14:14 1996 File Name: i4040e.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LVIII - Page 1

1mcnp ld=10/01/93 04/18/96 07:50:56 version 4a ************ probid = 04/18/96 07:50:56 inp=14040e outp=14040e0 Far-Field Criticality Study - 4.0% /40 GWD/mt - 30% H20/ 18% U02 (i4040e) 2 -С Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere 3-С CELL SPECIFICATIONS 4 -С INNER WATER REGION 5 -1 7.971195-2 -1 IMP:N=1 6-OUTSIDE WORLD С 7-8-9-2 0 1 IMP:N=0 C SURFACE SPECIFICATIONS 10-1* SO 30 **\$** INNER FUEL ZONE 11-MODE N 12-13-KCODE 4000 1. 7 37 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 14 -C 15-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 С 16-MATERIAL SPECIFICATIONS С 17-(30 vol% water in calico Hills tuff) x .82 18 vol% UO2 С 18-4.0% Original Enrichment/ 40 GWD/MT decayed to Uranium isotopes C 1001.50c 1.644787-2 8016.50c 4.377959-2 11023.50c 3.733773-4 19m1 12000.50c 2.193599-4 13027.50c 2.472617-3 14000.50c 1.081860-2 20-21-19000.50c 5.272592-4 20000.50c 5.401440-4 26000.55c 1.331318-4 92234.50c 2.244400-6 92235.50c 8.128301-5 92236.50c 3.631680-5 22-23-92238.50c 4.269544-3 93237.50c 1.061715-5 24 mt1 lwtr.01t 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 4.0% /40 GWD/mt - 30% H2O/ 18% UO2 (i4040e) probid = 04/18/96 07:50:56 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally 4000 neutrons per cycle. this problem has run 7 inactive cycles with 27979 neutron histories and 30 active cycles with 119975 neutron histories. this calculation has completed the requested number of keff cycles using a total of 147954 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cýcle values appear normallý distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.00343 with an estimated standard deviation of .00145 the estimated 68, 95, & 99 percent keff confidence intervals are 1.00196 to 1.00491, 1.00045 to 1.00641, and .99940 to 1.00746 the estimated collision/absorption neutron removal lifetime = 3.77E-05 seconds with an estimated standard deviation of 1.02E-07

Aug 27 13:28 1996 File Name: i4245a.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LIX - Page 1

1mcnp version 4a ld=10/01/93 08/21/96 15:06:06 *********** probid = 08/21/96 15:06:06 INP=i4245a OUTP=i4245a0 Far-Field Criticality Study - 4.2% /45 GWD/mt - 30% H20/ 10% U02 (i4245a) 2-3-Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere С CELL SPECIFICATIONS 4 -5 -С INNER WATER REGION 1 1 8.033424-2 -1 IMP:N=1 6-7-С OUTSIDE WORLD 2 0 1 IMP:N=0 8-9-С SURFACE SPECIFICATIONS 10-1* SO 30 **\$ INNER FUEL ZONE** 11-12-MODE N 13-KCODE 4000 1. 7 67 14-KSRC 001 0010 00-20 0029 0205 00-5 -100-10 C 15-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 С 16-C MATERIAL SPECIFICATIONS (30 vol% water in calico Hills tuff) x .90 .10 vol% UO2 4.2% Original Enrichment/ 45 GWD/MT decayed to Uranium isotopes 1001.50c 1.805254-2 8016.50c 4.328111-2 11023.50c 4.098044-4 17-С 18-С 19m1 12000.50c 2.407609-4 13027.50c 2.713848-3 14000.50c 1.187407-2 20-19000.50c 5.786991-4 20000.50c 5.928410-4 26000.55c 1.461203-4 92234.50c 1.463431-6 92235.50c 4.378063-5 92236.50c 2.204533-5 21-22-23-92238.50c 2.370558-3 93237.50c 6.599715-6 24mt1 lwtr.01t 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 4.2% /45 GWD/mt - 30% H2O/ 10% UO2 (i4245a) probid = 08/21/96 15:06:06 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 67 cycles with nominally this problem has run 7 inactive cycles with 27813 neutron histories and 60 active cycles with 4000 neutrons per cycle. 239404 neutron histories. this calculation has completed the requested number of keff cycles using a total of 267217 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .98086 with an estimated standard deviation of .00117the estimated 68, 95, 2 99 percent keff confidence intervals are .97969 to .98203, .97852 to .98320, and .97775 to .98397 the estimated collision/absorption neutron removal lifetime = 7.07E-05 seconds with an estimated standard deviation of 1.48E-07

Aug 27 13:30 1996 File Name: i4245b.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LX - Page 1

08/21/96 15:48:08 1mcnp version 4a ld=10/01/93 ************** probid = 08/21/96 15:48:08 INP=14245b OUTP=14245b0 Far-Field Criticality Study - 4.2% /45 GWD/mt - 30% H20/ 15% U02 (i4245b) 2-С Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere 3-C CELL SPECIFICATIONS 4 -5 -C INNER WATER REGION 1 1 7.994531-2 - 1 IMP:N=1 6-7-C OUTSIDE WORLD 2 0 1 IMP:N=0 8-**9**-C SURFACE SPECIFICATIONS 1* 10-SO 30 **\$** INNER FUEL ZONE 11-12-MODE N 13-KCODE 4000 1. 7 67 14 -KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 5 0 0 -5 -10 0 -10 С 15 -0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 16-MATERIAL SPECIFICATIONS С 17-С (30 vol% water in calico Hills tuff) x .85 .15 vol% UO2 18-4.2% Original Enrichment/ 45 GWD/MT decayed to Uranium isotopes **c** 19m1 1001.50c 1.704962-2 8016.50c 4.359266-2 11023.50c 3.870375-4 12000.50c 2.273853-4 13027.50c 2.563079-3 14000.50c 1.121440-2 19000.50c 5.465492-4 20000.50c 5.599054-4 26000.55c 1.380025-4 92234.50c 2.195147-6 92235.50c 6.567095-5 92236.50c 3.306800-9 20-21-22-92236.50c 3.306800-5 23-92238.50c 3.555837-3 93237.50c 9.899573-6 24lwtr.01t mt1 25 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 4.2% /45 GWD/mt - 30% H2O/ 15% UO2 (i4245b) probid = 08/21/96 15:48:08 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 67 cycles with nominally this problem has run 7 inactive cycles with 27899 neutron histories and 60 active cycles with 4000 neutrons per cycle. 239713 neutron histories. this calculation has completed the requested number of keff cycles using a total of 267612 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level ----the final estimated combined collision/absorption/track-length keff = .99348 with an estimated standard deviation of .00131the estimated 68, 95, & 99 percent keff confidence intervals are .99217 to .99479, .99087 to .99610, and .99000 to .99696 the estimated collision/absorption neutron removal lifetime = 4.68E-05 seconds with an estimated standard deviation of 1.03E-07

Aug 27 13:32 1996 File Name: i4245c.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXI - Page 1

ld=10/01/93 08/21/96 16:23:15 1mcnp version 4a ************ probid = 08/21/96 16:23:15 INP=i4245c OUTP=i4245c0 Far-Field Criticality Study - 4.2% /45 GWD/mt - 30% H2O/ 20% UO2 (i4245c) 2-3-Calico Hills Tuff 1.746 g/cc .306 porosity - reflected sphere С С CELL SPECIFICATIONS INNER WATER REGION С 1 7.955637-2 -1 IMP:N=1 1 С OUTSIDE WORLD 2 0 1 IMP:N=0 9-С SURFACE SPECIFICATIONS 10-1* SO 30 **\$** INNER FUEL ZONE 11-12-MODE N 13-KCODE 4000 1. 7 67 14 -KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 5 0 0 -5 -10 0 -10 C 15-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 16-C MATERIAL SPECIFICATIONS (30 vol% water in calico Hills tuff) x .80 .20 vol% UO2 4.2% Original Enrichment/ 45 GWD/MT decayed to Uranium isotopes 1001.50c 1.604670-2 8016.50c 4.390421-2 11023.50c 3.642706-4 12000.50c 2.140097-4 13027.50c 2.412310-3 14000.50c 1.055473-2 17-C 18-С 19m1 20-21-22-19000.50c 5.143992-4 20000.50c 5.269698-4 26000.55c 1.298847-4 92234.50c 2.926862-6 92235.50c 8.756126-5 92236.50c 4.409066-5 23-92238.50c 4.741116-3 93237.50c 1.319943-5 24mt1 lwtr.01t PRINT 25 initial source from file srctp 1keff results for: Far-Field Criticality Study - 4.2% /45 GWD/mt - 30% H2O/ 20% UO2 (i4245c) probid = 08/21/96 16:23:15 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 67 cycles with nominally this problem has run 7 inactive cycles with 27872 neutron histories and 60 active cycles with 4000 neutrons per cycle. 239942 neutron histories. this calculation has completed the requested number of keff cycles using a total of 267814 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .97442 with an estimated standard deviation of .00110the estimated 68, 95, & 99 percent keff confidence intervals are .97332 to .97552, .97222 to .97661, and .97150 to .97734 the estimated collision/absorption neutron removal lifetime = 3.35E-05 seconds with an estimated standard deviation of 6.49E-08

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May 23 10:42 1996 File Name: s3020me.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXII - Page 1

Ld=10/01/93 1mcnp version 4a 04/30/96 18:00:32 ************* probid = 04/30/96 18:00:32 INP=s3020me OUTP=s3020me0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H2O/ 18.5% UO2 (s3020me) 1 -2-С Calico Hills Tuff 1.137 g/cc .47 porosity - sphere surrounded by tuff 3-С CELL SPECIFICATIONS 4 -С INNER WATER REGION 1 8.374149-2 -1 5-IMP:N=1 2 8.610406-2 1 -2 IMP:N=1 2 6-7-С OUTSIDE WORLD 8-3 0 2 IMP:N=0 9-10-C SURFACE SPECIFICATIONS 11-SO 57 **\$ INNER FUEL ZONE** 12-2 SO 117 **\$** INNER FUEL ZONE 13-14-MODE N 15-KCODE 4000 1. 25 75 16-KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 15 0 0 -55 -10 0 -40 C 17-0 -50 -20 -30 0 -13 0 -10 60 0 0 -25 -30 -15 -56 5 5 0 10 30 17 C 18-C MATERIAL SPECIFICATIONS 19-(47 vol% water in calico Hills tuff) x .815 18.5 vol% UO2 C 20-21-3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes С 1001.50c 2.561121-2 8016.50c 4.215845-2 11023.50c 2.834054-4 m1 22-23-24-25-26-12000.50c 1.665012-4 13027.50c 1.876796-3 14000.50c 8.211662-3 19000.50c 4.002067-4 20000.50c 4.099866-4 26000.55c 1.010513-4 92234.50c 1.085591-6 92235.50c 8.845975-5 92236.50c 2.116674-5 92238.50c 4.406469-3 93237.50c 5.048015-6 mt1 lwtr.01t 27-28-30 vol% water in calico Hills tuff 1001.50c 3.142479-2 8016.50c 4.063067-2 11023.50c 3.477367-4 С m2 29-30-12000.50c 2.042960-4 13027.50c 2.302817-3 14000.50c 1.007566-2 19000.50c 4.910511-4 20000.50c 5.030511-4 26000.55c 1.239894-4 31lwtr.01t mt2 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H2O/ 18.5% UO2 (s3020me) probid = 04/30/96 18:00:32 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 25 cycles and run a total of 75 cycles with nominally this problem has run 25 inactive cycles with 100297 neutron histories and 50 active cycles with 4000 neutrons per cycle. 199475 neutron histories. this calculation has completed the requested number of keff cycles using a total of 299772 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .97870 with an estimated standard deviation of .00143

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the estimated 68, 95, & 99 percent keff confidence intervals are .97726 to .98014, .97582 to .98159, and .97486 to .98255 the estimated collision/absorption neutron removal lifetime = 7.34E-05 seconds with an estimated standard deviation of 3.99E-07 May 23 10:40 1996 File Name: s3020md.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXIII - Page 1

1mcnp version 4a ld=10/01/93 04/26/96 18:52:57 probid = 04/26/96 18:52:57 INP=s3020md OUTP=s3020md0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H2O/ 18.5% UO2 (s3020mc) 1 -Calico Hills Tuff 1.137 g/cc .47 porosity - sphere surrounded by tuff 2-С 3-С CELL SPECIFICATIONS 4 -С INNER WATER REGION 5 -8.374149-2 -1 1 1 IMP:N=1 8.610406-2 1 -2 IMP:N=1 6-2 2 7-С OUTSIDE WORLD 8-0 2 IMP:N=0 3 **9**-SURFACE SPECIFICATIONS 10-С 11-SO 61 **\$** INNER FUEL ZONE SO 121 12-2 **\$** INNER FUEL ZONE 13-MODE N 14 -15 -KCODE 4000 1. 25 75 KSRC 001 0010 00-20 0029 02015 00-55 -100-40 16-С 17-0 -50 -20 -30 0 -13 0 -10 60 0 0 -25 -30 -15 -56 5 5 0 10 30 17 C 18-С MATERIAL SPECIFICATIONS 19-(47 vol% water in calico Hills tuff) x .815 18.5 vol% UO2 С 3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes 20-С 21-22-23-24-25-26-27-28m1 1001.50c 2.561121-2 8016.50c 4.215845-2 11023.50c 2.834054-4 12000.50c 1.665012-4 13027.50c 1.876796-3 14000.50c 8.211662-3 20000.50c 4.099866-4 26000.55c 1.010513-4 92235.50c 8.845975-5 92236.50c 2.116674-5 19000.50c 4.002067-4 92234.50c 1.085591-6 92238.50c 4.406469-3 93237.50c 5.048015-6 mt1 lwtr.01t 30 vol% water in calico Hills tuff 1001.50c 3.142479-2 8016.50c 4.063067-2 11023.50c 3.477367-4 С m2 29-12000.50c 2.042960-4 13027.50c 2.302817-3 14000.50c 1.007566-2 30-19000.50c 4.910511-4 20000.50c 5.030511-4 26000.55c 1.239894-4 31mt2 lwtr.01t 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H2O/ 18.5% UO2 (s3020mc) probid = 04/26/96 18:52:57 the initial fission neutron source distribution was read from the srctp file named srctp . the criticality problem was scheduled to skip 25 cycles and run a total of 75 cycles with nominally this problem has run 25 inactive cycles with 100232 neutron histories and 50 active cycles with 4000 neutrons per cycle. 199265 neutron histories. this calculation has completed the requested number of keff cycles using a total of 299497 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .99496 with an estimated standard deviation of .00137
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the estimated 68, 95, & 99 percent keff confidence intervals are .99359 to .99634, .99221 to .99771, and .99129 to .99863 the estimated collision/absorption neutron removal lifetime = 6.96E-05 seconds with an estimated standard deviation of 3.58E-07 May 23 10:37 1996 File Name: s3020mb.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXIV - Page 1

04/26/96 17:18:56 1mcno version 4a Ld=10/01/93 ************** nrobid = 04/26/96 17:18:56 INP=s3020mb OUTP=s3020mb0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H20/ 18.5% U02 (s3020mb) Calico Hills Tuff 1.137 g/cc .47 porosity - sphere surrounded by tuff 2-С 3-C CELL SPECIFICATIONS 4-C INNER WATER REGION 5-1 1 8.374149-2 -1 IMP:N=1 2 8.610406-2 1 -2 IMP:N=1 6-7-2 OUTSIDE WORLD С 8-3 0 2 IMP:N=0 9-10-С SURFACE SPECIFICATIONS 11-SO 70 **\$** INNER FUEL ZONE 12-13-Ż SO 130 **\$ INNER FUEL ZONE** 14 -MODE N 15-KCODE 4000 1. 25 75 16-KSRC 001 0010 00-20 0029 02015 00-55 -100-40 C 17-0 -50 -20 -30 0 -13 0 -10 60 0 0 -25 -30 -15 -56 5 5 0 10 30 17 C 18-С MATERIAL SPECIFICATIONS 19-(47 vol% water in calico Hills tuff) x .815 18.5 vol% UO2 C 3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes 1001.50c 2.561121-2 8016.50c 4.215845-2 11023.50c 2.834054-4 2000.50c 1.665012-4 13027.50c 1.876796-3 14000.50c 8.211662-3 20-21-22-23-23-25-26-27-28-29-30c m1 12000.50c 1.665012-4 20000.50c 4.099866-4 26000.55c 1.010513-4 92235.50c 8.845975-5 92236.50c 2.116674-5 19000.50c 4.002067-4 92234.50c 1.085591-6 92238.50c 4.406469-3 93237.50c 5.048015-6 lwtr.01t mt1 30 vol% water in calico Hills tuff 1001.50c 3.142479-2 8016.50c 4.063067-2 11023.50c 3.477367-4 m2 12000.50c 2.042960-4 13027.50c 2.302817-3 14000.50c 1.007566-2 19000.50c 4.910511-4 20000.50c 5.030511-4 26000.55c 1.239894-4 31mt2 lwtr.01t 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H2O/ 18.5% UO2 (s3020mb) 04/26/96 17:18:56 probid = the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 25 cycles and run a total of 75 cycles with nominally this problem has run 25 inactive cycles with 100201 neutron histories and 50 active cycles with 4000 neutrons per cycle. 199091 neutron histories. this calculation has completed the requested number of keff cycles using a total of 299292 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.02021 with an estimated standard deviation of .00158

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the estimated 68, 95, & 99 percent keff confidence intervals are 1.01862 to 1.02179, 1.01704 to 1.02338, and 1.01598 to 1.02444 the estimated collision/absorption neutron removal lifetime = 6.38E-05 seconds with an estimated standard deviation of 2.57E-07

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May 23 10:12 1996 File Name: s3020ma.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXV - Page 1

version 4a ld=10/01/93 04/26/96 16:36:42 1mcnp ************** probid = 04/26/96 16:36:42 INP=s3020ma OUTP=s3020ma0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H20/ 18.5% UO2 (s3020ma) Calico Hills Tuff 1.137 g/cc .47 porosity - sphere surrounded by tuff 2-С 3-С CELL SPECIFICATIONS 4 -5 -С INNER WATER REGION 1 1 8.374149-2 -1 IMP + N=1 6-7-8-2 8.610406-2 1 -2 IMP:N=1 2 С OUTSIDE WORLD 3 0 2 IMP:N=0 9. 10-C SURFACE SPECIFICATIONS 11-SO 77 **\$** INNER FUEL ZONE 12-13so 137 2 **\$ INNER FUEL ZONE** 14 -15 -16 -MODE N KCODE 4000 1. 25 75 KSRC 001 0010 00-20 0029 02015 00-55 -100-40 C 17-0 -50 -20 -30 0 -13 0 -10 60 0 0 -25 -30 -15 -56 5 5 0 10 30 17 C 18-C MATERIAL SPECIFICATIONS 19-(47 vol% water in calico Hills tuff) x .815 18.5 vol% UO2 С 20 -21 -22 -23 -24 -25 -26 -27 -28 -28 -29 -30 -3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes С m1 1001.50c 2.561121-2 8016.50c 4.215845-2 11023.50c 2.834054-4 12000.50c 1.665012-4 13027.50c 1.876796-3 14000.50c 8.211662-3 19000.50c 4.002067-4 20000.50c 4.099866-4 26000.55c 1.010513-4 92235.50c 8.845975-5 92236.50c 2.116674-5 92234.50c 1.085591-6 92238.50c 4.406469-3 93237.50c 5.048015-6 mt1 lwtr.01t 30 vol% water in calico Hills tuff С m2 1001.50c 3.142479-2 8016.50c 4.063067-2 11023.50c 3.477367-4 12000.50c 2.042960-4 13027.50c 2.302817-3 14000.50c 1.007566-2 19000.50c 4.910511-4 20000.50c 5.030511-4 26000.55c 1.239894-4 31mt2 lwtr.01t 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H2O/ 18.5% UO2 (s3020ma) probid ≃ 04/26/96 16:36:42 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 25 cycles and run a total of 75 cycles with nominally this problem has run 25 inactive cycles with 100226 neutron histories and 50 active cycles with 4000 neutrons per cycle. 199837 neutron histories. this calculation has completed the requested number of keff cycles using a total of 300063 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points.

the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are:

the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

the final estimated combined collision/absorption/track-length keff = 1.02899 with an estimated standard deviation of .00119

May 23 10:12 1996 File Name: s3020ma.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXV - Page 2

the estimated 68, 95, & 99 percent keff confidence intervals are 1.02779 to 1.03018, 1.02660 to 1.03138, and 1.02580 to 1.03218 the estimated collision/absorption neutron removal lifetime = 6.05E-05 seconds with an estimated standard deviation of 2.69E-07 May 23 10:51 1996 File Name: s3020ca.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXVI - Page 1

1mcnp version 4a ld=10/01/93 05/03/96 16:29:24 ---probid = 05/03/96 16:29:24 INP=s3020oa OUTP=s3020oa0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H20/ 17% U02 (s3020oa) 1 ż-С Calico Hills Tuff 1.5095 g/cc .40 porosity - sphere surrounded by tuff 3-C CELL SPECIFICATIONS 4 -INNER WATER REGION C 5 -1 8.237774-2 - 1 IMP:N=1 1 6-7-2 2 8.423019-2 1 -2 IMP:N=1 C OUTSIDE WORLD 8-3 0 2 IMP:N=0 ō. 10-С SURFACE SPECIFICATIONS 11-SO 60 **\$** INNER FUEL ZONE 12-13-2 SO 120 **\$ INNER FUEL ZONE** 14-MODE N 15 -KCODE 4000 1. 40 240 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 16-C 17-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 18-MATERIAL SPECIFICATIONS С 19-(40 vol% water in calico Hills tuff) x .83 17 vol% UO2 С 20-3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes С 21-22-23-24m1 1001.50c 2.219794-2 8016.50c 4.282386-2 11023.50c 3.267412-4 12000.50c 1.919611-4 13027.50c 2.163779-3 14000.50c 9.467317-3 19000.50c 4.614027-4 20000.50c 4.726782-4 92234.50c 9.975705-7 92235.50c 8.128734-5 26000.55c 1.165032-4 92236.50c 1.945052-5 25 -92238.50c 4.049188-3 93237.50c 4.638717-6 26mt1 lwtr.01t 27-40 vol% water in calico Hills tuff • 28-29m2 1001.50c 2.674450-2 8016.50c 4.158162-2 11023.50c 3.936641-4 12000.50c 2.312785-4 13027.50c 2.606963-3 14000.50c 1.140641-2 30-19000.50c 5.559069-4 20000.50c 5.694918-4 26000.55c 1.403653-4 31lwtr.01t mt2 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 17% UO2 (s3020oa) probid = 05/03/96 16:29:24 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 40 cycles and run a total of 240 cycles with nominally 4000 neutrons per cycle. this problem has run 40 inactive cycles with 160615 neutron histories and 200 active cycles with 801227 neutron histories. this calculation has completed the requested number of keff cycles using a total of 961842 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .95784 with an estimated standard deviation of .00072

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the estimated 68, 95, & 99 percent keff confidence intervals are .95712 to .95855, .95641 to .95927, and .95594 to .95973 the estimated collision/absorption neutron removal lifetime = 8.01E-05 seconds with an estimated standard deviation of 1.94E-07 May 23 10:53 1996 File Name: s3020ob.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXVII - Page 1

imcnp version 4a ld=10/01/93 05/03/96 19:46:17 *********** probid = 05/03/96 19:46:17 INP=s3020ob OUTP=s3020ob0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 17% UO2 (s3020ob) 2-Calico Hills Tuff 1.5095 g/cc .40 porosity - sphere surrounded by tuff С 3-С CELL SPECIFICATIONS INNER WATER REGION 4-С 1 8.237774-2 -1 IMP:N=1 2 8.423019-2 1 -2 IMP:N=1 5 -1 6-2 7-С OUTSIDE WORLD 8-Ĵ 0 2 IMP:N=0 9-10-С SURFACE SPECIFICATIONS 11-SO 65 **\$** INNER FUEL ZONE SO 125 12-2 **\$** INNER FUEL ZONE 13-14-MODE N KCODE 4000 1. 40 240 15 -KSRC 001 0010 00-20 0029 0205 00-5 -100-10 16-C 17-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 С 18-С MATERIAL SPECIFICATIONS 19-(40 vol% water in calico Hills tuff) x .83 17 vol% UO2 С 3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes 20-С 1001.50c 2.219794-2 8016.50c 4.282386-2 11023.50c 3.267412-4 12000.50c 1.919611-4 13027.50c 2.163779-3 14000.50c 9.467317-3 21-22-23-24-25-26-27-28-29m1 19000.50c 4.614027-4 20000.50c 4.726782-4 26000.55c 1.165032-4 92234.50c 9.975705-7 92235.50c 8.128734-5 92236.50c 1.945052-5 92238.50c 4.049188-3 93237.50c 4.638717-6 mt1 lwtr.01t 40 vol% water in calico Hills tuff **c** 1001.50c 2.674450-2 8016.50c 4.158162-2 11023.50c 3.936641-4 12000.50c 2.312785-4 13027.50c 2.606963-3 14000.50c 1.140641-2 m2 30-19000.50c 5.559069-4 20000.50c 5.694918-4 26000.55c 1.403653-4 31lwtr.01t mt2 32-PRINT 1 initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 17% UO2 (s3020ob) probid = 05/03/96 19:46:17 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 40 cycles and run a total of 240 cycles with nominally this problem has run 40 inactive cycles with 160174 neutron histories and 200 active cycles with 4000 neutrons per cycle. 798926 neutron histories. this calculation has completed the requested number of keff cycles using a total of 959100 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. warning. there appears to be decreasing trend in the average col/abs/tl keff estimator over the last 10 active cycles. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .97469 with an estimated standard deviation of .00069

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the estimated 68, 95, & 99 percent keff confidence intervals are .97399 to .97538, .97331 to .97607, and .97286 to .97652 the estimated collision/absorption neutron removal lifetime = 7.53E-05 seconds with an estimated standard deviation of 1.85E-07

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May 23 10:55 1996 File Name: s3020oc.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXVIII - Page 1

1mcnp version 4a ld=10/01/93 05/03/96 22:25:22 ************* probid = 05/03/96 22:25:22 INP=s3020oc OUTP=s3020oc0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H20/ 17% U02 (s3020oc) Calico Hills Tuff 1.5095 g/cc .40 porosity - sphere surrounded by tuff 2-С 3-С CELL SPECIFICATIONS 4 -С INNER WATER REGION 5 -1 8.237774-2 -1 1 IMP:N=1 8.423019-2 1 -2 IMP:N=1 6-2 2 7-OUTSIDE WORLD C Ĵ 0 2 IMP:N=0 8-9-SURFACE SPECIFICATIONS 10-С 11-SO 70 **\$ INNER FUEL ZONE** 1 SO 130 12-2 **\$** INNER FUEL ZONE 13-14-MODE N 15-KCODE 4000 1. 40 240 KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 5 0 0 -5 -10 0 -10 16-С 17-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 С 18-MATERIAL SPECIFICATIONS С 19-(40 vol% water in calico Hills tuff) x .83 17 vol% UO2 С 20-3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes С 1001.50c 2.219794-2 8016.50c 4.282386-2 11023.50c 3.267412-4 2000.50c 1.919611-4 13027.50c 2.163779-3 14000.50c 9.467317-3 21-22-23-24-25-26-27-28m1 12000.50c 1.919611-4 20000.50c 4.726782-4 26000.55c 1.165032-4 92235.50c 8.128734-5 92236.50c 1.945052-5 19000.50c 4.614027-4 92234.50c 9.975705-7 92238.50c 4.049188-3 93237.50c 4.638717-6 mt1 lwtr.01t 40 vol% water in calico Hills tuff 1001.50c 2.674450-2 8016.50c 4.158162-2 11023.50c 3.936641-4 12000.50c 2.312785-4 13027.50c 2.606963-3 14000.50c 1.140641-2 C m2 29-30-19000.50c 5.559069-4 20000.50c 5.694918-4 26000.55c 1.403653-4 31lwtr.01t mt2 32 -PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 17% UO2 (s3020oc) 05/03/96 22:25:22 probid = the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 40 cycles and run a total of 240 cycles with nominally this problem has run 40 inactive cycles with 159913 neutron histories and 200 active cycles with 4000 neutrons per cycle. 800364 neutron histories. this calculation has completed the requested number of keff cycles using a total of 960277 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .98732 with an estimated standard deviation of .00074

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the estimated 68, 95, & 99 percent keff confidence intervals are .98657 to .98806, .98583 to .98880, and .98535 to .98929 the estimated collision/absorption neutron removal lifetime = 7.18E-05 seconds with an estimated standard deviation of 1.74E-07 May 23 11:05 1996 File Name: s3020od.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXIX - Page 1

1mcnp version 4a ld=10/01/93 05/04/96 01:00:16 ---probid = 05/04/96 01:00:16 INP=s3020od OUTP=s3020od0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H20/ 17% U02 (s3020od) Calico Hills Tuff 1.5095 g/cc .40 porosity - sphere surrounded by tuff 2-С 3-С CELL SPECIFICATIONS 4 -С INNER WATER REGION 1 8.237774-2 -1 IMP:N=1 2 8.423019-2 1 -2 IMP:N=1 5-6-2 7-OUTSIDE WORLD С 8-3 0 2 IMP:N=0 ġ. SURFACE SPECIFICATIONS 10-С 11-SO 75 **\$** INNER FUEL ZONE 12-2 SO 135 **\$** INNER FUEL ZONE 13-14-MODE N KCODE 4000 1. 40 240 15 -KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 5 0 0 -5 -10 0 -10 16-С 17-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 18-MATERIAL SPECIFICATIONS С 19-(40 vol% water in calico Hills tuff) x .83 17 vol% UO2 С 20-3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes C 1001.50c 2.219794-2 8016.50c 4.282386-2 11023.50c 3.267412-4 21 -22 -23 -24 -25 -26 -27 -28 m1 12000.50c 1.919611-4 13027.50c 2.163779-3 14000.50c 9.467317-3 19000.50c 4.614027-4 20000.50c 4.726782-4 26000.55c 1.165032-4 92234.50c 9.975705-7 92235.50c 8.128734-5 92236.50c 1.945052-5 92238.50c 4.049188-3 93237.50c 4.638717-6 lwtr.01t mt1 40 vol% water in calico Hills tuff C m2 1001.50c 2.674450-2 8016.50c 4.158162-2 11023.50c 3.936641-4 12000.50c 2.312785-4 13027.50c 2.606963-3 14000.50c 1.140641-2 29-30-19000.50c 5.559069-4 20000.50c 5.694918-4 26000.55c 1.403653-4 31mt2 lwtr.01t 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 17% UO2 (s3020od) 05/04/96 01:00:16 probid = the initial fission neutron source distribution was read from the srctp file named srctp the critical lisy problem was scheduled to skip 40 cycles and run a total of 240 cycles with nominally this problem has run 40 inactive cycles with 160078 neutron histories and 200 active cycles with 4000 neutrons per cycle. 799513 neutron histories. this calculation has completed the requested number of keff cycles using a total of 959591 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .99855 with an estimated standard deviation of .00072

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the estimated 68, 95, & 99 percent keff confidence intervals are .99783 to .99927, .99711 to .99999, and .99664 to 1.00046 the estimated collision/absorption neutron removal lifetime = 6.87E-05 seconds with an estimated standard deviation of 1.63E-07 May 23 11:06 1996 File Name: s3020oe.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXX - Page 1

1mcnp version 4a ld=10/01/93 05/04/96 03:37:08 probid = 05/04/96 03:37:08 INP=s3020oe OUTP=s3020oe0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H20/ 17% U02 (s3020oe) 2-Calico Hills Tuff 1.5095 g/cc .40 porosity - sphere surrounded by tuff С 3-C CELL SPECIFICATIONS 4-5-67-С INNER WATER REGION 1 8.237774-2 -1 IMP:N=1 2 8.423019-2 1 -2 IMP:N=1 2 С OUTSIDE WORLD 8-0 2 IMP:N=0 3 9. 1Ó-11-SURFACE SPECIFICATIONS C SO 80 **\$** INNER FUEL ZONE 12-13-2 SO 140 **\$ INNER FUEL ZONE** 14-15-MODE N KCODE 4000 1. 40 240 16-17-KSRC 001 0010 00-20 0029 0205 00-5 -100-10 C 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 С 18-MATERIAL SPECIFICATIONS С 19-(40 vol% water in calico Hills tuff) x .83 17 vol% UO2 С 20-3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes С 1001.50c 2.219794-2 8016.50c 4.282386-2 11023.50c 3.267412-4 12000.50c 1.919611-4 13027.50c 2.163779-3 14000.50c 9.467317-3 21-22+ 23-24-25-26-27-28m1 19000.50c 4.614027-4 20000.50c 4.726782-4 26000.55c 1.165032-4 92234.50c 9.975705-7 92235.50c 8.128734-5 92236.50c 1.945052-5 92238.50c 4.049188-3 93237.50c 4.638717-6 mt1 lwtr.01t 40 vol% water in calico Hills tuff 1001.50c 2.674450-2 8016.50c 4.158162-2 11023.50c 3.936641-4 С m2 29-12000.50c 2.312785-4 13027.50c 2.606963-3 14000.50c 1.140641-2 30-19000.50c 5.559069-4 20000.50c 5.694918-4 26000.55c 1.403653-4 31lwtr.01t mt2 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 17% UO2 (s3020oe) = bidora 05/04/96 03:37:08 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 40 cycles and run a total of 240 cycles with nominally this problem has run 40 inactive cycles with 160532 neutron histories and 200 active cycles with 4000 neutrons per cycle. 799503 neutron histories. this calculation has completed the requested number of keff cycles using a total of 960035 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 99 percent confidence level, but not at 95 percent the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.01003 with an estimated standard deviation of .00070

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the estimated 68, 95, & 99 percent keff confidence intervals are 1.00933 to 1.01073, 1.00864 to 1.01142, and 1.00819 to 1.01187 the estimated collision/absorption neutron removal lifetime = 6.55E-05 seconds with an estimated standard deviation of 1.56E-07

May 23 11:08 1996 File Name: s3020of.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXI - Page 1

version 4a ld=10/01/93 05/04/96 06:06:23 1mcnp probid = 05/04/96 06:06:23 INP=s3020of OUTP=s3020of0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 17% UO2 (s3020of) 1 -Calico Hills Tuff 1.5095 g/cc .40 porosity - sphere surrounded by tuff 2-С 3-С CELL SPECIFICATIONS 4-INNER WATER REGION С 1 8.237774-2 -1 IMP:N=1 2 8.423019-2 1 -2 IMP:N=1 5-1 6-2 7-OUTSIDE WORLD С 8-3 0 2 IMP:N=0 <u>9</u>-10-С SURFACE SPECIFICATIONS 11-SO 85 **\$** INNER FUEL ZONE 12-2 SO 145 **\$** INNER FUEL ZONE 13-14-MODE N 15-KCODE 4000 1. 40 240 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 16-C 17-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 18-MATERIAL SPECIFICATIONS С 19-(40 vol% water in calico Hills tuff) x .83 17 vol% UO2 С 3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes 20-С 21-1001.50c 2.219794-2 8016.50c 4.282386-2 11023.50c 3.267412-4 m1 22-23-24-12000.50c 1.919611-4 13027.50c 2.163779-3 14000.50c 9.467317-3 20000.50c 4.726782-4 26000.55c 1.165032-4 19000.50c 4.614027-4 92234.50c 9.975705-7 92235.50c 8.128734-5 92236.50c 1.945052-5 25 -92238.50c 4.049188-3 93237.50c 4.638717-6 26-27-28-29-30lwtr.01t mt1 40 vol% water in calico Hills tuff С 1001.50c 2.674450-2 8016.50c 4.158162-2 11023.50c 3.936641-4 12000.50c 2.312785-4 13027.50c 2.606963-3 14000.50c 1.140641-2 m2 19000.50c 5.559069-4 20000.50c 5.694918-4 26000.55c 1.403653-4 31lwtr.01t mt2 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 40% H2O/ 17% UO2 (s3020of) probid = 05/04/96 06:06:23 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 40 cycles and run a total of 240 cycles with nominally this problem has run 40 inactive cycles with 160496 neutron histories and 200 active cycles with 4000 neutrons per cycle. 800373 neutron histories. this calculation has completed the requested number of keff cycles using a total of 960869 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.01583 with an estimated standard deviation of .00071

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the estimated 68, 95, & 99 percent keff confidence intervals are 1.01512 to 1.01654, 1.01442 to 1.01724, and 1.01396 to 1.01770 the estimated collision/absorption neutron removal lifetime = 6.36E-05 seconds with an estimated standard deviation of 1.45E-07

May 20 07:08 1996 File Name: C1-3.0E-20GWD-30W15U BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXII -. Page 1 1mcnp 1d=10/01/93 04/30/96 20:36:50 version 4a ************** probid = 04/30/96 20:36:50 INP=3E30.9C OUTP=3E3.9C.0 1 -FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 15% U-Np 02 2-C .90 k-eff Critical Radius 3-С 4 -С SPHERE 5-7.99453114353-2 1 IMP:N=1 \$ Uranium/Tuff/Water 6-5 8.11121144000-2 1 -2 IMP:N=1 \$ Tuff/Water Reflector 3 7-С 8-C OUTSIDE WORLD **9**-30 0 2 IMP:N=0 \$ Void 10-11-C SURFACES 12-000 59.00 **\$** FISSILE SPHERE 1 S warning. this surface has been replaced by a surface of type so 13-0 0 0 119.00 \$ REFLECTOR 2 S 14 warning. this surface has been replaced by a surface of type so 15-16-MODE N 17-KCODE 500 1 3 1003 18-KSRC 0 0 0 0 0 0 0 0 1 0 0 -1 0 0 С 1 -1 0 1 0 19-1 0 1 -1 0 1 0 1 0 -1 C 1 20--1 -1 Ó -1 0 -1 - 1 n 0 -1 C 1 -1 21-Ω 0 -1 Ω 0 -1 -1 C 1 1 - 1 -1 1 22-23-24-C 1 1 -1 1 -1 -1 1 -1 -1 -1 - 1 92234.50C 8.802093-7 92235.50C 7.172412-5 92236.50C 1.716222-5 M1 \$ Fi 93237.500 4.092986-6 92238.50C 3.572813-3 8016.50C 4.359266-2 \$ At 25-1001.50C 1.704962-2 \$ an 26-27-28-29-14000.500 1.121440-2 13027.50C 2.563079-3 \$ Ca 12000.50C 2.273853-4 19000.50C 5.465492-4 26000.55C 1.380025-4 20000.50C 5.599054-4 \$ Wi 11023.500 3.870375-4 \$ 30 MT1 LWTR.01T \$ Wa 30-\$ Ca M3 1001.50C 2.005838-2 14000.50C 1.319341-2 13027.50C 3.015387-3 Ś 31-8016.50C 4.265802-2 Wi 32-26000.55C 1.623559-4 12000.50C 2.675121-4 20000.50C 6.587122-4 \$ 30 33-11023.50C 4.553382-4 19000.50C 6.429990-4 \$ 34-MT3 LWTR.01T \$ Wa 35 -PRINT 1 initial source from file srctp 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 15% U-Np 02 04/30/96 20:36:50 probid = the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem_was scheduled to skip 3 cycles and run a total of 1003 cycles with nominally 500 neutrons per cycle. this problem has run 3 inactive cycles with 1415 neutron histories and 1000 active cycles with 499868 neutron histories. this calculation has completed the requested number of keff cycles using a total of 501283 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

May 20 07:08 1996 File Name: C1-3.0E-20GWD-30W15U BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXII - Page 2

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the final estimated combined collision/absorption/track-length keff = .89801 with an estimated standard deviation of .00092 the estimated 68, 95, & 99 percent keff confidence intervals are .89709 to .89893, .89618 to .89983, and .89559 to .90043 the estimated collision/absorption neutron removal lifetime = 9.78E-05 seconds with an estimated standard deviation of 2.89E-07

ld=10/01/93 05/01/96 21:33:51 1mcnp version 4a probid = 05/01/96 21:33:51 INP=3E30.9C OUTP=3E.9C.0 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 15% U-Np 02 1-2 -С .985 k-eff Critical Radius 3-С 4 -С SPHERE 5-7.99453114353-2 1 IMP:N=1 \$ Uranium/Tuff/Water 5 8.11121144000-2 1 - 2 \$ Tuff/Water Reflector 6-3 IMP:N=1 7-C 8-OUTSIDE WORLD C 9-30 0 2 IMP:N=0 \$ Void 10-C 11-SURFACES 0 0 0 97.86 **\$** FISSILE SPHERE 12-1 S warning. this surface has been replaced by a surface of type so 13-2 S 0 0 0 157.86 \$ REFLECTOR 14 this surface has been replaced by a surface of type so warning. 15 -16-MODE N KCODE 500 17-1 3 1003 Ö 0 18-С KSRC 0 0 0 -1 0 0 0 1 0 0 -1 0 0 0 1 0 1 0 0 - 1 19-С 1 0 1 - 1 0 1 1 1 20-0 - 1 0 0 1 -1 0 -1 С - 1 - 1 -1 - 1 21-22-23-24-25-С 0 0 0 0 -1 -1 - 1 1 - 1 1 - 1 1 С - 1 -1 -1 1 -1 -1 -1 - 1 - 1 1 1 92234.500 8.802093-7 92235.50C 7.172412-5 92236.50C 1.716222-5 M1 \$ Fi 93237.50C 4.092986-6 92238.500 3.572813-3 8016.50C 4.359266-2 \$ At 1001.50C 1.704962-2 \$ an 26-14000.500 1.121440-2 13027.50c 2.563079-3 \$ Ca 26000.550 1.380025-4 27-12000.500 2.273853-4 20000.50C 5.599054-4 \$ Wi 28-11023.50c 3.870375-4 19000.50c 5.465492-4 \$ 30 29-30-MT1 LWTR.01T \$ Wa \$ Ca M3 1001.50C 2.005838-2 14000.50C 1.319341-2 13027.50C 3.015387-3 31-8016.50C 4.265802-2 \$ Wi 32-26000.55C 1.623559-4 \$ 30 12000.50C 2.675121-4 20000.50C 6.587122-4 33 -11023.50C 4.553382-4 19000.50C 6.429990-4 34-MT3 LWTR.01T \$ Wa 35 -PRINT 1 initial source from file srctp 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 15% U-Np 02 probid = 05/01/96 21:33:51 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 3 cycles and run a total of 1003 cycles with nominally 500 neutrons per cycle. this problem has run 3 inactive cycles with 1762 neutron histories and 1000 active cycles with 499963 neutron histories. this calculation has completed the requested number of keff cycles using a total of 501725 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

May 17 14:36 1996 File Name: C2-3.0E-20GWD-30W15U BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXIII - Page 1

May 17 14:36 1996 File Name: C2-3.0E-20GWD-30W15U BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXIII - Page 2

the final estimated combined collision/absorption/track-length keff = .98461 with an estimated standard deviation of .00089 the estimated 68, 95, & 99 percent keff confidence intervals are .98372 to .98549, .98284 to .98637, and .98226 to .98695 the estimated collision/absorption neutron removal lifetime = 6.95E-05 seconds with an estimated standard deviation of 2.15E-07 Jun 10 10:37 1996 File Name: s3020a.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXIV - Page 1

ld=10/01/93 05/02/96 13:44:17 1mcnp version 4a *********** probid = 05/02/96 13:44:17 inp=s3020a outp=s3020a0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 30% H20/ 15% UO2 (s3020a) 1 -2-С Calico Hills Tuff 1.746 g/cc .306 porosity - sphere surrounded by tuff 3-C CELL SPECIFICATIONS 4-С INNER WATER REGION 1 7.994531-2 5 -1 - 1 IMP:N=1 2 8.035742-2 1 -2 IMP:N=1 2 6-7-OUTSIDE WORLD C 8-3 0 2 IMP:N=0 9-10-С SURFACE SPECIFICATIONS 11-**\$** INNER FUEL ZONE 1 SO 103 12-2 SO 163 **\$ INNER FUEL ZONE** 13-14-MODE N 15-KCODE 4000 1. 20 75 KSRC 001 0010 00-20 0029 02015 00-55 -100-40 16-. С 17-0 -50 -20 -30 0 -13 0 -10 60 0 0 -25 -30 -15 -56 5 5 0 10 30 17 С 18-С MATERIAL SPECIFICATIONS 19-(30 vol% water in calico Hills tuff) x .85 .15 vol% UO2 C 20-21-3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes С m1 1001.50c 1.704962-2 8016.50c 4.359266-2 11023.50c 3.870375-4 22-23-24-25-26-12000.50c 2.273853-4 13027.50c 2.563079-3 14000.50c 1.121440-2 19000.50c 5.465492-4 20000.50c 5.599054-4 26000.55c 1.380025-4 92234.50c 8.802093-7 92235.50c 7.172412-5 92236.50c 1.716222-92236.50c 1.716222-5 92238.50c 3.572813-3 93237.50c 4.092986-6 mt1 lwtr.01t 27-30 vol% water in calico Hills tuff С 28m2 1001.50c 3.142479-2 8016.50c 3.695585-2 11023.50c 2.964542-4 29-12000.50c 1.741675-4 13027.50c 1.963209-3 14000.50c 8.589752-3 19000.50c 4.186334-4 20000.50c 4.288637-4 26000.55c 1.057041-4 30-31lwtr.01t mt2 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 30% H2O/ 15% UO2 (s3020a) probid = 05/02/96 13:44:17 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 20 cycles and run a total of 75 cycles with nominally this problem has run 20 inactive cycles with 80438 neutron histories and 55 active cycles with 4000 neutrons per cycle. 219449 neutron histories. this calculation has completed the requested number of keff cycles using a total of 299887 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

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the final estimated combined collision/absorption/track-length keff = .98934 with an estimated standard deviation of .00137

Jun 10 10:37 1996 File Name: s3020a.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXIV - Page 2

the estimated 68, 95, & 99 percent keff confidence intervals are .98796 to .99071, .98658 to .99209, and .98567 to .99300 the estimated collision/absorption neutron removal lifetime = 6.49E-05 seconds with an estimated standard deviation of 2.47E-07 May 20 07:16 1996 File Name: C4-3.0E-20GWD-30W15U BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXV - Page 1

ld=10/01/93 04/18/96 13:17:28 1mcnp version 4a ***** probid = 04/18/96 13:17:28 INP=3.0EC OUTP=3.0E.CO 1-FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 15% U-Np 02 2-С Critical Radius 3-С 4-C SPHERE 5 -7.99453114353-2 IMP:N=1 - 1 \$ Uranium/Tuff/Water 1 6-5 8.11121144000-2 1 - 2 \$ Tuff/Water Reflector 3 IMP:N=1 **7**-C 8-С OUTSIDE WORLD 9-30 0 2 IMP:N=0 \$ Void 10-11-С SURFACES 12-1 S 0 0 0 113.15 **\$** FISSILE SPHERE warning. this surface has been replaced by a surface of type so 0 0 0 173.15 13-2 S **\$** REFLECTOR 14warning. this surface has been replaced by a surface of type so 15 -16-MODE N 17-KCODE 2000 1 13 138 KSRC 0 0 0 0 0 18-С 0 -1 0 0 1 0 0 - 1 00 1 1 0 0 19-0 1 -1 0 0 1 0 -1 С 1 1 1 1 20-0 -1 -1 -1 0 -1 0 -1 С - 1 1 0 1 21-0 0 - 1 0 1 - 1 0 С 1 1 1 -1 -1 ŽŻ-С 1 1 -1 1 1 -1 -1 1 -1 -1 -1 92234.50c 8.802093-7 92235.50c 7.172412-5 92236.50c 1.716222-5 23-M1 \$ Fi 24 -25 -26 -27 -92238.50C 3.572813-3 93237.50C 4.092986-6 8016.50C 4.359266-2 \$ At 1001.500 1.704962-2 \$ an 14000.50C 1.121440-2 13027.50C 2.563079-3 \$ Ca 26000.55C 1.380025-4 12000.50C 2.273853-4 20000.50C 5.599054-4 \$ Wi 28-11023.50C 3.870375-4 19000.50C 5.465492-4 \$ 30 29-30-MT 1 LWTR.01T \$ Wa M3. 1001.50C 2.005838-2 14000.50C 1.319341-2 13027.50C 3.015387-3 \$ Ca 31-8016.50C 4.265802-2 26000.55C 1.623559-4 12000.50C 2.675121-4 \$ Wi 32-20000.50C 6.587122-4 \$ 30 33-11023.50C 4.553382-4 19000.50C 6.429990-4 2 34 -MT3 LWTR.01T \$ Wa 35 -PRINT initial source from file srctp 1 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 15% U-Np 02 probid = 04/18/96 13:17:28 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 13 cycles and run a total of 138 cycles with nominally this problem has run 13 inactive cycles with 25682 neutron histories and 125 active cycles with 2000 neutrons per cycle. 250101 neutron histories. this calculation has completed the requested number of keff cycles using a total of 275783 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

May 20 07:16 1996 File Name: C4-3.0E-20GWD-30W15U BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXV - Page 2

the final estimated combined collision/absorption/track-length keff = .99847 with an estimated standard deviation of .00118 the estimated 68, 95, & 99 percent keff confidence intervals are .99729 to .99965, .99612 to 1.00082, and .99535 to 1.00159 the estimated collision/absorption neutron removal lifetime = 6.44E-05 seconds with an estimated standard deviation of 2.63E-07

ld=10/01/93 1mcnp version 4a 04/18/96 15:05:39 ************* probid = 04/18/96 15:05:39 INP=3.0EC OUTP=3.0E.CO FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 15% U-Np 02 1 -2 -С Critical Radius 3-С **4** -С SPHERE 5-7.99453114353-2 1 IMP:N=1 \$ Uranium/Tuff/Water 8.11121144000-2 6-IMP:N=1 5 3 1 - 2 \$ Tuff/Water Reflector 7-С 8-С OUTSIDE WORLD 9-30 Ω 2 IMP:N=0 \$ Void 10-11-C SURFACES 0 0 0 114.51 12-S **\$** FISSILE SPHERE -1 warning. this surface has been replaced by a surface of type so 13-0 0 0 174.51 **\$** REFLECTOR 2 S 14warning. this surface has been replaced by a surface of type so 15 -16-MODE N 17-**KCODE 2000** 1 13 138 18-C KSRC 0 0 0 1 0 0 - 1 0 n 0 1 0 0 -1 0 0 0 1 0 19-1 n - 1 0 1 0 1 0 - 1 C 1 1 1 20-C - 1 1 0 -1 -1 0 - 1 0 -1 0 -1 1 21-22-23-24-25-26-27-28-С 0 1 1 0 - 1 1 0 1 - 1 0 -1 -1 -1 1 -1 -1 1 -1 -1 -1 C 1 1 1 92234.50C 8.802093-7 92235.50C 7.172412-5 92236.50C 1.716222-5 М1 \$ Fi 92238.50C 3.572813-3 93237.50C 4.092986-6 8016.50C 4.359266-2 \$ At 1001.50C 1.704962-2 \$ an 14000.50C 1.121440-2 13027.50C 2.563079-3 \$ Ca 12000.50C 2.273853-4 26000.55C 1.380025-4 20000.50C 5.599054-4 S Wi 11023.50C 3.870375-4 19000.500 5.465492-4 \$ 30 29-MT1 LWTR.01T \$ Wa 30-1001.50C 2.005838-2 14000.50C 1.319341-2 13027.50C 3.015387-3 \$ Ca M3 31-8016.500 4.265802-2 \$ Vi 32-26000.550 1.623559-4 12000.50C 2.675121-4 20000.500 6.587122-4 \$ 30 33-11023.50C 4.553382-4 19000.50C 6.429990-4 \$ 34-MT3 LWTR.01T \$ Wa 35 -PRINT 1 initial source from file srctp 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 15% U-Np 02 probid ≠ 04/18/96 15:05:39 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem_was scheduled to skip 13 cycles and run a total of 138 cycles with nominally 2000 neutrons per cycle. 25772 neutron histories and 125 active cycles with this problem has run 13 inactive cycles with 249934 neutron histories. this calculation has completed the requested number of keff cycles using a total of 275706 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

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May 20 07:19 1996 File Name: C5-3.0E-20GWD-30W15U BBA000000-01717-0200-00016 REV 00

May 20 07:19 1996 File Name: C5-3.0E-20GWD-30W15U BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXVI - Page 2

the final estimated combined collision/absorption/track-length keff = .99925 with an estimated standard deviation of .00127 the estimated 68, 95, & 99 percent keff confidence intervals are .99798 to 1.00053, .99672 to 1.00179, and .99590 to 1.00261 the estimated collision/absorption neutron removal lifetime = 6.41E-05 seconds with an estimated standard deviation of 2.55E-07 May 20 07:13 1996 File Name: C6-3.0E-20GWD-30W15U BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXVII - Page 1

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ld=10/01/93 04/18/96 12:22:24 1mcnp version 4a probid = 04/18/96 12:22:24 INP=3.0EC OUTP=3.0E.CO FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 15% U-Np 02 2-С Critical Radius 3-С 4 -С SPHERE 5-7.99453114353-2 IMP:N=1 \$ Uranium/Tuff/Water 1 6-7-8.11121144000-2 1 -2 \$ Tuff/Water Reflector 5 3 IMP:N=1 C 8-С OUTSIDE WORLD <u>9</u>-30 0 2 IMP:N=0 **\$** Void 10-11-С SURFACES 12 -S 0 0 0 123.15 **\$** FISSILE SPHERE warning. this surface has been replaced by a surface of type so \$ REFLECTOR 13-2 S 0 0 0 183.15 14 warning. this surface has been replaced by a surface of type so 15 -16-MODE N KCODE 2000 17-1 13 138 18-C KSRC 0 0 0 1 0 0 - 1 0 Ω 0 1 0 0 -1 0 0 0 1 0 19-C 1 n 1 - 1 0 1 0 1 1 0 - 1 1 20-C - 1 1 0 -1 -1 0 - 1 0 1 -1 0 -1 21-22-23-24-25-26-27-28-29--1 0 С 0 1 1 0 1 1 - 1 0 -1 -1 -1 -1 -1 - 1 1 -1 -1 1 С 1 1 -1 M1 92234.50C 8.802093-7 92235.50C 7.172412-5 92236.50C 1.716222-5 \$ Fi 92238.50C 3.572813-3 93237.50C 4.092986-6 8016.50C 4.359266-2 \$ At 1001.50C 1.704962-2 \$ an 13027.50C 2.563079-3 14000.50C 1.121440-2 \$ Ca 12000.50C 2.273853-4 20000.500 5.599054-4 26000.55C 1.380025-4 \$ Wi 11023.50C 3.870375-4 19000.50C 5.465492-4 \$ 30 \$ Wa MT1 LWTR.01T \$ Ca 30-M3 1001.50C 2.005838-2 14000.50C 1.319341-2 13027.50C 3.015387-3 31-32-8016.50C 4.265802-2 \$ Wi 26000.55c 1.623559-4 12000.50c 2.675121-4 20000.50C 6.587122-4 \$ 30 33-11023.50C 4.553382-4 19000.50C 6.429990-4 \$ 34-MT3 LWTR.01T \$ Wa 35 -PRINT initial source from file srctp 1 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 30% Water 15% U-Np 02 04/18/96 12:22:24 probid = the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 13 cycles and run a total of 138 cycles with nominally 2000 neutrons per cycle. this problem has run 13 inactive cycles with 26087 neutron histories and 125 active cycles with 249887 neutron histories. this calculation has completed the requested number of keff cycles using a total of 275974 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level

the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

May 20 07:13 1996 File Name: C6-3.0E-20GWD-30W15U BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXVII - Page 2

the final estimated combined collision/absorption/track-length keff = 1.00875 with an estimated standard deviation of .00116 the estimated 68, 95, & 99 percent keff confidence intervals are 1.00759 to 1.00992, 1.00644 to 1.01107, and 1.00568 to 1.01183 the estimated collision/absorption neutron removal lifetime = 6.17E-05 seconds with an estimated standard deviation of 2.64E-07

1mcnp version 4a ld=10/01/93 05/02/96 07:39:43 ******* probid = 05/02/96 07:39:43 inp=s30e12h outp=s30e12h0 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 С 2-Critical Size Optimization Confirmation 3-С 4-С SPHERE 5 -7.13439813085-2 IMP:N=1 \$ Uranium/Tuff/Water 1 7.10829224000-2 1 - 2 6-3 \$ Tuff/Water Reflector 5 IMP:N=1 Ž-С 8-OUTSIDE WORLD С 9-30 0 2 IMP:N=0 \$ Void 10-11-С SURFACES 12-1 SO 180 **\$** FISSILE SPHERE 13-2 SO 240 **\$** REFLECTOR 14-С 15 -16-MODE N 17-KCODE 4000 1 30 130 Ó 18-KSRC 0 0 1 0 0 -1 0 0 0 1 0 0 -1 0 С 0 0 1 0 19-1 0 1 - 1 0 1 0 1 0 - 1 C 1 1 20--1 -1 0 -1 0 1 -1 0 -1 С - 1 1 0 21 -22 -23 -24 -25 -26 -27 -28 -С 0 1 1 0 -1 1 0 1 - 1 0 -1 -1 С 1 1 -1 1 1 -1 -1 1 -1 -1 -1 92234.500 6.806952-7 92235.500 5.546665-5 92236.500 1.327212-5 M1 \$ Fi 92238.500 2.762975-3 93237.500 3.165242-6 8016.500 4.042554-2 \$ At 1001.50C 1.182107-2 \$ an 14000.50C 1.166297-2 13027.50C 2.665602-3 26000.55C 1.435226-4 12000.50C 2.364807-4 11023.50C 4.025190-4 19000.50C 5.684111-4 \$ Ca 20000.50C 5.823016-4 \$ Wi \$ 30 29-30-\$ Wa MT1 LWTR.01T 1001.50c 1.337225-2 14000.50c 1.319341-2 13027.50c 3.015387-3 M3 \$ Ca 31-8016.50C 3.931496-2 \$ ₩i 32-33-26000.55c 1.623559-4 12000.50c 2.675121-4 20000.50C 6.587122-4 \$ 30 11023.50C 4.553382-4 19000.50C 6.429990-4 ¢. 34-MT3 LWTR.01T \$ Wa 35 -PRINT initial source from file srctp 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 05/02/96 07:39:43 probid = the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 30 cycles and run a total of 130 cycles with nominally 4000 neutrons per cycle. this problem has run 30 inactive cycles with 120473 neutron histories and 100 active cycles with 398791 neutron histories. this calculation has completed the requested number of keff cycles using a total of 519264 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level _____

Jun 07 10:10 1996 File Name: s30e12h.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXVIII - Page 1

Jun 07 10:10 1996 File Name: s30e12h.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXVIII - Page 2

the final estimated combined collision/absorption/track-length keff = .97549 with an estimated standard deviation of .00097 the estimated 68, 95, & 99 percent keff confidence intervals are .97451 to .97646, .97355 to .97742, and .97292 to .97805 the estimated collision/absorption neutron removal lifetime = 7.04E-05 seconds with an estimated standard deviation of 1.93E-07

Jun 07 10:08 1996 File Name: s30e12g.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXIX - Page 1 1mcnp version 4a ld=10/01/93 05/02/96 09:39:40 ************** probid = 05/02/96 09:39:40 inp=s30e12g outp=s30e12g0 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 2-C Critical Size Optimization Confirmation 3-C 4-С SPHERE 5-7.13439813085-2 1 IMP:N=1 \$ Uranium/Tuff/Water 7.10829224000-2 1 -2 \$ Tuff/Water Reflector 5 3 IMP:N=1 C С OUTSIDE WORLD 30 0 2 IMP:N=0 \$ Void 10-11-С SURFACES 12-13-14-15-SO 220 **\$** FISSILE SPHERE 1 2 SO 280 \$ REFLECTOR С 16-17-MODE N KCODE 4000 30 130 1 18-19-KSRC 0 0 0 1 0 0 -1 0 0 0 1 0 С 0 -1 0 0 0 1 0 С 1 1 0 1 - 1 0 1 0 1 1 0 -1 20-21-22-23-24-25-26-27-28-29-30-С - 1 1 0 -1 -1 0 -1 0 1 -1 0 -1 С 0 1 1 0 -1 1 0 1 - 1 0 -1 -1 -1 1 -1 -1 1 -1 -1 -1 С 1 1 1 1 M1 92234.50C 6.806952-7 92235.50C 5.546665-5 92236.50C 1.327212-5 S Fi 92238.50C 2.762975-3 93237.50C 3.165242-6 8016.50C 4.042554-2 \$ At 1001.50C 1.182107-2 \$ an 14000.50C 1.166297-2 13027.50C 2.665602-3 \$ Ca 26000.55C 1.435226-4 12000.50C 2.364807-4 11023.50C 4.025190-4 19000.50C 5.684111-4 20000.500 5.823016-4 \$ ₩i \$ 30 MT1 LWTR.01T \$ Wa Μ3 1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 \$ Ca 31-32-8016.500 3.931496-2 \$ Wi 26000.55C 1.623559-4 12000.50C 2.675121-4 \$ 30 20000.50C 6.587122-4 33-11023.50C 4.553382-4 19000.50C 6.429990-4 \$ 34 -MT3 LWTR.01T \$ Wa 35-PRINT initial source from file srctp 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 probid = 05/02/96 09:39:40 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 30 cycles and run a total of 130 cycles with nominally this problem has run 30 inactive cycles with 120371 neutron histories and 100 active cycles with 4000 neutrons per cycle. 399911 neutron histories. 520282 fission neutron source histories. this calculation has completed the requested number of keff cycles using a total of all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

Jun 07 10:08 1996 File Name: s30e12g.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXIX - Page 2

the final estimated combined collision/absorption/track-length keff = .98489 with an estimated standard deviation of .00086 the estimated 68, 95, & 99 percent keff confidence intervals are .98403 to .98575, .98318 to .98660, and .98262 to .98716 the estimated collision/absorption neutron removal lifetime = 6.59E-05 seconds with an estimated standard deviation of 1.89E-07 Jun 07 10:10 1996 File Name: s30e12f.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXX - Page 1

version 4a ld=10/01/93 05/01/96 14:08:35 1mcnp **** *********** 05/01/96 14:08:35 probid = inp=s30e12f outp=s30e12f0 1 -FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 2-С Critical Size Optimization Confirmation 3-С 4 -С SPHERE 5 -7.13439813085-2 IMP:N=1 \$ Uranium/Tuff/Water 1 - 1 1 6-7-5 7.10829224000-2 1 - 2 IMP:N=1 \$ Tuff/Water Reflector 3 С 8-OUTSIDE WORLD С <u>9</u>-30 0 IMP:N=0 \$ Void 2 10-11-C SURFACES 12-SO 250 **\$** FISSILE SPHERE 1 SO 310 13-2 \$ REFLECTOR 14 -С 15 -16-MODE N **KCODE 4000** 17-1 30 130 18-С KSRC 0 0 0 1 0 0 - 1 0 0 0 1 0 0 -1 0 0 0 1 0 19-1 0 -1 Ó Ó 1 0 -1 С 1 1 1 1 20-С - 1 0 -1 -1 0 -1 0 - 1 0 - 1 1 1 21 -22 -23 -24 -0 -1 Ð 0 -1 -1 С 0 1 1 1 1 - 1 1 -1 1 -1 -1 1 -1 -1 -1 C 1 1 92234.50C 6.806952-7 92235.50C 5.546665-5 92236.50C 1.327212-5 M1 \$ Fi 92238.50C 2.762975-3 93237.500 3.165242-6 8016.50C 4.042554-2 \$ At 25 -26 -27 -28 -1001.500 1.182107-2 \$ an 13027.50C 2.665602-3 14000.50C 1.166297-2 \$ Ca 26000.55C 1.435226-4 12000.500 2.364807-4 20000.50C 5.823016-4 \$ Wi 11023.50C 4.025190-4 19000.50C 5.684111-4 \$ 30 29-30-MT1 LWTR.01T \$ Wa 1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 M3 \$ Ca 31-8016.50C 3.931496-2 \$ Wi 26000.55C 1.623559-4 11023.50C 4.553382-4 32-12000.50C 2.675121-4 20000.500 6.587122-4 \$ 30 33-19000.500 6.429990-4 \$ 34 -MT3 LWTR.01T \$ Wa 35 -PRINT initial source from file srctp 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 05/01/96 14:08:35 = bidora the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 30 cycles and run a total of 130 cycles with nominally this problem has run 30 inactive cycles with 120085 neutron histories and 100 active cycles with 4000 neutrons per cycle. 398167 neutron histories. this calculation has completed the requested number of keff cycles using a total of 518252 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

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the final estimated combined collision/absorption/track-length keff = .98870 with an estimated standard deviation of .00094 the estimated 68, 95, & 99 percent keff confidence intervals are .98777 to .98964, .98684 to .99057, and .98623 to .99118 the estimated collision/absorption neutron removal lifetime = 6.52E-05 seconds with an estimated standard deviation of 1.91E-07

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ld=10/01/93 05/01/96 08:43:08 1mcnp version 4a ---probid = 05/01/96 08:43:08 inp=s30e12e outp=s30e12e0 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 Ż-С Critical Size Optimization Confirmation 3-C 4 -С SPHERE Ś-7.13439813085-2 IMP:N=1 \$ Uranium/Tuff/Water 1 - 1 7.10829224000-2 1 -2 \$ Tuff/Water Reflector 6-5 3 IMP:N=1 7-C 8-C OUTSIDE WORLD 9-30 0 IMP:N=0 \$ Void 2 10-C 11-SURFACES 12-1 SO 300 **\$** FISSILE SPHERE 13-2 SO 360 \$ REFLECTOR 14 -С 15 -16-MODE N 17-**KCODE** 4000 30 130 1 Ó Õ O 1 0 0 18-KSRC -1 0 0 0 1 0 0 -1 0 0 С 0 1 n 19-0 1 1 0 - 1 С 1 0 1 -1 0 1 1 С 0 -1 -1 0 - 1 0 1 -1 0 -1 20-21-22-23-24-25-26-27-28--1 1 C 0 1 1 0 -1 1 0 1 - 1 0 -1 -1 1 1 1 -1 1 1 -1 1 -1 -1 -1 -1 -1 -1 92234.50C 6.806952-7 92235.50C 5.546665-5 92236.50C 1.327212-5 С M1 \$ Fi 92238.500 2.762975-3 93237.500 3.165242-6 8016.500 4.042554-2 \$ At 1001.50C 1.182107-2 14000.50C 1.166297-2 13027.50C 2.665602-3 26000.55C 1.435226-4 12000.50C 2.364807-4 11023.50C 4.025190-4 19000.50C 5.684111-4 \$ an \$ Ca \$ Wi \$ 30 20000.50C 5.823016-4 29-\$ Wa MT1 LWTR.01T 30-M3 1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 \$ Ca 8016.50C 3.931496-2 31-\$ Wi 32-26000.55C 1.623559-4 12000.50C 2.675121-4 20000.50C 6.587122-4 \$ 30 33-11023.50C 4.553382-4 19000.50C 6.429990-4 \$ 34 -MT3 LWTR.01T \$ Wa PRINT 35 initial source from file srctp 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 probid = 05/01/96 08:43:08 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 30 cycles and run a total of 130 cycles with nominally this problem has run 30 inactive cycles with 119681 neutron histories and 100 active cycles with 4000 neutrons per cycle. 399203 neutron histories. this calculation has completed the requested number of keff cycles using a total of all cells with fissionable material were sampled and had fission neutron source points. 518884 fission neutron source histories. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level _____

Jun 07 10:09 1996 File Name: s30e12e.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXXI - Page 1
Jun 07 10:09 1996 File Name: s30e12e.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXXI - Page 2 -

the final estimated combined collision/absorption/track-length keff = .99516 with an estimated standard deviation of .00095 the estimated 68, 95, & 99 percent keff confidence intervals are .99421 to .99611, .99327 to .99705, and .99265 to .99767 the estimated collision/absorption neutron removal lifetime = 6.16E-05 seconds with an estimated standard deviation of 1.57E-07

ld=10/01/93 04/24/96 12:55:39 1mcnp version 4a probid = 04/24/96 12:55:39 inp=s30e12b outp=s30e12b0 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 1 -2-С Critical Size Optimization Confirmation 3-C 4-С SPHERE 5-7.13439813085-2 IMP:N=1 \$ Uranium/Tuff/Water 1 1 - 1 5 7.10829224000-2 1 -2 \$ Tuff/Water Reflector 6-7-3 IMP:N=1 С 8-С OUTSIDE WORLD <u>9</u>-0 30 2 IMP:N=0 \$ Void 10-11-С SURFACES 12-SO 325 **\$** FISSILE SPHERE -1 13-2 SO 385 **\$** REFLECTOR 14-С 15-MODE N 16-17-KCODE 4000 30 130 1 18-C KSRC 0 0 0 1 0 0 -1 0 0 0 1 0 0 - 1 0 0 0 1 0 19-1 1. С 1 0 1 - 1 0 1 0 1 0 -1 -1 20-C - 1 1 0 -1 -1 0 0 1 -1 0 -1 21-22-23-24-25-26-27-28-29-30-С 0 1 0 -1 1 0 1 - 1 0 - 1 - 1 1 C 1 1 -1 1 -1 -1 1 -1 -1 -1 1 92234.500 6.806952-7 92235.500 5.546665-5 92236.500 1.327212-5 M1 \$ Fi 92238.50C 2.762975-3 93237.50C 3.165242-6 8016.50C 4.042554-2 \$ At 1001.50C 1.182107-2 \$ an 14000.50C 1.166297-2 13027.50C 2.665602-3 \$ Ca 12000.50C 2.364807-4 19000.50C 5.684111-4 26000.550 1.435226-4 20000.500 5.823016-4 \$ Wi 11023.50C 4.025190-4 \$ 30 MT1 LWTR.01T \$ Wa 1001.50c 1.337225-2 14000.50c 1.319341-2 13027.50c 3.015387-3 \$ Ca Μ3 31-8016.50C 3.931496-2 \$ Wi 26000.550 1.623559-4 12000.500 2.675121-4 32-20000.50C 6.587122-4 \$ 30 33-11023.50C 4.553382-4 19000.50C 6.429990-4 \$ 34 -MT3 LWTR.01T \$ Va 35-PRINT initial source from file srctp 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 04/24/96 12:55:39 probid = the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 30 cycles and run a total of 130 cycles with nominally this problem has run 30 inactive cycles with 120156 neutron histories and 100 active cycles with 4000 neutrons per cycle. 400694 neutron histories. this calculation has completed the requested number of keff cycles using a total of 520850 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

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the final estimated combined collision/absorption/track-length keff = .99753 with an estimated standard deviation of .00095 the estimated 68, 95, & 99 percent keff confidence intervals are .99658 to .99848, .99564 to .99942, and .99502 to 1.00004 the estimated collision/absorption neutron removal lifetime = 6.15E-05 seconds with an estimated standard deviation of 1.52E-07 Jun 07 10:05 1996 File Name: s30e12a.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXXIII - Page 1

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2-3-С Critical Size Optimization Confirmation С 4 -С SPHERE Ś-7.13439813085-2 \$ Uranium/Tuff/Water 1 - 1 IMP:N=16-5 7.10829224000-2 1 -2 IMP:N=1 \$ Tuff/Water Reflector 3 7-С 8-OUTSIDE WORLD С 9-30 0 IMP:N=0 \$ Void 2 10-11-С SURFACES 12-SO 345 **\$** FISSILE SPHERE -1 13-2 SO 405 \$ REFLECTOR 14-С 15-16-MODE N 17-**KCODE 4000** 30 1 130 18-С KSRC 0 0 0 0 0 -1 0 0 0 1 0 0 -1 0 0 0 1 0 19-0 0 1 0 -1 С 1 1 - 1 0 1 1 20-21-22-23-24-25-26-27-28-29-30--1 0 -1 0 -1 С - 1 - 1 0 - 1 0 -1 1 C Ω 1 0 - 1 1 0 1 - 1 0 -1 -1 - 1 С 1 -1 1 -1 -1 1 -1 -1 -1 92234.500 6.806952-7 92235.500 5.546665-5 92236.500 1.327212-5 M1 \$ Fi 92238.50C 2.762975-3 93237.500 3.165242-6 8016.50C 4.042554-2 \$ At 1001.50C 1.182107-2 \$ an 14000.50C 1.166297-2 13027.50C 2.665602-3 \$ Ca 26000.55C 1.435226-4 11023.50C 4.025190-4 12000.500 2.364807-4 20000.500 5.823016-4 \$ Wi 19000.50C 5.684111-4 \$ 30 \$ Wa MT1 LWTR.01T 1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 \$ Ca M3 31-8016.50C 3.931496-2 \$ Vi 32-26000.550 1.623559-4 12000.50C 2.675121-4 20000.50C 6.587122-4 \$ 30 11023.50C 4.553382-4 19000.50C 6.429990-4 33-\$ Ś Wa 34 -MT3 LWTR.01T 35 -PRINT initial source from file srctp 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 probid = 04/24/96 10:46:06 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 30 cycles and run a total of 130 cycles with nominally this problem has run 30 inactive cycles with 120272 neutron histories and 100 active cycles with 4000 neutrons per cycle. 398955 neutron histories. this calculation has completed the requested number of keff cycles using a total of 519227 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points.

the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 99 percent confidence level, but not at 95 percent the k(absorption) cycle values appear normally distributed at the 95 percent confidence level

warning. the k(trk length) cycle values do not appear normally distributed at the 99 percent confidence level

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the final estimated combined collision/absorption/track-length keff = 1.00036 with an estimated standard deviation of .00084 the estimated 68, 95, & 99 percent keff confidence intervals are .99952 to 1.00120, .99869 to 1.00203, and .99814 to 1.00258 the estimated collision/absorption neutron removal lifetime = 6.09E-05 seconds with an estimated standard deviation of 1.49E-07

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Jun 07 10:07 1996 File Name: s30e12c.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXXIV - Page 1

1mcnp version 4a ld=10/01/93 04/24/96 14:18:50 probid = 04/24/96 14:18:50 inp=s30e12c outp=s30e12c0 FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 2-C Critical Size Optimization Confirmation 3-С SPHERE 4 -С <u>5</u>-7.13439813085-2 1 -1 IMP:N=1 \$ Uranium/Tuff/Water 6-5 7.10829224000-2 1 - 2 IMP:N=1 \$ Tuff/Water Reflector 3 7-C 8-OUTSIDE WORLD С 9-30 0 2 IMP:N=0 \$ Void 10-11-С SURFACES 12-1 so 365 **\$** FISSILE SPHERE 13-SO 425 2 **\$** REFLECTOR 14-C 15 -16-MODE N 17-KCODE 4000 30 130 1 0 0 1 0 -1 0 0 18-С KSRC 0 0 0 1 0 0 -1 0 n 0 1 n 19-0 -1 1 0 1 - 1 0 1 0 1 С 1 1 20--1 -1 -1 0 1 -1 0 -1 С - 1 1 0 0 21-С 0 1 1 0 -1 1 0 1 - 1 0 -1 -1 22-23-25-26-27-28-29-30-С 1 1 1 -1 1 1 -1 -1 1 -1 -1 -1 92234.50C 6.806952-7 92235.50C 5.546665-5 92236.50C 1.327212-5 M1 \$ Fi 92238.500 2.762975-3 93237.500 3.165242-6 8016.500 4.042554-2 \$ At 1001.50C 1.182107-2 \$ an 14000.500 1.166297-2 13027.50C 2.665602-3 \$ Ca 12000.50C 2.364807-4 19000.50C 5.684111-4 26000.55C 1.435226-4 20000.50C 5.823016-4 \$ Wi 11023.500 4.025190-4 \$ 30 MT1 LWTR.01T \$ Wa 1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 \$ Ca MX. 31-32-8016.50C 3.931496-2 \$ Wi 26000.55C 1.623559-4 12000.50C 2.675121-4 20000.50C 6.587122-4 \$ 30 33-11023.50C 4.553382-4 19000.50C 6.429990-4 \$ 34 -MT3 LWTR.01T \$ Wa 35 -PRINT initial source from file srctp 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 probid = 04/24/96 14:18:50 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 30 cycles and run a total of 130 cycles with nominally this problem has run 30 inactive cycles with 120681 neutron histories and 100 active cycles with 4000 neutrons per cycle. 400391 neutron histories. this calculation has completed the requested number of keff cycles using a total of 521072 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level _____

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the final estimated combined collision/absorption/track-length keff = .99869 with an estimated standard deviation of .00098 the estimated 68, 95, & 99 percent keff confidence intervals are .99771 to .99967, .99674 to 1.00064, and .99610 to 1.00127 the estimated collision/absorption neutron removal lifetime = 6.04E-05 seconds with an estimated standard deviation of 1.46E-07 Jun 07 10:08 1996 File Name: s30e12d.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXXV - Page 1

04/24/96 15:28:49 1mcnp version 4a ld=10/01/93 probid = 04/24/96 15:28:49 inp=s30e12d outp=s30e12d0 1 -FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 2-С Critical Size Optimization Confirmation 3-C SPHERE 4 -C 5-7.13439813085-2 IMP:N=1\$ Uranium/Tuff/Water 1 1 6-7-5 3 7.10829224000-2 1 -2 IMP:N≃1 \$ Tuff/Water Reflector С **8**-C OUTSIDE WORLD <u>9</u>-Ō 30 2 IMP:N=0 \$ Void 10-11-С SURFACES 12-1 SO 385 **\$** FISSILE SPHERE SO 445 2 \$ REFLECTOR 14-С 15 -16-MODE N 17-**KCODE 4000** 30 130 1 Ó Ō 0 0 0 0 18-С KSRC 1 0 -1 0 1 0 0 -1 0 Ω 0 1 0 0 1 19-1 0 1 0 - 1 С 1 1 -1 0 1 Ó 1 20-0 -1 -1 0 -1 -1 0 -1 С - 1 1 21 -22 -23 -24 -0 -1 -1 С 0 1 0 - 1 0 1 - 1 1 1 1 1 -1 1 1 -1 -1 1 -1 -1 -1 C 92234.50c 6.806952-7 92235.50c 5.546665-5 92236.50c 1.327212-5 92238.50c 2.762975-3 93237.50c 3.165242-6 8016.50c 4.042554-2 M1 \$ Fi \$ At 25-1001.500 1.182107-2 \$ an 26-14000.50C 1.166297-2 13027.50C 2.665602-3 \$ Ca 26000.55C 1.435226-4 12000.50C 2.364807-4 11023.50C 4.025190-4 19000.50C 5.684111-4 27-28-29-12000.50C 2.364807-4 20000.50C 5.823016-4 \$ Wi \$ 30 MT1 LWTR.01T \$ Wa 30-M3 1001.50C 1.337225-2 14000.50C 1.319341-2 13027.50C 3.015387-3 \$ Ca 31-8016.50C 3.931496-2 S Wi 32-26000.55C 1.623559-4 12000.50C 2.675121-4 20000.500 6.587122-4 \$ 30 33-11023.50C 4.553382-4 19000.50C 6.429990-4 \$ MT3 LWTR.01T 34-\$ Wa 35 -PRINT initial source from file srctp 1keff results for: FarField Criticality - Sphere of Transmuted 3.0E 20GWD 20% Water 11.6% U-Np 02 04/24/96 15:28:49 probid = the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 30 cycles and run a total of 130 cycles with nominally this problem has run 30 inactive cycles with 120407 neutron histories and 100 active cycles with 4000 neutrons per cycle. 399728 neutron histories. this calculation has completed the requested number of keff cycles using a total of 520135 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level _____

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the final estimated combined collision/absorption/track-length keff = 1.00198 with an estimated standard deviation of .00092 the estimated 68, 95, & 99 percent keff confidence intervals are 1.00106 to 1.00290, 1.00015 to 1.00380, and .99956 to 1.00440 the estimated collision/absorption neutron removal lifetime = 5.99E-05 seconds with an estimated standard deviation of 1.34E-07 Jun 06 13:16 1996 File Name: s3020mh.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXXVI - Page 1

ld=10/01/93 05/29/96 12:55:21 1mcnp version 4a ************* 05/29/96 12:55:21 probid = inp=s3020mh outp=s3020mh0 Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H2O/ 15% UO2 (s3020mh) Calico Hills Tuff 1.137 g/cc .47 porosity - sphere surrounded by tuff 2-С 3-С CELL SPECIFICATIONS 4-C INNER WATER REGION 5 -1 8.418847-2 -1 1 IMP:N=1 6-2 2 8.610406-2 1 -2 IMP:N=1 7-С OUTSIDE WORLD 8-3 0 2 IMP:N=0 ĝ-10-С SURFACE SPECIFICATIONS 11-**\$** INNER FUEL ZONE 1 SO 61 12-2 SO 121 **\$ INNER FUEL ZONE** 13-14 -MODE N 15-KCODE 4000 1. 25 75 16-C KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 15 0 0 -55 -10 0 -40 17-C 0 -50 -20 -30 0 -13 0 -10 60 0 0 -25 -30 -15 -56 5 5 0 10 30 17 18-MATERIAL SPECIFICATIONS С (47 vol% water in calico Hills tuff) x .85 .15 vol% UO2 3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes 19-С 20-21-22-23-0 1001.50c 2.671107-2 8016.50c 4.186941-2 11023.50c 2.955762-4 13027.50c 1.957395-3 14000.50c 8.564310-3 m1 12000.50c 1.736516-4 19000.50c 4.173934-4 20000.50c 4.275934-4 26000.55c 1.053910-4 92234.50c 8.802093-7 92235.50c 7.172412-5 92236.50c 1.716222-5 24-25 -26 -27 -28 -92238,50c 3.572813-3 93237.50c 4.092986-6 lwtr.01t mt 1 30 vol% water in calico Hills tuff C 1001.50c 3.142479-2 8016.50c 4.063067-2 11023.50c 3.477367-4 m2 29-30-12000.50c 2.042960-4 13027.50c 2.302817-3 14000.50c 1.007566-2 19000.50c 4.910511-4 20000.50c 5.030511-4 26000.55c 1.239894-4 31mt2 lwtr.01t 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H2O/ 15% UO2 (s3020mh) probid = 05/29/96 12:55:21 the initial fission neutron source distribution was read from the srctp file named srctp 4000 neutrons per cycle. the criticality problem was scheduled to skip 25 cycles and run a total of 75 cycles with nominally this problem has run 25 inactive cycles with 100223 neutron histories and 50 active cycles with 200748 neutron histories. this calculation has completed the requested number of keff cycles using a total of 300971 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .98786 with an estimated standard deviation of .00152

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the estimated 68, 95, & 99 percent keff confidence intervals are .98633 to .98939, .98481 to .99092, and .98378 to .99194 the estimated collision/absorption neutron removal lifetime = 7.80E-05 seconds with an estimated standard deviation of 2.94E-07

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05/29/96 14:44:20 1mcnp version 4a ld=10/01/93 ************** probid = 05/29/96 14:44:20 inp=s3020mi outp=s3020mi0 1 -Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H20/ 20% U02 (s3020mi) Calico Hills Tuff 1.137 g/cc .47 porosity - sphere surrounded by tuff 2 -С 3-С CELL SPECIFICATIONS 4-C INNER WATER REGION 5-1 1 8.354993-2 -1 IMP:N=1 6. 2 2 8.610406-2 1 -2 IMP:N=1 7-OUTSIDE WORLD С 8-3 0 2 IMP:N=0 9-10-С SURFACE SPECIFICATIONS 11-SO 61 **\$ INNER FUEL ZONE** 12-13-SO 121 **\$** INNER FUEL ZONE 2 14-MODE N KCODE 4000 1, 25 75 15-KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 15 0 0 -55 -10 0 -40 16-C 17-0 -50 -20 -30 0 -13 0 -10 60 0 0 -25 -30 -15 -56 5 5 0 10 30 17 С 18-С MATERIAL SPECIFICATIONS 19-(47 vol% water in calico Hills tuff) x .80 20 vol% UO2 С 3.0% Original Enrichment/ 20 GWD/MT decayed to Uranium isotopes 1001.50c 2.513983-2 8016.50c 4.228232-2 11023.50c 2.781893-4 12000.50c 1.634368-4 13027.50c 1.842254-3 14000.50c 8.060527-3 c m1 19000.50c 3.928409-4 20000.50c 4.024409-4 26000.55c 9.199150-5 92234.50c 1.173612-6 92235.50c 9.563216-5 92236.50c 2.288296-5 92238.50c 4.763750-3 93237.50c 5.457314-6 mt1 lwtr.01t 30 vol% water in calico Hills tuff C 1001.50c 3.142479-2 8016.50c 4.063067-2 11023.50c 3.477367-4 12000.50c 2.042960-4 13027.50c 2.302817-3 14000.50c 1.007566-2 m2 19000.50c 4.910511-4 20000.50c 5.030511-4 26000.55c 1.239894-4 31mt2 lwtr.01t 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.0% /20 GWD/mt - 47% H2O/ 20% UO2 (s3020mi) probid = 05/29/96 14:44:20 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 25 cycles and run a total of 75 cycles with nominally this problem has run 25 inactive cycles with 100120 neutron histories and 50 active cycles with 4000 neutrons per cycle. 199728 neutron histories. this calculation has completed the requested number of keff cycles using a total of 299848 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .99245 with an estimated standard deviation of .00157

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the estimated 68, 95, & 99 percent keff confidence intervals are .99087 to .99402, .98929 to .99560, and .98824 to .99666 the estimated collision/absorption neutron removal lifetime = 6.72E-05 seconds with an estimated standard deviation of 3.42E-07

ld=10/01/93 1mcnp version 4a 05/01/96 16:24:18 *********** probid = 05/01/96 16:24:18 inp=s3530i outp=s3530i0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H20/ 14% UO2 (s3530i) 2-С Calico Hills Tuff 1.746 g/cc .306 porosity - sphere surrounded by tuff 3-С CELL SPECIFICATIONS 4 -С INNER WATER REGION 1 8.002310-2 -1 IMP:N=1 2 8.111211-2 1 -2 IMP:N=1 5 -6-2 7-OUTSIDE WORLD С 8-3 0 2 IMP:N=0 9-10-С SURFACE SPECIFICATIONS 11so 120 **\$ INNER FUEL ZONE** SO 180 12-2 **\$** INNER FUEL ZONE 13-14-MODE N 15-KCODE 4000 1. 20 75 KŚŔC 00100100-200029020500-5-100-10 16-С 17-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 С 18-MATERIAL SPECIFICATIONS С 19-(30 vol% water in calico Hills tuff) x .86 .14 vol% UO2 С 20-21-22-23-24-25-26-27-28-3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes С 1001.50c 1.725021-2 8016.50c 4.353035-2 11023.50c 3.915909-4 12000.50c 2.300604-4 13027.50c 2.593233-3 14000.50c 1.134633-2 m1 19000.50c 5.529791-4 20000.50c 5.664925-4 26000.55c 1.396261-4 92234.50c 1.216825-6 92235.50c 6.479434-5 92236.50c 2.236042-5 92238.50c 3.327729-3 93237.50c 6.127100-6 mt1 lwtr.01t 30 vol% water in calico Hills tuff C 1001.50c 2.005838-2 8016.50c 4.265802-2 11023.50c 4.553382-4 m2 29-12000.50c 2.675121-4 13027.50c 3.015387-3 14000.50c 1.319341-2 30-19000.50c 6.429990-4 20000.50c 6.587122-4 26000.55c 1.623559-4 31lwtr.01t mt2 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (s3530i) probid = 05/01/96 16:24:18 the initial fission neutron source distribution was read from the srctp file named srctp . the criticality problem was scheduled to skip 20 cycles and run a total of 75 cycles with nominally this problem has run 20 inactive cycles with 79981 neutron histories and 55 active cycles with 4000 neutrons per cycle. 219362 neutron histories. this calculation has completed the requested number of keff cycles using a total of 299343 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .98207 with an estimated standard deviation of .00147

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the estimated 68, 95, & 99 percent keff confidence intervals are .98060 to .98355, .97913 to .98502, and .97815 to .98600 the estimated collision/absorption neutron removal lifetime = 6.60E-05 seconds with an estimated standard deviation of 2.63E-07 May 24 07:12 1996 File Name: s3530h.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT LXXXIX - Page 1

version 4a ld=10/01/93 05/01/96 15:25:40 1mcnp probid = 05/01/96 15:25:40 inp=s3530h outp=s3530h0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (s3530h) 2-C Calico Hills Tuff 1.746 g/cc .306 porosity - sphere surrounded by tuff 3-С CELL SPECIFICATIONS INNER WATER REGION 4-С 5-1 8.002310-2 1 - 1 IMP:N=1 6-2 8.111211-2 1 -2 IMP:N=1 2 7-С OUTSIDE WORLD 8ž 0 2 IMP:N=0 <u>9</u>-10-С SURFACE SPECIFICATIONS 11so 130 \$ INNER FUEL ZONE 1 12-13-2 SO 190 **\$ INNER FUEL ZONE** 14-MODE N 15-KCODE 4000 1, 20 75 16-KSRC 001 0010 00-20 0029 0205 00-5 -100-10 C 17-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 18-MATERIAL SPECIFICATIONS С 19-(30 vol% water in calico Hills tuff) x .86 .14 vol% UO2 С 20-3.5% Original Enrichment/ 30 GWD/NT decayed to Uranium isotopes С 21-22-23-24-25-26-27-28-29-30-1001.50c 1.725021-2 **m1** 8016.50c 4.353035-2 11023.50c 3.915909-4 12000.50c 2.300604-4 13027.50c 2.593233-3 14000.50c 1.134633-2 19000.50c 5.529791-4 20000.50c 5.664925-4 92234.50c 1.216825-6 92235.50c 6.479434-5 26000.55c 1.396261-4 92236.50c 2.236042-5 92238.50c 3.327729-3 93237.50c 6.127100-6 mt1 lwtr.01t 30 vol% water in calico Hills tuff C 1001.50c 2.005838-2 8016.50c 4.265802-2 11023.50c 4.553382-4 m2 12000.50c 2.675121-4 13027.50c 3.015387-3 14000.50c 1.319341-2 19000.50c 6.429990-4 20000.50c 6.587122-4 26000.55c 1.623559-4 31lwtr.01t mt2 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (s3530h) probid = 05/01/96 15:25:40 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 20 cycles and run a total of 75 cycles with nominally 4000 neutrons per cycle. this problem has run 20 inactive cycles with 79436 neutron histories and 55 active cycles with 219660 neutron histories. this calculation has completed the requested number of keff cycles using a total of 299096 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .98774 with an estimated standard deviation of .00107

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the estimated 68, 95, & 99 percent keff confidence intervals are .98666 to .98882, .98559 to .98989, and .98488 to .99060 the estimated collision/absorption neutron removal lifetime = 6.40E-05 seconds with an estimated standard deviation of 2.65E-07 May 24 07:11 1996 File Name: s3530g.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XC - Page 1

05/01/96 14:19:52 1mcnp version 4a ld=10/01/93 ********** 05/01/96 14:19:52 probid = inp=s3530g outp=s3530g0 1 -Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H20/ 14% UO2 (s3530g) 2-3-Calico Hills Tuff 1.746 g/cc .306 porosity - sphere surrounded by tuff С С CELL SPECIFICATIONS 4 -С INNER WATER REGION 5-1 8.002310-2 -1 1 IMP:N=1 6-7-8-2 8.111211-2 1 -2 IMP:N=1 2 С OUTSIDE WORLD ž 0 2 IMP:N=0 <u>9</u>-10-С SURFACE SPECIFICATIONS 11-**\$ INNER FUEL ZONE** 1 SO 134 12-13-2 194 SO **\$ INNER FUEL ZONE** 14-MODE N 15 -KCODE 4000 1. 20 75 16-C KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 5 0 0 -5 -10 0 -10 17-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 18-MATERIAL SPECIFICATIONS С 19-С (30 vol% water in calico Hills tuff) x .86 .14 vol% UO2 20-21-22-23-24-25-26-3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes С 8016.50c 4.353035-2 11023.50c 3.915909-4 m 1 1001.50c 1.725021-2 12000.50c 2.300604-4 19000.50c 5.529791-4 13027.50c 2.593233-3 14000.50c 1.134633-2 20000.50c 5.664925-4 26000.55c 1.396261-4 92235.50c 6.479434-5 92234.50c 1.216825-6 92236.50c 2.236042-5 92238.50c 3.327729-3 93237.50c 6.127100-6 lwtr.01t mt1 27-28-29-30 vol% water in calico Hills tuff С 1001.50c 2.005838-2 8016.50c 4.265802-2 11023.50c 4.553382-4 m2 12000.50c 2.675121-4 13027.50c 3.015387-3 14000.50c 1.319341-2 30-19000.50c 6.429990-4 20000.50c 6.587122-4 26000.55c 1.623559-4 31mt2 lwtr.01t 32-PRINT initial source from file srctp 1keff results for: far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (s3530g) probid = 05/01/96 14:19:52 the initial fission neutron source distribution was read from the srctp file named srctp 4000 neutrons per cycle. the criticality problem was scheduled to skip 20 cycles and run a total of 75 cycles with nominally this problem has run 20 inactive cycles with 79472 neutron histories and 55 active cycles with 219457 neutron histories. this calculation has completed the requested number of keff cycles using a total of 298929 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

the final estimated combined collision/absorption/track-length keff = .99010 with an estimated standard deviation of .00127

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the estimated 68, 95, & 99 percent keff confidence intervals are .98883 to .99138, .98756 to .99265, and .98671 to .99349 the estimated collision/absorption neutron removal lifetime = 6.27E-05 seconds with an estimated standard deviation of 2.43E-07 May 23 16:39 1996 File Name: s3530f.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XCI - Page 1

ld=10/01/93 05/01/96 11:32:55 1mcnp version 4a probid = 05/01/96 11:32:55 inp=s3530f outp=s3530f0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (s3530f) Calico Hills Tuff 1.746 g/cc .306 porosity - sphere surrounded by tuff 2-С 3-C CELL SPECIFICATIONS 4 -C INNER WATER REGION 5 -1 8.002310-2 -1 1 IMP:N=1 6. 2 2 8.111211-2 1 -2 IMP:N=1 . 7-С OUTSIDE WORLD 8-3 0 2 IMP:N=0 <u>9</u>-10-С SURFACE SPECIFICATIONS 11-SO 140 **\$ INNER FUEL ZONE** 1 12-2 200 SO **\$ INNER FUEL ZONE** 13-14-MODE 15-KCODE 4000 1. 20 75 16-C KSRC 001 0010 00-20 0029 0205 00-5 -100-10 17-С 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 18-MATERIAL SPECIFICATIONS С 19-С (30 vol% water in calico Hills tuff) x .86 .14 vol% UO2 20-21-22-23-24-25-26-27-28-29-30-3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes C 1001.50c 1.725021-2 8016.50c 4.353035-2 11023.50c 3.915909-4 13027.50c 2.593233-3 14000.50c 1.134633-2 m1 12000.50c 2.300604-4 19000.50c 5.529791-4 20000.50c 5.664925-4 26000.55c 1.396261-4 92234.50c 1.216825-6 92235.50c 6.479434-5 92236.50c 2.236042-5 92238.50c 3.327729-3 93237.50c 6.127100-6 lwtr.01t mt1 30 vol% water in calico Hills tuff С т2 1001.50c 2.005838-2 8016.50c 4.265802-2 11023.50c 4.553382-4 12000.50c 2.675121-4 13027.50c 3.015387-3 14000.50c 1.319341-2 19000.50c 6.429990-4 20000.50c 6.587122-4 26000.55c 1.623559-4 31mt2 lwtr.01t 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (s3530f) probid = 05/01/96 11:32:55 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 20 cycles and run a total of 75 cycles with nominally this problem has run 20 inactive cycles with 79630 neutron histories and 55 active cycles with 4000 neutrons per cycle. 219242 neutron histories. this calculation has completed the requested number of keff cycles using a total of 298872 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 99 percent confidence level, but not at 95 percent the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .99460 with an estimated standard deviation of .00130

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the estimated 68, 95, & 99 percent keff confidence intervals are .99329 to .99591, .99199 to .99721, and .99112 to .99808 the estimated collision/absorption neutron removal lifetime = 6.23E-05 seconds with an estimated standard deviation of 2.52E-07 May 23 16:29 1996 File Name: s3530b.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XCII - Page 1

1mcnp version 4a ld=10/01/93 04/17/96 08:54:32 probid = 04/17/96 08:54:32 inp=s3530b outp=s3530b0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (s3530b) 2-С Calico Hills Tuff 1.746 g/cc .306 porosity - sphere surrounded by tuff 3-CELL SPECIFICATIONS С 4 -5 -С INNER WATER REGION 1 8.002310-2 -1 IMP:N=1 2 8.111211-2 1 -2 IMP:N=1 1 6-2 7-С OUTSIDE WORLD 8-Ĵ. 0 2 IMP:N=0 9-10-С SURFACE SPECIFICATIONS 11-SO 150 **\$** INNER FUEL ZONE - 1 12-13-SO 210 2 **\$** INNER FUEL ZONE 14-MODE N KCODE 4000 1. 7 37 15 -16-17-KSRC 001 0010 00-20 0029 0205 00-5 -100-10 С 0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 С 18-С MATERIAL SPECIFICATIONS 19-(30 vol% water in calico Hills tuff) x .86 .14 vol% UO2 C 20-3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes С 21-22-23-24-25-26-27-28-29-1001.50c 1.725021-2 8016.50c 4.353035-2 11023.50c 3.915909-4 m1 12000.50c 2.300604-4 13027.50c 2.593233-3 14000.50c 1.134633-2 19000.50c 5.529791-4 20000.50c 5.664925-4 26000.55c 1.396261-4 92234.50c 1.216825-6 92235.50c 6.479434-5 92236.50c 2.236042-5 92238.50c 3.327729-3 93237.50c 6.127100-6 mt1 lwtr.01t 30 vol% water in calico Hills tuff 1001.50c 2.005838-2 8016.50c 4.265802-2 11023.50c 4.553382-4 **C** т2 12000.50c 2.675121-4 13027.50c 3.015387-3 14000.50c 1.319341-2 30-19000.50c 6.429990-4 20000.50c 6.587122-4 26000.55c 1.623559-4 31lwtr.01t mt2 PRINT 32initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (s3530b) probid = 04/17/96 08:54:32 the initial fission neutron source distribution was read from the srctp file named srctp . the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27939 neutron histories and 30 active cycles with 4000 neutrons per cycle. 119658 neutron histories. this calculation has completed the requested number of keff cycles using a total of 147597 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .99714 with an estimated standard deviation of .00149

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the estimated 68, 95, & 99 percent keff confidence intervals are .99563 to .99865, .99408 to 1.00020, and .99300 to 1.00128 the estimated collision/absorption neutron removal lifetime = 6.05E-05 seconds with an estimated standard deviation of 3.64E-07 May 23 16:31 1996 File Name: s3530c.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XCIII - Page 1

version 4a ld=10/01/93 04/17/96 10:04:27 1mcnp probid = 04/17/96 10:04:27 inp=s3530c outp=s3530c0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (s3530c) 2-С Calico Hills Tuff 1.746 g/cc .306 porosity - sphere surrounded by tuff 3-С CELL SPECIFICATIONS 4 -С INNER WATER REGION 5 -1 8.002310-2 -1 IMP:N=1 1 2 8.111211-2 1 -2 IMP:N=1 6-2 7-С OUTSIDE WORLD 8-3 0 2 IMP:N=0 <u>9</u>-10-С SURFACE SPECIFICATIONS 11-SO 151 **\$** INNER FUEL ZONE 12-2 SO 211 **\$** INNER FUEL ZONE 13-14-MODE N 15-KCODE 4000 1. 7 37 KSRC 001 0010 00-20 0029 0205 00-5 -100-10 16-С 17-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 С 18-MATERIAL SPECIFICATIONS С 19-(30 vol% water in calico Hills tuff) x .86 .14 vol% UO2 С 3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes 20-C 21-22-23-24-25-26-27-28-29-1001.50c 1.725021-2 8016.50c 4.353035-2 11023.50c 3.915909-4 m1 12000.50c 2.300604-4 13027.50c 2.593233-3 14000.50c 1.134633-2 19000.50c 5.529791-4 20000.50c 5.664925-4 26000.55c 1.396261-4 92234.50c 1.216825-6 92235.50c 6.479434-5 92236.50c 2.236042-5 92238.50c 3.327729-3 93237.50c 6.127100-6 lwtr.01t mt1 30 vol% water in calico Hills tuff C 1001.50c 2.005838-2 8016.50c 4.265802-2 11023.50c 4.553382-4 m2 12000.50c 2.675121-4 13027.50c 3.015387-3 14000.50c 1.319341-2 30-19000.50c 6.429990-4 20000.50c 6.587122-4 26000.55c 1.623559-4 31lwtr.01t mt2 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (s3530c) probid = 04/17/96 10:04:27 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 28110 neutron histories and 30 active cycles with 4000 neutrons per cycle. 120590 neutron histories. 148700 fission neutron source histories. this calculation has completed the requested number of keff cycles using a total of all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .99695 with an estimated standard deviation of .00203

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the estimated 68, 95, & 99 percent keff confidence intervals are .99489 to .99900, .99279 to 1.00110, and .99133 to 1.00256 the estimated collision/absorption neutron removal lifetime = 6.12E-05 seconds with an estimated standard deviation of 3.11E-07 May 23 16:33 1996 File Name: s3530d.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XCIV - Page 1

version 4a ld=10/01/93 04/17/96 11:02:51 1mcnp 04/17/96 11:02:51 probid = inp=s3530d outp=s3530d0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H20/ 14% UO2 (s3530d) 2-Calico Hills Tuff 1.746 g/cc .306 porosity - sphere surrounded by tuff С 3-С CELL SPECIFICATIONS 4 -С INNER WATER REGION 1 8.002310-2 -1 IMP:N=1 2 8.111211-2 1 -2 IMP:N=1 5-1 6-2 ٠ 7-С OUTSIDE WORLD 8-3 0 2 IMP:N=0 9-10-С SURFACE SPECIFICATIONS 11-SO 152 **\$** INNER FUEL ZONE -1 SO 212 12-2 **\$** INNER FUEL ZONE 13-14-MODE N 15-KCODE 4000 1. 7 37 KSRC 0 0 1 0 0 10 0 0 -20 0 0 29 0 20 5 0 0 -5 -10 0 -10 16-C 17-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 18-MATERIAL SPECIFICATIONS С 19-(30 vol% water in calico Hills tuff) x .86 .14 vol% UO2 С 20-3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes С 21-1001.50c 1.725021-2 8016.50c 4.353035-2 11023.50c 3.915909-4 m1 22-23-24-25-26-27-28-29-30-12000.50c 2.300604-4 13027.50c 2.593233-3 14000.50c 1.134633-2 19000.50c 5.529791-4 20000.50c 5.664925-4 26000.55c 1.396261-4 92234.50c 1.216825-6 92235.50c 6.479434-5 92236.50c 2.236042-5 92238.50c 3.327729-3 93237.50c 6.127100-6 mt1 lwtr.01t 30 vol% water in calico Hills tuff ~ 1001.50c 2.005838-2 8016.50c 4.265802-2 11023.50c 4.553382-4 12000.50c 2.675121-4 13027.50c 3.015387-3 14000.50c 1.319341-2 ៣2 19000.50c 6.429990-4 20000.50c 6.587122-4 26000.55c 1.623559-4 31lwtr.01t mt2 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (s3530d) probid = 04/17/96 11:02:51 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 28108 neutron histories and 30 active cycles with 4000 neutrons per cycle. 119667 neutron histories. this calculation has completed the requested number of keff cycles using a total of 147775 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .99551 with an estimated standard deviation of .00169

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the estimated 68, 95, & 99 percent keff confidence intervals are .99380 to .99722, .99205 to .99897, and .99083 to 1.00018 the estimated collision/absorption neutron removal lifetime = 6.03E-05 seconds with an estimated standard deviation of 3.09E-07 May 23 16:36 1996 File Name: s3530e.sum BBA000000-01717-0200-00016 REV 00 ATTACHMENT XCV - Page 1

ld=10/01/93 04/17/96 13:40:06 1mcnp version 4a probid = 04/17/96 13:40:06 inp=s3530e outp=s3530e0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (s3530e) 2-С Calico Hills Tuff 1.746 g/cc .306 porosity - sphere surrounded by tuff 3-C CELL SPECIFICATIONS 4 -C INNER WATER REGION 5-1 1 8.002310-2 -1 IMP:N=1 6-7-2 8.111211-2 1 -2 IMP:N=1 2 С OUTSIDE WORLD 8-9-3 0 2 IMP:N=0 10-С SURFACE SPECIFICATIONS 11-1 SO 153 **\$ INNER FUEL ZONE** 12-13-14-15-SO 213 \$ INNER FUEL ZONE 2 MODE N KCODE 4000 1. 7 37 16-KSRC 001 0010 00-20 0029 0205 00-5 -100-10 С 17-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 18-C MATERIAL SPECIFICATIONS 19-20-21-22-23-24-25-26-27-28-(30 vol% water in calico Hills tuff) x .86 .14 vol% UO2 C 3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes 1001.50c 1.725021-2 8016.50c 4.353035-2 11023.50c 3.915909-4 12000.50c 2.300604-4 13027.50c 2.593233-3 14000.50c 1.134633-2 C m1 12000.50c 2.300604-4 19000.50c 5.529791-4 20000.50c 5.664925-4 26000.55c 1.396261-4 92234.50c 1.216825-6 92235.50c 6.479434-5 92236.50c 2.236042-5 92238.50c 3.327729-3 93237.50c 6.127100-6 mt1 lwtr.01t 30 vol% water in calico Hills tuff 1001.50c 2.005838-2 8016.50c 4.265802-2 11023.50c 4.553382-4 m2 29-12000.50c 2.675121-4 13027.50c 3.015387-3 14000.50c 1.319341-2 30-19000.50c 6.429990-4 20000.50c 6.587122-4 26000.55c 1.623559-4 31mt2 lwtr.01t PRINT 32initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (s3530e) 04/17/96 13:40:06 probid = the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally 4000 neutrons per cycle. this problem has run 7 inactive cycles with 28463 neutron histories and 30 active cycles with 119992 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148455 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = .99939 with an estimated standard deviation of .00184

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the estimated 68, 95, & 99 percent keff confidence intervals are .99752 to 1.00125, .99560 to 1.00317, and .99428 to 1.00449 the estimated collision/absorption neutron removal lifetime = 6.02E-05 seconds with an estimated standard deviation of 3.12E-07

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1mcnp version 4a ld=10/01/93 04/17/96 14:12:23 probid = 04/17/96 14:12:23 inp=s3530a outp=s3530a0 Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (s3530a) 2-С Calico Hills Tuff 1.746 g/cc .306 porosity - sphere surrounded by tuff 3-С CELL SPECIFICATIONS INNER WATER REGION 4 -С 5-1 8.002310-2 -1 IMP:N=1 2 2 8.111211-2 1 -2 IMP:N=1 6-7-С OUTSIDE WORLD 8-3 0 2 IMP:N=0 ġ. 10-С SURFACE SPECIFICATIONS 11-SO 154.9 \$ INNER FUEL ZONE 12-2 SO 215 **\$ INNER FUEL ZONE** 13-14-MODE N KCODE 4000 1. 7 37 15 -KSRC 001 0010 00-20 0029 0205 00-5 -100-10 16-С 17-0 -5 -20 -10 0 -13 0 -10 14 0 0 -15 -10 -5 -16 5 5 0 10 10 17 C 18-MATERIAL SPECIFICATIONS С 19-С (30 vol% water in calico Hills tuff) x .86 .14 vol% UO2 20-3.5% Original Enrichment/ 30 GWD/MT decayed to Uranium isotopes С 21-223-234-254-26-278-28-29-30-1001.50c 1.725021-2 8016.50c 4.353035-2 11023.50c 3.915909-4 m1 12000.50c 2.300604-4 13027.50c 2.593233-3 14000.50c 1.134633-2 19000.50c 5.529791-4 20000.50c 5.664925-4 26000.55c 1.396261-4 92234.50c 1.216825-6 92235.50c 6.479434-5 92236.50c 2.236042-5 92238.50c 3.327729-3 93237.50c 6.127100-6 lwtr.01t mt1 30 vol% water in calico Hills tuff C 1001.50c 2.005838-2 8016.50c 4.265802-2 11023.50c 4.553382-4 12000.50c 2.675121-4 13027.50c 3.015387-3 14000.50c 1.319341-2 m2 19000.50c 6.429990-4 20000.50c 6.587122-4 26000.55c 1.623559-4 31mt2 lwtr.01t 32-PRINT initial source from file srctp 1keff results for: Far-Field Criticality Study - 3.5% /30 GWD/mt - 30% H2O/ 14% UO2 (s3530a) probid = 04/17/96 14:12:23 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 7 cycles and run a total of 37 cycles with nominally this problem has run 7 inactive cycles with 27814 neutron histories and 30 active cycles with 4000 neutrons per cycle. 121022 neutron histories. this calculation has completed the requested number of keff cycles using a total of 148836 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level the final estimated combined collision/absorption/track-length keff = 1.00132 with an estimated standard deviation of .00201

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the estimated 68, 95, & 99 percent keff confidence intervals are .99928 to 1.00336, .99720 to 1.00544, and .99576 to 1.00688 the estimated collision/absorption neutron removal lifetime = 6.04E-05 seconds with an estimated standard deviation of 2.73E-07

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May 21 10:28 1996 File Name: C1-4.0E-40GWD-30W15U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XCVII - Page 1

1mcnp 05/03/96 10:49:38 version 4a ld=10/01/93 probid = 05/03/96 10:49:38 INP=4.0EC OUTP=4EC.0 FarField Criticality - Sphere of Transmuted 4.0E 40GWD 30% Water 15% U-Np 02 1 -2-3-Ċ Criticality С 4 -5 -С SPHERE 7.99453107100-2 1 IMP:N=1 \$ Uranium/Tuff/Water 6-5 8.11121144000-2 1 - 2 IMP:N=1 \$ Tuff/Water Reflector 3 7-С 8-C OUTSIDE WORLD 9-30 0 IMP:N=0 \$ Void 2 10-11-С SURFACES 12-1 S 0 0 0 160.00 **\$** FISSILE SPHERE warning this surface has been replaced by a surface of type so 13-2 S 0 0 0 220.00 **S** REFLECTOR 14 -C. warning. this surface has been replaced by a surface of type so 15 -16-MODE N KCODE 500 17-3 1 1003 18-KSRC 0 0 0 0 0 0 0 -1 0 ۵ С 1 0 - 1 Ω 1 0 0 1 0 19-1 0 - 1 0 1 0 1 0 - 1 С 1 1 20-0 1 C 0 - 1 0 -1 -1 0 -1 - 1 1 - 1 21-22-23-24-25-26-27-28-29-30-C 0 0 -1 -1 0 - 1 1 0 -1 1 1 - 1 C 1 - 1 1 1 -1 -1 1 -1 -1 -1 92235.50C 6.773585-5 92236.50C 3.026400-5 M1 92234.50C 1.870334-6 S Fi 92238.50C 3.557954-3 93237.50C 8.847626-6 8016.50C 4.359266-2 \$ At 1001.50C 1.704962-2 \$ an 14000.500 1.121440-2 13027.50C 2.563079-3 \$ Ca 26000.550 1.380025-4 12000.50C 2.273853-4 20000.50C 5.599054-4 \$ Wi 11023.50C 3.870375-4 19000.50C 5.465492-4 \$ 30 \$ Wa \$ Ca MT1 LWTR.01T 1001.500 2.005838-2 14000.50C 1.319341-2 13027.50C 3.015387-3 M3 31-8016.50C 4.265802-2 \$ Wī \$ 30 32-26000.550 1.623559-4 12000.500 2.675121-4 20000.500 6.587122-4 33-11023.50C 4.553382-4 19000.50C 6.429990-4 ŝ 34 -MT3 LWTR.01T \$ Wa 35-PRINT 1 initial source from file srctp 1keff results for: FarField Criticality - Sphere of Transmuted 4.0E 40GWD 30% Water 15% U-Np 02 probid = 05/03/96 10:49:38 the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 3 cycles and run a total of 1003 cycles with nominally 500 neutrons per cycle. 1510 neutron histories and 1000 active cycles with 499501 neutron histories. this problem has run 3 inactive cycles with this calculation has completed the requested number of keff cycles using a total of 501011 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level

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the final estimated combined collision/absorption/track-length keff = .98060 with an estimated standard deviation of .00088 the estimated 68, 95, & 99 percent keff confidence intervals are .97971 to .98148, .97884 to .98235, and .97827 to .98293 the estimated collision/absorption neutron removal lifetime = 5.68E-05 seconds with an estimated standard deviation of 1.50E-07 May 20 16:11 1996 File Name: C2-4.0E-40GWD-30W15U BBA000000-01717-0200-00016 REV 00 ATTACHMENT XCVIII - Page 1 ld=10/01/93 05/01/96 19:21:29 1mcnp version 4a ************* probid = 05/01/96 19:21:29 INP=4E30.9RS OUTP=4E.9RS.0 FarField Criticality - Sphere of Transmuted 4.0E 40GWD 30% Water 15% U-Np 02 2-3-С .985 k-eff Reflector Savings С 4 -5 -C SPHERE 7.99453107100-2 1 IMP:N=1 \$ Uranium/Tuff/Water 6-7-5 8.11121144000-2 1 - 2 IMP:N=1 \$ Tuff/Water Reflector -3 С 8-С OUTSIDE WORLD <u>9</u>-30 0 2 IMP:N=0 \$ Void 10-11-С SURFACES 12-0 0 0 187.00 **\$** FISSILE SPHERE 1 S warning this surface has been replaced by a surface of type so 13-0 0 0 247.00 **\$** REFLECTOR 2 S 14 this surface has been replaced by a surface of type so warning. 15 -16-MODE N 17-KCODE 500 1 3 1003 18-С KSRC 0 Õ 0 1 0 0 - 1 0 n 0 1 0 0 -1 0 0 0 1 0 19-0 1 0 -1 С 1 0 - 1 0 1 1 1 -1 20-0 -1 -1 -1 0 - 1 0 -1 С 0 1 - 1 1 21 -22 -23 -24 -25 -26 -27 -28 -29 -30 -С 0 1 0 -1 0 1 - 1 0 -1 -1 1 1 -1 -1 -1 -1 -1 C 1 1 -1 1 1 1 92234.50C 1.870334-6 92235.50C 6.773585-5 92236.50C 3.026400-5 M1 \$ Fi 92238.50C 3.557954-3 93237.50C 8.847626-6 8016.50C 4.359266-2 \$ At 1001.50C 1.704962-2 \$ an 14000.50C 1.121440-2 13027.50C 2.563079-3 \$ Ca 26000.55C 1.380025-4 11023.50C 3.870375-4 12000.50C 2.273853-4 20000.50C 5.599054-4 \$ ₩i 19000.500 5.465492-4 \$ 30 MT1 LWTR.01T \$ Wa \$ Ca M3 1001.50C 2.005838-2 14000.50C 1.319341-2 13027.50C 3.015387-3 31-8016.500 4.265802-2 \$ Vi 32-26000.55C 1.623559-4 12000.50C 2.675121-4 20000.50C 6.587122-4 \$ 30 33-11023.50C 4.553382-4 19000.50C 6.429990-4 34 -MT3 LWTR.01T \$ Va 35 -PRINT initial source from file srctp 1 1keff results for: FarField Criticality - Sphere of Transmuted 4.0E 40GWD 30% Water 15% U-Np 02 05/01/96 19:21:29 probid = the initial fission neutron source distribution was read from the srctp file named srctp the criticality problem was scheduled to skip 3 cycles and run a total of 1003 cycles with nominally this problem has run 3 inactive cycles with 1462 neutron histories and 1000 active cycles with 500 neutrons per cycle. 500449 neutron histories. this calculation has completed the requested number of keff cycles using a total of 501911 fission neutron source histories. all cells with fissionable material were sampled and had fission neutron source points. the results of the w test for normality applied to the individual collision, absorption, and track-length keff cycle values are: the k(collision) cycle values appear normally distributed at the 95 percent confidence level the k(absorption) cycle values appear normally distributed at the 95 percent confidence level the k(trk length) cycle values appear normally distributed at the 95 percent confidence level