



CALCULATION SUMMARY SHEET (CSS)

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Title COMMERCIAL REACTOR CRITICALITY DEPLETION FOR GRAND GULF, UNIT 1

PREPARED BY:

REVIEWED BY:

METHOD: DETAILED CHECK INDEPENDENT CALCULATION

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COST CENTER 212020 REF. PAGE(S) 71

TM STATEMENT: REVIEWER INDEPENDENCE *wsl*

PURPOSE AND SUMMARY OF RESULTS:

Purpose: The purpose of this calculation is to document the Grand Gulf, Unit 1 (GG1), fuel depletion calculations.

Summary: The summary of the isotopes for each State-Point is provided in the applicable computer run. A summary of all calculational files begins on page 70 of this file.

This revision affects references only. Calculation results are not affected in any way by this revision.

THE FOLLOWING COMPUTER CODES HAVE BEEN USED IN THIS DOCUMENT:

THE DOCUMENT CONTAINS ASSUMPTIONS THAT MUST BE VERIFIED PRIOR TO USE ON SAFETY-RELATED WORK

CODE/VERSION/REV

CODE/VERSION/REV

SCALE, VERSION 4.4A

YES

NO

FIGURES

	Page
Figure 1. GG1 Cycle 2 Fuel Assembly Identification and Location	23
Figure 2. GG1 Cycle 3 Fuel Assembly Identification and Location	24
Figure 3. GG1 Cycle 4 Fuel Assembly Identification and Location	25
Figure 4. GG1 Cycle 5 Fuel Assembly Identification and Location	26
Figure 5. GG1 Cycle 6 Fuel Assembly Identification and Location	27
Figure 6. GG1 Cycle 7 Fuel Assembly Identification and Location	28
Figure 7. GG1 Cycle 8 Fuel Assembly Identification and Location	29
Figure 8. Nodal Average U235 wt% vs. "Cross-section"	41
Figure 9. Path B Model with Central Cell Representing a Gadolinium Rod.....	47
Figure 10. Grand Gulf Unit 1 Control Blade Information.....	48

RECORD OF REVISIONS

<u>Revision Number</u>	<u>Date</u>
00 (Initial)	July 2003
01	December 2004

- Revised Calculation Summary Sheet to note that this revision does not affect calculation results in any way.
- Revised title for Reference 7.11, page 6 of 427.
- Revised title for Reference 7.11, page 71 of 427.
- Completed Design Verification Checklist to reflect revisions.

1. PURPOSE

The objective of this calculation is to document the Grand Gulf, Unit 1 (GG1), fuel depletion calculations. The GG1 reactor is a boiling water reactor (BWR) owned and operated by Entergy Operations Inc. The Commercial Reactor Criticality (CRC) evaluations support the development and validation of the neutronic models used for criticality analyses involving commercial spent nuclear fuel in a geologic repository. This calculation is performed as part of the evaluation CRC program.

This report is an engineering calculation supporting the burnup credit methodology of YMP 2000 (Reference 7.5) and was performed under Framatome ANP Administrative Procedure 0402-01, Preparing and Processing FANP Calculations (Reference 7.4) and Framatome Fuel Sector Quality Management Manual (Reference 7.11). This calculation is subject to the Quality Assurance Requirements and Description (Reference 7.6) per the activity evaluation under work package number ACRM02 in the technical work plan TWP-EBS-MD-000014 REV 00 (Reference 7.8).

2. METHOD

The calculational method used to perform the fuel depletion calculations consists of using the SCALE code system to deplete GG1 fuel assemblies. The selected fuel assemblies are depleted through their unique operating histories such that their modified fuel compositions are available at specified exposure times. These exposure times correspond to the time (state-points) at which detailed core reactivity calculations are available. Each fuel assembly depletion calculation is based on detailed core follow information.

3. ASSUMPTIONS

The following assumptions were used for all depletion calculations. It necessary, additional confirmatory sensitivity calculations can be performed to evaluate the impact of the modeling assumption.

- 3.1 It is assumed that the approximation of uniformly distributed non-fuel lattice cells in the Path B models of the SAS2H calculations is acceptable within the fidelity of these calculations. The basis for this assumption is provided in the SAS2H manual, Section S2.2.3.1 of Volume 1, Rev. 6 in Oak Ridge National Laboratory (ORNL) 2000 of Reference 7.1.
- 3.2 It is assumed that the 44-group ENDF/B-V cross section library, which was originally collapsed from the 238-group ENDF/B-V cross section library using a fuel cell spectrum described by a PWR assembly, is considered acceptable for BWR depletions. The applicability of this cross section collapsing method for BWR assemblies has not been determined. A known bias caused by inadequate plutonium cross-section representation has been identified. The basis for this assumption is provided in the SAS2H manual, Section M4.2.9 of Volume 3, Rev. 5 in Oak Ridge National Laboratory (ORNL) 1995 of Reference 7.10, p M4.2.29.

6. REFERENCES

- 7.1 *SAS2H: A Coupled One-Dimensional Depletion and Shielding Analysis Module*, NUREG/CR-200, Revision 6, Volume 1, Section S2, ORNL/NUREG/CSD-2/V2/R6, March 2000. Distributed by the Computational Physics and Engineering Division, Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee
- 7.2 *Nuclides and Isotopes, Chart of the Nuclides*, Fifteenth Edition, 1996. San Jose, California, General Electric Corporation and KAPL, Inc. (BSC TIC: 233705)
- 7.3 Framatome ANP Doc. 38-5028974-00, June 2003, DOE, *Summary Report of Commercial Reactor Criticality Data for Grand Gulf Unit 1*, TRN-UDC-NU-000002 REV 00, Bechtel SAIC Company, LLC, Las Vegas, Nevada
- 7.4 Framatome ANP, Administrative Procedure, Number: 0402-01, Preparing and Processing FANP Calculations, February 2003, Framatome ANP, Lynchburg, VA
- 7.5 YMP (Yucca Mountain Site Characterization Project) 2000, *Disposal Criticality Analysis Methodology Topical Report*, YMP/TR-004Q, Rev. 1. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.20001214.0001.
- 7.6 DOE 2002. *Quality Assurance Requirements and Description*, DOE/RW-0333P, Rev. 12, Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20020819.0387.
- 7.7 Framatome ANP Doc. 38-5029126-00, June 2003, *Calculation of Isotopic Bias and Uncertainty for PWR SNF*, CAL-DSU-NU-000001 REV A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: MOL.20020814.0055.
- 7.8 *Technical Work Plan for: Risk and Criticality Department*. TWP-EBS-MD-000014 REV 00. Las Vegas, Nevada: Bechtel SAIC Company. ACC: MOL.20021209.0011.
- 7.9 CRC Handbook of Chemistry and Physics, 58th Edition (BSC TIC: 24512)
- 7.10 Oak Ridge National Laboratory (ORNL) 1995. *SCALE, Version 4.3: Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation*, User's Manual Volumes 0 through 3. Document Number: CCC-545 Oak Ridge, Tennessee: Distributed by the Radiation Shielding Information Center. TIC: 235920
- 7.11 AREVA/FANP Document Number FQM Rev 01, July 2003. Framatome ANP, Inc. Fuel Sector Quality Management Manual (US Version).



DESIGN VERIFICATION CHECKLIST

Document Identifier 32 - 5028092 - 01

Title Commercial Reactor Criticality Depletion for Grand Gulf, Unit 1

1.	Were the inputs correctly selected and incorporated into design or analysis?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
2.	Are assumptions necessary to perform the design or analysis activity adequately described and reasonable? Where necessary, are the assumptions identified for subsequent re-verifications when the detailed design activities are completed?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
3.	Are the appropriate quality and quality assurance requirements specified? Or, for documents prepared per FANP procedures, have the procedural requirements been met?	<input checked="" type="checkbox"/> Y	<input type="checkbox"/> N	<input type="checkbox"/> N/A
4.	If the design or analysis cites or is required to cite requirements or criteria based upon applicable codes, standards, specific regulatory requirements, including issue and addenda, are these properly identified, and are the requirements/criteria for design or analysis met?	<input checked="" type="checkbox"/> Y	<input type="checkbox"/> N	<input type="checkbox"/> N/A
5.	Have applicable construction and operating experience been considered?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
6.	Have the design interface requirements been satisfied?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
7.	Was an appropriate design or analytical method used?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
8.	Is the output reasonable compared to inputs?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
9.	Are the specified parts, equipment and processes suitable for the required application?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
10.	Are the specified materials compatible with each other and the design environmental conditions to which the material will be exposed?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
11.	Have adequate maintenance features and requirements been specified?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
12.	Are accessibility and other design provisions adequate for performance of needed maintenance and repair?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
13.	Has adequate accessibility been provided to perform the in-service inspection expected to be required during the plant life?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
14.	Has the design properly considered radiation exposure to the public and plant personnel?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
15.	Are the acceptance criteria incorporated in the design documents sufficient to allow verification that design requirements have been satisfactorily accomplished?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
16.	Have adequate pre-operational and subsequent periodic test requirements been appropriately specified?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
17.	Are adequate handling, storage, cleaning and shipping requirements specified?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
18.	Are adequate identification requirements specified?	<input type="checkbox"/> Y	<input type="checkbox"/> N	<input checked="" type="checkbox"/> N/A
19.	Is the document prepared and being released under the FANP Quality Assurance Program? If not, are requirements for record preparation review, approval, retention, etc., adequately specified?	<input checked="" type="checkbox"/> Y	<input type="checkbox"/> N	<input type="checkbox"/> N/A

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Comments:

See Record of Revisions for change to Reference. No other parts were affected.

Verified By:

Mehmet Saglam

(First, MI, Last)

Printed / Typed Name

A handwritten signature in black ink, appearing to read 'M. Saglam', written over a horizontal line.

Signature

12/8/04

Date

Framatome ANP, Inc., an AREVA and Siemens company