

ENGINEERING DESIGN FILE

EDF-7885 ³⁵ per C. Satterwhite MS

EDF No.: 7835 EDF Rev. No.: 0 Project File No.: _____

1. Title: Hazard Classification for AFIP-1 ATRC Experiment Transfer				
2. Index Codes: Building/Type <u>N/A</u> SSC ID <u>N/A</u> Site Area <u>RTC</u>				
3. NPH Performance Category: _____ or <input checked="" type="checkbox"/> N/A				
4. EDF Safety Category: _____ or <input checked="" type="checkbox"/> N/A SCC Safety Category: _____ or <input checked="" type="checkbox"/> N/A				
5. Summary: This document presents the results of the hazard categorization for the transfer from Materials and Fuels Complex of the unirradiated AFIP-1/ATRC experiment to the Advanced Test Reactor Critical facility. In order to determine the safety basis required, this transfer activity was categorized according to the methodology prescribed in laboratory procedures. The transfer is categorized as a less than hazard category 3.				
6. Review [R] and Approval [A] and Acceptance [Ac] Signatures: [See instructions for definitions of terms and significance of signatures.]				
	R/A	Typed Name/Organization	Signature	Date
Performer/Author	N/A	CA Satterwhite/G125	<i>C. Satterwhite</i>	2/27/2007
Technical Checker	R	JF Williams/G121	<i>J.F. Williams</i>	2/27/07
Independent Peer Reviewer [if applicable]	R	NA		
Approver	A	JC Chapman/G125	<i>J.C. Chapman</i>	22 March 2007
Requestor [if applicable]	Ac	EJ Schuebert/G111	<i>E. Schuebert</i>	3/6/07
Doc. Control		KATHY SCHRECK	<i>Kathy Schreck</i>	3/27/07
7. Distribution: [Name and Mail Stop] Original to Document Control				
8. Does document contain sensitive unclassified information? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If Yes, what category:				
9. Can document be externally distributed? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No				
10. Uniform File Code: 286 Disposition Authority: RD1-B-9-c Cut off after project/program completion; cancellation or termination. Record Retention Period: Destroy 10 years after project/program termination.				
11. For QA Records Classification Only: <input type="checkbox"/> Lifetime <input type="checkbox"/> Nonpermanent <input type="checkbox"/> Permanent Item and activity to which the QA Record apply:				
12. NRC related? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No				

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13. Registered Professional Engineer's Stamp [if required]

Hazard Analysis

1. FACILITY ACTIVITY/DESCRIPTION

1.1 Introduction

The purpose of this document is to provide a hazard categorization per the requirements in Subpart B, "Safety Basis Requirements," of Code of Federal Regulations [10CFR830] for the transfer of an experiment inside the Reactor Technology Complex boundary.ⁱ Subpart B requires that if an activity has a hazard categorization of level 1, 2, or 3 work must be performed according to a safety basis which in this case could be an experiment safety analysis or a transport plan. In order to determine the safety basis required, this transfer activity was categorized according to the methodology prescribed in laboratory procedures which implement the regulations and requirements.

1.2 Description

The experiment transfer is for the Reduced Enrichment Research and Test Reactors Program's project for Advanced Test Reactor [ATR] full-size-plates-in-the-center-flux-trap-position, which is the AFIP-1 experiment. The program consists of irradiation testing of fuel at moderate power to a moderate burn-up. Prior to experiment insertion in the ATR reactor, nuclear data measurements and related testing of an experiment mock-up will be performed in the Advanced Test Reactor Critical [ATRC] facility. The ATRC facility will receive unirradiated AFIP-1/ATRC fuel to assemble an experiment mockup. The fuel, in the form of plates, is fabricated at the Materials and Fuels Complex [MFC]. The fuel in the plates is enriched radioactive uranium [U-238]. The U-238 is 25 percent [nominal] enriched with uranium 235. [See data in Appendix] The experiment composition is listed in Table 1. The performance of the experiment in the ATRC facility is governed by a test plan, and is outside the scope of this document.

2. HAZARD ANALYSIS

2.1 Requirements

This analysis was conducted per NS-18102, "INL Facility Categorization Process" requirements.ⁱⁱ This document was used in conjunction with Laboratory-wide Procedure, LWP-18002, "INL Facility Categorization".ⁱⁱⁱ Guidance for this analysis is in DOE-STD-1027-92, "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23 Nuclear Safety Analysis Reports".^{iv}

2.2 Hazard Classification

Per DOE-STD-1027, categorization is based on the unmitigated release of the radioactive material inventory. Evaluation of the radioactive material inventory for release can consider the location, or segregation, dispersibility of the material, interaction with available energy sources, and/or the possible initiating events or release mechanisms.^{iv} The 10CFR830 requirement is that if an activity has a hazard categorization of level 1, 2, or 3 then work must be performed according to a safety basis. However there are some allowed exclusions to this requirement such as transportation activities regulated by the Department of Transportation.ⁱ

2.2.1 Hazard Categorization Designation

The hazard categorization process is performed to determine the safety basis documentation required to support the activity. The hazard categorization required by DOE-STD-1027 is performed by making a direct comparison of the radioactive material inventory within the facility or operation to the Hazard Category 2 and 3 [HC-2 and HC-3] threshold quantity values [TQVs] listed in the standard.^{iv} The activity is further categorized per NS-18102 by comparing quantities of radioactive material inventory to the reportable quantities in Appendix B of 40 CFR 302.^v If the radioactive material inventory of the facility does not meet or exceed the threshold quantities for Hazard Category 3, it is categorized as a "radiological facility" then if the radioactive material inventory of the facility does not meet or exceed the criteria in Appendix B of 40 CFR 302, it is designated as an "other facility" for the purpose of safety analysis. Both these classifications are less than hazard Category 3.

Shipments at Idaho National Laboratory [INL] are to be in compliance with the Department of Transportation Hazardous Materials Regulations [DOT HMR]. If unable to comply with the DOT HMR and restricted to a route within

the laboratory geographic boundary, then shipment is in accordance with the INL transportation safety document [INL TSD].^{vi} The INL TSD defines such a shipment as non-routine and specifies that it be conducted in accordance with an approved transport plan. Transport plans as safety basis documents are governed by the DOE's nuclear facility management rule as applicable depending on the hazard category.ⁱ For hazard category 3 or greater, the INL TSD, with the transport plan appended to it, is the safety basis for the shipment. For less-than-hazard-category-3, the transport plan by itself is the safety basis for the shipment. Laboratory procedures govern the receipt and shipment of radioactive and fissile material.

2.2.2 Radioactive Material Inventory

The activity to be categorized is the transfer from MFC of the unirradiated AFIP-1/ATRC experiment to ATRC. Based on the methodology in NS-18102, the radioactive material inventory was compared to the TQVs of DOE-STD-1027 and a ratio calculated. The sum of the ratios must be less than one in order to remain below a categorization designation. The experiment radioactive inventory consists of two isotopes of uranium [See Appendix] and is listed in Table 1.

Table 1. Fuel Plate Nominal Constituent Masses

Fuel Plate	Fuel Type	Fuel Phase Composition	Fuel Phase Constituent Masses (grams)		
			U-238	U-235	Total U
A-1	disp	U-7Mo	55.5	18.5	74.0
A-2	disp	U-7Mo	55.5	18.5	74.0
B-1	blank	n/a		0.0	0.0
B-2	blank	n/a		0.0	0.0
Total			111	37.0	148.0

The inventory data was entered into a Microsoft® EXCEL 2003 spreadsheet run with Microsoft® Windows XP on a Dell OptiPlex GX620 personal computer and the ratio between the inventory and each category's TQV calculated. First the DOE-STD-1027 ratio was calculated based on threshold values for U-235 assuming no potential for a criticality due to the mass being well below the critical value.^{vii} Second, it was calculated with 40 CFR 302 threshold values after converting grams to curies. In either case the resulting ratio is less than one [see Table 2]. Thus the transfer is categorized as a less than hazard category 3 "other facility".

Table 2. Ratio Calculation Results

Nuclide	Inventory grams	DOE-STD-1027	DOE-STD-1027	40CFR302 Ratio	40CFR302 TQV Ci	Inventory Ci	Ci/gm ^{viii}
		HC 3 TQV Ratio	HC 3 TQV grams				
U-235	3.7E+01	1.9E-05	1.9E+06	8.0E-04	0.1	8.0E-05	2.16E-06
U-238	1.1E+02	8.5E-06	1.3E+07	3.7E-04	0.1	3.7E-05	3.36E-07
Total ratio		2.8E-05		1.2E-03			

2.3 Conclusion

The hazard category associated with this shipment is identified. If the activity is regulated by the Department of Transportation via the laboratory procedures it is excluded from the hazard categorization requirement of having a safety basis document. The actions necessary to mitigate the hazards to acceptable levels are in laboratory procedures. If the experiment is not transferred per DOT requirements then a transport plan is the safety basis needed for the shipment.

3. REFERENCES

- i. Nuclear Safety Management”, Title 10 Code of Federal Regulations [CFR] Part 830, Office of the Federal Register, January 2001
- ii. NS-18102, “INL Facility Categorization Process”
- iii. LWP-18002, “INL Facility Categorization”
- iv. DOE-STD-1027-92, “Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports,” U.S. Department of Energy, Change 1, September 1997
- v. Title 40 of the Code of Federal Regulations Part 302, Protection of Environment, Designation, Reportable Quantities, and Notification, Office of Federal Register
- vi. PRD-310, INL Site Transportation Safety Document
- vii. LRD-18001, INL Criticality Safety Program Requirements Manual
- viii. LA-12981-MA, Table of DOE-STD-1027-92 Hazard Category 3 Threshold Quantities for the ICRP-30 List of 757 Radionuclides, LANL Fact Sheet, Los Alamos National Laboratory, August 1995

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APPENDIX

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11/20/2006 10:08 AM

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Subject AFIP

FYI



AFIP-1 mass-dens NOM.xls

Constituents	Atomic Wt.	Density	Element
Elem1:	238.0	18.90	LEU
Elem2:	95.9	10.20	Mo
Elem3:	47.9	4.50	Ti
Elem4:	91.2	6.49	Zr

AFIP-1 Fuel Plate Nominal Constituent Masses.

Fuel Plate	Plate ID	Fuel Type	Fuel Phase Composition	Martix Phase	Foil Thickness (mm)	Fabrication Technique	Fuel Meat Mass	Fuel Phase Constituent Masses (g)		
								Total U	U-235	Mo
A-1	tbd	disp	U-7Mo	Al-4043	---	Roll	79.5	74.0	18.5	5.6
A-2	tbd	disp	U-7Mo	Al-2.0 Si	---	Roll	79.5	74.0	18.5	5.6
B-1	tbd	blank	n/a	--	--	n/a	0.0	0.0	0.0	0.0
B-2	tbd	blank	n/a	--	--	n/a	0.0	0.0	0.0	0.0
Totals:								148.0	37.0	11.1

Analysis Plan [per MCP-2374]

Task Description:

Hazard category will be determined for experiment transfer to ATRC to determine the safety basis documentation required.

Technical Requirements:

Calculate DOE-STD-1027 ratio using Microsoft® EXCEL 2003 spreadsheet run with Microsoft® Windows XP on a Dell OptiPlex GX620 personal computer.

Deliverables:

Conclusions based on analysis results will be used to determine type of safety basis if any is required for the transfer.

Assumptions:

Calculations will be based on the best data available at the time of execution. Conservatism will be applied when appropriate.

Task Constraints or Prerequisites:

Inventory data is provided by the requesting organization by email.

Analysis Verification:

Describe the level of checking needed:

Per MCP-2374 either method listed below should be applied

1. Hand calculations
2. independently checking the equations and algorithms for correctness and applicability and assess the input and output values for each

Independent Peer Review Required: Yes No

(An independent peer review is required by DOE-STD-1020 for analyses of SSCs that include the consideration of NPH loads and that are classified PC-2 and higher.)

Performer/Organization Interfaces:

Interface between BEA and MFC is necessary to ensure fuel plate data is transferred.

Controlling Documents:

MCP-2374, "Analyses and Calculations", NS-18102, "INL Facility Hazard Categorization Process" and LWP-18002, "INL Facility Categorization"