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SUPPORTING DOCUMENT

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Name: R. F. Richard

R.F. Richard
Signature

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7. Abstract

This CSER establishes the technical basis for allowing N Reactor fuel, that is currently located on the PUREX dissolver cell floor, to be retrieved, placed into Mark II canisters and stored on the fuel canister rack.

8. RELEASE STAMP

CSER 95-001

Title: CRITICALITY SAFETY EVALUATION REPORT FOR PUREX FUEL CANISTER RACK

Prepared by: R.F. Richard
Engineer, Criticality & Radiological Analyses

Date: 2-9-95

Reviewed by: Tony Chica
Engineer, Criticality & Radiological Analyses

Date: 2-13-95

Approved by: Bob Lalle
Manager, Criticality & Radiological Analyses

Date: 2-16-95

Introduction and Summary

This Criticality Safety Evaluation Report (CSER) establishes the technical basis for allowing N Reactor fuel, that is currently located on the PUREX dissolver cell floor, to be retrieved, placed into Mark II canisters and stored on the fuel canister rack.

Since the amount of fuel involved is far below the N Reactor fuel critical mass, it is concluded that there is a large safety margin and the system will remain safely subcritical.

Description of System

N Reactor fuel recovered from the PUREX dissolver cell floor will be stored in canisters before shipment to the K Basins. Review of crane operator logs and inspection of B Cell has revealed that there are 40 fuel elements on the floor consisting of 27 inner elements and 12 1/2 outer elements. In addition, there is also one aluminum clad element that is most likely from prior to N Reactor operation and is therefore a 0.95 wt%(or less) fuel element.

The fuel will be retrieved and placed into Mark II canisters provided by K Basins. The canisters will be filled with water and then stored in the new canister rack. The rack will store 4 canisters back-to-back separated by 2 inch by 2 inch square tubing. The rack allows two rows of 4 canisters separated by approximately 3 feet. They will be stored on the PUREX deck. PUREX has been shutdown for over a year and so for the most part the deck is clear of operating material. There is no other fuel in PUREX except for SPR aluminum clad fuel that will remain in the Slug Storage Basin at the east end of the plant.

Accident or Error Condition

A conceivable accident would be for the fuel to somehow fall out of the canisters onto the deck. In this case the most reactive fuel configuration would be a hemisphere.

Analyses and Results

Criticality safety calculations have previously been performed that determined the critical mass for unirradiated N Reactor fuel (Reference 1). In the event of a spill the most reactive configuration of the fuel would be a hemispherical shape on the deck. Critical masses from reference 1 for both spherical and hemispherical geometries are reproduced in Table 1.

Table 1. Critical Masses for N Reactor Fuel (kg)				
	Sphere		Hemispherical	
Fuel Form	MK IV	MK 1A	MK IV	MK 1A
assemblies	7795	1893	12569	3211
outers	5273	1087	8522	1864
inners	4220	4315	6898	7068

The total fuel mass of the N Reactor fuel on the dissolver cell floor is less than 400 kilograms (Reference 2). A conservative total fuel mass of 500 kilograms would more than account for the addition of any reasonable fuel mass that might be contained in the aluminum clad element.

From inspection of Table 1 it can be seen that MK 1A outers have the smallest critical mass of the various fuel forms. If the assumption is made that the fuel consists entirely of MK 1A outers, then the 500 kilograms represents at most 46% of a critical mass. For any other fuel type the mass represents a smaller percentage of a critical mass. Arrangement of the fuel into a sphere is not a realistic configuration and is only presented to acknowledge the most conservative geometry conceivable. Instead, separation of the fuel mass will be provided by the containers. A container will typically hold 8 pieces of fuel and they will be separated by 2 inch square tube. In addition, the fuel rack will provide about 3 feet of separation between two rows of 4 containers. The low mass, fuel form and the separation provided by the containers assure a subcritical configuration.

In the event that the fuel spills onto the deck the most reactive, and therefore conservative, geometry would be a hemisphere. Critical masses for the hemispherical geometry are larger than for the sphere, so that the 500 kilograms of fuel represents a smaller percentage of a critical mass. Flooding is considered not to be credible. If double batching is assumed the total mass is still less than a critical mass.

Table 2 shows the percent of a critical mass 500 kilograms represents for the various fuel forms.

Table 2. Percent of Critical Mass				
Fuel Form	Sphere		Hemispherical	
	MK IV	MK 1A	MK IV	MK 1A
assemblies	6%	26%	4%	16%
outers	9%	46%	6%	27%
inners	12%	12%	7%	7%

It is clear that the small amount of fuel on the dissolver cell floor is well below that needed to attain a critical mass and therefore, a criticality is not a credible event.

Technical Review

T. Chiao of Criticality Radiological Analyses carried out the independent, technical review of "CSAR 95-001, Criticality Safety Evaluation Report for PUREX Fuel Canister Rack" and provided the following comments.

The criticality safety evaluation was reviewed for technical adequacy for the Criticality Safety considerations for PUREX Fuel Canister Rack. The references and logic were confirmed to establish the intended conclusions. Some comments and suggested clarifications were discussed with the author of this CSER. Additional comments are provided below.

The quantity of fuel mass of the N Reactor fuel elements are well defined and using a total fuel mass of 500 kilograms for criticality evaluation is adequate and conservative. In the accident situation defined in this evaluation, the forming of a hemisphere under full water reflection seems incredible.

The reviewer agrees the assumptions and logic adopt in this evaluation and concurs the conclusions derived in this ADDENDUM.

References

1. WHC-SD-NR-CSER-010 REV 0, "Criticality Safety Evaluation Report for 300 Area N Reactor Fuel Fabrication and Storage Facility", KN Schwinkendorf, January 24, 1994.
2. Personal Communication with Mark B. Enghusen on January 31.1995.