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7. Abstract

This report documents the determination that the in-basin activities associated with the fuel characterization program are classified as Hazard Category 3 (hazard analysis shows the potential for only significant localized consequences).

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HAZARD CATEGORIZATION OF 100K EAST AND 100K WEST IN-BASIN FUEL CHARACTERIZATION PROGRAM ACTIVITIES

1.0 PURPOSE AND SCOPE

The purpose of this report is to provide a hazard categorization of the 105 K East (KE) and 105 K West (KW) in-basin activities associated with the fuel sampling and transport preparations.

The scope of this hazard categorization is limited to those characterization activities performed in the 105 KE and 105 KW fuel storage basin structures.

The methodology of DOE Standard DOE-STD-10227-92 (Reference 6.1) is used for this hazard categorization.

2.0 SUMMARY

Review of the in-basin activities and potential accident consequences associated with the fuel characterization program indicate that the activities are Hazard Category 3.

3.0 DESCRIPTION OF SIGNIFICANT ACTIVITIES

The significant activities that will occur at the 105 KE and 105 KW basins during the fuel characterization program (Reference 6.2) are as follows:

3.1 Canister transport to the south loadout pit transfer channel

Canisters that have been chosen for fuel element shipment and examination will be transported from their main storage basin rack locations to the south loadout pit transfer channel using current canister hoists and canister-handling tools.

3.2 Canister decapping (KW only)

Once in the south loadout pit transfer channel, canisters will be decapped using current canister-handling tools. Fuel elements chosen for examination will be removed from the fuel storage canister and placed in single element canisters in preparation for shipment to the 327 facility.

3.0 DESCRIPTION OF SIGNIFICANT ACTIVITIES (continued)

3.3 Single element canister hydrogen generation pressure test

After placement of a fuel element in the single element canister, the canister will be sealed and monitored for pressure increase. The pressure measurements will be evaluated to ensure that any hydrogen generation is within transportation limits. Once the pressure test is complete, a new, vented lid will be installed on the single element canister.

3.4 Loading single element canisters into the shipping cask and decontaminating cask internal surfaces

A Chem Nuclear CNS-1-13G (or equivalent) cask will be used for the shipment of fuel. A single element canister can hold one assembly, an inner element, or an outer element. A maximum of three single element canisters may be placed in the shipping cask subject to an equivalent ^{235}U weight limit of 500 grams. In practical terms, this limits shipments to any combination of fuel having a mass that is equivalent to or less than three Mark IV type E fuel outer elements.

The outside surfaces of the cask will be coated with a strippable paint to minimize decontamination efforts after the cask is removed from the south loadout pit.

The steps to be taken for cask loading are as follows:

- a) The cask will be placed in the south loadout pit.
- b) The single element canister(s) will be placed in the shipping cask.
- c) Gross particulates will be flushed out of the cask, as practical.
- d) The cask lid will be installed (but not sealed). The cask will be lifted from the south loadout pit and allowed to drain.
- e) If required for decontamination purposes, the internal cavity of the cask will be filled with water from the drain port and then the flush water will be drained from the cask.
- f) The cask will be sealed.
- g) The strippable paint will be removed, the cask will be surveyed and then readied for placement on the flat-bed trailer.

3.5 Placement of shipping cask on flat-bed trailer

The building 27,215 kilogram (30-ton) capacity crane will be used to lift the shipping cask from the south loadout pit and place it on the flat-bed trailer. The trailer will be positioned to the south of the south loadout pit/transfer channel area.

3.0 DESCRIPTION OF SIGNIFICANT ACTIVITIES (continued)

3.6 Receipt of test elements back from the 327 facility

After characterization analysis activities on specific fuel elements are completed, the elements or element pieces will be shipped back to the appropriate basin in single element canisters inside the shipping cask. Up to three single element canisters may be shipped at one time. The trailer containing the shipping cask will be backed into the west end of the basin structure south of the south loadout pit and the shipping cask will be lowered into the south loadout pit using the building crane. Fuel elements will be placed in Mark II canisters in the south loadout pit transfer channel and placed in a main basin storage rack location. Small pieces of fuel returned from the 327 facility may be placed into scrap canisters.

Fuel elements/pieces returning to the 105 KE basin will be placed in open Mark II canisters for storage in the main storage basin. Fuel elements/pieces returning to the 105 KW basin will be encapsulated prior to storage in the main basin.

3.7 Re-encapsulation of opened canisters (KW only)

Canisters that are opened for removal of fuel elements must be sealed and encapsulated prior to leaving the south loadout pit transfer channel. Re-encapsulation will consist of recapping the canister barrel, introduction of nitrogen purge gas through the lid purge valve, and addition of a corrosion inhibitor to the water in the canister. The encapsulated canister will then be placed in a main basin storage rack location.

4.0 HAZARD IDENTIFICATION AND MANAGEMENT

4.1 Identification of potential hazards

The major activities associated with the in-basin fuel characterization program have been evaluated with respect to the following potential hazards:

- a) Industrial Safety (Electrical)
- b) Industrial Safety (Fire Safety)
- c) Industrial Safety (Crane Operations)
- d) Industrial Safety (Hygiene) - activities which result in worker stress because the equipment or tools do not fit the worker well

4.0 HAZARD IDENTIFICATION AND MANAGEMENT (continued)

4.1 Identification of potential hazards (continued)

- e) Industrial Safety (Other) - other considerations based on operator experience and knowledge of the plant
- f) Industrial Hygiene - potential toxic material exposure or release
- g) Radiation Exposure - potential As Low As Reasonably Achievable (ALARA) considerations and unshielded high radiation fields, inadvertent criticality or inadvertent removal of the fuel from the water
- h) Airborne Material Exposure - airborne radionuclides from radionuclides in suspension or solution in the basin water, airborne radionuclides from work in surface contamination zones
- i) Nuclear Safety - possibility that the activity exceeds the existing Safety Analysis Report

4.2 Hazards from Fuel Handling Operations

There are no new hazards introduced as a result of normal fuel handling operations. There are no new industrial safety or industrial hygiene issues identified. Radiation exposure directly from the transported fuel within the basin will be less than 1 mRem per hour because of the greater than 2.4 meters (8 feet) of water over the fuel canister (Reference 6.3 section 5.2.3). Background radiation at the KE basin will be significantly higher than this and will be managed using ALARA principles.

There is the potential for a slight increase in fission products in the basin water as a result of fuel movement, but this should not result in a noticeable increase in airborne activity. Periodic center-of-basin water samples will provide indication of an increase of radionuclides in the basin water.

The spilling of the contents of one canister of fuel (14 assemblies) onto the fuel storage basin floor will result in a k_{eff} substantially below the 0.98 limit (Reference 6.3 section 8.1.3).

Decapping of the fuel will be required in the KW basin in order for samples to be obtained. There are no new industrial safety or industrial hygiene issues identified as a result of canister decapping at 105 KW. Since decapping will be performed in the South Loadout Pit Transfer Channel subject to the limits of Process Standard C-303 section D.3, no new criticality issues are introduced.

4.0 HAZARD IDENTIFICATION AND MANAGEMENT (continued)

4.3 Hazards from Cask Spill Scenarios

The cask spill scenario provides the maximum amount of radionuclide material available for airborne release. Assuming no credit is taken for decontamination effects of the single element canister, the shipping cask, or the form of the fuel, the radionuclide inventory of three single element canister is at risk for release. The cask spill scenario is the bounding accident since underwater fuel handling activities would have a decontamination factor of 10,000 (Reference 6.4 section 4.2.1).

The maximum physical capacity of the cask is limited to three Mark IV fuel assemblies. Multiple operator errors could potentially result in the cask containing 3 Mark IV type E fuel assemblies. Three assemblies are above the hazard Category 3 threshold of 0.03 assemblies, but below the Hazard Category 2 threshold of 3.91 assemblies as shown on Table 1.

There are no new industrial safety or industrial hygiene issues identified from analysis of the cask spill scenarios. Since the maximum contents in a shipping cask are substantially below the number previously analyzed for well car shipments in the Safety Analysis Report, no new criticality issues are introduced (Reference 6.3 section 8.1.1).

5.0 CONCLUSIONS

Based on analysis of the in-basin activities associated with the fuel characterization program, the appropriate hazard classification is Hazard Category 3 (hazard analysis shows the potential for only significant localized consequences).

6.0 REFERENCES

- 6.1 DOE-STD-10227-92, DOE Standard - Hazard Categorization and Accident Analysis Techniques for Compliance With DOE Order 5480.23, Nuclear Safety Analysis Reports
- 6.2 WHC-SD-SNF-FRD-007, Revision 0, Functions and Requirements for K Basin SNF Characterization Shipping
- 6.3 WHC-SD-WM-SAR-062, Revision 1, Safety Analysis Irradiated N Reactor Fuel
- 6.4 WHC-SD-SNF-SARR-001, Revision 0, Review of Consequences of Uranium Hydride Formation in N-Reactor Fuel Elements Stored in the K-Basin

7.0 TABLES

Table 1 Hazard Category 2 and 3 Thresholds

Isotope	Ci/MTU	Ci/Assembly	Cat 3 Threshold Ci	Cat 2 Threshold Ci	Cat 2 Ratio	Cat 3 Ratio
Pu-236	2.20E-04	4.99E-06		5.50E+01	9.07E-08	
Pu-238	4.80E+01	1.09E+00	6.20E-01	6.20E+01	1.76E-02	1.76E+00
Pu-239	1.10E+02	2.49E+00	5.20E-01	5.60E+01	4.45E-02	4.80E+00
Pu-240	5.80E+01	1.32E+00		5.50E+01	2.39E-02	
Pu-241	4.40E+03	9.98E+01	3.20E+01	2.90E+03	3.44E-02	3.12E+00
Pu-242	2.10E+02	4.76E+00	5.20E-01	5.50E+01	8.66E-02	9.16E+00
Am-241	9.30E+01	2.11E+00	5.20E-01	5.50E+01	3.83E-02	4.06E+00
Cm-244	4.60E+00	1.04E-01		5.50E+01	1.90E-03	
Eu-154	8.80E+01	2.00E+00		1.10E+05	1.81E-05	
Cs-134	1.30E+02	2.95E+00	4.20E+01	6.00E+04	4.91E-05	7.02E-02
Cs-137	7.30E+03	1.66E+02	6.00E+01	8.90E+04	1.86E-03	2.76E+00
Ce-144	2.80E+01	6.35E-01	1.00E+02	8.20E+04	7.74E-06	6.35E-03
Pr-144	2.80E+01	6.35E-01		4.30E+05	1.48E-06	
Pr-144M	3.30E-01	7.48E-03		4.30E+05	1.74E-08	
Pm-147	2.00E+03	4.54E+01	1.00E+03	8.40E+05	5.40E-05	4.54E-02
Sb-125	1.20E+02	2.72E+00		4.30E+05	6.33E-06	
Te-125M	3.00E+01	6.80E-01		4.30E+05	1.58E-06	
Ru-106	5.20E+01	1.18E+00	1.00E+02	6.50E+06	1.81E-07	1.18E-02
Sr-90	5.80E+03	1.32E+02	1.60E+01	2.20E+04	5.98E-03	8.22E+00
Y-90	5.80E+03	1.32E+02		4.30E+05	3.06E-04	
Total					2.56E-01	3.40E+01
Number of assemblies to exceed Hazard Category 2 Threshold -- DF=1					3.91	
Number of assemblies to exceed Hazard Category 3 Threshold -- DF=1						0.03
Cat 2 Threshold from DOE-STD-1027-92						
Cat 2 or 3 ratio is Ci/assembly divided by Threshold Ci						
Uranium isotopes are not shown because they are negligible						
Fuel weight is assumed to be 50 pounds per assembly						