ENGINEERING CHANGE NOTICE

1. ECN 605355

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.		4. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [X] Cancel/Void []	R. H. Meichle/ Safety Technical Support/X3-77/ 372-1369		9/21/94
	5. Project Title/No./Work Order No. Fuel Storage Basins	6. Bldg./Sys./Fac. No. K Basins	7. Impact Level SQ
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-SNF-SARR-002 REV ~~1~~ 0	9. Related ECN No(s). N/A	10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 11b) [X] No (NA Blks. 11b, 11c, 11d)	N/A	N/A Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

General: This reponds to DOE comments on Rev 0. The basis supporting Readiness Assessment has been enhanced. A section has been added to address the inventory at risk and to enhance justication for less than hazard Cat 3. A conduct of operations has been added. These changes resulted in changes to section numbers, but minor content change except for Section 1, new section 3 & 4, and table to address readiness requirements.

13a. Justification (mark one)							
		Criteria Change	[X]	Design Improvement	[]	Environmental	[]
As-Found	[]	Facilitate Const.	[]	Const. Error/Omission	[]	Design Error/Omission	[]

13b. Justification Details

~~See continuation Sheet~~ RWM 9/27/94

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1. ECN (use no. from pg. 1): ECN 605355

15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[0] $0	Savings	[0] $0	Delay	[0] 0

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]		[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog Engineer R. H. Meichle R H Meichle	9/22/94	PE	NA
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QA G. M. Davis DW Smith for	9/23/94	Safety	NA
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Environ.		Environ.	NA
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J. P. Schmidt C L Bennett for	9/22/94	DEPARTMENT OF ENERGY	
J. C. Wiborg	9/22/94	Signature or Letter No.	
R. A. Eschenbaum RAE per telecon	9/22/94		
		ADDITIONAL	

RELEASE AUTHORIZATION

Document Number:	WHC-SD-SNF-SARR-002, REV 1
Document Title:	SAFETY ASSESSMENT OF DISCHARGE CHUTE ISOLATION BARRIER PREPARATION AND INSTALLATION
Release Date:	September 28, 1994

* * * * * * * * * * * * * *

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WHC Information Release Administration Specialist:

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SUPPORTING DOCUMENT

1. Total Pages ~~40~~ 41 JCB 10/10/94

2. Title

SAFETY ASSESSMENT OF DISCHARGE CHUTE ISOLATION BARRIER PREPARATION AND INSTALLATION

3. Number

WHC-SD-SNF-SARR-002

4. Rev No.

1

5. Key Words

K Basins, fuel storage basins, N fuel, KE and KW fuel storage basins, irradiated fuel, fuel storage canisters, encapsulated fuel, safety analysis, isolation barrier, seismic

APPROVED FOR PUBLIC RELEASE

KMB 9/28/94

6. Author

Name: R. H. Meichle

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Signature

Organization/Charge Code 2A340/KK4DC

7. Abstract

This revision responds to RL comments and increases the discussion of the "effective hazard categorization" and the readiness review basis.

The safety assessment is made for the activities for the preparation and installation of the discharge chute isolation barriers. The safety assessment includes a hazard assessment and comparison of potential accidents/events to those addressed by the current safety basis documentation. No significant hazards were identified. An evaluation against the USQ evaluation questions were made and the determination made that the activities do not represent a USQ. Hazard categorization techniques were used to provide a basis for readiness review classification.

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9. Impact Level SQ

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RECORD OF REVISION	(1) Document Number WHC-SD-SNF-SARR-002	Page 1

(2) Title
Safety Assessment of Discharge Chute Isolation Barrier Preparation & Installation

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
	(7)		
0	EDT-602987 JKB 10/10/94		
RS 1	Complete Revision RCN-605355 JKB 10/10/94	R L Marchio	C J Bennett 4/94

SAFETY ASSESSMENT OF DISCHARGE CHUTE ISOLATION BARRIER PREPARATION & INSTALLATION

Revision 1
September 22, 1994

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SAFETY ASSESSMENT OF DISCHARGE CHUTE ISOLATION BARRIER PREPARATION & INSTALLATION

1.0 SUMMARY

This analysis concludes that activities associated with installation of isolation barriers in the K Basins at Hanford can be performed safely. Further, it concludes that a readiness assessment is an appropriate control to manage the assessment of readiness.

1.1 PURPOSE AND SCOPE OF THE DOCUMENT

The purpose of this analysis is to: a) identify, analyze, and provide the basis for managing the hazards associated with activities specific to preparing the basin for installation of isolation barriers, installation of isolation barriers, and testing of isolation barriers, and b) document the determination of the appropriate readiness level, as well as the technical basis for this determination.

The scope of this analysis is limited to activities at 105 KE & 105 KW Basins necessary to install isolation barriers in the entry to discharge chutes. These activities are preparatory to resolution of a USQ related to seismic integrity; these activities do not in themselves resolve the USQ.

1.1.1 ASSESSMENT OF THE SAFETY OF PLANNED ACTIVITIES

The approach selected for preparation of the basin and installation of the isolation barriers is based on simple, proven technology. Discipline in conduct of operations has been enhanced by providing compensatory measures for known weaknesses; examples include controlling all field work to a Master Work Plan (MWP), and verifying all operating procedures applicable to these activities. Activities have been considered to determine what failures were credible, identifying measures to limit failure risk, and evaluating the need for recovery procedures. All planned activities can be performed with minimal risk to plant personnel and to the general public.

1.1.2 ACTIVITY HAZARD CLASSIFICATION

Although DOE Orders provide for grading of readiness activities by safety risk, they do not provide a method for reaching the threshold determination within existing Hazard Class 2 facilities. One default would be to subject all activities within a Hazard Category 2 facility like K Basins to a full readiness review for all activities, regardless of risk. A more practical method of grading can be developed. After applying the top level tests (specified in DOE Order 5480.31) whether an Operational Readiness Reviews (ORRs) is required, one method of making such an additional determination is applying the Unreviewed Safety Question (USQ) screening to demonstrate all planned activities are within the existing safety envelope. A second method, which has gained usage at Hanford, is to perform activity specific hazard categorization, using the actual materials at risk and determining an activity specific hazard categorization. Both methods were applied here to supplement the basic determination.

The activity specific hazard category of the activity is determined in accordance with DOE-STD-1027-92, a supporting guide for DOE Order 5480.23, "Nuclear Safety Analysis Reports." This determination is based on

a comparison of Threshold Quantities with the at-risk inventory consisting of the fuel, including transuranics and fission products, covered by the water in the basin. For fuel movement, only one canister is handled at a time and, if dropped, would likely only damage the fuel in less than 4 other canisters. In addition there is no possible equipment drop that could credibly impact 17 canisters. Hence, the amount of inventory of fuel that is at risk of contributing to airborne dose is less than the Cat 3 Threshold Quantities. Further, because of the low initial enrichment of the fuel (1.25 wt% or less) and the burn out during irradiation, a drop involving release of the fuel from a moving canister with fuel assemblies dispersed in the worst geometry on or among other canisters does not exceed the DOE-STD-1027-92 (ANSI 8.1) criticality threshold.

Ultimately, although the above approach would indicate the actual risk is less than that posed by a typical Hazard Category 3 facilities activity (lab operations or waste handling), it is prudent to recognize the perception of the activities and address this activity as a Hazard Category 3 activity, requiring a readiness assessment.

1.2 BACKGROUND

Dynamic seismic analysis, construction joint integrity projections and leak rate calculations for the K Fuel Storage have resulted in a post earthquake leak rate estimates in excess of the 1500 gph limit in the SAR. Expert and peer reviews have indicated that the complexity of the problem is such that a definitive value for leak rate is not possible. Estimates have been between 5000 and 25000 gph. This range, in addition to being higher than that used in the safety analysis, challenges the capability to adequately respond to the event to maintain fuel coverage.

Based on the foregoing, there is an increase in consequences of a previously evaluated event and reduced margin in OSRs. The discovery involves increase in the previously analyzed seismically induced leakage rather than a new basin malfunction, or new accident.

This report addresses and assesses the activities planned in 105 KE and 105 KW to resolve potential public safety and environmental impacts from postulated basin leakage following an earthquake, provides an evaluation of the risks associated with these activities, and identifies precautions which will be taken to manage these risks. Insights from this analysis are integrated with the Master Work Procedure (MWP) and detailed procedures for controlling field work.

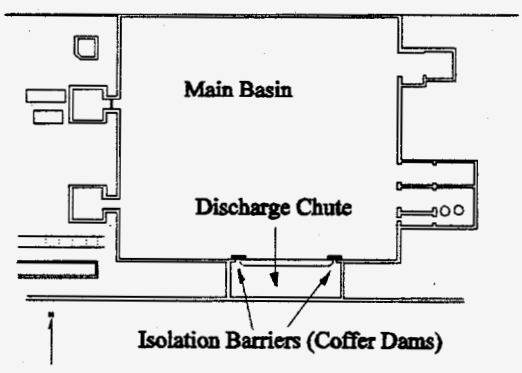

Figure 1 - Overview sketch of the basin showing the location of isolation barriers.

In response to the safety issue raised concerning a potential seismic event in the K Basins, a corrective action plan has been developed. Seismically induced leakage in the discharge chute portion of the basin could result in significant water level reductions in the basin. The corrective action plan requires installation of isolation barriers (i.e., upgraded cofferdams) to separate the discharge chute from the rest of the basin. A sketch of the isolation barrier location is included (see Figure 1).

A cleanup system will be installed to treat the discharge chute water. Piping will be added that will introduce treated water from the Ion Exchange Module (IXM) into the chute via a pump, and an overflow weir slot is provided in the isolation barrier to return water from the discharge chute back to the main basin. Water quality in the discharge chute is then expected to improve over that in the main basin.

1.3 REGULATORY PERSPECTIVE

1.3.1 DISCUSSION OF ASSESSMENT METHODOLOGY OF POTENTIAL FOR PERSONNEL EXPOSURE, PERSONNEL INJURY OR AIRBORNE RELEASE RESULTING FROM ACTIVITIES

The Office of Safety & Health (EM-23) within the U.S. Department of Energy Office of Environmental Management (EM) is currently developing guidance on hazard baseline documentation for EM facilities.[1] This guidance is still preliminary, but it provides useful insights on an appropriate methodology for addressing hazards assessment activities associated with this activity. It is particularly useful in addressing the evolving subject of worker protection, where it prescribes, "The principles and requirements of Process Safety Management (PSM) shall be integrated into the nuclear safety analysis process if the hazardous chemical thresholds established in 29 CFR 1910.119[2], are reached or exceeded. The principles and requirements of PSM are encouraged even for those facilities where the thresholds are not reached or exceed." Although none of the planned activities use toxic materials which would trigger the threshold requiring it be addressed under 29 CFR 1910.119, WHC & RL have elected to follow a PSM style approach and provide safety assessments of direct use to the workers in managing the risk of activities.

Planned activities have been evaluated, using hazards analysis techniques, to identify potential risks and provide appropriate controls to manage these risks. The overall hazard checklist was developed by reviewing material in draft guidance on hazard baseline documentation for EM facilities. Actual facility hazards were identified by systematically reviewing the planned activities and potential related accidents. Potential accidents can be divided into three major categories: accidents resulting in direct injury to people, radiation exposure from a field, and airborne radiation or toxic material exposure. Note that nuclear safety is embedded in these three for analysis purposes.

Industrial Safety - The first category, commonly referred to as industrial safety accidents, include electrical safety, fire safety, crane operations safety, and elements of ergonomics. Of these, the dominant risk results from improper crane operations or crane failures. These risks are minimized by utilizing trained operators and subjecting the involved cranes to maintenance and surveillance procedures.

Radiation Exposure - The second category, radiation exposure (from fields) can result from failure to plan work to minimize exposure, or from an activity which produces high fields in areas occupied by personnel. The first concern will be addressed by an As Low As Reasonably Achievable (ALARA) plan, which will be used to plan work to the lowest exposure possible, consistent with performing the work. The second area of concern, high radiation fields, was identified as possible only in the event of an unshielded inadvertent criticality or inadvertent removal of the fuel from the water. Both are precluded by design and by operating procedures.

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[1] Hazard Baseline Documentation; EM-STD-SAFT-0024-94 PROPOSED; DRAFT appended to Letter, "EM Hazard Categorization and Accident Handbook Working Group Meeting No. 2"; Irwin Spickler, Acting Director, Technical Support Division (EM-23) to distribution; May 4, 1994.

[2] Title 29, Labor, Part 1910 - Occupational Safety Standards, Section 119, Process Safety Management; U.S. Government Printing Office; 1993.

Airborne material exposure (includes Industrial Hygiene) - The third category, airborne material exposure, will require careful management because it poses the greatest potential. No source of airborne toxic material has been identified, but airborne radionuclides are expected for some portions of the job. Airborne release can result from radionuclides in suspension or solution in the basin water, or from work in surface contamination zones.

All activities will be managed to minimize airborne releases. Consistent with practices established for the current air permit for KE encapsulation, a water sample will be obtained each shift and an analysis performed for Cs-137 activity. Any tasks involving above water work will be conducted consistent with the current encapsulation permit numerical limits. Continuous air monitors will be operated in the vicinity of the work to detect significant changes in airborne activity.

The potential for airborne release into KE (and potentially from KE) resulting from planned activities can be compared with encapsulation. The planned activities are fewer, and they have limited potential to suspend radioactive particulate in the water (especially when compared with fuel and sludge encapsulation). The airborne release potential is well bounded by the airborne emissions forecast for encapsulation.[3]

The activities in KW have a lower potential for airborne release than those in KE because the fuel is encapsulated, the concentration of waterborne radionuclides is at least an order of magnitude lower, and free sludge is limited.

Nuclear Safety - Nuclear Safety hazards deal with potential criticality, over exposure of personnel to radioactive material or over exposure of the public or personnel because of release of radioactive material. Criticality is controlled predominately by maintaining geometric control of fissionable material by canister and racks. Other controls are administrative limits on mass. Control of exposure is by maintaining the radioactive material under water, except for a very limited amount of airborne particulate radionuclides, by maintaining water level. The level is maintained by assuring structural integrity of the basin boundary. The SAR addresses events and accidents that deal with the above.

Table 1 provides a summary of the accidents/events addressed by the safety basis documentation, identifies which are applicable to the described activities and provides a determination of whether the activities are bounded by the accident/event addressed.

1.3.2 READINESS ACTIVITY LEVEL

This discussion reviews the regulatory basis for making a determination on an appropriate readiness activity level. It also develops the regulatory interpretation applied to the WHC recommendation for K Basins.

1.3.2.1 REVIEW OF UPPER TIER REQUIREMENTS

On August 4, 1977, pursuant to the Department of Energy Organization Act (Pub. Law 95-91), all functions

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[3] Notice of Construction for the 105 KE Encapsulation Activity; March 1993; DOE/RL-93-13.

of Energy Research and Development Administration (ERDA) as well as the functions of the Federal Energy Administration and Federal Power Commission were transferred to the Department of Energy ("DOE"). Under Section 107(a) of the Energy Reorganization Act of 1974 ("ERA")(Pub. Law 93-438), ERDA had been authorized to perform certain functions specified in the Atomic Energy Act of 1954 ("AEA"). In particular, Section 161(b) of the AEA authorized ERDA, and now DOE, to control the use of special nuclear material through "rule[s], regulation[s], or order[s]." The authority given to DOE under Section 161 is broad and includes all aspects of assuring the safe management of nuclear facilities authorized by the AEA.

Based on its authority under the AEA, DOE has promulgated various regulations and orders that establish the requirements under which contractors carry out their obligations.

Regulation 10 CFR 830, Nuclear Safety was initially promulgated by 59 FR 15843 on 4/5/94. It lays the frame work for a series of rules dealing with nuclear safety. At this time only elements of the planned regulations (e.g., §830.3 - Definitions,§820 - Radiation Protection, and §830.120 - Quality Assurance Requirements) have been issued. The DOE plans on converting a number of other orders, including DOE Order 5480.21 (12/24/91), "Unreviewed Safety Questions", DOE 5480.22, "Technical Safety Requirements", DOE 5480.23, "Nuclear Safety Analysis Report" and DOE 5480.31, "Startup and Restart of Nuclear facilities" into rules, over the next several years.

1.3.2.2 STANDARDS AND THEIR APPLICATION

In moving toward rules, the DOE has also been evolving Standards which provide "guidance for facility managers and Program Senior Officers (PSOs) to help them comply consistently and efficiently." This is analogous to the Nuclear Regulatory Commission (NRC) approach of providing guidance in the form of Regulatory Guides to aid in implementing NRC promulgated rules. The following table relates several of these standards to the order which they implement.

DOE Order	Implementing Standard
DOE 5480.23, "Nuclear Safety Analysis Reports"	DOE-STD-1027-92, "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports"
DOE 5480.31, "Startup and Restart of Nuclear facilities"	DOE-STD-3006-93, "Planning and Conduct of Operational Readiness Reviews (ORR)"

The implementing standards are developed to cover a number of exigencies. However, as with Regulatory Guides, they only cover upper tier guidance, and leave detailed interpretation to the field. Such interpretations should be carefully documented and ultimately should become formalized in field procedures, once maturity in approach has been developed.

1.3.2.3 RECOMMENDATION OF READINESS LEVEL

This section reviews the administrative basis for contractor recommendation of readiness level.

DOE-STD-3006-93: "Planning and Conduct of Operational Readiness Reviews (ORR)" section 4.2.1 states, "each responsible contractor ... and propose those which will require and ORR, both DOE and responsible contractor. The responsible contractor will also propose the approval authority for each new start and restart action."

In making this recommendation, the contractor must determine what level is appropriate. Further insight into a top tier grading process for making this recommendation can be obtained from a core requirement of 5480.31 section 9.a.(3):

> "Determination of when an Operational Readiness Review is performed is based on the hazard category of the facility as defined in DOE 5480.23 and Attachment 1 to this Order. DOE shall conduct and ensure that contractors conduct an Operational Readiness Review in accordance with this Order when any of the following conditions occur:
> 1) Initial startups of new hazard category 1, 2, and nuclear facilities;
> 2) Restart after a nuclear facility unplanned shutdown directed by a DOE management official for safety or other appropriate reasons;
> 3) Restart after an extended shutdown for hazard category 1 and 2 nuclear facilities. Extended shutdown for a category 1 nuclear facility is 6 months. Extended shutdown for a category 2 nuclear facility is 12 months;
> 4) Restart of hazard category 1 and 2 nuclear facilities after substantial plant or facility modifications required for future program work and/or for enhanced safety which require changes in the safety basis previously approved by DOE;
> 5) Restart after a nuclear facility shutdown because of operations outside the safety basis; or
> 6) When deemed appropriate by DOE management officials, including those restarts of nuclear facilities that have a hazard category less than 1 or 2."

DOE goes further in providing for application of the graded approach by providing potential grading criteria. Insight into the intention can be seen from the definition in 5480.31,

> "GRADED APPROACH. A process by which the level of analysis, documentation, and actions necessary to comply with a requirement in this Order are commensurate with:
> a. The relative importance to safety, safeguards, and security;
> b. The magnitude of any hazard involved;
> c. The life cycle stage of a facility;
> d. The programmatic mission of a facility;
> e. The particular characteristics of a facility; and
> f. Any other relevant factor."

Clearly it is the Department's intent that systematic approaches should be developed to provide grading.

Finally, DOE-STD-3006-93, "Planning and Conduct of Operational Readiness Reviews (ORR)" section 1.2 establishes "a uniform process for when and ORR 1) of any new facility to be started, 2) a previously operated facility is to be restarted, or 3) any new operating phase that results in significant increase in existing hazards, or could introduce significant hazards not previously encountered is planned." Explicit in this purpose is that an ORR is appropriate if there is a significant increase in existing hazards, or new significant hazards (not previously encountered).

Thus, the readiness level recommendation decision can be reduced to a procedure with the following steps:

Readiness Level Decision Procedure			
Step	Decision Point	If Yes	If no, go to
1	Is this an initial startup of new hazard category 1, 2, and nuclear facility?	ORR	2
2	Is this a restart after DOE management directed shutdown?	ORR	3
3	Is this a restart of unlimited operation after an extended shutdown for hazard category 1 and 2 nuclear facilities (Extended shutdown for a category 1 nuclear facility is 6 months. Extended shutdown for a category 2 nuclear facility is 12 months.)?	ORR	4
4	Is this a restart of hazard category 1 and 2 nuclear facilities after substantial plant or facility modifications required for future program work and/or for enhanced safety which require changes in the safety basis previously approved by DOE?	Verify with 6 below	5
5	Is this a restart after a nuclear facility shutdown because of operations outside the safety basis?	ORR	6
6	Is this a new operating phase that results in significant increase in existing hazards, or could introduce significant hazards not previously encountered. to apply this test, use questions 6a and 6b below		
6a	Apply 5480.21 USQ screening process against planned work and determine whether any activity screens positive as a USQ.	ORR	6b
6b	Perform Activity Specific Hazard Classification and determine if planned activity is Activity specific Hazard Category 2.	ORR	7
7	Perform Activity Specific Hazard Analysis and determine if planned activity is Activity specific Hazard Category 3.	RA	Plant Manager Discretion

1.3.2.4 INTERPRETATIONS OF THE IMPLEMENTING STANDARDS

Specific DOE direction on determining the "magnitude of any hazard involved" is not provided. DOE 5480.31 does reference DOE STD 1027-92, "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE 5480.23, NUCLEAR SAFETY ANALYSIS REPORTS," of 12-92, which establishes guidance for a uniform methodology for facility hazard categorization under the Order. This guide serves to provide guidance into initial and final full facility hazard classification. Further, it can be used as a basis for Performing Activity Specific Hazard Classification for answering question 7 in the table above.

In applying this standard for Activity Specific Hazard Analysis, WHC SNFP has applied the following process:

1) Identify the activities planned.

2) Identify the credible boundaries for the activity by identifying potential propagation. Facility segmentation, appropriate to the activity, is appropriate for "processes, operations, or activities" and not necessarily the whole facility (see DOE STD 1027-92, A-1). The concept of facility (activity) segmentation may be applied where facility features preclude bringing material together, of causing harmful interactions. Note: Activity hazard classification does not change the overall facility Hazard Categorization.

3) Identify existing mitigation factors as appropriate for a final hazard classification (if and only if the USQ determination was negative). For hazards analysis, mitigative features may include passive barriers such as dikes, confinement systems and water decontamination, as well as active systems such as air cleanup systems (see DOE STD 1027-92, 4.1.1.d).

4) The analysis then calculate radiological thresholds and compare with the criteria in DOE STD 1027-92, A-1, Table A.1.

5) Total fuel material moved is compared against the criteria from ANSI 8.1 -"Standard for Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors." If quantities in excess of ANSI 8.1 Minimum Critical Mass are involved in activities after segmentation, the activities would be category 2.

To reach appropriate conclusions regarding consideration of the potential for criticality, DOE-STD-1027-92, Appendix A, indicates:

> "In addition, any facility containing fissile material in quantities greater than the theoretical minimum mass limits for criticality emergencies as specified in ANSI 16.1 - "Standard for Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors" should be included. For aqueous solutions of U^{233}, U^{235}, Pu^{239}, these values are 500, 700, and 450 grams, respectively. Credit may be taken if segmentation or the nature of process precludes potential for criticality."

A review of current standards indicates that ANSI 16.1, issued in 1986, is currently titled "Measurement of the leachability of Solidified Low-Level Radioactive Wastes by a Short-Term Test Procedure." However, ANSI/ANS 8.1 - 1983 is titled "Standard for Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors." Review of ANSI/ANS 8.1 - 1983 indicates that it is a Revision of ANSI N16.1-1975, "Standard for Nuclear Criticality Safety in Operations with Fissionable Material

Outside Reactors." and supersedes that document. Hence it is reasonable to assume that the reference cited in DOE-STD-1027-92 was intended to be the superseded ANSI N16.1-1975, "Standard for Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors." To assure conservative application, ANSI/ANS 8.1-1983 wording relating to minimum critical mass (MCM) are compared with the former ANSI N16.1-1975; no difference exists in methodology for determining the MCM (although 450 grams has been revised to 480 grams as a limit for Pu^{239}). As a result, with the exception of the Pu^{239} material limit, all application in analysis below is taken from ANSI/ANS 8.1-1983. Note that ANSI/ANS 8.1-1983 considers both material characteristics (such as enrichment) and other fixed factors such as fuel form.

2.0 PLANNED ACTIVITIES

Activities for installation of the isolation barriers in 105 KE & KW can be categorized into five groups: 1) inspection and evaluation activities 2) relocation of equipment and fuel to support installation of the isolation barriers, 3) cleaning and surfacing of the discharge chute to limit the source term remaining in the chute, 4) installation of the barriers, and leak rate testing of the barrier seals.

2.1 INSPECTION AND EVALUATION ACTIVITIES

Prior to installation of hardware in the basin, detailed inspection and evaluation are necessary to support and assure and adequate design. Figure 2 illustrates the isolation barrier layout, and demonstrates the need for accurate dimension verification of the discharge chute entry way. Inspection and evaluation, common to many plant modification, can normally be performed with minimal intrusion in the basins. The most intrusive activity will be verifying the discharge chute openings dimensions using a video micrometer. The video micrometer camera will be moved underwater, filming the opening and verifying the dimensions which the isolation barriers must be built to.

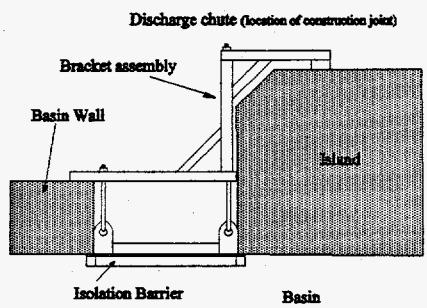

Figure 2 - Top view of the isolation barrier illustrating the general configuration.

2.1.1 Safety Assessment Check sheet for activities.

GENERAL CHECK SHEET HAZARDS IDENTIFICATION & MANAGEMENT of MAJOR ACTIVITIES ASSOCIATED WITH THE BASIN INTEGRITY TASK		
Operation(s)	Potential Hazards	Assessment & Controls
Detailed inspection and evaluation are necessary to support design	Industrial Safety - Evaluate for electrical safety.	Camera power supplies are routinely used in the basins.
	Industrial Safety - Evaluate for fire safety.	Minimal change in fire loading.
	Industrial Safety - Evaluate for crane operations safety.	No crane operations required.
	Industrial Safety (Hygiene) - Evaluate for activities which result in worker physical stress because the equipment or tools do not fit the worker well (ergonomics).	None.
	Industrial Safety - Evaluate for other considerations based on operator experience and knowledge of the plant.	None.
	Industrial Hygiene - Evaluate for potential toxic material exposure or release.	No toxic materials used.
	Radiation Exposure - Evaluate for potential As Low As Reasonably Achievable (ALARA) considerations.	Specific ALARA plan will be prepared for field work in each basin. Dominant exposure concerns result from activities in KE because of routine high fields.
	Radiation Exposure - Evaluate for high radiation fields unshielded inadvertent criticality or inadvertent removal of the fuel from the water .	No fuel will be moved. The equipment to be used (video cameras and associated cables) is light enough to preclude damage to fuel or movement of fuel.
	Airborne material exposure - Evaluate for airborne radionuclides from radionuclides in suspension or solution in the basin water.	Suspension of radionuclides in the water is not required as part of this activity, nor is it likely. The camera motion will be clear of sludge.
	Airborne material exposure - Evaluate for airborne radionuclides from work in surface contamination zones.	Standard ALARA procedures will be used for these activities consistent with other video camera work that has recently been conducted in KE and KW basins.
	Nuclear Safety - Evaluate the activity for the possibility that it exceeds the existing SAR (basis for USQ screening).	See Table 1 - Activities bounded by existing safety basis.

2.2 RELOCATION OF EQUIPMENT AND FUEL TO SUPPORT INSTALLATION OF THE ISOLATION BARRIERS

Installation of the isolation barriers requires fuel or equipment relocation. These changes are basin specific:

a) In 105 KW the location for installation of isolation barriers (see Figure 3) is currently close to existing fuel occupied storage. Some limited fuel relocation and storage rack modification (13 canisters in front of one opening and 11 in front of the other) will be required. Because KW basin is relatively clean and the canisters are closed, this activity is not expected to be a large contributor to air emissions. Canister integrity (lock bars holding the lid on and general condition) has been verified by a video survey.

This represents a rather limited fuel move (1 to 2 shifts of activity when done cautiously). The equipment is designed to stress simple and safe operation. Individual fuel canisters are grappled, suspended by a lifting tool designed to preclude lifting the canisters from the water, with design features, (length of tool) which protects against operator error. The worst credible accident, dropping of fuel, is analyzed by the existing criticality analysis. The fuel drop would not result in any risk of criticality.

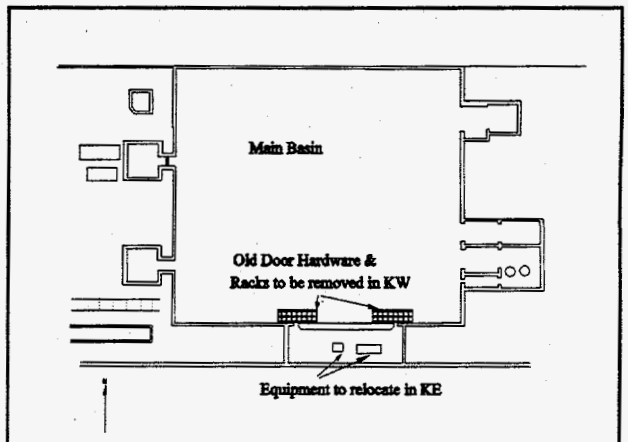

Figure 3 - This figure is a composite of both 105 KE & 105 KW activities. It shows equipment relocation necessary in both basins.

The 105 KW & KE isolation barrier sealing surfaces will also be modified by removing the existing inflatable seals and associated hardware. The removal of selected hardware in 105 KE & KW will be accomplished by using an underwater "side grinder" for cutting. This equipment, which has been tested in mockups external to the basins, provides for local filtering of potential waterborne or airborne emissions. The equipment will be operated remotely, limiting the risk of operator exposure. Equipment used in these tasks will be surveyed prejob and postjob to ensure the spread of contamination is limited. Green houses have been installed in both KE & KW to provide a confined area where repair on equipment can be performed, should it malfunction during operation.

b) Some equipment must be relocated in the 105 KE discharge chutes to assure it does not interact with the barriers during an earthquake. This will be accomplished by moving the equipment to the center of the discharge chute, e.g., the old coffer dams currently located in the discharge chute will be moved to the center of the chute. In addition, it is prudent to move selected encapsulation equipment in KE out of the discharge chute into the main basin. Moving this equipment out of the chute will eliminate the necessity of removing the equipment from the water for reinstallation after the barriers are installed. For example, several empty canisters may be removed from the main basin storage racks and the packager relocated to storage, resting directly on the racks outside the chute. Additionally, one fuel element (inner) and portions of another are still located in the KE discharge chute. The will be removed.

All equipment will be moved underwater to minimize the air emissions. Hoisting equipment will be surveyed before, during and after the work. Decontamination or replacement of the equipment will be done based on survey results. All these activities are similar to previously approved encapsulation activities. All activities are bounded by the existing Safety Analysis Report.

2.2.1 SAFETY ASSESSMENT CHECK SHEET FOR 105 KW ACTIVITIES.

GENERAL CHECK SHEET HAZARDS IDENTIFICATION & MANAGEMENT of MAJOR ACTIVITIES ASSOCIATED WITH THE BASIN INTEGRITY TASK		
Operation(s)	Potential Hazards	Assessment & Controls
Limited fuel relocation and storage rack modification (40 canisters) will be required. 105 KW isolation barrier sealing surface will also be modified by removing the existing inflatable seals and associated hardware. The removal of hardware in 105 KE was formerly accomplished by using an underwater "side grinder" for cutting. Use of remotely controlled side grinders and similar cutting or surfacing tools is planned in both KE and KW.	**Industrial Safety** - Evaluate for electrical safety.	None. No electrical modifications will be made to the facility. Existing facility outlets will be used for equipment.
	Industrial Safety - Evaluate for fire safety.	Minimal change in fire loading.
	Industrial Safety - Evaluate for crane operations safety.	Crane operations will be required for fuel movement and for storage rack modification. The worst postulated accident is a water drop of one fuel canister. See discussion below under Radiation Exposure for consequences.
	Industrial Safety (Hygiene) - Evaluate for activities which result in worker physical stress because the equipment or tools do not fit the worker well (ergonomics).	None.
	Industrial Safety - Evaluate for other considerations based on operator experience and knowledge of the plant.	None.
	Industrial Hygiene - Evaluate for potential toxic material exposure or release.	No toxic materials used.
	Radiation Exposure - Evaluate for potential As Low As Reasonably Achievable (ALARA) considerations.	Specific ALARA plan will be prepared for field work in each basin. KW fields are routinely less than 2 MREM/hr and specific controls are not anticipated.
	Radiation Exposure - Evaluate for high radiation fields unshielded inadvertent criticality or inadvertent removal of the fuel from the water .	Fuel handling has been performed annually for the past 10 years, and crane usage is considered routine. the worst case crane failure would result in dropping a canister of fuel on other fuel. Such a crane failure has ben analyzed for criticality safety and will not cause an unplanned criticality.
	Airborne material exposure - Evaluate for airborne radionuclides from radionuclides in suspension or solution in the basin water.	Suspension of radionuclides in the water is not required as part of this activity, nor is it likely. Past fuel handling has resulted in no increase. Standard ALARA procedures will be updated and used for these activities. Rack removal poses even less risk than fuel movement. Equipment used in these tasks will be surveyed before, during and after the work to ensure the spread of contamination is limited.
	Airborne material exposure - Evaluate for airborne radionuclides from work in surface contamination zones.	No work will be performed in surface contamination zones. Greenhouses provided for equipment removal from basin. Local filtration provided. Work will be controlled remotely (from outside of zone) for surface preparation activities.

	Nuclear Safety - Evaluate the activity for the possibility that it exceeds the existing SAR (basis for USQ screening).	See Table 1 - Activities bounded by existing safety basis.

2.2.2 SAFETY ASSESSMENT CHECK SHEET FOR 105 KE ACTIVITIES.

GENERAL CHECK SHEET HAZARDS IDENTIFICATION & MANAGEMENT of MAJOR ACTIVITIES ASSOCIATED WITH THE BASIN INTEGRITY TASK		
Operation(s)	Potential Hazards	Assessment & Controls
Some equipment must be relocated in discharge chute to protect the barriers from damage during an earthquake. This will be accomplished by moving equipment to center of chute. Selected encapsulation eqpt moves out of the discharge chute into the main basin. A single inner fuel element and portions of another will be removed from the discharge chute.	**Industrial Safety** - Evaluate for electrical safety.	None.
	Industrial Safety - Evaluate for fire safety.	Minimal change in fire loading.
	Industrial Safety - Evaluate for crane operations safety.	Crane operations will be considered as critical lifts as added assurance that basin structure, racks, canisters and fuel will not sustain unacceptable damage.
	Industrial Safety (Hygiene) - Evaluate for activities which result in worker physical stress because the equipment or tools do not fit the worker well (ergonomics).	None.
	Industrial Safety - Evaluate for other considerations based on operator experience and knowledge of the plant.	None.
	Industrial Hygiene - Evaluate for potential toxic material exposure or release.	No toxic materials used.
	Radiation Exposure - Evaluate for potential As Low As Reasonably Achievable (ALARA) considerations.	Specific ALARA plan will be prepared for field work in each basin. Dominant exposure concerns result from activities in the main KE Basin because of routine high fields found there. Activities will center, as much as possible, around the discharge chute in a lower field region. Work will be controlled remotely (from outside of zone) for surface preparation activities. Work will be performed in KW (low field basin) before performed in KE to assure disciplined operation with minimum time at risk (de facto training verification in KW).
	Radiation Exposure - Evaluate for high radiation fields unshielded inadvertent criticality or inadvertent removal of the fuel from the water .	None anticipated. Minimal fuel will be moved. The equipment to be used is light enough to preclude damage to fuel.
	Airborne material exposure - Evaluate for airborne radionuclides from radionuclides in suspension or solution in the basin water.	Suspension of radionuclides in the water is not required as part of this activity, nor is it likely. Several empty canisters may be removed from the main basin storage racks and the packager relocated to storage, resting on empty fuel storage racks. Dropping of equipment on canisters will be limited by avoiding moves over fuel. Damage of fuel from empty canister drops would not be significant due to low mass.

	Airborne material exposure - Evaluate for airborne radionuclides from work in surface contamination zones.	Standard ALARA procedures will be used for these activities consistent with other work that has recently been conducted in KE and KW basins. No work will be performed in surface contamination zones. Greenhouses provided for equipment removal from basin. Local filtration provided.
	Nuclear Safety - Evaluate the activity for the possibility that it exceeds the existing SAR (basis for USQ screening).	See Table 1 - Activities bounded by existing safety basis.

2.3 CLEANING AND SURFACING OF THE DISCHARGE CHUTE TO LIMIT THE REMAINING SOURCE TERM

Cleaning of the discharge chute in 105 KE will involve depositing activated hardware, debris, and fuel from the discharge chute into canisters and moving these canisters to other underwater locations in the main basin, as has been previously described as -encapsulation activities. The underwater cleaning of sealing surfaces (of the main basin walls at the entry to the discharge chute) for the barriers in both 105 KE and 105 KW will involve minor water jet cleaning and mild abrasive, such as wire brushing. All loose material must be displaced from these areas to ensure adequate sealing of the barriers. A basin water treatment system will be operational during these activities to minimize the levels of radionuclides present in the basin water.

2.3.1 SAFETY ASSESSMENT CHECK SHEET FOR DISCHARGE CHUTE CLEANUP ACTIVITIES.

GENERAL CHECK SHEET HAZARDS IDENTIFICATION & MANAGEMENT of MAJOR ACTIVITIES ASSOCIATED WITH THE BASIN INTEGRITY TASK		
Operation(s)	Potential Hazards	Assessment & Controls
Cleaning: 1) put activated hardware, debris and fuel from the discharge chute into canisters and moving these canisters to other underwater locations in the main basin 2) underwater cleaning of sealing surfaces	**Industrial Safety** - Evaluate for electrical safety.	None
	Industrial Safety - Evaluate for fire safety.	None
	Industrial Safety - Evaluate for crane operations safety.	Crane operations will be treated as critical lifts, if lift is over fuel or if it is over the basin and exceeds 800 pounds, to minimize damage potential to basin boundary and fuel.
	Industrial Safety (Hygiene) - Evaluate for activities which result in worker physical stress because the equipment or tools do not fit the worker well (ergonomics).	None
	Industrial Safety - Evaluate for other considerations based on operator experience and knowledge of the plant.	None
	Industrial Hygiene - Evaluate for potential toxic material exposure or release.	No toxic materials used
	Radiation Exposure - Evaluate for potential As Low As Reasonably Achievable (ALARA) considerations.	Specific ALARA plan to be prepared for field work in each basin. Dominant exposure will be from activities in the main KE Basin because of routine high fields found there.
	Radiation Exposure - Evaluate for high radiation fields unshielded inadvertent criticality or inadvertent removal of the fuel from the water .	Fuel handling has been performed annually for the past 10 years and crane usage is considered routine. Potential has been analyzed (see Table 1).
	Airborne material exposure - Evaluate for airborne radionuclides from radionuclides in suspension or solution in the basin water.	Some suspension of radionuclides in the water may occur but additions are not considered to be significant.
	Airborne material exposure - Evaluate for airborne radionuclides from work in surface contamination zones.	Standard ALARA procedures to be used for these activities consistent with other work that has recently been conducted in KE and KW basins. No work will be performed in surface contamination zones.
	Nuclear Safety - Evaluate the activity for the possibility that it exceeds the existing SAR (basis for USQ screening).	See Table 1 - Activities bounded by existing safety basis.

2.4 INSTALLATION OF THE BARRIERS

The barriers will be moved outside of the basin along the reactor interface wall until they are above the entry location located in the discharge chute (see Figure 4). Once there, they will be lowered into the water in the discharge chute. They will then be suspended from the crane in an upright position, and moved through the discharge chute entry openings into the main basin. They will be moved only in an area from which fuel has been removed to assure that they are never over fuel canisters. They are then installed by attaching to Z-brackets which mate with the walls inside the discharge chute portion basin. (See Figure 2) At no point will the barriers or associated equipment be located above fuel.

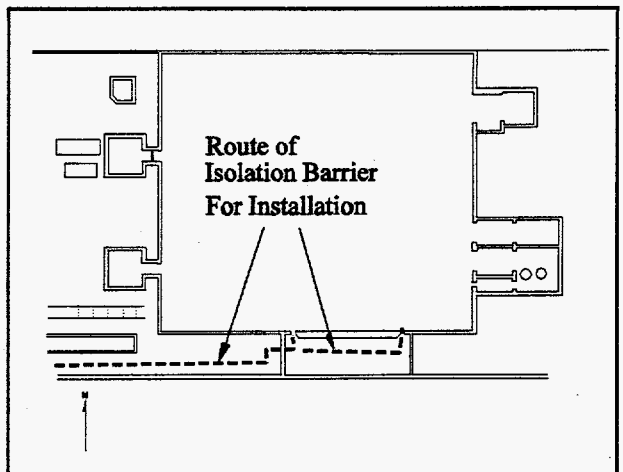

Figure 4 - Sketch showing path which isolation barriers will follow during installation.

Water quality will be maintained in the discharge chute by continuous flow through the region. Piping will be provided to return treated water (less than 200 gpm) from the IXM to the chute. The water level will be allowed to rise several inches higher inside the discharge chute than in the main basin; it will overflow a weir (slot cut into the barrier) and return to the main basin. This system will be shut off during barrier installation to prevent difficulty in installing barriers across the entries, but will routinely operate there after.

Installation of the barriers will produce limited airborne emissions since the doors and hardware are uncontaminated prior to installation. The only potential source of emissions comes from tools removed following installation. Normal practices (rinsing, bagging out, and monitoring) will be followed.

A leak rate test involving lowering the level in the discharge chute to effect a head across the barrier will be performed to confirm that leakage is within acceptable limits. This test will be accomplished by lowering the level of water in the discharge chute by 11 inches; the water from the discharge chute will be pumped into the main basin, raising the main basin level by fractions of an inch. Although a "go - no go" test can be accomplished in less than an hour, the test will continue for one shift (8 hours) to improve data accuracy. following the test, the water level in the discharge chute will be returned to its normal operating level by restoring flow from the IXM.

2.4.1 SAFETY ASSESSMENT CHECK SHEET FOR BARRIER INSTALLATION ACTIVITIES.

GENERAL CHECK SHEET HAZARDS IDENTIFICATION & MANAGEMENT of MAJOR ACTIVITIES ASSOCIATED WITH THE BASIN INTEGRITY TASK		
Operation(s)	Potential Hazards	Assessment & Controls
1) Barriers moved near the basin until they are at entry location. Then lowered into the water and installed by attaching to brackets. 2) Piping installed to return water from the IXM to the chute. 3)Leak test establish head between main basin	**Industrial Safety** - Evaluate for electrical safety.	None. No electrical modifications will be made to the facility. Existing outlets will be used for equipment.
	Industrial Safety - Evaluate for fire safety.	Minimal change in fire loading
	Industrial Safety - Evaluate for crane operations safety.	Crane operations required and will be treated as critical lifts, to minimize damage potential to basin boundary and fuel.
	Industrial Safety (Hygiene) - Evaluate for activities which result in worker physical stress because the equipment or tools do not fit the worker well (ergonomics).	None
	Industrial Safety - Evaluate for other considerations based on operator experience and knowledge of the plant.	A water safety protection program will be provided.
	Industrial Hygiene - Evaluate for potential toxic material exposure or release.	None
	Radiation Exposure - Evaluate for potential As Low As Reasonably Achievable (ALARA) considerations.	Specific ALARA plan to be prepared for field work in each basin. Dominant exposure will be from activities in the main KE Basin because of routine high fields found there. Some increase in field when discharge chute level is lowered, due to "bath-tub ring" unshielding.
	Radiation Exposure - Evaluate for high radiation fields unshielded inadvertent criticality or inadvertent removal of the fuel from the water .	None, no fuel to be moved.
	Airborne material exposure - Evaluate for airborne radionuclides from radionuclides in suspension or solution in the basin water.	Because dropping of equipment on fuel canisters could damage fuel, fuel will be removed from the working areas prior to barrier installation. Additional airborne activity risk is not significant.
		Standard ALARA procedures to be used for these activities consistent with other work that has recently been conducted in KE and KW basins. No work will be performed in surface contamination zones.
	Nuclear Safety - Evaluate the activity for the possibility that it exceeds the existing SAR (basis for USQ screening).	See Table 1 - Activities bounded by existing safety basis.

3.0 INVENTORY AT RISK

This section is developed to feed as activity specific hazard categorization into question 7 of the section 7.1 readiness level determination procedure. It concludes that the basic activities planned pose no nuclear safety risk to the general public or to personnel in the plant. The hazards personnel encounter are comparable to those encountered in routine laboratory operations or in waste handling operations.

As part of this determination, the activities involved with installation of discharge chute isolation barriers to mitigate the seismic induced leakage from basin-reactor building construction joint have been reviewed for hazards to identify the inventory at risk. The identified hazards are controlled or mitigated by the existing systems or procedures or will be mitigated or controlled by implementation of existing administrative practices. No new hazards have been identified that have not been addressed by the existing safety basis documentation.

Two classes of events have been identified for which inventory at risk determinations are necessary, mechanical damage resulting in fuel failure, and criticality. these are developed below.

3.1 MECHANICAL DAMAGE OF FUEL

Fuel damage may be bounded by considering two event sequences. The first is drop of a fuel canister on other fuel canisters; a fuel canister is the heaviest object which will be moved over fuel. The second is drop of a large mechanical object on fuel; a drop of the door is selected because it represents the largest component to be moved in the vicinity of the fuel (but not over fuel).

As allowed by DOE-STD-1027-92, the threshold values applied for existing facilities can be modified to reflect the form and amount of radioactive material. The threshold values of DOE-STD-1027-92 are based on the assumption that the fraction of releasable material for solids is 1/100 and for other solids is 1/1000. Noble gas and halogen release fractions are not relevant in K Basin fuel; the quantities of these materials are negligible due to decay. The threshold values were established by back fitting airborne dose calculations to determine the threshold release value by isotope.

The activities for the preparation for and installation of the barriers do not require removal of fuel, fuel pieces, or sludge from the basin. Therefore the form of the material is fuel with at least 3 meters (9.5 feet) of water coverage. Further, for all accidents identified, 4 meters (13 feet) of coverage exists.

Research on decontamination factors associated with pool scrubbing of fuel and corrosion product particulate has been conducted since the 1960's and represents a mature nuclear reactor safety technology. Radioactive material released under water will be reduced by the scrubbing action of the water. The amount released to the air is reduced by a decontamination factor (DF) due to this scrubbing. The DF for a particle passing through 4 meters of water is 10^8; through 3 meters of water it is 10^6. A regulatory case is best built when insensitive to variation, hence a conservative factor of only 10^4 was selected for this analysis. The threshold values used to evaluate hazard categories for the barrier installation activities were reduced by a DF of 10^4.[4]

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[4] WHC-SD-SNF-SARR-001; Pool Scrubbing of Fuel and Corrosion Product Particulate; M.G. Plys, H.K. Fauske & Associates, 1994.

Appendix A documents the calculation which determines the number of elements or canisters necessary to exceed the Category 3 and Category 2 thresholds. These values are conservative since they are based on MK IV elements, which are 30% heavier than the MK 1A fuel. The fuel to be moved in 105 KW basin is MK 1A, 105 KE fuel movement in 105 KE is limited to one inner element of a MK IV assembly, plus a fuel element fragments. Appendix A shows that the inventory of 17 canisters is required to reach the Category 3 threshold and 2795 canisters would be required to reach the Category 2 threshold based on radiological inventory.

3.1.1 FUEL CANISTER DROP

The first is drop of a fuel canister on other fuel canisters; a fuel canister is the heaviest object which will be moved over fuel.

Each canister can be bounded by an envelope of roughly 10" by 20" by 30"high ((8 3/4" by 18" by 26 5/8"). During fuel movement a canister is lifted approximately 3 1/2 feet (the maximum lift is limited by the handling tool which consists of a hook attached to a shaft which is long enough to preclude lifting the fuel higher using installed cranes). If the canister drops, the energy is bounded by the potential energy of the loaded canister; free fall would be limited by clearance to 6" and by hydraulic resistance. Damage to canisters or fuel is highly unlikely. For the sake of a bounding number, the falling canister could cover 3 other canisters stored in racks for a total of 4 canisters in a single accident. If the dropped canister splits, it may be credible to involve up to five canisters (although highly unlikely). Thus, fuel drops during transfer of the fuel remain well below the Category 3 threshold, even for multiple canister drops (multiple canister handling is precluded by design).

3.1.2 DOOR HANDLING ERROR

The second is drop of a large mechanical object on fuel; a drop of the door is selected because it represents the largest component to be moved in the vicinity of the fuel. The door is brought into the basin through the discharge chute, and does not move over the fuel. It moves nearest the fuel when it is uprighted and moved out of the discharge chute entry. A worst case scenario, dropping the door while moving it into final position, would result in it moving down approximately 1 foot, at which point the door would pivot about the point in contact with the basin floor. The main door would pivot down either on edge or flat. If it drops "flat", pressure drag will tend to absorb the energy of the fall and also rotate the door such that it is coming down on edge. Just as with a fuel canister drop, the mechanical damage to the fuel resulting from the edge could be estimated based on the total energy available and the strength of the canisters and fuel. For a bounding argument, however, it is arguable that even in the unlikely event all 10 canisters potentially involved as the door came down totally failed (crushed), this would remain below the category 3 threshold.

Factors which would mitigate such damage include treatment of all door lifts as critical lifts (whether in the vicinity of the fuel or not), removal of 24 canisters of fuel in the vicinity of the openings, and limitations on the total energy available for damage. A further major palliation is the significant conservatism in water DF, which suggests that in the event that the door could damage 1700 canisters, the release would not actually exceed the adjusted threshold.

3.2 CRITICALITY

Criticality is a significant consideration in the basins. This section develops the activity specific hazard assessment for isolation barrier related fuel moves. As a basis for following this discussion, one needs to be aware that up to 14 fuel assemblies may be stored in any canister (2 connected barrels with a maximum of seven assemblies

per barrel). The material contained is irradiated fuel (in assemblies composed of inner and outer elements) which, when fabricated, originally had enrichments of either 0.95 wt% or 1.25 wt% of U^{235}. The fuel to be moved has been irradiated. The irradiated fuel contains significantly less U^{235} than green fuel, but has seen generation of Pu^{239} (less than 50 grams per assembly).

ANSI/ANS 8.1-1983, section 6.1, addresses metal-water mixtures at low U^{235} enrichments. It specifies that, "Subcritical limits applicable to uranium metal or uranium oxide (UO_2), regardless of the size and shape of metal or oxide pieces, are specified as functions of enrichment in Figures 1 through 5 which give, respectively, the mass of U^{235}, the cylinder diameter, the slab thickness, the volume, and the areal density." For a conservative bounding case at K Basins, Figure 1, "Mass limit for uranium-water lattices" is most conservative, and is used. For the most highly enriched fuel in either basin (1.25 wt%) the mass limit is 7 Kilograms (15.4 pounds) of U^{235}. A full canister of green fuel has a total mass of less than 318 Kg (700 pounds) of uranium metal, of which 4 Kg (8.75 pounds) could be U^{235}. Activities involving a single canister of green fuel fall below the mass limit.

Use of the simple green fuel mass limit, although instructive, does not consider the actual fuel form, as allowed by ANSI/ANS 8.1-1983. Since specific fuel canisters have been identified for movement and movement routes identified, it is possible to provide facility and fuel move specific determinations, as tabulated below.

Basin	Type of fuel	Maximum mass per assembly[5]	Maximum Canister Mass	Maximum current U^{235} wt %	ANSI 8.1 1983 Figure 1 U^{235} Mass Limit	Maximum U^{235} mass per canister	Number of canisters to reach mass limit
KW	MK IA	16.61 Kg 36.55 lbs	232.6 Kg 511.7 lbs	1.0 wt%	11 Kg	2.33 Kg 5.13 lbs	More than 4.7 canisters
KE	MK IV	23.96 Kg 52.72 lbs	335.5 738.1 lbs	0.71 wt%	Greater than 250 Kg	2.38 Kg 5.24 lbs	More than 100 canisters

Since less than one fuel assembly will be moved in KE, any error in handling of this fuel could not involve more than 4 canisters at one time (dropping the element between or on them. Up to 4 canisters could be concivevably be involved in KW making this the bounding case. This case is arguably bounnding since spreading of fuel results in a larger margin to criticality (i.e., safer).

The actual reactivity of the fuel is reduced lower than the above argument would suggest because fission products and transuranics (e.g. Pu^{240}) are present and act as a poison to reduce reactivity. Hence, because significant near term fission product and transuranic concentration changes is not credible in fuel in K Basins, segmentation can be applied to criticality considerations as well. The bounding case for an activity specific scenario is one fuel canister drop, with complete loss of fuel elements into the space above and around the stored fuel canisters.

For the drops expected (as analyzed in the SAR) the racks and canisters will retain the fuel. In all cases the drop of one canister will not exceed a) the areal density of that for a drop of all hanging fuel stored in a "1 over 3" array. This areal density is 443 lbs/ft^2 which is less than the critical mass limit of 500 lbs/ft^2 for exposed MK IA (6% Pu^{240}); b) the hemispherical critical limit of 169 elements; or c) K_{eff} of 0.833 for drop of multiple canisters

[5] SD-CP-TI-105; "ORIGEN2 Prediction of N Reactor Fuel Actinide Composition"

of MK IA from "1 over 3" array.

Another significant isotope, Pu^{239}, is present in the fuel as a result of production during irradiation. The total mass of Pu^{239} is less than 50 grams per element or 700 grams per canister. This would exceed the limit ANSI/ANS 8.1-1983 Table 1 limit of 480 grams of Pu^{239}; however, guidance in the final footnote of DOE-STD-1027-92, Table A.1 indicates that curie limits may be used when segmentation or the nature of the process precludes the potential for criticality. As discussed above, criticality is precluded with very substantial margin for the most serious accident considered credible in the activity being analyzed. That criticality calculation includes the reactivity contribution of both U^{235} and Pu^{239}. Hence the controlling limit is the radionuclide limit as developed elsewhere in this analysis.

Criticality is not a credible consequence of the activities planned in the basin.

4.0 CONDUCT OF OPERATIONS

Discipline in conduct of operations has been enhanced by providing compensatory measures for known weaknesses. All barrier related plant work is now being controlled to an approved schedule. All field work for barrier installation will be controlled to a Master Work Plan (MWP), which will be maintained by operations. All operating procedures invoked by the MWP and applicable to these activities will be verified prior to use; where inadequacies are identified, the procedures have been or will be revised. Detailed procedures have been developed for work done by others (e.g. ICF Kaiser Hanford crane operations). Field supervision will be required for all significant activities (e.g., fuel handling).

Activities have been considered to determine what failures were credible, identify measures to limit failure risk, and evaluate the need for recovery procedures. As an example, past experience shows that drop of a fuel canister is unlikely, but possible. As a result the operating procedure for fuel handling has been revised to require that the operator verify proper engagement of the hook on the canister lifting bail after lifting the canister 2 to 3 inches. The canister covers have been examined, documented on video footage, to verify that lock bars are in the locked position and that the lock bar condition is satisfactory. The canisters themselves have been examined for signs of corrosion which may indicate structural weakness (considered precautionary, no record of such a failure exists). All fuel transfers will be performed only with a supervisor present. Previous practice had allowed continued fuel handling after dropping up to 3 canisters; the upgraded requirement now requires full work stoppage until the problem causing the drop is evaluated and a problem specific recovery plan is developed.

A set of sub-systems has been identified as required to be operational to assure the safety of the planned activity. They are:

System 05 - The installed radiation monitoring system including alarm and annunciation components is required to be in-service for all fuel movement.

System 07 - Fuel Handling Equipment - Necessary equipment includes all components necessary to preclude an accidental fuel drop. Also the modification of the fuel storage racks shall be performed to an approved Engineering Change Notice (documenting the completed USQ screening) and a detailed procedure to assure conformance of the process to requirements for modification to a Safety Class I component.

System 14 - Cranes and Hoists - The cranes and hoist designated for use in the subject fuel handling evolution and door rigging will be covered.

System 43 - Water Sampling and Analysis - Those elements required to satisfy protection of personnel and the conditions of the WDOH air permit will be covered.

System 50 - Environmental Monitoring - Those elements required to provide protection of personnel and to satisfy conditions of the WDOH air permit will be covered.

- Level Monitoring
- Skimmer System - The skimmer system including IXM and sand filters to assure compliance with the WDOH air permit (KE only).

Plant readiness will be verified following the detailed guidance of the "Plant Readiness Plan to Move Fuel to Support Isolation Barrier Installation", which will be submitted for DOE approval following DOE approval of the readiness level. This plant readiness plan (PRP) defines the actions required to assure the Basins readiness to support isolation barrier installation and will provide the basis for conducting the Readiness Assessment (RA). The purpose of this plan is to provide a comprehensive methodology to assure basin readiness to perform the activity while ensuring the safety of the workers, the public and the environment, and that applicable requirements and regulations are met. When completed and documented, the actions prescribed in this plan will provide a high degree of confidence in the ability of the K Basin personnel to successfully complete the fuel movement and other activities. This objective will be achieved by confirming that required management systems and documentation are in place, that a qualified staff is assigned and trained, procedures are in place, and that systems and equipment are ready for operation within the approved safety envelope.

5.0 CONTINGENCY MANAGEMENT

It is expected that some changes to the above will be necessary as the work progresses. Such changes will be reviewed for impact to assess whether a) a major change in scope of work is involved, b) radioactive contaminants are being disturbed, c) the amount of hardware being inserted into or removed from the basin is affected, and d) to determine whether the activity change poses an USQ.

6.0 SAFETY EVALUATION

The general check sheets identify general hazards resulting from identified activities. Table 1 identifies the accident/events addressed by the existing safety documentation, determines whether the accident/event is applicable to operations for described activities, and provides the basis for the determination that it is bounded by the existing safety basis.

Table 2 provides the response to the Unreviewed Safety Question screening questions.

The hazard category of the activity is determined in accordance with DOE-STD-1027-92, a supporting guide for DOE Order 5480.23, "Nuclear Safety Analysis Reports." This determination is based on a comparison of Threshold Quantities with the at-risk inventory consisting of the fuel, including transuranics and fission products, covered by the water in the basin. This form is used because all activities involving fuel or events/accidents on fuel are underwater. A conservative decontamination factor (DF) of 10^4 is assumed. As allowed by DOE-STD-1027-92, the threshold quantities provided by the standard can be divided by this value. The amount of fuel to reach the Cat 3 threshold is then calculated. The Cat 3 threshold quantity is 243 fuel assemblies (17 canisters). For fuel movement, only one canister is handled at a time and if drop would likely only damage the fuel in less than 4 other canisters. In addition there is no possible equipment drop that could impact 17 canisters. Hence, the amount of inventory of fuel that is at risk of contributing to airborne dose is less than the Cat 3 Threshold Quantities. Appendix A provides the calculations for this determination.

Further, because of the low initial enrichment of the fuel (1.25 wt% or less) and the burn out during irradiation, a drop involving release of the fuel from a moving canister with fuel assemblies dispersed in the worst geometry among 3 to 4 other canisters does not exceed the DOE-STD-1027-92 threshold.

7.0 BASIS FOR RECOMMENDATION OF READINESS LEVEL

7.1 READINESS LEVEL DECISION PROCEDURE APPLICATION

Applying the decision algorithm developed in Section 1 above results in the determination that the proposed activity warrants, at most, a readiness assessment. The basis is developed in the discussion below:

Readiness Level Decision Procedure K Basins Isolation Barrier installation activity		
Step	Decision Point	Assessment
1	Is this an initial startup of new hazard category 1, 2, and nuclear facility?	No - The facility has been final classified as Hazard Category 2. This is not an initial startup of a new hazard category 2 nuclear facility.
2	Is this a restart after DOE management directed shutdown?	This is not a restart after DOE management directed shutdown,
3	Is this a restart of unlimited operation after an extended shutdown for hazard category 1 and 2 nuclear facilities (Extended shutdown for a category 1 nuclear facility is 6 months. Extended shutdown for a category 2 nuclear facility is 12 months.)?	This is a Hazard Category 2 facility. It has not been shut down, but operations have been limited for a period in excess of 12 months. However, this is not a restart of unlimited operation, but rather the start of restricted scope operation.
4	Is this a restart of hazard category 1 and 2 nuclear facilities after substantial plant or facility modifications required for future program work and/or for enhanced safety which require changes in the safety basis previously approved by DOE?	The modifications being performed as part of this activity will be required to enhance the safety basis for ultimate unlimited operation. However, this is not the restart of a hazard category 2 nuclear facility after substantial facility modifications required for enhanced safety; rather this activity is the performance of modification which will be required for later restart of the facility. The safety basis for the facility does not require revision prior to performing this work (see test 6a below for further insight).
5	Is this a restart after a nuclear facility shutdown because of operations outside the safety basis?	This is not an unlimited facility restart. Prior to unrestricted operation, an Operational Readiness Review is planned. It will follow a series of three activity specific readiness assessments, which will restart the facility (ie release it for unrestricted operation).

6	Is this a new operating phase that results in significant increase in existing hazards, or could introduce significant hazards not previously encountered. to apply this test, use questions 6a and 6b below	See 6a & 6b below.
6a	Apply 5480.21 USQ screening process against planned work and determine whether any activity screens positive as a USQ.	The USQ screening, documented in Table 1 below, indicates that all activities are bounded by the existing safety analyses. Barrier installation, using the basic Coffer Dam design, is an activity which has been previously analyzed and performed.
6b	Perform Activity Specific Hazard Classification and determine if planned activity is Activity specific Hazard Category 2.	Activity Specific Hazard Classification determined that the activity is arguably less than Category 3, and clearly less than Category 2. This is primarily a result of the narrow range of in-basin activities planned.
7	Perform Activity Specific Hazard Analysis and determine if planned activity is Activity specific Hazard Category 3.	A less than category 3 determination supports Plant Manager Discretion. Because of the high visibility of work required to resolve Unreviewed Safety questions, the plant manager has elected to consider this a Category 3 activity and to go with a DOE-STD-3006-93 Criteria Review & Approach Documents (CRAD) based Readiness assessment (RA) with internal formality approaching that of an Operational Readiness Review (ORR).

8.0 CONCLUSION

The hazard category of the activity has been as specified in DOE-STD-1027-92, a supporting guide for DOE Order 5480.23, "Nuclear Safety Analysis Reports." is less that Cat 3.

The activities involved with installation of discharge chute isolation barriers to mitigate the seismic induced leakage from basin-reactor building construction joint have been reviewed for hazards. The identified hazards are controlled or mitigated by the existing systems or procedures or will be mitigated or controlled by implementation of existing administrative practices. No new hazards have been identified that have not been addressed by the existing safety basis documentation. The hazard category of the activity has been as specified in DOE-STD-1027-92, a supporting guide for DOE Order 5480.23, "Nuclear Safety Analysis Reports." is less that Cat 3. The activities described, therefore, present no undo risk and also do not represent an unreviewed safety question.

TABLE I
SAFETY EVALUATION OF ACTIVITIES VS SAFETY BASES EVENTS/ACCIDENTS

Accident/Event (1)	Assumptions	Probability	Consequences (Remarks)	INVOLVES FUEL MOVE/BARRIER INSTALLATION (2)
1. Rail Car Fuel Spill - Criticality (SAR 8.1.1)	Contents of 3 casks spill and form a hemispherical configuration with optimal moderation and reflection.	10^{-4} to 10^{-6} "Not expected to occur during the lifetime of the facilities."	No criticality. Less than the necessary 169 elements for a criticality.	NO - FUEL NOT HANDLED OUT OF BASIN
2. Cask Fuel Spill - Criticality (SAR 8.1.2)	Contents of one cask spill into an optimally moderated and reflected hemisphere.	10^{-2} to 10^{-4} "Infrequent"	No criticality. Less than the minimum critical mass (169 elements).	NO - NO CASKS BEING USED
3. Canister Drop - Criticality (SAR 8.1.3)	1 over 3 storage configuration.	10^{-2} to 10^{-4} "Infrequent"	Spike fuel - Keff remains below 0.822. No criticality.	YES (for fuel movement only) - NO CHANGE
4. Broken Fuel Elements - Criticality (SAR 8.1.4)	Estimated 5% of total fuel is broken and 1% of the fuel has gone into solution immediately surrounding the fuel elements.	1 to 10^{-2} "Anticipated"	No criticality.	YES - NO CHANGE
5. Water Loss and Partial Moderation - Criticality (SAR 8.1.5)	Loss of coolant water. Reduction in density of the cooling water.	10^{-4} to 10^{-6} "Not expected to occur during the lifetime of the facilities."	No criticality. The Keff for a partially moderated array is less than for a fully moderated array.	YES - NO CHANGE
6. Loss of Storage Array Geometry - Criticality (SAR 8.1.6)	Maximum storage array is 1 over 3. No storage of unirradiated fuel. No storage of Mark IA fuel in the west bays and no hanging fuel in the west bays.	10^{-4} to 10^{-6} "Not expected to occur during the lifetime of the facilities."	No criticality. The storage restrictions prevent a critical mass configuration.	No - NO HANGING FUEL
7. Well Car Drop Into the Fuel Storage Basin - Criticality (SAR 8.1.7)	Derailers, railstops and bumpers are utilized. Locomotive speed limited to 2 mph. No Mark IA and no hanging fuel in west bays.	$< 10^{-6}$ "Incredible"	No criticality. Measures noted in the Assumptions prevent critical mass formation.	NO - NO TRAIN AND WELL CAR REQUIRED, NO FUEL MOVEMENT OUT OF BASIN
8. Loss of Monitoring Instrumentation (SAR 8.2.1)	Annunciation of instrument loss in the Control Room	1 to 10^{-2} "Anticipated"	No significant consequences. Immediate response procedures in place.	YES - NO CHANGE IN EVALUATION, WORK MAY NEED TO STOP BECAUSE OF RESPONSE PROCEDURES
9. Liquid Waste Car Accident (SAR 8.2.2)	Spill from tank car loaded with low level waste water in transit to the 200 Area.	1 to 10^{-6} From "Anticipated to Extremely Unlikely."	For low level waste release of a small quantity the consequences are minimal. For total release of a shipment, the consequences could be great. Not quantified.	NO - NO LIQUID WASTE GENERATED BY ACTIVITY
10. Crane Failure and Cask Dropped Into the Fuel Loadout Pit (SAR 8.2.3)	Fully loaded cask. Drop pulverizes the concrete beneath the cask. Percolation through the concrete slab and the soil are equal.	10^{-2} to 10^{-4} "Infrequent"	Leak of 2 gal. per min. to the soil. Environmental release is minimal due to under basin membrane and tile field.	YES - FOR LIFTS OF EQUIPMENT AND GATE CASK EVENT IS BOUNDING. (3)

TABLE I
SAFETY EVALUATION OF ACTIVITIES VS SAFETY BASES EVENTS/ACCIDENTS

11. Crane Failure and Cask Dropped Onto the Floor of Transfer Area (SAR 8.2.4)	Fully loaded cask (42 elements) drops 15 feet or more and overturns. The lid comes off and fuel spills out. Three broken elements per cask with break at a 45° angle. Fuel has been stored 150 days. 100% of the noble gases and 50% of the iodines are released as the only source term.	10^{-2} to 10^{-4} "Infrequent"	Site boundary dose: 7×10^{-6} mrem whole body and 1.5×10^{-3} mrem thyroid. (On-site dose - 16 mrem EDE 286 mrem limiting organ) (Off-site dose - 21 mrem EDE 386 mrem limiting organ)	NO - NO FUEL HANDLING OUT OF BASIN
11A. Crane Failure and Cask Dropped Onto the Floor of Transfer Area (Maximum Credible Accident) (SAR 8.2.4)	Cask fully loaded with broken fuel elements drops at least 15 feet, overturns and spills fuel out. Fuel is 150 days old. Only 100% nobel gases and 50% iodines are released.	10^{-4} to 10^{-6} "Not expected to occur during the lifetime of the facility"	Offsite population exposure of 2×10^{-5} mrem whole body and 4.5×10^{-2} mrem thyroid doses. SEE ITEM 17 BELOW FOR A REANALYSIS OF THIS ACCIDENT.	
12. Loaded Canister Dropped from a Lifting Hoist to the Pool Floor (SAR 8.2.5)	Fully loaded canister dropped 3.5 feet.	10^{-2} to 10^{-4} (Not defined in SAR)	No leakage. There is no fracture of the cement slab.	YES (FOR FUEL HANDLING ONLY) - NO CHANGE CANISTER HANDLING WILL BE THE SAME
13. Fire and Explosion Hazard (SAR 8.2.6)	Noncombustible facilities. Adequate fire water supply. No ion exchange material regeneration.	TBD	None to very minimal. Hydrogen hazard in IXC and IXM being evaluated.	YES - NO CHANGE, NO UNUSUAL EXPLOSIVES OR COMBUSTIBLES
14. Loss of Pool Coolant (SAR 8.2.7)	Total loss of pool water. Maximum of 5% of total fuel is damaged.	$< 10^{-6}$ "Incredible"	Release is less than 200 times that of the cask drop. (On-site dose - 3.1 mrem EDE 57.1 mrem limiting organ) (Off-site dose - 3.6 mrem EDE 77.1 mrem limiting organ)	YES - NO CHANGE
15. Uncontrolled Railroad Train (SAR 8.2.8)	Runaway train enters pool causing floor damage and leak of pool water. Derailers, railstops and bumpers in place and functional. Train speed controlled.	$< 10^{-6}$ "Incredible"	None since event is incredible. If credible, the leak would cause water loss and release of material.	YES - EQUIPMENT DELIVERY WILL BE BY VEHICLES MUCH LIGHTER THAN TRAIN AND CASK.

TABLE I
SAFETY EVALUATION OF ACTIVITIES VS SAFETY BASES EVENTS/ACCIDENTS

16. Sludge Criticality (SER 3.1.8)	0.95 fuel only stored in KE.	$< 10^{-6}$ "Cannot Occur"	Homogeneous sludge cannot become critical.	YES - BUT NO CHANGE
17. Crane Failure and Cask Dropped Onto the Floor of Transfer Area (Maximum Credible Accident) (SER 3.2.4 replaces SAR 8.2.4) 17A. Cask Drop with 3 Canisters of Sludge	Cask contains 3 canisters (42 elements) of all broken fuel. Fuel is 10 years old and is 12% Pu fuel. On-site exposure is for 2 hours and the off-site exposure is 8 hours. Sludge escapes ruptured canisters, dries and release radioactive materials. Sludge source term is 1985 sludge decayed 6 years.	Maximum of 10^{-4} "Not expected during plant lifetime."	On-site dose - 220 mrem EDE 4 rem limiting organ Off-site dose - 290 mrem EDE 5.4 rem limiting organ On-site dose - 250 mrem EDE 4.7 rem limiting organ Off-site dose - 83 mrem EDE 1.6 rem limiting organ	NO - NO FUEL MOVEMENT OUT OF BASIN
18. Loss of Off-site Power (SER 3.3.1 - SAR 5.3.3)	Total loss of power from offsite. Fuel handling operations cease with the power outage.	1 to 10^{-4} "Infrequent to Anticipated"	Heating up of pool due to loss of cooling. Maximum temperature is 130° F after 60 hours. (Being re-evaluated for current fuel age)	YES - NO CHANGE
19. Loss of Pool Cooling (SER 3.3.2 - SAR 5.3.3)	Loss of cooling with maximum heat load and no natural phenomena cooling. Initial temperature of 100° F and a maximum of 1.45 MW heat load.	1 to 10^{-4} "Infrequent to Anticipated"	Heating up of pool to a maximum of 130° F after 60 hours. (Being re-evaluated for current fuel age)	YES - NO CHANGE
20. Design Basis Earthquake (SER 3.3.3 - SAR 2.5)	Maximum horizontal acceleration of 0.25 g with simultaneous vertical acceleration of 0.17 g.	2.0×10^{-4}	Basin leakage from either cracks in basin walls or at the construction joint between the basin and the reactor. Water loss is less than total. (See Item 44)	YES - CUTTING OF RACKS WILL NOT COMPROMISE SEISMIC CAPABILITY. (4)
21. Tornado (SER 3.3.4 - SAR 2.6)	Maximum wind speed of 175 mph.	6.82×10^{-6}	Failure of wall and roof panels. Steel frame remains intact.	YES - NO CHANGE
22. Floods (Probable Maximum Flood) (SER 3.3.5 - SAR 4.3)	Reaches 423 feet above mean sea level.	(SDC 4.1 Design Basis Flood)	Loss of raw water (pumps submerged).	YES - NO CHANGE
23. Ashfall (SER 3.3.6 - SAR 4.6)	Maximum depth of 6 inches followed by heavy rain.	1 to 10^{-4} "Infrequent to Anticipated"	Roof loading of 25 lb/ft^2	YES - NO CHANGE

TABLE I
SAFETY EVALUATION OF ACTIVITIES VS SAFETY BASES EVENTS/ACCIDENTS

24. Low/No Flow of Service Water (SER 3.4.1)	Pipe break causes basin overflow at KE. Flow is 2000 gpm to the basin. 8 hours to respond.	Low probability	Discharge of 90,900 gal. to the river via 1908-K outfall and formation of a 5.4 acre shallow (3 in. deep) lake at KE. Total off-site dose of 4.1 E-1 mrem/yr. and 3.4 mrem/yr on-site dose at 100 meters.	YES - NO CHANGE
25. Fuel Storage Basin Water Level Low (SER 3.4.2)	See items 5 and 14.	10^{-4} to 10^{-6}	See item #s 5 and 14	YES - NO CHANGE
26. Fuel Storage Basin Water Level Very Low or None; Fuel Storage Basin Leakage Catastrophic (SER 3.4.3)	See items 5, 14, 18, 19 and 20.	10^{-4} to 10^{-6}	See item #s 5, 14, 18, 19 and 20.	YES - NO CHANGE
27. Fuel Storage Basin Temperature Very High (SER 3.4.4)	See items 18 and 19.	10^{-2} to 10^{-4}	See item #s 18 and 19.	YES - NO CHANGE
28. Fuel Storage Basin Leakage (SER 3.4.5)	See items 5 and 14	10^{-4} to 10^{-6}	See item #s 5 and 14.	NO CHANGE TO 5 OR 14
29. Contaminated Building Atmosphere (SER 3.4.6)	Canister removed from basin with unnoticed fuel assembly. Hoist fails in "on" position. Evacuation of the basin and impacted areas.	$< 10^{-6}$ "Not expected to occur during the life of the facility."	On-site dose: 5 mrem EDE 90 mrem limiting organ Off-site dose: 7 mrem EDE 130 mrem limiting organ	Yes - No change
30. Confinement of Gaseous Radiolysis Products (SER 3.4.7)	Radiolysis of sludge in basin and of canister contents.	Sludge -$< 10^{-6}$ "Incredible" Canister-Not Defined	No consequences for sludge since it is incredible. Canister seal will leak at 100 psi and release gases.	Yes - No change
31. Nitrogen Cylinder Rupture (SER 3.4.8)	Rupture of cylinder and formation of missile impacting fuel.	$< 10^{-6}$ "Incredible"	No longer credible. Bottles have been moved out of basin.	No - No pressurized gases required
32. Oxidation of Uranium Hydrides - Failure to Add Corrosion Inhibitor (SER 3.4.9)	Corrosion inhibitor not added to canister. Hydration of uranium has occurred.	$< 10^{-6}$ "Incredible"	None, the event is incredible.	Yes - No change
33. Release of Chlorine (SER 3.5.1)	Chlorine released from KE Water Treatment Facility.	TBD	Being re-evaluated due to modification and upgrade of chlorine system.	Yes - No change

TABLE I
SAFETY EVALUATION OF ACTIVITIES VS SAFETY BASES EVENTS/ACCIDENTS

34. Release of Sulfuric Acid/Sodium Hydroxide (SER 3.5.2)		$< 10^{-6}$ "Incredible"	None. Sources have been removed.	No - No acids/bases required
35. Sulfuric Acid or Sodium Hydroxide Solution Sent Directly to Basin (SER 3.5.3)		$< 10^{-6}$ "Incredible"	None. Sources have been removed.	No - No acids/bases required
36. OSR Fissile Mass Limits - Addition of Sludge to Open Canisters (SER 3.6.1)	Sludge canister spill into a loaded fuel canister.	10^{-2} to 10^{-4} "Infrequent"	Reduces reactivity.	NO - KW HAS CLOSED CANISTERS, NO FUEL CANISTER MOVEMENT AT KE.
37. Keff 0.98 vs 0.95 (SER 3.6.2)	NA	NA	Non concern. Evaluation and resolution sent to Tiger Team.	No -Issue resolved
38. DBE Basin Water Level (SER 3.6.3)	See item #s 14 and 20.	2×10^{-4}	See item #s 14 and 20.	Yes - Evaluated by #14 & # 20
39. Spent Ion Exchange Shipment for Burial (SER 3.6.4)	NA	NA	Tiger Team item - resolution submitted.	Yes - No change
40. Basin Leakage Monitoring (SER 3.6.5)	NA	NA	Tiger Team item - resolution submitted.	Yes - No change
41. Release of Ion Exchange Medium (SER 3.6.6)	Drop of one IXM from crane or drop of two IXCs from crane. Release of 1% of the radioactive inventory from the resin.	10^{-2} to 10^{-4} "Unlikely Event"	Being re-evaluated with revised source terms. Previous analysis had results of: On-site does: 1.9 mrem EDE 28 mrem limiting organ Off-site dose: 0.92 mrem EDE 8.6 mrem limiting organ	Yes - No change
42. Clearwell Integrity During DBE (SER 3.6.7)	Loss of clearwell due to DBE.	2×10^{-4}	Loss of coolant makeup water. No significant basin impact. (Credit no longer taken)	No - No credit for integrity of Clearwell during DBE
43. Ventilation Stack Failure (SER 3.6.8)	Stack failure due to aircraft striking it.	$< 10^{-7}$ "Incredible"	Upper part of stack impacts basin.	No - No affect on stack

TABLE I
SAFETY EVALUATION OF ACTIVITIES VS SAFETY BASES EVENTS/ACCIDENTS

44. Unsupported Basin Construction Joint (SER 3.6.9)	No rebar or doweling across joint.	2×10^{-4}	Leak rate less than the ability to makeup. Leak rate from failure of 17 sq. ft. area of the basin floor is 2 gpm. (Being re-evaluated in conjunction with DBE review.)	Yes - Until isolation barrier installed no change in potential affect on basin water level.

(1) SAR - Safety Analysis Report Irradiated N Reactor Fuel, WHC-SD-WM-SAR-062 REV 1.

SER - Safety Evaluation of Fuel Encapsulation in the 105-KE Storage Basin, WHC-SD-TA-020 REV 0. Also contained in Addendum 1 of SAR.

N.N.N - Refers to section of SAR or SER.

(2) Applicability is for all activities unless otherwise noted.

(3) The existing accident analysis reference by the SAR, UNI-287, "Extreme Load Analysis of the 100K Fuel Storage Basins and Clearwells", evaluated the consequences of dropping a fully loaded fuel canister, 728 lbs, on the 2 ft thick basin floor from a height of 3.5 ft. The energy of the falling canister, just before impact, would be about 2290 ft-lb, allowing for buoyancy effects. The maximum impacting force would be 68,500 lb which is less than the punching shear resistance of the concrete of 291,320 lb. For this drop no damage to basin is sustained.

A 25 foot drop of a transfer cask which weighs 48,000 lb will result in fracture of the basin floor, however leakage would be limited such that water make up can be effected before there is significant reduction in water level.

For the activities involving isolation barrier installation the maximum weight object would be the gate portion of the barrier with a weight of less than 2700 lbs. Using the same velocity values as for the fuel canister the impacting force would be 0.87 of the resistance. The drop height of the gate could be higher but because of its shape would likely sustain deformation which would reduce the impact force. Therefore damage to fuel basin is not likely to be sustained by equipment drops and in any case any damage would be much less than that of a cask drop. In addition such lifts will be handled as critical lifts which makes the probability of drops very small.

Drops on the fuel in racks will damage fuel but would be limited to a few canisters. Such damage could result in additional spread of radioactive materials to the water. Because the corrosion rates are slow the amount added would not be significant to that already in the water. The additional airborne radioactivity would thus also not be significant.

(4) **Refer to ECN 610292/610293, Prepare Isolation Barrier Location for Doors KE/KW.**

TABLE 2
USQ EVALUATION

1	Does the proposed activity increase the probability of occurrence of an accident previously evaluated in the safety basis?	NO
	Basis: The handling of the fuel is the same as was done in the past so there should be no difference in probability of canister drop or lifting of fuel to basin surface. The activity involving other equipment with the potential for damage to safety structures are one or two time activities with special lift requirements such that the probability of a drop should be vanishingly small (> 10^{-6}. For other applicable accidents identified in Table 1 there is no change in operation thus no change in probability.	
2	Does the proposed change increase the consequences of an accident previously evaluated in the safety basis?	NO
	Basis: The drop accidents are all bounded by the existing safety basis as indicated in Table 1. For other applicable accidents there is no change.	
3	Does the proposed activity increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the safety basis?	NO
	Basis: The only potential malfunctions are to the basin structure and fuel racks that would be caused by drops. These were addressed by 1 above.	
4	Does the proposed activity increase the consequences of a malfunction of equipment important to safety previously evaluated in the safety basis?	NO
	Basis: The only potential malfunctions are to the basin structure and fuel racks that would be caused by drops. These were addressed by 2 above.	
5	Does the proposed activity create the possibility of an accident of a different type than any previously evaluated in the safety basis?	NO
	Basis: The general check sheets for hazard identification did not identify any different accidents.	
6	Does the proposed activity create the possibility of a malfunction of equipment important to safety previously evaluated in the safety basis?	NO
	Basis: Only mechanical damage to basin structure and fuel racks was identified and these are addressed by existing safety basis.	
7	Does the proposed activity reduce the margin of safety as defined in the basis for any Technical Safety Requirement?	NO
	Basis: No technical safety requirement(OSR) is impacted by the described activities.	

EVALUATION OF MINIMUM AMOUNT OF FUEL TO EXCEED HAZARD CATEGORY 2 OR 3 THRESHOLDS
WITH WATER SCRUBBING DF OF 10,000

PREPARED BY R H Meade
DATE 9/21/94
CHECKED BY [illegible]
DATE 9/21/94

Isotope	Ci/MTU	Ci/Element	Threshold Cat 3 Ci	Threshold Cat 2 Ci	Cat 3 Ratio	Cat 2 Ratio
U-235	2.68E-02	6.08E-04	4.20E+00	2.40E+02	1.45E-04	2.53E-06
U-238	3.29E-01	7.46E-03	4.20E+00	2.40E+02	1.78E-03	3.11E-05
Pu-236*	2.20E-04	4.99E-06	5.20E-01	5.50E+01	9.60E-06	9.07E-08
Pu-238	4.80E+01	1.09E+00	6.20E-01	6.20E+01	1.76E+00	1.76E-02
Pu-239	1.10E+02	2.49E+00	5.20E-01	5.60E+01	4.80E+00	4.45E-02
Pu-240*	5.80E+01	1.32E+00	5.20E-01	5.50E+01	2.53E+00	2.39E-02
Pu-241	4.40E+03	9.98E+01	3.20E+01	2.90E+03	3.12E+00	3.44E-02
Pu-242	2.10E+02	4.76E+00	5.20E-01	5.50E+01	9.16E+00	8.66E-02
Am-241	9.30E+01	2.11E+00	5.20E-01	5.50E+01	4.06E+00	3.83E-02
Cm-244*	4.60E+00	1.04E-01	5.20E-01	5.50E+01	2.01E-01	1.90E-03
Eu-154*	8.80E+01	2.00E+00	5.20E-01	1.10E+05	3.84E+00	1.81E-05
Cs-134	1.30E+02	2.95E+00	4.20E+01	6.00E+04	7.02E-02	4.91E-05
Cs-137	7.30E+03	1.66E+02	6.00E+01	8.90E+04	2.76E+00	1.86E-03
Ce-144	2.80E+01	6.35E-01	1.00E+02	8.20E+04	6.35E-03	7.74E-06
Pr-144*	2.80E+01	6.35E-01	4.30E+05	1.00E+07	1.48E-06	6.35E-08
Pr-144M*	3.30E-01	7.48E-03	4.30E+05	1.00E+07	1.74E-08	7.48E-10
Pm-147	2.00E+03	4.54E+01	1.00E+03	8.40E+05	4.54E-02	5.40E-05
Sb-125	1.20E+02	2.72E+00	2.10E+02	4.30E+05	1.30E-02	6.33E-06
Te-125M*	3.00E+01	6.80E-01	2.10E+02	4.30E+05	3.24E-03	1.58E-06
Ru-106	5.20E+01	1.18E+00	1.00E+02	6.50E+06	1.18E-02	1.81E-07
Sr-90	5.80E+03	1.32E+02	1.60E+01	2.20E+04	8.22E+00	5.98E-03
Y-90*	5.80E+03	1.32E+02	2.10E+02	4.30E+05	6.26E-01	3.06E-04
				Totals	4.12E+01	2.56E-01
NUMBER OF ASSEMBLIES TO EXCEED CAT 3 OR 2 THRESHOLD					0.02	3.91
NUMBER OF ASSEMBLIES TO EXCEED CAT 3 THRESHOLD WITH DF OF 10,000 (1)					243	
NUMBER OF CANISTERS TO EXCEED CAT 3 THRESHOLD WITH DF OF 10,000 (1) (2)					17	
NUMBER OF ASSEMBLIES TO EXCEED CAT 2 THRESHOLD WITH DF OF 10,000 (1)						39125
NUMBER OF CANISTERS TO EXCEED CAT 2 THRESHOLD WITH DF OF 10,000 (1) (2)						2795

* NO THRESHOLD VALUES PROVIDED BY STD 1027 VALUES ESTIMATED BASED ON COMPARISON OF DOSE CONVERSION GUIDES

(1) FORM OF MATERIAL IS FUEL AND SLUDGE UNDER WATER, DF IS DUE TO SCRUBBING OF MATERIAL BY WATER

(2) THERE ARE 14ASSEMBLIES PER CANISTER