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ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 155516

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		10. System/Bldg./Facility: 105 K East
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		13. Permit/Permit Application No.: N/A
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15. DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Impact Level	Reason for Trans- mittal	Origi- nator Dispo- sition	Receiv- er Dispo- sition
1	WHC-SD-NR-TA-026		0 NA 4/30/94	K East Encapsulation Packager Modifications	3SQ NA 4/30/94	2	1	1

16. KEY					
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(G)	(H)	17. SIGNATURE/DISTRIBUTION (See Impact Level for required signatures)										(G)	(H)
Reason	Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	Reason	Disp.		
1	1	Cog. Eng. M.A. Jensen	<i>M. A. Jensen</i>	8/19/92	X0-44	PC Data	<i>PC Data</i>	8/27/92	R3-01	1	2		
1	1	Cog. Mgr. C.L. Bennett	<i>C. L. Bennett</i>	8/19/92	X0-44								
1	1	QA C.L. Volkman	<i>C. L. Volkman</i>	8/19/92	X1-80								
1	1	Safety R.V. Skinner	<i>R. V. Skinner</i>	8/19/92	X6-05								
		Env.											
4	4	L.D. Alwardt	<i>L. D. Alwardt</i>	8/19/92	X0-44								
4	4	R.J. Kuhta	<i>R. J. Kuhta</i>	8/19/92	X5-34								

18. Signature of EDT Originator <i>M. A. Jensen</i> Date: 8/19/92	19. Authorized Representative for Receiving Organization Date: 8/19/92	20. Cognizant/Project Engineer's Manager <i>C. L. Bennett</i> Date: 9/17/92	21. DOE APPROVAL (if required) Ltr. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments
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Document Number: WHC-SD-NR-TA-026, REV 0

Document Title: K EAST ENCAPSULATION PACKAGER MODIFICATIONS

Release Date: 8/22/94

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This document was reviewed following the
procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

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WHC Information Release Administration Specialist:

Kara Broz
(Signature)

8/22/94
(Date)

SUPPORTING DOCUMENT		1. Total Pages 5
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5. Key Words K East, K Basins, Encapsulation, Packager, Criticality Safety <div style="text-align: center; font-weight: bold; font-size: 1.2em;">APPROVED FOR PUBLIC RELEASE</div> <div style="text-align: left; margin-top: 10px;"><i>KMB 9/22/94</i></div>	6. Author Name: M. A. Jensen <div style="margin-top: 10px;"> <div style="text-align: center; font-size: 0.8em;">Signature</div> </div> Organization/Charge Code 11110/KK221	
7. Abstract This Supporting Document analyzes a proposal for reducing the under-packager volume to decrease the amount of fissile material that could accumulate there. The analysis shows that restricting the under packager volume to no more than 4080 in ³ will assure that if accumulated fissile material beneath the packager is added to the worst-case mass of fissile material in the discharge chute, a k_{eff} of 0.98 will not be exceeded.		
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9. Impact Level <i>JSQ</i> <div style="text-align: left; margin-top: 5px;"><i>NR 9/21/94</i></div>		

MASTER

K EAST ENCAPSULATION PACKAGER MODIFICATIONS

1.0 INTRODUCTION

The packager designed for the K East fuel storage basin encapsulation project has been studied to determine the potential for a buildup of fissile material underneath the unit. It was concluded that a small but finite possibility exists that fissile material in the form of fuel chips or fines could accumulate underneath the packager; therefore modifications are necessary in order to reduce the amount of material that could accumulate.

2.0 DISCUSSION

The packager-dump table assembly (drawings H-1-51841 and H-1-51842) consists of a large table connected to a packaging unit. Fuel from the currently stored canisters will be dumped onto the table. Fuel will be manually moved with tongs from the dump table and placed into one of two cradles, each of which holds up to seven fuel assemblies. When the two cradles are full, or the contents of the old canister have been completely transferred to the cradles, a plunger will push the fuel into the new canister. This canister will be removed, weighed, and encapsulated prior to its storage in the main basin. The plunger is connected to a piston which lies in a recessed slot in the packager body. Although the possibility of fuel pieces or sludge from damaged elements getting into the slot and accumulating underneath the packager is small, it cannot be ruled out completely. Since the criticality safety evaluation for encapsulation (Schwinkendorf 1992) sets a total mass limit on the amount of fissile material that can accumulate in the discharge chute, this possibility of accumulation must be studied.

The CSER limits the total mass of uranium in the discharge chute to 2031 kg (4476 lb). If the entire volume beneath the packager were filled with close-packed uranium scrap of optimum reactive size, the mass contained would be about 3043 kg. It is not likely that the entire volume could fill with close-packed scrap; however a significant amount of material could accumulate. The CSER determined that the stainless steel of the packager provided adequate neutronic isolation from any other fissile material present in the discharge chute. However, should an event occur that would overturn or lift the packager, the fissile material beneath it would be added to the inventory already in the discharge chute and possibly cause the k_{eff} 0.98 mass (3282 kg for hemispherical arrays) to be exceeded. A hemispherical array was chosen as being the most representative of actual conditions in a lifting or overturning accident.

3.0 BUILDUP MITIGATION

Several methods exist or have been proposed to reduce the amount of material that could accumulate beneath the packager. First, the existing design provides piping for water clarification that flows away from the packager cradles and towards the dump table. Thus any sludge stirred up as a result of dumping a canister of highly-corroded fuel onto the dump table will be pushed away from the packager cradles (and the slot). The dump table itself has a high wall separating it from the attached packager which will minimize material billowing over the packager where it might settle into the slot.

Second, a rubber boot will be installed along the slot. This will provide a method of closing off the slot yet still allowing normal plunger travel. The boot will effectively prevent the larger chips from entering the slot and should prevent most of the finer silt-like sludge from entering as well. Sludge composed of fines is not a criticality concern according to the CSER.

To reduce the volume under the packager that could accumulate fissile material, it has been proposed that the volume be filled with foam except around the area of piston travel to provide a means of access in case maintenance is needed (drawing SK-072192RAL of WA 1N-91-00301). A space four inches by six inches by 85 inches (2040 in^3) was specified as the minimum that would allow easy access to the piston. The resulting open space needs to be analyzed to determine the amount of fissile material that could accumulate there to determine if that mass, added to the discharge chute mass, would exceed the k_{eff} values.

4.0 ANALYSIS

The total open volume under the packager is $10,880 \text{ in}^3$. The CSER determined that this volume could hold up to 3043 kg of close-packed, optimum-sized scrap (i.e., .5 inch outside diameter rods). This provides an effective density of the material of $.2797 \text{ kg/in}^3$. If the entire volume held close-packed optimum-sized scrap, and the discharge chute held the CSER limit of 2031 kg, an over-turning accident would result in a total chute mass of 5074 kg, exceeding the hemispherical minimum critical mass of 4793 kg. Note that this assumes all of the fissile material in the chute is in the form of .5 inch OD rods instead of a combination of fines, chunks of various sizes, and intact fuel assemblies. Clearly, the volume beneath the packager needs to be reduced to the point where an accumulation would not cause k_{eff} to exceed 0.98 in the event that the accumulation is added to a chute inventory already at the CSER mass limit. Subtracting the CSER mass limit from the hemispherical k_{eff} value gives a mass of 1251 kg; this would be the upper limit allowable under the packager to ensure that the k_{eff} value is not exceeded. In order to compensate for dimensional errors, etc., a mass of 1200 kg will be used. Dividing 1200 kg by $.2797 \text{ kg/in}^3$ gives an allowable open volume of 4290 in^3 . Assuming the open

area is four inches deep by 85 inches long, the width is calculated to be 12.6 inches. Rounding down to dimensions of 4" x 12" x 85" will yield a total volume of 4080 in³ and a total mass of 1141.2 kg. If the hypothetical event overturned or lifted the packager and added this mass to the CSER limit of 2031 kg the total mass would be 3172.2 kg, which is less than the k_{eff} mass of 3282 kg by nearly 110 kg. A smaller area, such as 4" x 6" x 85", will yield a total mass of 570.6 kg, or 680.4 kg less than the k_{eff} mass.

The calculational results are presented below in tabular form:

Under-packager openings	Volume of opening, in ³	Mass if filled with scrap, kg	Opening mass plus chute mass, kg	Difference from k_{eff} 0.98 mass, kg
Total packager (4" x 85" x 32")	10,880	3043.14	5074.14	+1792.14
4" x 12" x 85"	4080	1141.2	3172.2	-109.8
4" x 6" x 85"	2040	570.6	2601.6	-680.4

Using foam as a filling material will not present a problem insofar as being a more effective moderator than water. The polyurethane foam being considered will be no more effective at neutron moderation than water, and its presence after an overturning accident would be moot.

5.0 REQUIREMENTS

The rubber boot and the polyurethane foam must be installed to prevent or minimize the accumulation of uranium fines or chips beneath the packager. Since any material that does find its way underneath the packager is isolated by the stainless steel packager walls from the rest of the fissile material inventory in the chute, there is no criticality concern, nor, if the volume underneath the packager is reduced as specified, is there a concern if the material should somehow be added to the chute inventory. The volume should be reduced as much as practicable but in no case should the access to the piston be greater than 4" x 12" x 85". Should the material build up to the point where operation of the packager is impaired, all other fissile material in the chute must be removed or cleaned up and removed prior to the lifting of the packager in order to prevent a violation of the Process Standards limit of 4450 lbs. (2018.5 kg). The packager may then be cleaned out, the material removed, and the chute declared "clean" according to approved procedures. It is recommended that the visible boot along the packager slot be periodically inspected for evidence of wear that might allow an increased amount of material to enter the slot, and if the packager must be removed from the basin for maintenance purposes the

foam must be inspected for integrity. Additionally, an opening has been identified in the dump table that could allow fissile material accumulation beneath it. This opening must be filled with foam sufficient to prevent accumulation under the dump table.

Both the rubber boot and the foam must be sufficiently radiation-resistant to prevent unacceptable deterioration over the anticipated working life of the packager.

6.0 REFERENCE:

Schwinkendorf, K.N., 1991, Criticality Safety Evaluation Report, 105-KE Basin Fuel Encapsulation", WHC-SD-NR-CSER-007, Rev.1, Westinghouse Hanford Company, Richland, Washington.