Attachment 2

Non-proprietary Calculations

A	Form 3.2-1	ulation No.:	13302-060
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DCR NO (if applicable) : 13302-001	PROJECT NAME: SMUD Gen	aral Services	**************************************
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CALCULATION TITLE:	anne ann an an ann an ann ann ann ann an		
Rancho Seco NUHOMS [®] -24P Cri FO- and FC- DSCs	ticality Analysis – Damaged Fuel Eval	uation for A	s Loaded
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0	04/23/2008	Initial Issue	5 		ALL	1
1	9/17/08		correct a typographical error pages shown by a Revision b and 5		ALL	None
	SNM-251Appendix	l0 c to the Mate	endent Spent Fuel Storage In erial License No. SNM-2510: Final Safety Analysis Report,	Technical	Specifications	3
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1.0 PURPOSE

The purpose of this calculation package is to determine the effect of loading fuel assemblies with known or suspected cladding defects greater than a pinhole or hairline cracks on the criticality of the NUHOMS[®]-24P FO- / FC- DSCs. The NUHOMS[®]-24P FO- / FC- DSCs are designed to be loaded with intact B&W 15x15 fuel assemblies. The NUHOMS[®]-24P FF- DSC is designed to be loaded with failed B&W 15x15 fuel assemblies.

An evaluation performed by the Sacramento Municipal Utility District (SMUD) at the Rancho Seco Plant determined that some of the fuel assemblies that were loaded in the FO- / FC-DSCs contained cladding defects that were greater than a hairline crack or a pinhole. This evaluation, documented in, reference [2.9] that 5 DSCs out of the 20 loaded DSCs contained such damaged assemblies with one DSC being loaded with a maximum of 2 suspected damaged assemblies. The spent fuel parameters (initial enrichment, burnup and cooling time) of the loaded fuel assemblies and the position of these fuel assemblies within each DSC is described in reference [2.7] and [2.8] respectively. This information is utilized to perform a criticality evaluation with bounding representation of the damaged assemblies, as loaded within the FO- / FC- DSC.

The results of this calculation will demonstrate that the criticality safety of the NUHOMS[®]-24P FO-/FC-DSCs loaded with damaged fuel assemblies (one or two assemblies per DSC with limited damaged) in an as loaded configuration is not affected. These results will demonstrate that the k_{eff} values of such DSCs are bounded by the design basis k_{eff} of the NUHOMS[®]-24P FO-/FC-DSCs.

2.0 REFERENCES

- 2.1 Transnuclear Calculation NUH005.0650, "Rancho Seco NUHOMS[®]-24P Criticality Analysis –FF– DSCs (for intact and failed fuel), Revision 5.
- 2.2 Transnuclear Calculation NUH005.0651, "Rancho Seco NUHOMS®-24P Criticality Analysis –FO– and FC– DSCs, Revision 3.
- 2.3 Transnuclear Calculation NUH005:0652, "Rancho Seco NUHOMS[®]-24P Criticality Analysis – Atom Density Calculations, Revision 3.
- 2.4 Transnuclear Calculation NUH005.0655, "Rancho Seco NUHOMS[®]-24P Criticality Analysis –Calculation of keff, Revision 3.
- 2.5 Transnuclear Calculation NUH32PTH1-0602, "KENO V.a Benchmarks for Criticality Analysis," Revision 0.

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3.0 NOMENCLATURE

DSC Dry Shielded Canister

A double seal-welded stainless steel vessel which has integral shielded end plugs and an aluminum flame-sprayed carbon steel basket assembly. The basket is designed to maintain subcriticality by fixed neutron absorber panels and geometry control. There are three types of DSCs at Rancho Seco:

FO-DSC Fuel-Only DSC

A short-cavity DSC for storing 24 fuel assemblies without any associated non-fuel hardware. The basket has borated neutron absorbing panels. The DSC end plugs are solid carbon steel.

FC-DSC Fuel-With-Control-Component DSC

A long-cavity DSC for storing 24 fuel assemblies with their associated non-fuel hardware. The basket has borated neutron absorbing panels. The DSC end plugs are composite lead/stainless steel.

FF-DSC Failed Fuel DSC

A long-cavity DSC for storing 13 fuel assemblies without any associated non-fuel hardware. Fuel with damaged cladding or minor structural damage may be stored in the FF-DSC. The basket has thick unborated stainless steel guide tubes. The DSC end plugs are composite lead/stainless steel.

HSM Horizontal Storage Module

A passive concrete bunker which provides biological shielding and missile protection for the DSC during onsite storage.

MP187 Cask NUHOMS® MultiPurpose-187 Cask

A dual-purpose cask for off-site transportation (10CFR71). The MP187 also serves a function as the transfer cask to carry loaded, sealed DSCs from the Fuel Building to the HSM.

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7.3 Summary and Conclusions

Criticality calculations were performed to determine the effect of loading of fuel assemblies with postulated damage on the criticality of the NUHOMS[®]-24P FO- / FC- DSCs. The design basis criticality cases from reference [2.2] were modified to be compatible with the CSAS25 calculational module. Criticality benchmarks were performed to determine a USL for the NUHOMS[®]-24P FO- / FC- DSC with the SCALE4.4 code package. The results of the criticality calculations for the design basis intact assemblies show that the maximum calculated k_{eff} is below the USL of 0.9425 with a large margin.

Criticality calculations are also performed on a conservative representation of an "as loaded" DSC with two damaged assemblies. The conservatism in the modeling of the DSC was quantified to be approximately 0.005 Δk_{eff} . The evaluated damaged configurations ranged from modeling a row of de-cladded fuel rods within the guide-sleeves to modeling a 2" - 40x40 array of fuel pellets at the bottom of the DSC. These configurations conservatively cover all postulated damage ranging from cracking of the cladding to complete cladding damage of several fuel rods.

The maximum k_{eff} for the NUHOMS[®]-24P FO- / FC- DSC in an as loaded configuration with two damaged assemblies is calculated to be 0.9151. This value is well below the design basis maximum k_{eff} of 0.9298 for the FO- / FC- DSC. These results demonstrate that the loading of damaged fuel assemblies with damage greater than pinhole or hairline crack does not result in any significant impact on the criticality of the system.

ARI	EVA	Calculat	tion	Calculation No.: Revision No.: Page:	13302-0600 <i>1</i> 34 of 35
TRANSNUC	LEAR INC.			, ugci	04 01 00
B.O APPEN	IDIX				
3.1 File List	ing				
Computer Sof	tware: SC/	ALE 4.4 PC (CSAS	25 Module)		
Software Versic		545MNYCP00			
Computer Type		Workstation with	Windows-XI	5	
			and Outerrate	- iloo	
		CSAS25 Input a		าแตร	
	Date	Size (Bytes)		File name	
	2/14/2008	38,425	csas?!	5-FOHXF000 inp	
	2/14/2008	631,475	······································	5-FOHXF000.out	-
	2/14/2008	38,425	And a second s	5-FOHXF005.inp	
	2/14/2008	631,619		5-FOHXF005.out	
	2/14/2008	38,425		5-FOHXF010.inp	
	2/14/2008	631,734	**************************************	5-FOHXF010.out	~
	2/14/2008	38,425	· · · · · · · · · · · · · · · · · · ·	5-FOHXF020.inp	
	2/14/2008	631,782	**************************************	5-FOHXF020.out	
	2/14/2008	38,425	csas26	5-FOHXF030.inp	-
	2/14/2008	631,291	csas28	5-FOHXF030.out	
	2/14/2008	38,425	csas2t	5-FOHXF040.inp	
	2/14/2008	631,577		5-FOHXF040.out	
	2/14/2008	38,425	Construction and the second se	5-FOHXF050.inp	
	2/14/2008	631,485	······································	5-FOHXF050.out	
	2/14/2008	38,425	47959990 (199995 100 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	5-FOHXF060.inp	
	2/14/2008	631,906		5-FOHXF060.out	
	2/14/2008	38,425		5-FOHXF070.inp	
	2/14/2008	631,644		25-fohxf070.out	
	2/14/2008	38,425		5-FOHXF080.inp	
	2/14/2008	631,465	2 C	5-FOHXF080.out	
	2/14/2008 2/14/2008	38,425	4 And and a state of the second state of the s	5-FOHXF090.inp 5-FOHXF090.out	
	2/14/2008	631,483 38,425		5-FOHXF100.inp	mail
	2/14/2008	631,577	······································	5-FOHXF100.out	
	4/1/2008	61,660	Sector Street Stre	0-24ass-e000.inp	
	4/1/2008	757,942		00-24ass-e000.mp	
	4/1/2008	61,655		001-24ass-e000.001	~~~~~
	4/1/2008	768,721		01-24ass-e000 out	
	4/1/2008	63,447		02-24ass-e000.inp	
	4/1/2008	785,179	A management of the second	002-24ass-e000.out	
	4/1/2008	63,447		03-24ass-e000.inp	
	4/1/2008	784,992	· · · · · · · · · · · · · · · · · · ·	103-24ass-e000.out	

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				· · · ·	
	Date	Size (Bytes)		File name	
	4/1/2008	63,447	fodsc10	-004-24ass-e000.inp	:
	4/1/2008	784,922	fodsc10	-004-24ass-e000.out	
	4/1/2008	64,879	fodsc10	011-24ass-e000.inp	
Ì	4/1/2008	780,304	fodsc10	011-24ass-e000.out	
	4/2/2008	64,348	fodsc10	-021-24ass-e000.inp	
	4/2/2008	782,194	fodsc10	-021-24ass-e000.out	
er of sector of the sector of	4/2/2008	64,193		-022-24ass-e000.inp	·
1	4/2/2008	785,972	fodsc10-	-022-24ass-e000.out	
.	4/2/2008	65,203	fodsc10	-031-24ass-e000.inp	
	4/2/2008	795,331	fodsc10	-031-24ass-e000.out	
	4/2/2008	65,207	fodsc10	-041-24ass-e000 inp	
	4/2/2008	795,269	fodsc10	-041-24ass-e000.out	
	4/2/2008	65,216	fodsc10	-041-24ass-e005.inp	
	4/2/2008	791,900	fodsc10	-041-24ass-e005.out	
	4/2/2008	65,216	fodsc10	-041-24ass-e010.inp	
	4/2/2008	792,075	fodsc10	-041-24ass-e010.out	
	4/2/2008	65,216	a second s	-041-24ass-e020.inp	
	4/2/2008	792,105	· ····································	-041-24ass-e020.out	
	4/2/2008	65,216	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	-041-24ass-e030.inp	
	4/2/2008	791,918	fodsc10	-041-24ass-e030.out	
	4/2/2008	65,216	fodsc10	-041-24ass-e040.inp	
	4/2/2008	792,092	fodsc10	-041-24ass-e040.out	
	4/2/2008	65,216	fodsc10	-041-24ass-e050 inp	
	4/2/2008	791,880		-041-24ass-e050.out	1000
	4/2/2008	65,216		-041-24ass-e060.inp	
	4/2/2008	791,848		-041-24ass-e060.out	
	4/2/2008	65,216		-041-24ass-e070.inp	
	4/2/2008	791,918		-041-24ass-e070.out	
	4/2/2008	65,216	fodsc10	-041-24ass-e080.inp	
	4/2/2008	791,858	in a subscription of the second se	-041-24ass-e080.out	
	4/2/2008	65,216	fodsc10	-041-24ass-e090.inp	
	4/2/2008	792,598	fodsc10	-041-24ass-e090.out	
	4/2/2008	65,216	and the second	-041-24ass-e100.inp	
	4/2/2008	791,746		-041-24ass-e100.out	
	4/2/2008	65,200		1-051-24ass-e000.inp	
	4/2/2008	794,356		1-051-24ass-e000.out	·