JUL 01 1997
Station 34
(21)

ENGINEERING DATA TRANSMITTAL

1. EDT 621292

2. To: (Receiving Organization)	3. From: (Originating Organization)	4. Related EDT No.:
Distribution	Criticality and Shielding	621292
5. Proj./Prog./Dept./Div.: SNF	6. Design Authority/ Design Agent/Cog. Engr.: K. N. Schwinkendorf	7. Purchase Order No.: NA

8. Originator Remarks:
This calculation note documents the criticality analysis of a recent design change in the MCO scrap basket.

9. Equip./Component No.: NA

10. System/Bldg./Facility:

11. Receiver Remarks: 11A. Design Baseline Document? [X] Yes [] No

12. Major Assm. Dwg. No.: NA

13. Permit/Permit Application No.: NA

14. Required Response Date:

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	HNF-SD-SNF-CN-025		0	Results for Case A for Task Order 041-001	~~S~~ N/A KN	3		

16. KEY

Approval Designator (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION
(See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN
		Design Authority L. H. Goldmann			R3-86	(See	page	2 for signature) KN
		Design Agent						
1		Cog.Eng. K. N. Schwinkendorf	K. N. Schwinkendorf	6/17/97	B0-35			
1		Cog. Mgr. J. Greenborg	J. Greenborg	6/19/97	B0-35			
		QA						
		Safety						
		Env.						

18.	19.	20.	21. DOE APPROVAL (if required)
K. N. Schwinkendorf K. N. Schwinkendorf 6/17/97 Signature of EDT Originator Date	Authorized Representative for Receiving Organization Date	J. Greenborg J. Greenborg 6/19/96 Design Authority/ Cognizant Manager Date	Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-2 (05/96) GEF097

BD-7400-172-1

ENGINEERING DATA TRANSMITTAL

Page 2 of 2

1. EDT 621292

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Criticality and Shielding	4. Related EDT No.: 621292
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		10. System/Bldg./Facility:
11. Receiver Remarks: 11A. Design Baseline Document? [X] Yes [] No		12. Major Assm. Dwg. No.: NA
		13. Permit/Permit Application No.: NA
		14. Required Response Date:

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(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	HNF-SD-SNF-CN-025		0	Results for Case A for Task Order 041-001	~~S~~ N/A	3		

16. KEY

Approval Designator (F)	Reason for Transmittal (G)		Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information	4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION
(See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN	(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN
1	1	Design Authority [signature] 7/1/97			FAX TO Karen Noland 373-3804 from Lou - thanks
		Design Agent			
1		Cog. Eng. K. N. Schwinkendorf [signature] 6/17/97 R3-35			
1		Cog. Mgr. J. Greenborg [signature] 6/19/97 R3-35			
		QA			
		Safety			
		Env.			

18.	19.	20.	21. DOE APPROVAL (if required)
K. N. Schwinkendorf [signature] 6/17/97 Signature of EDT Originator Date	Authorized Representative Date for Receiving Organization	Greenborg [signature] 6/19/97 Design Authority/ Cognizant Manager Date	Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments

BD-7400-172-2 (05/96) GEF097

Louis H. Goldmann R3-86

Results for Case A for Task Order 041-001

K. N. Schwinkendorf
Fluor Daniel Northwest, Inc., Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 621292 UC: 510
Org Code: 403 Charge Code: E55480
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Key Words: Spent Nuclear Fuel, MCO, MCNP

Abstract: A design change in the Multicanister Overpack (MCO) container scrap basket has required a reevaluation for criticality safety. The bounding case, the drop accident case for MarkIV-loaded MCOs, was reanalyzed with less mass in the baseplate of the upper scrap basket. The reduction in mass was from 50 lb to 27lb. No statistically significant difference between the two cases was found. The original analysis is therefore considered valid and no additional analysis is required.

Karen G. Noland 7/1/97
Release Approval Date

Release Stamp

Approved for Public Release

CHECKLIST FOR INDEPENDENT REVIEW

Document Reviewed: Results for CASEA for Task Order 041-001

Author: K. N. Schwinkendorf

Yes	No	N/A	
[X]	[ ]	[ ]	Problem completely defined.
[X]	[ ]	[ ]	Necessary assumptions explicitly stated and supported.
[X]	[ ]	[ ]	Computer codes and data files documented.
[X]	[ ]	[ ]	Data checked for consistency with original source information as applicable.
[ ]	[ ]	[X]	Mathematical derivations checked including dimensional consistency of results.
[X]	[ ]	[ ]	Models appropriate and used within range of validity or use outside range of established validity justified.
[ ]	[ ]	[X]	Hand calculations checked for errors.
[X]	[ ]	[ ]	Code run streams correct and consistent with analysis documentation.
[X]	[ ]	[ ]	Code output consistent with input and with results reported in analysis documentation.
[ ]	[ ]	[X]	Acceptability limits on analytical results applicable and supported. Limits checked against sources.
[X]	[ ]	[ ]	Safety margins consistent with good engineering practices.
[X]	[ ]	[ ]	Conclusions consistent with analytical results and applicable limits.
[X]	[ ]	[ ]	Results and conclusions address all points required in the problem statement.
[ ]	[ ]	[X]	Have all reasonable accidents been considered?
[ ]	[ ]	[X]	Has low density water (steam) been evaluated as a moderator?
[X]	[ ]	[ ]	Is the fuel and other hardware composition correct?
[ ]	[ ]	[X]	Are the cases considered conservative? Too conservative?
[ ]	[ ]	[X]	Do the computer models adequately reflect the actual geometry? Have cross sectional cuts of the geometry been made and do they show the desired geometry?
[ ]	[ ]	[X]	Has the analysis been reviewed by Safety? This may not be required in a preliminary design.
[ ]	[ ]	[X]	Has the reviewer completed the Criticality Safety Course for Managers and Engineers?

Reviewed by: Victor Rotman Date 6/18/97

NOTE: Any hand calculations, notes, or summaries generated as part of this review should be signed, dated, and attached to this checklist. Materials should be labeled and recorded so that it is intelligible to a technically-qualified third party.

RESULTS FOR CASE A FOR TASK ORDER 041-001

Methodology

The Monte Carlo N-Particle (MCNP) (Breismeister 1993) computer code was used to perform the calculation documented in this report. MCNP was used to perform a Monte Carlo simulation of the transport of neutrons through a model of the Multicanister Overpack (MCO) container to obtain a statistical estimate of the effective neutron multiplication factor, k_{eff}.

Assumptions

MCNP calculation CASE4 (Schwinkendorf 1997) was based on an assumption of 3/8-inch stainless steel baseplates forming the bottom of the scrap baskets. These baseplates are assumed in the MCNP input model to be solid (the holes are not explicitly modeled). Given the diameter of the baseplate, this model includes nearly 50 lbs of steel. The current scrap basket design calls for 27.13 lb instead of the 50 lbs assumed in the reference. This calculation was therefore modified by reducing the material density of the scrap basket baseplate so that the weight is reduced to 27.13 lb.

CASE4 is the Mark IV-loaded MCO after the drop accident, where all the intact fuel in the central three fuel baskets are assumed to fragment, and pack together into an optimal configuration with a packing fraction of 0.4 (the scrap baskets in the top and bottom locations remain loaded with optimal 0.95 wt% enriched uranium metal scrap).

Input Data

The input file for this calculation may be found in filename case4_nu.inp, located on the workstation server disk under the directory: /home_area/h56712/mcnp This data file is also appended to this calculation note.

Calculations

This calculation was performed using 50 neutron generations of 1,000 neutron histories per generation, and 10 generations were skipped before statistical information was included in the result. The calculation was performed on the sgi1 Silicon Graphics workstation.

Results

The results are as follows:

CASE4 from the Schwinkendorf reference:
$k_{eff} = 0.9341 \pm 0.0028$, 95% upper bound estimate = 0.9398

Modified CASE4 with the reduced-density scrap basket baseplate:
$k_{eff} = 0.9329 \pm 0.0027$, 95% upper bound estimate = 0.9382

Conclusions

The removal of neutron-absorbing material (reduced steel density in the scrap basket baseplate) from the MCNP model should have increased the k_{eff} of the system. However, this change in the model is so slight that MCNP was not able to discern a statistically-significant difference in the neutron multiplication constants between the two cases. The difference between the two k_{eff} values is only one-third of the 1-sigma statistical error in the two cases. The conclusion is that, within the statistical uncertainty in the Monte Carlo results, there is no statistically significant difference between how the scrap basket baseplates were modeled in the reference and the modified design. It is felt that no further analysis is required.

References

Breismeister, J. F., Editor, 1993, *MCNP — A General Monte Carlo N-Particle Transport Code, Version 4A*, LA-12625, Los Alamos National Laboratory, Los Alamos, New Mexico.

Schwinkendorf, K. N., 1997, *Criticality Safety Evaluation Report for Spent Nuclear Fuel Processing and Storage Facilities*, HNF-SD-SNF-CSER-005 Revision 3, Fluor Daniel Northwest, Richland, Washington.

MCNP input file

The following is a listing of the input file used to perform this calculation:

```
message:

 multiple canister over-pack - RUN 4 - MKIV Drop Case
 1  1 -18.82  -1                              u=1 imp:n=1 $ MKIV fuel scrap
 2  2  -6.55   1 -2                           u=1 imp:n=1 $ fuel clad
 3  4  -1.00   2                              u=1 imp:n=1 $ lattice water
 4  0  -5  6 -9  8 -7  10             lat=2   u=2 fill=1  imp:n=1
 5  1 -18.82  -3                              u=3 imp:n=1 $ MKIV fuel rubble
 6  2  -6.55   3 -4                           u=3 imp:n=1 $ fuel clad
 7  4  -1.00   4                              u=3 imp:n=1 $ lattice water
 8  0  -11  12 -15  14 -13  16        lat=2   u=4 fill=3  imp:n=1
 9  4  -1.00  -20  21 -19                         imp:n=1 $ top water reflector
10  4  -1.00  -21  22 -17                         imp:n=1 $ water in gap #1
11  0     -17 -22  23                 fill=2      imp:n=1 $ scrap in basket #1
12  3  -4.717 -23  24 -17                         imp:n=1 $ ss plate #1
13  0     -17 -24  25                 fill=4      imp:n=1 $ MKIV rubble #2
14  3  -8.03  -25  26 -17                         imp:n=1 $ ss plate #2
15  0     -17 -26  27                 fill=4      imp:n=1 $ MKIV rubble #3
16  3  -8.03  -27  28 -17                         imp:n=1 $ ss plate #3
17  0     -17 -28  29                 fill=4      imp:n=1 $ MKIV rubble #4
18  3  -8.03  -29  30 -17                         imp:n=1 $ ss plate #4
19  0     -17 -30  31                 fill=2      imp:n=1 $ scrap in basket #5
20  3  -8.03  -31  32 -17                         imp:n=1 $ ss plate #5
21  3  -8.03  -32  33 -18                         imp:n=1 $ ss mco bottom end cap
22  3  -8.03   36 -18 -21   32                    imp:n=1 $ steel on side of mco
23  4  -1.00  -19  18 -21   33                    imp:n=1 $ water surrounding mco
24  4  -1.00  -33  34 -19                         imp:n=1 $ water below ss end cap
25  3  -8.03   17 -35  32   -21                   imp:n=1 $ mco liner
26  4  -1.00   35 -36  32   -21                   imp:n=1 $ water gap
27  0          20: -34: 19                        imp:n=0 $ outside world

 1  cz      0.9                       $ optimum scrap radius
```

```
 2  cz      0.96444                       $ scrap token clad radius
 3  cz      1.5                           $ optimum rubble radius
 4  cz      1.60741                       $ rubble token clad radius
 5  px      1.51418                       $ lattice hexagon planes for scrap



 6  px     -1.51418
 7  p      -0.57735  1.0  0.0  1.74842
 8  p       0.57735  1.0  0.0 -1.74842
 9  p       0.57735  1.0  0.0  1.74842
10  p      -0.57735  1.0  0.0 -1.74842
11  px      2.25861                       $ lattice hexagon planes for rubble
12  px     -2.25861
13  p      -0.57735  1.0  0.0  2.60802
14  p       0.57735  1.0  0.0 -2.60802
15  p       0.57735  1.0  0.0  2.60802
16  p      -0.57735  1.0  0.0 -2.60802
17  cz     29.5275                        $ basket diameter 23.25"
18  cz     50.8                           $ outer steel radius 20"
19  cz     81.28                          $ water outside mco
20  pz    209.48565                       $ top of water reflector
21  pz    179.00565                       $ top of water gap #1
22  pz    161.03685                       $ top of scrap #1
23  pz     93.79035                       $ top of ss plate #1
24  pz     92.83785                       $ top of MKIV rubble #2
25  pz     31.58095                       $ top of ss plate #2
26  pz     30.62845                       $ top of MKIV rubble #3
27  pz    -30.62845                       $ top of ss plate #3
28  pz    -31.58095                       $ top of MKIV rubble #4
29  pz    -92.83785                       $ top of ss plate #4
30  pz    -93.79035                       $ top of scrap #5
31  pz   -161.03685                       $ top of ss plate #5
32  pz   -161.98935                       $ top of ss end cap
33  pz   -181.03935                       $ bottom of ss end cap
34  pz   -211.51935                       $ water below ss end cap
35  cz     30.7975                        $ mco liner
36  cz     31.75                          $ water gap

mode n
kcode   1000 1.0  10  50
ksrc      12.11344  0.0       122.89155
         -12.11344  0.0       122.89155
           9.03444  0.0        59.1947
          -9.03444  0.0        59.1947
           9.03444  0.0         0.0
          -9.03444  0.0         0.0
           9.03444  0.0       -59.1947
          -9.03444  0.0       -59.1947
          12.11344  0.0      -122.89155
         -12.11344  0.0      -122.89155          $ 10 source points
m1      92235.50c  -0.009471 92238.50c  -0.990529 $ mkiv inners
m2      40000.50c  -1.000                         $ zr clad
m3       6000.50c  -0.0004                        $ stainless steel 304
        25055.50c  -0.0200                        $ (8.03 g/cc)
        14000.50c  -0.0100
        24000.50c  -0.1900
        28000.50c  -0.0925
        26000.55c  -0.6871
m4       1001.50c  -0.1119    8016.50c  -0.8881   $ water
mt4      lwtr.01t
m5       6000.50c  -0.000396                      $ borated stainless steel 304
        25055.50c  -0.0198                        $ (8.03 g/cc)
        14000.50c  -0.0099
        24000.50c  -0.1881
        28000.50c  -0.091575
        26000.55c  -0.680229
         5010.50c  -0.00199
         5011.55c  -0.00801
m6      92235.50c  -0.009471 92238.50c  -0.990529 $ mkiv outers
```

```
totnu
ctme 350.
print
```

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	Criticality and Shielding	Date June 17, 1997
Project Title/Work Order		EDT No. 621292
Results for Case A for Task Order 041-001		ECN No.

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
P. J. Bedell	S0-04	X			
J. Greenborg	H0-35	X			
K. N. Schwinkendorf	H0-35	X			
K. M. Walterskirchen	G3-17	X			
J. L. Wise	X3-85	X			
Central Files (1 + Original)	A3-88	X			
KN L. H. Goldmann	R3-86	X			