OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT CALCULATION COVER SHEET

1. QA: QA

Page: 1

Of: 15

2. Calculation Title

Horizontal Lifting of 5 DHLW/DOE - Long, 12-PWR Long and 24-BWR Waste Packages

3. Document Identifier (including Revision Number)

CAL-EBS-ME-000010 REV 00

4. Total Attachments

7

5. Attachment Numbers - Number of pages in each

I-4, II-4, III-4, IV-9, Attachments V through VII are on one CD (See Remarks).

	Print Name	Signature	Date
6. Originator	Valérie de la Brosse	<i>V. de la Brosse</i>	05/17/01
7. Checker	Sreten Mastilovic	<i>Sreten Mastilovic</i>	05/17/2001
8. Lead	Scott M. Bennett	<i>Scott M. Bennett</i>	05/18/01

9. Remarks

Attachments V through VII are electronic media attachments (compact disc) containing ANSYS V5.4 electronic files. The name, size, date and time of creation of each file are listed in section 8 of this document.

Revision History

10. Revision No.	11. Description of Revision
00	Initial Issue

CONTENTS

	Page
1. PURPOSE	4
2. METHOD	4
3. ASSUMPTIONS	4
4. USE OF COMPUTER SOFTWARE AND MODELS	6
4.1 SOFTWARE	6
4.2 SOFTWARE ROUTINES	6
4.3 MODELS	6
5. CALCULATION	7
5.1 MATERIAL PROPERTIES	7
5.2 MASS OF PWR FUEL ASSEMBLIES	8
5.3 MASS OF BWR FUEL ASSEMBLIES	8
5.4 FINITE ELEMENT REPRESENTATIONS	8
6. RESULTS	10
7. REFERENCES	12
8. ATTACHMENTS	14

TABLES

Page

1. Maximum Stress Intensities for the 5 DHLW/DOE - Long Waste Package at Three Different Temperatures.....	10
2. Maximum Stress Intensities for the 12-PWR Long Waste Package at 316°C	11
3. Maximum Stress Intensities for the 24-BWR Waste Package at 316°C	11
4. Name, Size, Date and Time of Creation of the Files in Attachments V to VII	15

1. PURPOSE

The objective of this calculation was to determine the structural response of a 12-Pressurized Water Reactor (PWR) Long, a 24-Boiling Water Reactor (BWR) and a 5-Defense High Level Waste/Department of Energy (DHLW/DOE) - Long spent nuclear fuel waste packages lifted in a horizontal position (see Ref. 8, Section 1.2.1.18). The scope of this calculation was limited to reporting the calculation results in terms of maximum stress intensities in the trunnion collar sleeves. In addition, the maximum stress intensities in the inner and outer shells of the waste packages were presented for illustrative purposes. The information provided by the sketches (Attachments I, II and III) is that of the potential design of the types of waste packages considered in this calculation, and all obtained results are valid for these designs only. This calculation is associated with the waste package design and was performed by the Waste Package Design Section in accordance with the *Technical work plan for: Waste Package Design Description for LA* (Ref. 7). AP-3.12Q, *Calculations* (Ref. 13), was used to perform the calculation and develop the document.

2. METHOD

The finite element calculations were performed using the commercially available ANSYS version (V) 5.4 (Ref. 6) finite element code. The results of these calculations are provided in terms of stress intensities.

With regard to the development of this calculation, the control of the electronic management of data was accomplished in accordance with the *Technical work plan for: Waste Package Design Description for LA* (Ref. 7) and evaluated in accordance with AP-SV.1Q, *Control of the Electronic Management of Information* (Ref. 14). The evaluation (Addendum B of Ref. 7) determined that current work processes and procedures are adequate for the control of electronic management of data for this activity.

3. ASSUMPTIONS

In the course of developing this document, the following assumptions were made regarding the structural calculations for the waste packages.

- 3.1 Some of the temperature-dependent material properties were not available for SB-575 N06022 (Alloy 22) and SA-240 S31600 (316 nuclear grade [NG] stainless steel [SS]). Therefore, room-temperature (RT) (20°C) density and RT Poisson's ratio were assumed for both materials used. The impact of using RT density and RT Poisson's ratio was anticipated to be small. The rationale for this assumption was that the mechanical properties of these materials do not change significantly at the temperatures experienced during handling and lifting operations. This assumption was used in Section 5.1.
- 3.2 The Poisson's ratio of Alloy 22 was not available in literature. Therefore, the Poisson's ratio of Alloy 625 (SB-443 N06625) was assumed for Alloy 22. The impact of this assumption

was anticipated to be negligible. The rationale for this assumption was that the chemical compositions of Alloy 22 and Alloy 625 are similar (see Ref. 2 and Ref. 1, respectively). This assumption was used in Section 5.1.

- 3.3 The masses of the BWR and PWR fuel assemblies were increased by 25 lbs. The rationale for this assumption was to take into account potential variations in fuel assembly weight while providing a set of bounding results. This assumption was used in Section 5.2 and 5.3.

4. USE OF COMPUTER SOFTWARE AND MODELS

4.1 SOFTWARE

The finite element analysis (FEA) computer code used for this calculation is ANSYS V5.4 (see Ref. 6), which was obtained from Software Configuration Management in accordance with appropriate procedures, and is identified by the Computer Software Configuration Item number 30040 V5.4. ANSYS V5.4 is a commercially available FEA code and is appropriate for structural calculations of waste packages as performed in this calculation. The calculations using the ANSYS V5.4 software were executed on the Hewlett-Packard (HP) 9000 series workstation identified with YMP (Yucca Mountain Project) tag number 117161. The software qualification of ANSYS V5.4 was summarized in reference 6. The ANSYS evaluation performed for this calculation is fully within the range of the validation performed for the ANSYS V5.4 code. Access to the code was granted by the Software Configuration Secretariat in accordance with the appropriate procedures.

The input files (identified by .inp file extensions) and output files (identified by .out file extensions) for ANSYS V5.4 are provided in Attachments V, VI and VII.

4.2 SOFTWARE ROUTINES

None used.

4.3 MODELS

None used.

5. CALCULATION

5.1 MATERIAL PROPERTIES

Material properties used in this calculation are listed in this section. Some of the temperature-dependent material properties were not available for Alloy 22 and 316NG SS. Therefore, RT density and RT Poisson's ratio were used for Alloy 22 and 316NG SS (see Assumption 3.1).

SB-575 N06022 (Alloy 22) (outer shell, outer shell lids, extended outer shell lid, upper and lower trunnion collar sleeves, and inner shell support ring):

- Density = 8690 kg/m^3 (0.314 lb/in^3) (at RT) (Ref. 2, SB-575 Section 7.1)
- Yield strength = 310 MPa (45 ksi) (at RT) (Ref. 2, Table Y-1)
Yield strength = 236 MPa (34.3 ksi) (at $400^\circ\text{F} = 204^\circ\text{C}$) (Ref. 2, Table Y-1)
Yield strength = 211 MPa (30.6 ksi) (at $600^\circ\text{F} = 316^\circ\text{C}$) (Ref. 2, Table Y-1)
- Poisson's ratio = 0.278 (at RT) (Ref. 1, p. 143; see Assumption 3.2)
- Modulus of elasticity = 206 GPa (at RT) (Ref. 12, p. 14)
Modulus of elasticity = 196 GPa (at $400^\circ\text{F} = 204^\circ\text{C}$) (Ref. 12, p. 14)
Modulus of elasticity = 190 GPa (at $600^\circ\text{F} = 316^\circ\text{C}$) (Ref. 12, p. 14)

SA-240 S31600 (316NG SS, which is 316 SS with tightened control on carbon and nitrogen content and has the same material properties as 316 SS [see Ref. 2, page 931 and Ref. 2, Section II, SA-240 Table 1]) (Inner shell and inner shell lids):

- Density = 7980 kg/m^3 (at RT) (Ref. 4, Table X1, p. 7)
- Yield strength = 207 MPa (30 ksi) (at RT) (Ref. 2, Table Y-1)
Yield strength = 148 MPa (21.4 ksi) (at $400^\circ\text{F} = 204^\circ\text{C}$) (Ref. 2, Table Y-1)
Yield strength = 130 MPa (18.9 ksi) (at $600^\circ\text{F} = 316^\circ\text{C}$) (Ref. 2, Table Y-1)
- Poisson's ratio = 0.298 (at RT) (Ref. 1, Figure 15, p. 755)
- Modulus of elasticity = 195 GPa ($28.3 \cdot 10^6 \text{ psi}$) (at RT) (Ref. 2, Table TM-1)
Modulus of elasticity = 183 GPa ($26.5 \cdot 10^6 \text{ psi}$) (at $400^\circ\text{F} = 204^\circ\text{C}$) (Ref. 2, Table TM-1)
Modulus of elasticity = 174 GPa ($25.3 \cdot 10^6 \text{ psi}$) (at $600^\circ\text{F} = 316^\circ\text{C}$) (Ref. 2, Table TM-1)

5.2 MASS OF PWR FUEL ASSEMBLIES

This calculation was performed by using the following mass of the PWR fuel assemblies (Ref. 8, Table 2, p. 10 and Assumption 3.3):

$$\text{Total mass} = 1920 + 25 = 1945 \text{ lbs (882.2 kg)}$$

5.3 MASS OF BWR FUEL ASSEMBLIES

This calculation was performed by using the following mass of the BWR fuel assemblies (Ref. 8, Table 1, p. 10 and Assumption 3.3):

$$\text{Total mass} = 699 + 25 = 724 \text{ lbs (328.4 kg)}$$

5.4 FINITE ELEMENT REPRESENTATIONS

A three-dimensional FER of each waste package was developed in ANSYS V5.4 using the dimensions provided in Attachments I, II and III.

The internal structure of the waste packages was simplified as follow: The fuel plates and tubes, the basket sideguides and stiffeners and the fuel assemblies were not taken into account in the FER representation of the 12-PWR long and 24-BWR waste packages. The FER representation of the 5 DHLW/DOE - long does not include the divider plates, brackets, support tubes, HLW glass assemblies and canister. Nevertheless, the mass of those elements were taken into account in the mass of the inner shell of the corresponding waste package. The lid lifting features were not represented in the FER either. Their mass was taken into account in the mass of the lid they are attached to. Furthermore, the densities of all components of the waste packages were adjusted so that the masses of the waste packages match the masses given in Attachment I, II and III.

Besides, the inner and outer shells were represented with solid connections at their adjacent surfaces, although reference 9 specifies loose fit between those two components. However, since the structural performance of the trunnion collar sleeves was the main objective of this calculation and total force acting on the trunnion collar sleeves remained unchanged, this had no impact on the results for the trunnion collar sleeves.

Due to the geometry and loadings of these calculations, half-symmetry models were used.

The benefit of using this approach was to reduce the computer execution time while preserving all features of the problem relevant to the structural calculation.

The mesh of each FER was appropriately generated and refined in the contact region according to standard engineering practice. Thus, the accuracy and representativeness of the results of this calculation were deemed acceptable. The meshes of the 5 DHLW/DOE - long, 12-PWR long and 24-BWR waste packages are presented in Figures 1, 5 and 7 of Attachment IV, respectively.

Each FER was then used in ANSYS V5.4 to perform the static analysis for the 5 DHLW/DOE - long,

Waste Package Project

Title: Horizontal Lifting of 5 DHLW/DOE - Long, 12-PWR Long and 24-BWR Waste Packages

Document Identifier: CAL-EBS-ME-000010 REV 00

Page 9 of 15

12-PWR long and 24-BWR waste packages horizontal lifting (See Ref. 8) at RT, 204 °C , and 316 °C .

6. RESULTS

The maximum stresses were found by examining the results of the calculations for each part of the waste packages. Table 1 lists the maximum stress intensities in the outer and inner shells, as well as in the trunnion collar sleeves of the 5 DHLW/DOE - long waste package at three different temperatures: RT, 204 °C, and 316 °C. Figures 2, 3 and 4 of Attachment IV show the stress intensities in the 5 DHLW/DOE - long waste package at those temperatures.

Table 1. Maximum Stress Intensities for the 5 DHLW/DOE - Long Waste Package at Three Different Temperatures

Temperature	5 DHLW/DOE - Long		
	Inner Shell and Lids	Outer Shell and Lids	Trunnion Collar Sleeves
RT	3.4 MPa (see Att. V, post5DRT.out, line 483)	5.1 MPa (see Att. V, post5DRT.out, line 395)	5.1 MPa (see Att. V, post5DRT.out, line 294)
204 °C	3.4 MPa (see Att. V, post5D400.out, line 483)	5.1 MPa (see Att. V, post5D400.out, line 395)	5.0 MPa (see Att. V, post5D400.out, line 294)
316 °C	3.4 MPa (see Att. V, post5D600.out, line 483)	5.2 MPa (see Att. V, post5D600.out, line 395)	5.0 MPa (see Att. V, post5D600.out, line 294)

The above table shows that for each temperature condition, the maximum stress intensities in the outer and inner shells, as well as in the trunnion collar sleeves, of the 5 DHLW/DOE - long were far lower than the yield strength of the corresponding materials (see Sections 5.1). Furthermore, it shows that the increase of temperature has a negligible influence on the results. Therefore, for the two other waste package designs -12-PWR long and 24-BWR-, the behavior of the waste package was studied only at 316°C.

Remark: As noted in Section 5.4, the inner and outer shells were represented with solid connections at their adjacent surfaces, although reference 9 specifies loose fit between those two components. Although this approach had no impact on the results in the trunnion collar sleeves, this could affect the results in the inner and outer shells of the waste packages. Nevertheless, considering that the level of the maximum stress intensities in these components were low, and that these components were of secondary importance in this study, the representation of the connection between inner and outer shell in the FER was deemed acceptable for the purpose of this calculation.

The maximum stress intensities in the outer and inner shells, as well as in the trunnion collar sleeves, of the 12-PWR long waste package at 316°C are presented in Table 2. Figure 6 of Attachment IV shows the stress intensities in the 12-PWR long waste package at this temperature.

Waste Package Project

Title: Horizontal Lifting of 5 DHLW/DOE - Long, 12-PWR Long and 24-BWR Waste Packages

Document Identifier: CAL-EBS-ME-000010 REV 00

Page 11 of 15

Table 2. Maximum Stress Intensities for the 12-PWR Long Waste Package at 316°C

Temperature	12-PWR Long		
	Inner Shell and Lids	Outer Shell and Lids	Trunnion Collar Sleeves
316 °C	4.0 MPa (see Att. VI, post12PWR.out, line 483)	6.1 MPa (see Att. VI, post12PWR.out, line 395)	5.7 MPa (see Att. VI, post12PWR.out, line 294)

The maximum stress intensities in the outer and inner shells, as well as in the trunnion collar sleeves of the 24-BWR waste package at 316°C are presented in Table 3. Figure 8 of Attachment IV shows the stress intensities in the 24-BWR waste package at this temperature.

Table 3. Maximum Stress Intensities for the 24-BWR Waste Package at 316°C

Temperature	24-BWR		
	Inner Shell and Lids	Outer Shell and Lids	Trunnion Collar Sleeves
316 °C	3.4 MPa (see Att. VII, post24BWR.out, line 483)	5.2 MPa (see Att. VII, post24BWR.out, line 395)	5.0 MPa (see Att. VII, post24BWR.out, line 294)

The values of the stress intensities were far lower than the yield strength of the corresponding material in both inner and outer shell, and in the trunnion collar sleeves, for the 12-PWR long and 24-BWR waste package designs.

7. REFERENCES

1. ASM (American Society for Metals) 1980. *Properties and Selection: Stainless Steels, Tool Materials and Special-Purpose Metals*. Volume 3 of *Metals Handbook*. 9th Edition. Benjamin, D., ed. Metals Park, Ohio: American Society for Metals. TIC: 209801.
2. ASM International 1987. *Corrosion*. Volume 13 of *Metals Handbook*. 9th Edition. Metals Park, Ohio: ASM International. TIC: 209807.
3. ASME (American Society of Mechanical Engineers) 1998. *1998 ASME Boiler and Pressure Vessel Code*. 1998 Edition with 1999 and 2000 Addenda. New York, New York: American Society of Mechanical Engineers. TIC: 247429.
4. ASTM G 1-90 (Reapproved 1999). 1990. *Standard Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens*. West Conshohocken, Pennsylvania: American Society for Testing and Materials. TIC: 238771.
5. CRWMS M&O 1997. *Waste Container Cavity Size Determination*. BBAA00000-01717-0200-00026 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980106.0061
6. CRWMS M&O 1998. *ANSYS. V5.4. HP-UX 10.20. 30040 5.4*.
7. CRWMS M&O 2000. *Technical Work Plan for: Waste Package Design Description for LA*. TWP-EBS-MD-000004 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20001107.0304.
8. CRWMS M&O 2000. *Uncanistered Spent Nuclear Fuel Disposal Container System Description Document*. SDD-UDC-SE-000001 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000822.0004.
9. CRWMS M&O 2000. *Waste Package Operations Fabrication Process Report*. TDR-EBS-ND-000003 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000927.0002.
10. DOE (U.S. Department of Energy) 1998. "Design Specification." Volume 1 of *Preliminary Design Specification for Department of Energy Standardized Spent Nuclear Fuel Canisters*. DOE/SNF/REP-011, Rev. 1. Washington, D.C.: U.S. Department of Energy, Office of Spent Fuel Management and Special Projects. TIC: 241528.
11. DOE (U.S. Department of Energy) 1999. *Waste Acceptance System Requirements Document*. DOE/RW-0351, Rev. 03. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: HQO.19990226.0001.
12. Haynes International 1997. *Hastelloy C-22 Alloy*. Kokomo, Indiana: Haynes International. TIC: 238121.

Waste Package Project

Title: Horizontal Lifting of 5 DHLW/DOE - Long, 12-PWR Long and 24-BWR Waste Packages

Document Identifier: CAL-EBS-ME-000010 REV 00

Page 13 of 15

13. AP-3.12Q, Rev. 0, ICN 4. *Calculations*. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20010404.0008
14. AP-SV.1Q, Rev. 0, ICN 2. *Control of the Electronic Management of Information*. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20000831.0065

8. ATTACHMENTS

- Attachment I: Design sketches (*5 DHLW/DOE SNF - long waste package configuration for Site Recommendation* [SK-0200 REV 04] and *5 DHLW/DOE SNF - long weld configuration* [SK-0201 REV 00]. This attachment uses Ref. 10 and 11)
- Attachment II: Design sketches (*12-PWR long waste package configuration for Site Recommendation* [SK-0183 REV 01] and *12-PWR long waste package weld configuration* [SK-0205 REV 00]. This attachment uses Ref. 5)
- Attachment III: Design sketches (*24-BWR waste package configuration for Site Recommendation* [SK-0184 REV 00] and *24-BWR waste package assembly weld configuration* [SK-0202 REV 00]. This attachment uses Ref. 5)
- Attachment IV: Figures obtained from ANSYS V5.4 for the horizontal lifting of the 5 DHLW/DOE - long, 12-PWR long and 24-BWR waste packages
- Attachments V to VII (Compact Disc):
ANSYS V5.4 electronic files for the horizontal lifting of the 5 DHLW/DOE - long, 12-PWR long and 24-BWR waste packages
- Table 4 contains the name, size, date and time of creation of each file in Attachments V to VII.

Waste Package Project

Title: Horizontal Lifting of 5 DHLW/DOE - Long, 12-PWR Long and 24-BWR Waste Packages

Document Identifier: CAL-EBS-ME-000010 REV 00

Page 15 of 15

Table 4. Name, Size, Date and Time of Creation of the Files in Attachments V to VII

Attachment # and title	Name	Size (Kbytes)	Date	Time
V: Horizontal lifting of the 5 DHLW/DOE - long waste package at three different temperatures	horiz_5D400.inp	2	4/10/01	5:08 pm
	horiz_5D400.out	72	4/10/01	5:08 pm
	horiz_5D600.inp	2	4/10/01	5:08 pm
	horiz_5D600.out	72	4/10/01	5:08 pm
	horiz_5DRT.inp	2	4/10/01	5:08 pm
	horiz_5DRT.out	71	4/10/01	5:08 pm
	mesh5DHLW.inp	22	4/10/01	5:08 pm
	mesh5DHLW.out	961	4/10/01	5:08 pm
	post5D400.inp	2	4/10/01	5:09 pm
	post5D400.out	23	4/10/01	5:09 pm
	post5D600.inp	2	4/10/01	5:08 pm
	post5D600.out	23	4/10/01	5:08 pm
	post5DRT.inp	2	4/10/01	5:09 pm
	post5DRT.out	23	4/10/01	5:09 pm
VI: Horizontal lifting of the 12-PWR long waste package at 316°C	horiz_12PWR.inp	2	4/10/01	3:18 pm
	horiz_12PWR.out	24	4/10/01	3:18 pm
	mesh12PWR.inp	22	4/10/01	3:18 pm
	mesh12PWR.out	846	4/10/01	3:18 pm
	post12PWR.inp	2	4/10/01	3:18 pm
	post12PWR.out	23	4/10/01	3:18 pm
VII: Horizontal lifting of the 24-BWR waste package at 316°C	horiz24BWR.inp	2	4/10/01	4:02 pm
	horiz24BWR.out	24	4/10/01	4:02 pm
	mesh24BWR.inp	22	4/10/01	4:02 pm
	mesh24BWR.out	830	4/10/01	4:02 pm
	post24BWR.inp	2	4/10/01	4:02 pm
	post24BWR.out	23	4/10/01	4:02 pm

ATTACHMENT I

Design sketches

*5 DHLW/DOE SNF - Long Waste Package Configuration
for Site Recommendation [SK-0200 REV 04]*

*5 DHLW/DOE SNF - Long Weld Configuration
[SK-0201 REV 00]*

COMPONENT NAME	MATERIAL	THICKNESS	MASS KG	QTY REQ
DIVIDER PLATE	SA-516 K02100	12.7 (0.5")	100	5
INNER BRACKET	SA-516 K02100	25.4 (1")	296	5
OUTER BRACKET	SA-516 K02100	12.7 (0.5")	375	5
SUPPORT TUBE	SA-516 K02100	31.75 (1.25")	1924	1
INNER SHELL	SA-240 S31600	50	11507	1
INNER SHELL LID	SA-240 S31600	105	2314	2
INNER LID LIFTING FEATURE	SA-240 S31600	27	12	1
OUTER SHELL	SB-575 N06022	25	6918	1
EXTENDED OUTER SHELL LID	SB-575 N06022	25	172	1
EXTENDED OUTER SHELL LID BASE	SB-575 N06022	25	629	1
EXTENDED LID REINFORCEMENT RING	SB-575 N06022	50	129	1
OUTER LID LIFTING FEATURE	SB-575 N06022	27	13	2
OUTER SHELL FLAT CLOSURE LID	SB-575 N06022	10	268	1
OUTER SHELL FLAT BOTTOM LID	SB-575 N06022	25	669	1
UPPER TRUNNION COLLAR SLEEVE	SB-575 N06022	40	655	1
LOWER TRUNNION COLLAR SLEEVE	SB-575 N06022	40	642	1
INNER SHELL SUPPORT RING	SB-575 N06022	20	53	1
TOTAL ALLOY 22 WELDS	SFA-5.14 N06022	-	325	***
TOTAL 316 WELDS	SFA-5.9 S31680	-	194	***
WASTE PACKAGE ASSEMBLY	-	-	32610	1
HLW GLASS ASSEMBLY	-	-	4200**	5
18" CANISTER LONG	-	-	2721*	1
WP ASSEMBLY WITH SNF	-	-	56331	-

UNITED STATES DEPARTMENT OF ENERGY 1998. DESIGN SPECIFICATION FOR DEPARTMENT OF ENERGY STANDARDIZED SPENT NUCLEAR FUEL CANISTERS, VOLUME 1, DESIGN SPECIFICATION, REV 01 WASHINGTON D.C.: UNITED STATES DEPARTMENT OF ENERGY. TIC: 241528

WASTE ACCEPTANCE SYSTEM REQUIREMENTS DOCUMENT E00000000-00811-1708-00001 REV 03, DOE/RW-0351. ACC: HQO.1990228.0001, PAGE 18, SECTION 4.2.3.1, A.4.

SEE SK-0201 FOR WELD CONFIGURATION AND MASSES

REV	DESCRIPTION	DATE	BY
00	ISSUED APPROVED	1/25/00	DCM
01	INNER SHELL LID THICKNESS 105 "WAS" 80 IN TABLE	1/26/00	DCM
02	OUTER SHELL THICKNESS 25 "WAS" 20 IN TABLE	2/9/00	DCM
03	SKETCHED BY "WAS" ORIGINATOR, "REDESIGNED" REVISION BLOCK, SDHLW LONG "WAS" NEW LONG, "ADDED" VIEW "D" TO SHEET 2	3/2/00	EJC
04	IN NOTE **, DOE/RW-0351 "WAS" DOE/RW-315P	6/5/00	EJC

SECTION B-B

FOR INFORMATION ONLY

5 DRLW/DOE SNF - LONG WASTE PACKAGE CONFIGURATION FOR SITE RECOMMENDATION

SKETCH NUMBER: SK-0200 REV 04	SHEET 1 OF 2
SKETCHED BY: EUGENE CONNELL	DATE: 06/05/00
FILE: /home/proc1/library/checkboxes/checkboxes/5dhlw/5dhlw_long/at-0182cr-c04.dwg

DETAIL A

DETAIL D

DETAIL C

DETAIL B

SECTION A-A
SCALE 0.062

DETAIL A
SCALE 0.609

DETAIL B
SCALE 0.609

WELD	MATERIAL	WELD	WELD
1	SFA-5.14 NO5022	18	1
2	SFA-5.14 NO5022	45	1
3	SFA-5.14 NO5022	127	1
4	SFA-5.14 NO5022	4.1	2
5	SFA-5.14 NO5022	4.9	1
6	SFA-5.9 531880	97	2
7	SFA-5.14 NO5022	17	2
8	SFA-5.14 NO5022	11	2
9	SFA-5.14 NO5022	18	1
10	SFA-5.14 NO5022	46	1
TOTAL ALLOY 22 WELDS	SFA-5.14 NO5022	325	-
TOTAL 316 WELDS	SFA-5.9 531880	194	-

"FOR INFORMATION ONLY"		APPROVALS		DATE PACKAGE DEPARTMENT	
THIRD ANGLE PROJECTION		DESIGNED BY BRYAN HARRIS		DATE 05/14/00	
DRAWN BY SCOTT BENNETT		CHECKED BY JERRY COOK		DATE 05/14/00	
DIMENSIONS ARE IN MILLIMETERS AND DEGREES UNLESS OTHERWISE NOTED		DESIGN GROUP MGR THOMAS DOUGLAS		DATE 05/14/00	
DO NOT SCALE FROM SKETCH		WELDED BY WELDED		DATE 05/14/00	
SCALE .062		SHEET 1 OF 1		REVISION 00	

ALL SHEETS ARE THE SAME REVISION STATUS			
ZONE	REV	DESCRIPTION	DATE
00	00	00	00
01	01	01	01
02	02	02	02
03	03	03	03
04	04	04	04
05	05	05	05
06	06	06	06
07	07	07	07
08	08	08	08
09	09	09	09
10	10	10	10
11	11	11	11
12	12	12	12
13	13	13	13
14	14	14	14
15	15	15	15
16	16	16	16
17	17	17	17
18	18	18	18
19	19	19	19
20	20	20	20
21	21	21	21
22	22	22	22
23	23	23	23
24	24	24	24
25	25	25	25
26	26	26	26
27	27	27	27
28	28	28	28
29	29	29	29
30	30	30	30
31	31	31	31
32	32	32	32
33	33	33	33
34	34	34	34
35	35	35	35
36	36	36	36
37	37	37	37
38	38	38	38
39	39	39	39
40	40	40	40
41	41	41	41
42	42	42	42
43	43	43	43
44	44	44	44
45	45	45	45
46	46	46	46
47	47	47	47
48	48	48	48
49	49	49	49
50	50	50	50
51	51	51	51
52	52	52	52
53	53	53	53
54	54	54	54
55	55	55	55
56	56	56	56
57	57	57	57
58	58	58	58
59	59	59	59
60	60	60	60
61	61	61	61
62	62	62	62
63	63	63	63
64	64	64	64
65	65	65	65
66	66	66	66
67	67	67	67
68	68	68	68
69	69	69	69
70	70	70	70
71	71	71	71
72	72	72	72
73	73	73	73
74	74	74	74
75	75	75	75
76	76	76	76
77	77	77	77
78	78	78	78
79	79	79	79
80	80	80	80
81	81	81	81
82	82	82	82
83	83	83	83
84	84	84	84
85	85	85	85
86	86	86	86
87	87	87	87
88	88	88	88
89	89	89	89
90	90	90	90
91	91	91	91
92	92	92	92
93	93	93	93
94	94	94	94
95	95	95	95
96	96	96	96
97	97	97	97
98	98	98	98
99	99	99	99
100	100	100	100

ATTACHMENT II

Design sketches

*12-PWR Long Waste Package Configuration
for Site Recommendation [SK-0183 REV 01]*

*12-PWR Long Waste Package Weld Configuration
[SK-0205 REV 00]*

SECTION A-A

SECTION B-B

COMPONENT NAME	MATERIAL	THICKNESS	MASS KG	QTY KID
BASKET SIDEGUIDE	SA-516 K02700	10	28	32
BASKET SIDEGUIDE STIFFENER	SA-516 K02700	10	0.50	64
BASKET CORNER GUIDE	SA-516 K02700	10	48	16
BASKET CORNER GUIDE STIFFENER	SA-516 K02700	10	2.5	32
FUEL BASKET A-PLATE	NEUTRONIT A 978	7	76	4
FUEL BASKET B-PLATE	NEUTRONIT A 978	7	76	4
FUEL BASKET C-PLATE	NEUTRONIT A 978	7	34	16
FUEL BASKET D-PLATE	SB-209 A96061 T4	5	19	4
FUEL BASKET E-PLATE	SB-209 A96061 T4	5	19	4
FUEL BASKET TUBE	SA-516 K02700	5	187	12
INNER SHELL	SA-240 S31600	50	7589	1
INNER SHELL LID	SA-240 S31600	70	538	2
INNER LID LIFTING FEATURE	SA-240 S31600	27	12	1
OUTER SHELL	SB-575 N06022	(10) 20	3666	1
EXTENDED OUTER SHELL LID	SB-575 N06022	25	104	1
EXTENDED OUTER SHELL LID BASE	SB-575 N06022	25	226	1
EXTENDED LID REINFORCEMENT RING	SB-575 N06022	50	76	1
OUTER LID LIFTING FEATURE	SB-575 N06022	27	13	2
OUTER SHELL FLAT CLOSURE LID	SB-575 N06022	10	100	1
OUTER SHELL FLAT BOTTOM LID	SB-575 N06022	25	250	1
UPPER TRUNNION COLLAR SLEEVE	SB-575 N06022	40	408	1
LOWER TRUNNION COLLAR SLEEVE	SB-575 N06022	40	400	1
INNER SHELL SUPPORT RING	SFA-5.14 N06022	20	32	1
TOTAL ALLOY 22 WELDS	SFA-5.14 N06022	-	196	**
TOTAL 316 WELDS	SFA-5.9 S31680	-	67	**
WASTE PACKAGE ASSEMBLY	-	-	19341	1
PMR FUEL ASSEMBLY	-	-	882.2*	12
WP ASSEMBLY WITH SNF	-	-	30127	1

* CRMS MDO 1997, WASTE CONTAINER CAVITY SIZE DETERMINATION. BBA000000-01717-0200-00028 REV 00
LAS VEGAS, NEVADA: CRMS MDO, ACC: MOL. 19980106-0081
** REFER TO SK-0205 REV 00 "12-PMR LONG PACKAGE WELD CONFIGURATION"

UNITS: mm
DO NOT SCALE FROM SKETCH

REV	DESCRIPTION	DATE
01	ISSUED APPROVED	01/27/10
02	20 OUTER SHELL THICKNESS "MAX 25, REVISION TABLE "A0063"	02/23/10

"FOR INFORMATION ONLY"
12-PMR LONG WASTE PACKAGE CONFIGURATION
FOR SITE RECOMMENDATION

SKETCH NUMBER: SK-0183 REV 01
SKETCHED BY: BRYAN HARKINS
DATE: 03/23/10
FILE: /home/proc/liberty/sketches/12pmr/12pmr_long/SK-0183.dwg
SHEET 1 OF 2
3/23/10
3/23/10
3/23/10

DETAIL A

DETAIL B

SK-0183 REV 01

SHEET 2 OF 2

ATTACHMENT III

Design sketches

*24-BWR Waste Package Configuration
for Site Recommendation [SK-0184 REV 00]*

*24-BWR Waste Package Assembly Weld Configuration
[SK-0202 REV 00]*

SECTION A-A

SECTION B-B

FOR INFORMATION ONLY

24-BWR WASTE PACKAGE CONFIGURATION FOR SITE RECOMMENDATION

SKETCH NUMBER: SK-0184 REV 00	SHEET 1 OF 2
SKETCHED BY: BRYAN HARRIS	DATE: 01/25/00
FILE: /home/pro-library/checkout/sketches/24-bwr/st-0184.dwg	

UNITS: mm
DO NOT SCALE FROM SKETCH

COMPONENT NAME	MATERIAL	THICKNESS	MASS KG	QTY KGD
BASKET A-GUIDE	SA-516 K02100	10	27	16
BASKET B-GUIDE	SA-516 K02100	10	1.3	16
BASKET CORNER GUIDE	SA-516 K02100	10	22	32
BASKET STIFFENER	SA-516 K02100	10	1.6	64
FUEL BASKET A-PLATE	NEUTRONIT A 978	10	89	4
FUEL BASKET B-PLATE	NEUTRONIT A 978	10	89	4
FUEL BASKET C-PLATE	NEUTRONIT A 978	10	90	8
FUEL BASKET D-PLATE	NEUTRONIT A 978	10	90	8
FUEL BASKET E-PLATE	NEUTRONIT A 978	10	30	16
FUEL BASKET TUBE	SA-516 K02100	5	113	24
INNER SHELL	SA-240 S31600	50	6731	1
INNER SHELL LID	SA-240 S31600	65	489	2
INNER SHELL LID LIFTING FEATURE	SA-240 S31600	27	12	1
OUTER SHELL	SB-575 N06022	20	3268	1
EXTENDED OUTER SHELL LID	SB-575 N06022	25	103	1
EXTENDED OUTER SHELL LID BASE	SB-575 N06022	25	221	1
OUTER SHELL LID LIFTING FEATURE	SB-575 N06022	27	13	2
EXTENDED LID REINFORCEMENT RING	SB-575 N06022	50	75	1
OUTER SHELL FLAT CLOSURE LID	SB-575 N06022	10	98	1
OUTER SHELL FLAT BOTTOM LID	SB-575 N06022	25	245	1
UPPER TRUNNION COLLAR SLEEVE	SB-575 N06022	40	404	1
LOWER TRUNNION COLLAR SLEEVE	SB-575 N06022	40	366	1
INNER SHELL SUPPORT RING	SB-575 N06022	20	32	1
TOTAL ALLOY 22 WELDS	SFA-5.14 N06022	-	194	88
TOTAL 316 WELDS	SFA-5.9 S31680	-	59	88
WASTE PACKAGE ASSEMBLY	-	-	19437	1
BWR FUEL ASSEMBLY	-	-	*328.4	24
WASTE PACKAGE ASSEMBLY WITH SNF	-	-	27318	1

ATTACHMENT IV

Figures obtained from ANSYS V 5.4 for the Horizontal Lifting
of the 5DHLW/DOE - Long, 12-PWR Long and 24-BWR Waste Packages

Figure 1: Mesh of the 5 DHLW/DOE - Long Waste Package

Figure 2: Stress Intensity in the 5 DHLW/DOE - Long Waste Package at RT

Figure 3: Stress Intensity in the 5 DHLW/DOE - Long Waste Package at 204°C

Figure 4: Stress Intensity in the 5 DHLW/DOE - Long Waste Package at 316°C

Figure 5: Mesh of the 12-PWR Long Waste Package

ANSYS 5.4
 APR 9 2001
 18:09:53
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SINT (AVG)
 DMX =.771E-07
 SMN =.002311
 SMX =5.734
 SMXB=9.36
 ZV =1
 DIST=3108
 YF =2455
 ZF =-332.5
 A-ZS=-90
 Z-BUFFER
 .002311
 .639204
 1.276
 1.913
 2.55
 3.187
 3.824
 4.461
 5.097
 5.734

Figure 6: Stress Intensity in the 12-PWR Long Waste Package at 316°C

1
SYS

Figure 7: Mesh of the 24-BWR Waste Package

ANSYS 5.4
 APR 10 2001
 16:04:10
 NODAL SOLUTION
 STEP=1
 SUB =1
 TIME=1
 SINT (AVG)
 DMX =.556E-07
 SMN =.002417
 SMX =4.952
 SMXB=8.365
 ZV =1
 DIST=2808
 YF =2182
 ZF =-329.5
 A-ZS=-90
 Z-BUFFER
 .002417
 .552377
 1.102
 1.652
 2.202
 2.752
 3.302
 3.852
 4.402
 4.952

Figure 8: Stress Intensity in the 24-BWR Waste Package at 316°C

✓ file list 5/30/01 pc

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
SPECIAL INSTRUCTION SHEET

1. QA: QA

Page: 1 of: 1

Complete Only Applicable Items

This is a placeholder page for records that cannot be scanned.

2. Record Date 05/24/2001		3. Accession Number ATT-10 MOL-20010530.0143	
4. Author Name(s) VALERIE DE LA BROSSE		5. Author Organization N/A	
6. Title/Description HORIZONTAL LIFTING OF 5 DHLW/DOE - LONG, 12-PWR LONG AND 24 BWR WASTE PACKAGES ATTACHMENT V, VI, VII			
7. Document Number(s) CAL-EBS-ME-000010		8. Version Designator REV. 00	
9. Document Type CD-ROM		10. Medium DATA	
11. Access Control Code PUB			
12. Traceability Designator DC #26242			

AB 5/30/01

13. Comments
THIS IS A SPECIAL PROCESS CD-ROM AS PART OF ATTACHMENT V, VI, VII, AND CAN BE LOCATED THROUGH THE RPC

AB 5/30/01

THIS DATA SUBMITTAL TO THE
RECORDS PROCESSING CENTER IS
FOR ARCHIVE PURPOSES ONLY, AND
IS NOT AVAILABLE FOR VIEWING OR
REPRODUCTION