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	5. Attachment Numbers - Number of pages in each
7	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	V. de la Brosse	05/17/01
7. Checker	Sreten Mastilovic		05/17/2001
8. Lead	Scott M. Bennett	Scott M Bennett	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

TABLES

Page

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°*F* = 204°*C*) (Ref. 2, Table Y-1)
  Yield strength = 211 *MPa* (30.6 *ksi*) (at 600°*F* = 316°*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°*F* = 204°*C*) (Ref. 12, p. 14)
  Modulus of elasticity = 190 *GPa* (at 600°*F* = 316°*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°*F* = 204°*C*) (Ref. 2, Table Y-1)
  Yield strength = 130 *MPa* (18.9 *ksi*) (at 600°*F* = 316°*C*) (Ref. 2, Table Y-1)

- Poisson's ratio = 0.298 (at RT) (Ref. 1, Figure 15, p. 755)

- Modulus of elasticity = 195 *GPa* ($28.3 \cdot 10^6$ psi) (at RT) (Ref. 2, Table TM-1)
  Modulus of elasticity = 183 *GPa* ($26.5 \cdot 10^6$ psi) (at 400°*F* = 204°*C*) (Ref. 2, Table TM-1)
  Modulus of elasticity = 174 *GPa* ($25.3 \cdot 10^6$ psi) (at 600°*F* = 316°*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):

Total mass = 1920 + 25 = 1945 *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):

Total mass = 699 + 25 = 724 *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,

12-PWR long and 24-BWR waste packages horizontal lifting (See Ref. 8) at RT, 204 $^{\circ}C$, and 316 $^{\circ}C$.

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.

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

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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.

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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.

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12. Haynes International 1997. *Hastelloy C-22 Alloy.* Kokomo, Indiana: Haynes International. TIC: 238121.

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.

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
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	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
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	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
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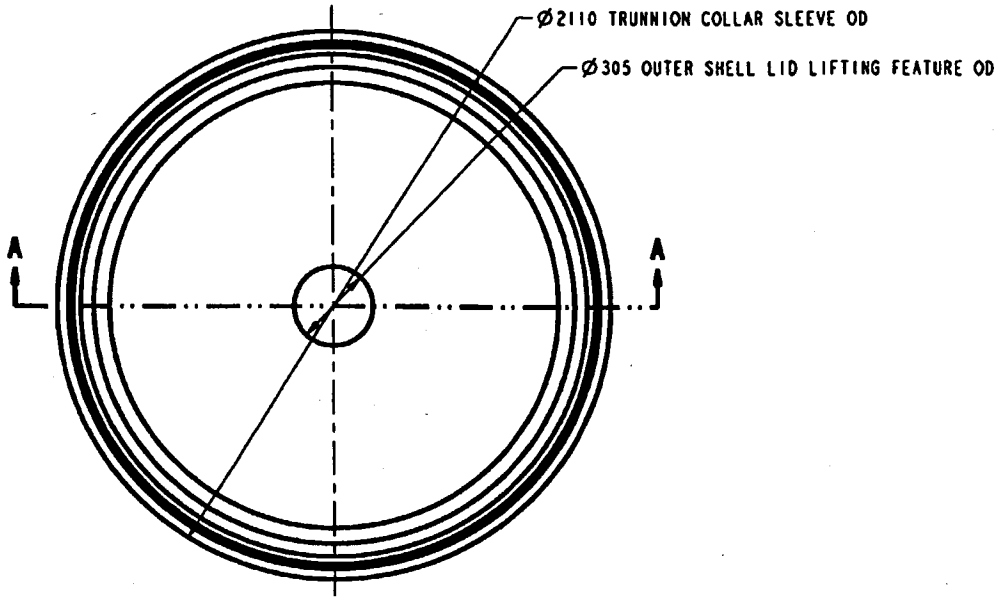
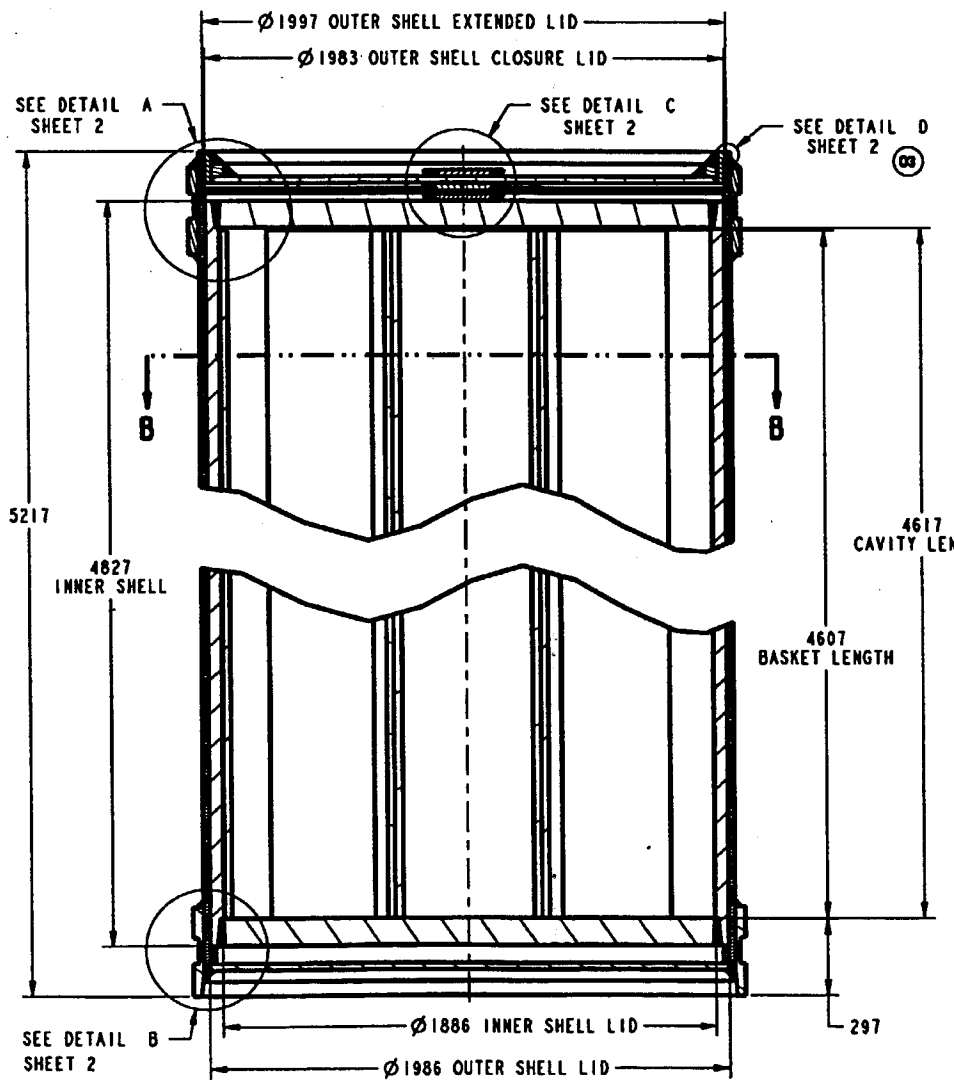
	mesh24BWR.inp	22	4/10/01	4:02 pm
	mesh24BWR.out	830	4/10/01	4:02 pm
	post24BWR.inp	2	4/10/01	4:02 pm
	post24BWR.out	23	4/10/01	4:02 pm

ATTACHMENT I
Design sketches

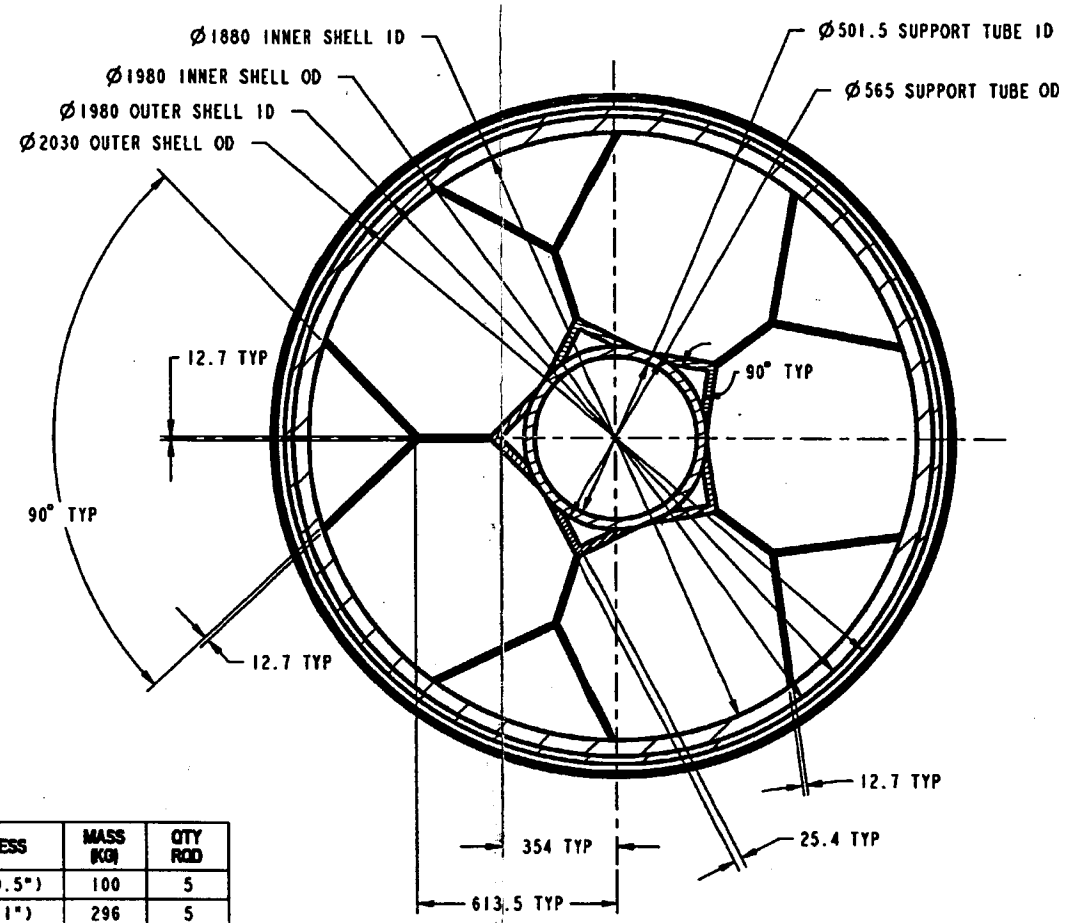
5 DHLW/DOE SNF - Long Waste Package Configuration for Site Recommendation [SK-0200 REV 04]

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





SECTION A-A



SECTION B-B

COMPONENT NAME	MATERIAL	THICKNESS	MASS (KG)	QTY PER
DIVIDER PLATE	SA-516 K02700	12.7 (0.5")	100	5
INNER BRACKET	SA-516 K02700	25.4 (1")	296	5
OUTER BRACKET	SA-516 K02700	12.7 (0.5")	375	5
SUPPORT TUBE	SA-516 K02700	31.75 (1.25")	1924	1
INNER SHELL	SA-240 S31600	50	11507	1
INNER SHELL LID	SA-240 S31600	105 (01)	2314	2
INNER LID LIFTING FEATURE	SA-240 S31600	27	12	1
OUTER SHELL	SB-575 N06022	25 (02)	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 I, DESIGN SPECIFICATION, REV 01 WASHINGTON D.C.: UNITED STATES DEPARTMENT OF ENERGY. TIC: 241528

(04) ** WASTE ACCEPTANCE SYSTEM REQUIREMENTS DOCUMENT. E0000000-00811-1708-00001 REV 03, DOE/RW-0351. ACC: HQO.19990226.0001, PAGE 18, SECTION 4.2.3.1.A.4.

*** SEE SK-0201 FOR WELD CONFIGURATION AND MASSES

UNITS: mm

DO NOT SCALE FROM SKETCH

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

"FOR INFORMATION ONLY"

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

SKETCH NUMBER: SK-0200 REV 04 SHEET 1 OF 2

SKETCHED BY: EUGENE CONNELL EJC 6/6/00 SMD 06/06/00 SMD for MJA 06/06/00

DATE: 06/05/00 (03)

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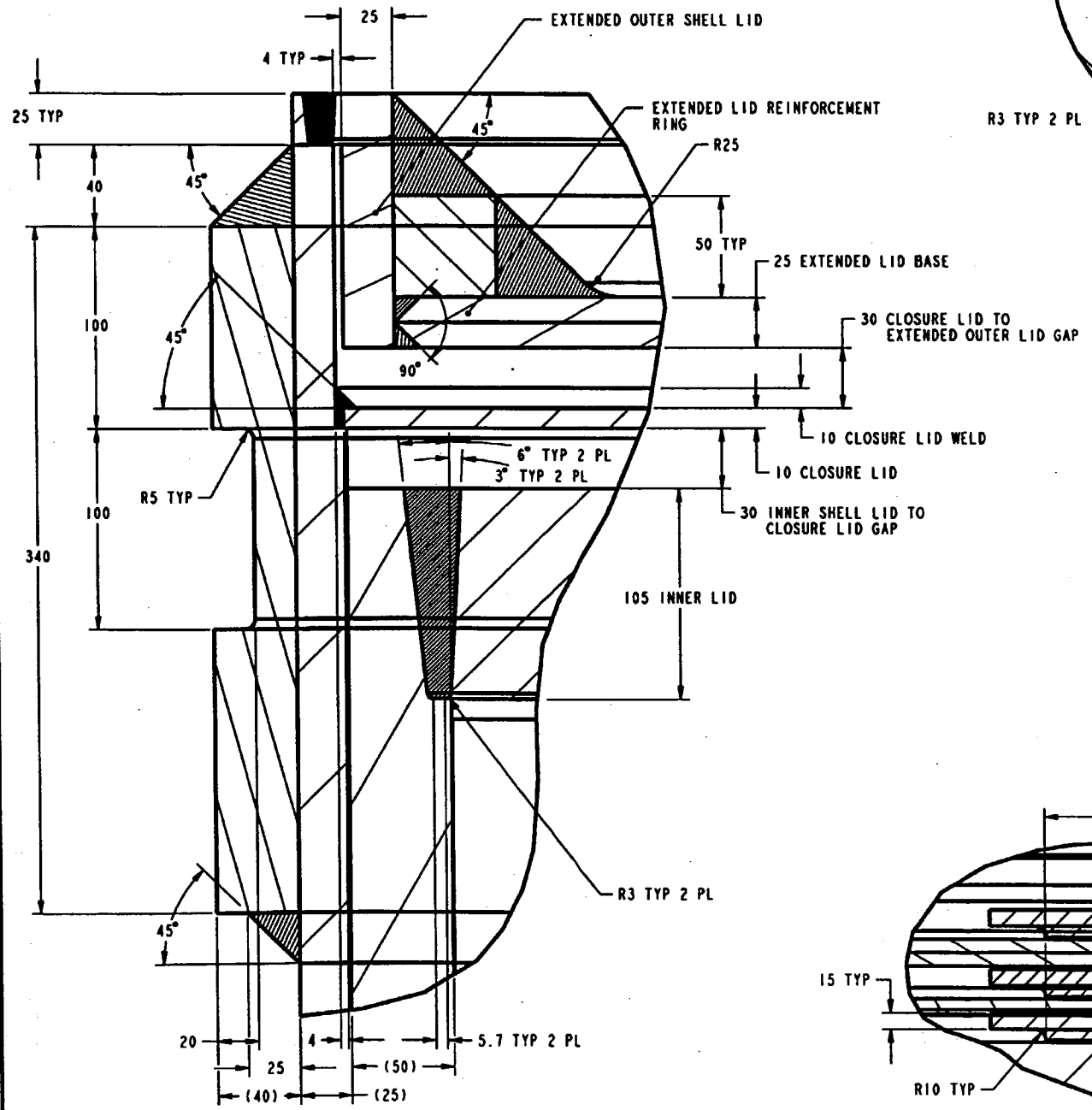

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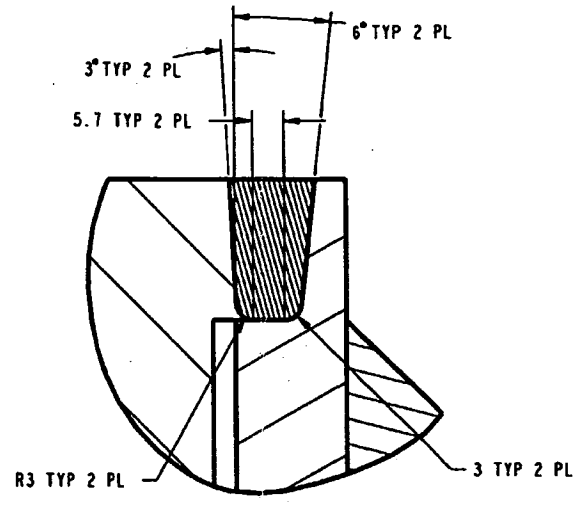

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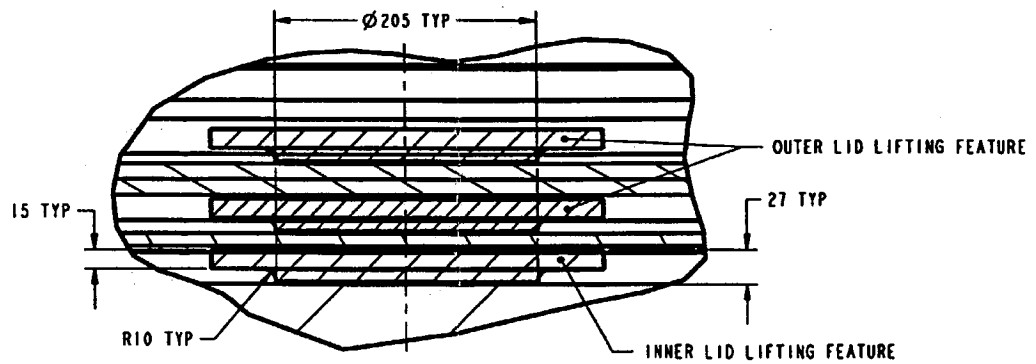

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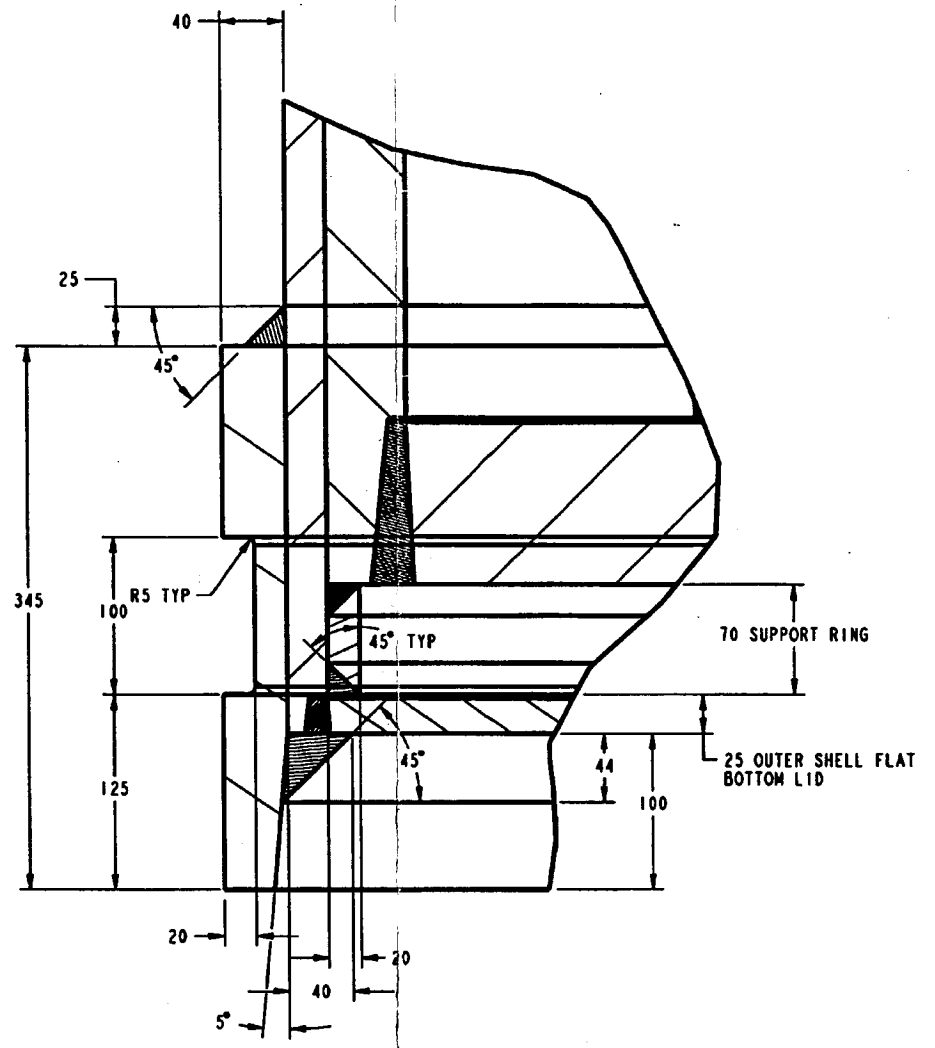

DETAIL B

SK-0200 REV 04 | SHEET 2 OF 2

REVISION HISTORY				
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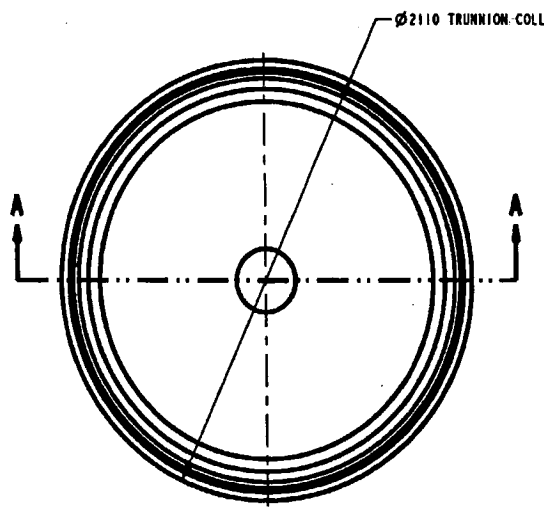
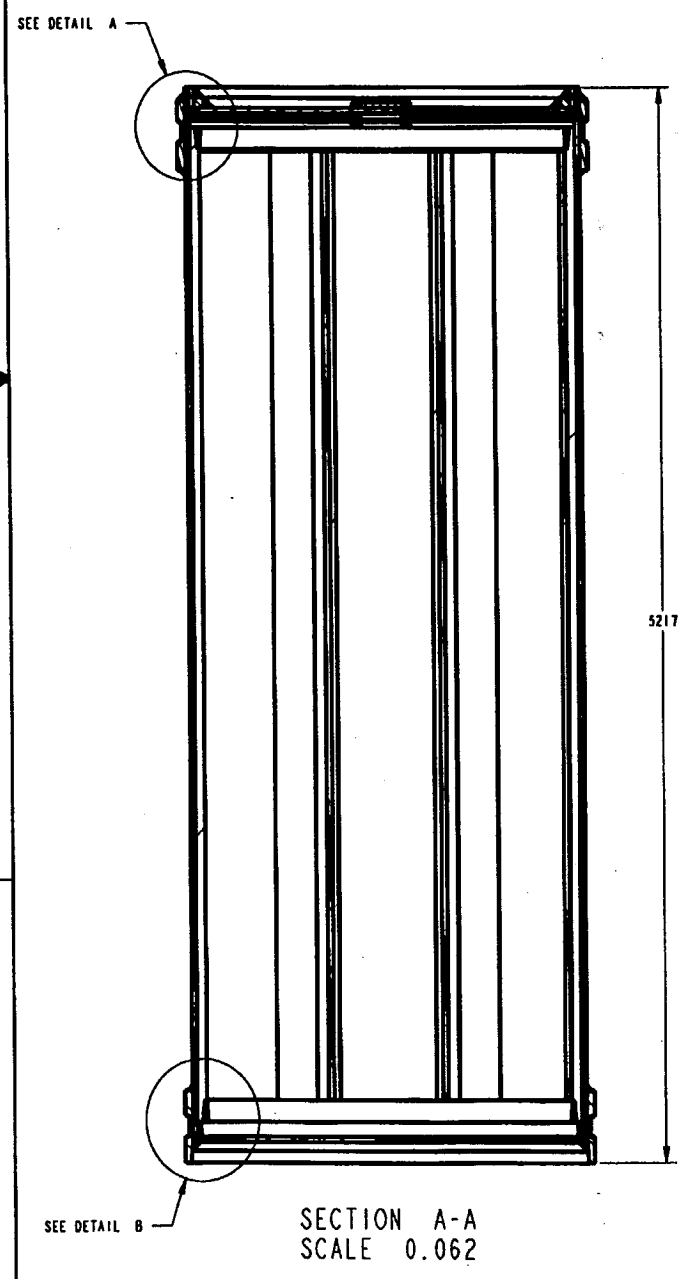
SHEET NUMBER SK-0201 | SHEET 1 OF 1 | REVISION 00

ALL SHEETS ARE THE SAME REVISION STATUS





SECTION A-A
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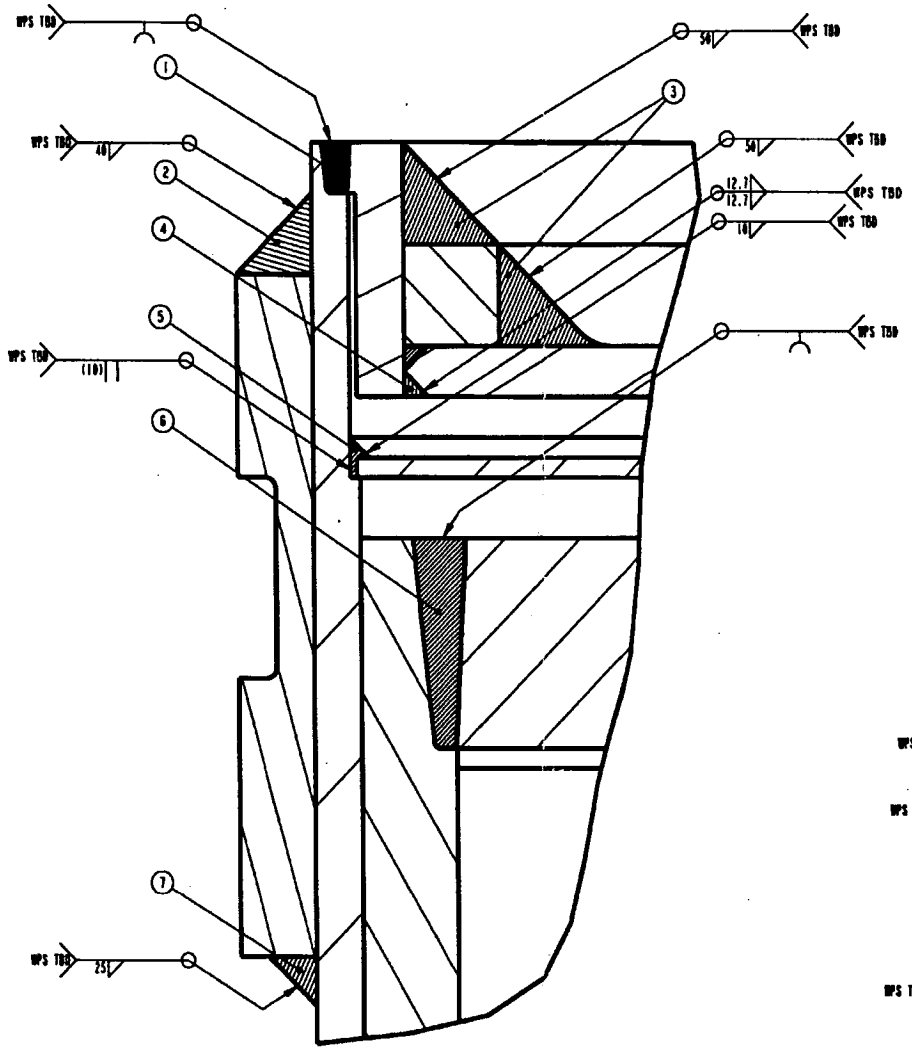
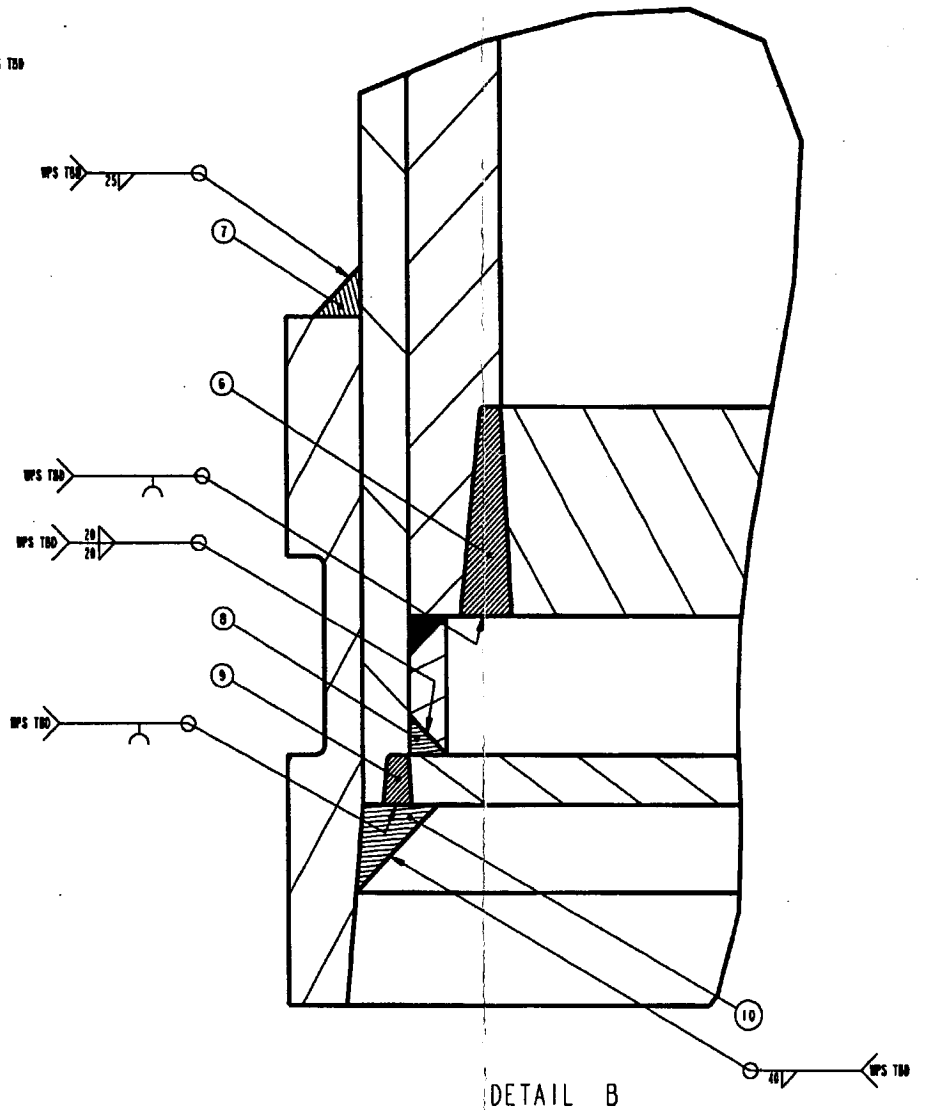


DETAIL A
SCALE 0.609



DETAIL B
SCALE 0.609

WELD	MATERIAL	MASS (KG)	QTY ROD
1	SFA-5.14 NO6022	18	1
2	SFA-5.14 NO6022	45	1
3	SFA-5.14 NO6022	127	1
4	SFA-5.14 NO6022	4.1	2
5	SFA-5.14 NO6022	4.9	1
6	SFA-5.9 S31680	97	2
7	SFA-5.14 NO6022	17	2
8	SFA-5.14 NO6022	11	2
9	SFA-5.14 NO6022	18	1
10	SFA-5.14 NO6022	48	1
TOTAL ALLOY 22 WELDS	SFA-5.14 NO6022	325	-
TOTAL 316 WELDS	SFA-5.9 S31680	194	-

"FOR INFORMATION ONLY"
THIRD ANGLE PROJECTION
DIMENSIONS ARE IN MILLIMETERS AND DEGREES UNLESS OTHERWISE NOTED
DO NOT SCALE FROM SKETCH

APPROVALS	INITIAL/DATE
SKETCHED BY BRYAN HARKINS	BH 28 March 00
STRUCTURAL LEAD SCOTT BENNETT	SwB 05/11/00
MANUFACTURING MGR JERRY COGAR	SOC 5/11/00
DESIGN GROUP MGR ~~THOMAS DOERING~~ MICHAEL ANDERSON	

WASTE PACKAGE DEPARTMENT
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

TITLE
5 DHLW/DOE SNF - LONG
WELD CONFIGURATION

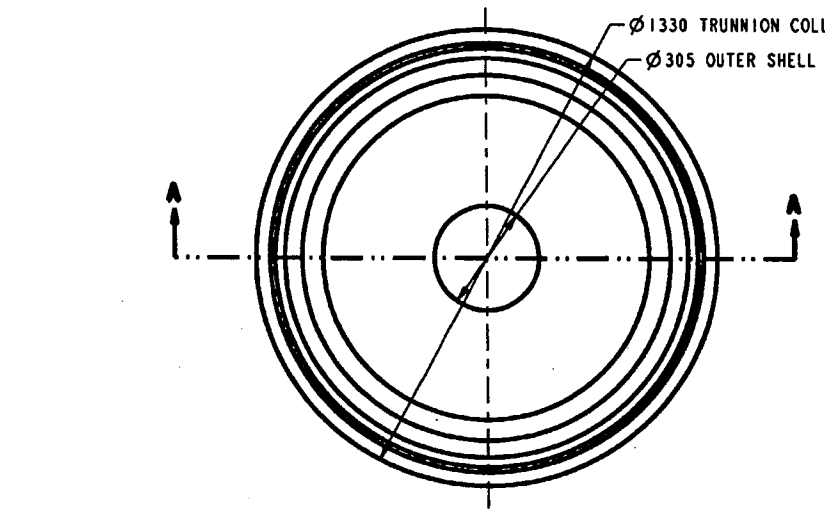
SKETCH NUMBER	REVISION
SK-0201	00
SCALE .062	SHEET 1 OF 1

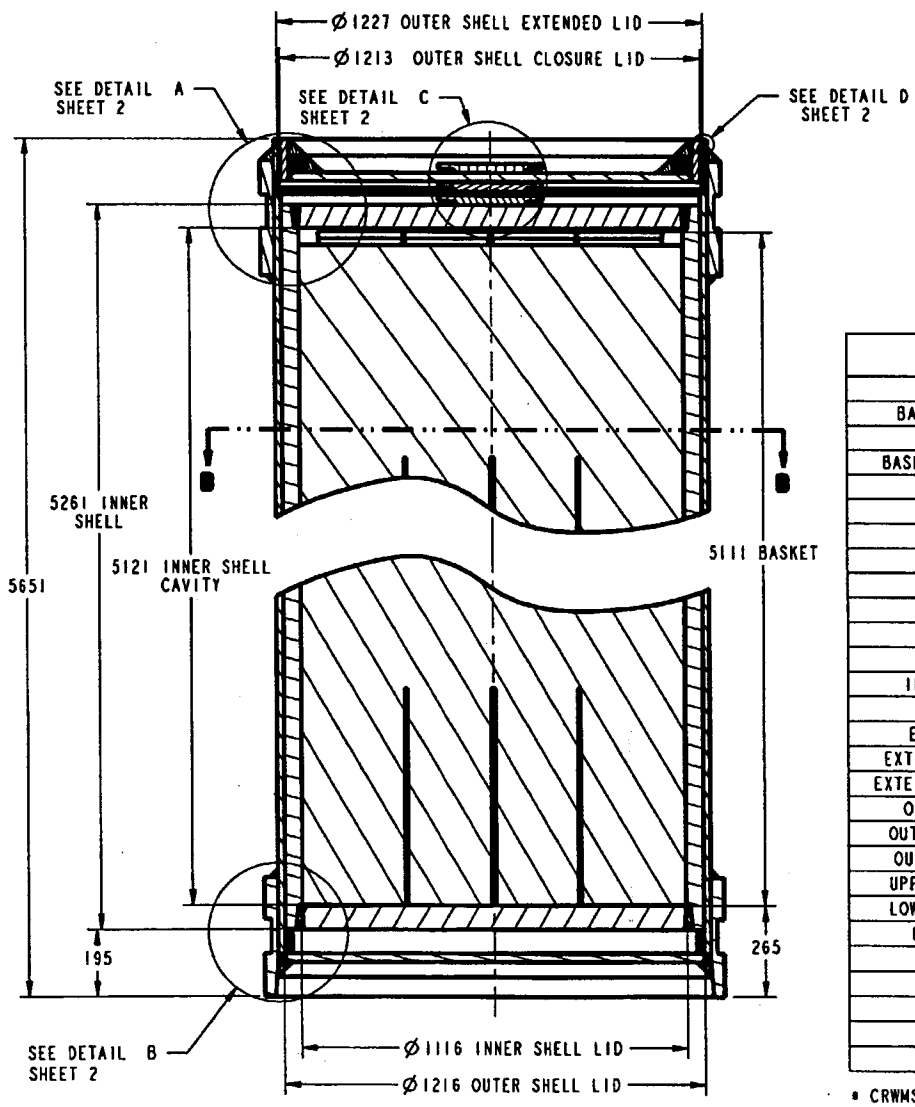
CAL-EBS-ME-000010 REV 00

ATTACHMENT II
Design sketches

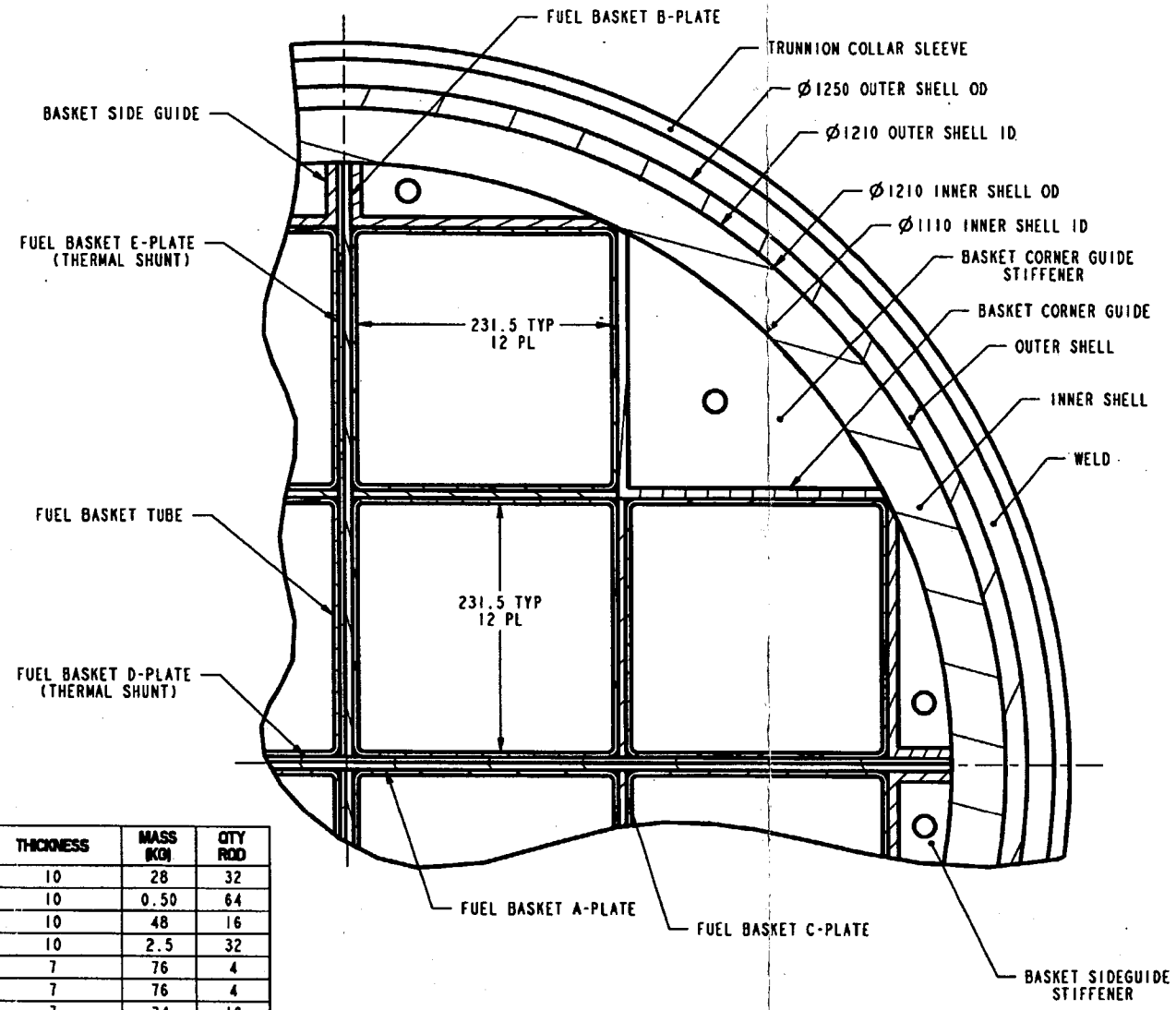
12-PWR Long Waste Package Configuration for Site Recommendation [SK-0183 REV 01]

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





SECTION A-A



SECTION B-B

COMPONENT NAME	MATERIAL	THICKNESS	MASS (KG)	QTY ROD
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	(01) 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	SB-575 N06022	20	32	1
TOTAL ALLOY 22 WELDS	SFA-5.14 N06022	-	196	**
TOTAL 316 WELDS	SFA-5.9 S31680	-	67	**
WASTE PACKAGE ASSEMBLY	-	-	19541	1
PWR FUEL ASSEMBLY	-	-	882.2*	12
WP ASSEMBLY WITH SNF	-	-	30127	1

* 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

** REFER TO SK-0205 REV 00 "12-PWR LONG PACKAGE WELD CONFIGURATION"

UNITS: mm

DO NOT SCALE FROM SKETCH

(01)

REVISIONS			
REV	DESCRIPTION	ORIG BY	DATE
00	ISSUED APPROVED	GC	01/26/00
01	20 OUTER SHELL THICKNESS "WAS" 25, REVISION TABLE "ADDED"	BH	03/23/00

"FOR INFORMATION ONLY"

12-PWR LONG WASTE PACKAGE CONFIGURATION FOR SITE RECOMMENDATION

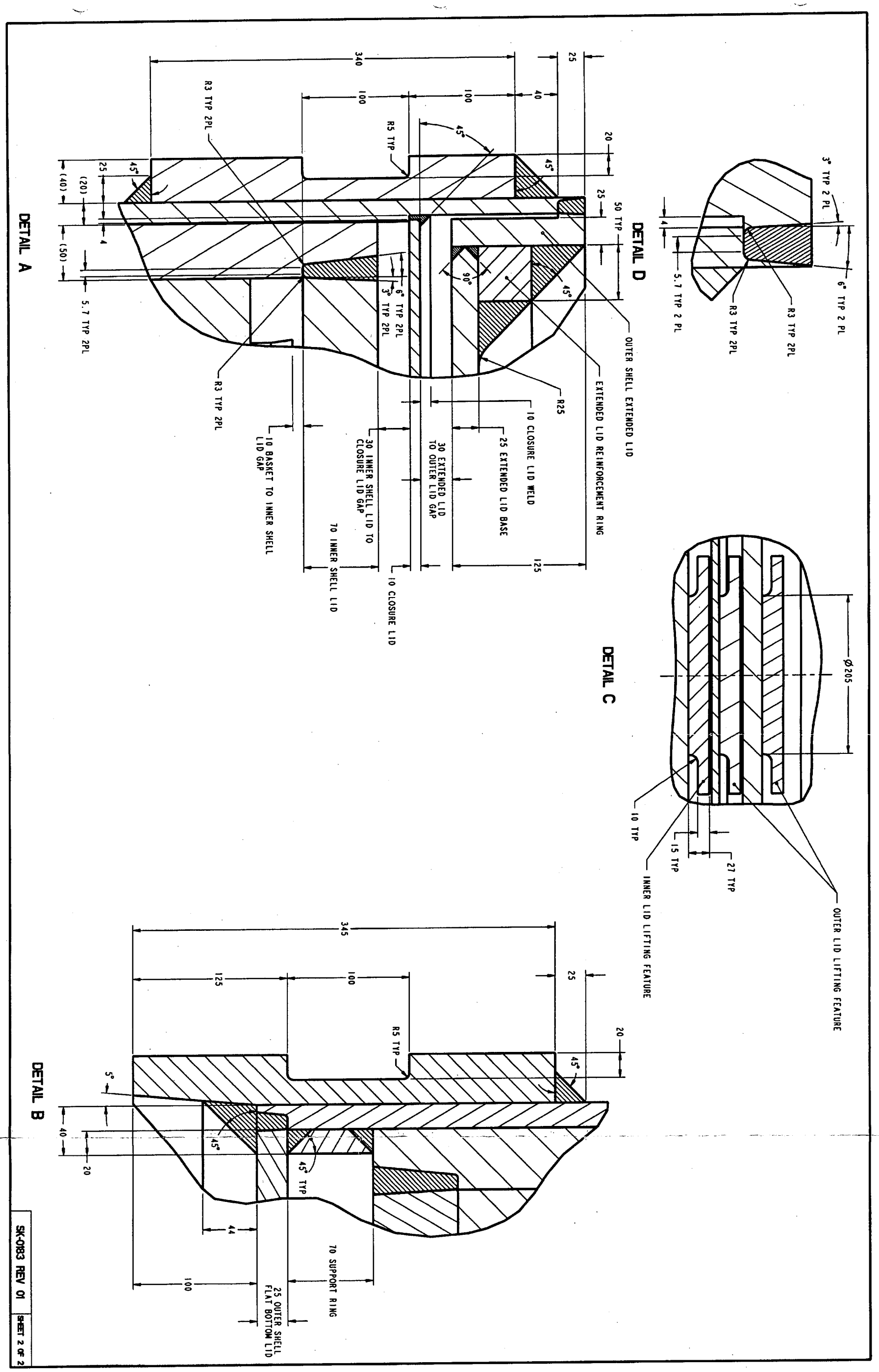
SHEET 1 OF 2

SKETCH NUMBER: SK-0183 REV 01

SKETCHED BY: BRYAN HARKINS BH 23 March 00

DATE: 03/23/00 T.W.S. 3.23.00 Z.C. for SME 3/23/00 JC 3/23/00

FILE: /home/pro_library/checkout/sketches/12pwr/12pwr long/SK-0183.dwg


DETAIL A
DETAIL B
DETAIL C
DETAIL D
3° TYP 2 PL
6° TYP 2 PL
R3 TYP 2PL
5.7 TYP 2 PL
OUTER LID LIFTING FEATURE
INNER LID LIFTING FEATURE
EXTENDED LID REINFORCEMENT RING
OUTER SHELL EXTENDED LID
Ø205
10 TYP
15 TYP
27 TYP
R5 TYP
45°
90°
50 TYP
20
25
40
100
340
345
125
R25
10 CLOSURE LID WELD
25 EXTENDED LID BASE
30 EXTENDED LID TO OUTER LID GAP
10 CLOSURE LID
30 INNER SHELL LID TO CLOSURE LID GAP
70 INNER SHELL LID
10 BASKET TO INNER SHELL LID GAP
6° TYP 2PL
3° TYP 2PL
5.7 TYP 2PL
(40)
(20)
(50)
4
5°
44
70 SUPPORT RING
25 OUTER SHELL FLAT BOTTOM LID
SK-0183 REV 01
SHEET 2 OF 2

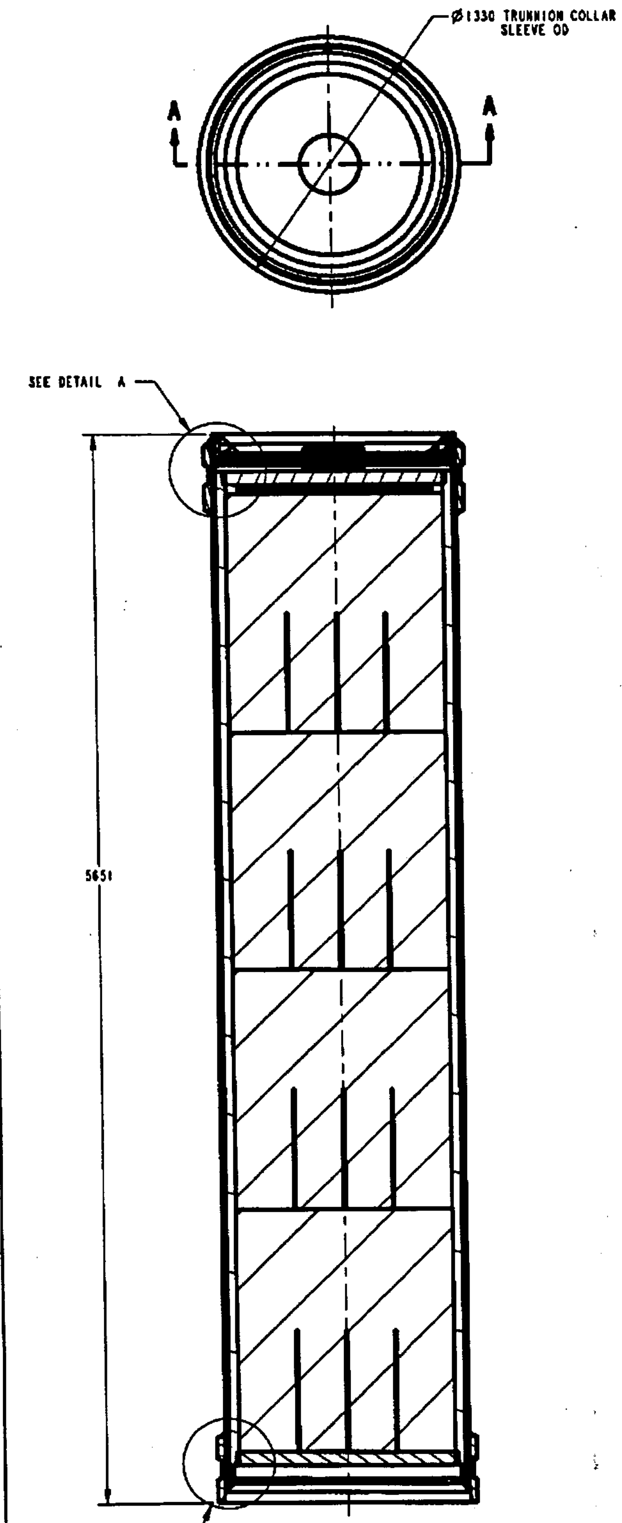
Illegibility does not impact the technical meaning or content of the record. VB. 05/17/01

ALL SHEETS ARE THE SAME REVISION STATUS

SKETCH NUMBER	SHEET	REVISION
SK-0205	1 OF 1	00

REVISION HISTORY

ZONE	REV	DESCRIPTION	DATE	APPROVED



SECTION A-A
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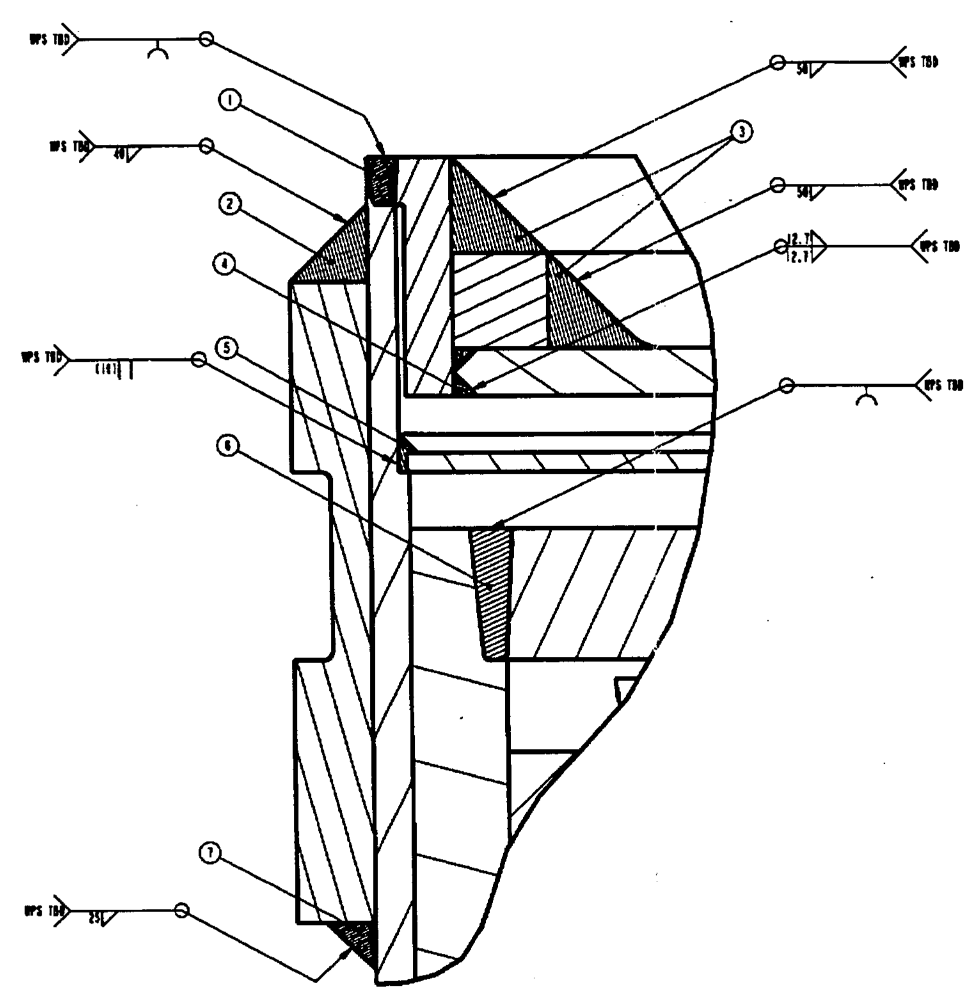

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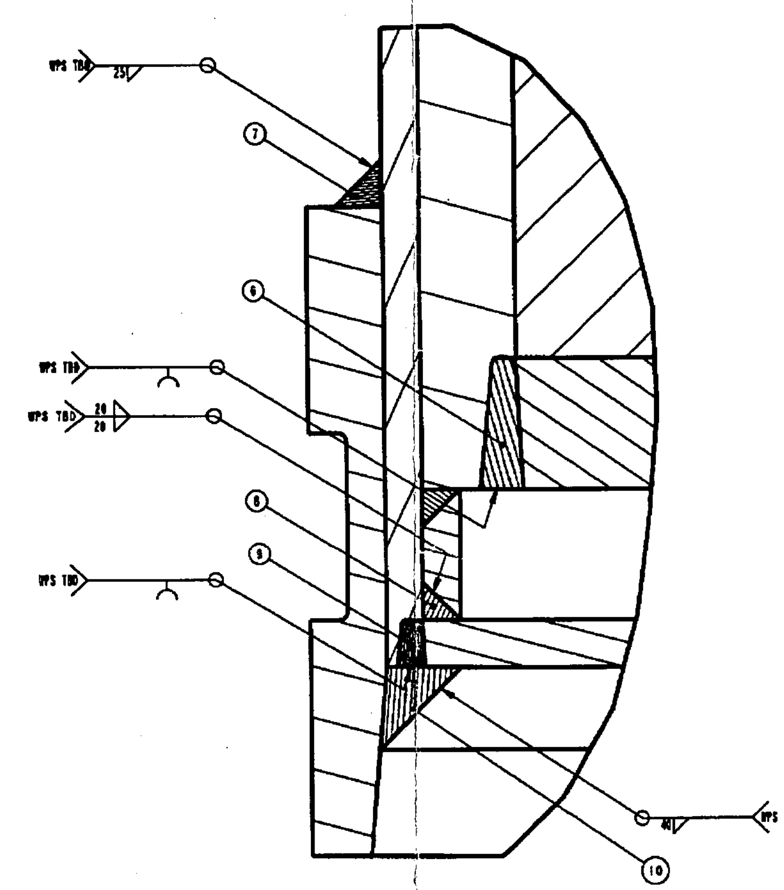


DETAIL B
SCALE 0.625

WELDS	MATERIAL	MASS (KG)	QTY RQD
WELD 1	SFA-5.14 N06022	11	1
WELD 2	SFA-5.14 N06022	28	1
WELD 3	SFA-5.14 N06022	74	1
WELD 4	SFA-5.14 N06022	2.5	2
WELD 5	SFA-5.14 N06022	3.0	1
WELD 6	SFA-5.9 S31680	34	2
WELD 7	SFA-5.14 N06022	11	2
WELD 8	SFA-5.14 N06022	6.5	2
WELD 9	SFA-5.14 N06022	11	1
WELD 10	SFA-5.14 N06022	29	1
TOTAL ALLOY 22 WELDS	SFA-5.14 N06022	196	-
TOTAL 316 WELDS	SFA-5.9 S31680	67	-

For Information and Completeness, No Approvals Required. SMB 12/06/00

"FOR INFORMATION ONLY"
THIRD ANGLE PROJECTION

DIMENSIONS ARE IN MILLIMETERS AND DEGREES UNLESS OTHERWISE NOTED

DO NOT SCALE FROM SKETCH

APPROVALS	INITIAL/DATE
SKETCHED BY BRYAN HARKINS	N/A
STRUCTURAL LEAD SCOTT BENNETT	
MANUFACTURING MGR JERRY COGAR	
DESIGN GROUP MGR THOMAS DOERING	

WASTE PACKAGE DEPARTMENT
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

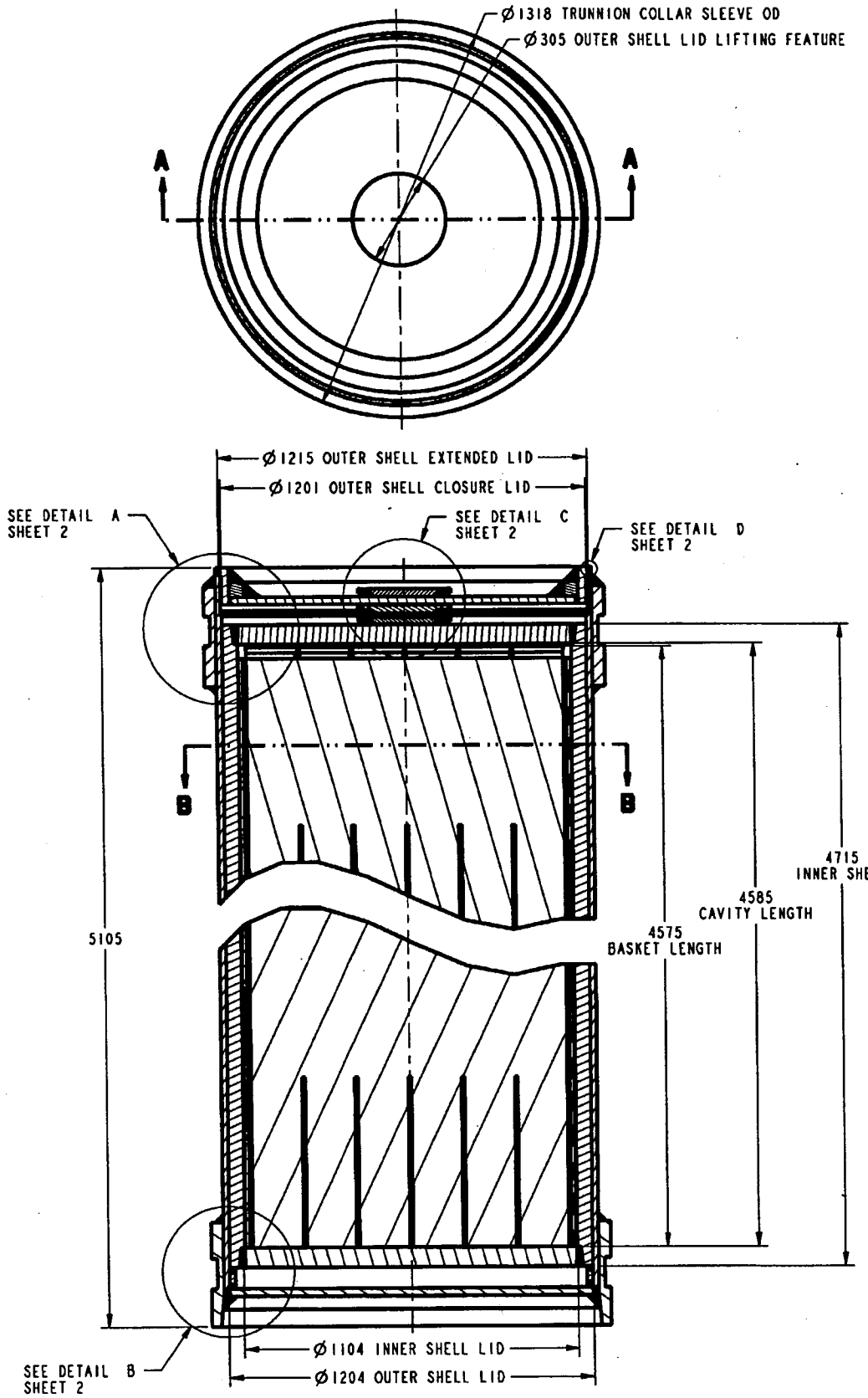
TITLE
12-PWR LONG WASTE PACKAGE WELD CONFIGURATION

SKETCH NUMBER SK-0205 | REVISION 00
SCALE .0625 | SHEET 1 OF 1

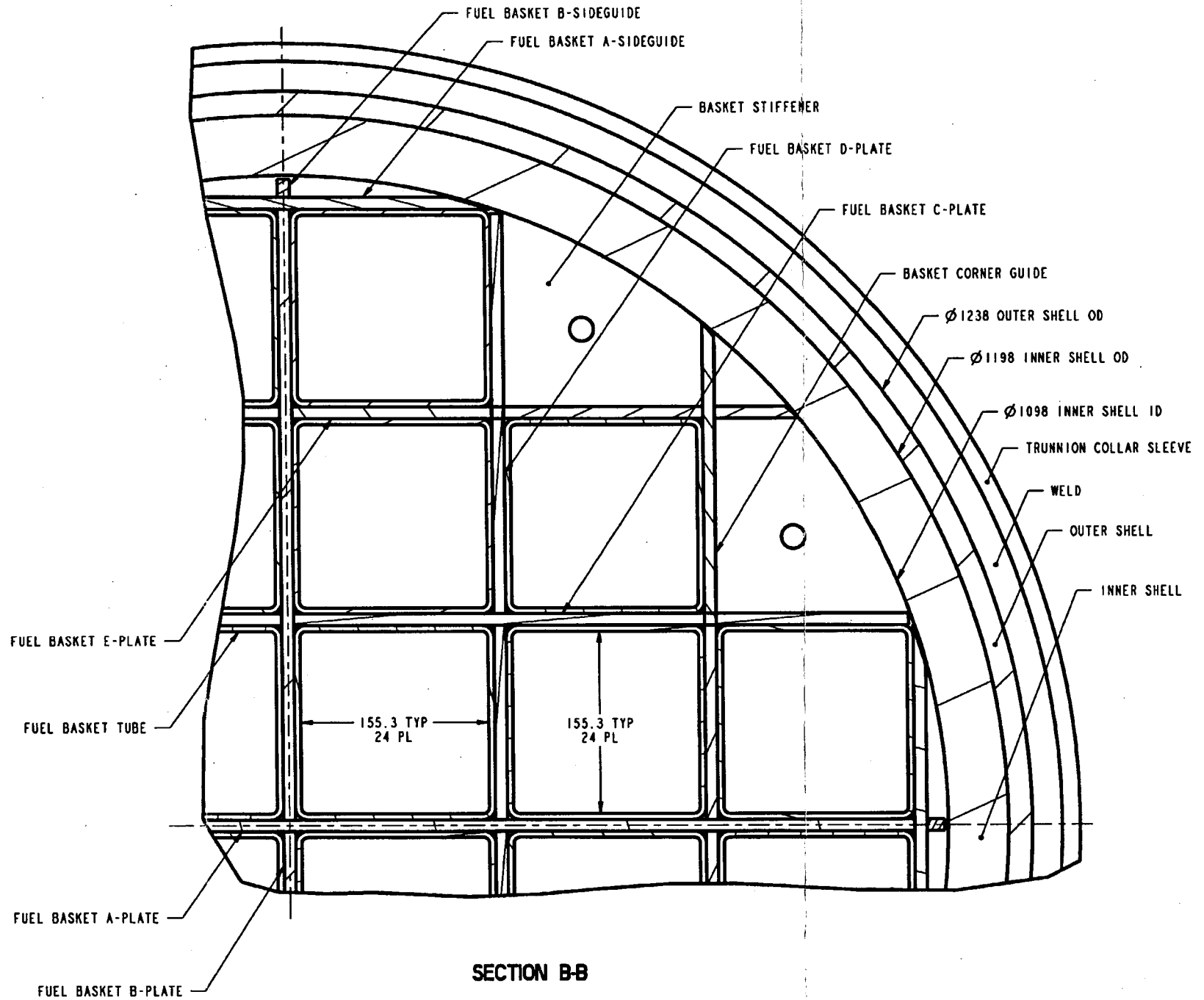
ATTACHMENT III
Design sketches

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



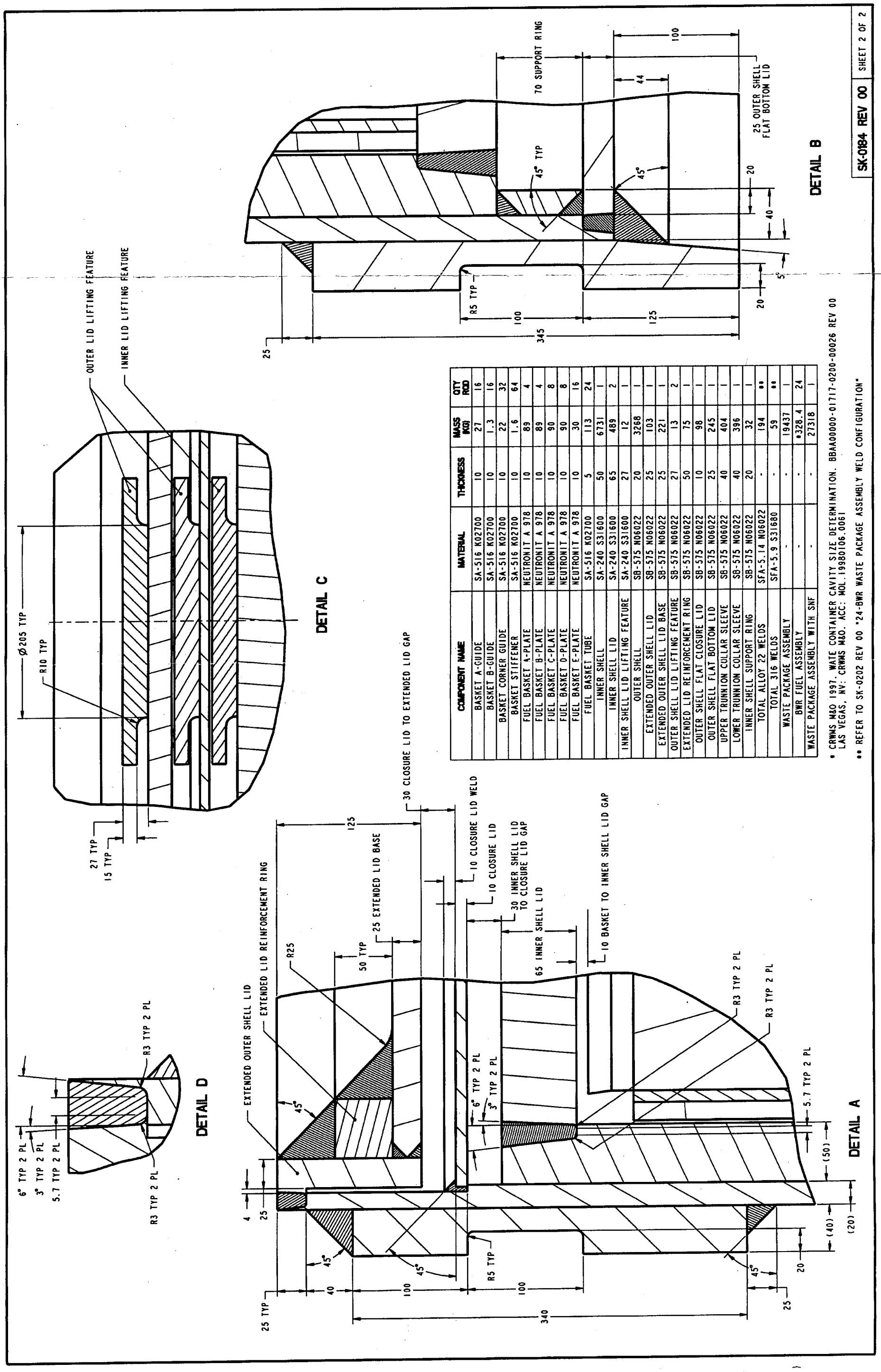
SECTION B-B

"FOR INFORMATION ONLY"

24-BWR WASTE PACKAGE CONFIGURATION FOR SITE RECOMMENDATION		
SKETCH NUMBER: SK-0184 REV 00		SHEET 1 OF 2
SKETCHED BY: BRYAN HARKINS	BH 25Jan00	
DATE: 01/25/00	JAC 1/25/00	SMB 01/25/00
FILE: /home/pro_library/checkout/sketches/24-bwr/sk-0184.dwg		

UNITS: mm

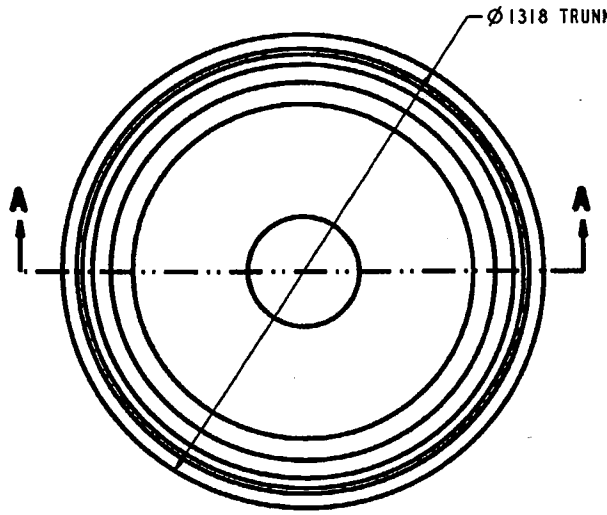
DO NOT SCALE FROM SKETCH

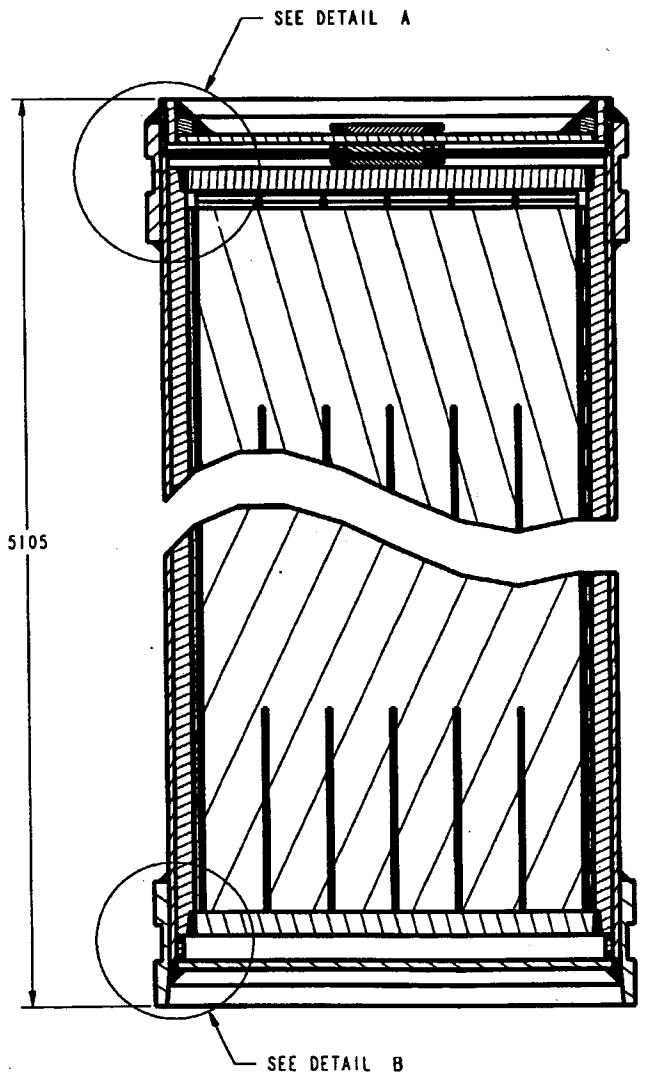


COMPONENT NAME	MATERIAL	THICKNESS	MASS (KG)	QTY ROD
BASKET A-GUIDE	SA-516 K02700	10	27	16
BASKET B-GUIDE	SA-516 K02700	10	1.3	16
BASKET CORNER GUIDE	SA-516 K02700	10	22	32
BASKET STIFFENER	SA-516 K02700	10	1.6	64
FUEL BASKET A-PLATE	NEUTRONIT A 978	10	89	4
FUEL BASKET B-PLATE	NEUTRONIT A 978	10	89	4
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 K02700	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	396	1
INNER SHELL SUPPORT RING	SB-575 N06022	20	32	1
TOTAL ALLOY 22 WELDS	SFA-5.14 N06022	-	194	**
TOTAL 316 WELDS	SFA-5.9 S31680	-	59	**
WASTE PACKAGE ASSEMBLY	-	-	19437	1
BWR FUEL ASSEMBLY	-	-	*328.4	24
WASTE PACKAGE ASSEMBLY WITH SNF	-	-	27318	1

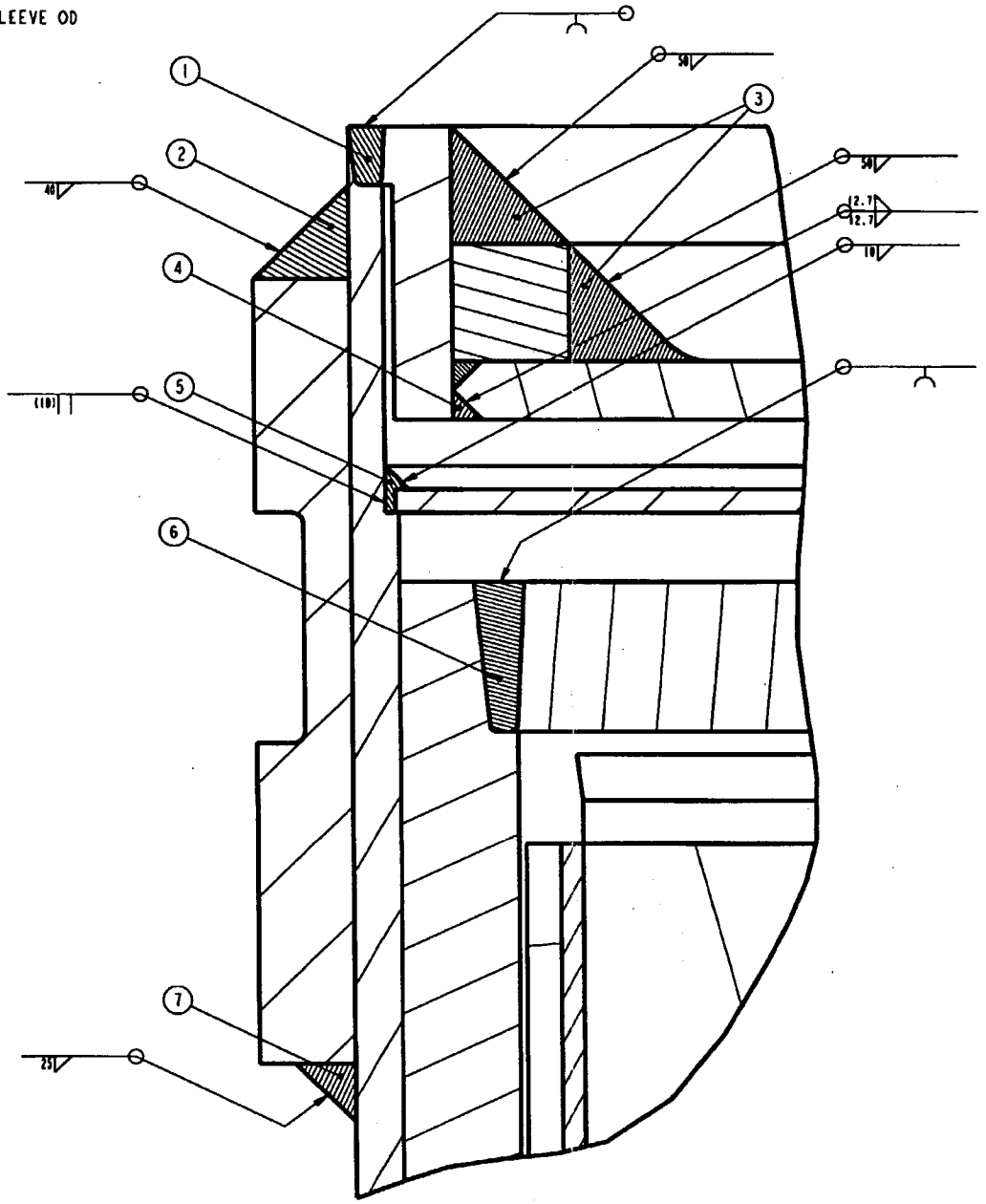
* CRWMS M&O 1997. WATE CONTAINER CAVITY SIZE DETERMINATION. BBAA00000-01717-0200-00026 REV 00 LAS VEGAS, NV: CRWMS M&O. ACC: MOL.19980106.0061

** REFER TO SK-0202 REV 00 "24-BWR WASTE PACKAGE ASSEMBLY WELD CONFIGURATION"



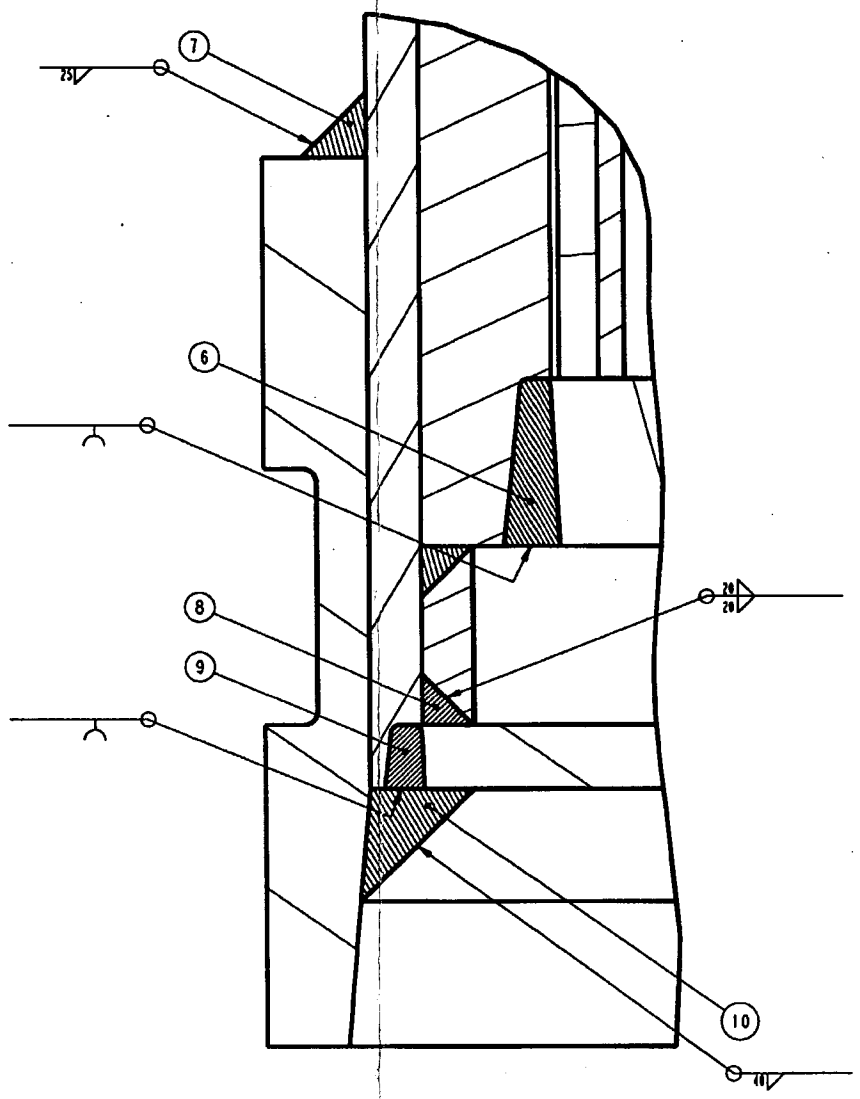


SECTION A-A



DETAIL A

WELD	MATERIAL	MASS (KG)	QTY ROD
1	SFA-5.14 N06022	11	1
2	SFA-5.14 N06022	28	1
3	SFA-5.14 N06022	73	1
4	SFA-5.14 N06022	2.4	2
5	SFA-5.14 N06022	3.0	1
6	SFA-5.9 S31680	30	2
7	SFA-5.14 N06022	11	2
8	SFA-5.14 N06022	6.5	2
9	SFA-5.14 N06022	11	1
10	SFA-5.14 N06022	29	1
TOTAL ALLOY 22 WELDS	SFA-5.14 N06022	194	-
TOTAL 316 WELDS	SFA-5.9 S31680	59	-



DETAIL B

UNITS: mm

DO NOT SCALE FROM SKETCH

REVISIONS			
REV	DESCRIPTION	DRW BY	DATE
00	ISSUED APPROVED	BH	03/07/00

"FOR INFORMATION ONLY"

24-BWR WASTE PACKAGE ASSEMBLY WELD CONFIGURATION

SKETCH NUMBER: SK-0202 REV 00

SKETCHED BY: BRYAN HARKINS BH 13March00

DATE: 03/07/00 SMB 03/15/00 3/13/00 3.15.00

FILE: /home/pro_library/checkout/sketches/24bwr/sk-0202.dwg

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

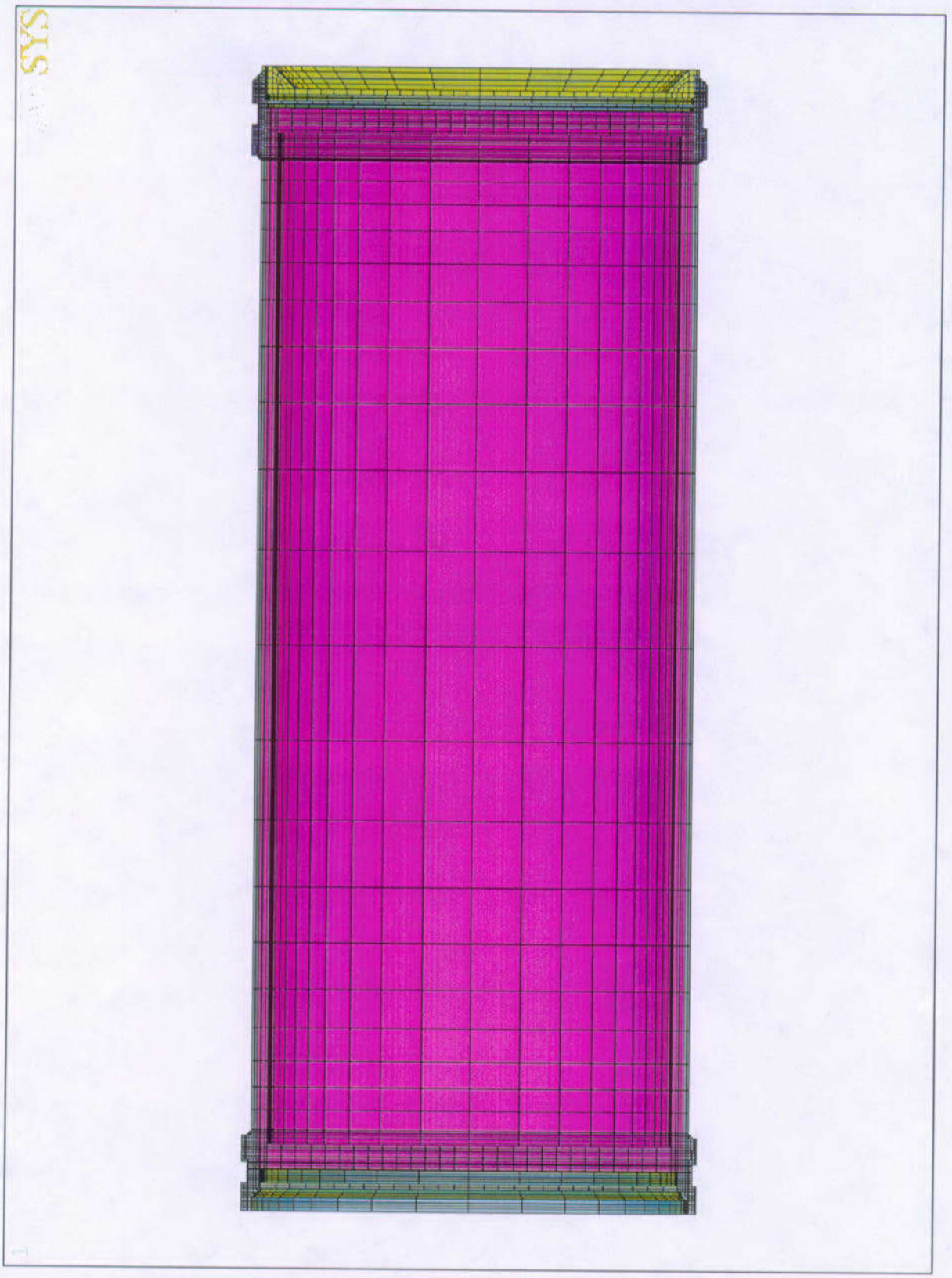


Figure 1: Mesh of the 5 DHLW/DOE - Long Waste Package

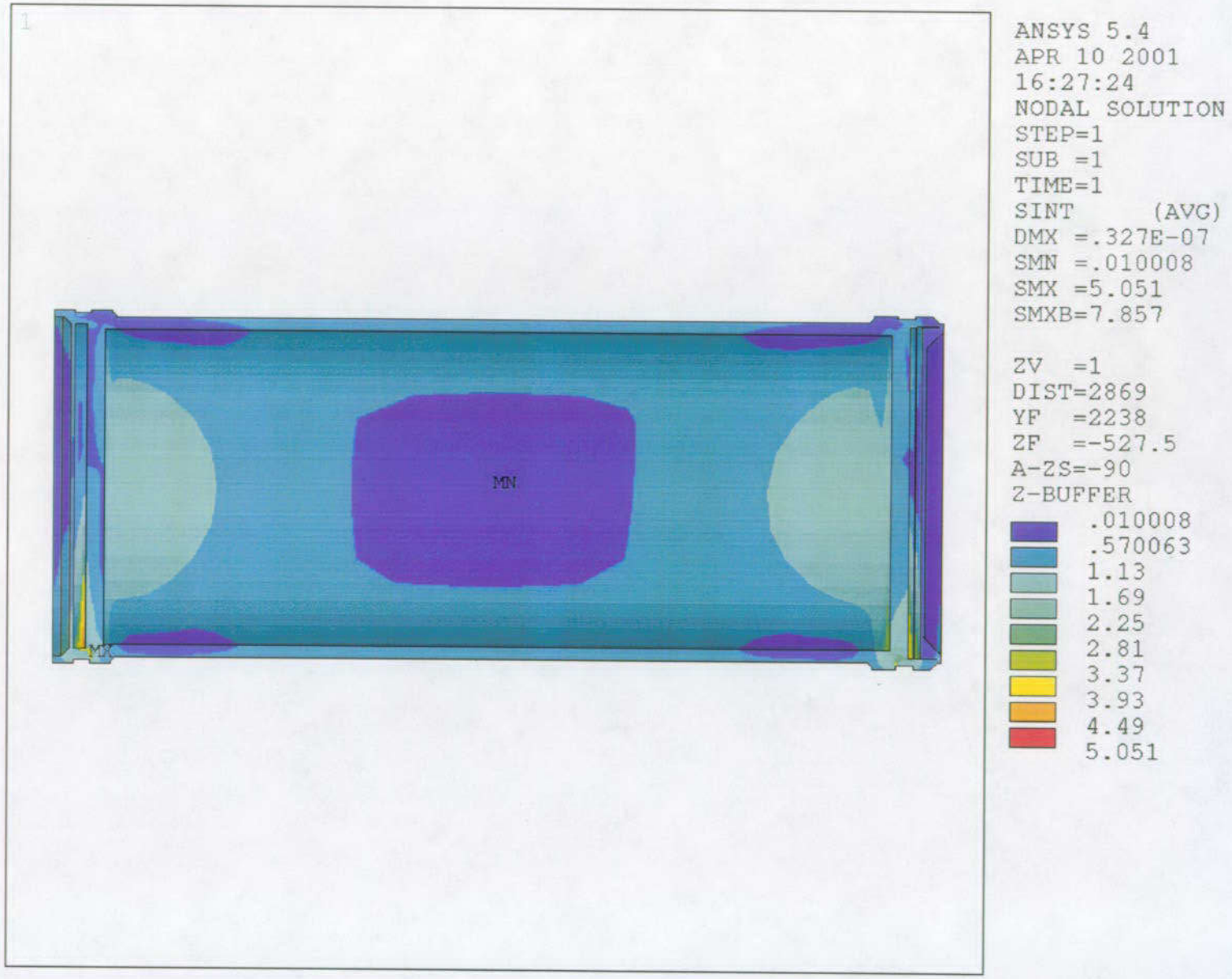


Figure 2: Stress Intensity in the 5 DHLW/DOE - Long Waste Package at RT

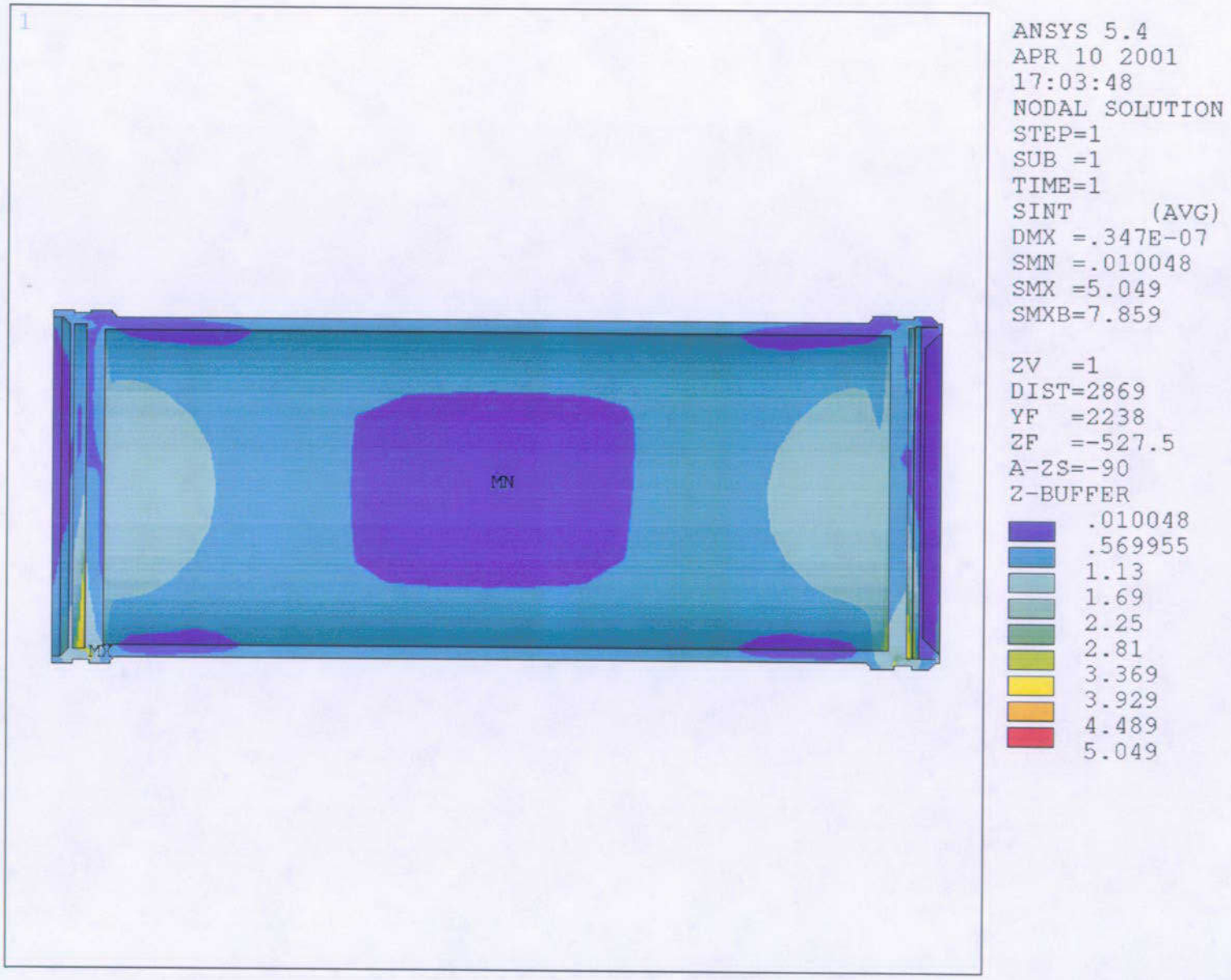


Figure 3: Stress Intensity in the 5 DHLW/DOE - Long Waste Package at 204°C

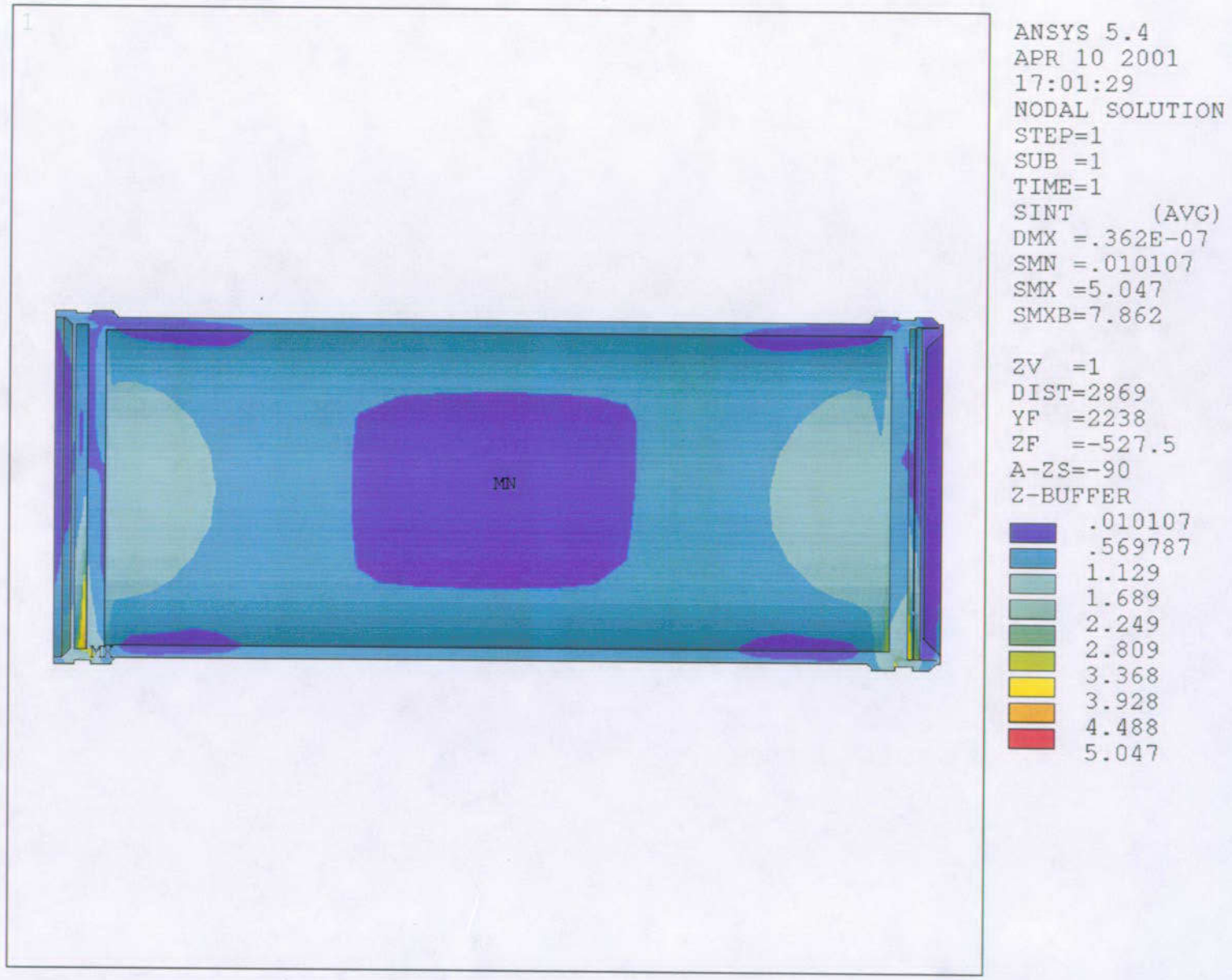


Figure 4: Stress Intensity in the 5 DHLW/DOE - Long Waste Package at 316°C

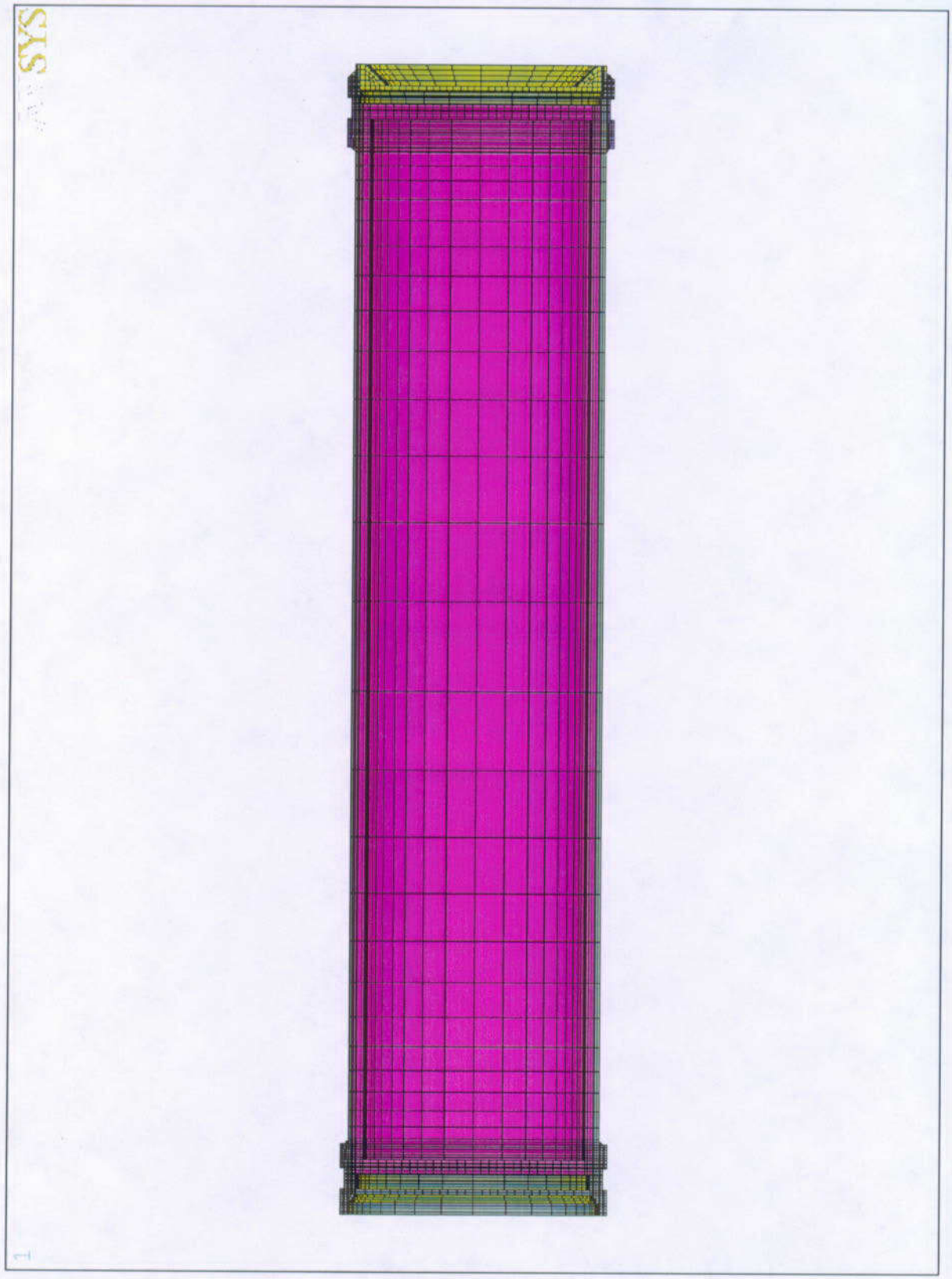


Figure 5: Mesh of the 12-PWR Long Waste Package

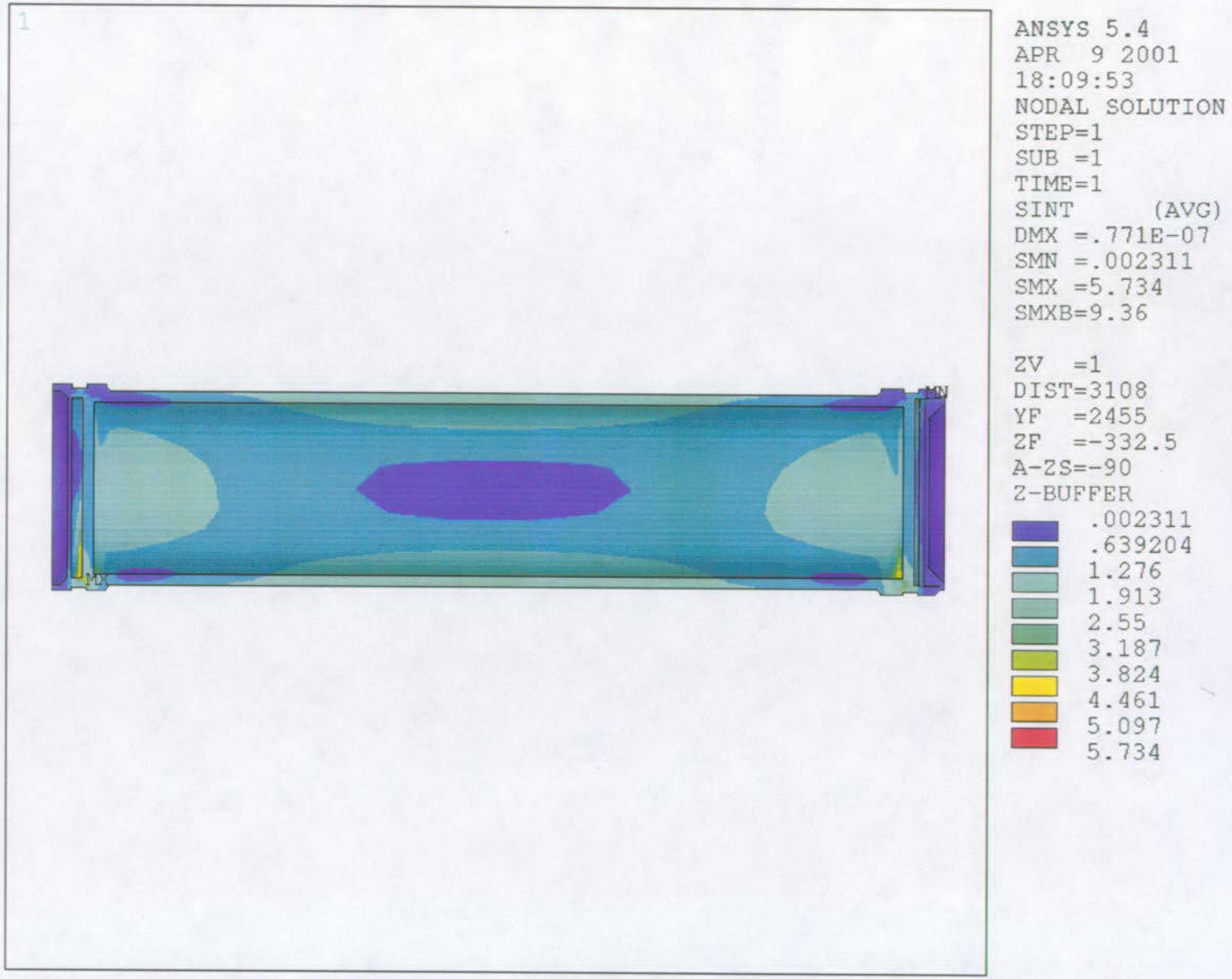


Figure 6: Stress Intensity in the 12-PWR Long Waste Package at 316°C

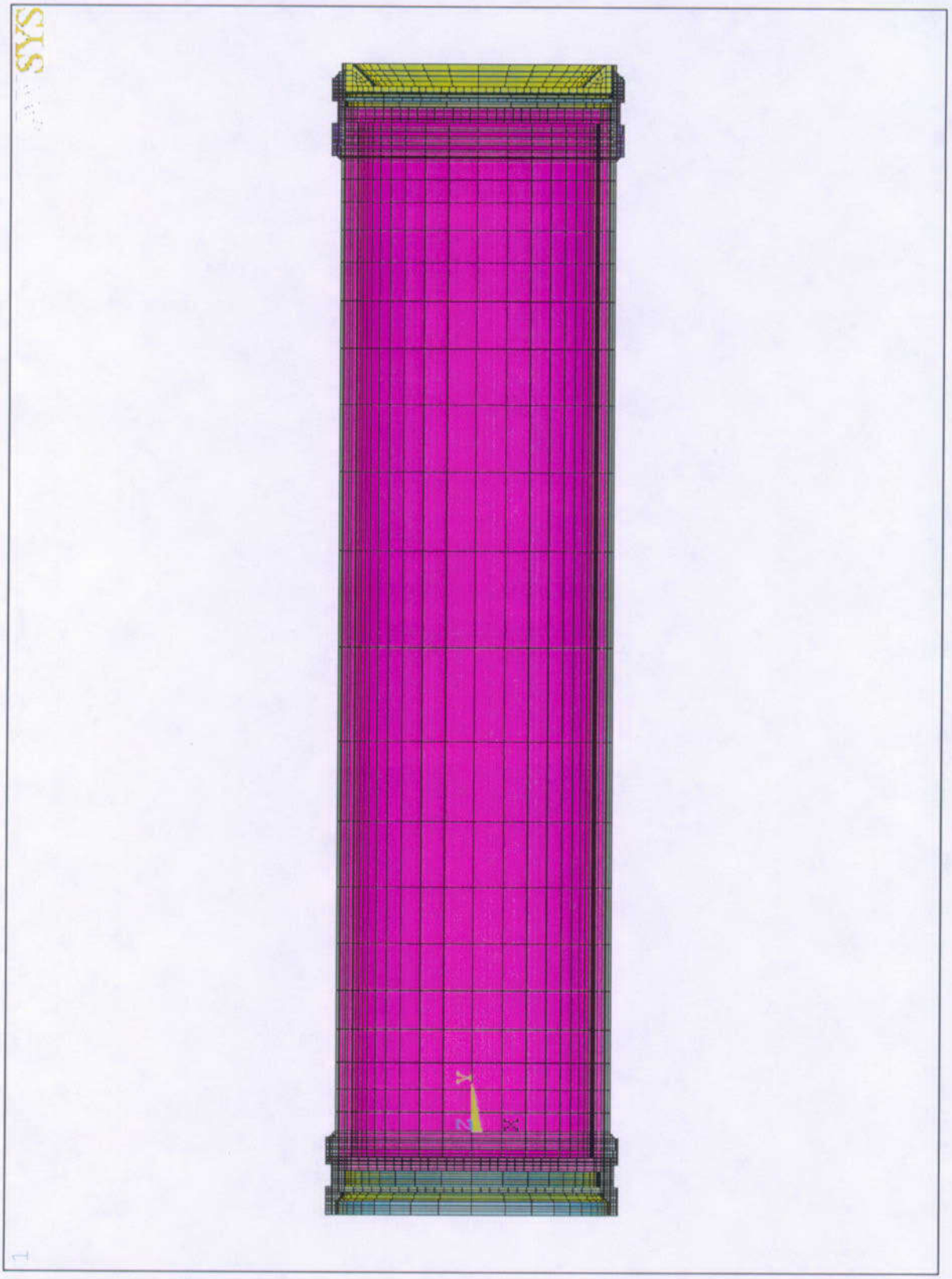


Figure 7: Mesh of the 24-BWR Waste Package

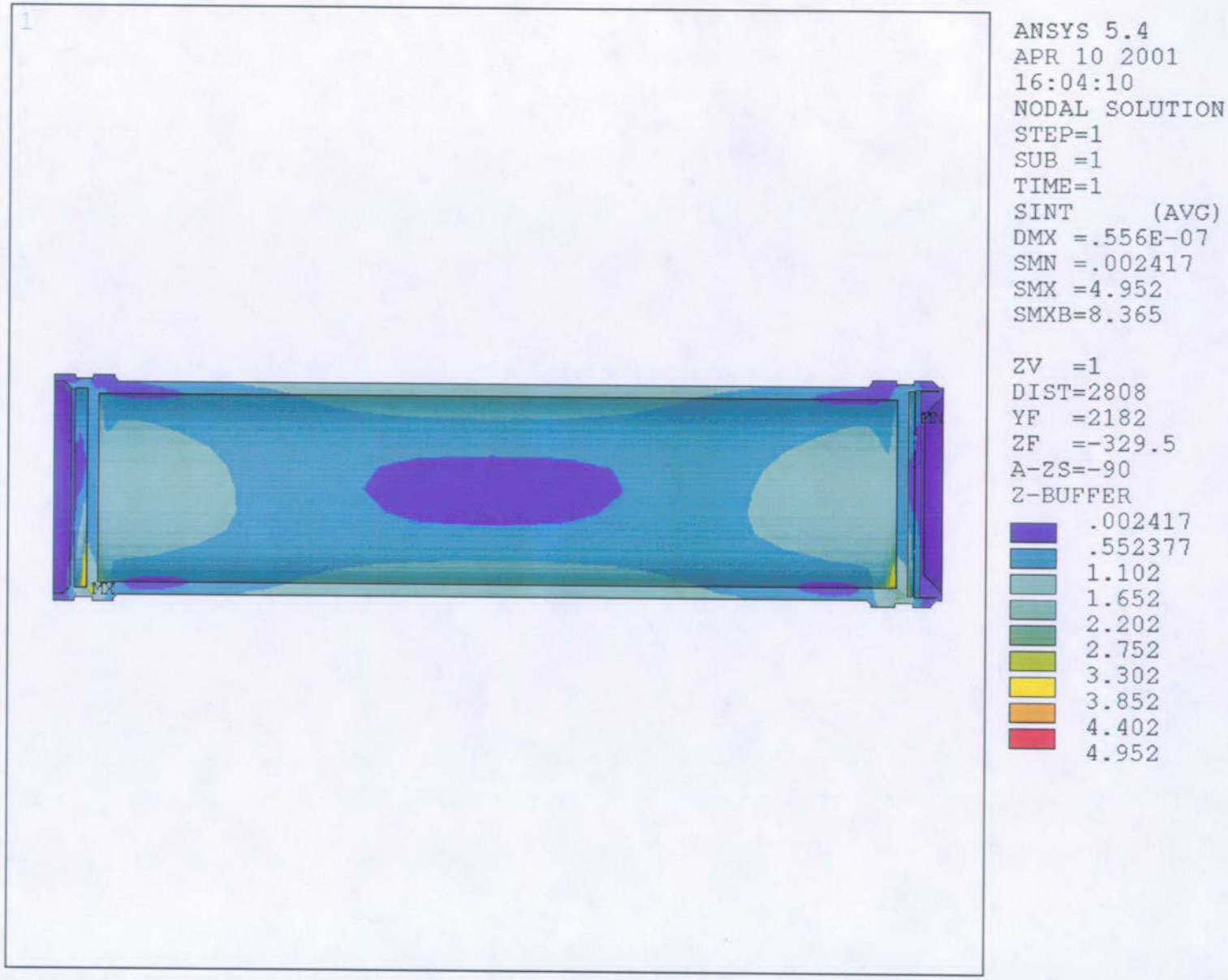


Figure 8: Stress Intensity in the 24-BWR Waste Package at 316°C

√ file list 5/30/01 DE

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
SPECIAL INSTRUCTION SHEET

1. QA: QA

Complete Only Applicable Items

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2. Record Date	3. Accession Number
05/24/2001	ATT-TO MOL.20010530.0143
4. Author Name(s)	**5. Author Organization**
VALERIE DE LA BROSSE	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)	8. Version Designator
CAL-EBS-ME-000010	REV. 00

9. Document Type	10. Medium
CD-ROM	DATA

11. Access Control Code
PUB

12. Traceability Designator
DC #26242

(AB) 5/30/01

13. Comments
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