OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
CALCULATION COVER SHEET

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Horizontal Drop of 21-PWR Waste Package

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9. Remarks
None

Revision History

10. Revision No.	11. Description of Revision
00	Initial Issuance.
01	Inner Shell top lid changed to Shear Ring design. The temperature cases analyzed used ASME elongation values at 70, 400, and 600 degrees Fahrenheit. A fourth case was analyzed at 600 degrees Fahrenheit using vendor elongation data to provide a range of possible results.

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1. PURPOSE

The objective of this calculation is to determine the structural response of the waste package (WP) dropped horizontally from a specified height. The WP used for that purpose is the 21-Pressurized Water Reactor (PWR) WP. The scope of this document is limited to reporting the calculation results in terms of stress intensities. The information provided by the sketches (Attachment I) is that of the potential design of the type of WP considered in this calculation, and all obtained results are valid for that design only. This calculation is associated with the WP design and was performed by the Waste Package Design group in accordance with the *Technical Work Plan for: Waste Package Design Description for LA* (Ref. 16). AP-3.12Q, *Calculations* (Ref. 11) is used to perform the calculation and develop the document. The sketches attached to this calculation provide the potential dimensions and materials for the 21-PWR WP design.

2. METHOD

The finite element calculation was performed by using the commercially available ANSYS Version (V) 5.6.2 (Software Tracking Number [STN] 10364-5.6.2-00; Ref. 4) and LS-DYNA V950.C (STN 10300-950-00; Ref. 7) finite element codes. The results of this calculation were provided in terms of maximum stress intensities in the outer shell (OS), inner shell (IS), and Shear Ring.

With regard to the development of this calculation, the control of electronic management of data was evaluated in accordance with AP-SV.1Q, *Control of the Electronic Management of Information* (Ref. 10) and the Technical Work Plan (Ref. 16). The evaluation (Addendum B of Ref. 16) determined that current work processes and procedures are adequate for the control of the electronic management of data for this activity.

3. ASSUMPTIONS

In the course of developing this document, the following assumptions are made regarding the structural calculation.

3.1 Some of the temperature-dependent material properties, such as Poisson’s Ratio, Coefficient of Thermal Expansion, and density, are not available for SB-575 N06022 (Alloy 22), SA-516 K02700 (516 carbon steel [CS]), and SA-240 S31600 (316 stainless steel [SS]). The room-temperature (20 °C) material properties are assumed for both materials. The impact of using room-temperature material properties is anticipated to be small. The rationale for this assumption is that undetermined material properties of said materials will not significantly impact the results. This assumption is used in Section 5.2.

3.2 The Poisson’s ratio of Alloy 22 is not available in literature. The Poisson’s ratio of Alloy 625 (SB-443 N06625) is assumed for Alloy 22. The impact of this assumption is anticipated to be negligible. The rationale for this assumption is that the chemical compositions of Alloy 22 and Alloy 625 are similar (see Ref. 2, SB-575 Table 1 and Ref. 13, p. 143, respectively). This assumption is used in Section 5.2.

3.3 Some of the rate-dependent material properties are not available for SB-575 N06022 (Alloy 22), SA-516 K02700 (516 carbon steel [CS]), and SA-240 S31600 (316 stainless steel [SS]). Linear approximations are assumed for all materials. The impact of using such an approximation is anticipated to be small. The rationale for this assumption is that this is the most common and accepted way of approximating these properties. This assumption is used in Section 5.2.

3.4 Poisson's ratio is not available for 516 CS. Therefore, Poisson's ratio of cast carbon steel is assumed for 516 CS. The impact of this assumption is anticipated to be negligible. The rationale for this assumption is that the elastic constants of cast carbon steels are only slightly affected by changes in composition and structure (see Ref. 3). This assumption is used in Section 5.2.

3.5 The exact geometry of the loaded internals is simplified for the purpose of this calculation. The spent fuel was modeled as 21 separate solid rectangles made from SS304L, but the thermal shunts, fuel tubes, and dividers between the fuel assemblies were omitted. The density of the spent fuel was increased to account for the missing mass. However, the sideguides, cornerguides, and stiffeners were included to accurately represent the contact with the inner shell. The rationale for this assumption is to simplify the finite element representation (FER), thus reducing processing time and file size, without compromising the accuracy of the calculation. This assumption is used in Section 5.4 and Section 5.2.

3.6 The elongations of Alloy 22 and 316NG SS at elevated temperatures are not available from traditional sources. However, vendor data is available (Ref. 6 and Ref. 17). The percent difference between elongations at room temperature and elevated temperatures can be normalized and applied to the data available from accepted codes. The rationale for this assumption is that the relative change of typical elongations should be bounding for the relative change of minimum elongation. Even though the values are not from traditional sources, the values are conservative and create higher stress intensities for the same temperature. This assumption is used in Section 5.2.1.

3.7 The impact surface that the WP is to be dropped on is conservatively assumed to be perfectly rigid (unyielding). Such a material does not exist. LS-DYNA is able to simulate such a surface. The result will be that the stresses produced by this calculation will be small percentage higher than those that would result if a realistic surface were used. The rationale is that this is a conservative assumption. This assumption is used in Section 5.4.

3.8 Three-stage deformation characteristics are not observed in the stress-strain curves for Alloy 22 or Type 316 stainless steel (Ref. 12). However, in order to capture the uniform strain of the material from the curves, the total elongation should be conservatively reduced by 10%. The rationale for this assumption is to truncate the last portion of the curve that has decreasing slope. This assumption is used in Section 5.2.2.

3.9 The uniform strain of A 516 Grade 70 CS is not available in literature. Therefore, it is conservatively assumed that the uniform strain is 50% of its elongation. The rationale for this assumption is the stress-strain curve for A 36 CS (see Refs. 5 and 8), which has similar chemical composition with A 516 Grade 70 CS (see Ref. 2, SA-516/SA-516M and SA-36/SA-36M), displays uniform strain which is 50% of its elongation. This assumption is used in Section 5.2.2.

4. USE OF COMPUTER SOFTWARE AND MODELS

4.1 SOFTWARE

The first finite element analysis (FEA) computer code used for this calculation is ANSYS V5.6.2 (Ref. 4), which is identified with the Software Tracking number (STN) 10364-5.6.2-00 and was obtained from Software Configuration Management in accordance with appropriate procedures. ANSYS V5.6.2 is a commercially available finite element analysis code and is appropriate for structural calculations of WPs as performed in this calculation. The calculations using the ANSYS V5.6.2 software were executed on a Hewlett-Packard (HP) 9000 Series UNIX workstation, Yucca Mountain Project (YMP) tag number 700314 located in Las Vegas, NV. The ANSYS evaluations performed for these designs are fully within the range of the validation performed for the ANSYS V5.6.2 code. Access to the code was granted by the Software Configuration Secretariat in accordance with the appropriate procedures.

The second FEA code used is Livermore Software Technology Corporation (LSTC) LS-DYNA V950.C (Ref. 7). LS-DYNA V950.C was obtained from the Software Configuration Secretariat in accordance with the appropriate procedures and is identified by STN 10300-950-00. LS-DYNA V950.C is appropriate for its intended use. The LS-DYNA evaluation performed for this calculation is fully within the range of the validation perfromed for the LS-DYNA V950.C code. The calculations were executed on HP 9000 series UNIX workstations identified with YMP tag numbers 117161 and 117162 located in Las Vegas, NV.

The input and output files are defined in Section 8 of this document. They are located in Attachment II to this document.

4.2 SOFTWARE ROUTINES

None used.

4.3 MODELS

None used.

5. CALCULATION

5.1 MASS AND GEOMETRIC DIMENSIONS OF WASTE PACKAGE

This calculation was performed using mass and geometric dimensions of the 21-PWR waste package (see pp. I-1, I-15, and I-24):

Total mass of the loaded WP = 41,598 *kg*
Length = 5.129 *m*
Outer diameter of outer shell = 1.574 *m*
Outer diameter of trunnion collar sleeve = 1.654 *m*

5.2 MATERIAL PROPERTIES

Material properties used in these calculations are listed in this section. Some of the temperature-dependent and rate-dependent material properties are not available for Alloy 22, 316NG SS, and 516 CS. Therefore, room-temperature density and Poisson's ratio obtained under the static loading conditions are used for Alloy 22, 316NG SS, and 516 CS (see Assumptions 3.1 and 3.3). All references to Ref. 2 in this Section are from Section II of Ref. 2.

SB-575 N06022 (Alloy 22) (Outer shell, outer shell lids, upper and lower trunnion collar sleeves):

- Density = 8690 kg/m^3 (0.314 lb/in^3) (at room temperature) (Ref. 2, SB-575 Section 7.1)

- Yield strength = 310 *MPa* (45 *ksi*) (at room temperature) (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)

- Tensile strength = 690 *MPa* (100 *ksi*) (at room temperature) (Ref. 2, Table U)
  Tensile strength = 657 *MPa* (95.3 *ksi*) (at 400 °F = 204 °C) (Ref. 2, Table U)
  Tensile strength = 628 *MPa* (91.1 *ksi*) (at 600 °F = 316 °C) (Ref. 2, Table U)

- Elongation = 0.45 (at room temperature) (Ref. 2, SB-575 Table 3)

- Poisson's ratio = 0.278 (at room temperature) (Ref. 13, p. 143; see Assumption 3.2)

- Modulus of elasticity = 206 *GPa* (at room temperature) (Ref. 6, p. 14)
  Modulus of elasticity = 196 *GPa* (at 400 °F = 204 °C) (Ref. 6, p. 14)
  Modulus of elasticity = 190 *GPa* (at 600 °F = 316 °C) (Ref. 6, 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. 18, page 931 and Ref. 2, Section II, SA-240 Table 1]) (Inner shell, inner shell lids, and inner shell lifting feature):

- Density = 7980 kg/m^3 (at room temperature) (Ref. 14, Table X1, p. 7)

- Yield strength = 207 *MPa* (30 *ksi*) (at room temperature) (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)

- Tensile strength = 517 *MPa* (75 *ksi*) (at room temperature) (Ref. 2, Table U)
  Tensile strength = 496 *MPa* (71.9 *ksi*) (at 400 °F = 204 °C) (Ref. 2, Table U)
  Tensile strength = 495 *MPa* (71.8 *ksi*) (at 600 °F = 316 °C) (Ref. 2, Table U)

- Elongation = 0.40 (at room temperature) (Ref. 2, SA-240 Table 2)

- Poisson's ratio = 0.298 (at room temperature) (Ref. 13, Figure 15, p. 755)

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

SA-516 K02700 (516 CS) (Sideguides, stiffeners, and baskets):

- Density = 7850 kg/m^3 (at room temperature) (Ref. 2, SA-20/SA20M, Section 14.1)

- Yield strength = 262 *MPa* (38 *ksi*) (at room temperature) (Ref. 2, Table Y-1)
  Yield strength = 224 *MPa* (32.5 *ksi*) (at 400 °F = 204 °C) (Ref. 2, Table Y-1)
  Yield strength = 201 *MPa* (29.1 *ksi*) (at 600 °F = 316 °C) (Ref. 2, Table Y-1)

- Tensile strength = 483 *MPa* (70 *ksi*) (at room temperature) (Ref. 2, Table U)
  Tensile strength = 483 *MPa* (70 *ksi*) (at 400 °F = 204 °C) (Ref. 2, Table U)
  Tensile strength = 483 *MPa* (70 *ksi*) (at 600 °F = 316 °C) (Ref. 2, Table U)

- Elongation = 0.21 (at room temperature) (Ref. 2, SA-516 Table 2)

- Poisson's ratio = 0.3 (at room temperature) (Ref. 3, p. 374) (see Assumption 3.4)

- Modulus of elasticity = 203 *GPa* ($29.5 * 10^6$ *psi*) (at room temperature) (Ref. 2, Table TM-1)
  Modulus of elasticity = 191 *GPa* ($27.7 * 10^6$ *psi*) (at 400 °F = 204 °C) (Ref. 2, Table TM-1)
  Modulus of elasticity = 184 *GPa* ($26.7 * 10^6$ *psi*) (at 600 °F = 316 °C) (Ref. 2, Table TM-1)

SA-240 S30400 (304 SS) (21-PWR Fuel):

- Yield strength = 207 *MPa* (30 *ksi*) (at room temperature) (Ref. 2, Table Y-1)
  Yield strength = 143 *MPa* (20.7 *ksi*) (at 400 °F = 204 °C) (Ref. 2, Table Y-1)
  Yield strength = 127 *MPa* (18.4 *ksi*) (at 600 °F = 316 °C) (Ref. 2, Table Y-1)

- Tensile strength = 517 *MPa* (70 *ksi*) (at room temperature) (Ref. 2, Table U)
  Tensile strength = 441 *MPa* (70 *ksi*) (at 400 °F = 204 °C) (Ref. 2, Table U)
  Tensile strength = 437 *MPa* (70 *ksi*) (at 600 °F = 316 °C) (Ref. 2, Table U)

- Elongation = 0.40 (at room temperature) (Ref. 2, SA-240 Table 2)
- Poisson's ratio = 0.290 (at room temperature) (Ref. 13, Figure 15, p. 755)
- Modulus of elasticity = 195 *GPa* (28.3 * 10^6 *psi*) (at room temperature) (Ref. 2, Table TM-1)
  Modulus of elasticity = 183 *GPa* (26.5 * 10^6 *psi*) (at 400 °F = 204 °C) (Ref. 2, Table TM-1)
  Modulus of elasticity = 174 *GPa* (25.3 * 10^6 *psi*) (at 600 °F = 316 °C) (Ref. 2, Table TM-1)

5.2.1 Calculations for Elevated-Temperature Material Properties

The values for elongation at elevated temperatures are not listed in conventional listings such as American Society for Testing and Materials (ASTM) Standards or American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code. However, the elongation values at elevated temperatures are available from vendor data. This vendor data will be used to estimate elevated temperature elongation normalized to the room temperature values from accepted codes (see Assumption 3.6).

For Alloy 22, the vendor data shows an approximate 10% increase in elongation values between room temperature and 600 °F (Ref. 6). Therefore the elongation values for Alloy 22 at 600 °F will be as follows:

$\text{Elongation}_{600\ °F} = 0.45 * (1 + 0.10) = 0.50$

For SS 316, the vendor data shows an approximate 30% decrease in elongation values between 600 °F and room temperature (Ref. 17).

Therefore the elongation values for SS 316 at 600 °F will be as follows:

$\text{Elongation}_{600\ °F} = 0.40 * (1 – 0.30) = 0.28$

Since the components made of SA-516 and SS304 will not be analyzed for stresses, their elongations are not needed at elevated temperatures.

5.2.2 Calculations for True Measures of Ductility

The material properties in Sections 5.2 and 5.2.1 refer to engineering stress and strain definitions:

$$s = \frac{P}{A_0} \quad \text{and} \quad e = \frac{L - L_0}{L_0} \qquad \text{(Ref. 15)}$$

Where P stands for the force applied during static tensile test, L is the deformed-specimen length, and L_0 and A_0 are original length and cross-sectional area of specimen, respectively. It is generally accepted that the engineering stress-strain curve does not give a true indication of the deformation characteristics of a material during the plastic deformation since it is based entirely on the original dimensions of the specimen. Therefore, the LS-DYNA V950.C finite element code requires input in terms of true stress and strain definitions:

$$s = \frac{P}{A} \quad \text{and} \quad e = \ln\left(\frac{L}{L_0}\right) \qquad \text{(Ref. 15)}$$

The relationships between the true stress and strain definitions and engineering stress and strain definitions can be readily derived based on constancy of volume ($A_o*L_o = A*L$) and strain homogeneity during plastic deformation:

$$\sigma = s * (1 + e) \quad \text{and} \quad e = \ln(1+e) \qquad \text{(Ref. 15)}$$

These expressions are applicable only in the hardening region of stress-strain curve that is limited by the onset of necking.

The following parameters are used in the subsequent calculations:

$s_y \approx s_y \equiv$ yield strength
$s_u \equiv$ engineering tensile strength
$s_u \equiv$ true tensile strength
$e_y \approx e_y \equiv$ strain corresponding to yield strength
$e_u \equiv$ engineering strain corresponding to tensile strength (engineering uniform strain)
$e_u \equiv$ true strain corresponding to tensile strength (true uniform strain)

In absence of the uniform strain data in available literature, it needs to be estimated based on stress-strains curves and elongation (strain corresponding to rupture of the tensile specimen).

The stress-strain curves for Alloy 22, 316 SS and 316NG SS do not manifest three-stage deformation characteristics (Ref. 12). Therefore, the elongation, reduced by 10% for the sake of conservativism (Assumption 3.8), can be used in place of uniform strain. 516 CS does manifest three-stage deformation, and will be reduced by 50% for the sake of conservatism (Assumption 3.9).

In the case of Alloy 22 (e_u = 0.9 * *elongation* = 0.41 at room temperature), the true measures of ductility are

$e_u = \ln(1 + e_u) = \ln(1 + 0.41) = 0.34$
$s_u = s_u * (1 + e_u) = 690 * (1 + 0.41) = 973\ MPa$

<u>400 °F (204 °C) Alloy 22</u>
$e_u = \ln(1 + e_u) = \ln(1 + 0.41) = 0.34$

$s_u = s_u * (1 + e_u) = 657 * (1 + 0.41) = 926$ *MPa*

<u>600 °F (316 °C) Alloy 22</u>
$e_u = \ln(1 + e_u) = \ln(1 + 0.41) = 0.34$ (ASME values)
$s_u = s_u * (1 + e_u) = 628 * (1 + 0.41) = 885$ *MPa* (ASME values)

$e_u = \ln(1 + e_u) = \ln(1 + 0.45) = 0.37$ (vendor data)
$s_u = s_u * (1 + e_u) = 628 * (1 + 0.45) = 911$ *MPa* (vendor data)

For 316NG SS at room temperature, $e_u = 0.9 * elongation = 0.36$, therefore:
$e_u = \ln(1 + e_u) = \ln(1 + 0.36) = 0.31$
$s_u = s_u * (1 + e_u) = 517 * (1 + 0.36) = 703$ *MPa*

<u>400 °F (204 °C) SS 316NG</u>
$e_u = \ln(1 + e_u) = \ln(1 + 0.36) = 0.31$
$s_u = s_u * (1 + e_u) = 496 * (1 + 0.36) = 675$ *MPa*

<u>600 °F (316 °C) SS 316NG</u>
$e_u = \ln(1 + e_u) = \ln(1 + 0.36) = 0.31$ (ASME values)
$s_u = s_u * (1 + e_u) = 495 * (1 + 0.36) = 673$ *MPa* (ASME values)

<u>600 °F (316 °C) SS 316NG</u>(cont'd)
$e_u = \ln(1 + e_u) = \ln(1 + 0.25) = 0.22$ (vendor data)
$s_u = s_u * (1 + e_u) = 495 * (1 + 0.25) = 619$ *MPa* (vendor data)

For 516 CS at room temperature, $e_u = 0.5 * elongation = 0.11$, therefore:
$e_u = \ln(1 + e_u) = \ln(1 + 0.11) = 0.10$
$s_u = s_u * (1 + e_u) = 483 * (1 + 0.11) = 536$ *MPa*

<u>400 °F (204 °C) 516 CS</u>
$e_u = \ln(1 + e_u) = \ln(1 + 0.11) = 0.10$
$s_u = s_u * (1 + e_u) = 483 * (1 + 0.11) = 536$ *MPa*

<u>600 °F (316 °C) 516 CS</u>
$e_u = \ln(1 + e_u) = \ln(1 + 0.11) = 0.10$
$s_u = s_u * (1 + e_u) = 483 * (1 + 0.11) = 536$ *MPa*

For 304 SS at room temperature, $e_u = 0.75 * elongation = 0.30$, therefore:
$e_u = \ln(1 + e_u) = \ln(1 + 0.30) = 0.26$
$s_u = s_u * (1 + e_u) = 517 * (1 + 0.30) = 672$ *MPa*

<u>400 °F (204 °C) 304 SS</u>
$e_u = \ln(1 + e_u) = \ln(1 + 0.30) = 0.26$
$s_u = s_u * (1 + e_u) = 441 * (1 + 0.30) = 573$ *MPa*

600 °F (316 °C) 304 SS
$e_u = \ln(1 + e_u) = \ln(1 + 0.30) = 0.26$
$s_u = s_u * (1 + e_u) = 437 * (1 + 0.30) = 568\ MPa$

5.2.3 Calculations for Tangent Moduli

As previously discussed, the results of this simulation are required to include elastic and plastic deformations for Alloy 22, 516 CS, and 316NG SS. When the materials are driven into the plastic range, the slope of stress-strain curve continuously changes. Thus, a simplification for this curve is needed to incorporate plasticity into the FER. A standard approximation commonly used in engineering is to use a straight line that connects the yield point and the tensile strength point of the material. The parameters used in the subsequent calculations in addition to those defined in Section 5.2.2 are modulus of elasticity (E) and tangent modulus (E_1). The tangent (hardening) modulus represents the slope of the stress-strain curve in the plastic region.

In the case of Alloy 22, the strain corresponding to the yield strength is:

$e_{y,rt} = s_y/E = 310 * 10^6 / 206 * 10^9 = 0.0015$ (see Section 5.2.1)

Hence, the tangent modulus at room temperature is:

$E_{1,rt} = (s_{u,rt} - s_{y,rt}) / (e_{u,rt} - e_{y,rt}) = (0.973 – 0.310)/(0.34 – 0.0015) = 2.0\ GPa$ (see Section 5.2, 5.2.1, and 5.2.2)

For Alloy 22 at 400 °F (204 °C)
$E_{1,400°F} = (s_{u,400°F} - s_{y,400°F}) / (e_{u,400°F} - s_{y,400°F}/E_{400°F}) = (0.926 – 0.236)/(0.34 – 236/196e3) = 2.0\ GPa$ (see Section 5.2, 5.2.1, and 5.2.2)

For Alloy 22 at 600 °F (316 °C, ASME values)
$E_{1,600°F} = (s_{u,600°F} - s_{y,600°F}) / (e_{u,600°F} - s_{y,600°F}/E_{600°F}) = (0.885 – 0.211)/(0.34 – 211/190e3) = 2.0\ GPa$ (see Section 5.2, 5.2.1, and 5.2.2)

For Alloy 22 at 600 °F (316 °C, vendor data)
$E_{1,600°F} = (s_{u,600°F} - s_{y,600°F}) / (e_{u,600°F} - s_{y,600°F}/E_{600°F}) = (0.911 – 0.211)/(0.37 – 211/190e3) = 1.9\ GPa$ (see Section 5.2, 5.2.1, and 5.2.2)

Similarly, for 316NG SS at room temperature:

$E_{1,rt} = (s_{u,rt} - s_{y,rt}) / (e_{u,rt} - s_{y,rt}/E_{rt}) = (0.703 – 0.207)/(0.31 – 207/195e3) = 1.6\ GPa$ (see Section 5.2, 5.2.1, and 5.2.2)

For 316NG SS at 400 °F (204 °C)
$E_{1,400°F} = (s_{u,400°F} - s_{y,400°F}) / (e_{u,400°F} - s_{y,400°F}/E_{400°F}) = (0.675 – 0.148)/(0.31 – 148/183e3) = 1.7\ GPa$ (see Section 5.2, 5.2.1, and 5.2.2)

<u>For 316NG SS at 600 °F (316 °C, ASME values)</u>
$E_{1,600°F} = (s_{u,600°F} - s_{y,600°F}) / (e_{u,600°F} - s_{y,600°F}/E_{600°F}) = (0.673 – 0.130)/(0.31 – 130/174e3) = 1.8$ *GPa* (see Section 5.2, 5.2.1, and 5.2.2)

<u>For 316NG SS at 600 °F (316 °C, vendor data)</u>
$E_{1,600°F} = (s_{u,600°F} - s_{y,600°F}) / (e_{u,600°F} - s_{y,600°F}/E_{600°F}) = (0.619 – 0.130)/(0.22 – 130/174e3) = 2.2$ *GPa* (see Section 5.2, 5.2.1, and 5.2.2)

Tangent Modulus of 516 CS at room temperature:

$E_{1,rt} = (s_{u,rt} - s_{y,rt}) / (e_{u,rt} - \sigma_{y,rt}/E_{rt}) = (0.536 – 0.262)/(0.10 – 262/203e3) = 2.8$ *GPa* (see Section 5.2, 5.2.1, and 5.2.2)

<u>516 CS at 400 °F (204 °C)</u>
$E_{1,400°F} = (s_{u,400°F} - s_{y,400°F}) / (e_{u,400°F} - s_{y,400°F}/E_{400°F}) = (0.536 – 0.224)/(0.10 – 224/191e3) = 3.2$ *GPa* (see Section 5.2, 5.2.1, and 5.2.2)

<u>516 CS at 600 °F (316 °C)</u>
$E_{1,600°F} = (s_{u,600°F} - s_{y,600°F}) / (e_{u,600°F} - s_{y,600°F}/E_{600°F}) = (0.536 – 0.201)/(0.10 – 201/184e3) = 3.4$ *GPa* (see Section 5.2, 5.2.1, and 5.2.2)

Tangent Modulus of 304 SS at room temperature:

$E_{1,rt} = (s_{u,rt} - s_{y,rt}) / (e_{u,rt} - \sigma_{y,rt}/E_{rt}) = (0.672 – 0.207)/(0.26 – 207/195e3) = 1.8$ *GPa* (see Section 5.2, 5.2.1, and 5.2.2)

<u>304 SS at 400 °F (204 °C)</u>
$E_{1,400°F} = (s_{u,400°F} - s_{y,400°F}) / (e_{u,400°F} - s_{y,400°F}/E_{400°F}) = (0.573 – 0.143)/(0.26 – 143/183e3) = 1.7$ *GPa* (see Section 5.2, 5.2.1, and 5.2.2)

<u>304 SS at 600 °F (316 °C)</u>
$E_{1,600°F} = (s_{u,600°F} - s_{y,600°F}) / (e_{u,600°F} - s_{y,600°F}/E_{600°F}) = (0.568 – 0.127)/(0.26 – 127/174e3) = 1.7$ *GPa* (see Section 5.2, 5.2.1, and 5.2.2)

5.3 INITIAL VELOCITY OF WASTE PACKAGE

To reduce the computer execution time while preserving all features of the problem relevant to the structural calculation, the WP is set in a position just before impact and given an appropriate initial velocity, as can be seen in Figure 1.

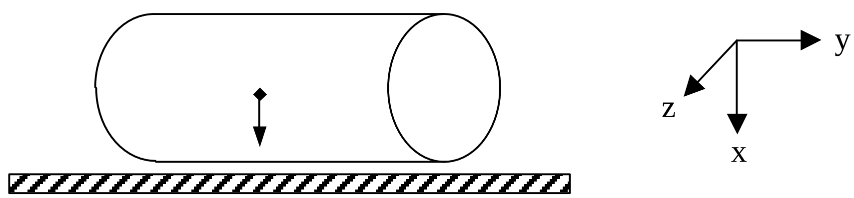

Figure 1. Horizontal Drop Geometry

Using the following parameters:

g ≡ acceleration due to gravity = 9.81 m/s^2
S ≡ Drop Height = 2.4 *m* (Ref. 1)

and Newton's equation of motion:

$V^2 = V_o^2 + 2a(S - S_o)$

Substituting values in yields

$V^2 = 0^2 + 2*(9.81\ m/s^2)*(2.4\ m)$, which reduces to

$V = 6.86\ m/s$

5.4 FINITE ELEMENT REPRESENTATION

A full three-dimensional (3-D) FER of the WP was developed in ANSYS V5.4 using the dimensions provided in Attachment I. The FER was created with a radial gap of 5 *mm* between the inner and outer shells. The same gap was used between the internals and the inner shell. The initial orientation of the inner shell maintains a 5 *mm* gap around the circumference of the shell.

The internal structure of the WP was simplified. The fuel assemblies of the IS were represented using solid elements as 21 separate rectangles. The thermal shunts, fuel tubes, and dividing plates were omitted. The spent fuel density was increased to account for the missing mass. But, the sideguides, conerguides, and stiffeners were included (Assumption 3.5). This method of representing the contact between the internals and the IS is more accurate than previously used in Revision 00.

The target surface was conservatively assumed to be unyielding (Assumption 3.7). This was accomplished using the *RIGIDWALL command within LS-DYNA. This command creates an invisible rigid wall within LS-DYNA. All nodes are slaves to the RIGIDWALL, and the RIGIDWALL is immovable.

The mesh of the FER was appropriately generated and refined in the contact region according to standard engineering practice. Thus, the accuracy of the results of this calculation is deemed acceptable.

The initial drop height of the WP was reduced to 0.01 m before impact and the WP was given an initial velocity equal to 6.86 m/s (see Section 5.3).

The FER was then used in LS-DYNA V950.C to perform the transient dynamic analysis for the 21-PWR Waste Package horizontal drop.

6. RESULTS

This document may be affected by technical product input information that requires confirmation. Any changes to the document that may occur as a result of completing the confirmation activities will be reflected in subsequent revisions. The status of the technical product input information quality may be confirmed by review of the DIRS database.

Attachment II includes the input files and results files that show execution of the programs occurred correctly. The stresses were reported via plots that have been made interactively using the postprocessor LSPOST. The stresses were recorded every 0.001 seconds after impact. The stresses in all components peaked between 0.004 and 0.017 seconds. However, the solution was allowed to reach 0.021 seconds to ensure that all stresses had climaxed.

The results file, d3hsp (Attachment II), lists the calculated masses used by LS-DYNA. The sum of the masses of the WP equals 42,550 *kg*, with the mass of the loaded WP 41,598 *kg* from Section 5.1. The percent difference in mass would then be ~ 2.3%. However, this difference is on the positive side, and thus considered to be conservative and negligible.

The following pages contain figures that show various parts at states of maximum stress. These start on the next page with Figure 2, which shows the maximum stress in the lower trunnion collar at room temperature.

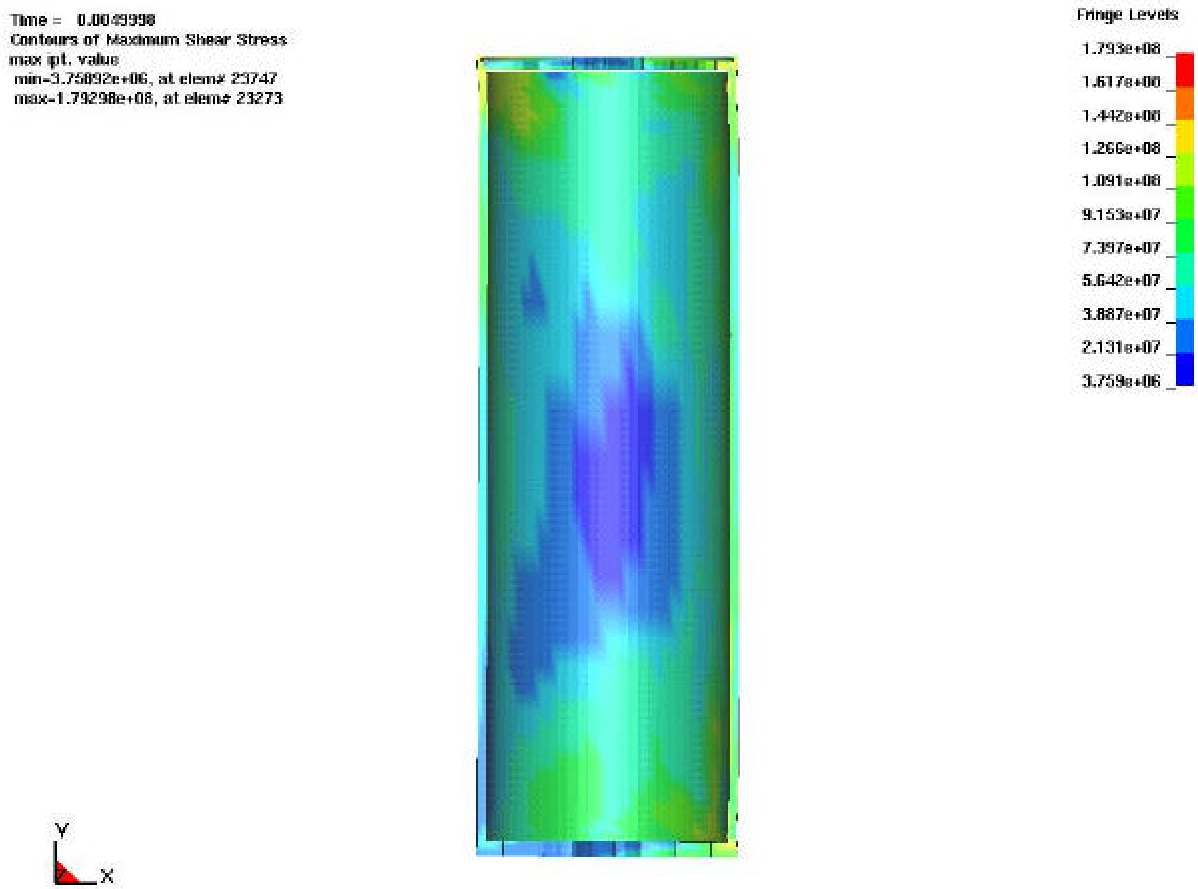

Figure 2. Inner Shell Stresses at Room Temperature

All of the stresses that are reported in the legends of the plots are Tresca Stresses or Maximum Shear Stresses. The units are Pascals. Figure 2 shows that the maximum stress intensity in the IS is 359 MPa at 0.005 seconds.

Figure 3 may be found on the next page. It shows the maximum stress in the same part, but at 400 degrees Fahrenheit.

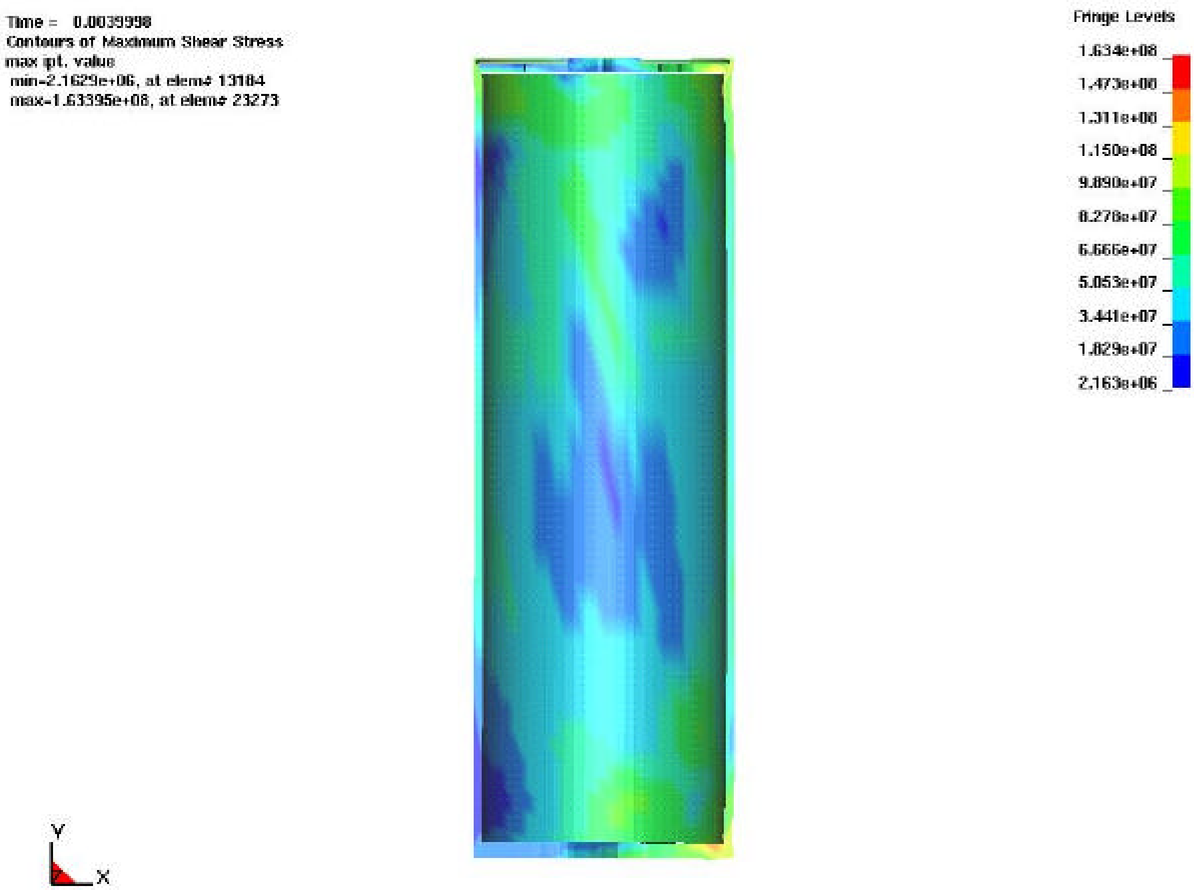

Figure 3. Inner Shell Stresses at 400 °F

Figure 3 shows that the maximum stress intensity in the IS is 327 MPa at 0.004 seconds. This is slightly lower than the room temperature value, which is to be expected.

Figure 4 may be found on the next page. It shows the maximum stress in the same part, but at 600 degrees Fahrenheit.

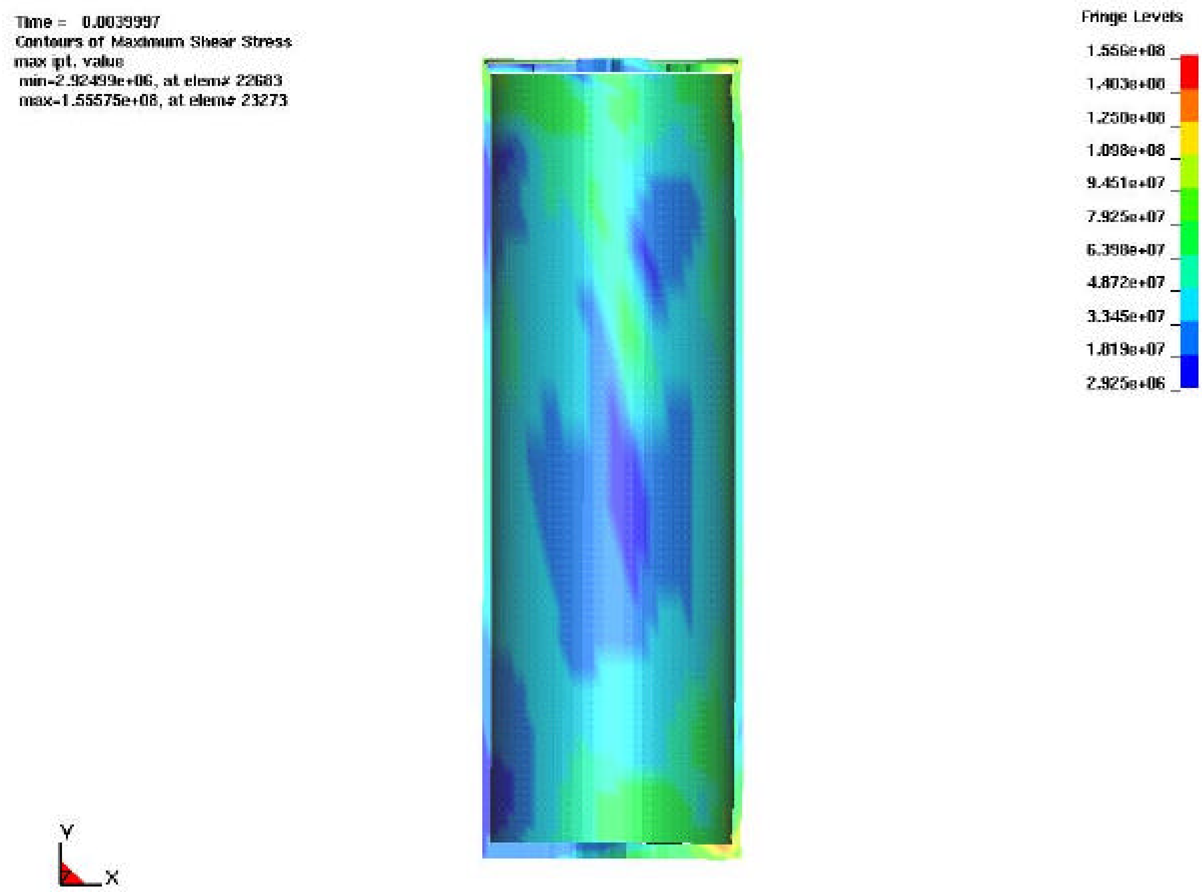

Figure 4. Inner Shell Stresses at 600 °F

Figure 4 shows that the maximum stress intensity in the IS is 311 MPa at 0.004 seconds. This is slightly lower than the 400 °F value, which is to be expected.

Figure 5 may be found on the next page. It shows the maximum stress in the Inner Shell at 600 degrees Fahrenheit, but using vendor data for the elongation values.

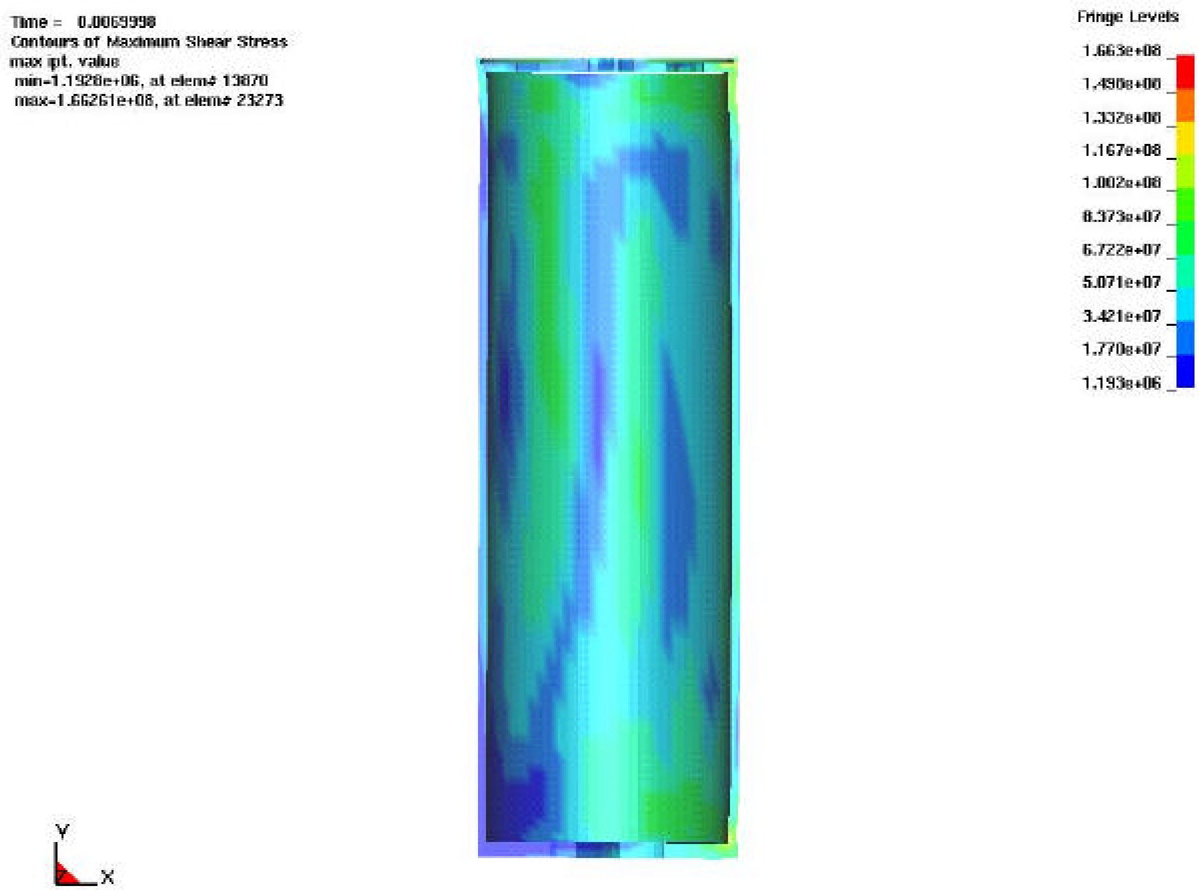

Figure 5. Inner Shell Stresses at 600 °F Using Vendor Elongation Values

Figure 5 shows that the maximum stress intensity in the IS is 333 MPa at 0.007 seconds. This is slightly higher than that shown in Figure 4, which is to be expected due to the elongation values of 316NG SS at elevated temperatures.

Figure 6 may be found on the next page. It shows the maximum stress in the outer shell at room temperature.

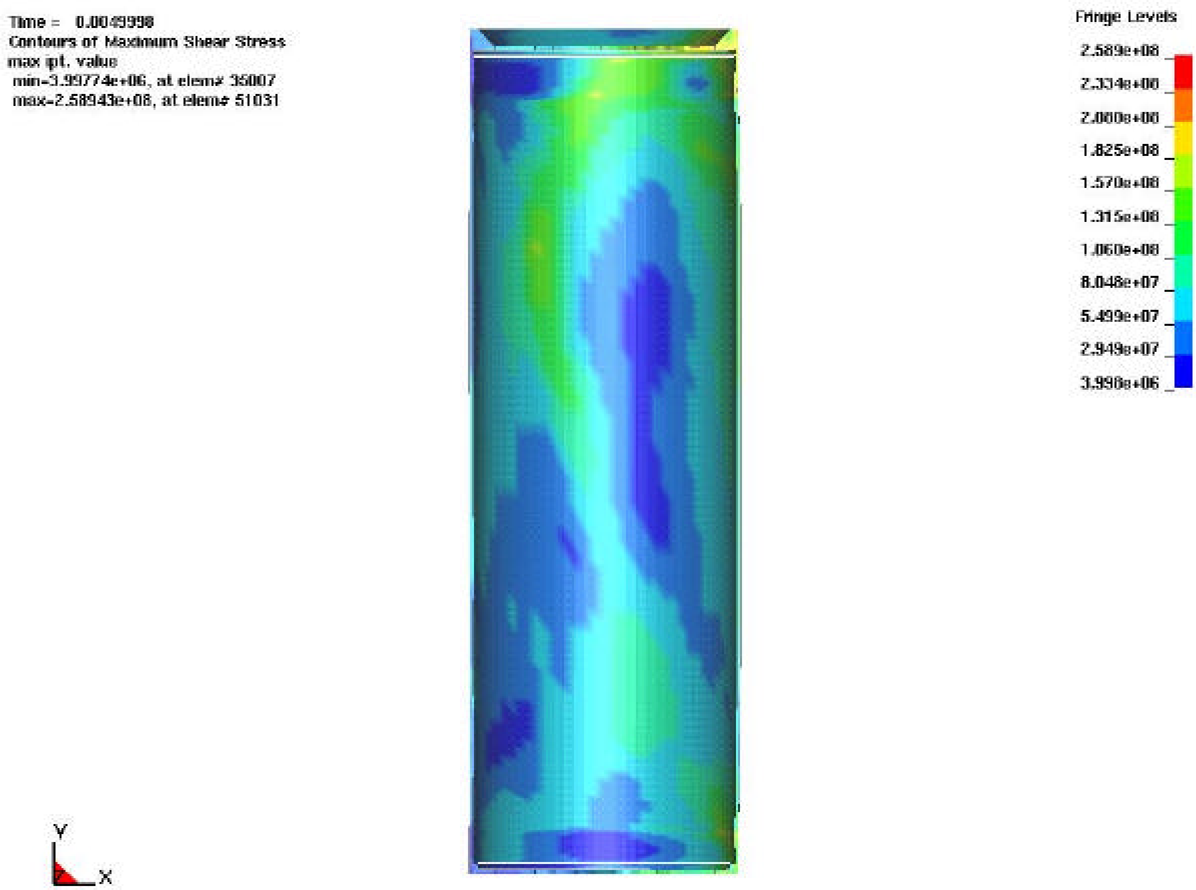

Figure 6. Outer Shell Maximum Stresses at Room Temperature

Figure 6 shows that the maximum stress intensity in the OS is 518 MPa at 0.005 seconds.

Figure 7 may be found on the next page. It shows the maximum stress in the same part, but at 400 degrees Fahrenheit.

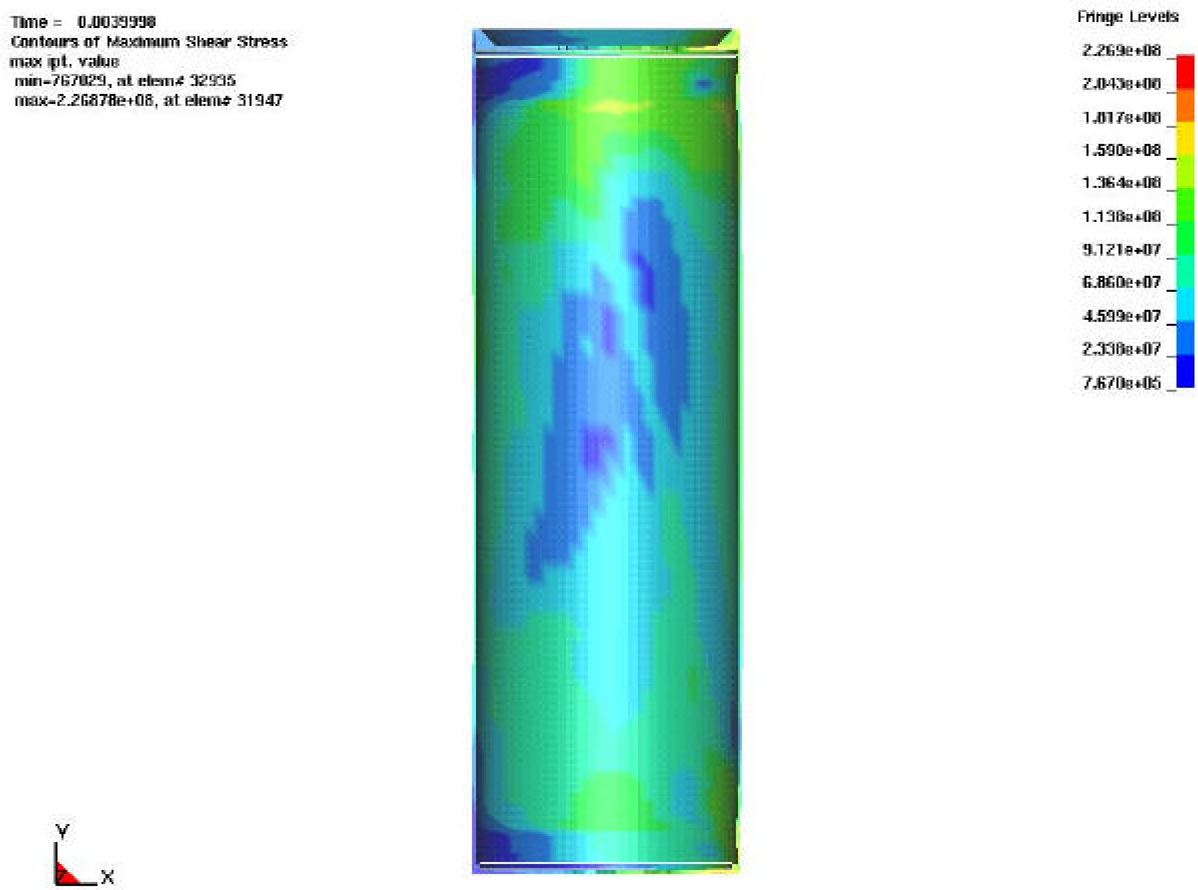

Figure 7. Outer Shell Maximum Stresses at 400 °F

Figure 7 shows that the maximum stress intensity in the OS is 454 MPa at 0.004 seconds. This is slightly lower than the 400 °F value, which is to be expected.

Figure 8 may be found on the next page. It shows the maximum stress in the OS at 600 degrees Fahrenheit.

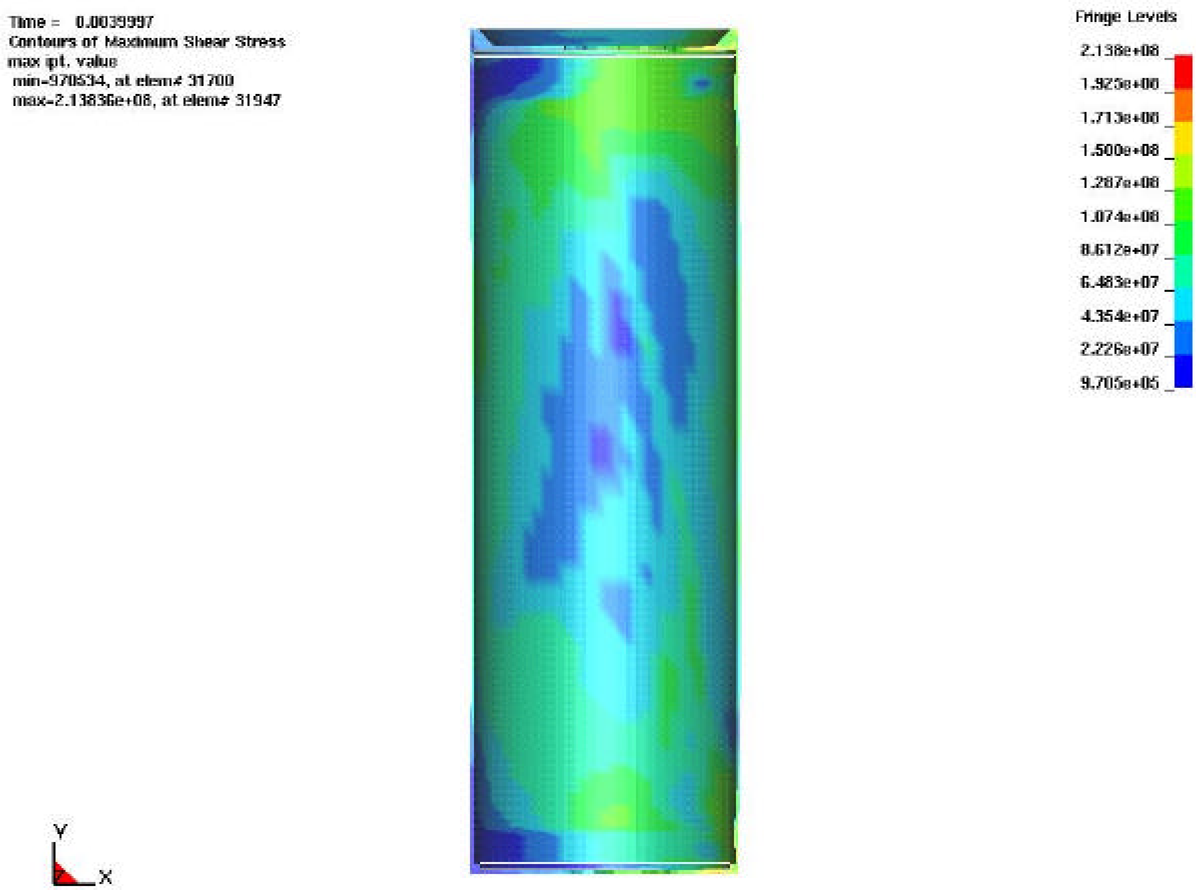

Figure 8. Outer Shell Maximum Stresses at 600 °F

Figure 8 shows that the maximum stress intensity in the OS is 428 MPa at 0.004 seconds. This is slightly lower than the 400 °F value, which is expected.

Figure 9 may be found on the next page. It shows the maximum stress in the same part and at the same temperature, but using vendor data for the elongation values.

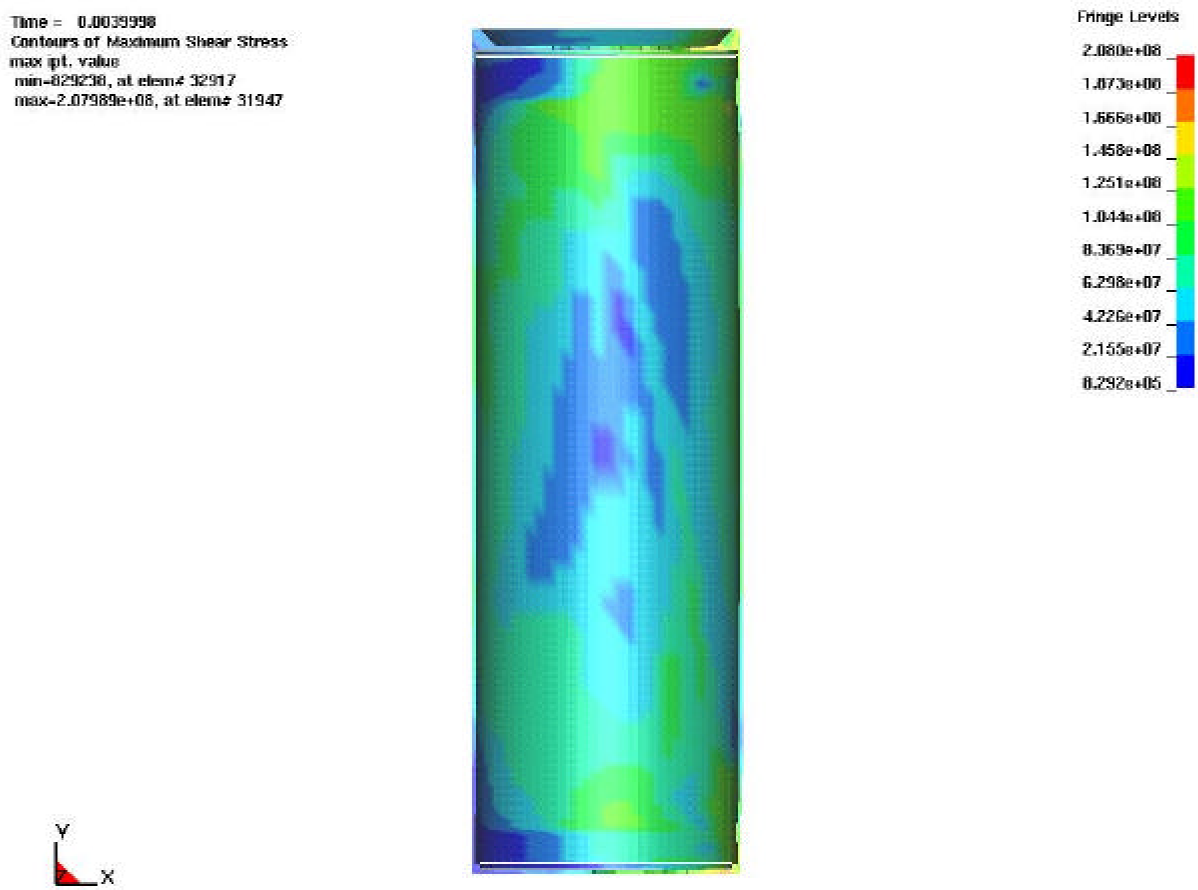

Figure 9. Outer Shell Maximum Stresses at 600 °F Using Vendor Elongation

Figure 9 shows that the maximum stress intensity in the OS is 416 MPa at 0.004 seconds. This is slightly higher than shown in Figure 8, which is to be expected due to Alloy 22 elongation properties at elevated temperatures.

Figure 10 may be found on the next page. It shows the maximum stress in the Shear Ring at room temperature.

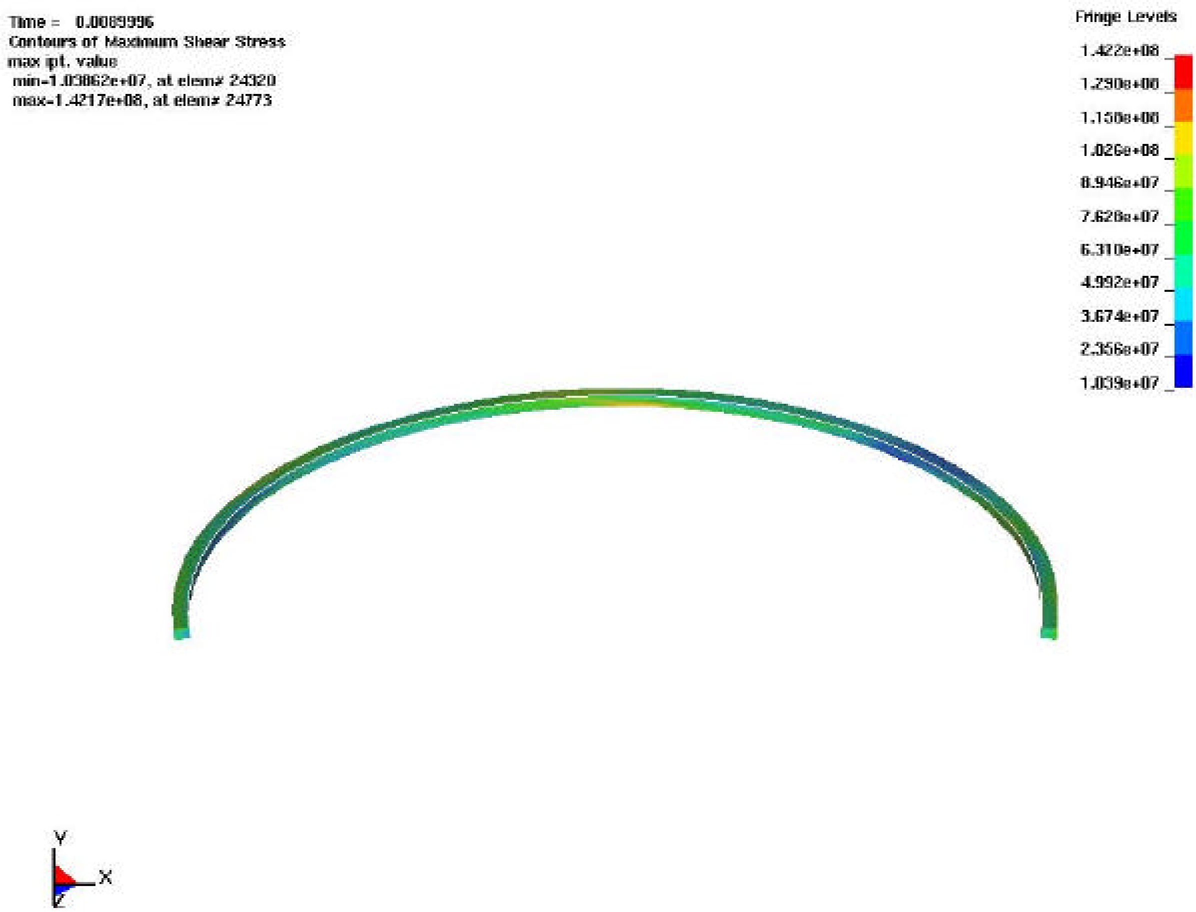

Figure 10. Shear Ring Maximum Stresses at Room Temperature

Figure 10 shows that the maximum stress intensity in the Shear Ring is 284 MPa at 0.009 seconds.

Figure 11 may be found on the next page. It shows the maximum stress in the Shear Ring at 400 degrees Fahrenheit.

Figure 11. Shear Ring Maximum Stresses at 400 °F

Figure 11 shows that the maximum stress intensity in the Shear Ring is 211 MPa at 0.010 seconds. This is lower than the room temperature value, which is to be expected.

Figure 12 may be found on the next page. It shows the maximum stress in the Shear Ring at 600 degrees Fahrenheit.

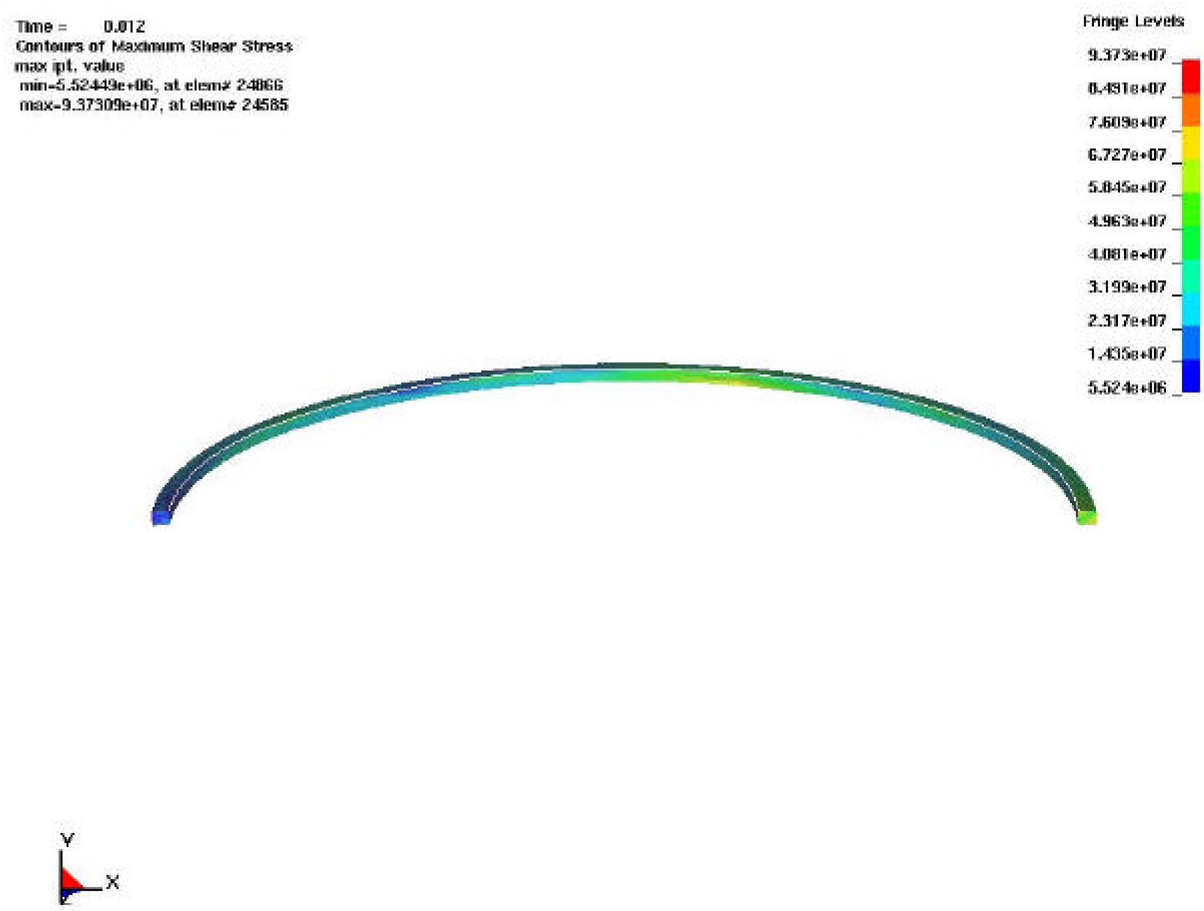

Figure 12. Shear Ring Maximum Stresses at 600 °F

Figure 12 shows that the maximum stress intensity in the Shear Ring is 187 MPa at 0.012 seconds. This is slightly higher than the 400 °F value, which is to be expected.

Figure 13 may be found on the next page. It shows the maximum stress in the Shear Ring at the same temperature, but using vendor data elongation values.

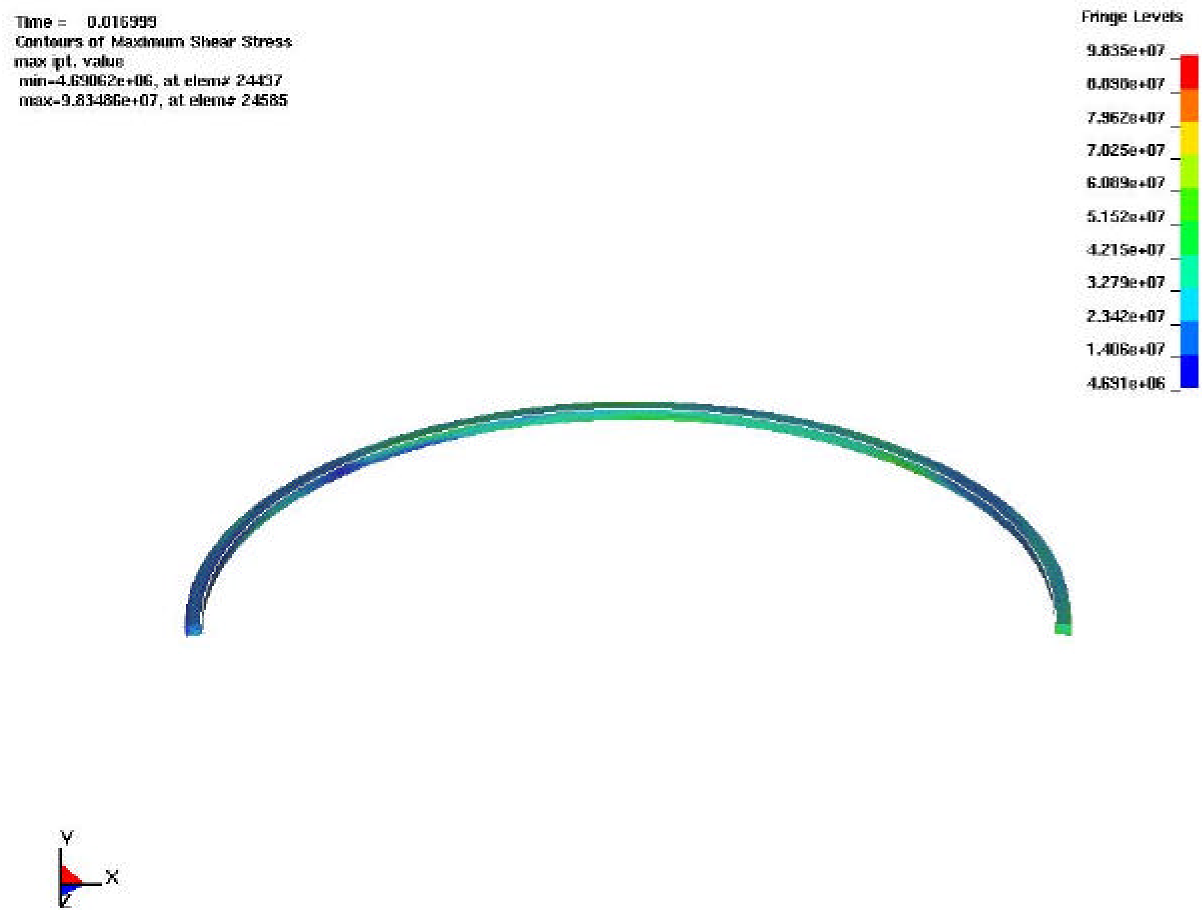

Figure 13. Shear Ring Maximum Stresses at 600 °F Using Vendor Elongation

Figure 13 shows that the maximum stress intensity in the Shear Ring is 197 MPa at 0.017 seconds. This is slightly higher than that shown in Figure 12, which is expected due to 316NG SS elongation properties at elevated temperatures.

Table 6-1 summarizes the maximum Stress Intensities, sorted by Part, Temperature, and Elongation Value per Load Case.

Table 6-1. Maximum Stress Intensity by Load Case

Part	Temperature	Elongation Value	Max Stress Intensity	S_{int} / $S_{allowable}$
Inner Shell	70 °F	ASME	359 MPa	0.567
Outer Shell	70 °F	ASME	518 MPa	0.592
Shear Ring	70 °F	ASME	284 MPa	0.449
Inner Shell	400 °F	ASME	327 MPa	0.538
Outer Shell	400 °F	ASME	454 MPa	0.545
Shear Ring	400 °F	ASME	211 MPa	0.347
Inner Shell	600 °F	ASME	311 MPa	0.513
Outer Shell	600 °F	ASME	428 MPa	0.537
Shear Ring	600 °F	ASME	187 MPa	0.309
Inner Shell	600 °F	ASME - 30%	333 MPa	0.598
Outer Shell	600 °F	ASME + 10%	416 MPa	0.507
Shear Ring	600 °F	ASME - 30%	197 MPa	0.354

Note: $S_{allowable}$ is equal to 90% of σ_u.

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8. ATTACHMENTS

Attachment I (25 pages): Design sketch (*21-PWR Waste Package Concept for License Application* [SK-0219 REV 01, 25 sheets])

Attachment II (on compact disc): contains electronic files (see Table 8-1 for a complete list). The *.k files are input files for LS-DYNA at the three temperatures and they call the *.inc files. The d3hsp files are the LS-DYNA output files at the three temperatures.

Table 8-1 provides a list of attachments submitted in the form of electronic files (compact disc) in Attachment II.

Table 8-1. List of Attachments Submitted in the Form of Electronic Files in Attachment II

Description	Date	Time	Size
d3hspt1	01/31/2001	1:44 pm	26,341 KB
d3hspt2	01/31/2001	1:49 pm	26,332 KB
d3hspt3	01/31/2001	1:51 pm	26,327 KB
d3hspt3v	01/31/2001	1:47 pm	26,327 KB
elist.inc	01/31/2001	1:44 pm	5,439 KB
hdsr.inp	01/31/2001	1:45 pm	37 KB
hdt1.k	01/31/2001	1:44 pm	3 KB
hdt2.k	01/31/2001	1:49 pm	3 KB
hdt3.k	01/31/2001	1:51 pm	3 KB
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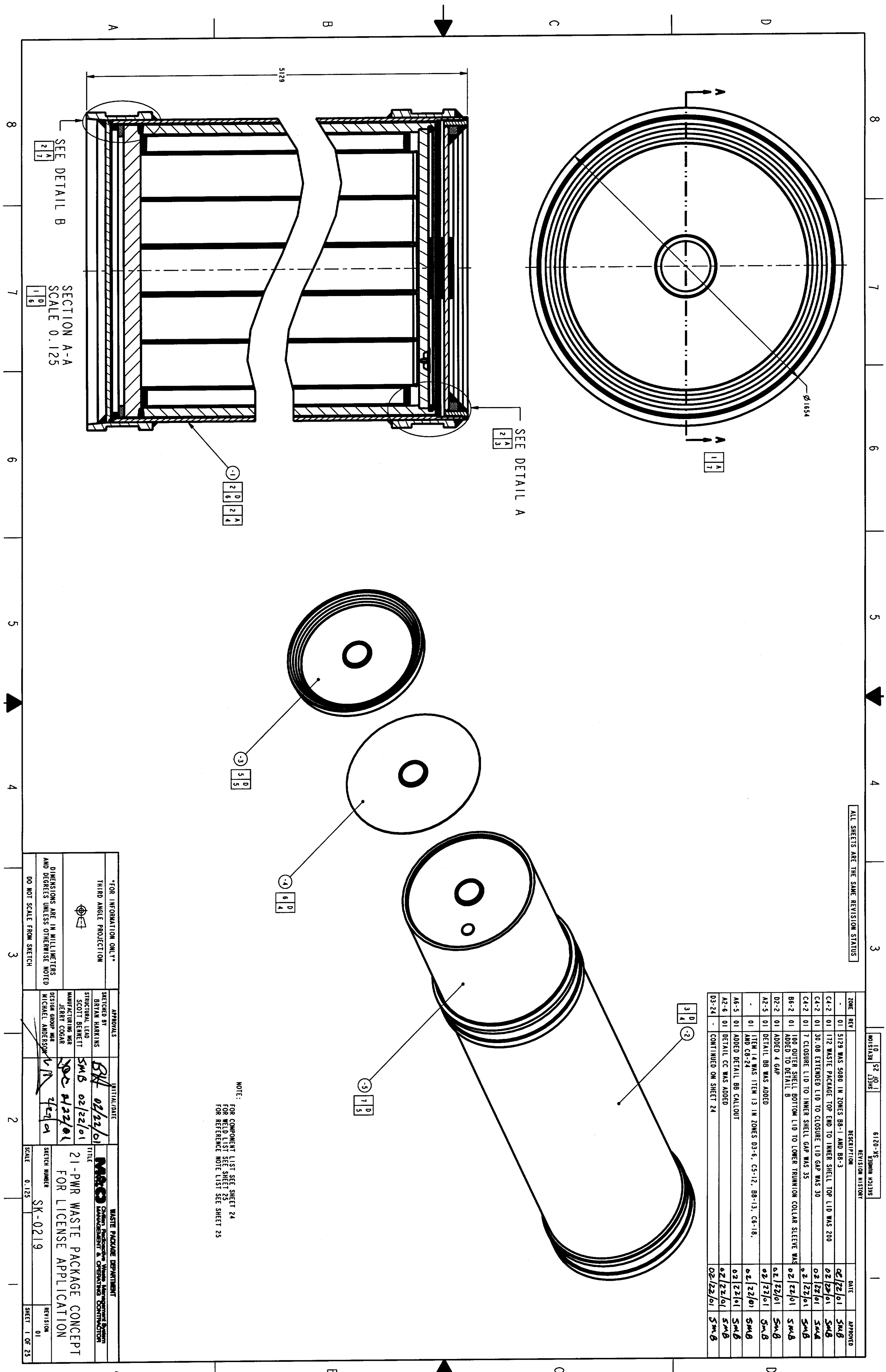
NOTE: The file sizes may vary with operating system.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C4-2 | 01 | 172 WASTE PACKAGE TOP END TO INNER SHELL TOP LID WAS 200 | 02/22/01 | SMB
C4-2 | 01 | 30.08 EXTENDED LID TO CLOSURE LID GAP WAS 30 | 02/22/01 | SMB
C4-2 | 01 | 7 CLOSURE LID TO INNER SHELL GAP WAS 35 | 02/22/01 | SMB
B6-2 | 01 | 100 OUTER SHELL BOTTOM LID TO LOWER TRUNNION COLLAR SLEEVE WAS ADDED TO DETAIL B | 02/22/01 | SMB
D2-2 | 01 | ADDED 4 GAP | 02/22/01 | SMB
A2-5 | 01 | DETAIL BB WAS ADDED | 02/22/01 | SMB
- | 01 | ITEM 14 WAS ITEM 13 IN ZONES D3-6, C5-12, B8-13, C6-18, AND C8-24 | 02/22/01 | SMB
A6-5 | 01 | ADDED DETAIL BB CALLOUT | 02/22/01 | SMB
A2-6 | 01 | DETAIL CC WAS ADDED | 02/22/01 | SMB
D3-24 | - | CONTINUED ON SHEET 24 | 02/22/01 | SMB
NOTE:
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FOR WELD LIST SEE SHEET 25
FOR REFERENCE NOTE LIST SEE SHEET 25
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SEE DETAIL B
SECTION A-A
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DIMENSIONS ARE IN MILLIMETERS AND DEGREES UNLESS OTHERWISE NOTED
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APPROVALS | INITIAL/DATE
SKETCHED BY BRYAN HARKINS | 02/22/01
STRUCTURAL LEAD SCOTT BENNETT | SMB 02/22/01
MANUFACTURING MGR JERRY COGAR | 02/22/01
DESIGN GROUP MGR MICHAEL ANDERSON | 2/22/01
WASTE PACKAGE DEPARTMENT
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR
TITLE
21-PWR WASTE PACKAGE CONCEPT FOR LICENSE APPLICATION
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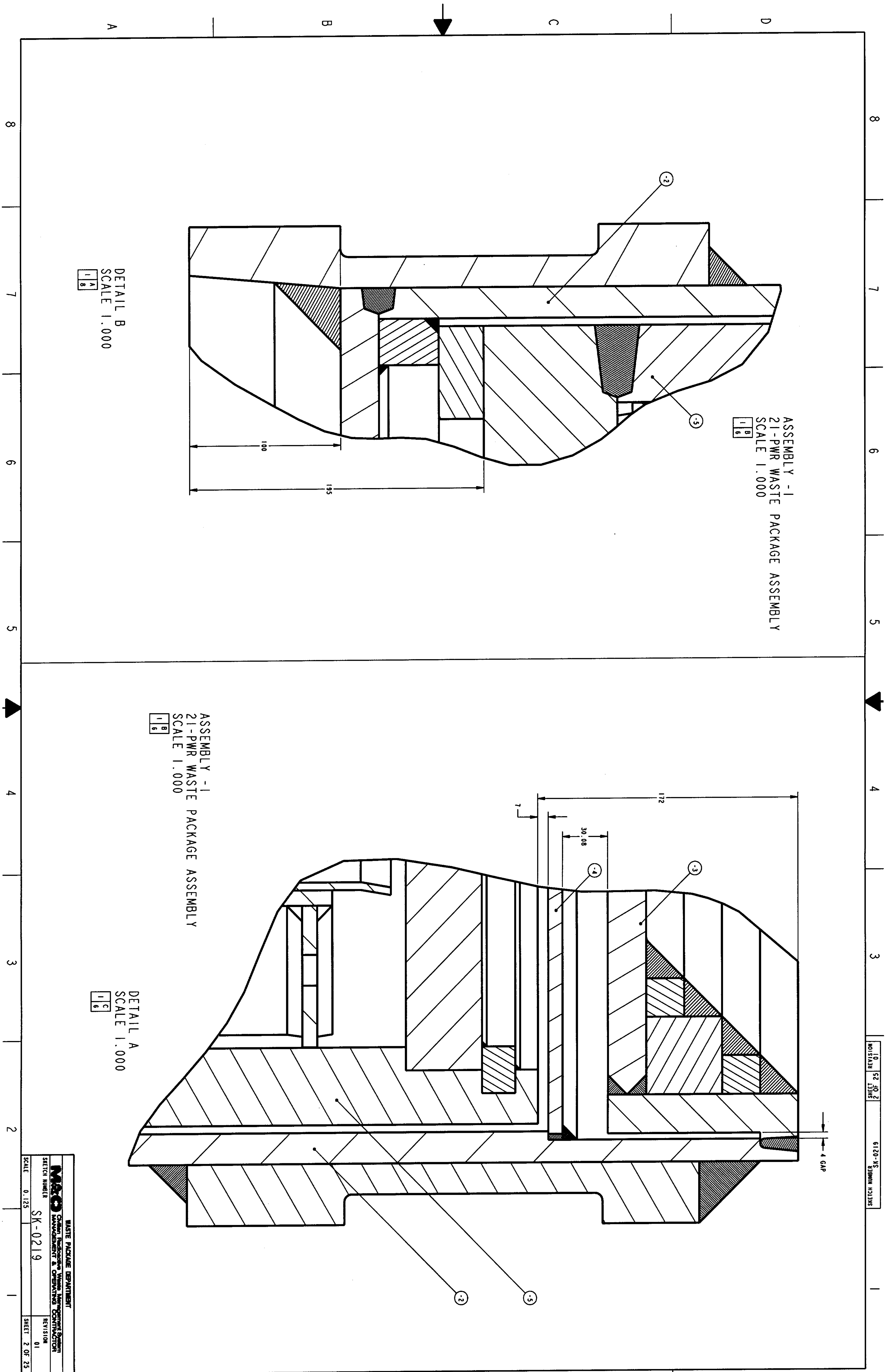
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M&O
MANAGEMENT & OPERATING CONTRACTOR
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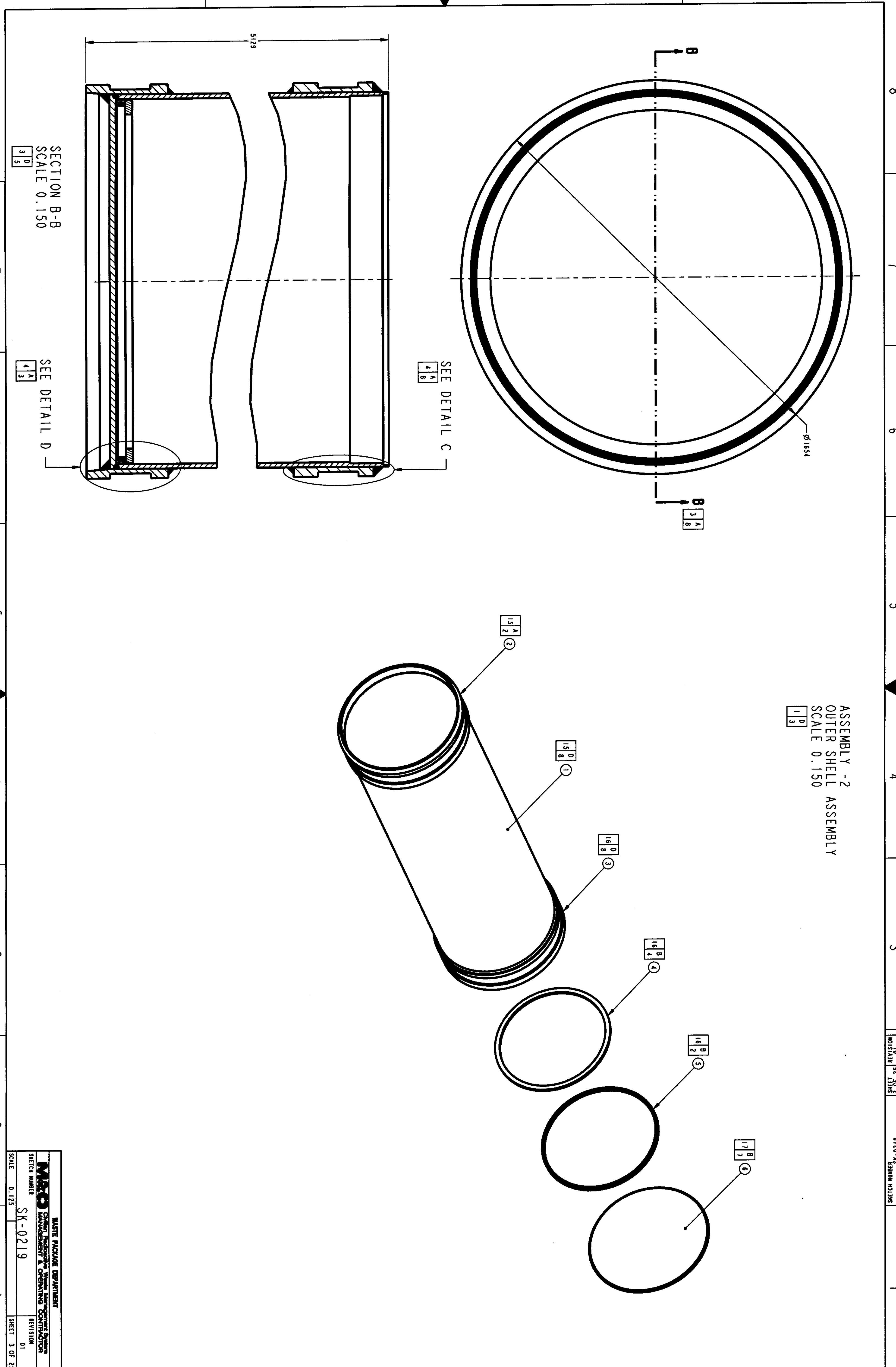
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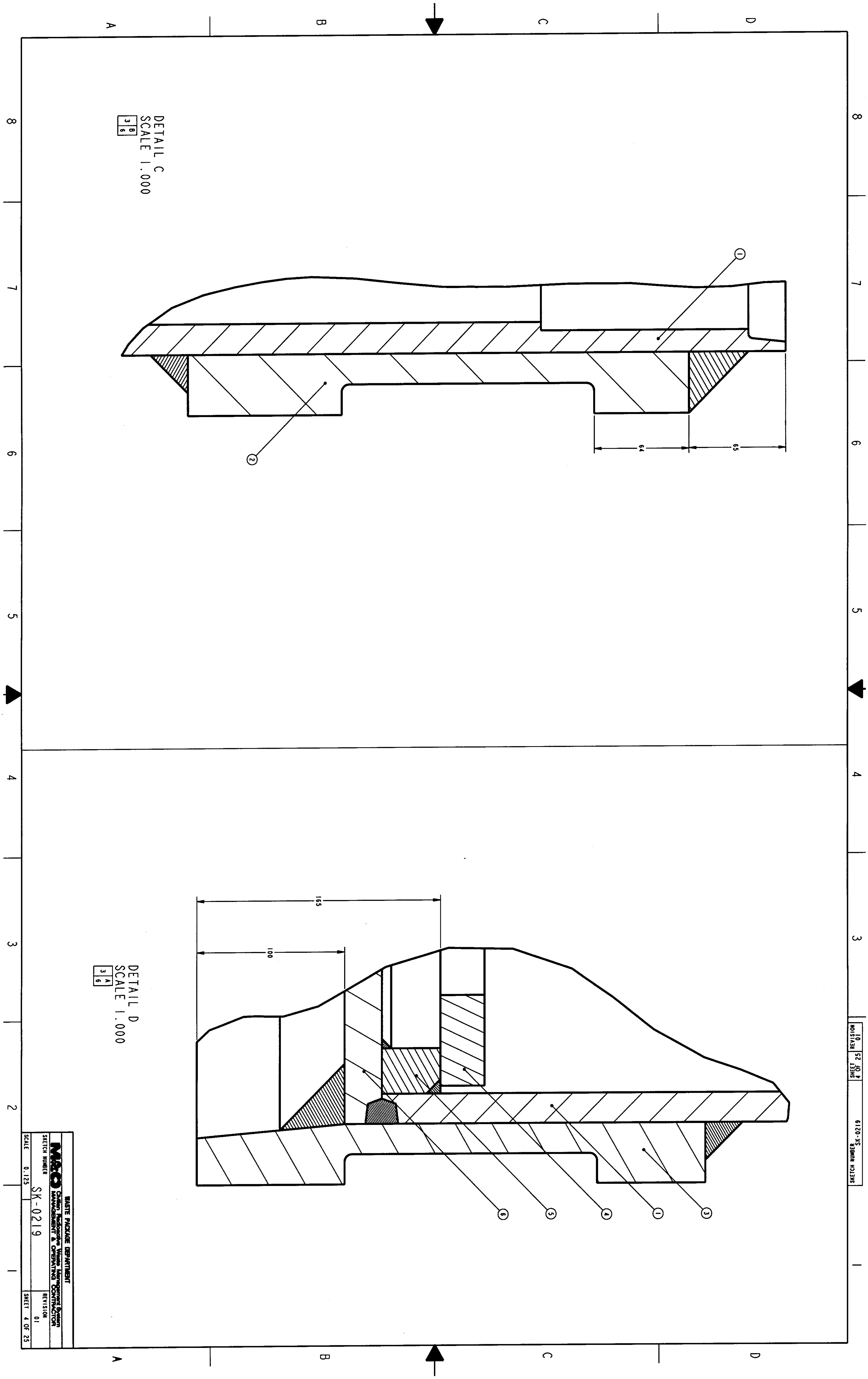
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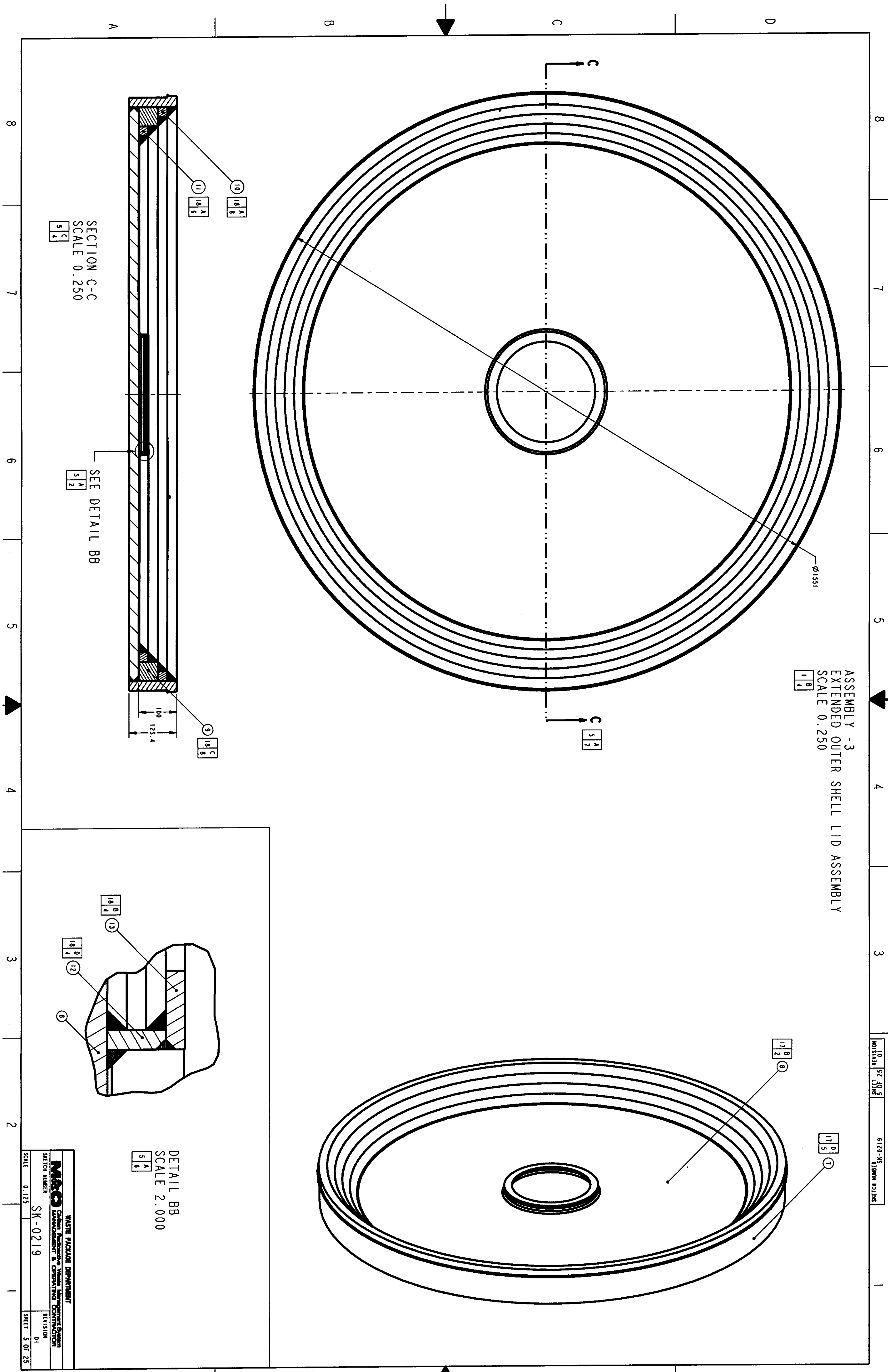
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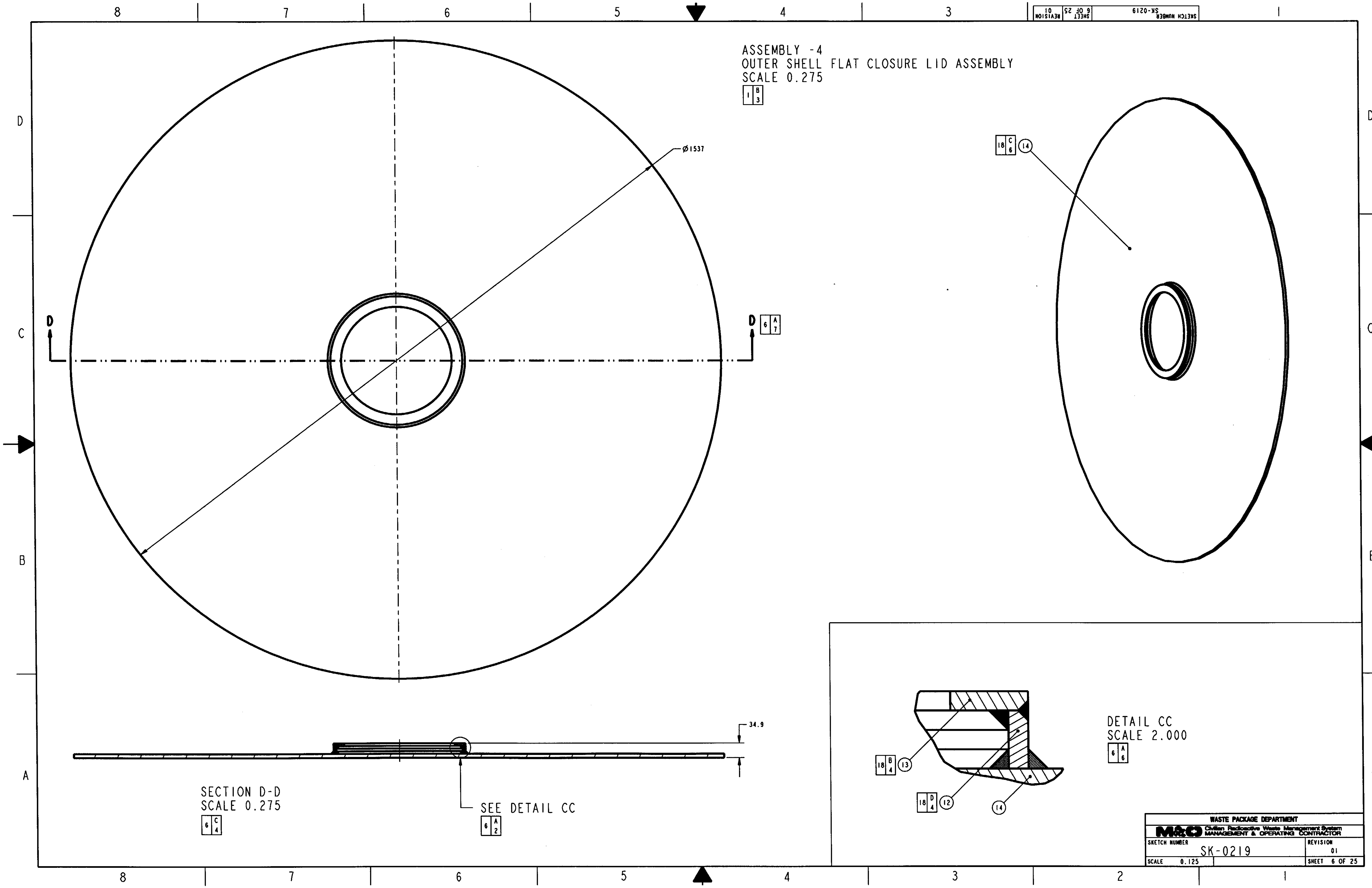
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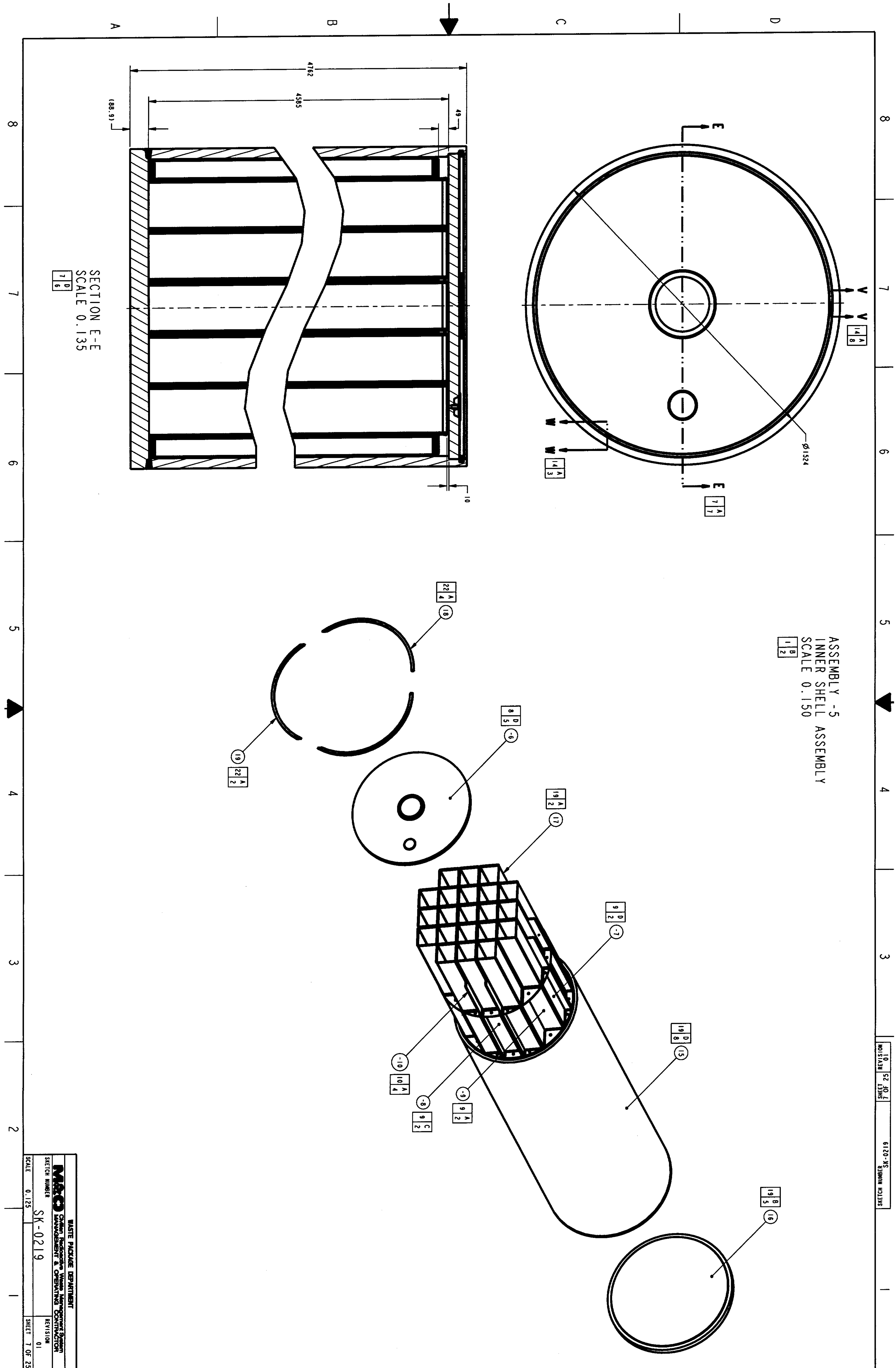
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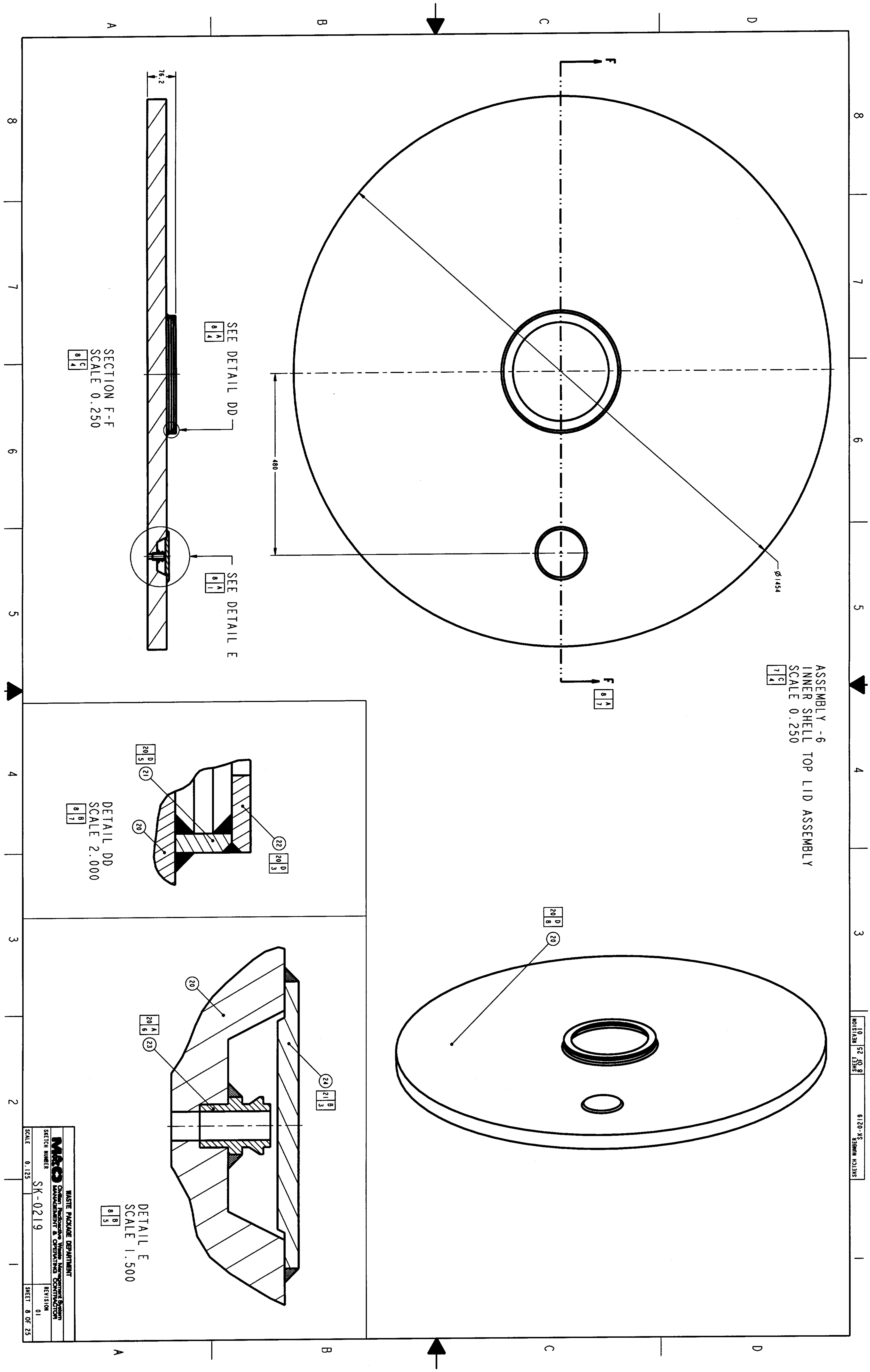
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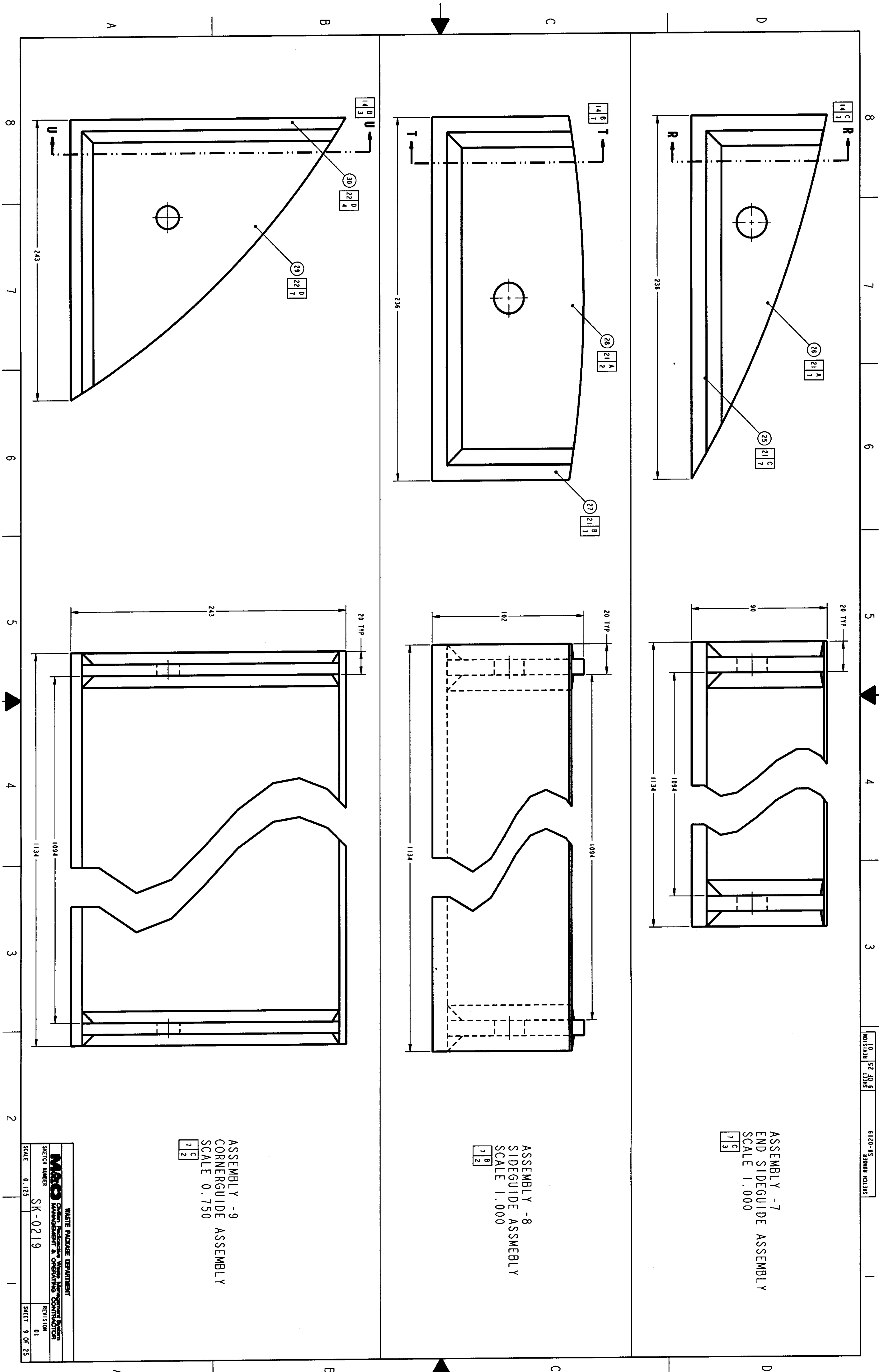
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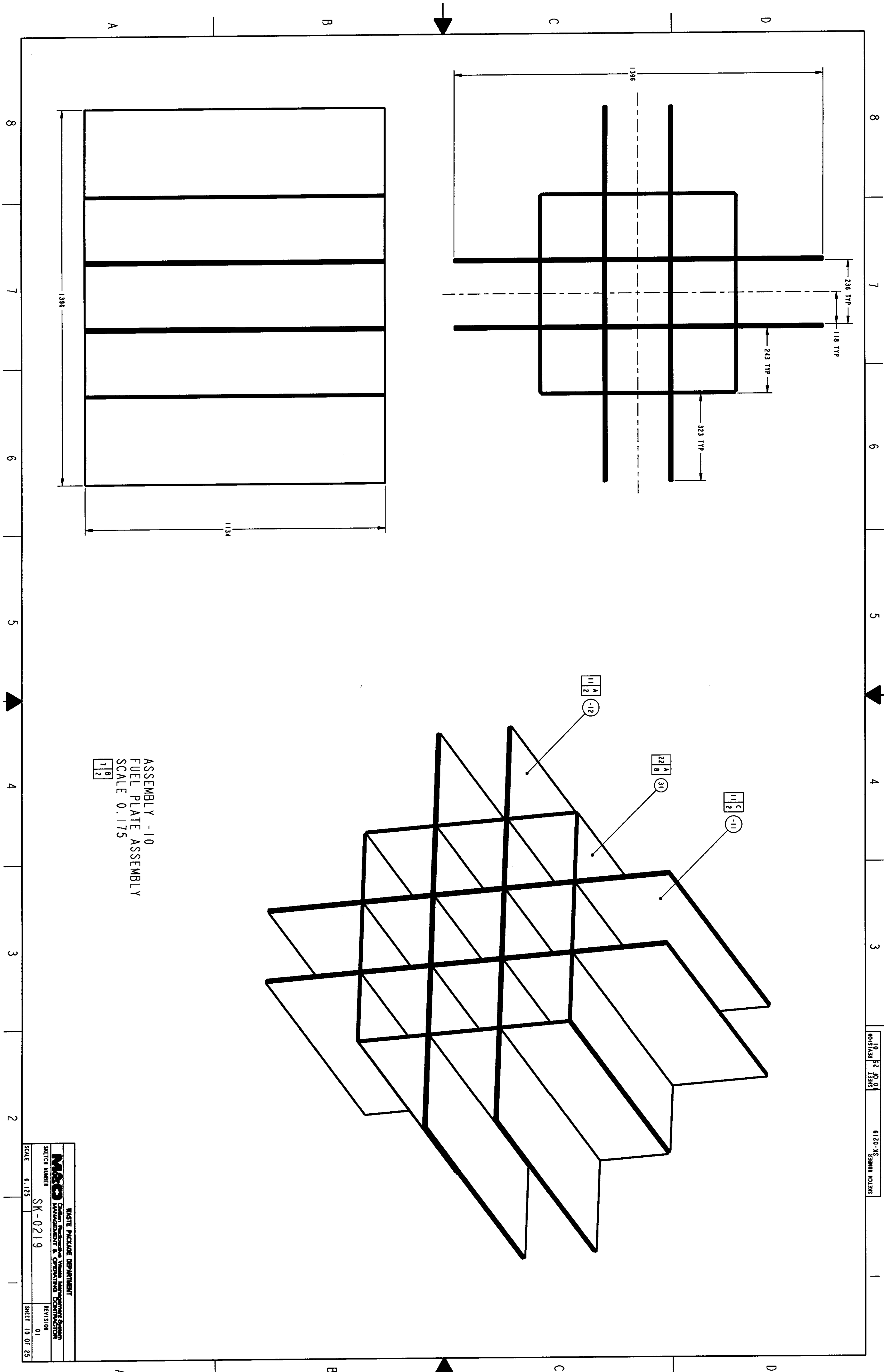
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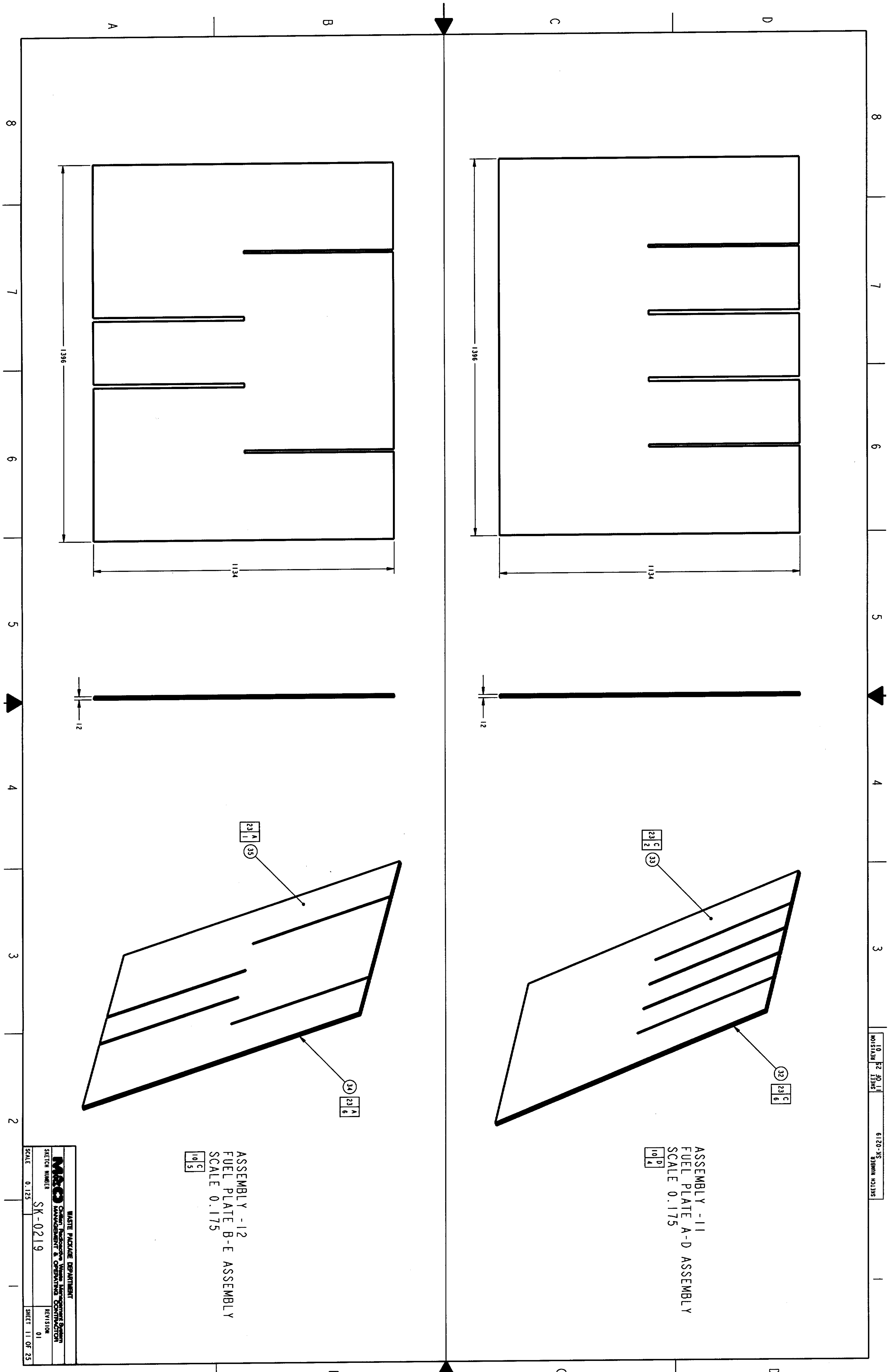
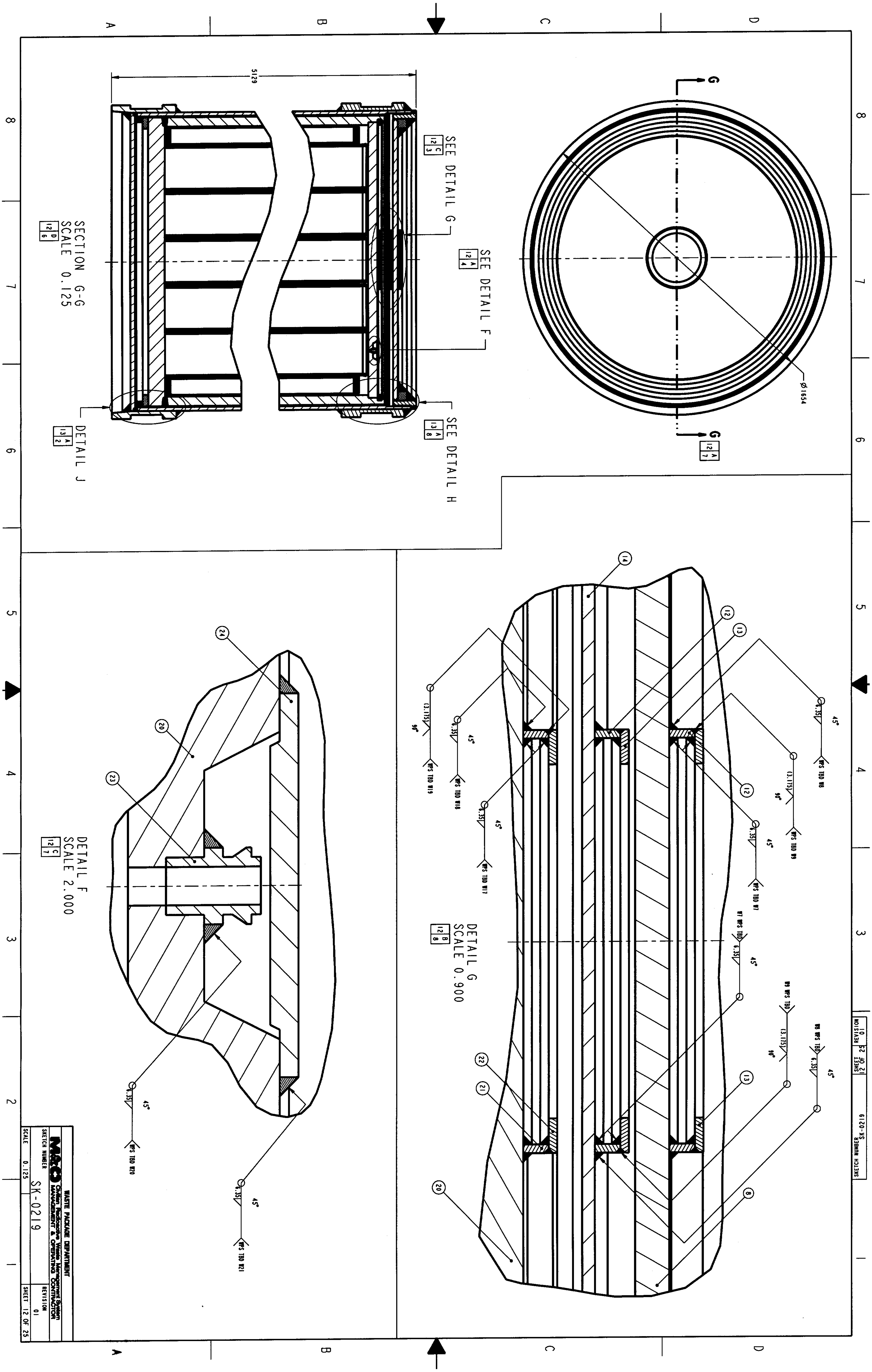
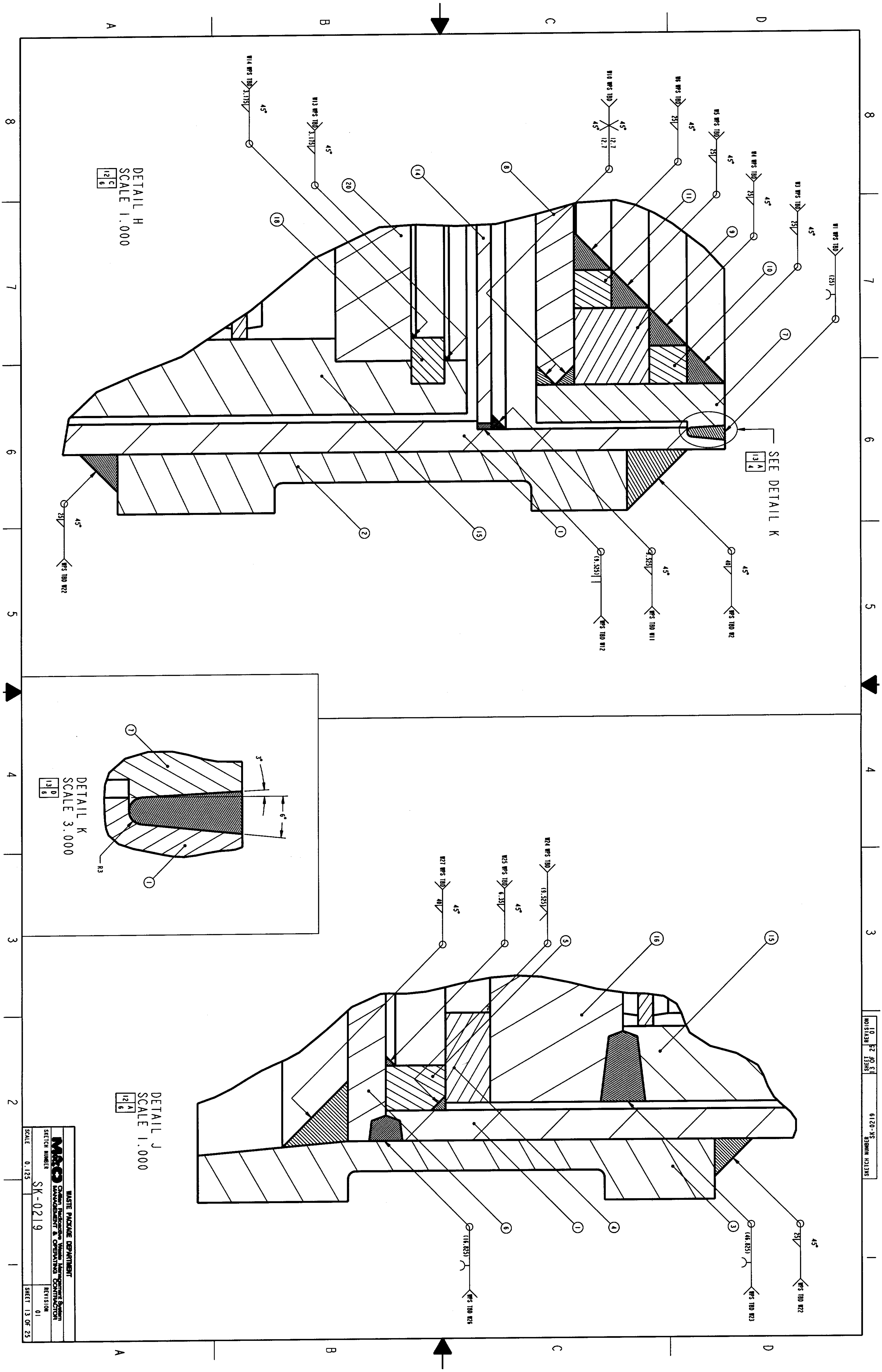
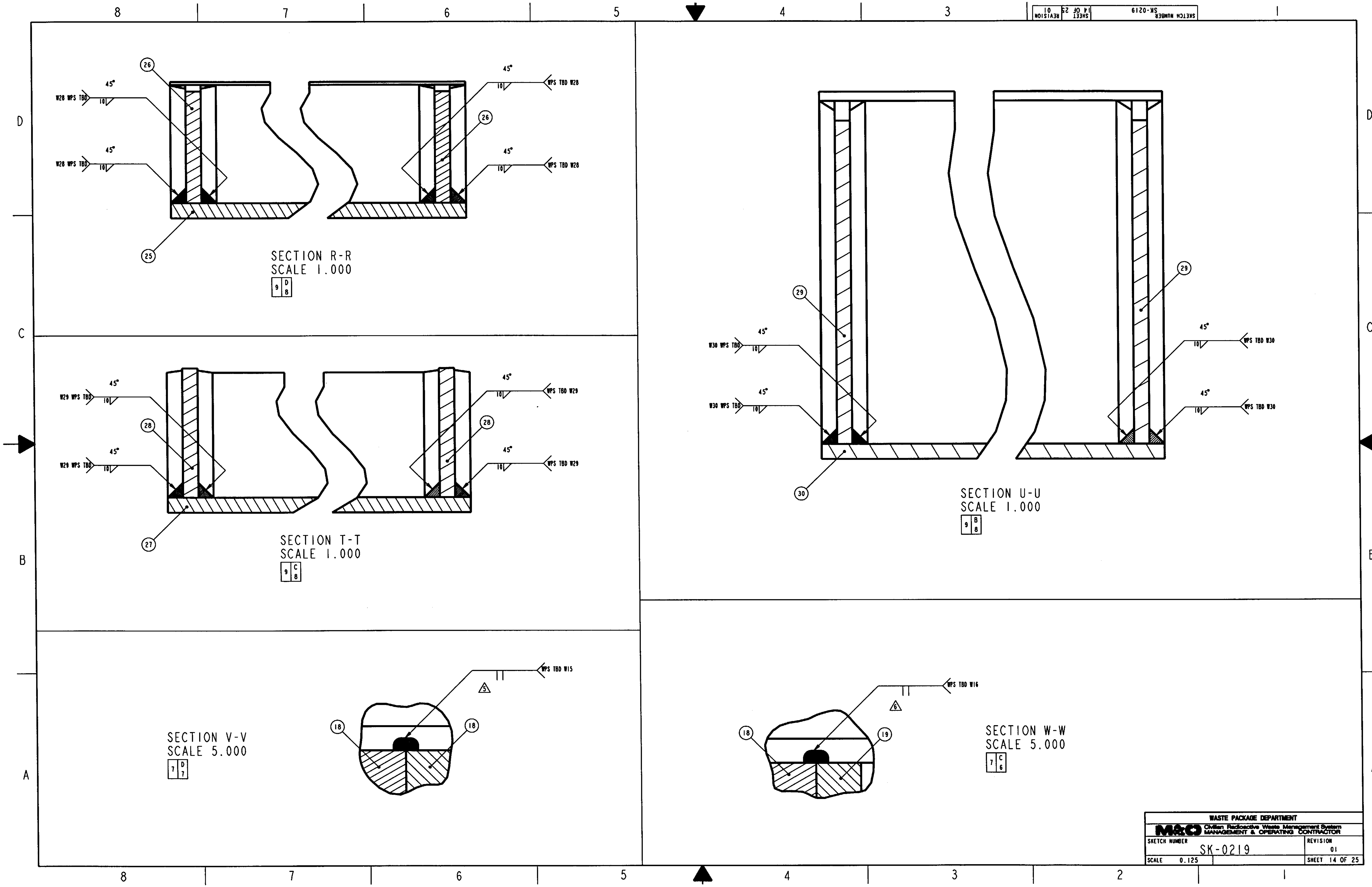
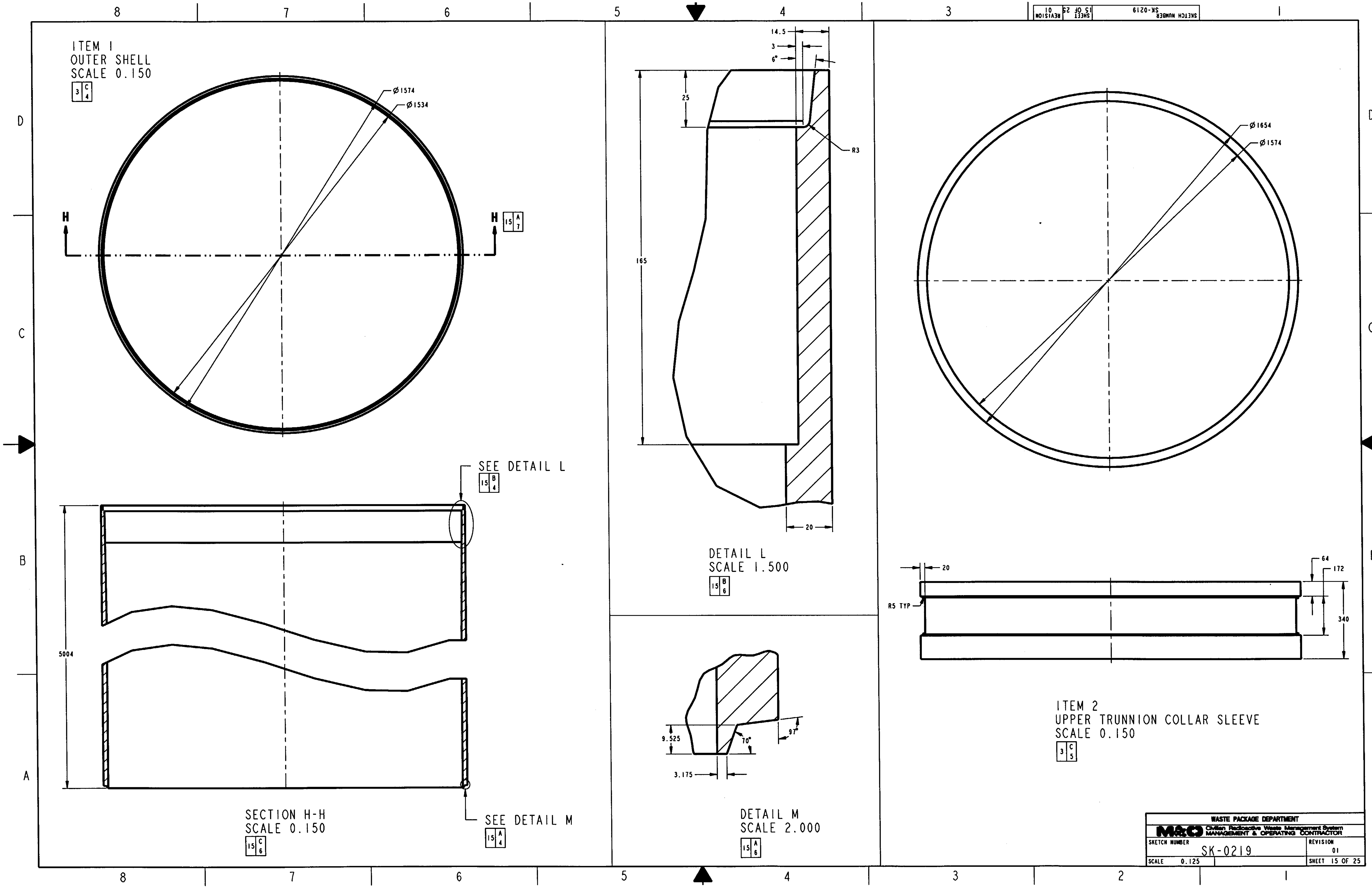
01
SCALE 0.125
SHEET 10 OF 25

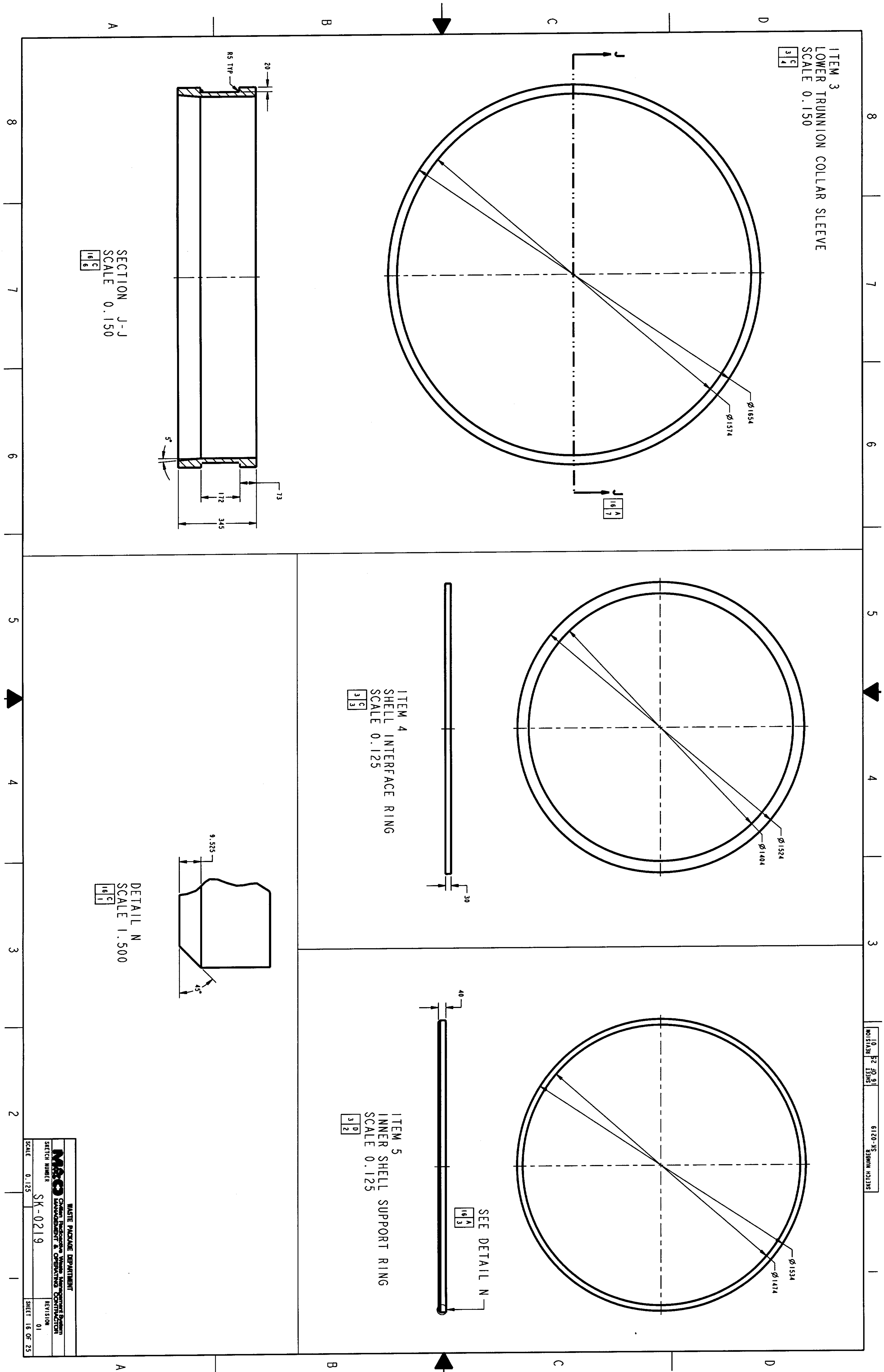

ASSEMBLY -11
FUEL PLATE A-D ASSEMBLY
SCALE 0.175
ASSEMBLY -12
FUEL PLATE B-E ASSEMBLY
SCALE 0.175
1396
1134
12
WASTE PACKAGE DEPARTMENT
SKETCH NUMBER SK-0219
REVISION 01
SCALE 0.125
SHEET 11 OF 25

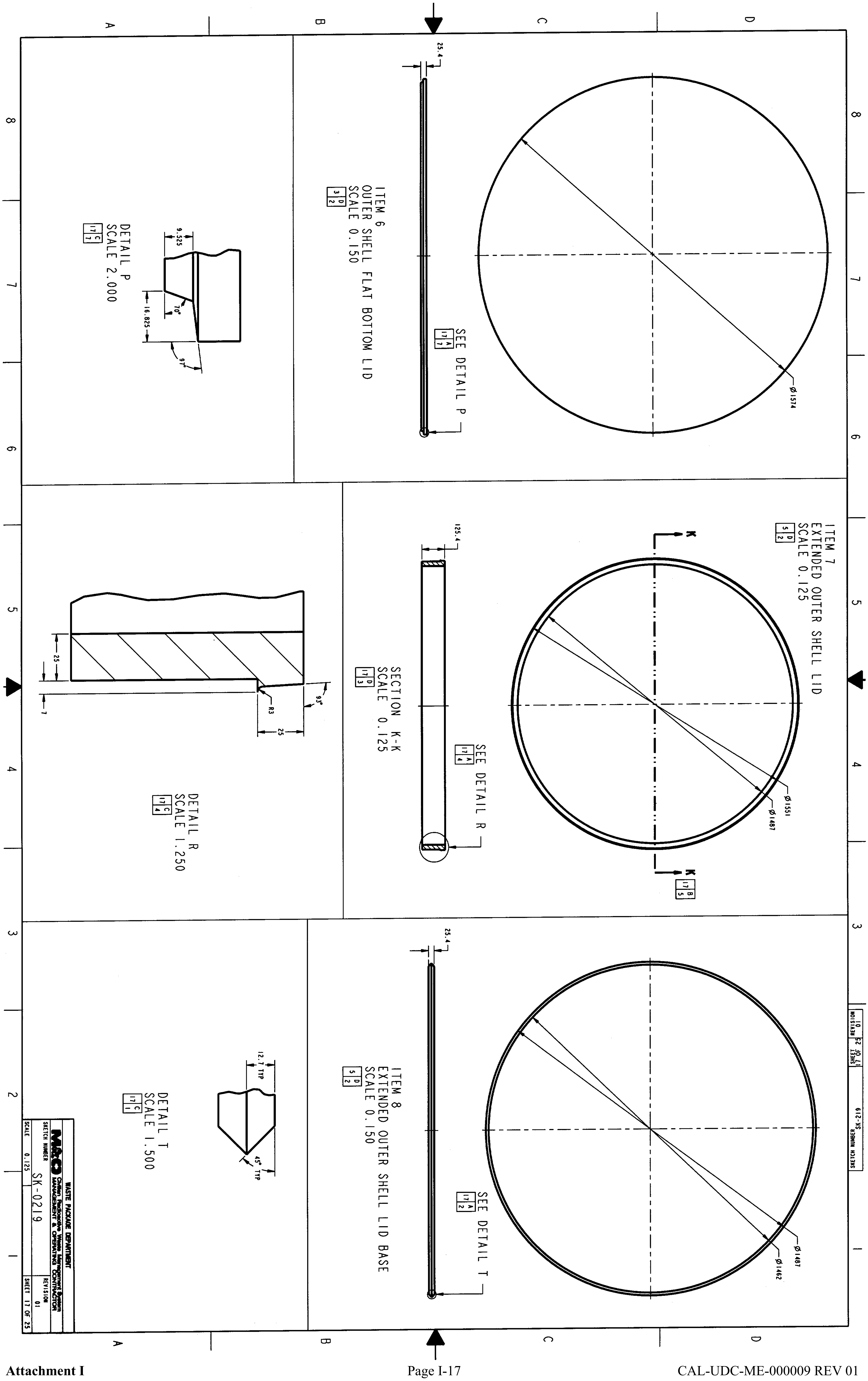

SECTION G-G
SCALE 0.125
SEE DETAIL G
SEE DETAIL F
SEE DETAIL H
DETAIL J
5129
Ø1654
G
DETAIL G
SCALE 0.900
DETAIL F
SCALE 2.000
WPS TBD W8
WPS TBD W9
WPS TBD W7
WPS TBD W17
WPS TBD W18
WPS TBD W19
WPS TBD W20
WPS TBD W21
W8 WPS TBD
W9 WPS TBD
W7 WPS TBD
6.35
(3.175)
45°
90°
WASTE PACKAGE DEPARTMENT
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR
SKETCH NUMBER
SK-0219
REVISION
01
SCALE 0.125
SHEET 12 OF 25

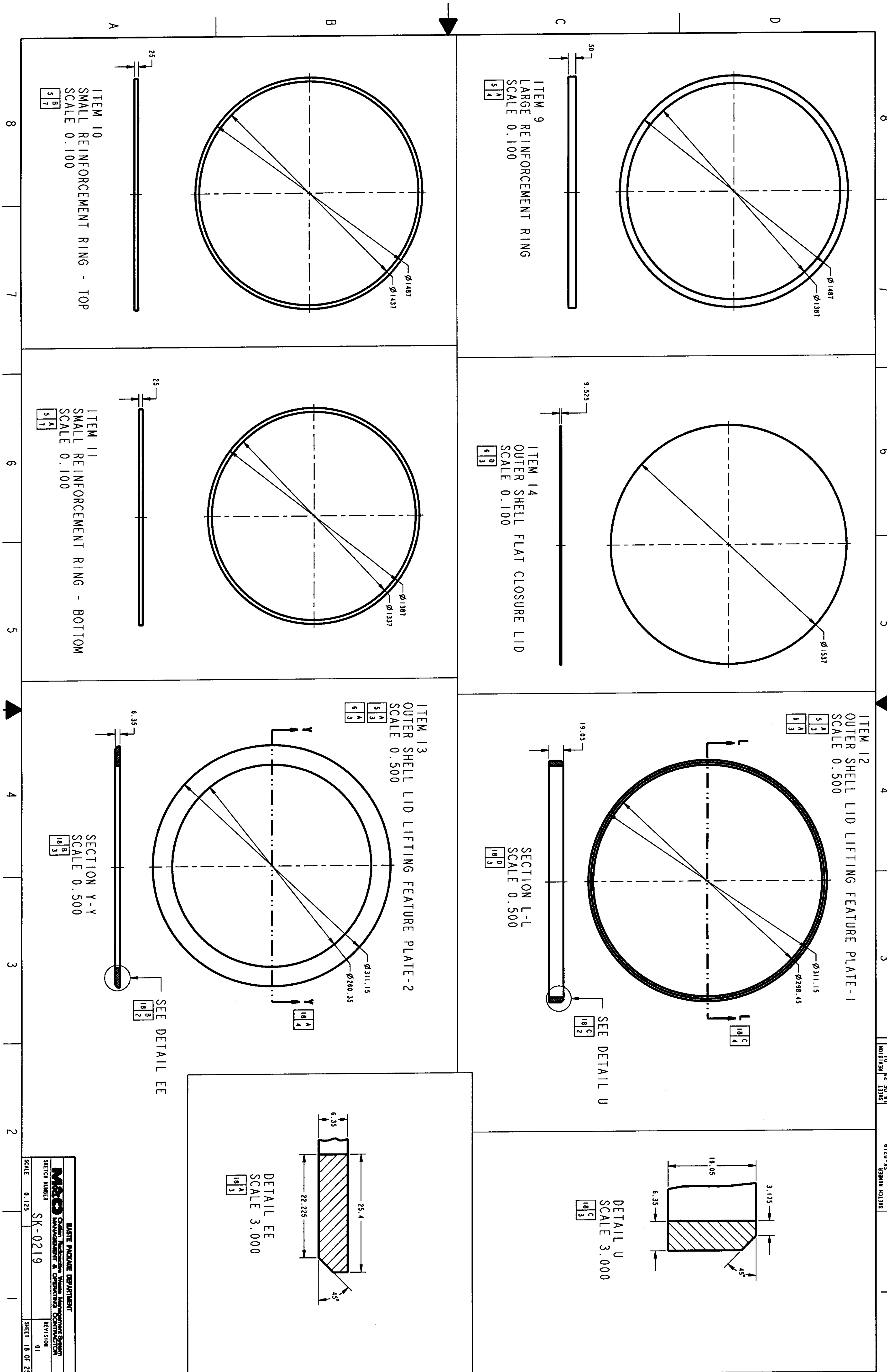

DETAIL H
SCALE 1.000
SEE DETAIL K
DETAIL K
SCALE 3.000
DETAIL J
SCALE 1.000
WASTE PACKAGE DEPARTMENT
M&O
Civilian Radioactive Waste Management System
MANAGEMENT & OPERATING CONTRACTOR
SKETCH NUMBER
SK-0219
REVISION
01
SCALE 0.125
SHEET 13 OF 25

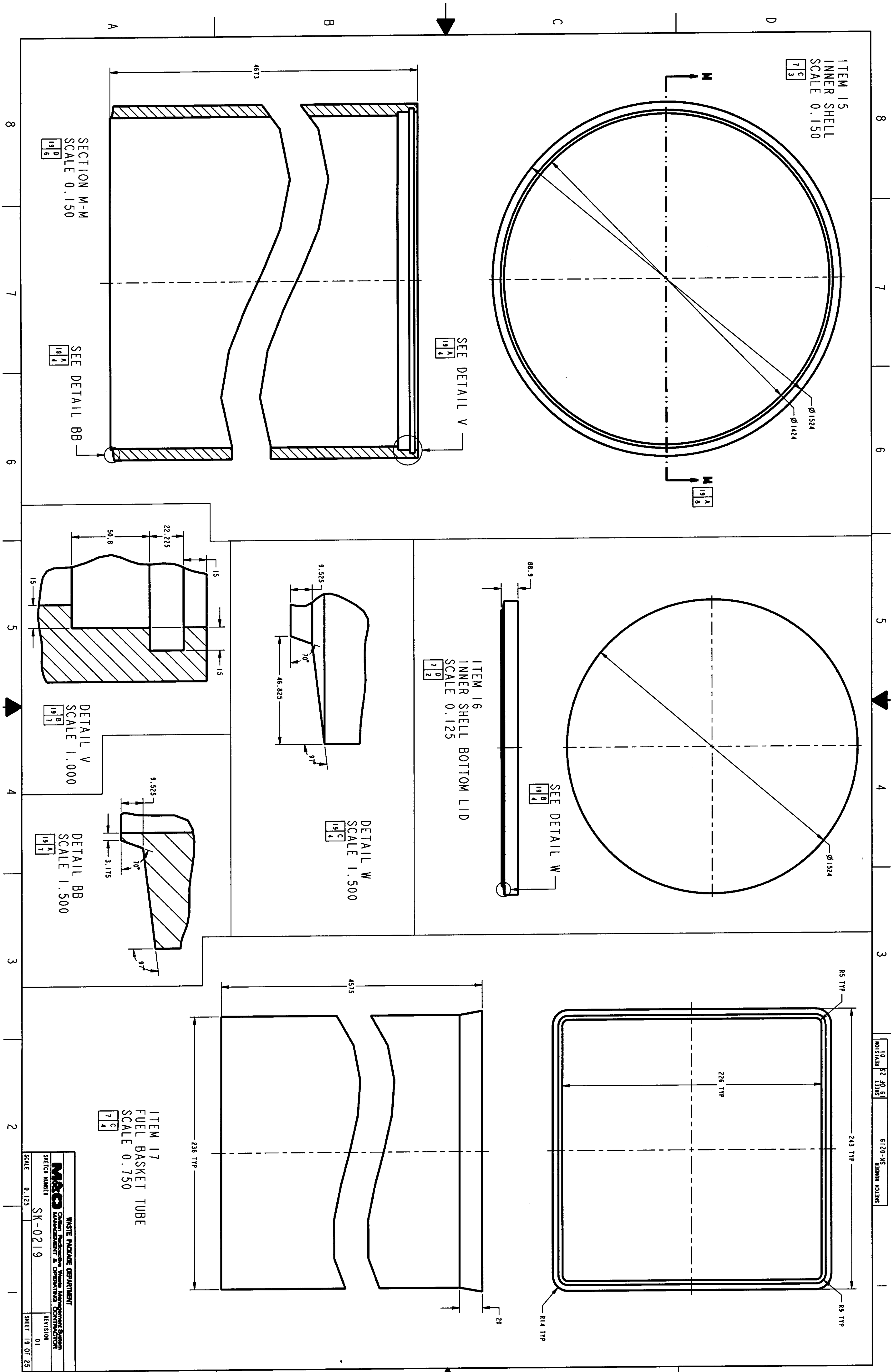

SECTION R-R
SCALE 1.000
SECTION T-T
SCALE 1.000
SECTION U-U
SCALE 1.000
SECTION V-V
SCALE 5.000
SECTION W-W
SCALE 5.000
WPS TBD W28
W28 WPS TBD
W29 WPS TBD
WPS TBD W29
W30 WPS TBD
WPS TBD W30
WPS TBD W15
WPS TBD W16
45°
WASTE PACKAGE DEPARTMENT
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR
SKETCH NUMBER
SK-0219
REVISION
01
SCALE 0.125
SHEET 14 OF 25

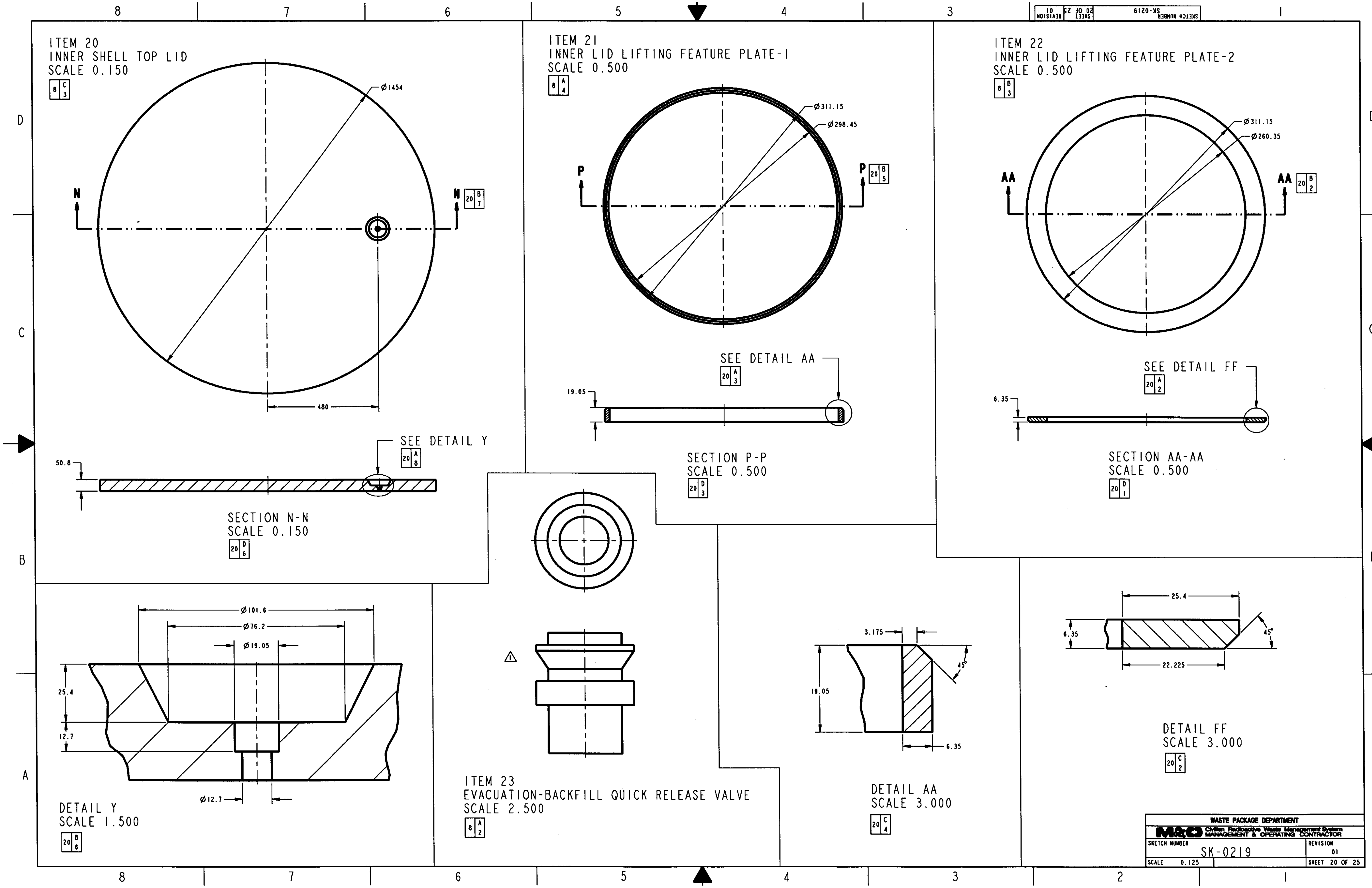

ITEM 1
OUTER SHELL
SCALE 0.150
Ø1574
Ø1534
H
SECTION H-H
SCALE 0.150
SEE DETAIL L
SEE DETAIL M
5004
DETAIL L
SCALE 1.500
14.5
3
6°
25
165
R3
20
DETAIL M
SCALE 2.000
9.525
3.175
70°
97°
ITEM 2
UPPER TRUNNION COLLAR SLEEVE
SCALE 0.150
Ø1654
Ø1574
20
64
172
340
R5 TYP
WASTE PACKAGE DEPARTMENT
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR
SKETCH NUMBER SK-0219
REVISION 01
SCALE 0.125
SHEET 15 OF 25

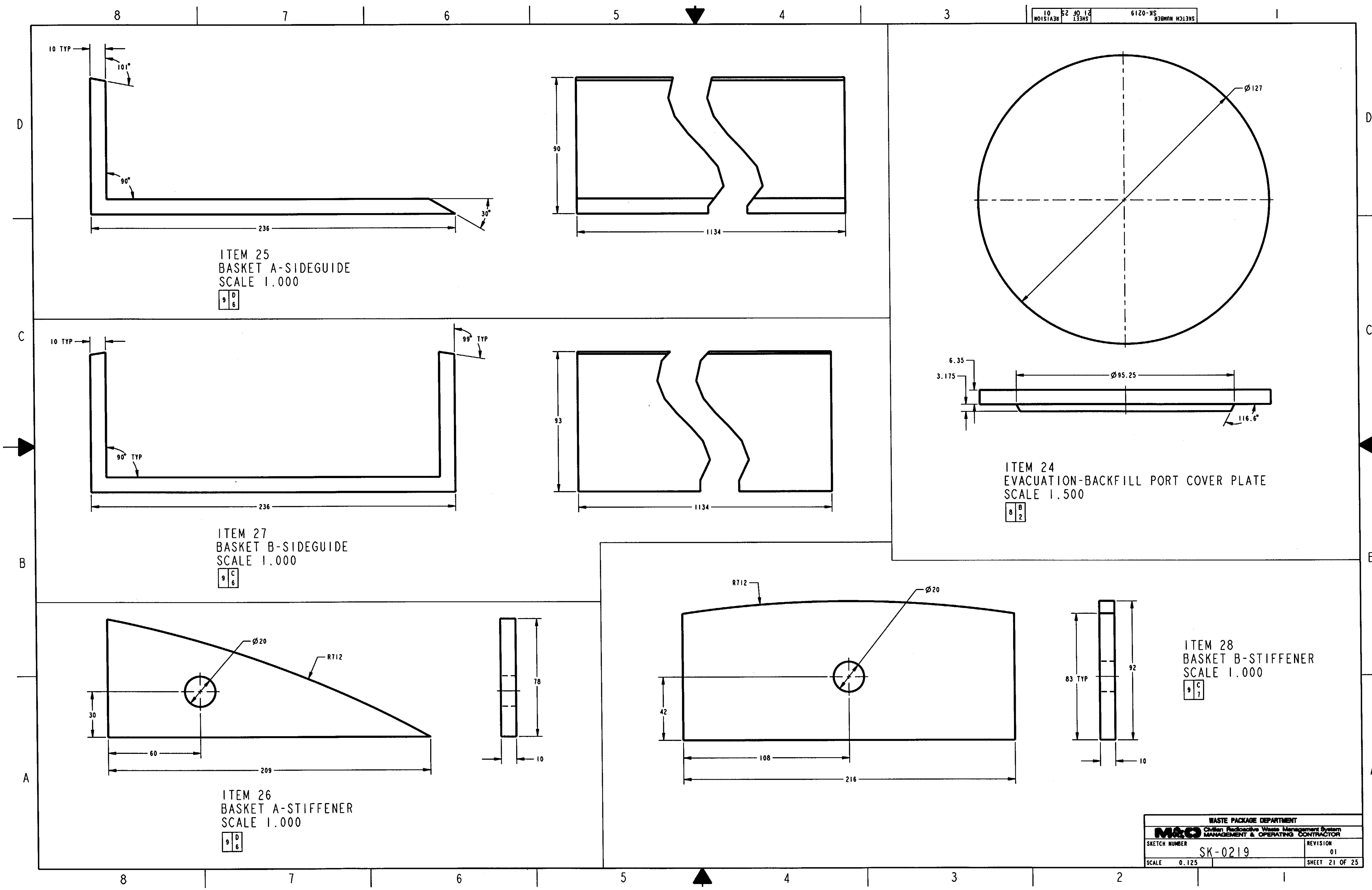

ITEM 3
LOWER TRUNNION COLLAR SLEEVE
SCALE 0.150
Ø1654
Ø1574
J
J
SECTION J-J
SCALE 0.150
R5 TYP
20
5°
172
73
345
ITEM 4
SHELL INTERFACE RING
SCALE 0.125
Ø1524
Ø1404
30
ITEM 5
INNER SHELL SUPPORT RING
SCALE 0.125
SEE DETAIL N
Ø1534
Ø1474
40
DETAIL N
SCALE 1.500
9.525
45°
WASTE PACKAGE DEPARTMENT
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR
SKETCH NUMBER SK-0219
REVISION 01
SCALE 0.125
SHEET 16 OF 25

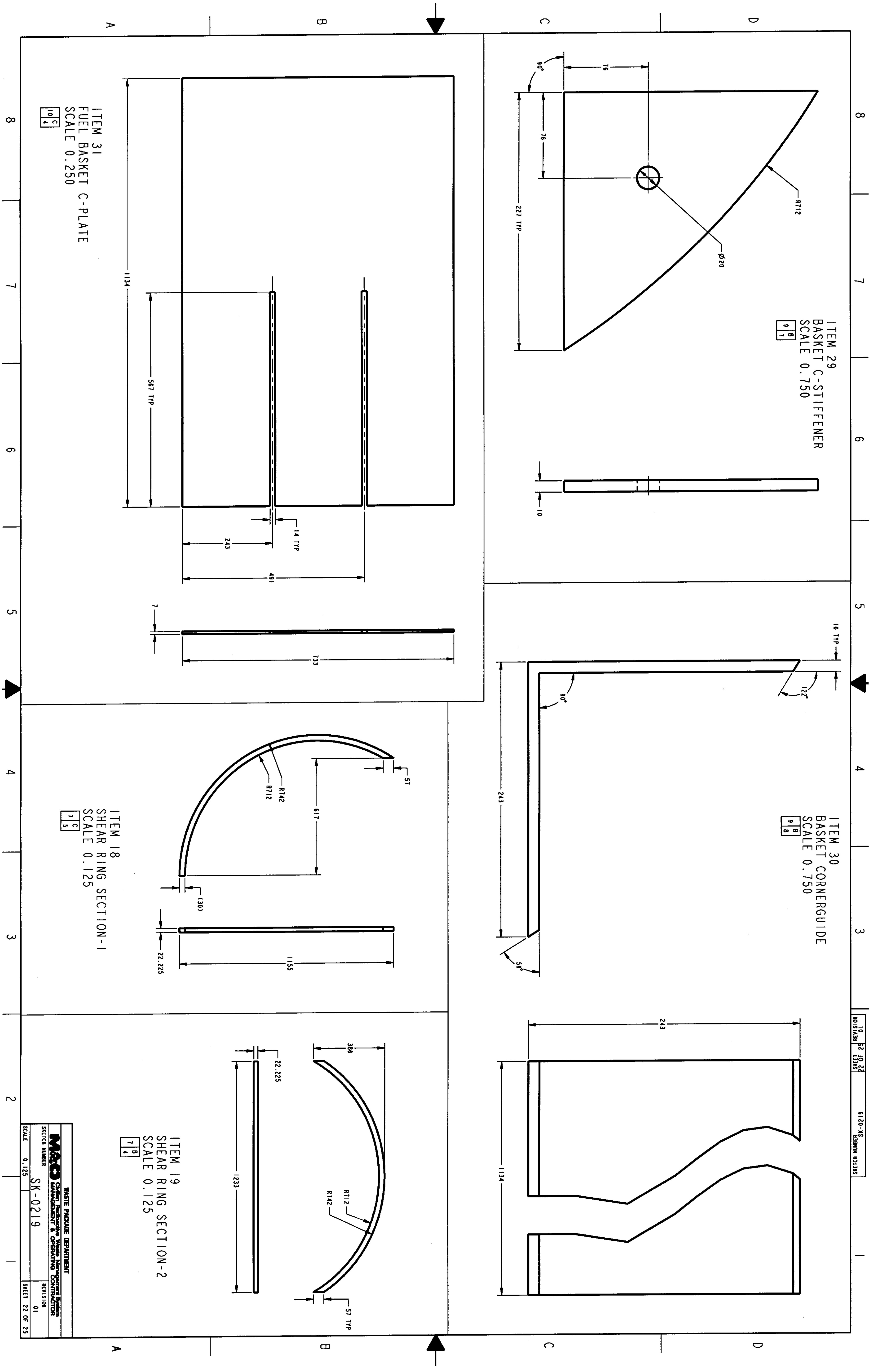

ITEM 6
OUTER SHELL FLAT BOTTOM LID
SCALE 0.150
SEE DETAIL P
Ø1574
25.4
DETAIL P
SCALE 2.000
9.525
16.825
70°
97°
ITEM 7
EXTENDED OUTER SHELL LID
SCALE 0.125
Ø1551
Ø1487
K
SEE DETAIL R
SECTION K-K
SCALE 0.125
125.4
DETAIL R
SCALE 1.250
25
93°
R3
7
ITEM 8
EXTENDED OUTER SHELL LID BASE
SCALE 0.150
SEE DETAIL T
Ø1487
Ø1462
25.4
DETAIL T
SCALE 1.500
12.7 TYP
45° TYP
WASTE PACKAGE DEPARTMENT
Civilian Radioactive Waste Management System
MANAGEMENT & OPERATING CONTRACTOR
SKETCH NUMBER SK-0219
REVISION 01
SCALE 0.125
SHEET 17 OF 25

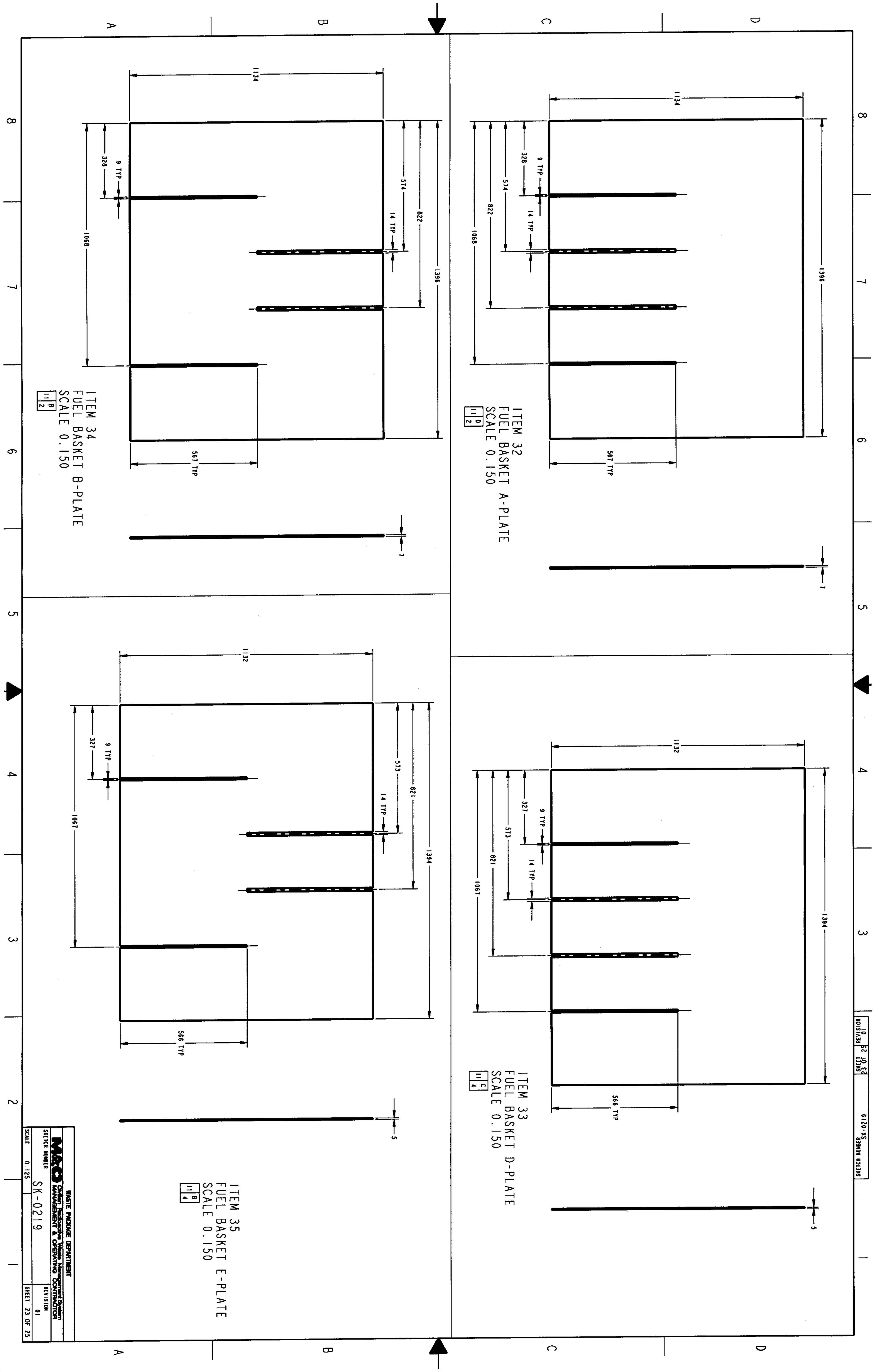

ITEM 10
SMALL REINFORCEMENT RING - TOP
SCALE 0.100
25
Ø1487
Ø1437
ITEM 9
LARGE REINFORCEMENT RING
SCALE 0.100
50
Ø1487
Ø1387
ITEM 11
SMALL REINFORCEMENT RING - BOTTOM
SCALE 0.100
25
Ø1387
Ø1337
ITEM 14
OUTER SHELL FLAT CLOSURE LID
SCALE 0.100
9.525
Ø1537
ITEM 13
OUTER SHELL LID LIFTING FEATURE PLATE-2
SCALE 0.500
Ø311.15
Ø260.35
SECTION Y-Y
SCALE 0.500
6.35
SEE DETAIL EE
ITEM 12
OUTER SHELL LID LIFTING FEATURE PLATE-1
SCALE 0.500
Ø311.15
Ø298.45
SECTION L-L
SCALE 0.500
19.05
SEE DETAIL U
DETAIL EE
SCALE 3.000
6.35
25.4
22.225
45°
DETAIL U
SCALE 3.000
19.05
3.175
6.35
45°
WASTE PACKAGE DEPARTMENT
Civilian Radioactive Waste Management System
MANAGEMENT & OPERATING CONTRACTOR
SKETCH NUMBER SK-0219
REVISION 01
SCALE 0.125
SHEET 18 OF 25


ITEM 15
INNER SHELL
SCALE 0.150
SECTION M-M
SCALE 0.150
SEE DETAIL V
SEE DETAIL BB
Ø1524
Ø1424
4673
ITEM 16
INNER SHELL BOTTOM LID
SCALE 0.125
SEE DETAIL W
Ø1524
88.9
DETAIL V
SCALE 1.000
DETAIL W
SCALE 1.500
DETAIL BB
SCALE 1.500
ITEM 17
FUEL BASKET TUBE
SCALE 0.750
243 TYP
226 TYP
236 TYP
4575
R5 TYP
R9 TYP
R14 TYP
WASTE PACKAGE DEPARTMENT
Civilian Radioactive Waste Management System
MANAGEMENT & OPERATING CONTRACTOR
SKETCH NUMBER
SK-0219
REVISION
01
SCALE 0.125
SHEET 19 OF 25


ITEM 20
INNER SHELL TOP LID
SCALE 0.150
Ø1454
480
N
SECTION N-N
SCALE 0.150
50.8
SEE DETAIL Y
ITEM 21
INNER LID LIFTING FEATURE PLATE-1
SCALE 0.500
Ø311.15
Ø298.45
P
SEE DETAIL AA
19.05
SECTION P-P
SCALE 0.500
ITEM 22
INNER LID LIFTING FEATURE PLATE-2
SCALE 0.500
Ø311.15
Ø260.35
AA
SEE DETAIL FF
6.35
SECTION AA-AA
SCALE 0.500
Ø101.6
Ø76.2
Ø19.05
25.4
12.7
Ø12.7
DETAIL Y
SCALE 1.500
ITEM 23
EVACUATION-BACKFILL QUICK RELEASE VALVE
SCALE 2.500
3.175
19.05
45°
6.35
DETAIL AA
SCALE 3.000
25.4
6.35
45°
22.225
DETAIL FF
SCALE 3.000
WASTE PACKAGE DEPARTMENT
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR
SKETCH NUMBER SK-0219
REVISION 01
SCALE 0.125
SHEET 20 OF 25


ITEM 25
BASKET A-SIDEGUIDE
SCALE 1.000
10 TYP
101°
90°
30°
236
90
1134
ITEM 27
BASKET B-SIDEGUIDE
SCALE 1.000
99° TYP
90° TYP
93
ITEM 24
EVACUATION-BACKFILL PORT COVER PLATE
SCALE 1.500
Ø127
Ø95.25
6.35
3.175
116.6°
ITEM 26
BASKET A-STIFFENER
SCALE 1.000
Ø20
R712
30
60
209
78
10
ITEM 28
BASKET B-STIFFENER
SCALE 1.000
42
108
216
83 TYP
92
WASTE PACKAGE DEPARTMENT
M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR
SKETCH NUMBER SK-0219
REVISION 01
SCALE 0.125
SHEET 21 OF 25


ITEM 31
FUEL BASKET C-PLATE
SCALE 0.250
ITEM 29
BASKET C-STIFFENER
SCALE 0.750
ITEM 30
BASKET CORNERGUIDE
SCALE 0.750
ITEM 18
SHEAR RING SECTION-1
SCALE 0.125
ITEM 19
SHEAR RING SECTION-2
SCALE 0.125
WASTE PACKAGE DEPARTMENT
SKETCH NUMBER SK-0219
SCALE 0.125
REVISION 01
SHEET 22 OF 25


ITEM 32
FUEL BASKET A-PLATE
SCALE 0.150
ITEM 33
FUEL BASKET D-PLATE
SCALE 0.150
ITEM 34
FUEL BASKET B-PLATE
SCALE 0.150
ITEM 35
FUEL BASKET E-PLATE
SCALE 0.150
WASTE PACKAGE DEPARTMENT
Civilian Radioactive Waste Management System
MANAGEMENT & OPERATING CONTRACTOR
SKETCH NUMBER SK-0219
REVISION 01
SCALE 0.125
SHEET 23 OF 25

SKETCH NUMBER	SHEET	REVISION
SK-0219	24 OF 25	01

△2 COMPONENT LIST

ITEM NUMBER	ASSEMBLY	SUBASSEMBLY	SUBASSEMBLY	SUBASSEMBLY	COMPONENT NAME	MATERIAL	THICKNESS	MASS (KG)	QTY RQD
-1	21-PWR WASTE PACKAGE ASSEMBLY	-	-	-	-	-	-	25333	1
		-	-	-	-	-	-	△3 25357	△3 1
-2	-	OUTER SHELL ASSEMBLY	-	-	-	-	-	5728	1
1	-	-	-	-	OUTER SHELL	SB-575 N06022	20	4194	1
2	-	-	-	-	UPPER TRUNNION COLLAR SLEEVE	SB-575 N06022	40	446	1
3	-	-	-	-	LOWER TRUNNION COLLAR SLEEVE	SB-575 N06022	40	436	1
4	-	-	-	-	SHELL INTERFACE RING	SA-240 S31600	30	66	1
5	-	-	-	-	INNER SHELL SUPPORT RING	SB-575 N06022	40	47	1
6	-	-	-	-	OUTER SHELL FLAT BOTTOM LID	SB-575 N06022	25.4	423	1
-3	-	EXTENDED OUTER SHELL LID ASSEMBLY	-	-	-	-	-	713	1
7	-	-	-	-	EXTENDED OUTER SHELL LID	SB-575 N06022	25	133	1
8	-	-	-	-	EXTENDED OUTER SHELL LID BASE	SB-575 N06022	25.4	377	1
9	-	-	-	-	LARGE REINFORCEMENT RING	SB-575 N06022	50	98	1
10	-	-	-	-	SMALL REINFORCEMENT RING - TOP	SB-575 N06022	25	25	1
11	-	-	-	-	SMALL REINFORCEMENT RING - BOTTOM	SB-575 N06022	25	23	1
12	-	-	-	-	OUTER SHELL LID LIFTING FEATURE PLATE-1	SB-575 N06022	6.35	0.96	1
13	-	-	-	-	OUTER SHELL LID LIFTING FEATURE PLATE-2	SB-575 N06022	6.35	1.2	1
-4	-	OUTER SHELL FLAT CLOSURE LID ASSEMBLY	-	-	-	-	-	156	1
14	-	-	-	-	OUTER SHELL FLAT CLOSURE LID	SB-575 N06022	9.525	154	1
12	-	-	-	-	OUTER SHELL LID LIFTING FEATURE PLATE-1	SB-575 N06022	6.35	0.96	1
13	-	-	-	-	OUTER SHELL LID LIFTING FEATURE PLATE-2	SB-575 N06022	6.35	1.2	1
-5	-	INNER SHELL ASSEMBLY	-	-	-	-	-	18725	1
	-		-	-	-	-	-	△3 18748	△3 1
15	-	-	-	-	INNER SHELL	SA-240 S31600	50	8554	1
16	-	-	-	-	INNER SHELL BOTTOM LID	SA-240 S31600	88.9	1274	1
17	-	-	-	-	FUEL BASKET TUBE	SA-516 K02700	5	164	21
18	-	-	-	-	SHEAR RING SECTION-1	SA-240 S31600	22.225	8.2	2
19	-	-	-	-	SHEAR RING SECTION-2	SA-240 S31600	22.225	7.8	1
-6	-	-	INNER SHELL TOP LID ASSEMBLY	-	-	-	-	675	1
20	-	-	-	-	INNER SHELL TOP LID	SA-240 S31600	50.8	672	1
21	-	-	-	-	INNER LID LIFTING FEATURE PLATE-1	SA-240 S31600	6.35	0.89	1
22	-	-	-	-	INNER LID LIFTING FEATURE PLATE-2	SA-240 S31600	6.35	1.1	1
23	-	-	-	-	EVACUATION-BACKFILL QUICK RELEASE VALVE	SA-240 S31600	12.7	0.06	1
24	-	-	-	-	EVACUATION-BACKFILL PORT COVER PLATE	SA-240 S31600	6.35	0.82	1
-7	-	-	END SIDEGUIDE ASSEMBLY	-	-	-	-	29	32
25	-	-	-	-	BASKET A-SIDEGUIDE	SA-516 K02700	10	27	32
26	-	-	-	-	BASKET A-STIFFENER	SA-516 K02700	10	0.72	64
-8	-	-	SIDEGUIDE ASSEMBLY	-	-	-	-	39	16
27	-	-	-	-	BASKET B-SIDEGUIDE	SA-516 K02700	10	36	16
28	-	-	-	-	BASKET B-STIFFENER	SA-516 K02700	10	1.5	32
-9	-	-	CORNERGUIDE ASSEMBLY	-	-	-	-	47	16
29	-	-	-	-	BASKET C-STIFFENER	SA-516 K02700	10	2.3	32
30	-	-	-	-	BASKET CORNERGUIDE	SA-516 K02700	10	42	16
-10	-	-	FUEL PLATE ASSEMBLY	-	-	-	-	599	4
	-	-		-	-	-	-	△3 605	△3 4
31	-	-	-	-	FUEL BASKET C-PLATE	NEUTRONIT A 978	7	44	16
	-	-	-	-		△3 SA-516 K02700	△3 7	△3 45	△3 16
-11	-	-	-	FUEL PLATE A-D ASSEMBLY	-	-	-	106	8
	-	-	-		-	-	-	△3 107	△3 8
32	-	-	-	-	FUEL BASKET A-PLATE	NEUTRONIT A 978	7	85	8
	-	-	-	-		△3 SA-516 K02700	△3 7	△3 86	△3 8
33	-	-	-	-	FUEL BASKET D-PLATE	SB-209 A96061 T4	5	21	8
-12	-	-	-	FUEL PLATE B-E ASSEMBLY	-	-	-	106	8
	-	-	-		-	-	-	△3 107	△3 8
34	-	-	-	-	FUEL BASKET B-PLATE	NEUTRONIT A 978	7	85	8
	-	-	-	-		△3 SA-516 K02700	△3 7	△3 86	△3 8
35	-	-	-	-	FUEL BASKET E-PLATE	SB-209 A96061 T4	5	21	8
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	TOTAL CARBON STEEL WELDS	SFA-5.18 K10726	-	34	-
-	-	-	-	-	TOTAL ALLOY 22 WELDS	SFA-5.14 N06022	-	182	-
-	-	-	-	-	TOTAL 316 WELDS	SFA-5.9 S31680	-	41	-
-	-	-	-	-	-	-	-	-	-
-	-	-	PWR FUEL ASSEMBLY	-	-	-	-	△4 773.4	21
-	21-PWR WP ASSEMBLY WITH SNF	-	-	-	-	-	-	41574	1
		-	-	-	-	-	-	△3 41598	△3 1

REVISION HISTORY

ZONE	REV	DESCRIPTION	DATE	APPROVED
D3-1	-	CONTINUED FROM SHEET 1	02/22/01	SMB
A4-6	01	34.9 WAS 37	02/22/01	SMB
A6-6	01	ADDED DETAIL CC CALLOUT	02/22/01	SMB
C6-7	01	ADDED SECTION W	02/22/01	SMB
D7-7	01	ADDED SECTION V	02/22/01	SMB
-	01	ADDED ITEM 18 IN ZONES C5-7, B7-13, C8-24, AND A4-22	02/22/01	SMB
-	01	ADDED ITEM 19 IN ZONES B4-7, C8-24, AND A2-22	02/22/01	SMB
C3-7	01	INNER SHELL ASSEMBLY PERSPECTIVE VIEW MODIFIED TO SHOW EXPLODED FUEL BASKET TUBES AND PLATE ASSEMBLY	02/22/01	SMB
-	01	ITEM 15 WAS ITEM 14 IN ZONES C2-7, C5-13, D3-13, D8-19, AND C8-24	02/22/01	SMB
-	01	ITEM 16 WAS ITEM 15 IN ZONES D1-7, C3-13, C5-19, AND C8-24	02/22/01	SMB
-	01	ITEM 17 WAS ITEM 16 IN ZONES C4-7, A2-19, AND C8-24	02/22/01	SMB
B8-7	01	4762 WAS 4712	02/22/01	SMB
-	01	88.9 WAS 50 IN ZONES A8-7, C5-19, AND C4-24	02/22/01	SMB
-	01	ITEM 20 WAS ITEM 17 IN ZONES C3-8, C1-12, B8-13, A4-12, D8-20, AND C8-24	02/22/01	SMB
A4-8	01	ADDED DETAIL DD TO SHOW CALLOUTS OF ITEM 21 AND ITEM 22	02/22/01	SMB
B7-8	01	ADDED DETAIL DD CALLOUT	02/22/01	SMB
A3-8	01	ADDED ITEM 20 CALLOUT	02/22/01	SMB
C2-12	01	ADDED ITEM 22	02/22/01	SMB
-	01	ITEM 23 WAS ITEM 19 IN ZONES A2-8, A4-12, A6-20, AND B8-24	02/22/01	SMB
-	01	ITEM 24 WAS ITEM 20 IN ZONES B2-8, B5-12, B2-21, AND B8-24	02/22/01	SMB
A8-8	01	76.2 WAS 77	02/22/01	SMB
D5-8	01	1454 WAS 1430	02/22/01	SMB
D8-9	01	ADDED SECTION R	02/22/01	SMB
-	01	DELETED 10 TYP IN ZONES B5-9, C5-9, AND D5-9	02/22/01	SMB
-	01	ADDED 20 TYP IN ZONES B5-9, C5-9, AND D5-9	02/22/01	SMB
-	01	ITEM 26 WAS ITEM 22 IN ZONES D7-9, A7-21, AND B8-24	02/22/01	SMB
-	01	ITEM 25 WAS ITEM 21 IN ZONES D6-9, C7-21, AND B8-24	02/22/01	SMB
-	01	ITEM 28 WAS ITEM 24 IN ZONES C7-9, B1-21, AND B8-24	02/22/01	SMB
-	01	ITEM 27 WAS ITEM 23 IN ZONES B7-21, C6-9, AND B8-24	02/22/01	SMB
C8-9	01	ADDED SECTION T	02/22/01	SMB
-	01	ITEM 30 WAS ITEM 26 IN ZONES B8-9, D3-22, AND B8-24	02/22/01	SMB
-	01	ITEM 29 WAS ITEM 25 IN ZONES D6-22, B7-9, AND B8-24	02/22/01	SMB
B8-9	01	ADDED SECTION U	02/22/01	SMB
-	01	ITEM 31 WAS ITEM 27 IN ZONES C4-10, A8-22, AND B8-24	02/22/01	SMB
-	01	ITEM 33 WAS ITEM 29 IN ZONES C4-11, C2-23, AND B8-24	02/22/01	SMB
-	01	ITEM 32 WAS ITEM 28 IN ZONES D2-11, C6-23, AND B8-24	02/22/01	SMB
-	01	ITEM 35 WAS ITEM 31 IN ZONES B4-11, B1-23, AND A8-24	02/22/01	SMB
-	01	ITEM 34 WAS ITEM 30 IN ZONES B2-11, A6-23, AND A8-24	02/22/01	SMB
-	01	6.35 WAS 12.7 IN ZONES D4-12 AND D2-12	02/22/01	SMB
D3-12	01	ADDED W9 IN 2 PLACES	02/22/01	SMB
D8-25	01	ADDED WELD 9	02/22/01	SMB
D3-12	01	ADDED W7 IN 2 PLACES	02/22/01	SMB
B4-12	01	ADDED W19	02/22/01	SMB
-	01	ADDED ITEM 13 CALLOUT IN ZONES D2-12 AND D5-12	02/22/01	SMB
C2-12	01	ITEM 21 WAS ITEM 18	02/22/01	SMB
C8-25	01	ADDED WELD 19	02/22/01	SMB
C4-12	01	W18 WAS W14	02/22/01	SMB
C8-25	01	WELD 18 WAS WELD 14	02/22/01	SMB
C4-12	01	6.35 WAS 12.7	02/22/01	SMB
C3-12	01	W17 WAS W13	02/22/01	SMB
C8-25	01	WELD 17 WAS WELD 13	02/22/01	SMB
C4-12	01	ADDED W17	02/22/01	SMB
B1-12	01	W21 WAS W16	02/22/01	SMB
C8-25	01	WELD 21 WAS WELD 16	02/22/01	SMB
A2-12	01	W20 WAS W15	02/22/01	SMB
C8-25	01	WELD 20 WAS WELD 15	02/22/01	SMB
C8-13	01	W10 WAS W9	02/22/01	SMB
C8-25	01	WELD 10 WAS WELD 9	02/22/01	SMB
C8-13	01	12.7 WAS 12.5 IN 2 PLACES	02/22/01	SMB
-	01	TYP WAS REMOVED FROM DIMENSIONS IN ZONES A3-13 AND B4-13	02/22/01	SMB
-	01	REFERENCE NOTE 1 CALLOUT WAS REMOVED IN ZONES A3-13 AND B4-13	02/22/01	SMB
C8-25	01	ADDED WELD 13 AND WELD 14	02/22/01	SMB
D3-25	-	CONTINUED ON SHEET 25	02/22/01	SMB

WASTE PACKAGE DEPARTMENT

M&O Civilian Radioactive Waste Management System MANAGEMENT & OPERATING CONTRACTOR

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WELD LIST

WELD NUMBER	WELD TYPE	MATERIAL	MASS (KG)	QTY REQ
1	GROOVE	SFA-5.14 N06022	7.8	1
2	FILLET	SFA-5.14 N06022	35	1
3	FILLET	SFA-5.14 N06022	13	1
4	FILLET	SFA-5.14 N06022	12	1
5	FILLET	SFA-5.14 N06022	12	1
6	FILLET	SFA-5.14 N06022	11	1
7	FILLET	SFA-5.14 N06022	0.16	4
8	FILLET	SFA-5.14 N06022	0.17	2
9	GROOVE	SFA-5.14 N06022	0.09	2
10	GROOVE	SFA-5.14 N06022	3.3	2
11	FILLET	SFA-5.14 N06022	1.9	1
12	SQUARE	SFA-5.14 N06022	1.6	1
13	FILLET	SFA-5.9 S31680	0.18	1
14	FILLET	SFA-5.9 S31680	0.18	1
15	SQUARE	SFA-5.9 S31680	0.001	1
16	SQUARE	SFA-5.9 S31680	0.002	2
17	FILLET	SFA-5.9 S31680	0.15	2
18	FILLET	SFA-5.9 S31680	0.16	1
19	GROOVE	SFA-5.9 S31680	0.08	1
20	FILLET	SFA-5.9 S31680	0.01	1
21	FILLET	SFA-5.9 S31680	0.07	1
22	FILLET	SFA-5.14 N06022	14	2
23	GROOVE	SFA-5.9 S31680	40	1
24	GROOVE	SFA-5.14 N06022	1.9	1
25	FILLET	SFA-5.14 N06022	0.81	1
26	GROOVE	SFA-5.14 N06022	13	1
27	FILLET	SFA-5.14 N06022	37	1
28	FILLET	SFA-5.18 K10726	0.11	128
29	FILLET	SFA-5.18 K10726	0.15	64
30	FILLET	SFA-5.18 K10726	0.17	64
TOTAL CARBON STEEL WELDS		SFA-5.18 K10726	34	-
TOTAL ALLOY 22 WELDS	-	SFA-5.14 N06022	182	-
TOTAL 316 WELDS	-	SFA-5.9 S31680	41	-

NOTES:

1. GEOMETRY FOR THE EVACUATION-BACKFILL VALVE IS TBD.
2. THE 21-PWR WASTE PACKAGE CONFIGURATION WITH ABSORBER PLATES IS IDENTICAL TO THE 21-PWR WASTE PACKAGE CONFIGURATION WITH CONTROL RODS, EXCEPT FOR THE MATERIAL COMPOSITION OF THE FUEL BASKET A, B, AND C PLATES. ALL INFORMATION PROVIDED IN THIS TABLE IS FOR THE 21-PWR WASTE PACKAGE CONFIGURATION WITH ABSORBER PLATES, UNLESS OTHERWISE NOTED.
3. INFORMATION FOR THE 21-PWR WASTE PACKAGE CONFIGURATION WITH CONTROL RODS.
4. CRWMS M&O 1997. WASTE CONTAINER CAVITY SIZE DETERMINATION. BBAA00000-01717-0200-00026 REV 00. LAS VEGAS, NV: CRWMS M&O. ACC: MOL. 19980106.0061
5. WELD 15 SQUARE BUTT WELD IS PLACED ON THE EXPOSED SURFACES ABOVE THE OPEN CREVICE CREATED BETWEEN THE MATING SURFACES OF BOTH SHEAR RING SECTION-1 COMPONENTS. THIS WELD IS INTENDED TO INSURE ISOLATION OF THE INTERIOR OF THE INNER SHELL ASSEMBLY FROM EXTERNAL ENVIRONMENTS.
6. WELD 16 SQUARE BUTT WELDS ARE PLACED ON THE EXPOSED SURFACES ABOVE THE OPEN CREVICE CREATED BETWEEN THE MATING SURFACES OF THE SHEAR RING SECTION-1 AND THE SHEAR RING SECTION-2 COMPONENTS. THIS WELD IS INTENDED TO INSURE ISOLATION OF THE INTERIOR OF THE INNER SHELL ASSEMBLY FROM EXTERNAL ENVIRONMENTS.

REVISION HISTORY

ZONE	REV	DESCRIPTION	DATE	APPROVED
A3-25	-	CONTINUED FROM SHEET 25	02/22/01	SMB
A3-20	01	DETAIL AA WAS MODIFIED DUE TO ITEM 21 REDESIGN	02/22/01	SMB
-	01	ITEM 22 WAS ADDED IN ZONES D3-20 WITH SECTION AA AND C8-24	02/22/01	SMB
B2-20	01	ADDED SECTION AA-AA WITH DETAIL FF	02/22/01	SMB
A2-20	01	ADDED DETAIL FF	02/22/01	SMB
C2-21	01	95.25 WAS 101.6	02/22/01	SMB
D3-24	01	25333 WAS 24647	02/22/01	SMB
D3-24	01	25357 WAS 24671	02/22/01	SMB
D3-24	01	5728 WAS 5679	02/22/01	SMB
D3-24	01	4194 WAS 4152	02/22/01	SMB
D3-24	01	423 WAS 416	02/22/01	SMB
D3-24	01	713 WAS 718	02/22/01	SMB
D3-24	01	377 WAS 371	02/22/01	SMB
C4-24	01	6.35 WAS 27 IN 3 PLACES	02/22/01	SMB
C3-24	01	0.96 WAS 13 IN 2 PLACES	02/22/01	SMB
C3-24	01	154 WAS 161	02/22/01	SMB
C3-24	01	156 WAS 176	02/22/01	SMB
C3-24	01	8554 WAS 8529	02/22/01	SMB
C3-24	01	18725 WAS 18062	02/22/01	SMB
C3-24	01	18748 WAS 18086	02/22/01	SMB
C3-24	01	1274 WAS 708	02/22/01	SMB
C3-24	01	675 WAS 646	02/22/01	SMB
C3-24	01	672 WAS 632	02/22/01	SMB
C3-24	01	0.89 WAS 12	02/22/01	SMB
B4-24	01	6.35 WAS 6.4	02/22/01	SMB
B3-24	01	0.82 WAS .84	02/22/01	SMB
-	01	ADDED TOTAL CARBON STEEL WELDS IN ZONES A5-24 AND B8-25	02/22/01	SMB
-	01	182 WAS 183 IN ZONES A3-24 AND B7-25	02/22/01	SMB
-	01	41 WAS 59 IN ZONES A3-24 AND B7-25	02/22/01	SMB
A3-24	01	41574 WAS 40889	02/22/01	SMB
A3-24	01	41598 WAS 40913	02/22/01	SMB
D7-25	01	0.16 WAS .20	02/22/01	SMB
D6-25	01	4 WAS 2	02/22/01	SMB
D7-25	01	0.17 WAS .98	02/22/01	SMB
D7-25	01	3.3 WAS 3.2	02/22/01	SMB
C7-25	01	1.9 WAS 2.1	02/22/01	SMB
C7-25	01	1.6 WAS 1.7	02/22/01	SMB
C7-25	01	0.15 WAS .18	02/22/01	SMB
C7-25	01	0.16 WAS .90	02/22/01	SMB
C7-25	01	0.01 WAS .01	02/22/01	SMB
-	01	REFERENCE NOTE 1 WAS REFERENCE NOTE 2 IN ZONES B6-20 AND B8-25	02/22/01	SMB
-	01	REFERENCE NOTE 2 WAS REFERENCE NOTE 3 IN ZONES B8-25 AND D6-24	02/22/01	SMB
-	01	REFERENCE NOTE 3 WAS REFERENCE NOTE 4 IN ZONES D3-24 IN 2 PLACES, C3-24 IN 2 PLACES, B4-24 IN 4 PLACES, B3-24 IN 8 PLACES, A4-24 IN 2 PLACES, A3-24 IN 6 PLACES, AND B8-25	02/22/01	SMB
A8-25	01	REFERENCE NOTE 4 WAS REFERENCE NOTE 5 IN ZONES A8-25 AND A3-24	02/22/01	SMB
A8-25	01	REFERENCE NOTE 5 WAS ADDED	02/22/01	SMB
A8-25	01	REFERENCE NOTE 6 WAS ADDED	02/22/01	SMB

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REVISION HISTORY

ZONE	REV	DESCRIPTION	DATE	APPROVED
A3-24	-	CONTINUED FROM SHEET 24	02/22/01	SMB
B8-13	01	ADDED W13 AND W14	02/22/01	SMB
-	01	W22 WAS W17 IN ZONES A5-13 AND D1-13	02/22/01	SMB
C8-25	01	WELD 22 WAS WELD 17	02/22/01	SMB
C5-13	01	W12 WAS W11	02/22/01	SMB
C8-25	01	WELD 12 WAS WELD 11	02/22/01	SMB
C5-13	01	9.525 WAS 10 IN 2 PLACES	02/22/01	SMB
C5-13	01	W11 WAS W10	02/22/01	SMB
C8-25	01	WELD 11 WAS WELD 10	02/22/01	SMB
C4-13	01	W24 WAS W19	02/22/01	SMB
C8-25	01	WELD 24 WAS WELD 19	02/22/01	SMB
C3-13	01	9.525 WAS 9.5	02/22/01	SMB
C3-13	01	W25 WAS W20	02/22/01	SMB
C8-25	01	WELD 25 WAS WELD 20	02/22/01	SMB
C3-13	01	6.35 WAS 6.4	02/22/01	SMB
C3-13	01	W27 WAS W22	02/22/01	SMB
C8-25	01	WELD 27 WAS WELD 22	02/22/01	SMB
C1-13	01	W26 WAS W21	02/22/01	SMB
C8-25	01	WELD 26 WAS WELD 21	02/22/01	SMB
D1-13	01	W23 WAS W18	02/22/01	SMB
C8-25	01	WELD 23 WAS WELD 18	02/22/01	SMB
C7-14	01	ADDED SECTION R-R TO SHOW ADDITION OF W28 IN 4 PLACES	02/22/01	SMB
C8-25	01	ADDED WELD 28	02/22/01	SMB
C8-25	01	ADDED WELD 29	02/22/01	SMB
B7-14	01	ADDED SECTION T-T TO SHOW ADDITION OF W29 IN 4 PLACES	02/22/01	SMB
A8-14	01	ADDED SECTION V-V TO SHOW ADDITION OF W15 WITH REFERENCE NOTE 5	02/22/01	SMB
C8-25	01	ADDED WELD 15	02/22/01	SMB
A3-14	01	ADDED SECTION W-W TO SHOW ADDITION OF W16 WITH REFERENCE NOTE 6	02/22/01	SMB
C8-25	01	ADDED WELD 16	02/22/01	SMB
B3-14	01	ADDED SECTION U-U TO SHOW ADDITION OF W30 IN 4 PLACES	02/22/01	SMB
D6-15	01	OD AND ID REMOVED FROM DIMENSIONS	02/22/01	SMB
B8-15	01	5004 WAS 4955	02/22/01	SMB
A6-16	01	245 DIMENSION WAS REMOVED	02/22/01	SMB
B8-25	01	ADDED WELD 30	02/22/01	SMB
-	01	25.4 WAS 25 IN ZONES C3-17, C8-17, AND D4-24 IN 2 PLACES	02/22/01	SMB
B2-17	01	12.7 WAS 12.5	02/22/01	SMB
-	01	9.525 WAS 10 IN ZONES C6-18 AND C4-24	02/22/01	SMB
-	01	ITEM 13 WAS ADDED IN ZONES B4-18 WITH SECTION Y AND C8-24 IN 2 PLACES	02/22/01	SMB
A4-18	01	ADDED SECTION Y-Y WITH DETAIL EE	02/22/01	SMB
B2-18	01	ADDED DETAIL EE	02/22/01	SMB
-	01	ITEM 12 OUTER SHELL LID LIFTING FEATURE PLATE-1 WAS OUTER SHELL LID LIFTING FEATURE IN ZONES D4-18 AND C5-24 IN 2 PLACES	02/22/01	SMB
D4-18	01	ITEM 12 WAS REDESIGNED	02/22/01	SMB
C4-18	01	SECTION L-L MODIFIED DUE TO ITEM 12 REDESIGN	02/22/01	SMB
C1-18	01	DETAIL U WAS MODIFIED DUE TO ITEM 12 REDESIGN	02/22/01	SMB
A5-19	01	INNER SHELL CLOSURE CONFIGURATION MODIFIED	02/22/01	SMB
B8-19	01	4673 WAS 4635	02/22/01	SMB
D6-20	01	1454 WAS 1430	02/22/01	SMB
-	01	50.8 WAS 50 IN ZONES B8-20 AND C4-24	02/22/01	SMB
B7-20	01	101.6 WAS 102	02/22/01	SMB
B7-20	01	76.2 WAS 76	02/22/01	SMB
B7-20	01	19.05 WAS 19	02/22/01	SMB
A6-20	01	SCALE 2.500 WAS 3.500	02/22/01	SMB
A8-20	01	DETAIL Y MODIFIED DUE TO REDESIGN OF ITEM 20	02/22/01	SMB
A8-20	01	25.4 WAS 25	02/22/01	SMB
-	01	12.7 WAS 13 IN ZONES A7-20 AND A8-20	02/22/01	SMB
D8-20	01	ITEM 20 WAS REDESIGNED	02/22/01	SMB
B7-20	01	SECTION N-N MODIFIED DUE TO REDESIGN OF ITEM 20	02/22/01	SMB
-	01	ITEM 21 INNER LID LIFTING FEATURE PLATE-1 WAS ITEM 18 INNER LID LIFTING FEATURE IN ZONES D5-20 AND C5-24	02/22/01	SMB
D5-20	01	ITEM 21 WAS REDESIGNED	02/22/01	SMB
B5-20	01	SECTION P-P MODIFIED DUE TO REDESIGN OF ITEM 21	02/22/01	SMB
D5-25	-	CONTINUED ON SHEET 25	02/22/01	SMB

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