WBS: 1.2.2
QA: QA

Civilian Radioactive Waste Management System
Management & Operating Contractor

Waste Package Operations FY-00 Closure Weld Technical Guidelines Document

TDP-EBS-ND-000005 REV 00

January 2000

Prepared for:

U.S. Department of Energy
Yucca Mountain Site Characterization
Project Office
P.O. Box 30307
Las Vegas, Nevada 89036-0307

Prepared by:

TRW Environmental Safety Systems Inc.
1261 Town Center Drive
Las Vegas, Nevada 89144

Under Contract Number
DE-AC08-91RW00134

WM-11
NM35D7

INFORMATION COPY
LAS VEGAS DOCUMENT CONTROL

Enclosure 2

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do no necessarily state or reflect those of the United States Government or any agency thereof.

Civilian Radioactive Waste Management System
Management and Operating Contractor

Waste Package Operations FY-00 Closure Weld Technical Guidelines Document

TDP-EBS-ND-000005 REV 00

January 2000

PREPARED BY:

Mark C. Knapp — Date 1/14/00
Waste Package Fabrication
Management and Operating Contractor

CHECKED BY:

Michael J. Plinski — Date 1/14/00
Waste Package Fabrication
Management and Operating Contractor

APPROVED BY:

Jerry A. Cogar — Date 1/14/00
Task Manager, Waste Package Fabrication
Management and Operating Contractor

APPROVED BY:

Hugh A. Benton FOR HAB — Date 1-14-00
Operations Manager, Waste Package Operations
Management and Operating Contractor

INTENTIONALLY LEFT BLANK

CONTENTS

Page

1. STATEMENT OF WORK 1

2. QUALITY ASSURANCE REQUIREMENTS 1
   - 2.1 CONTROLS 2
   - 2.2 RIGHT OF ACCESS 2
   - 2.3 SUB-TIER SUPPLIERS 2
   - 2.4 DOCUMENTATION 2
   - 2.5 RECORD RETENTION 3
   - 2.6 CORRECTIVE ACTION 3
   - 2.7 NONCONFORMANCE 3
   - 2.8 REPORTING 3
   - 2.9 CERTIFICATE OF CONFORMANCE 3
   - 2.10 MEASURING AND TEST EQUIPMENT 4

3. TECHNICAL REQUIREMENTS 4
   - 3.1 TEST PROGRAM OBJECTIVES 4
   - 3.2 TEST PROGRAM 5
     - 3.2.1 Cylinder Construction 5
     - 3.2.2 Welding 5
     - 3.2.3 Residual Stress Measurements 5
     - 3.2.4 Outer Cylinder Anneal 6
     - 3.2.5 Fit and Weld the Inner Lid–Top End 6
     - 3.2.6 Fit and Weld the Outer Lid–Top End 6
     - 3.2.7 Top Lid Ultrasonic Inspection 6
     - 3.2.8 Top Lid Liquid Penetrant Inspect 6
     - 3.2.9 Additional Workscope (Deferred Work) 6
     - 3.2.10 Titanium Drip Shield 7
     - 3.2.11 Induction Heat Test Mockup 7

4. REPORTING REQUIREMENTS 7

5. WORK SCOPE CHANGES 8

6. CONCLUSIONS 8

7. REFERENCES 9
   - 7.1 DOCUMENTS CITED 9
   - 7.2 CODES, STANDARDS, REGULATIONS, AND PROCEDURES 9

8. ATTACHMENTS 11

INTENTIONALLY LEFT BLANK

1. STATEMENT OF WORK

The purpose of this document is to describe the scope and requirements of the fiscal year (FY)-00 Waste Package Engineering Development of Alloy 22/stainless steel (SS) waste package development program (work packages 11012125M3 and 11012125MC) to be conducted by Framatome Technologies, Inc. (FTI) using their Safety Related Quality Assurance Program. The scope of this program will be to fabricate and test a mock-up representing approximately the top one-fourth of the waste package design. This mock-up will be fabricated using the cylinder-in-cylinder thermally enhanced fit method, as well as semi-automatic welding and inspection techniques. Tests will be conducted on the mock-up to determine, to the maximum extent possible, contact between the two cylinders, residual weld stress, and weld quality. This will be done by conducting nondestructive examinations (NDE) as a part of this development program. The intent of the development program is to demonstrate remote welding techniques that exhibit the required properties for stress relieved and non-stress relieved welds and to demonstrate inspection techniques that confirm the integrity of the welds. This program is designed to investigate the feasibility of fabricating and welding an Alloy 22/SS waste package while minimizing the resulting residual stresses in the area of the welds.

2. QUALITY ASSURANCE REQUIREMENTS

This technical guidelines document (TGD) was prepared in accordance with NLP-7-3, *Framatome Cogema Fuel and Framatome Technologies Incorporated Home Office Support* (CRWMS M&O 1998). The information provided in the report is to be indirectly used in the evaluation of the Monitored Geologic Repository (MGR) waste package and engineered barrier segment. The waste package has been identified as Quality Level 1 item in the QAP-2-3 evaluations (e.g., *Classification of the MGR Uncanistered Spent Nuclear Fuel Disposal Container System*) (CRWMS M&O 1999a). The Waste Package Operations (WPO) responsible manager has evaluated the report development activity in accordance with QAP-2-0 Conduct of Activities. The *Activity Evaluation WP Engineering and Fabrication* (CRWMS M&O 1999b) evaluation has determined the preparation and review of the document is subject to *Quality Assurance Requirements and Description* (QARD) (OCRWM 1998) controls. There is no determination of importance evaluation developed in accordance with Nevada Line Procedure, NLP-2-0, *Determination of Importance Evaluations*, since the report does not involve any field activity.

None of the development work performed under direction of this TGD by the FTI personnel will involve use of any computer software subject to QARD controls. Any post-test analyses destined for inclusion in the WPO FY-00 Closure Methods Report, which may be performed utilizing computer software, will only be performed by WPO Las Vegas (LV) personnel, using computer software verified and validated to requirements of the Office of Civilian Radioactive Waste Management (OCRWM) Quality Assurance Requirements and Description. Specific QA requirements are as follows.

2.1 CONTROLS

The work described in the TGD shall be performed under the controls described in the current FTI Safety Related QA Program Manual (with the exception of Section 3.2.10) and shall only use the safety related portion of the manual which implements the applicable QARD requirements. Any applicable QARD requirements that are not addressed by the FTI Safety Related Quality Assurance Program are addressed in this TGD. The FTI QA program shall be accepted by the Management and Operating Contractor (M&O) Task Manager and the Office of Quality Assurance (OQA) prior to the performance of work or service described in this document. Any changes or revisions to the FTI QA Program shall be evaluated and accepted by the M&O, in writing, prior to the implementation of the revision.

2.2 RIGHT OF ACCESS

The Office of Civilian Radioactive Waste Management, CRWMS M&O, its agents or designees, shall have the right to inspect and evaluate FTI facilities, records, and activities at any time during the performance of the work described herein. This right shall extend to sub-tier suppliers and shall be coordinated through FTI.

2.3 SUB-TIER SUPPLIERS

FTI shall be responsible for ensuring that the sub-tier suppliers implement a QA Program commensurate with the work or services rendered. When a sub-tier supplier is used to satisfy the specific actions defined in this TGD, all technical and quality requirements imposed in this document and its supplements shall be transmitted and apply to all sub-tier suppliers. Purchase orders subject to the requirements of the QARD shall contain words to the effect of "Implement your QA program which has been audited and accepted by FTI to meet the FTI Safety Related QA program," and be reviewed by FTI QA for compliance.

Recognizing that there may be no qualified fabricators of the mock-up, FTI may choose to qualify a vendor in accordance with FTI's QA Safety Related Program, direct QA monitoring, or dedicate the mock-up in accordance with their Quality Assurance Manual, Section 7.2.1. Should they choose the latter method, the critical characteristics for the development program are the type of material (i.e., stainless steel and nickel-base alloy) and the physical dimensions of the mock-up. Proving total compliance with all the requirements of the American Society for Testing and Materials (ASTM) specification is not essential since this is a development program utilizing a mock-up of a typical waste package, the designs of which are still in development.

2.4 DOCUMENTATION

Documentation required to be submitted for acceptance, by M&O objective evidence review, is identified in Section 4. All records and reports identified in this TGD must be referenced or be traceable to the TGD and shall be of sufficient quality to be reproduced legibly and be dated and bear the title and signature of an individual who is responsible for the content of the record.

2.5 RECORD RETENTION

Record retention times shall be in accordance with the FTI QA Program as accepted by the M&O with the exception that any records classified by FTI as nonpermanent will be submitted to WPO-LV for inclusion into the records package.

2.6 CORRECTIVE ACTION

Deliverables and work or services performed that do not meet the requirements of the TGD and/or FTI's QA program shall be promptly reported and evaluated in accordance with the FTI corrective action system. These must then be submitted to the M&O for disposition.

2.7 NONCONFORMANCE

FTI shall submit a report of nonconformance to the M&O for approval including recommended disposition and technical justification for the dispositions of "Use-As-Is" or "Repair." Additionally, FTI shall comply with the provisions of the Code of Federal Regulation, Title 10, Part 21, Reporting of Defects and Noncompliance (10 CFR 21). It is understood that due to the material being ordered early and subsequent design changes, nonconforming conditions may exist. These will be handled under the nonconformance process and will be accepted "as is" if they do not violate the critical dimensions on the sketch or effect the end use of the mockup.

2.8 REPORTING

The final report and test results provided to the M&O (WPO-LV) under the terms and conditions of the TGD shall include the following, as applicable:

- Number of the TGD (i.e., TDP-EBS-ND-000005 Rev 00)
- Name of organization (company) performing the test or analysis
- Unique identification of the sample or material analyzed
- Name or identification of the person(s) performing the analysis
- Unique identification of the instruments used in the performance of the analysis
- Unique identification of the reference standard used in the analysis
- Procedure or instruction, and revision, used to perform the analysis.

2.9 CERTIFICATE OF CONFORMANCE

A Certificate of Conformance is required for all hardware or services performed. The Certificate of Conformance shall contain the following as a minimum:

- Identification of the material, equipment, or service provided

- Identification of the specific TGD requirements that are met (Requirements identified shall include any approved changes to the TGD test plan. Where maintenance or rework has been performed, include description of principal activity performed and identification of specific part(s) or hardware replaced.)

- Identification of any TGD requirements that have not been met, together with an explanation and the means for resolving the nonconformance(s)

- Signature or authentication otherwise by a person responsible for this QA function and whose function and position are described in the FTI QA Program.

- A statement that work was performed in accordance with FTI QA program including revision level

2.10 MEASURING AND TEST EQUIPMENT

Measuring and test equipment shall be calibrated by an FTI audited and approved organization and/or may be done in-house using standards that were calibrated by an audited and approved organization, and the calibration documentation shall include the following information:

- Identification of the measuring or test equipment calibrated
- Traceability to the calibration standard used for calibration
- Calibration data (including as-found/as-left data)
- Identification of the individual performing the calibration
- Identification of the date of calibration and the re-calibration due date or interval, as appropriate
- Results of the calibration and statement of acceptability
- References to any actions taken in connection with out-of-calibration or nonconforming measuring and test equipment including evaluation results, as appropriate
- Identification of the implementing document (including revision level) used in performing the calibration.

3. TECHNICAL REQUIREMENTS

3.1 TEST PROGRAM OBJECTIVES

The objective of the test program is to (1) demonstrate that a Alloy 22/SS full cylinder mock-up can be remotely welded using the automatic gas tungsten arc method while limiting the residual stress as a result of the closure weld and (2) complete the ultrasonic investigation resulting in the identification of the minimum detectable defect. The welding and NDE processes must be conducted under the FTI Safety Related QA Program. Residual stress values of the outer cylinder both before and after annealing will be recorded.

3.2 TEST PROGRAM

3.2.1 Cylinder Construction

A mock-up will be constructed consisting of two cylinders (Attachment 1). The outer cylinder will be nickel-based Alloy 22 (CRWMS M&O 1999c), ~1 inch thick by ~52 inches long. The outside diameter of the outer cylinder will be ~62 inches. The inner cylinder will be Nuclear Grade 316 Stainless Steel (CRWMS M&O 1999c), ~2.0 inch thick by ~37 inches long. Four datum lines (A, B, C, and D) shall be scribed on the outer surface of each cylinder, longitudinally from top to bottom and 90 degrees apart. Datum A shall be centered on the longitudinal weld. Locate datum B, C, and D at 90-degree intervals from datum A and in a clockwise direction when viewed from the top. Both cylinders shall also have permanent identification indicating top and bottom. The outer cylinder will be fabricated with a machined or installed ring to support the inner cylinder during the assembly of the inner and outer cylinders. The bottom end lids on each of the cylinders will be welded in place before the installation of the inner cylinder within the outer cylinder. Assembly of the inner cylinder within the outer cylinder will be thermally enhanced and will result in a final inner-outer cylinder interface tolerance of 0 to 4 mm (verified by measurement prior to assembly). The outer cylinder shall be heated to a maximum temperature of 700° F, the inner cylinder is then fully inserted into (inside of) the outer cylinder to the point of contact with the support ring, and allowed to air cool. This mock-up may be fabricated by FTI or sublet in accordance with Section 2.3.

3.2.2 Welding

The bottom lids will be welded on each of the cylinders during the fabrication, prior to the assembly of the two cylinders. The top end (closure) welds will be performed after the cylinder assembly. The configuration and welding process for these welds is to be determined. Welding procedure specifications and performance qualifications for all welds will be in accordance with the *American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code*, Section III, Subsection NB, (ASME 1995), 1995 Edition, 1996 Addenda. The longitudinal weld for the outer cylinder shall be radiographic, ultrasonic, and liquid penetrant inspected. The bottom end welds for both of the cylinders shall be ultrasonic and liquid penetrant inspected. The top end welds will be performed after the cylinder assembly and shall be ultrasonic and liquid penetrant inspected. Inspection of these welds will be in accordance with the *ASME Boiler and Pressure Vessel Code* Section III, Subsection NB, (ASME 1995), 1995 Edition, 1996 Addenda, or repaired/reworked to meet this criteria.

3.2.3 Residual Stress Measurements

Analytical evaluations to predict the residual stresses following welding will not be required. Rather than have a prediction of the stresses, measurements will be taken, so that actual residual stresses can be determined in the areas of the weld and near the weld. All of the measurements will be taken using the ring core method and shall be taken by calibrated equipment in accordance with Section 2.10. Measurements will be taken on the bottom end outer cylinder lid weld at four locations at 90-degree intervals. Measurements will also be taken on the longitudinal weld near each end and in the center of the weld length of the outer cylinder. Each of the measurements shall be taken before and after annealing the outer cylinder. At each location, measurements should be made at the weld centerline, the fusion line, 0.2 inches into the heat affected zone (HAZ) and 0.3 inches into the HAZ.

In addition to the stress measurements, additional measurements may be taken as a result of consultation between FTI and WPO-LV.

3.2.4 Outer Cylinder Anneal

The outer cylinder shall be annealed after the bottom lid has been welded and inspected and stress measurements have been taken. The outer cylinder shall be furnace heated and held at a soak temperature of 2050° F ± 50° F for 20 minutes minimum. Cooling shall be performed using a water spray quench sufficient to cool the entire cylinder at a rate of 100° F/minute from the soak temperature to below 700° F.

3.2.5 Fit and Weld the Inner Lid–Top End

After inner-outer cylinder assembly, the inner top lid is to be welded to the inner barrier using the automatic gas tungsten arc or other fusion welding process. Record the weld parameters; the filler material heat/lot number, type, and size used; and the method (i.e., automatic gas tungsten arc). Record actual arc time and shrinkage as required. These records must be traceable to the mock-up. After the lid is welded, perform the NDE work scope for the inner lid per Sections 3.2.7 and 3.2.8. Chart or describe any distortion to the inner and outer barrier.

3.2.6 Fit and Weld the Outer Lid–Top End

After inner lid welding and inspection, the outer top lid is to be welded to the outer barrier using the automatic gas tungsten arc or other fusion welding process. Record the weld parameters; the filler material heat/lot number, type, and size used; and the method (i.e., automatic gas tungsten arc). Record actual arc time and shrinkage as required. These records must be traceable to the mock-up. After the lid is welded, perform the NDE work scope for the outer lid per Sections 3.2.7 and 3.2.8. Chart or describe any distortion to the inner and outer barrier.

3.2.7 Top Lid Ultrasonic Inspection

After the welding of each of the top lids, ultrasonic inspection shall be performed in accordance with *ASME Boiler and Pressure Vessel Code* Section III, Subsection NB, 1995 Edition, 1996 Addenda, (ASME 1995) acceptance criteria, or be repaired/reworked to meet these criteria.

3.2.8 Top Lid Liquid Penetrant Inspect

After the welding of each of the top lids, liquid penetrant inspection shall be performed in accordance with *ASME Boiler and Pressure Vessel Code* Section III, Subsection NB, 1995 Edition, 1996 Addenda, (ASME 1995) acceptance criteria, or be repaired/reworked to meet these criteria.

3.2.9 Additional Workscope (Deferred Work)

During the FY-99 development program there were two tasks that were unable to be completed per the *Waste Package Operations FY-99 Closure Weld Development Technical Guidelines Document* (CRWMS M&O 1999d). These two tasks need to be completed as part of the FY-00 development program. The two tasks are to complete the development of the plasma arc welding evaluation as part of the weld process strain study (Section 3.2.3.3) and to complete the evaluation of ultrasonic

examination investigation of alternate surface examination techniques (Section 3.2.1.3). These tasks will be completed under the same QA requirements as the FY-00 program and will be reported on in the report on the FY-00 program produced by FTI and the Closure Weld Development document.

3.2.10 Titanium Drip Shield

A scaled model of a drip shield may be fabricated as part of this development program. This will be a build to print mock-up and fabricated from commercially pure titanium Grade 7. The fabrication of this model is dependent on funding, schedule, and material availability as stated in Section 5 of this document. This model will not be subject to the QA controls described in Section 2 as this will be built as a presentation model only.

3.2.11 Induction Heat Test Mockup

A number of mockups will be fabricated to support the induction heating study. These will be straight plate mock-ups and configured similar to the top end of waste package mock-up and will be used to configure the coil for the induction heating and to prove feasibility. The testing performed will be described in another work package. The mock ups will be made from the same material as the waste package mock up. Any additional materials required will require the same material test reports as previously ordered material and will be submitted as part of the final report.

4. REPORTING REQUIREMENTS

FTI will submit weekly reports on the progress of the program schedule and budget information; these will be the basis for discussions on the program. The weekly reports will be submitted no later than the close of business on the last day of the workweek and should be submitted by electronic correspondence. These reports will not become part of the records package because they will contain budget and schedule information.

Hold points will be established at the following points:

- Prior to the start of the program to explain the QA requirements to FTI personnel
- Before welding of the inner and outer bottom lids
- Before outer cylinder anneal
- Before assembly of the inner and outer cylinder
- After the welding the inner cylinder top lid and before the outer cylinder top lid welding.

Other hold points may be established by WPO-LV, if needed. WPO-LV personnel may elect to witness the hold points or waive them by electronic correspondence.

At the conclusion of the closure development testing, FTI will submit a final report and a data package to WPO-LV no later than September 29th, 2000. Included will be, as applicable:

- Final report summarizing the work scope described in the TGD
- Welder and NDE personnel training records
- Weld Procedure Qualifications and Specifications
- Weld Performance Qualifications
- Weld Control Records

- NDE Procedure Qualifications
- All NDE Evaluation Reports
- Completed Process Traveler
- Equipment Calibration Records
- Cylinder Assembly Measurements (0-4mm)
- Stress Measurement Procedures and Records
- Materials Test Reports
- Nonconformance Reports.
- Heat Treat (Annealing) records
- Certificate of Conformance
- QA Requirements listed in Section 2.8

NOTE: All records must be entirely legible. There may be no obliterated areas. Records may not contain restrictions on publication such as copyright limitations. The acceptance criteria for all of the welding data will be the ability to duplicate the weld process based on the data provided. This will be determined by WPO-LV.

The data package will be used by WPO-LV to develop the WPO FY-00 Closure Methods Report for this development program. This report will be the responsibility of Waste Package Fabrication Department, and they will have the responsibility for all of the data included in the report. The acceptance of the content of the program will be by submittal of an acceptance document to CRWMS M&O. The acceptance document will contain the data supplied by FTI and the Certificate of Conformance issued by FTI. Acceptability of the performance of the program will be by audit or other methods, as QA deems appropriate.

5. WORK SCOPE CHANGES

Because this is a development program, there may be minor changes in Section 3, "Technical Requirements," as a result of the learning process associated with this type of program. This TGD will not be revised for these changes, unless other circumstances require a revision. These work scope changes will be identified by formal correspondence or FTI nonconformance process and must be approved by WPO-LV. Changes in the work scope may be determined by budget and material availability. All work scope changes will be detailed in the WPO FY-00 Closure Methods Report published by WPO-LV.

6. CONCLUSIONS

The purpose of this closure weld development program is to demonstrate that it is feasible to weld a circular weld the size of the waste package using a remote welding method. The success of the development program will be a weld that is visually acceptable and capable of the required NDE utilizing the *ASME Boiler and Pressure Vessel Code*, Section III, Subsection NB, 1995 edition, 1996 addenda, Article NB-5000 (ASME 1995). This will be proven by the actual performance of the NDE portion of this development program. The criteria for the acceptance of the waste package closure weld have not yet been established; however, for this development program, the weld will be considered acceptable if it meets the ASME acceptance criteria or is repairable to meet these criteria. Upon completion, the mock-up will be sent for further testing as determined by WPO-LV.

7. REFERENCES

7.1 DOCUMENTS CITED

CRWMS M&O (Civilian Radioactive Waste Management System Management and Operating Contractor) 1998. *Framatome Cogema Fuel and Framatome Technologies Incorporated Home Office Support.* NLP-7-3 REV 02. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980217.0604.

CRWMS M&O 1999a. *Classification of the MGR Uncanistered Spent Nuclear Fuel Disposal Container System.* ANL-UDC-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990928.0216.

CRWMS M&O 1999b. *WP Engineering and Fabrication – 1101 2125 M3.* Activity Evaluation. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19991001.0151.

CRWMS M&O 1999c. *License Application Design Selection Feature Report: Waste Package Corrosion Resistant Materials (Metal and Ceramic) (Design Feature 14).* B00000000-01717-2200-00216 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990319.0409.

CRWMS M&O 1999d. *Waste Package Operations FY-99 Closure Weld Development Technical Guidelines Document.* BBA000000-01717-2500-00017 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990511.0239.

OCRWM (Office of Civilian Radioactive Waste Management) 1998. *Quality Assurance Requirements and Description.* DOE/RW-0333P REV 08. Washington D.C.: U.S. Department of Energy (DOE). ACC: MOL.19980601.0022.

7.2 CODES, STANDARDS, REGULATIONS, AND PROCEDURES

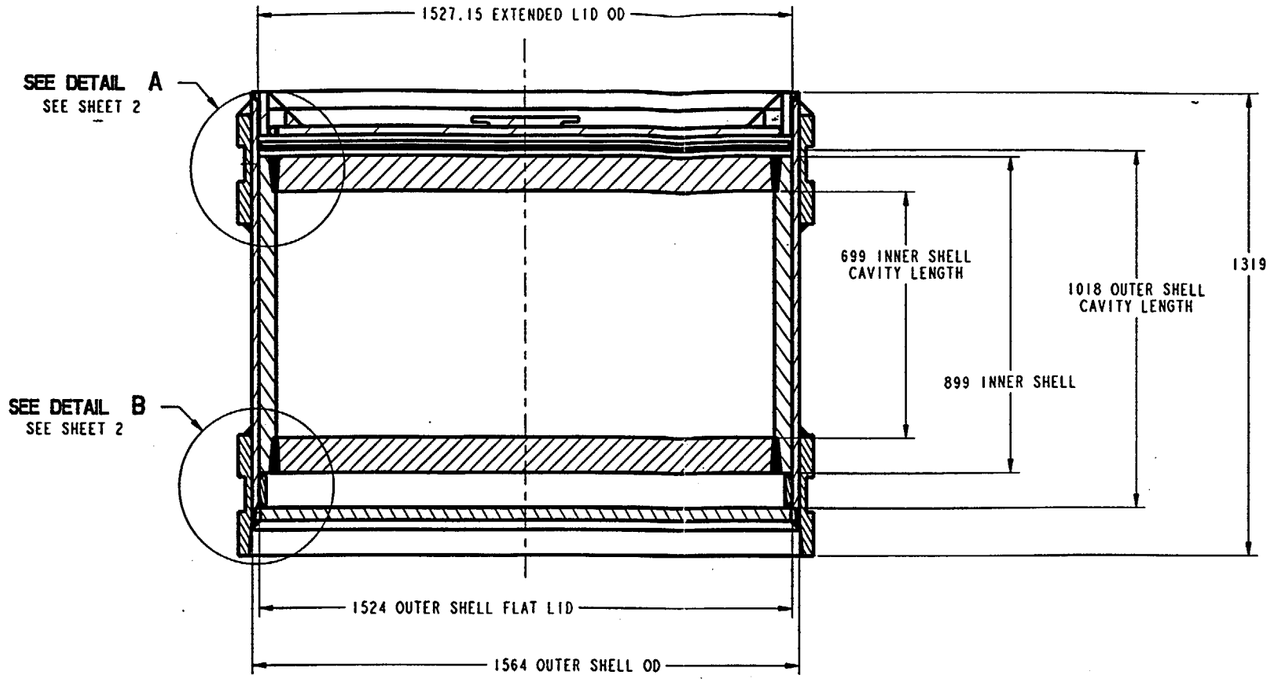
10 CFR (Code of Federal Regulations) 21. Energy: Reporting of Defects and Noncompliance. Readily Available.

ASME 1995. *ASME Boiler and Pressure Vessel Code.* Section III, Rules for Construction of Nuclear Power Plant Components. Division 1 – Subsection NB. New York, New York: ASME. TIC: 245287.

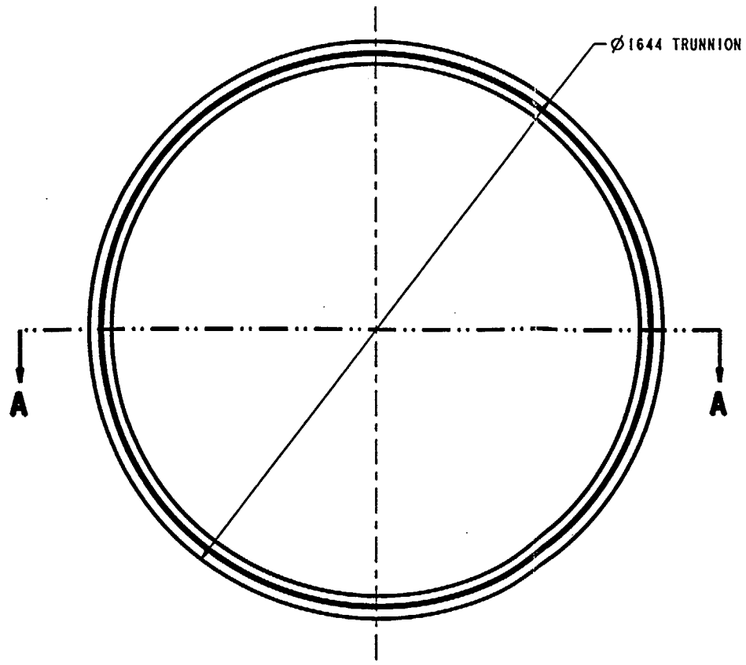
INTENTIONALLY LEFT BLANK

8. ATTACHMENTS

Attachment 1 – SK-0188 REV 02 *Waste Package Mock-up Weld Configuration* (2 Pages)



SECTION A-A

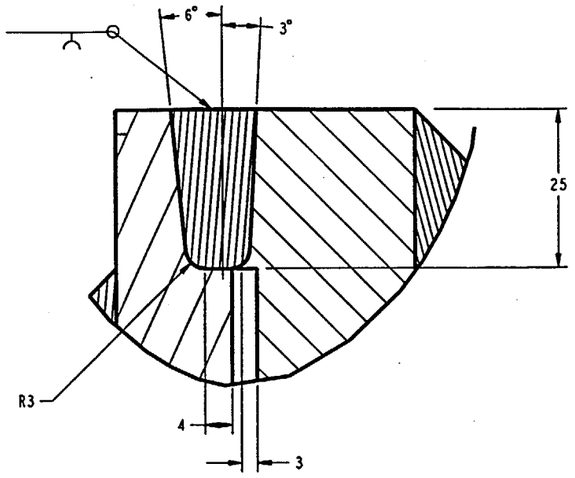


UNITS: mm

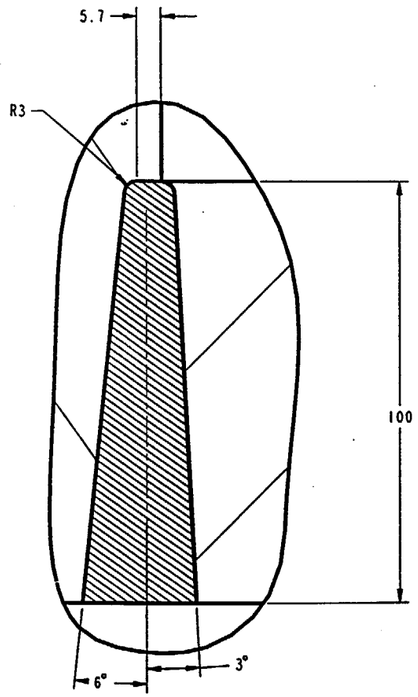
DO NOT SCALE FROM SKETCH

"FOR INFORMATION ONLY"

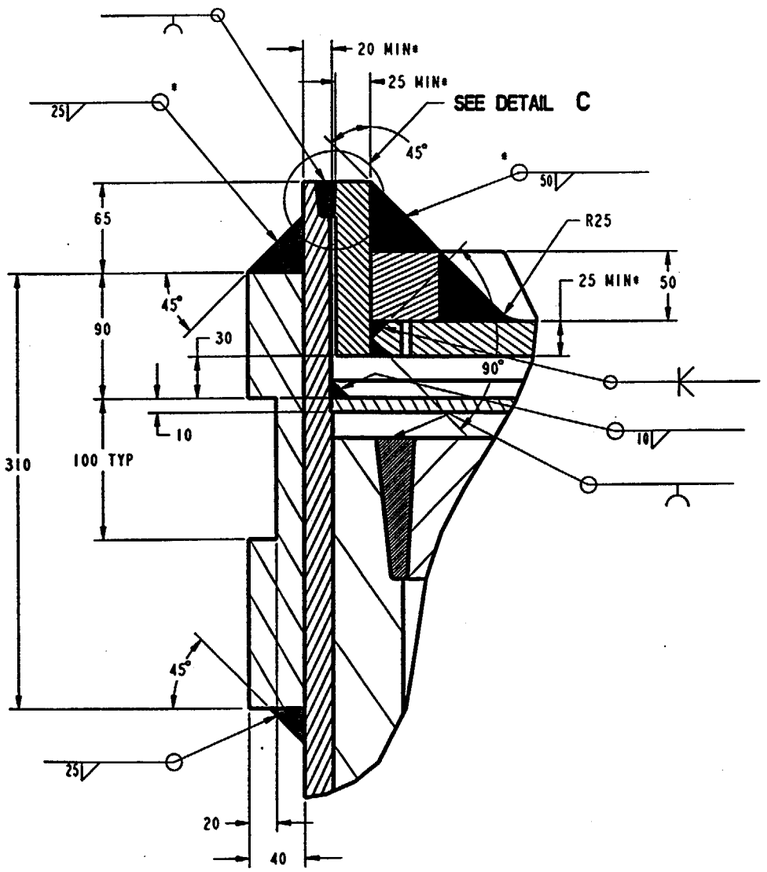
WASTE PACKAGE MOCK-UP WELD CONFIGURATION		
SKETCH NUMBER:	SK-0188 REV 02	SHEET 1 OF 2
SKETCHED BY:	GENE CONNELL	
DATE:	01/14/2000	
FILE:	/home/connell/proe/heat_treated_wp_designs/sk-0188_rev01.dwg	



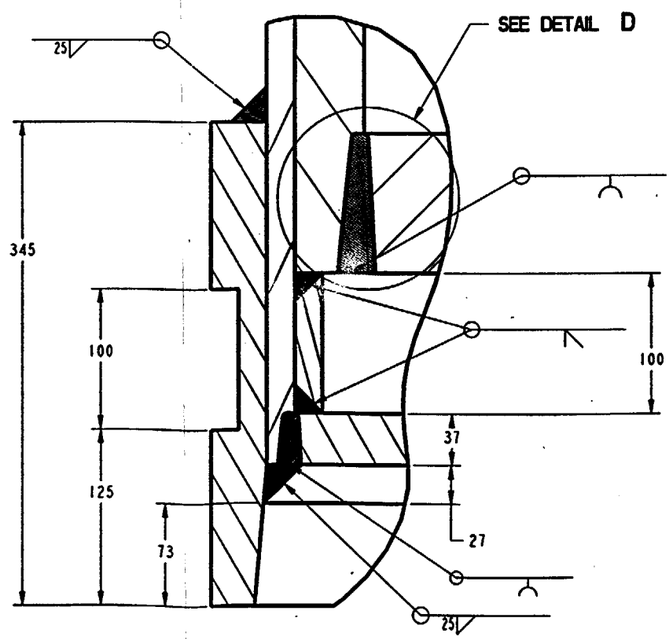
DETAIL C
SCALE 1.5



DETAIL D
SCALE 1.5



DETAIL A
SCALE 0.500



DETAIL B
SCALE 0.500

NOTES:

1. * REFERS TO CRITICAL DIMENSIONS