STA. 42
FEB 26 1997

ENGINEERING DATA TRANSMITTAL

Page 1 of 2
1. EDT 618172

2. To: (Receiving Organization) Distribution		3. From: (Originating Organization) WESF Capsule Management Team		4. Related EDT No.: N/A	
5. Proj./Prog./Dept./Div.: WESF		6. Design Authority/ Design Agent/Cog. Engr.: KA Jennings-Mills		7. Purchase Order No.: N/A	
8. Originator Remarks: Document issued for review and approval				9. Equip./Component No.: N/A	
				10. System/Bldg./Facility: WESF	
11. Receiver Remarks: 11A. Design Baseline Document? ☐ Yes ☒ No				12. Major Assm. Dwg. No.: N/A	
				13. Permit/Permit Application No.: N/A	
				14. Required Response Date: 10 Feb 1997	

15. DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Approval Designator	Reason for Transmittal	Originator Disposition	Receiver Disposition
1	HNF-SD-WM-FDC-056	-	0	Functional Design Criteria for WESF Type-W CsCl Capsule Overpack	SQ	1	1,2	1,2

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

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)											
(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
1,2	1	Design Authority:	KA Jennings-Mills	2/20/97	S6-51	1,2		RE Heinemann, Jr	RE Heinemann, Jr	2/20/97	S6-60
1,2		Design Agent: n/a				1,2	1	PT Saueressig	PT Saueressig	2/17/97	S6-51
1,2	1	Cog.Eng.: MM Pereira	MM Pereira	2-20-97	S6-51	1,2	1	KA Hedquist	KA Hedquist	2-12-97	S6-51
1,2	1	Cog. Mgr.: JL Pennock	JL Pennock	2-20-97	S6-51	1,2	1	LARRY BRIS	LARRY BRIS	2/18/97	
1,2	1	QA: MA Hill	MA Hill	2-20-97	S4-68						
1,2	4	Safety: EN Dode	EN Dode	2/14/97	S6-86						
1,2	1	Env.: SE Killoy	SE Killoy	2/19/97	S4-69						

18. KA Hedquist <i>KA Hedquist</i> Signature of EDT Originator Date 2-20-97		19. <i>KA Hedquist</i> Authorized Representative Date for Receiving Organization		20. <i>Pennock</i> Design Authority/Cognizant Manager Date 2-21-97		21. DOE APPROVAL (if required) Ctrl. No. I Approved II Approved w/comments III Disapproved w/comments	
---	--	---	--	---	--	---	--

Functional Design Criteria for WESF Type-W CsCl Capsule Overpack

K. A. Hedquist

B and W Hanford Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

EDT/ECN: 618172

UC: 510

Org Code: 16E00

Charge Code: KWDPN

B&R Code: EW7002010

Total Pages: 10 11 *BW 2/20/97*

Key Words: Type-W, WESF Capsules

Abstract: This Functional Design Criteria is designed to summarize and give guidance during the development of design, manufacturing and testing specification documents. As the overview document bounding parameters are specified with detailed acceptance criteria to be developed in the more detailed and separate design, manufacturing and testing specification documents.

TRADEMARK DISCLAIMER. 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.

Printed in the United States of America. To obtain copies of this document, contact:
WHC/BCS Document Control Services, P.O. Box 1970, Mailstop H6-08, Richland WA 99352,
Phone (509) 372-2420; Fax (509) 376-4989.

[Signature] *2/26/97*
Release Approval Date
Release Stamp

Approved for Public Release

Functional Design Criteria

WESF Type-W CsCl Capsule Overpack

Issued by:

B & W HANFORD COMPANY

February 20, 1997

Prepared By:	K. A. Hedquist WESF Baseline Support	Feb 12, 1997
BWHC Approvals:	M. M. Pereira System Engineer, WESF Capsule Management Team	Feb 20, 1997
	P. T. Saueressig Team Coordinator, WESF Capsule Management Team	Feb 19, 1997
	J. L. Pennock Project Activity Manager, WESF	Feb 20, 1997
	R. E. Heineman, Jr. Director, B Plant/WESF	Feb 20, 1997

This page intentionally left blank

Table of Content

	Page #
1.0 INTRODUCTION	4
1.1 Scope	4
1.2 Background	4
2.0 FUNCTIONAL CRITERIA	5
3.0 PROCESS CRITERIA	5
4.0 FACILITY CRITERIA	5
5.0 GENERAL CRITERIA for Type-W Overpack	5
5.1 Dimensions, tolerances and finishes	5
5.2 Calculations and Analyses	6
5.3 Material Parameters	6
5.4 Performance Testing	7
5.5 Inspections and Assembly	8
5.6 Records	9
5.7 Quality Assurance	9
6.0 CODES AND STANDARDS	9
7.0 REFERENCES	10
7.1 Type-W Specifications and Drawings	10
7.2 DOE and Other Government Manuals	10
7.3 Other Supporting Documents	10

1.0 INTRODUCTION

1.1 Scope

This document provides guidance for the design, fabrication and performance testing requirements of an additional outer containment (designated Type-W overpack) to be applied to the WESF CsCl capsules in which:

- 1) The integrity of the original double capsule barrier as provided in the WESF CsCl capsule design is not intact, or
- 2) movement of the internal capsule cannot be detected when the outer capsule is rotated end-to-end or shaken vertically (i.e. swollen inner capsule).

1.2 Background

From 1967 to 1983, cesium and strontium byproducts were recovered from Hanford nuclear waste following removal of plutonium and uranium from spent nuclear fuel. The major incentive for the recovery of cesium and strontium was reduction of the heat generation rate in the waste tanks due to radioactive decay of the cesium and strontium isotopes. Removal of these two heat producing elements provided a 90% reduction in heat generation in neutralized waste from 1-year-old fuel, thus reducing the temperature in the waste tanks. The cesium was recovered from the Hanford waste stream beginning in 1967 and was purified, converted to cesium chloride and encapsulated from 1974 to 1983, resulting in 1577 capsules containing a significant curie content of Cs^{137} (decayed to 100 MCi Cs^{137} and equilibrium daughters in January 1997). Capsules containing the CsCl were fabricated in the Waste Encapsulation and Storage Facility (WESF) at Hanford. The CsCl was doubly encapsulated in 316L SS tubular components to provide containment of the CsCl.

Although the capsules were designed specifically for containment of the CsCl in the WESF storage pool environment, several commercial firms petitioned the U.S. Department of Energy to obtain this material for radiation sterilization of commercial products. A total of 794 capsules were leased to three firms.

There are a total of 16 capsules which were returned following service at these commercial firms that are now in the 327 facility (13) and WESF F-cell (3). 12 of 13 capsules stored in the 327 facility were placed in seal welded overpacks designated Type-S for temporary storage. The 16 capsules do not meet the WESF pool cell storage requirements and require either removal of the outer Type S overpack capsule and installation of an original WESF outer capsule over any single capsule and all require a new Type W overpack. This will allow long term storage at WESF and be compatible with the original WESF capsules and the WESF Safety Basis.

2.0 FUNCTIONAL CRITERIA

The Type-W overpack must be capable of long term underwater storage and handling in the WESF storage pools. The functional design and performance of the overpack must meet the conditions listed below.

3.0 PROCESS CRITERIA

In order to install the new Type W overpack, custom equipment shall be provided to facilitate assembly, inspection and handling in the 324/327 buildings during assembly.

The Type-W overpack must be compatible with the current capsule surveillance and handling methods within the WESF facility and allow long term underwater storage.

4.0 FACILITY CRITERIA

The Type-W overpack physical configuration shall be compatible with the WESF facility configuration. Transfer to and examination in G-Cell, and movement through the transfer tube to the pool cell storage area is required. Retrieval from the pool cell area for later examination in G-cell shall be accomplished within the bounds of the facility current design and equipment.

The Type-W overpack shall be evaluated against the current Safety Analysis Report (SAR) and the Contractor approved Basis for Interim Operation (BIO). Any supplemental analysis required shall be completed prior to storage of overpacked capsules within the WESF storage pools.

5.0 GENERAL CRITERIA for Type-W Overpack

The following requirements are summarized briefly here. The detailed supporting specifications and acceptance criteria are to be defined per the documents listed in Section 7.1.

5.1 Dimensions, tolerances and finishes

The nominal finished tubing shall meet the following parameters:

Maximum outside diameter 3.250 inches.

Minimum inside diameter 2.945 inches.

Cut to minimum lengths of 21.225 inches after required testing.

The inside tubing diameter is designed to produce a minimum gap between the swollen WESF outer capsule and the Type-W overpack similar to the original WESF inner and outer capsule gap. The maximum swollen capsule outer diameter will be assumed to be 2.80 inches, which is the inside diameter of the ring gage used to test the swollen capsules prior to Type S overpacking.

The wall thickness to be determined as required to meet or exceed the original WESF inner

capsule testing performance (SAND82-1492). The performance tests shall be those listed in section 5.4.

The tubing shall be free of bends and the bow shall not exceed 0.017 inches over the length of the finished tube.

Maximum acceptable eccentricity shall be 0.014 inches as defined and measured by the difference between the maximum and minimum wall thickness at any cross-section.

Visual inspection shall be performed at a minimum of 100 foot candles of lighting.

Tubes and end caps shall be free of scale, oil, grease, lubricants, residue from cleaning solutions, or other foreign materials. Visible cracks shall be cause for rejection.

The finished tubing shall have both inside and outside surface finishes not exceeding 125 RMS.

5.2 Calculations and Analyses

Calculations shall be performed as required to ensure the Type-W overpack capsule will perform the same as the original WESF inner capsule and that the Type-W performance testing will demonstrate the overpack exceeds the requirements defined in Section 5.4.

5.3 Material Parameters

5.3.1 Composition

- Tubing and end cap plate shall be 316L stainless steel which conforms to and shall be characterized in accordance with the applicable requirements of ASTM A 269, A 240 and A 450.
- Tubing shall be provided in the fully solution annealed condition.
- Average grain size shall be 5 or finer as determined in accordance with ASTM E 112.

5.3.2 Testing/Inspections

The entire volume of tubing shall be inspected/tested for the following:

- ultrasonically measured for thickness per ASME Sec V, Art 5.
- longitudinal and/or transverse discontinuities using pulse echo shear wave technique with a 15% or greater indexing overlap, based on the smallest sensing diameter of the sensing transducers used.
- laminations using pulse-echo back reflection technique with a 10% or greater indexing overlap, based on the smallest sensing diameter of the sensing transducers used.
- Finished tubing shall be tested for susceptibility to intergranular attack in accordance with ASTM A 262, Practice A.
- Annealed tensile property testing shall be in accordance with ASTM A 370.

- A flattening test prescribed in ASTM A 450, Paragraph 17.
- A flaring test per ASTM A 450, Paragraph 19.
- Hydrostatic test per ASTM A 450 required pressure ± 25 psi prior to dimensional and non-destructive testing.
- Tested for corrosion resistance to intragranular cracking per ASTM A 262.
- Tested for annealed tensile properties per ASTM A 370.

5.4 Performance Testing

The overpacks must meet the performance tests of ANSI N43.6-1977(R1989) {Formerly N542-1977} and Special Form testing.

The highlighted tests below are to be performed on a minimum of two test dummies for each listed test. Each test dummy shall be manufactured with the same material and procedures as the Type-W overpack. These tests shall demonstrate that the Type-W overpack meets the containment boundary requirements of the original inner capsule.

Performance Feature	ANSI Requirements ¹	Special Form Requirements ²	WESF Capsule Tested Performance ³
Temperature	-40°C (20min) +400°C (1h) (Class 4)	800°C (10 min)	871°C (90 min)
Thermal Shock	400°C to 20°C (3 times) (Class 4)		800°C to 20°C (10 times)
External Pressure	25 kN/m ² abs to 2 MN/m ² abs (290 lb/in ² abs) (Class 3)		1.0 MN/m ² to 4.8 MN/m ² abs (1.0 atm to 47.3 atm)
Impact	2 kg (4.4 lb) from 1 m (Class 4)		5 kg (11 lb) from 1 meter
Impact (drop test)	None	9.15meters (30 ft) drop onto an unyielding surface	32.8 ft drop onto unyielding surface
Vibration	30 min at 25 to 500 hz at 5 g peak amp. (Class 2)	None	None
Puncture	50 g pointed rod (1.76 oz) from 1 m (Class 4)	2.54cm (1 inch) diameter billet, 1.4 kg from 1 m	Capsule drop (2.7kg) onto a pointed rod from 4.6 m

1. N43.6-1977(R1989) [Formerly ANSI N542-1977], Sealed Radioactive Sources, Classification
2. 49CFR173.469, Special Form Requirements
3. Kenna, B. T. , 1984 Sandia Report SAND82-1492, "WESF ¹³⁷Cs Gamma Ray Sources"

5.5 Inspections and Assembly

5.5.1 Inspections of capsules prior to Type-W overpacking

- All capsules shall be radiologically surveyed for removable surface contamination and decontaminated to less than 200 cpm above a maximum of 200 cpm background prior to being placed in the Type-W overpack.
- Any capsule with only a single WESF inner capsule shall have a WESF original outer capsule and end cap installed and seal welded prior to being placed in the Type-W overpack. Visual inspections are required of this seal weld to check for porosity and completeness of weld.
- A ring gage 2.840 inch $+0.000/-0.005$ inches inside diameter by twelve inches long shall pass of its own weight over each damaged capsule.

5.5.2 Assembly

The Type-W overpack shall be assembled and welded per the specifications listed in Section 7.1.

5.5.3 Testing

The overpack shall be helium leak checked immediately after welding in accordance with WHC-CM-4-38 to assure a helium leak rate less than 1×10^{-8} Std cc/sec for the following:

- Each welded tube and bottom end cap assembly.
- The final overpack weld.

All testing shall be completed using qualified procedures and personnel that meet the requirements of Section 5.7.

5.5.4 Inspections

The welds shall be inspected at 3X magnification.

Outer assembly surfaces exclusive of the weld shall be visually reinspected at 2X after welding.

Inspect the tube, end caps and weld area for the following:

- The completed tube and end cap assembly shall be free of scales, oil, grease, lubricants, or other foreign materials.
- Scratches, nicks, dings, pits or dents not located in the weld shall not exceed either 1/16 inch in length or 0.015 inch in depth.
- The weld or weld zone which must be free of any cracks, crevices and any surface porosity by rotating capsule a full 360° so the entire weld of both the hot and cold ends can be visually inspected.
- Any defects indicating corrosion or other unusual surface conditions that would compromise integrity of the capsule.

Both 'cold' and 'hot' end welds shall be examined ultrasonically per ASME Sec V, Art 5.

5.6 Records

Records of the material identity with respect to grade and manufacturing certification shall be maintained. Written and signed records of all data supporting acceptance of the components and assemblies shall be completed. All records and documents shall be generated and maintained in accordance with the programmatic QA Plan.

5.7 Quality Assurance

Design, material, fabrication and testing shall be accomplished in accordance with HNF-CM-4-2 and Quality requirements shall be applied appropriate to Safety Class, HNF-CM-4-46 (old SC1), equipment and systems. Care shall be taken to assure all phases of this activity are performed by qualified personnel. Certified materials and evaluated suppliers shall be used as required by HNF-CM-4-2.

6.0 CODES AND STANDARDS

▶ ASME Sec V Art 5	Ultrasonic Examination
▶ ASME Sec V Art 6	Liquid Penetrant Examination
▶ ASME Sec V Art 10	Helium Leak Testing
▶ ASME Sec IX	Welding and Brazing Qualifications
▶ ASTM A 240	Standard Specifications for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
▶ ASTM A 262	Recommended Practice for Detecting Susceptibility to Intergranular Attack in Austenitic-Stainless Steel
▶ ASTM A 269	Seamless Welded Austenitic Stainless Steel Tubing for General Service
▶ ASTM A 370	Standard Methods and Definitions for Mechanical Testing of Steel Products
▶ ASTM A 450	Specifications for General Requirements for Carbon, Ferritic Alloy and Austenitic Alloy Steel Tubes
▶ ASTM E 112	Standard Test Methods for Determining Average Grain Size
■ SNT-TC-1A (R1992)	Personnel Qualification and Certification in Nondestructive Testing
■ N43.6-1977(R1989)	ANSI N542 American National Standard, "Classification of Sealed Radioactive Sources".

7.0 REFERENCES

The following reference sources are to be used in the procurement, testing and assembly of the Type-W CsCl capsule overpack.

7.1 Type-W Specifications and Drawings

- ▶ HNF-SD-WM-EMS-001 Type W Capsule Overpack Tubing Specification
- ▶ HNF-SD-WM-EMS-002 Type W Capsule Overpack End Cap Specification
- ▶ HNF-SD-WM-TCP-008 Type W Capsule Overpack Assembly Specification
- ▶ HNF-SD-WM-TS -007 Type W Capsule Overpack Testing Specification
- ▶ H-3-307504 Type W Capsule Overpack Assembly and Details

7.2 DOE and Other Government Manuals

- ▶ HNF-CM-4-2 Quality Assurance Manual
- ▶ WHC-CM-4-38 Nondestructive Examination Procedures
- ▶ HNF-CM-4-46 Safety Analysis Manual
- ▶ WHC-RT4000 App C Capsule, Fuel, and Absorber Radiography
- ▶ 49 CFR 173.469 Special Form Requirements
- ▶ SAND82-1492 WESF 137 Cs Gamma Ray Sources

7.3 Other Supporting Documents

- ▶ H-2-66413 Structural Capsule Storage Rack
- ▶ H-2-66760 Cs Inner Capsule Assembly and Details
- ▶ H-2-66761 Cs Outer Capsule Assembly and Details
- ▶ H-2-66807 Details Capsule Transfer Device
- ▶ H-2-66808 Underwater Transfer Port Assembly

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	K. A. Hedquist	Date 21 Feb 1997
Project Title/Work Order		EDT No. 618172
HNF-SD-WM-FDC-056 Rev. 0		ECN No. n/a
Functional Design Criteria for WESF Type-W CsCl Capsule Overpack		

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
------	------	-----------------------------	-----------	------------------------------	-----------------

J. S. Durham	L1-02	X			
D. T. Evans	T1-98	X			
G. O. Hayner	L5-65	X			
K. A. Hedquist	S6-81	X			
R. E. Heineman	S6-65	X			
M. A. Hill	S4-69	X			
K. A. Jennings-Mills	S6-81	X			
S. E. Killoy	S6-69	X			
G. E. Kulynych	H5-31	X			
G. L. McCormick	H5-31	X			
J. L. Pennock	S6-81	X			
M. M. Pereira	S6-81	X			
P. E. Roege	S4-69	X			
P. T. Saueressig	S6-51	X			
D. M. Turner	R3-56	X			
M. K. Ullah	S6-69	X			
Central Files (1 copy + original	A3-88	X			

Parsons Infrastructure & Tech. Group, Inc

J. Haberman