2
SEP 16 1994

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT

142128

2. To: (Receiving Organization) Engineering Development		3. From: (Originating Organization) Restoration Projects		4. Related EDT No.: N/A							
5. Proj./Prog./Dept./Div.: Solid Waste Management		6. Cog. Engr.: R. S. McBeath		7. Purchase Order No.: N/A							
8. Originator Remarks: Approval by September 1, 1994.				9. Equip./Component No.: N/A							
				10. System/Bldg./Facility: 305 Building							
11. Receiver Remarks:				12. Major Assm. Dwg. No.: N/A							
				13. Permit/Permit Application No.: N/A							
				14. Required Response Date: September 1, 1994							
15. DATA TRANSMITTED											
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition			
1	WHC-SD-WM-TP-263		0	Elevated Drum Testing - Phase I Test Plan	SQ	1	1	1			
16. KEY											
Approval Designator (F)		Reason for Transmittal (G)			Disposition (H) & (I)						
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)		1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)			1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged						
(G)	(H)	17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)						(G)	(H)		
Reason	Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	Reason	Disp.
1	1	Cog.Eng. RS McBeath	RS McBeath	9/6/94	H5-71						
1	1	Cog. Mgr. TL Erickson	TL Erickson	9/6/94	H5-33						
1	1	QA DL Vance	DL Vance	9/12/94	T4-06						
1	1	Safety DJ Hart	DJ Hart	9/12/94	B3-54						
		Env.									
1	1	PV Meeuwse	PV Meeuwse	9/6/94	L6-13						
1	1	GL Neer	GL Neer	9/6/94	L6-13						
18.		19.		20.		21. DOE APPROVAL (if required) Ctrl. No.					
R. S. McBeath Signature of EDT Originator		G. L. Neer Authorized Representative Date for Receiving Organization		T. L. Erickson Cognizant Manager Date		☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments					

BD-7400-172-2 (04/94) GEF097

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BD-7400-172

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Document Number: WHC-SD-WM-TP-263, REV. 0

Document Title: Elevated Drum Testing Phase 1 Test Plan

Release Date: 9/15/94

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**This document was reviewed following the
procedures described in WHC-CM-3-4 and is:**

APPROVED FOR PUBLIC RELEASE

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WHC Information Release Administration Specialist:

N. L. Solis

N.L. SOLIS

(Signature)

9/15/94

(Date)

SUPPORTING DOCUMENT

1. Total Pages 25

2. Title Elevated Drum Testing-Phase 1 Test Plan	3. Number WHC-SD-WM-TP-263	4. Rev No. 0
5. Key Words Drum Drop, Combustion, Stacking, Storage APPROVED FOR PUBLIC RELEASE	6. Author Name: RS McBeath PV Meeuwssen <i>RS McBeath</i> Signature Organization/Charge Code 87330/A1871	
7. Abstract <i>9/15/94 D. Solis</i>		
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9. Impact Level SQ		

MASTER

WHC-SD-WM-TP-263
Revision 0

**ELEVATED DRUM TESTING
PHASE I TEST PLAN**

September 1, 1994

P. V. Meeuwsen
R. S. McBeath

Westinghouse Hanford Company
Richland, Washington

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Elevated Drum Testing Phase I Test Plan

1.0 INTRODUCTION

1.1 BACKGROUND

An important part of the Hanford environmental mission is the packaging, transportation, and storage of solid radioactive wastes in metal drums. Presently storage drums are placed four to a wooden pallet with the drums banded to each other. Palletized drums are stacked three units high in pre-engineered steel structures in the 200 Area of the Hanford site.

Storage space for drums in the Central Waste Complex (CWC) and the Waste Receiving And Processing Facility (WRAP) is limited. Permitted storage space is expensive to construct, maintain, and operate. Storage capacity is increased if additional drums can be stacked within existing facilities and a cost savings over new construction realized.

1.2 PURPOSE

The purpose of this plan is to outline the testing required to provide the safety criteria for elevated (i.e., tiers of four high) drum storage. Based on the *"Central Waste Complex Waste Safety Analysis Report, FSAD Upgrade"* (Cain, 1993), the major safety concern with elevated drum storage is the danger of a "significant" fire in the storage facility. The major fire load within the storage facilities is combustible material contained in the drums. If a seismic event, fork lift accident, or other credible incident were to cause drum failure or lid separation, combustible material could be available for fuel.

The goal of this testing is to find if drums could be stacked four units high without increasing the potential fire load in the facilities. To increase the initial burn in the facilities, the drums must spill their combustible contents, making them free for ignition. If, through testing, it can be shown that there is not sufficient damage to the drums to allow for release of their solid contents, then the data used for safety documentation will be re-examined.

The testing described in this document will become the basis for the Safety Analysis Report (SAR) revision. The Phase 1 testing will support storage within the CWC and WRAP Facilities. Future Phase 2 testing will be conducted to support the W-112 automated stacker/retriever storage system and TRU Retrieval.

Preliminary tests conducted in the configurations detailed in this test plan have shown that drums maintain their integrity; that is the drum covers remain attached and the drums do not breach. These tests will be conducted by

Westinghouse Hanford Company, Equipment Development organization, who is the designated DOE Center of Excellence to conduct drop tests for Department of Transportation (DOT) certification of DOE designed packages and containers.

2.0 TEST DESCRIPTION

2.1 FACILITIES, EQUIPMENT, AND PERSONNEL

All tests will be conducted in the 305 Building. Drum drop tests will be performed on the unyielding drop pad in the 305 Building pit area. This drop pad is built to the *Code of Federal Regulations* (49 CFR) to certify DOT packaging.

Verification of all instrument and scale calibrations shall be performed prior to their use in the test. The calibration data shall be recorded in the area provided on the data sheet shown as Appendix A.

All testing will be conducted by Westinghouse Equipment Testing personnel. Westinghouse Quality Assurance shall provide oversight personnel. Test personnel will be trained and qualified in crane operation.

2.2 TEST EXCEPTIONS

This test sequence may be altered by approval of the Test Director (TD). Westinghouse Safety will approve changes to the test procedure if thought necessary by the TD. Any exceptions to the test procedure will be recorded in the space provide on the data sheet.

2.3 TEST DATA

Data collected during testing shall consists of completed data sheets (Appendix B), still photos, and video. Photographs and video will be marked "Information Only". All original data and documentation shall be maintained by Engineering Testing. Test article(s) will be stored at the 305 Building until the final test report is issued.

2.4 TEST SEQUENCE

Testing will be broken into four stages as outlined below.

STAGE I.....	DOT-17 C drum (55 gal), 132 in. drop
STAGE II.....	DOT-17 H drum (55 gal), 132 in. drop
STAGE III.....	(4) DOT-17 C drums banded and on pallet (55 gal), 132 in. drop.
STAGE IV.....	(4) DOT-17 H drums banded and on pallet 55 gal), 132 in. drop.

2.5 TEST ARTICLE

The drums weights selected give the maximum energy to the dropped package. Less than 3% of waste drums weigh over 500 lbs and less than 1% weigh over 1000 lbs. The average drum weight is 174 lbs.

The drop height of 132 in. (11 ft) is 1 ft higher than three drum/pallet stacks (3 x 40" = 120") supporting the fourth tier and is equal to the highest possible dropped drum in Project W-026, WRAP 1.

Each test configuration is repeated three times, the identical procedure used to qualify DOT certifications.

STAGE I

Drums used for Stage I testing will be DOT-17C, 55 gal drums. These drums shall be loaded with moist sand and lead bricks. Gross weight of each drum will be 1000 lbs. Three drums are required.

STAGE II

Drums used for Stage II testing will be DOT-17 H, 55 gal drums loaded the same as Stage I above. Three drums are required.

STAGE III

Four DOT-17C drums will be loaded on a wooden pallet and banded in a manner identical to the practices in the CWC. Two of the drums will be loaded to 500 lbs. gross weight, and two loaded to 174 lbs. gross weight. Load the pallet so that the heavier drums fall onto the lighter weight drums. The 175 lb. drums will be placed on the pallet so that their locking ring bolts will contact the drop pad at impact. Three pallets of four drums are required. The drop apparatus and rigging is shown in Appendix C.

All drums shall be closed with lid, gasket, locking ring, bolt, and nut. After loading the nut shall be torqued to 40 ft lbs. No polyethylene bag liner will be used. Drums will be marked and identified for future reference.

STAGE IV

Stage IV testing will duplicate the Stage III tests except DOT-17H drums will be utilized.

2.6 TEST PROCEDURE

STAGE I

Rig loaded Stage I drum I-001 so that the drum is 45 degrees to the drop pad. Position so that the drum falls on the locking ring bolt. Raise the drum so the lowest portion of drum is 132 in. from the drop pad surface. Release the drum and record data on provided sheet.

Inspect for cover attachment and the drum for breaches. Take still photographs and video. Repeat using I-002 and I-003 drums.

STAGE II

Rig loaded Stage II drum II-001 so that the drum is 45 degrees to the drop pad. Position so that the drum falls on the locking ring bolt. Raise the drum so the lowest portion of drum is 132 in. from the drop pad surface. Release the drum and record data on provided sheet.

Inspect for cover attachment and the drum for breaches. Take still photographs and video. Repeat using II-002 and II-003 drums.

STAGE III

Rig the pallet drop apparatus. Load pallet with four loaded Stage III drums. Raise pallet so the bottom of the drums are horizontal and 132 in. from the drop pad. Release drums and record data provided sheets. Inspect for cover attachment and the drums for breaches. Take still photographs and video. Repeat test two times using eight new drums, pallets and banding.

STAGE IV

Rig the pallet drop apparatus. Load pallet with four loaded Stage IV drums. Raise pallet so the bottom of the drums are horizontal and 132 in. from the drop pad. Release drums and record data provided sheets. Inspect for cover attachment and the drums for breaches. Take still photographs and video. Repeat test two times using eight new drums, pallets, and banding.

3.0 SAFETY

All personnel shall wear appropriate safety equipment as directed by the Test Director. General shop safety per the "*Westinghouse Industrial Safety Manual*" (WHC-CM-4-3, *Industrial Safety Manual*) will be maintained at all times. The lead used as dummy payload is a known carcinogen and will be taken from the 305 Building lead supply and handled per 305 Building procedure.

4.0 QUALITY ASSURANCE

Testing will be conducted under the Quality Assurance (QA) requirements as specified in the "*Westinghouse Quality Assurance Manual*" (WHC-CM-4-2, *Quality Assurance Manual*). Westinghouse QA personnel will be notified of the testing schedule and will observe.

5.0 REFERENCES

WHC-CM-4-2, *Quality Assurance Manual*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-4-3, *Industrial Safety Manual*, Westinghouse Hanford Company, Richland, Washington.

Cain, F. G., 1993, *Central Waste Complex Final Safety Analysis Report, FSAD Upgrade*, WHC-SD-WM-SAR-049, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

49 CFR, Part 173.469, "Transportation," *Code of Federal Regulations*.

Sandia National Laboratory, 1983, *Analysis, Scale Modeling, and Full-Scale Tests of Low-Level Nuclear-Waste-Drum Response to Accident Environments*, SAND-80-2517, Sandia National Laboratories, Albuquerque, New Mexico.

APPENDIX A

CALIBRATION SHEETS

CALIBRATION

1

Equipment: Scale

Calibration Number _____

Calibration Date _____

2

Equipment: Torque Wrench

Calibration Number _____

Calibration Date _____

3

Equipment _____

Calibration Number _____

Calibration Date _____

4

Equipment _____

Calibration Number _____

Calibration Date _____

APPENDIX B

DATA SHEETS

DATA SHEET

STAGE I DOT-17 C drum (55 gallon), 132 inch drop

Stage I 001 drum

Verify 1000 pound (+/- 10 pounds plus tolerance on scale) gross weight.

Record Void Volume: _____

Raise test article and verify 132 inch elevation QA _____/TD _____

Start video. Drop on to locking ring bolt. Record data and photograph damage.

Test Results

Test Results/Data Recorded by: _____ Date: _____

Describe and measure maximum deformation. Inspect for drum integrity.

Exceptions _____

DATA SHEET

STAGE I DOT-17 C drum (55 gallon), 132 inch drop

Stage I 002 drum

Verify 1000 pound (+/- 10 pounds plus tolerance on scale) gross weight.

Record Void Volume: _____

Raise test article and verify 132 inch elevation QA _____/TD _____

Start video. Drop on to locking ring bolt. Record data and photograph damage.

Test Results

Test Results/Data Recorded by: _____ Date: _____

Describe and measure maximum deformation. Inspect for drum integrity.

Exceptions _____

DATA SHEET

STAGE I DOT-17 C drum (55 gallon), 132 inch drop

Stage I 003 drum

Verify 1000 pound (+/- 10 pounds plus tolerance on scale) gross weight.

Record Void Volume: _____

Raise test article and verify 132 inch elevation QA _____/TD _____

Start video. Drop on to locking ring bolt. Record data and photograph damage.

Test Results

Test Results/Data Recorded by: _____ Date: _____

Describe and measure maximum deformation. Inspect for drum integrity.

Exceptions _____

DATA SHEET

STAGE II DOT-17 H drum (55 gallon), 132 inch drop

Stage II 001 drum

Verify 1000 pound (+/- 10 pounds plus tolerance on scale) gross weight.

Record Void Volume: _____

Raise test article and verify 132 inch elevation QA _____/TD _____

Start video. Drop on to locking ring bolt. Record data and photograph damage.

Test Results

Test Results/Data Recorded by: _____ Date: _____

Describe and measure maximum deformation. Inspect for drum integrity.

Exceptions _____

DATA SHEET

STAGE II DOT-17 H drum (55 gallon), 132 inch drop

Stage II 002 drum

Verify 1000 pound (+/- 10 pounds plus tolerance on scale) gross weight.

Record Void Volume: _____

Raise test article and verify 132 inch elevation QA _____/TD _____

Start video. Drop on to locking ring bolt. Record data and photograph damage.

Test Results

Test Results/Data Recorded by: _____ Date: _____

Describe and measure maximum deformation. Inspect for drum integrity.

Exceptions _____

DATA SHEET

STAGE II DOT-17 H drum (55 gallon), 132 inch drop

Stage II 003 drum

Verify 1000 pound (+/- 10 pounds plus tolerance on scale) gross weight.

Record Void Volume: _____

Raise test article and verify 132 inch elevation QA _____/TD _____

Start video. Drop on to locking ring bolt. Record data and photograph damage.

Test Results

Test Results/Data Recorded by: _____ Date: _____

Describe and measure maximum deformation. Inspect for drum integrity.

Exceptions _____

DATA SHEET

STAGE III DOT-17 C drum (4 Drums per pallet), 132 inch drop

Stage III, Pallet 1, Drums 001-004

Record gross weight for each drum. Place 4 drums on a pallet so that the heavy drums fall on to the lighter drums. Rotate the locking ring bolt of the lighter drums to the outside so that it contacts the drop pad at impact. Band the drums to the pallet and each other as performed at the Central Waste Complex.

Record Gross Weight of Each Drum: 1 _____ 2 _____ 3 _____ 4 _____

Record Void Volume in Each Drum: 1 _____ 2 _____ 3 _____ 4 _____

Raise test article and verify 132 inch elevation QA _____/TD _____

Start video. Drop pallet on to pad. Record data and photograph damage.

Test Results

Test Results/Data Recorded by: _____ Date: _____

Describe and measure maximum deformation. Inspect for drum integrity.

Exceptions _____

DATA SHEET

STAGE III DOT-17 C drum (4 Drums per pallet), 132 inch drop

Stage III, Pallet 2, Drums 005-008

Record gross weight for each drum. Place 4 drums on a pallet so that the heavy drums fall on to the lighter drums. Rotate the locking ring bolt of the lighter drums to the outside so that it contacts the drop pad at impact. Band the drums to the pallet and each other as performed at the Central Waste Complex.

Record Gross Weight of Each Drum: 5 _____ 6 _____ 7 _____ 8 _____

Record Void Volume in Each Drum: 5 _____ 6 _____ 7 _____ 8 _____

Raise test article and verify 132 inch elevation QA _____/TD _____

Start video. Drop pallet on to pad. Record data and photograph damage.

Test Results

Test Results/Data Recorded by: _____ Date: _____

Describe and measure maximum deformation. Inspect for drum integrity.

Exceptions _____

DATA SHEET

STAGE III DOT-17 C drum (4 Drums per pallet), 132 inch drop

Stage III, Pallet 3, Drums 009-0012

Record gross weight for each drum. Place 4 drums on a pallet so that the heavy drums fall on to the lighter drums. Rotate the locking ring bolt of the lighter drums to the outside so that it contacts the drop pad at impact. Band the drums to the pallet and each other as performed at the Central Waste Complex.

Record Gross Weight of Each Drum: 9 _____ 10 _____ 11 _____ 12 _____

Record Void Volume in Each Drum: 9 _____ 10 _____ 11 _____ 12 _____

Raise test article and verify 132 inch elevation QA _____/TD _____

Start video. Drop pallet on to pad. Record data and photograph damage.

Test Results

Test Results/Data Recorded by: _____ Date: _____

Describe and measure maximum deformation. Inspect for drum integrity.

Exceptions _____

DATA SHEET

STAGE IV DOT-17 H drum (4 Drums per pallet), 132 inch drop

Stage IV, Pallet 1, Drums 001-004

Record gross weight for each drum. Place 4 drums on a pallet so that the heavy drums fall on to the lighter drums. Rotate the locking ring bolt of the lighter drums to the outside so that it contacts the drop pad at impact. Band the drums to the pallet and each other as performed at the Central Waste Complex.

Record Gross Weight of Each Drum: 1 _____ 2 _____ 3 _____ 4 _____

Record Void Volume in Each Drum: 1 _____ 2 _____ 3 _____ 4 _____

Raise test article and verify 132 inch elevation QA _____/TD _____

Start video. Drop pallet on to pad. Record data and photograph damage.

Test Results

Test Results/Data Recorded by: _____ Date: _____

Describe and measure maximum deformation. Inspect for drum integrity.

Exceptions _____

DATA SHEET

STAGE IV DOT-17 H drum (4 Drums per pallet), 132 inch drop

Stage IV, Pallet 2, Drums 005-008

Record gross weight for each drum. Place 4 drums on a pallet so that the heavy drums fall on to the lighter drums. Rotate the locking ring bolt of the lighter drums to the outside so that it contacts the drop pad at impact. Band the drums to the pallet and each other as performed at the Central Waste Complex.

Record Gross Weight of Each Drum: 5 _____ 6 _____ 7 _____ 8 _____

Record Void Volume in Each Drum: 5 _____ 6 _____ 7 _____ 8 _____

Raise test article and verify 132 inch elevation QA _____/TD _____

Start video. Drop pallet on to pad. Record data and photograph damage.

Test Results

Test Results/Data Recorded by: _____ Date: _____

Describe and measure maximum deformation. Inspect for drum integrity.

Exceptions _____

DATA SHEET

STAGE IV DOT-17 H drum (4 Drums per pallet), 132 inch drop

Stage IV, Pallet 3, Drums 009-012

Record gross weight for each drum. Place 4 drums on a pallet so that the heavy drums fall on to the lighter drums. Rotate the locking ring bolt of the lighter drums to the outside so that it contacts the drop pad at impact. Band the drums to the pallet and each other as performed at the Central Waste Complex.

Record Gross Weight of Each Drum: 9 _____ 10 _____ 11 _____ 12 _____

Record Void Volume in Each Drum: 9 _____ 10 _____ 11 _____ 12 _____

Raise test article and verify 132 inch elevation QA _____/TD _____

Start video. Drop pallet on to pad. Record data and photograph damage.

Test Results

Test Results/Data Recorded by: _____ Date: _____

Describe and measure maximum deformation. Inspect for drum integrity.

Exceptions _____

APPENDIX C

SKETCH OF PALLET DROP MECHANISM

Pallet Drop Mechanism

Lifting Configuration

Released Configuration