JUL 3 1 2000 Sta. 15 (20) **ENGINEERING DATA TRANSMITTAL** S

Page 1 of 1

1. EDT 628170

| 2. To: (Receiving Organization) | 3. From: (Originating Organization) | 4. Related EDT No.: |
|---|---|---|
| Distribution | WMFS Engineering | NA |
| 5. Proj./Prog./Dept./Div.: | 6. Design Authority/Design Agent/Cog. Engr.: | 7. Purchase Order No.: |
| 772031/246 111241/AJ60 HMWM0401 | D. L. Riley | NA |
| 8. Originator Remarks: | | 9. Equip./Component No.: |
| For approval and release. | | NA |
| | | 10. System/Bldg./Facility: |
| | | NA |
| 11. Receiver Remarks: | 11A. Design Baseline Document? ☐ Yes ☒ No | 12. Major Assm. Dwg. No.: |
| | | NA |
| | | 13. Permit/Permit Application No.: |
| | | NA |
| | | 14. Required Response Date: |
| | | NA |

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 Desig-nator | (G) Reason for Trans-mittal | (H) Origi-nator Dispo-sition | (I) Receiv-er Dispo-sition |
|---|---|---|---|---|---|---|---|---|
| 1 | HNF-6743 | NA | 0 | T Plant Overpack Tiedown | SQ | 1 2 | 1 | |
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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 |

17. SIGNATURE/DISTRIBUTION
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| (G) Reason | (H) Disp. | (J) Name | (K) Signature | (L) Date | (M) MSIN | (G) Reason | (H) Disp. | (J) Name | (K) Signature | (L) Date | (M) MSIN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Design Authority | | | | 1 | 1 | DW Fritz Jr | [signature] | 7/28/00 | H1-31 |
| | | Design Agent | | | | 1 | 1 | WS Josephson | [signature] for WSJ | 7/28/00 | H1-11 |
| 1 | 1 | Cog. Eng. DL Riley | [signature] | 7/28/00 | H1-11 | | | | | | |
| 1 | 1 | Cog. Mgr. DW Bergmann | [signature] | 7/28/00 | H1-11 | | | | | | |
| 1 | 1 | QA MF Nicol | [signature] Forrest Nicol | 7/24/00 | H1-11 | | | | | | |
| 1 | 1 | Safety DL McCall | [signature] | 7/28/00 | H1-11 | | | | | | |
| | | Env. | | | | | | | | | |

| 18. | 19. | 20. | 21. DOE APPROVAL (if required) |
|---|---|---|---|
| [signature] D. L. Riley 7/28/00 | | [signature] L. T. Blackford 7/28/00 | Ctrl No. _____ |
| Signature of EDT Originator / Date | Authorized Representative for Receiving Organization / Date | Design Authority/ Cognizant Manager / Date | ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments |

BD-7400-172-2 (10/97)

BD-7400-172-1

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| Distribution | WMFS Engineering | Date July 27, 2000 |
| Project Title/Work Order | | EDT No. 628170 |
| HNF-6743, Rev. 0, T Plant Overpack Tiedown Analysis | | ECN No. NA |

| Name | MSIN | Text With All Attach. | Text Only | Attach./ Appendix Only | EDT/ECN Only |
|---|---|---|---|---|---|
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United States Government Department of Energy

# memorandum

DATE: September 29, 2000

REPLY TO ATTN OF: NE-20

SUBJECT: Removal of Applied Technology Designation from Specific Documents

TO: M. Wilson, Office of Scientific and Technical Information

The Office of Nuclear Energy, Science and Technology requests the Applied Technology (AT) designation be removed from the following documents::

- WHC-SD-TP-RPT-005, Rev. 1, Thermal Analysis Methods for Safety Analysis Reports for Packaging (SARP), January 11, 1996
- HEDL-TC-1613, Thermal Characterization of Ident 1578 Container, June 1982
- WHC-SD-FF-ER-050, Rev. 0, TAP-A Code Notebook, March 1990
- HNF-6550 T Plant Canyon Items Safety Evaluation Report (SEP), July 2000
- HNF-6743 T Plant Overpack Tiedown Evaluation, July 2000
- HNF-4763 SARP (Onsite) Steel Waste Package, July 2000
- HNF-6807 Safety Analysis Report for Packaging (Onsite) for the Pipe Overpack Container
- 3I-SOP-REC-A-47
- 3I-SOP-REC-A-51
- 3I-SOP-REC-A-67
- Any other SARP, SER, or other document that is designated AT due to referencing one or more of the above documents.

Mr. O. A. Farabee's August 25, 2000, memorandum to Dr. Rob M. Versluis, on the subject of Applied Technology Designation Removal of Specific Documents, and its enclosure provides the explanation for making this request and is attached as part of the record. Also, Mr. Don Riley's e-mail to Rob Versluis dated September 11, 2000, is also attached as part of the record. I note further that the source AT document, which has caused a propagation of further AT document designations, contains technology information that, because of its age, is unlikely to provide commercial leverage to the Department in collaborative projects with other countries. The documents that received the AT designation by propagation (the rule is that a document that references an AT document is itself designated as AT) would not have been designated AT in their own right.

R. Shane Johnson, Acting Associate Director
for Technology and International Cooperation
Office of Nuclear Energy, Science
and Technology

Attachments

cc: O. A. Farabee, RL

(2)

**Enclosure:**
**Applied Technology Designation Removal on Specific Documents**

Waste Management Technical Services (WMTS) is assigned responsibility for developing and maintaining a program for the packaging and transportation of all hazardous material and wastes for the Hanford site. As part of this program, WMTS prepares and maintains safety analysis documentation for packaging, which includes Safety Analysis Reports for Packaging (SARPs) and Safety Evaluation Reports (SEPs).

One of the requirements of the SARPs and SEPs is to document safety of packaging from thermal environments, both normal and accident. WMTS has for the last five years included a reference to WHC-SD-TP-RPT-005, Rev. 1, *Thermal Analysis Methods for Safety Analysis Reports for Packaging*, January 11, 1996. Originally, this revised report was incorrectly cleared as a "Public Release" document on January 11, 1996. On March 3, 2000, the document was changed to Applied Technology (AT). The change was made due to the observation of an AT reference in the appendix of the document.

WMTS has many SARPs, and SEPs that have been released in the last five years that are public documents. Maintenance and revisions of these SARPs and SEPs will have the unnecessary AT designation added due to this reference. It is therefore requested that the documents causing this AT designation to the SARPs and SEPs have their AT designation removed, where necessary and permitted. Figure 1 shows a simple pictorial guide of effected documents and what drives the documents to be AT.

This request is to not remove all AT documents that are found in the references of the SARPs, but only those found in the upper three tiers of references in a SARP. It is proposed the SARP, what the SARP references, and what the references found in the SARP reference would all be made public documents. Below that tier there may likely remain AT references. The following discussion addresses each document as to the specific recommendations.

WHC-SD-TP-RPT-005, Rev. 1, *Thermal Analysis Methods for Safety Analysis Reports for Packaging*, January 11, 1996, was designated as Applied Technology information under the current guidelines because it references a document previously designated as Applied Technology, HEDL-TC-1613, *Thermal Characterization of Ident 1578 Container*, June 1982. This is what led to this documents redesignation earlier this year.

Under the current guidelines for designating Applied Technology information, it would not be appropriate to so designate HEDL-TC-1613. The document includes no references and provides no detailed engineering information about either fuel pins or the Ident 1578 fuel pin container. Electrical heaters were arrayed within the container and the container surface temperature was determined as a function of power input. The bulk of the document is a compilation of this test data. Therefore, there is no apparent reason to retain the Applied Technology designation for HEDL-TC-1613. Senior engineers of the FFTF technical team have provided basis for this conclusion. Their comments are included at the end of this enclosure.

WHC-SD-TP-RPT-005, Rev. 1, *Thermal Analysis Methods for Safety Analysis Reports for Packaging*, January 11, 1996, also references WHC-SD-FF-ER-050, Rev. 0, *TAP-A Code Notebook*, March 1990, which is currently identified as "Sponsor Limited." If further reviewed for unrestricted release, this document would have to be redesignated as "Applied Technology" due to a reference it makes to an AT document, HEDL-TC-2683, Rev. 0, *Evaluation of Natural Convective Air Cooling Test in FFTF Interim Decay Storage Vessel*, June 1985.

In view of the intended use of the report WHC-SD-TP-RPT-005, Rev. 1, *Thermal Analysis Methods for Safety Analysis Reports for Packaging*, January 11, 1996, the following action is recommended as reasonable and appropriate:

Identify the following documents as "base technology:"

- WHC-SD-TP-RPT-005, Rev. 1, *Thermal Analysis Methods for Safety Analysis Reports for Packaging*, January 11, 1996
- HEDL-TC-1613, *Thermal Characterization of Ident 1578 Container*, June 1982.
- WHC-SD-FF-ER-050, Rev. 0, *TAP-A Code Notebook*, March 1990,

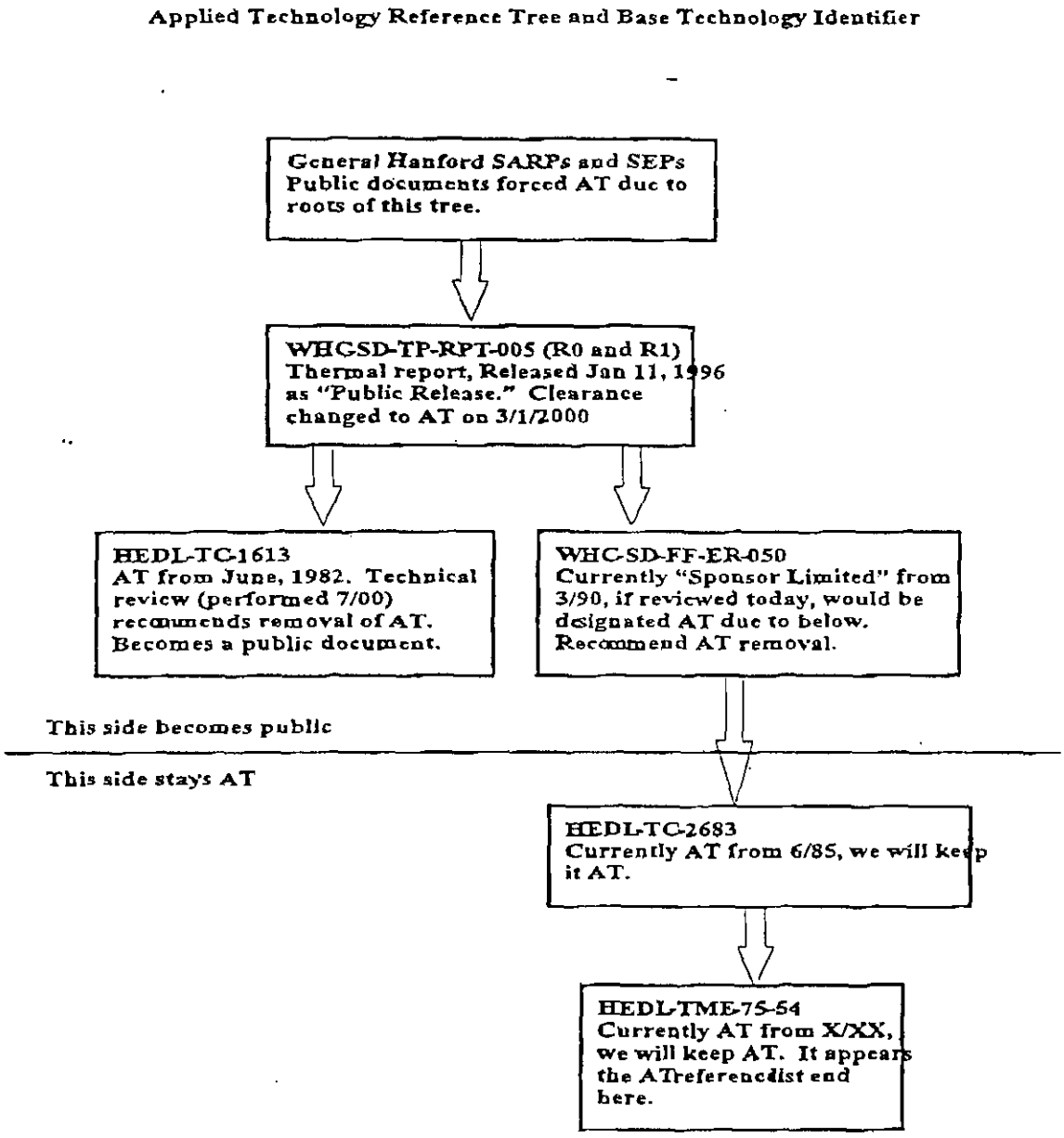
Retain the "Applied Technology" designation on HEDL-TC-2683, Rev. 0, *Evaluation of Natural Convective Air Cooling Test in FFTF Interim Decay Storage Vessel*, June 1985, even though it is referenced in WHC-SD-FF-ER-050.

In addition, the following new documents that are currently AT would need to be identified as "base technology." These documents are AT due solely to the reference to the AT designated WHC-SD-TP-RPT-005 report above:

- HNF-6550 *T Plant Canyon Items SEP*, July 2000
- HNF-6743 *T Plant Overpack Tiedown Evaluation*, July 2000
- HNF-4763 *SARP (Onsite) Steel Waste Package*, July 2000
- 3I-SOP-REC-A-47
- 3I-SOP-REC-A-51
- 3I-SOP-REC-A-67
- Any other SARP, SEP, or related document that is designated AT due to the above reference (those anticipated to be released during this redesignation process).

Satisfactory resolution of this recommendation will stop the unnecessary AT designation from propagating further.

Figure 1


Applied Technology Reference Tree and Base Technology Identifier
General Hanford SARPs and SEPs Public documents forced AT due to roots of this tree.
WHC-SD-TP-RPT-005 (R0 and R1) Thermal report, Released Jan 11, 1996 as "Public Release." Clearance changed to AT on 3/1/2000
HEDL-TC-1613 AT from June, 1982. Technical review (performed 7/00) recommends removal of AT. Becomes a public document.
WHC-SD-FF-ER-050 Currently "Sponsor Limited" from 3/90, if reviewed today, would be designated AT due to below. Recommend AT removal.
This side becomes public
This side stays AT
HEDL-TC-2683 Currently AT from 6/85, we will keep it AT.
HEDL-TME-75-54 Currently AT from X/XX, we will keep AT. It appears the ATreferencdist end here.

Following are the comments and analyses received from the FFTF senior engineers.

FFTF Technical Staff review of HEDL-TC-1613, emailed from RB Baker, 7/31/00:

Does this document look like it could be down graded from Applied Technology to open literature?

This is basically a report on a cold thermal test of a mockup of the Ident 1578 shipping container for mixed-oxide fuel pins such as used in FFTF. It does not review designs, discuss theories or provide detailed evaluations using base technology. There looks to be very little unique or innovative information:

- no references are used (neither AP nor cleared)
- the subject Ident container is not described in any detail and appears to be generally a pipe with end closures
- some general information is noted on the FFTF mixed oxide driver fuel pins (diameter, wire wrap size, etc.) all of which is in the open literature
- The maximum decay heat expected for the 40 mixed oxide fuel pins while in the Ident 1578 are noted as limit for T3 cask-- nothing else is provided on the T3 (T3 is not AP per SA Chastain review)
- The thermal test data and analyses could be viewed as base data which though interesting and perhaps unique at the time (1982) it is not particularly innovative and the test could be easily repeated in a thermal lab anywhere.

I have not been trained in determining if a document is "Applied Technology" or not. However, I am of the opinion, based on this limited review, that at this point in time the subject report does not appear to contain what I would infer are "applied technology" subjects or topics from the FFTF/LMR point of view. This based on my over 15 years experience working with FFTF/LMR/ALMR projects.
RB Baker 7/31/00

FFTF Technical Staff review of HEDL-TC-1613, emailed from S. Chastain, 7/28/00:

Can the document be down graded from Applied Technology to open literature?

The test is basically a cold thermal test in the laboratory of the IDENT 1578-shipping container for mixed-oxide fuel pins.

- Does not reference documents that are Applied Technology

(Verified that the T-3 Cask SARP is an open literature document therefore not Applied Technology – Verification from Dan Johnston and Erik Neilsen)

- Information on FFTF fuel pin design is contained, however this information has previously been presented in open literature

I am not trained in classification of documents. However, this document doesn't seem to contain information that would qualify as FFTF/LMR Applied Technology.

Steve Chastain 7/28/00

## Mcculley, Judith

From: Versluis, Rob
Sent: Monday, September 11, 2000 6:57 PM
To: Mcculley, Judith
Cc: Hawes, Jeanie
Subject: FW: AT Designation Removal for HNF-6807

Judy,

could you add this document to the list of the action that you just rescued!

Thx, rob

**********
Dr. Rob M. Versluis, NE-20
19901 Germantown Rd, Germantown, MD 20874
tel: 301-903-1890 fax: 301-903-5057
**********

-----Original Message-----
From: Riley, Don [mailto:don_riley@gtsduratek.com]
Sent: Monday, September 11, 2000 6:09 PM
To: Versluis, Rob
Cc: Almquist, Rodney A; Gantt, Douglas A (Doug); Bergmann, Dave; Reeves, John; Peters, Brian
Subject: AT Designation Removal for HNF-6807

Dr. Versluis:

Would you please add one document to the list of requested AT removal documents.

The document is: HNF-6807 "Safety Analysis Report for Packaging (Onsite) for the Pipe Overpack Container." We will be releasing this document this week, and it will be designated AT for the same reason as the others that we have requested to be redesignated.

You have received a request from O.A. Farabee, Acting Director of the FFTF, dated August 25, 2000 that lists nine specific documents. Note that the tenth bullet is identified as: "Any other SARP, SEP, or related document that is designated AT due to the above reference." HNF-6807 is such a document.

Thanks,

Don Riley.
WMFS.

U.S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
P. O. BOX 550 MSIN N2-36
825 JADWIN AVENUE
RICHLAND, WASHINGTON 99352

# FFTF STANDBY PROJECT OFFICE

VERIFY: (509) 376-6314

## FAX NUMBER: (509) 376-0177

DATE 10/6/00

TO: Yvonne Sherman 376-1563 Don Riley 372-1435
Chris Willingham 376-9989 Shirley Myers 372-1435
John Reeves 372-1435

FAX NUMBER _____

FROM: Bob Alnquist

TELEPHONE: 376-2171

This transmittal consists of 8 pages, including this cover sheet.

**MESSAGE:**

AT Approval

HNF-6743
Revision 0

# T Plant Overpack Tiedown Analysis

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

**Fluor Hanford**
**P.O. Box 1000**
**Richland, Washington**

# INFORMATION CLEARANCE FORM

A. Information Category

☐ Abstract ☐ Journal Article
☐ Summary ☐ Internet
☐ Visual Aid ☐ Software
☐ Full Paper ☒ Report
☐ Other _____

B. Document Number HNF-6743, Rev. 0

C. Title
T Plant Overpack Tiedown Analysis

D. Internet Address

E. Required Information

1. Is document potentially Classified? ☒ No ☐ Yes (MANDATORY)
(See Blk. H, below.)
Manager's Signature Required

If Yes _____ ☐ No ☐ Yes Classified
ADC Signature Required

2. Internal Review Required? ☒ No ☐ Yes
If Yes, Document Signatures Below

Counsel _____

Program _____

3. References in the Information are Applied Technology ☐ No ☒ Yes
Export Controlled Information ☒ No ☐ Yes

4. Does Information Contain the Following: (MANDATORY)

a. New or Novel (Patentable) Subject Matter? ☒ No ☐ Yes
If "Yes", Disclosure No.: _____

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☒ No ☐ Yes If "Yes", Affix Appropriate Legends/Notices.

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F. Complete for a Journal Article

1. Title of Journal

G. Complete for a Presentation

1. Title for Conference or Meeting _____

2. Group Sponsoring _____

3. Date of Conference _____ 4. City/State _____

5. Will Information be Published in Proceedings? ☐ No ☐ Yes 6. Will Material be Handed Out? ☐ No ☐ Yes

H. Author/Requestor
D. L. Riley 7-28-00
(Print and Sign)

Responsible Manager
D. W. Bergmann 7/28/2000
(Print and Sign)

I. Reviewers

| | Yes | Print | Signature | Public Y/N (If N, complete J) |
|---|---|---|---|---|
| General Counsel | ☐ | | | Y / N |
| Office of External Affairs | ☐ | | | Y / N |
| DOE-RL | ☐ | | | Y / N |
| Other - LMSI | ☒ | J. D. Aardal | Janis Aardal | Y / (N) |
| Other | ☐ | | | Y / N |

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☐ Patentable
☐ Other (Specify) _____
Ref is made to HNF-6550, which is AT.

Information Clearance Approval

APPROVED FOR PUBLIC RELEASE aw 11-15-00

APPROVED FOR Limited RELEASE
Janis Aardal
7-31-2000

K. If Additional Comments, Please Attach Separate Sheet

approved for Public Release per DOE/HQ Memo Dated 9-29-00

A-6001-401 (02/98)

HNF-6743
Revision 0
EDT 628170

# T Plant Overpack Tiedown Analysis

Document Type: TR Division: WM

D. L. Riley
Waste Management Federal Services, Inc., A Subsidiary of GTS Duratek

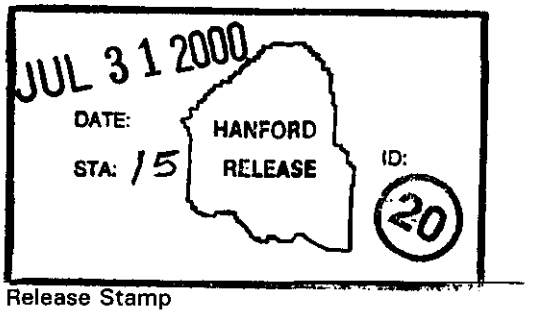
Date Published
July 2000

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

**Fluor Hanford**
**P.O. Box 1000**
**Richland, Washington**






Release Stamp

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Total Pages: 14

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**Keywords:** T Plant, Overpack, Canyon Items, SARP, Tiedown, Analysis, 49 CFR 393, HNF-6550

**Abstract:** This tiedown evaluation meets the requirement imposed by HNF-6550, *Safety Evaluation for Packaging (Onsite) T Plant Canyon Items,* (O'Brien 2000). O'Brien (2000) requires that any items prepared for shipment from T Plant to the burial grounds that are not bounded by the analysis in O'Brien (2000) must have a separate, approved, engineered tiedown analysis. The width of the overpack box is 9 ft. 7 in. This width is wider than the maximum width authorized in O'Brien (2000), which is 8ft.

# T PLANT OVERPACK TIEDOWN ANALYSIS

## 1.0 INTRODUCTION

This tiedown evaluation meets the requirement imposed by HNF-6550, *Safety Evaluation for Packaging (Onsite) T Plant Canyon Items* (O'Brien 2000). O'Brien (2000) requires that any items prepared for shipment from T Plant to the burial grounds that are not bounded by the analysis in O'Brien (2000) must have a separate, approved, engineered tiedown analysis. The width of the overpack box is 9 ft 7 in. This width is wider than the maximum width authorized in O'Brien (2000), which is 8 ft.

## 2.0 EVALUATION

This tiedown analysis is in addition to and not in place of the requirements and assumptions imposed by O'Brien (2000). In the presence of requirement contradictions between O'Brien (2000) and this evaluation, this evaluation takes precedence. General transport system guidance is presented in O'Brien (2000), Section 4.0, "Transport System."

The following evaluation (appendix) shows that the requirements of 49 CFR 393, "Parts and Accessories Necessary for Safe Operation," are met and approves for transport the loaded overpack on a trailer. As required by O'Brien (2000), Section 2.0, this tiedown analysis shall be approved by the Flour Hanford Transportation and Packaging program office, and a copy of the approved document is to be kept with the shipping papers.

## 3.0 REFERENCES

49 CFR 393, "Parts and Accessories Necessary for Safe Operation," *Code of Federal Regulations*, as amended.

O'Brien, J. H., 2000, *Safety Evaluation for Packaging (Onsite) T Plant Canyon Items*, HNF-6550, Rev. 0, prepared by Waste Management Federal Services, Inc., for Fluor Hanford, Richland, Washington.

## 4.0 APPENDIX: ENGINEERING SAFETY EVALUATION

# ENGINEERING SAFETY EVALUATION

| | | | |
|---|---|---|---|
| **Subject:** | T Plant Overpack Tiedown Analysis | **Page:** | 1 of 8 |
| **Preparer:** | Don Riley | **Date:** | 7/28/2000 |
| **Checker:** | Walt Josephson | **Date:** | 7/28/2000 |

## 1.0 OBJECTIVE

This evaluation is to determine the tiedown requirements for transporting the T Plant overpack box. The Safety Evaluation for Packaging (Onsite) T Plant Canyon Items (SEP) (HNF-6550, 2000) requires a separate approved engineered tiedown evaluation for any packages not specifically covered by the SEP. The overpack box is wider than packages authorized in the SEP. This evaluation shows that the requirements of 49 CFR 393 are met, and approves the transport of the loaded overpack on a low boy trailer.

## 2.0 REFERENCES

49 CFR 393, Subpart I, "Protection Against Shifting or Falling Cargo," *Code of Federal Regulations*.

AISC, 1989, Manual of Steel Construction, Ninth Edition, American Institute of Steel Construction, New York, New York.

CCMTA, 1999, *North American Cargo Securement Standard* (draft 4), Canadian Council of Motor Transport Administrators (CCMTA) Ottowa, Ontario Canada, and the Commercial Vehicle Safety Alliance (CVSA), Bethesda MD.

CPC, 2000, Container Assembly, SSB-1265-35-IP1-WRN, drawing number 02-1891-2-01, Container Products Corp, Wilmington North Carolina.

O'Brien, J. H., 2000, *Safety Evaluation for Packaging (Onsite) T Plant Canyon Items*, HNF-6550 Rev. 0, Waste Management Federal Services, Inc., Richland, Washington.

Ryffel, Henry H., ed., 1984, *Machinery's Handbook*, twenty-second Edition, Industrial Press Inc., New York, New York.

## 3.0 ASSUMPTIONS, RESULTS, AND CONCLUSIONS

The overpack shipment will be an onsite transport from T Plant to the 200 west area burial grounds. The conveyance used will be the HO-64-5741, HO-64-5729, or an equivalent lowboy trailer. The overpack is a wide package (9 feet 7 inches) and it is suggested that HO-64-5741 be used, as it is a 10-foot wide trailer with a usable length of 29-feet. HO-64-5729 is acceptable, as it is also a 10-foot wide trailer, but only has 24-feet of usable length, and does not have as readily accessible tiedown anchor points as trailer 5741. Both trailers are regulated, a requirement for

WASTE MANAGEMENT

# ENGINEERING SAFETY EVALUATION



burial activity use. Tiedown requirements are taken from 49 CFR 393, with recommendations taken from the North American Cargo Securement Standard (CCMTA, 1999).

This evaluation makes the following assumptions:

1. The overpack is loaded to its maximum payload weight, 35,000 lbs.

2. The overpack center of gravity is located at the geometric center. This is conservative, as the overpack is filled from the bottom and void filled to the top.

3. The overpack has two lifting sling cut-outs in the base channels that are used to route chains for tiedown.

4. The overpack will be centered widthwise on the trailer.

5. The overpack will be positioned against the front-end structure of the lowboy trailer.

6. The deck of the trailer shall be clean, dry, and free of any debris.

7. Trailer HO-64-5741 is the preferred trailer. Trailer HO-64-5729 is an acceptable alternate.

Figure 1 in the evaluation below shows the general layout of the overpack on trailer HO-64-5741. This trailer has a vertical front end structure that provides direct blocking for the forward direction deceleration. The rearward direction deceleration is constrained by friction between the overpack and the bed as well as two chains, one for each of the two channel cut-outs on the base of the overpack. These chains will attach on one side of the trailer, and go through the open cut-outs, and attach on the other side.

Webbing or straps should not be used through the open cutouts, as the cut-outs have a very rough edge (flame cut). The lateral loads caused by acceleration in either lateral direction are constrained indirectly by friction between the overpack and bed and directly by the attached chains. Commercial load mats are recommended to ensure proper friction is maintained.

The evaluation presented below shows the following requirements imposed on the tiedown configuration for the T Plant overpack:

Tiedown summary of results and requirements:

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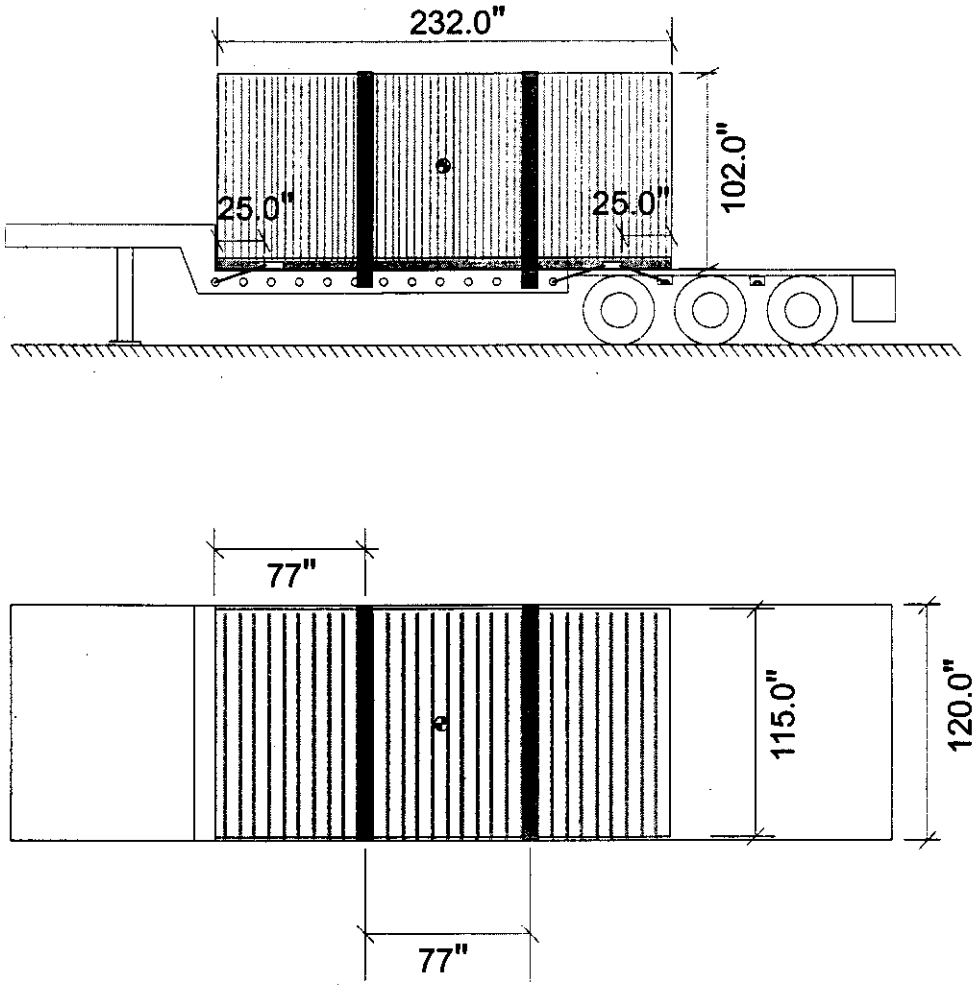
- Two vertical straps must be used to secure the overpack as shown in Figure 1. Each strap must have a WLL of at least 4,500 lbs. Corner protectors shall be used where the straps wrap over the overpack lid.

- Chain is required for the front most channel cut-out and two chains for the rear channel cut-out, as shown in Figure 1. The chain and any necessary binders shall have a WLL of at least 7,000 lbs. Chain slack should be removed by tightening to at least a snug condition.

## 4.0 EVALUATION

Figure 1, T Plant Overpack on Lowboy Trailer



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**T Plant Overpack Evaluation:**

Overpack Dimensions:

$Box_{width} := 115in$ (at the base)

$Box_{height} := 102in$

$Box_{length} := 234.56in$

Trailer is assumed to be H0-64-5741 (10 foot wide) or equivalent. Trailer H0-64-5729 was also inspected (direct access was not possible), and found to be suitable.

$Trailer_{width} := 10ft$ $Trialen_{length} := 29ft$

The overpack box has a maximum payload of:

$Box_{weight} := 35000lb$

Load factors from 49 CFR 393:

$g_{forward} := \frac{20}{32.174}$ $g_{rear} := 0.5$ $g_{lateral} := 0.5$ $g_{vertical} := 0.5$

Note: The North American Cargo Securement Standard (currently draft 4 as of May 1999) uses 0.8 g for the forward g-load. As the trailer used is a low boy with a direct blocking front-end structure, the 49 CFR value is acceptable.

The steel overpack and steel trailer bed friction is:

Friction factors taken from Machinery's Handbook (22nd edition) for steel on steel.

$\mu_{steelStatic} := 0.8$ $\mu_{steelDyn} := 0.4$

**Vertical Tiedowns:**

Number of tiedown legs constraining vertical motion: $nv_{td} := 4$

Vertical loading on tiedowns: $F_v := \frac{g_{vertical} \cdot Box_{weight}}{nv_{td}}$ $F_v = 4.375 \times 10^3 lb$

The overpack is nearly the width of the trailer, but there will be a small angle, causing this force to increase.

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Assume vertical tiedown straps connect to anchor points just off the bed width:

$offset_{out} := 2in$ $offset_{down} := 4in$

Angle off the deck: $\phi := atan\left(\frac{Box_{height} + offset_{down}}{\frac{Trailer_{width} - Box_{width}}{2} + offset_{out}}\right)$

$\phi = 87.6deg$

Tension on vertical tiedown straps is now:

$Strap_{load} := \frac{F_V}{\sin(\phi)}$ $Strap_{load} = 4378.9lb$

Therefore, the minimum working load shall be 4,500 lb for each strap.

Note: standard 4-inch synthetic straps have a WLL of 5,000 lbs.

**Rear loading:**

The overpack is a steel box that sets on sixteen 4-in wide channels along its length, and two 4-in channels along its sides. The base of the new box is in good condition. Friction will be assumed as acting, but for conservatism, the lower dynamic friction value will be used.

The overpack has two cutouts for lifting slings on the base. The cutouts allow access across the width of the box. Inspection of these cutouts has revealed that fairly sharp edges and surfaces will be in contact with the tiedown. Therefore, chain is the preferred tiedown hardware for securement at the channels.

Number of tiedown legs constraining rearward motion: $nr_{td} := 4$

Using the conservative dynamic friction value:

Loading is: $F_{rear} := \frac{Box_{weight} \cdot g_{rear} - \mu_{steelDyn} \cdot Box_{weight}}{nr_{td}}$

$F_{rear} = 875lb$

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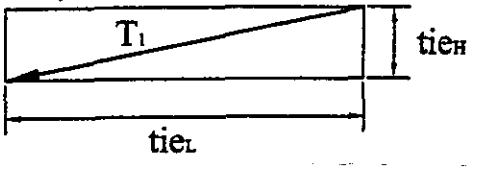
Distance from channel cutout to side attachment point on trailer:

$$side_{attach} := 25\ in$$

Angle of attachment.

From the top view, the chain geometry is:



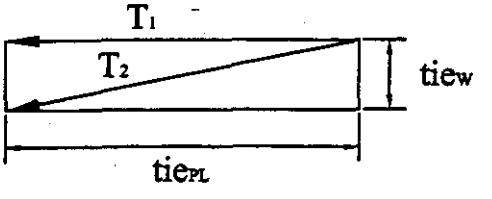

$$tie_H := \frac{Trailer_{width} - Box_{width}}{2} + offset_{out}$$

$$tie_L := side_{attach}$$

$$\theta_{top} := atan\left(\frac{tie_H}{tie_L}\right) \qquad \theta_{top} = 10.204 \cdot deg$$

$$T_1 := \frac{F_{rear}}{\cos(\theta_{top})} \qquad T_1 = 889.062\ lb$$

From the projected view, looking in on $T_1$:




$$tie_{PL} := \sqrt{tie_L^2 + tie_H^2}$$

$$tie_w := offset_{down}$$

$$\theta_{proj} := atan\left(\frac{tie_w}{tie_{PL}}\right) \qquad \theta_{proj} = 8.949 \cdot deg$$

$$T_2 := \frac{T_1}{\cos(\theta_{proj})}$$

$$Tension_{Rear} := T_2 \qquad Tension_{Rear} = 900.017\ lb$$

Therefore, use chain with a WLL of 1,000 lb.

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**Forward loading:**

The overpack is assumed to be on a lowboy trailer, either HO-64-5741, 64-5729, or equivalent. Both lowboys have a front-end structure that will provide direct blocking.

The load against the front end structure is:

$$F_{front} := Box_{weight} \cdot g_{forward} - \mu_{steelDyn} \cdot Box_{weight}$$

$$F_{front} = 7756.7\,lb$$

This load will be constrained by the front end structure. Alternatively, if chains are used to constrain the box:

Number of tiedown legs constraining forward motion: $nf_{td} := 2$

Friction is assumed to be acting, but for conservatism, dynamic friction will be used.

Loading is:

$$F_{forward} := \frac{Box_{weight} \cdot g_{forward} - \mu_{steelDyn} \cdot Box_{weight}}{nf_{td}}$$

$$F_{forward} = 3878.35\,lb$$

Distance from channel cutout to side D-ring attach points: $side_{attach} := 25in$

Angle of attachment (same as for the rear loading case above):

$$Tension_{forw} := \frac{F_{forward}}{\cos(\theta_{top}) \cdot \cos(\theta_{proj})} \qquad Tension_{forw} = 3989.2\,lb$$

Therefore use chain with a WLL of 4,000 lb.

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**Lateral Loadings:**

The lateral loads produced by the box are:

$$F_{side} := Box_{weight} \cdot g_{lateral} - \mu_{steelDyn} \cdot Box_{weight}$$

$$F_{side} = 3500lb$$

This side load will be constrained by the same three chains that run through the sling openings in the channel and connect to the tiedown rails and D-rings.

Number of tiedown legs constraining side motion: $ns_{td} := 3$

The chain tension is, refering to the Figure above:

$$Tension_{lat} := \frac{F_{side}}{ns_{td} \cdot \sin(\theta_{top}) \cdot \cos(\theta_{proj})} \qquad Tension_{lat} = 6666.8lb$$

Therefore use chain with a WLL of 7,000 lb, tighened to a snug condition.

Note: standard grade 8, 3/8-in chain has a minimum WLL of 7,100 lb