5

ENGINEERING CHANGE NOTICE	1. ECN 646742
Page 1 of 2	Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	RJ Smith/PE/H1-15/376-9501	[] Yes [X] No	11/06/98
	6. Project Title/No./Work Order No. PAS-1 Cask	7. Bldg./Sys./Fac. No. NA	8. Approval Designator SQ
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-TP-SEP-038, Rev. 0-A	10. Related ECN No(s). NA	11. Related PO No. NA

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	NA	NA Design Authority/Cog. Engineer Signature & Date	NA Design Authority/Cog. Engineer Signature & Date

13a. Description of Change — 13b. Design Baseline Document? [] Yes [X] No

The purpose of this change is as follows:
1. Re-release to extend the use of the SEP for one year.
2. References throughout the document are updated.
3. Part A, Section 6.2.2: Remove the leak test requirement. Add maintenance and inspection steps to Part A, Sections 5.0 and 6.2.2.

14a. Justification (mark one)

Criteria Change	[X]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

1. Re-release needed to conduct shipment of K Basin sludge samples. No other packaging is available.
2. Change to PHMC necessitates a change in manual references. Also, the PAS-1 cask is now fully licensed by the DOE, which requires a corresponding change in the references to the CoC and SAR.
3. To meet ALARA principles, a post-load leak test is not required. The payload is triply confined within the bottles, primary vessel, and secondary vessel. Additional steps are added to inspect the O-rings for damage and replace if necessary (Part A, Section 6.2.2), and to verify that the cask has successfully passed its annual maintenance leak test (Part A, Section 5.0).

Design verification of this change was performed, and the change(s) were found not to adversely impact the underlying safety bases and parameters of the package.

Verification performed by: J.E. Calvin 11·17·98

15. Distribution (include name, MSIN, and no. of copies)

See attached.

RELEASE STAMP

NOV 17 1998

DATE: HANFORD RELEASE

STA: 37 ID: 20

A-7900-013-2 (05/96) GEF095

A-7900-013-1

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1) 646742

16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[X] Yes	Additional	[NA] $	Additional	[NA] $	Improvement	[NA]
[] No	Savings	[NA] $	Savings	[NA] $	Delay	[NA]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
NA		

21. Approvals

	Signature	Date		Signature	Date
Design Authority:	JG Field [signature]	11/16/98	Design Agent:	RJ Smith [signature]	11/16/98
Cog. Eng.:	RJ Smith* [signature]	11/16/98	PE		
Cog. Mgr.:	JG Field* [signature]	11/16/98	QA		
QA:	MR Turner* [signature] for MRT	11-16-98	Safety		
Safety:	T Romano* Tino Romano	11-17-98	Design		
Environ.			Environ.		
Other:	DJ Trimble [signature] for DJ Trimble	11/16/98	Other		
Ind. Rev.:	JE Cabaniss J.E. Cabaniss	11/17/98			

DEPARTMENT OF ENERGY

Signature or a Control Number that tracks the Approval Signature

ADDITIONAL

* = Safety Review Board members

Safety Evaluation for Packaging for the Transport of K Basin Sludge Samples in the PAS-1 Cask

R. J. Smith
Waste Management Federal Services, Inc., Northwest Operations, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: 646742
Org Code: D1960000
CACN: ~~11AAGS~~ 105358
COA: EH00
B&R Code: NA
UC: 513
Task Order: GS080003
Project: 772032
Crosswalk: 108
Total Pages: ~~60~~ 60

Key Words: 325 Lab, 222-S Lab

Abstract: This safety evaluation for packaging authorizes the shipment of up to two 4-L sludge samples to and from the 325 Lab or 222-S Lab for characterization. The safety of this shipment is based on the current U.S. Department of Energy Certification of Compliance (CoC) for the PAS-1 cask, USA/9184/B(U) (DOE).

Janis Aardal 11-17-98
Release Approval Date

Approved for Public Release

RECORD OF REVISION	(1) Document Number HNF- ~~WHC~~-SD-TP-SEP-038	Page 1

(2) Title

Safety Evaluation for Packaging for the Transport of K Basin Sludge Samples in the PAS-1 Cask

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) EDT 611491, dated July 28, 1995		
0-A RS	Extend expiration date one year. Extend use of SEP for return shipments of K Basin sludge samples from 325 Lab to 222-S Lab. Replace pages iii-v, A3-1, and B2-1. Per ECN 625263.	RJ Smith	JG Field 9/18/96
1 RS	The purpose of this ECN is to extend the use of the SEP for one year. References throughout the document are updated and the leak test requirement has been removed from Part A, Section 6.2.2. Maintenance and inspection steps where added to Part A, Sections 5.0 and 6.2.2. Replace all pages. Per ECN 646742.	RJ Smith	JG Field 11/14/98

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PART B: PACKAGE EVALUATION

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LIST OF TERMS

ASTM	American Society for Testing and Materials
cm	centimeter
CM	controlled manual
DOE	U.S. Department of Energy
dpm/cm^2	disintegrations per minute per square centimeter
FDH	Fluor Daniel Hanford, Inc.
ft	feet
ft-lb	foot pound
g	gram
ID	inside diameter
in.	inch
kg	kilogram
L	liter
lb	pound
m	meter
mL	milliliter
mrem/h	millirem per hour
NRC	U.S. Nuclear Regulatory Commission
OD	outside diameter
psia	pounds per square inch, absolute
psig	pounds per square inch, gage
SAR	safety analysis report
SEP	safety evaluation for packaging
std cm^3/s	standard cubic centimeter per second
UNC	Unified National Course Thread
W/L	watts per liter
WHC	Westinghouse Hanford Company
WMNW	Waste Management Federal Services, Inc., Northwest Operations

SAFETY EVALUATION FOR PACKAGING FOR THE TRANSPORT OF K BASIN SLUDGE SAMPLES IN THE PAS-1 CASK

PART A: PACKAGE DESCRIPTION AND OPERATIONS

1.0 INTRODUCTION

1.1 BACKGROUND INFORMATION

Fuel handling operations in the K Basin have led to some cladding damage in N Reactor fuel. Subsequent fuel oxidation resulted in fuel and fission products, as well as aluminum oxide, iron oxide, concrete grit, and other materials accumulating to form a sludge on the basin floors.

Samples of this sludge will be placed in 4-L plastic bottles and transported from the 100 K Area to the 300 Area or 200 Area for characterization. The PAS-1 cask, which is dually certified by both the U.S. Department of Energy (DOE [1998]) and the U.S. Nuclear Regulatory Commission (NRC [1998]) for transporting Type B quantities of liquid radioactive material, will be used to transport the samples. The volume of the sludge samples per shipment will be 8 L (two 4-L bottles).

The current PAS-1 cask safety analysis report for DOE payloads (Vectra 1996) only authorizes up to a 4-L payload. Therefore, an additional evaluation is required due to the volume of the sludge samples. This safety evaluation for packaging (SEP) authorizes the onsite shipment of the PAS-1 cask containing up to 8 L of Type B quantity fissile-excepted sludge samples.

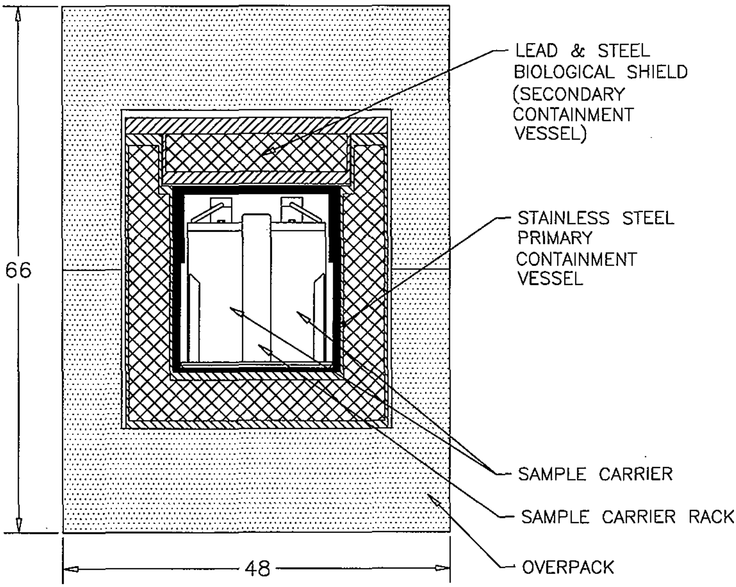
1.2 SYSTEM DESCRIPTION

1.2.1 PAS-1 Cask

The cask consists of a primary containment vessel enclosed inside a secondary containment vessel/environmental shield, thereby forming two containment barriers. The primary containment vessel can be configured to house various types of payloads. Figure A1-1 is a sketch of the PAS-1 cask in the configuration that will be used to transport the K Basin sludge samples. This configuration consists of up to two sample carriers arranged in a sample carrier rack. The primary containment vessel is constructed of 304 stainless steel. Positive closure is achieved through the use of eight screws and a double O-ring set.

The bulk of the shielding for the cask is provided by the secondary containment vessel. The secondary containment vessel consists of lead clad in American Society for Testing and Materials (ASTM)-A516 carbon steel. Positive closure is achieved through eight bolts and a double O-ring set.

Figure A1-1. PAS-1 Cask with Sample Carriers.



Impact protection for the PAS-1 cask is provided by two foam-filled, steel-clad overpacks.

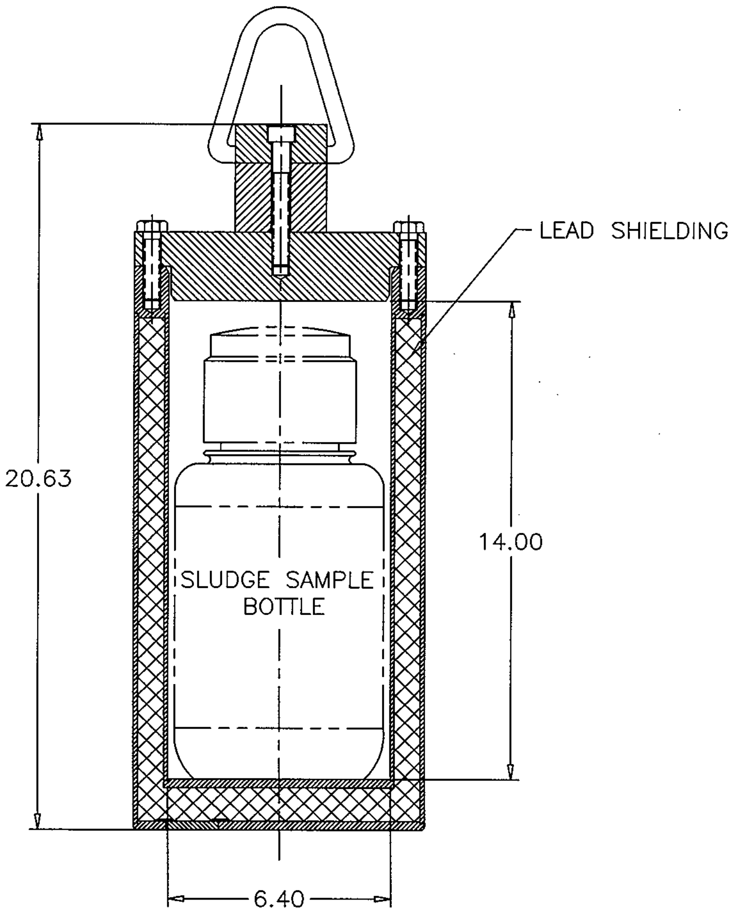
1.2.2 Sample Carrier Rack

The sample carrier rack is used to secure the sample carriers in the cask. It is constructed of carbon steel and can hold up to two sample carriers at one time. The sample carrier rack is fabricated per Westinghouse Hanford Company (WHC) drawing H-1-80793 (WHC 1995a).

1.2.3 Sample Carriers

The sample carriers (see Figure A1-2) are used to provide shielding for the sample bottles when the PAS-1 cask is open. They are constructed of lead shielding encased in a stainless

Figure A1-2. Sample Carrier.



steel shell. The lids are constructed entirely of stainless steel. The carriers are equipped with two bolts to ensure positive closure. The sample carriers are fabricated per WHC drawing H-1-80792 (WHC 1995b).

1.2.4 Sample Bottles

The sample bottles for the K Basin sludge samples have an internal volume of 4 L. They are constructed of plastic and feature a sealed cap. Only one bottle may be placed in a sample carrier. The PAS-1 cask can accommodate a total of two sample bottles, each contained in a sample carrier.

2.0 PACKAGING SYSTEM

2.1 CONFIGURATION AND DIMENSIONS

The dimensions of the PAS-1 cask are as follows.

Primary containment inner cavity	18.00 in. ID x 21.88 in. high
Primary containment exterior	20.50 in. OD x 23.38 in. high
Secondary containment inner cavity	20.65 in. ID x 23.62 in. high
Secondary containment exterior	32.50 in. OD x 39.00 in. high
Package with overpack	48.00 in. OD x 66.00 in. high

ID = Inside diameter.
OD = Outside diameter.

2.2 WEIGHTS AND CENTER OF GRAVITY

The maximum loaded PAS-1 cask weight is 5,806 kg (12,800 lb). The center of gravity is roughly located in the geometric center of the package.

2.3 CONTAINMENT BOUNDARIES

The PAS-1 cask has two leak testable containment boundaries. Primary containment is provided by the primary containment vessel and consists of a double O-ring seal. The secondary containment vessel also has a double O-ring seal. The sample bottles provide a nontestable confinement barrier through the design of the end cap.

2.4 SHIELDING

Source term shielding is provided by the sample carriers, primary containment vessel, and secondary containment vessel. The sample carrier provides some shielding during transport; however, its primary purpose is to provide shielding when the cask is open.

The shielding provided by the secondary containment vessel includes 12.95 cm (5.1 in.) of lead and 5.08 cm (2.0 in.) of steel on the bottom, 12.95 cm (5.1 in.) of lead and 1.92 cm (0.75 in.) of steel on the sides, and 12.19 cm (4.8 in.) of lead and 7.62 cm (3.5 in.) of steel on top.

Additional shielding is provided by the primary containment vessel, which has 1.27 cm (0.5 in.) of steel on the bottom, 1.91 cm (0.75 in.) of steel on the sides, and 2.54 cm (1.0 in.) of steel on top.

The sample carrier provides 2.71 cm (1.07 in.) of lead and 1.27 cm (0.5 in.) of steel on the bottom, 1.91 cm (0.75 in.) of lead and 0.58 cm (0.23 in.) of steel on the sides, and 5.08 cm (2.0 in.) of steel on top for shielding.

2.5 LIFTING DEVICES

The sample carriers are equipped with a lifting attachment built into the lid.

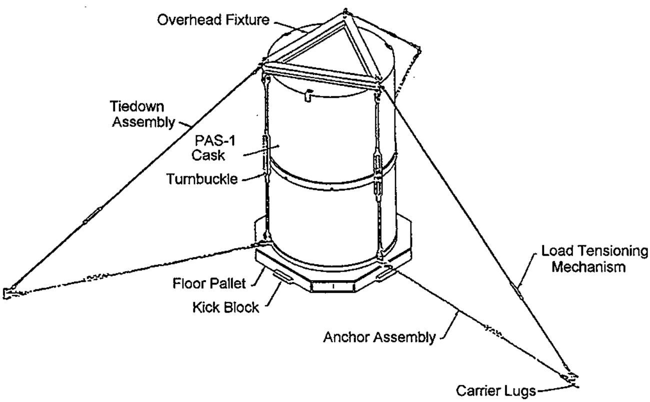
The primary containment vessel is lifted by installing three 1.27-cm (0.5-in.) lifting eyes into the top of the vessel. Similarly, three 3.18-cm (1.25-in.) lifting eyes are installed on the secondary containment vessel for lifting. The top half of the PAS-1 cask overpack is equipped with three lift lugs. These are not to be used for lifting the entire assembly and are rendered inoperable during transit by two flat washers held to the lug with a 0.64-cm (0.25-in.) bolt to act as a cover.

The lifting assembly for the PAS-1 cask consists of an overhead fixture connected to a floor pallet by three turnbuckles (see Figure A2-1). The cask may be lifted by the overhead fixture with a crane, or by the floor pallet with a forklift. There are no lifting devices that are a structural part of the package.

2.6 TIEDOWN DEVICES

The tiedown assembly for the PAS-1 cask consists of a floor pallet, three turnbuckles, an overhead fixture, three tiedown points, and three anchor points (see Figure A2-1). There are no tiedown devices that are a structural part of the package.

Figure A2-1. PAS-1 Cask with Tiedowns.



3.0 PACKAGE CONTENTS

3.1 GENERAL DESCRIPTION

For this shipping campaign, the PAS-1 cask will be used to transport up to two 4-L sludge samples from the K Basins. The cask will also be used to return sludge samples from the 325 Lab to the 222-S Lab. The samples are expected to contain significant quantities of dissolved radionuclides from the corroded fuel. Additionally, they are expected to contain small amounts of suspended transuranic (waste) isotopes.

3.2 CONTENT RESTRICTIONS

The contents of the sample bottles for this campaign shall be limited to fissile-excepted sludge samples from the K Basins. No fuel, other than that suspended in the sludge, shall be transported in the PAS-1 cask.

3.2.1 Radioactive Materials

The worst-case contents were formulated by assuming a 500-mL sample of sludge with an activity 10 times the average activity found in the basin. The remainder of the 4-L sample is assumed to be water. In addition to the sludge, the sample is assumed to contain a small piece of fuel (¼ in. x ¼ in. x ¼ in.) in direct contact with the inner wall of the bottle. The fuel is assumed to be 16% ^{240}Pu MARK 1A fuel 10 years after discharge into the basin.

Table A3-1 contains a breakdown of the anticipated activities for radioactive isotopes contained in this formulation of a worst-case sample.

3.2.2 Nonradioactive Materials

The nonradioactive materials include aluminum oxide, iron oxide, concrete grit, and other miscellaneous basin products and pollutants; e.g., insects, dust, sand. Of importance to this SEP is the 1.8% aluminum and negligible total organic content.

Table A3-1. Maximum Activity for Worst-Case Sample. (2 Sheets Total)

Isotope	Piece of fuel		500 mL of sludge		Combined fuel and sludge	
	Activity (curies)	A_2's	Activity (curies)	A_2's	Activity (curies)	A_2's
^{3}H	2.24E-04	2.24E-07	0.232	2.32E-03	2.32E-01	2.32E-04
^{55}Fe	5.95E-05	5.95E-08	NA	NA	5.95E-05	5.95E-08
^{60}Co	4.29E-05	6.13E-06	0.025	3.57E-03	2.5E-02	3.57E-03
^{63}Ni	0.00	0.00	NA	NA	0.00	0.00
^{85}Kr	0.004	8.00E-04	NA	NA	0.004	8.00E-04
^{90}Sr	0.046	1.15E-01	0.0028	7.00E-03	4.88E-02	1.22E-01
^{90}Y	0.046	4.60E-03	0.0028	2.80E-04	4.88E-02	4.88E-03
^{99}Tc	0.00	0.00	NA	NA	0.00	0.00
^{106}Ru	4.16E-04	5.94E-03	NA	NA	4.16E-04	5.94E-03
^{106}Rh	4.16E-04	NA	NA	NA	4.16E-04	NA
^{125}Sb	9.86E-04	3.94E-05	NA	NA	9.86E-04	3.94E-05
^{125m}Te	2.41E-04	2.41E-06	NA	NA	2.41E-04	2.41E-06
^{134}Cs	1.47E-04	1.47E-05	NA	NA	1.47E-04	1.47E-05
^{137}Cs	0.059	5.90E-03	0.0046	4.6E-04	6.36E-02	6.36E-03
^{137m}Ba	0.056	NA	0.0044	NA	6.04E-02	NA
^{144}Ce	1.94E-04	2.77E-05	NA	NA	1.94E-04	2.77E-05
^{144}Pr	1.94E-04	NA	NA	NA	1.94E-04	NA
^{144m}Pr	2.33E-06	NA	NA	NA	2.33E-06	NA
^{147}Pm	0.0133	5.32E-04	NA	NA	0.0133	5.32E-04
^{151}Sm	5.37E-04	5.97E-06	NA	NA	5.37E-04	5.97E-06
^{154}Eu	0.0011	2.20E-03	0.177	3.54E-02	1.78E-01	3.56E-02
^{155}Eu	2.51E-04	4.18E-06	0.005	8.33E-05	5.25E-03	8.75E-05
^{233}Pa	0.00	0.00	NA	NA	0.00	0.00
^{234}U	2.12E-06	2.12E-05	NA	NA	2.12E-06	2.12E-05
^{235}U	7.81E-08	3.91E-07	NA	NA	7.81E-08	3.91E-07
^{236}U	3.74E-07	1.87E-06	NA	NA	3.74E-07	1.87E-6
^{238}U	1.62E-06	UNLIM	NA	NA	1.62E-06	UNLIM
^{237}Np	0.00	0.00	NA	NA	0.00	0.00
^{238}Pu	5.96E-04	1.99E-01	NA	NA	5.96E-04	1.99E-01
^{239}Pu	6.69E-04	3.35E-01	0.022	1.1E+01	2.27E-02	1.13E+01
^{240}Pu	4.88E-04	2.44E-01	NA	NA	4.88E-04	2.44E-01
^{241}Pu	0.043	.430	NA	NA	0.043	0.430
^{242}Pu	0.00	0.00	NA	NA	0.00	0.00

Table A3-1. Maximum Activity for Worst-Case Sample. (2 Sheets Total)

Isotope	Piece of fuel		500 mL of sludge		Combined fuel and sludge	
	Activity (curies)	A_2's	Activity (curies)	A_2's	Activity (curies)	A_2's
^{241}Am	8.98E-04	1.12E-01	0.105	1.31E+01	0.1059	1.32E+01
^{242m}Am	0.00	0.00	NA	NA	0.00	0.00
^{243}Am	0.00	0.00	NA	NA	0.00	0.00
^{242}Cm	0.00	0.00	NA	NA	0.00	0.00
^{244}Cm	1.28E-04	1.28E-02	NA	NA	1.28E-04	1.28E-02
Total*	0.2183	1.038	0.576	24.149	0.794	25.14

*Total Activity values adjusted for comparison to the total A_2's values.

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4.0 TRANSPORTATION SYSTEM

4.1 TRANSPORTER

The PAS-1 cask will be transported on a flat bed trailer. Up to two PAS-1 casks may be loaded on a single trailer.

4.2 TIEDOWN SYSTEM

The tiedown system consists of (1) carrier lugs, (2) tiedown assemblies, and (3) kick blocks or anchor assemblies to prevent lateral movement. Part A, Section 6.3, gives a description of the tiedown procedure.

4.3 SPECIAL TRANSPORT REQUIREMENTS

4.3.1 Access Control

The transport route shall be controlled to preclude public access during the transport. This requirement does not apply to empty casks that meet the requirements of Part A, Section 6.5 and 49 CFR 173.428.

4.3.2 Radiation

The contact dose rate at any point on the surface of the overpack shall not exceed 200 mrem/h. The dose rate from the outer lateral surfaces of the transport vehicle shall be less than 10 mrem/h at 2 m (6.6 ft). The dose rate at any normally occupied space in the transport vehicle shall be less than 2 mrem/h.

4.3.3 Use Limits

The shipment of K Basin sludge samples in the PAS-1 cask in Type B quantities with a total volume of up to 8 L per cask per shipment is authorized per this SEP for up to one year.

4.3.4 Exclusive Use

The transport vehicle shall not carry any other packagings containing hazardous material during transport of the PAS-1 cask(s).

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5.0 ACCEPTANCE OF PACKAGE FOR USE

Pre-use inspections shall be performed before each use of a PAS-1 cask.

1. The user shall ensure that the packaging is in unimpaired physical condition before each use. No obvious flaws (i.e., broken welds, punctures, lid distortions) shall be present.

2. The user shall verify the following.

    - All closure bolts are in place and in good condition.
    - There are no graded fasteners installed in the packaging that exhibit headmarks matching those on the U.S. Department of Energy "Suspect Fastener Headmark List" (see HNF-PRO-301, *Control of Suspect/Counterfeit Items*).
    - No damage to the bolts (e.g., missing or damaged threads) exists that could limit the structural integrity of the closures.
    - All exposed carbon steel surfaces (except O-ring glands and adjacent seating surfaces) are painted.

3. The O-rings and overpack gasket shall be inspected to ensure that they are free of damage.

4. The sealing surfaces shall be inspected to ensure that they are free of surface defects.

5. Maintenance records shall be available that verify the packaging has successfully passed its annual maintenance verification helium leak test (Vectra 1996). The records shall indicate that the packaging exhibited a leak rate of less than 1×10^{-7} scc/sec for both the primary and secondary containment vessels.

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6.0 OPERATING REQUIREMENTS

6.1 GENERAL REQUIREMENTS

1. The approved SEP shall be the controlling document for the shipment of K Basin sludge samples in Type B quantities for characterization. The approved SEP shall be valid for one year from the date of release.

2. All applicable instructions and procedures for onsite shipment of radioactive material shall comply with HNF-PRO-154, *Responsibilities and Procedures for all Hazardous Material*, and HNF-PRO-157, *Radioactive Material/Waste Shipments.*

3. Operational controls presented in the SEP shall take priority over similar requirements presented in other Fluor Daniel Hanford, Inc. (FDH) manuals, except where other FDH requirements are more restrictive.

4. The PAS-1 cask, sample carrier, overpack, transportation method, and SEP shall not be altered or revised without documented approval in accordance with HNF-PRO-154 and HNF-PRO-440, *Engineering Document Change Control Requirements.*

5. Written operating procedures shall be followed when packaging and transporting payloads in the PAS-1 cask. These procedures shall provide guidance to ensure that the container is being used in accordance with this SEP. These procedures shall be reviewed and approved by the Waste Management Federal Services, Inc., Northwest Operations (WMNW) Engineering organization.

6. Application of paint, plastic film, or similar surface coatings to the cask components to cover surface contamination is not permitted.

7. Operating procedures shall require that the transport of PAS-1 cask be done in accordance with the "special transport requirements" noted in Section 4.0.

6.2 LOADING PACKAGE

6.2.1 Sample Carrier

The placement of the sample bottle in the sample carrier shall be done above water in accordance with established K Basin procedures. Each sample carrier shall contain a maximum of one 4-L sample bottle.

6.2.2 Primary Containment Loading

The following loading procedures for the PAS-1 cask have been excerpted from the *NuPac Consolidated Safety Analysis Report* (Vectra 1996). Portions of the procedure that are inappropriate or not applicable to this shipping campaign are not included in the following procedural steps.

1. If the sample carrier rack is not already in the primary containment vessel, install the rack into the primary containment vessel. Use care to prevent damage to the vessel seal area. The rack is not to be lifted with the sample carriers in place.

2. Lift the loaded sample carriers, one at a time, into the sample carrier rack without incurring damage to the primary containment vessel seal area.

3. Visually inspect the primary containment vessel lid O-rings and body sealing area for contaminates (e.g., dirt, dust) and O-ring damage (e.g., nicks, cuts). If necessary, clean these areas and/or replace O-rings, and apply a light coating of vacuum grease.

4. Install the primary containment vessel lid into the body, followed by eight 3/8-16 UNC closure bolts. Tighten the closure bolts to 16-18 ft-lb torque each.

5. Install the assembled primary containment vessel into the cavity of the secondary containment vessel.

6. Visually inspect the secondary containment vessel lid O-rings and body sealing area for contaminants (e.g., dirt, dust) and O-ring damage (e.g., nicks, cuts). If necessary, clean these areas and/or replace O-rings, and apply a light coating of vacuum grease.

7. Install the secondary containment vessel lid into the body, followed by eight 1-8 UNC closure bolts. Tighten the closure bolts to 450-500 ft-lb torque each.

8. Install the upper overpack followed by eight ¾-10 UNC Grade 5 screws tightened to 110-130 ft-lb torque each. The optional overpack closure requires 16 ½-13 UNC Grade 5 bolts tightened to 50-65 ft-lb torque each. Secure one bolt with a lockwire as a tamper-indicating device.

9. Install a ¼-20 UNC bolt, flat washers, and nut into each of the three overpack lifting holes to preclude their use as a tiedown device.

6.3 TIEDOWN

This section assumes the PAS-1 system is completely assembled with the overhead fixture in place and secured to the floor pallet via the three turnbuckles, as shown in Figure A2-1. The distance from the carrier lug to the cask center line, tiedown assembly capacity, kick block or anchor assembly capacity, and carrier lug requirements for several different angles of tiedown are delineated in Table A6-1. Either of two methods may be utilized to react the horizontal shear forces due to accelerations acting on the system. They are (1) kick blocks or (2) anchor assemblies. The cask can be tied down by either of two methods, as shown in Figures A2-1 and A6-1.

Table A6-1. Tiedown Load Requirements (Each Assembly).

Angle*	Minimum distance		Tiedown assembly		Kick blocks/ anchor assemblies		Carrier lugs (horizontal/ vertical)	
degrees	cm	in.	kg	lb	kg	lb	kg	lb
45	262	103	12,247	27,000	4,990	11,000	13,653/ 8,664	30,100/ 19,100
30	180	71	14,606	32,200	4,990	11,000	12,292/ 12,655	27,100/ 27,900
15	119	45	24,313	53,600	4,990	11,000	11,294/ 23,496	24,900/ 51,800

*Angle of tiedown assembly with respect to vertical.

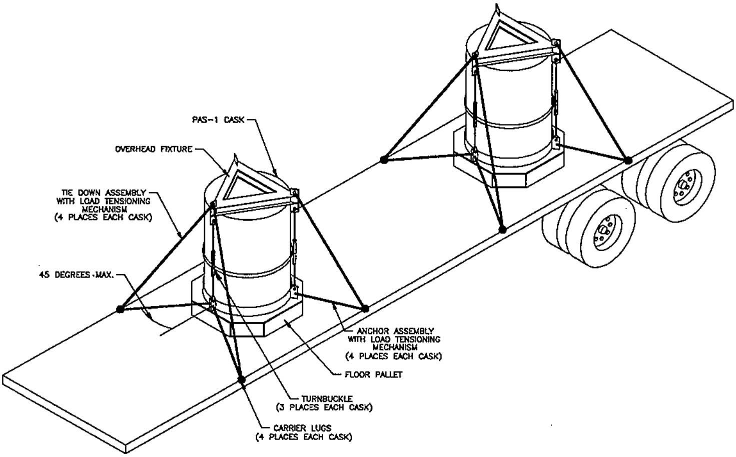
6.3.1 Kick Blocks

Install four kick blocks to the carrier bed, evenly spaced around the base of the floor pallet. The kick blocks should be sufficiently sized and anchored to react the loads specified in Table A6-1 to preclude horizontal motion of the PAS-1 cask. More than four blocks may be utilized about the periphery of the floor pallet, but the total block load capability in any direction must be at least as great as that specified in Table A6-1.

6.3.2 Anchor Assemblies

Install anchor assemblies, rated to a minimum breaking strength as specified in Table A6-1, between each of the three floor pallet turnbuckle lugs and the carrier tiedown lugs. Each anchor assembly should contain, as a minimum, a shackle or equivalent at both ends and a load tensioning mechanism somewhere between, each rated as specified above. Utilizing the load tensioning mechanism, remove all slack from the anchor assemblies prior to shipping.

Figure A6-1. PAS-1 Cask Tiedown Alternative.



6.3.3 Tiedown Assemblies

Install a tiedown assembly, rated to a minimum breaking strength as specified in Table A6-1, between each of the three tiedown lugs located on the overhead fixture and the carrier lugs. The tiedown assembly should contain, as a minimum, a shackle or equivalent at each end and a load tensioning mechanism somewhere between, each rated as specified above. Utilizing the load tensioning mechanism, remove all slack from the tiedown assemblies prior to shipping.

6.4 UNLOADING PACKAGE

6.4.1 PAS-1 Cask Unloading

In general, unloading the package is the reverse sequence of loading the package. Caution must be taken when removing the secondary containment vessel lid. An unusually high gamma dose indicates the sample has leaked from the sample bottle/sample carrier into the primary containment vessel. In this event, the bottle sample must be dealt with in accordance with receiving facility requirements.

6.4.2 Sample Carrier Unloading

The removal of the sample bottle from the sample carrier shall be done in either the 325 or 222-S Laboratories in accordance with established procedures.

6.5 EMPTY PACKAGE

To be transported as empty radioactive containers, the PAS-1 cask and sample carriers must:

a. Have a surface dose level equal to or less than 0.5 mrem/h

b. Have smearable internal contamination not greater than 2,200 dpm/cm^2 for beta/gamma-emitting radionuclides and 220 dpm/cm^2 for alpha- emitting radionuclides

c. Have smearable external contamination not greater than 22 dpm/cm^2 for beta/gamma-emitting radionuclides and 2.2 dpm/cm^2 for alpha- emitting radionuclides

d. Be in unimpaired condition and securely closed to prevent leakage of radioactive material under normal conditions of transport.

The requirements of Part A, Section 4.3.1 do not apply.

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7.0 QUALITY ASSURANCE PROGRAM

The PAS-1 cask packaging system was fabricated in accordance with 10 CFR 71 Subpart H. The package and its manufacturer fulfill all of the quality assurance requirements set forth for design, fabrication, assembly, testing, and maintenance of a Type B, liquid package. Vectra (1996) gives a full description of the quality assurance program used in the design, manufacture, and certification of the PAS-1 cask.

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8.0 MAINTENANCE

Because this SEP authorizes shipments in a one-year time span, annual maintenance of the cask falls outside the scope of this document. Prior to first use, the cask shall meet the requirements of Part A, Section 5.0. With the exception of O-rings, Waste Management Federal Services, Inc., Northwest Operations (WMNW) Engineering approval is required prior to any replacement or repair of a cask component.

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9.0 REFERENCES

10 CFR 71, "Packaging and Transportation of Radioactive Material," Subpart H, "Quality Assurance," *Code of Federal Regulations*, as amended.

DOE, 1998, *PAS-1 Shipping Cask Certification of Compliance 9184*, Rev. 0, U.S. Department of Energy, Washington, D.C.

HNF-PRO-154, *Responsibilities and Procedures for all Hazardous Material*, Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-PRO-157, *Radioactive Material/Waste Shipments*, Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-PRO-301, *Control of Suspect/Counterfeit Items*, Fluor Daniel Hanford, Inc., Richland, Washington.

HNF-PRO-440, *Engineering Document Change Control Requirements*, Fluor Daniel Hanford, Inc., Richland, Washington.

NRC, 1998, *PAS-1 Shipping Cask Certificate of Compliance 9184*, Rev. 4, U.S. Nuclear Regulatory Commission, Washington, D.C.

Vectra, 1996, *NuPac Consolidated Safety Analysis Report*, Rev. 5, Vectra Corporation, San Jose, California.

WHC, 1995a, *Cask Rack Assembly and Details*, drawing H-1-80793, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1995b, *Shipping Container Sludge Sample Bottle Assembly and Details*, drawing H-1-80792, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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PART B: PACKAGE EVALUATION

1.0 INTRODUCTION

1.1 SAFETY EVALUATION METHODOLOGY

The safety evaluation for the PAS-1 cask that will be used to transport the K Basin sludge samples is based on the current safety analysis report (SAR) (Vectra 1996). This SAR has been approved by the U.S. Department of Energy (DOE [1998]), permitting the use of the PAS-1 cask to ship Type B quantities of liquid radioactive material in volumes of up to 4 L per cask.

1.2 EVALUATION SUMMARY AND CONCLUSIONS

Although the sludge sample shipments may contain a greater volume of liquids than allowed by the PAS-1 cask Certification of Compliance (CoC) (DOE 1998), the following evaluations show that the contents are comparable to the allowable payloads such that a comparative analysis can be used. These comparative analyses demonstrate the PAS-1 cask may be used onsite to safely transport the K Basin sludge samples.

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2.0 CONTENTS EVALUATION

2.1 CHARACTERIZATION

The purpose of this shipment is to transport K Basin sludge samples to and from analytic facilities for characterization. Therefore, an exact breakdown of the chemical and radioactive components is not available. The worst-case samples are expected from the weasel pit area. According to WHC-SD-SNF-TI-006 (Baker 1995), it has the worst source term of any region of the basin.

2.1.1 Radioactive Source Term

The worst-case contents were formulated by assuming a 500 mL sample of sludge with an activity ten times the average activity found in the basin. The remainder of each 4-L sample is assumed to be water. In addition to the sludge, the sample is assumed to contain a small piece of fuel (¼ in. x ¼ in. x ¼ in.) in direct contact with the inner wall of the bottle. The fuel is assumed to be 16% ^{240}Pu MARK 1A fuel 10 years after discharge into the basin.

Table A3-1 contains a breakdown of the anticipated activities for radioactive isotopes contained in this formulation of a worst-case sample. The heat load is 0.0017 W/L, as shown in the appendix.

2.1.2 Chemical Source Term

The chemical constituents of the K Basins can be found in Baker (1995). Of concern to the PAS-1 cask CoC (DOE 1998) and this safety evaluation for packaging are the aluminum and total organic content. The total organic content of the K Basins is 0%. The maximum aluminum content based on the weasel pit is 1.8%.

2.2 RESTRICTIONS

The maximum number of sample bottles per PAS-1 cask shall be limited to two.

2.3 APPENDIX, HEAT LOAD ANALYSIS

```
File:  RADFILE.RAD
========== Input Information ==================================

Source from input:
        Nuclide:        Curies:
        H-3             4.64e-001
        Fe-55           1.19e-004
        Co-60           5.00e-002
        Kr-85           8.00e-003
        Sr-90           9.76e-002
        Y-90            9.76e-002
        Ru-106          8.32e-004
        Rh-106          8.32e-004
        Sb-125          1.97e-003
        Te-125m         4.82e-004
        Cs-134          2.94e-004
        Cs-137          1.27e-001
        Ba-137m         1.21e-001
        Ce-144          3.88e-004
        Pr-144          3.88e-004
        Pr-144m         4.66e-006
        Pm-147          2.66e-002
        Sm-151          1.10e-003
        Eu-154          3.56e-001
        Eu-155          1.05e-002
        U-234           4.24e-006
        U-235           1.56e-007
        U-236           7.48e-007
        U-238           3.24e-006
        Pu-238          1.19e-003
        Pu-239          4.54e-002
        Pu-240          9.76e-004
        Pu-241          8.60e-002
        Am-241          2.12e-001
        Cu-244          2.56e-004

Waste Form:     Normal
Physical Form:  Liquid
Container Type: PAS-1 Cask

                Entered Values:         Metric Values:
Package Volume: 5.96e+003 in^3          9.77e+004 cc
Waste Volume:   2.17e+003 in^3          3.55e+004 cc
Waste Mass:     610 lb                  2.77e+005 g
Void Volume:    0 in^3                  0 cc

Date to begin source decay:       9:00 Jun. 18, 1995
Date container sealed:            9:00 Jul. 18, 1995
Date container received:          9:00 Jul. 20, 1995
Days to decay source before seal time:  30.00 days
Days container is sealed:               2.00 days

Entered G-Values:
   G-Alpha      G-Beta        G-Gamma
   0            0             0

Comments:
Source term is based on a total of 8 liters.  Watts/liter
is found by dividing the heat generated by 8 liters.

========== Calculated Results ==================================

H2 Percent Concentration:  0.000 %
H2 Volume:                0 cc
H2 Generation Rate:       0 cc/hour
Heat Generated:           0.0139 Watts
Partial Pressure (H2):    0 kPa
Total Pressure (H2 and Air):  101 kPa
Radioactive:     Yes
Type Determination:       B  (from unity fraction 51.3)
Limited Quantity:         No
LSA Determination:        No  (from unity fraction 9.53)
HRC Determination:        No
Fissile Quantity:         0.805 g
Fissile Excepted:         Yes
Bulk Density:             7.78 g/cc
```

CHECKLIST FOR REVIEW

Document Reviewed: Heat Load Analysis

Scope of Review:

Yes	No	NA		
[ ]	[ ]	[X]	*	Previous reviews complete and cover analysis, up to scope of this review, with no gaps.
[X]	[ ]	[ ]		Problem completely defined.
[ ]	[ ]	[X]		Accident scenarios developed in a clear and logical manner.
[X]	[ ]	[ ]		Necessary assumptions explicitly stated and supported.
[X]	[ ]	[ ]		Computer codes and data files documented.
[X]	[ ]	[ ]		Data used in calculations explicitly stated in document.
[X]	[ ]	[ ]		Data checked for consistency with original source information as applicable.
[ ]	[ ]	[X]		Mathematical derivations checked including dimensional consistency of results.
[X]	[ ]	[ ]		Models appropriate and used within range of validity or use outside range of established validity justified.
[X]	[ ]	[ ]		Hand calculations checked for errors. Spreadsheet results should be treated exactly the same as hand calculations.
[X]	[ ]	[ ]		Software input correct and consistent with document reviewed.
[X]	[ ]	[ ]		Software output consistent with input and with results reported in document reviewed.
[ ]	[ ]	[X]		Limits/criteria/guidelines applied to analysis results are appropriate and referenced. Limits/criteria/guidelines checked against references.
[ ]	[ ]	[X]		Safety margins consistent with good engineering practices.
[X]	[ ]	[ ]		Conclusions consistent with analytical results and applicable limits.
[X]	[ ]	[ ]		Results and conclusions address all points required in the problem statement.
[ ]	[ ]	[X]		Format consistent with appropriate NRC Regulatory Guide or other standards
[X]		[ ]	*	Review calculations, comments, and/or notes are attached.
[X]	[ ]	[ ]		**Document approved.**

J.E. Mercado J.E. Mercado 7/18/95

Reviewer (Printed Name and Signature) Date

* Any calculations, comments, or notes generated as part of this review should be signed, dated and attached to this checklist. Such material should be labeled and recorded in such a manner as to be intelligible to a technically qualified third party.

PROGRAM to CLASSIFY RADIOACTIVE WASTE				
CONTAINERS for TRANSPORTATION and DISPOSAL		FILE REF:	stanh2.xls	
CP Deltete...Analytical Resources, Inc., 2/85 & 6/90				
(Modified for DOE Radionuclides and Thermal Wattage..		DATE:	7/18/95	
RP Genoni/JG Field..Westinghouse-Hanford Co....6/88)				
		BY:	J. Mercado	
Originally Published by the Electric Power Research				
Institute in NP-4938 and NP-4757				
*** WASTE GENERAL INFORMATION ***				
Enter waste description	>	PAS-1 cask		
"	>			
"	>			
Enter waste form ("Special" or "Normal")	>	Normal	>> Reqd input for DOT calculations	
Enter physical form ("Solid", "Liquid" or "Gas")	>	Liquid	>> Reqd input for DOT calculations	
Is waste Activated Metal ? ("Yes", or "No")	>	No	>> Reqd input for 10CFR61 calculations	
Enter container type (1=55 gal. drum, 2=4x4 liner 3=5x5 liner, 4=6x6 liner)	>	1	>> Reqd input for H2 calculations	
Is container a vented HIC ? ("Yes", or "No")	>	No	*Note: For a vented HIC, assume "Date sealed" is date shipped in Cask	
Enter date of curie calculations	>	06/18/95		
Enter date last sealed*	>	07/18/95	>>	
Enter date to be shipped	>	07/18/95	>> Must be later than Ci calcs	
Enter date of shipment receipt	>	07/20/95		
CALCULATED Decay before sealing (years)	=	0.08	Days=	30
CALCULATED Decay before shipment (years)	=	0.08	Days=	30
CALCULATED Duration package is sealed (years)	=	0.01	Days=	2
Enter package interior volume	>		Ft3	
Enter waste volume	>		Ft3	
CALCULATED Container void volume:		0.00	Ft3	
Enter estimated waste void volume	>		Ft3	
** OR **				
Enter waste true density (vendor data)	>		Lbs/Ft3	
CALCULATED Waste void fraction	=	0.000		
CALCULATED Waste void volume	=	0.00	Ft3	
CALCULATED Package interior volume	=	0.000E+00	cc	
CALCULATED Waste volume	=	0.000E+00	cc	
CALCULATED Total void volume	=	2.832E-03	cc	
Enter waste weight	>	610.00	Lbs	
CALCULATED Weight	=	2.769E+05	gms	
CALCULATED Waste bulk density	=	0.0000	gms/cc	
Enter G-H2 (molecules/100 ev)	>			
OR.				
Enter volume cation resin (cu ft)	>			
Enter volume anion resin (cu ft)	>			
Enter volume mix bed resin (cu ft)	>			
Enter volume other resin (cu ft)	>			
Enter G-H2 of other resin	>			
CALCULATED G-H2 for waste	=	0.00		
*** CALCULATED RESULTS ***				
H2 Generation Summary:				
Total Integrated Dose	=	5.278E+02	Rads	

H2 Volume	=	0.000E+00	cm3	
H2 Concentration	=	0.00	%	
H2 Generation Rate	=	0.000E+00	cc/hr	
Pressure Buildup Rate	=	0.000E+00	psi/day	
Pressure (seal to ship)	=	0.00E+00	psi	
Enter Measured H2 Concentration (if known)----------	>	0.00	%	
Ratio Measured to Calculated H2 Concentrations	=	0.00		
Activity Summary @ Shipment:				
Total Activity*	=	1.484E+00	Ci	(*Excludes Daughters
Specific Activity, Total*	=	Enter Waste Vol	mCi/cc	with T 1/2 < 10 days)
Specific Activity*, T 1/2 < 5 Years	==	Enter Waste Vol	µCi/cc	
T 1/2 > 5 Years	==	Enter Waste Vol	µCi/cc	
Decay Heat @ Shipment:				
Decay Heat @ Shipment	=	0.0137	Watts	
or		0.047	BTU/hr	
Fissile Material:				
Fissile Material (49 CFR 173 & 10 CFR 71)	==	0.807	gms	
Other DOE Fissile Material (DOE 5480.1A)		0.000	gms	>> Isotope list is incomplete
Special Nuclear Material:				
Special Nuclear Material (SNM)	==	0.812	gms	
Other DOE Accountable Material (DOE 5633.3)	==	0.066	gms	>> Isotope list is incomplete
Transuranics:				
Specific Activity, Transuranics	==	1247.392	nCi/gms	>>Potential GTCC
10 CFR 61.55 Classification:		Unity Fraction		Classification
Table 1 Isotopes	==	94.692	A	Class > C
(Long Lived)		N/A	B	
		9.469	C	Limiting Isotope
				Am-241
Table 2 Isotopes	==	Enter Waste Vol	A	
(Short Lived)		Enter Waste Vol	B.	Miscellaneous
		Enter Waste Vol	C	
Transportation Classification:		Unity Fraction		
LSA Determination	==	9.526E+00	> LSA	
Type Determination	==	5.130E+01	Type 'B'	
Highway Route Control (HRC) Determination	==	1.710E-02	Non HRC	
Limited Quantity (LQ) Determination	==	5.130E+05	> LQ	
Advance Notification Quantity ?	==	No		
EPA Reportable Quantity (RQ) Determination	==	2.722E+01	Reportable Quantity	

INPUT: LISTED ISOTOPES					
(**** = Daughter Product)				Curies when	Curies when
	Curies	or	%	Sealed	Shipped
Total Curies					
(ONLY if entering %) =				xxxxx	xxxxx
H-3——>	4.640E-01			4.619E-01	4.619E-01
C-14——>				0.000E+00	0.000E+00
Na-22——>				0.000E+00	0.000E+00
Cr-51——>				0.000E+00	0.000E+00
Mn-54——>				0.000E+00	0.000E+00
Fe-55——>	1.190E-04			1.165E-04	1.165E-04
Co-57——>				0.000E+00	0.000E+00
Co-58——>				0.000E+00	0.000E+00
Fe-59——>				0.000E+00	0.000E+00
Ni-59——>				0.000E+00	0.000E+00
Co-60——>	5.000E-02			4.946E-02	4.946E-02
Ni-63——>				0.000E+00	0.000E+00
Zn-65——>				0.000E+00	0.000E+00
Se-79——>				0.000E+00	0.000E+00
Kr-85——>	8.000E-03			7.958E-03	7.958E-03
Sr-89——>				0.000E+00	0.000E+00
Sr-90——>	9.760E-02			9.741E-02	9.741E-02
Y-90——>	****		****	9.741E-02	9.741E-02
Y-91——>				0.000E+00	0.000E+00
Zr-93——>				0.000E+00	0.000E+00
Nb-93m——>				0.000E+00	0.000E+00
Nb-94——>				0.000E+00	0.000E+00
Zr-95——>				0.000E+00	0.000E+00
Nb-95——>				0.000E+00	0.000E+00
Nb-95m——>				0.000E+00	0.000E+00
Tc-99——>				0.000E+00	0.000E+00
Ru-103——>				0.000E+00	0.000E+00
Rh-103m——>	****		****	0.000E+00	0.000E+00
Ru-106——>	8.320E-04			7.863E-04	7.863E-04
Rh-106——>	****		****	7.863E-04	7.863E-04
Pd-107——>				0.000E+00	0.000E+00
Cd-109——>				0.000E+00	0.000E+00
Ag-110m——>				0.000E+00	0.000E+00
Ag-110——>	****		****	0.000E+00	0.000E+00
Sn-113——>				0.000E+00	0.000E+00
In-113m——>	****		****	0.000E+00	0.000E+00
Cd-113m——>				0.000E+00	0.000E+00
Cd-115m——>				0.000E+00	0.000E+00
Sn-119m——>				0.000E+00	0.000E+00
Sn-121m——>				0.000E+00	0.000E+00
Sn-123——>				0.000E+00	0.000E+00
Te-123m——>				0.000E+00	0.000E+00
Sb-124——>				0.000E+00	0.000E+00
Sb-125——>	1.970E-03			1.930E-03	1.930E-03
Te-125m——>	4.820E-04			3.367E-04	3.367E-04
Sn-126——>				0.000E+00	0.000E+00
Sb-126m——>	****		****	0.000E+00	0.000E+00
Sb-126——>				0.000E+00	0.000E+00
Te-127m——>				0.000E+00	0.000E+00
Te-127——>			****	0.000E+00	0.000E+00
Te-129m——>				0.000E+00	0.000E+00
Te-129——>	****		****	0.000E+00	0.000E+00
I-129——>				0.000E+00	0.000E+00
I-131——>				0.000E+00	0.000E+00
Cs-134——>	2.940E-04			2.860E-04	2.860E-04
Cs-135——>				0.000E+00	0.000E+00
Cs-136——>				0.000E+00	0.000E+00
Cs-137——>	1.270E-01			1.268E-01	1.268E-01
Ba-137m——>	****		****	1.199E-01	1.199E-01

	Ba-140——>				0.000E+00	0.000E+00
	La-140——>	****		****	0.000E+00	0.000E+00
	Ce-141——>				0.000E+00	0.000E+00
	Pr-143——>				0.000E+00	0.000E+00
	Ce-144——>	3.880E-04			3.606E-04	3.606E-04
	Pr-144——>	****		****	3.555E-04	3.555E-04
	Pr-144m——>	4.660E-06			0.000E+00	0.000E+00
	Nd-147——>				0.000E+00	0.000E+00
	Pm-147——>	2.660E-02			2.603E-02	2.603E-02
	Pm-148m——>				0.000E+00	0.000E+00
	Pm-148——>	****		****	0.000E+00	0.000E+00
	Sm-151——>	1.100E-03			1.099E-03	1.099E-03
	Eu-152——>				0.000E+00	0.000E+00
	Gd-153——>				0.000E+00	0.000E+00
	Eu-154——>	3.560E-01			3.537E-01	3.537E-01
	Eu-155——>	1.050E-02			1.038E-02	1.038E-02
	Eu-156——>				0.000E+00	0.000E+00
	Tb-160——>				0.000E+00	0.000E+00
	Ta-182——>				0.000E+00	0.000E+00
	Ra-226——>				0.000E+00	0.000E+00
	U-233——>				0.000E+00	0.000E+00
	U-234——>	4.240E-06			4.240E-06	4.240E-06
	U-235——>	1.560E-07			1.560E-07	1.560E-07
	U-236——>	7.480E-07			7.480E-07	7.480E-07
	U-237——>				0.000E+00	0.000E+00
	U-238——>	3.240E-06			3.240E-06	3.240E-06
	Np-237——>				0.000E+00	0.000E+00
	Pu-238——>	1.190E-03			1.189E-03	1.189E-03
	Pu-239——>	4.540E-02			4.540E-02	4.540E-02
	Pu-240——>	9.760E-04			9.760E-04	9.760E-04
	Pu-241——>	8.600E-02			8.566E-02	8.566E-02
	Pu-242——>				0.000E+00	0.000E+00
	Am-241——>	2.120E-01			2.120E-01	2.120E-01
	Am-242m——>				0.000E+00	0.000E+00
	Am-242——>	****		****	0.000E+00	0.000E+00
	Am-243——>				0.000E+00	0.000E+00
	Cm-242——>				0.000E+00	0.000E+00
	Cm-244——>	2.560E-04			2.552E-04	2.552E-04

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3.0 CONTAINMENT STUDY

The containment analysis for the PAS-1 cask is contained in the SAR for packaging for the PAS-1 packaging (Vectra 1996). The containment analysis is not affected by the conditions of the sludge sample transfers or the DOE certificate to accommodate liquid payloads greater than 4 L.

An exception to the PAS-1 SAR is the elimination of the post-load leak test, to meet ALARA principles. The payload is triply confined within the bottles, primary containment vessel, and secondary containment vessel. O-rings will be inspected for damage and replaced if necessary (Part A, Section 6.2.2), and the cask must successfully pass its annual maintenance leak test (Part A, Section 5.0).

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4.0 SHIELDING EVALUATION

4.1 INTRODUCTION

The source term for the K Basin sludge sample is not bounded by the PAS-1 cask SAR (Vectra 1996). Therefore, the shielding effectiveness of the PAS-1 cask must be evaluated to ensure that dose rates are within allowable levels.

4.2 ACCEPTANCE CRITERIA

The dose rate at the accessible surfaces of the PAS-1 cask shall be less than or equal to 200 mrem/h. The dose rate at 2 m (6.6 ft) from the trailer shall not exceed 10 mrem/h, and the dose rate inside the transport vehicle cab shall be less than or equal to 2 mrem/h.

4.3 SHIELDING EVALUATIONS AND CONCLUSIONS

The appendix contains a shielding analysis, which shows that the maximum surface dose rate for 4 L of sludge is 1.4 mrem/h. This analysis did not give any credit for the shielding provided by the sample carrier and is therefore conservative. The dose rate for the type of analysis presented is linear, and for an 8-L sludge shipment, the surface dose rate would be 2.8 mrem/h. These levels meet the acceptance criteria.

4.4 APPENDIX, PAYLOAD EVALUATION

VECTRA

June 30, 1995
2161-95-043

Mr. Richard Smith
Westinghouse Hanford Company (G2-02)
Packaging Safety Engineering
Transportation and Packaging
P.O. Box 1970
Richland, WA 99352

Subject: PAS-1 Cask Payload Evaluation

Reference: (1) WHC FAX request dated 6/28/95
(2) WHC PO # MJF-SWV-375223

Dear Mr. Smith

In accordance with your request, VECTRA has performed an evaluation of the payload described in reference (1). A shielding analysis was performed using the same methodology described in the PAS-1 SAR, Chapter 5. With four liters of the fuel pool sludge inside the PAS-1, the on contact surface dose rate is calculated to be 1.4 mRem/hr, as shown in the enclosed MicroShield computer run. Note that source nuclide amounts are listed in curies.

Although the 1.4 mRem/hr dose rate is greater than that calculated for Payload B, it is far less than the calculated dose rate for Payload A. Therefore, the PAS-1 packaging has a large shielding margin for the fuel pool sludge payload. Because the fissile material content is less than 15 grams, no criticality evaluation is necessary. Although we have not specifically evaluated the gas generated by this payload, the heat generation rate should be very low due to the small amounts of Sr-90 and Cs-137.

We performed this task under the reference (2) agreement. If you have any questions, please feel free to call me at any time.

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Fax: (408) 281-6186 Engineering • Fax: (408) 281-6202 Fuel Services

VECTRA

Very truly yours,

Mat Waltrip, P.E.
Project Manager

cc: Mr. John Fleming
Senior Procurement Specialist
Westinghouse Hanford Company (G1-55)
P.O. Box 1970
Richland, WA 99352

MicroShield 4.00 - Serial #4.00-00104
Pacific Nuclear

Page : 1
DOS File: PAS2.MS4
Run Date: June 29, 1995
Run Time: 2:25 p.m. Thursday
Duration: 0:00:06

File Ref: 216-95-043
Date: 6/29/95
By: M K Walton
Checked: [illegible]

Case Title: PAS-1 Cask Side Dose Rate - 4L Fuel Pool Sludge Source Term

GEOMETRY 1 - Point

	centimeters	feet and	inches
Dose point coordinate X:	16.7894	0.0	6.6
Dose point coordinate Y:	0.0	0.0	.0
Dose point coordinate Z:	0.0	0.0	.0
Shield 1:	1.905	0.0	.8
Shield 2:	0.9652	0.0	.4
Shield 3:	12.954	0.0	5.1
Shield 4:	0.9652	0.0	.4

MATERIAL DENSITIES (g/cm^3)

Material	Shield 1 Slab	Shield 2 Slab	Shield 3 Slab	Shield 4 Slab
Iron	7.86	7.86		7.86
Lead			11.34	

BUILDUP
Method: Buildup Factor Tables
The material reference is Shield 3

INTEGRATION PARAMETERS
Case solved analytically.

SOURCE NUCLIDES

Nuclide		Nuclide	
Am-241	1.0590e-001	Ba-137m	6.0400e-002
Ce-144	1.9400e-004	Cm-244	1.2800e-004
Co-60	2.5000e-002	Cs-134	1.4700e-004
Cs-137	6.3600e-002	Eu-154	1.7810e-001
Eu-155	5.3000e-003	Fe-55	5.9500e-005
H-3	2.3200e-001	Kr-85	4.0000e-003
Pm-147	1.3300e-002	Pr-144	1.9400e-004
Pr-144m	2.3300e-006	Pu-238	5.9600e-004
Pu-239	2.2700e-002	Pu-240	4.8800e-004
Pu-241	4.3000e-002	Rh-106	4.1600e-004
Ru-106	4.1600e-004	Sb-125	9.8600e-004
Sm-151	5.3700e-004	Sr-90	4.8800e-002
Te-125m	2.4100e-004	U-234	2.1200e-006
U-235	7.8100e-008	U-236	3.7400e-007

Page : 2
DOS File: PAS2.MS4
Run Date: June 29, 1995
Run Time: 2:25 p.m. Thursday
Title : PAS-1 Cask Side Dose Rate - 4L Fuel Pool Sludge Source Term

Nuclide		Nuclide	
U-238	1.6200e-006	Y-90	4.8800e-002

RESULTS

Energy (MeV)	Activity (photons/sec)	Energy Fluence Rate (MeV/sq.cm/sec)		Exposure Rate In Air (mR/hr)	
		No Buildup	With Buildup	No Buildup	With Buildup
0.1	2.708e+009	0.000e+000	2.718e-005	0.000e+000	4.159e-008
0.15	8.672e+005	4.131e-124	1.002e-023	6.802e-127	1.650e-026
0.2	4.528e+008	2.652e-058	3.448e-022	4.680e-061	6.085e-025
0.3	1.541e+005	4.553e-025	8.490e-025	8.636e-028	1.611e-027
0.4	5.844e+007	5.731e-012	1.361e-011	1.117e-014	2.651e-014
0.5	2.194e+007	5.593e-008	1.586e-007	1.098e-010	3.113e-010
0.6	2.564e+009	1.337e-003	4.127e-003	2.609e-006	8.055e-006
0.8	2.575e+009	3.089e-001	1.106e+000	5.876e-004	2.103e-003
1.0	2.953e+009	5.953e+000	2.307e+001	1.097e-002	4.253e-002
1.5	3.497e+009	1.901e+002	7.795e+002	3.198e-001	1.311e+000
2.0	5.556e+004	1.112e-002	4.611e-002	1.720e-005	7.130e-005
TOTAL:	1.483e+010	1.964e+002	8.037e+002	3.314e-001	1.356e+000

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5.0 CRITICALITY ANALYSIS

The maximum amount of fissile material for the PAS-1 cask shipped in accordance with this SEP will occur when two 4-L sample bottles are transported in a single cask shipment. In this case, the maximum amount of fissile material is 0.8 g of fissile material. Therefore, the payload is fissile-excepted, and no criticality analysis is required.

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6.0 STRUCTURAL ANALYSIS

The SAR (Vectra 1996), Section 2.0, provides a structural analysis of the PAS-1 cask. The sample carrier rack weighs approximately 50 kg (110 lb), and two sample carriers with bottles and sludge samples weigh an additional 227 kg (500 lb) for a total payload weight of 276 kg (610 lb). This is less than the 624-kg (1,375-lb) payload weight for payload B analyzed in Vectra (1996). Therefore, the sludge shipment is bounded by the previous analyses.

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7.0 THERMAL ANALYSIS

The SAR (Vectra 1996), Section 3.0, provides a thermal analysis of the PAS-1 cask. It provides input into the structural analysis for determining PAS-1 cask integrity in the containment analysis. The 8-L sludge sample payload has a decay heat of 0.0017 W/L, a negligible (less than 1%) total organic content, and an aluminum content of 1.8%. This places the payload within category 4, which allows a decay heat of 0.0055 W/L, a total organic content of 1.8%, and an aluminum content of 12%. Therefore, the conditions of the sludge sample shipment are bounded by these previous analyses.

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8.0 GAS GENERATION

The SAR (Vectra 1996), Section 3.0, provides a gas generation analysis of the PAS-1 cask. The sludge samples fall within Category 4 of the previous analysis. In addition, the total volume of the sludge shipment, including the rack and sample carriers, is approximately 36,050 cm^3 (2,200 in^3). This is less than the 66,910 cm^3 (4,083 in^3) of volume for the payload analyzed. Therefore, the conditions of the sludge sample shipment are bounded by the previous analyses.

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9.0 REFERENCES

Baker, R. B., 1995, *Summary Status of K Basins Sludge Characterization*, WHC-SD-SNF-TI-006, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

DOE, 1998, *PAS-1 Shipping Cask Certificate of Compliance 9184*, Rev. 0, U.S. Department of Energy, Washington, D.C.

NRC, 1998, *PAS-1 Shipping Cask Certificate of Compliance 9184*, Rev. 4, U.S. Nuclear Regulatory Commission, Washington, D.C.

Vectra, 1996, *NuPac PAS-1 Consolidated SAR*, Rev. 5, Vectra Corporation, San Jose, California.

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DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	Packaging Engineering	Date 11/06/98
Project Title/Work Order		EDT No. NA
Safety Evaluation for Packaging for the Transport of K Basin Sludge Samples in the PAS-1 Cask (HNF-SD-TP-SEP-038)		ECN No. 646742

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
R. B. Baker	H0-40	X			
J. E. Cabaniss	H1-15	X			
J. G. Field	H1-15				X
T. Romano	H1-15				X
R. J. Smith	H1-15	X			
D. J. Trimble	H0-40	X			
M. R. Turner	H1-15				X
Work Control (D. L. Kelly)	H1-15				X
WHC-SD-TP-SEP-038 File	H1-15	X			
Central Files	B1-07	X			
DOE Reading Room	H2-53	X			

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