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PACKAGING DESIGN CRITERIA FOR THE HANFORD ECOROK PACKAGING

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Packaging Design Criteria for the Hanford Ecorok Packaging

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Abstract: The Hanford Ecorok Packaging (HEP) will be used to ship contaminated water purification filters from K Basins to the Central Waste Complex. This packaging design criteria documents the design of the HEP, its intended use, and the transportation safety criteria it is required to meet. This information will serve as a basis for the safety analysis report for packaging.

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LIST OF TERMS

ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
CEDE	committed effective dose equivalent
cm	centimeter
CWC	Central Waste Complex
EDE	effective dose equivalent
ft	foot
HEP	Hanford Ecorok packaging
in.	inch
kg	kilogram
kPa	kilopascals
ksi	kilopounds (force) per square inch
L/min	liters per minute
m	meter
m^2	square meter
MPa	megapascals
mrem/h	millirems per hour
NPT	national pipe thread
PDC	packaging design criteria
psi	pounds (force) per square inch
QA	quality assurance
rem/h	rems per hour
SARP	safety analysis report for packaging
SEG	Scientific Ecology Group, Inc.
TRU	transuranic (waste)
UNC	unified national coarse thread

PACKAGING DESIGN CRITERIA FOR THE HANFORD ECOROK PACKAGING

1.0 INTRODUCTION

1.1 BACKGROUND

The majority of the spent reactor fuel on the Hanford Site is presently being stored in the water-filled K East and K West Basins awaiting processing and/or disposal. The shielding/cooling water in each basin is purified through several different filter assemblies. During use, the filters become contaminated with the transuranic (TRU) material and fission products present in the basin water. This requires that the filters be shipped in a retrievable configuration to the Central Waste Complex (CWC).

There are currently 25 Ecorok[1] 25-11 containers at the K Basins, along with five 2-in.-thick steel liners. These containers and liners were not originally intended to be used as transportation packagings; however, several design modifications have been proposed, and the modified packaging is now a candidate for use in the onsite transportation and CWC storage of the contaminated filters. The modified packaging will be referred to as the Hanford Ecorok packaging (HEP).

NOTE: There are to be two configurations of the HEP. The initial configuration will use existing 2-in.-thick steel liners, with modifications. The final configuration will use an inner container. The criteria for the initial configuration are specifically addressed in Appendix D.

1.2 PURPOSE AND SCOPE

The purpose of this packaging design criteria (PDC) is to document the design of the HEP, its intended use, and the transportation safety criteria that it is required to meet. This information will serve as a basis for the safety analysis report for packaging (SARP). The SARP will finalize the criteria; identify any changes to the design or use of the HEP, as necessary, to meet these criteria; and show that the HEP meets these criteria.

The scope of this PDC is limited to the single-trip use of each HEP for shipping contaminated water filters from the K Basins to the CWC. In addition, the scope of this PDC has been limited by Task Plan TR-95-036 such that the requirements of the *Hanford Site Solid Waste Acceptance Criteria* (Willis 1993) are not specifically addressed.

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[1] Ecorok is a trademark of Scientific Ecology Group, Inc.

1.3 JUSTIFICATION

Previously, contaminated cartridge filters were shipped and stored in the K Area spent filter cartridge container. This packaging required that the filters be bagged and then placed inside a corrugated steel pipe. The void spaces between the filters and the steel pipe were then filled with concrete.

The K Area spent filter cartridge container is not suitable for heavily contaminated filters. These higher contamination levels are due to higher contamination levels in the basin water; longer run times; or, for the Memtec[2] filter assemblies and the Tri-Nuc[3] filters (see 2.1.1), differences in filter design, which will allow the filters to hold a much higher quantity of contamination.

The higher contamination levels will exceed the payload limitations of the existing packaging. In addition, the *Hanford Site Solid Waste Acceptance Criteria* (Willis 1993) classifies the filters as TRU waste and therefore requires that the filters be stored in a retrievable configuration.

As a result, a SARP is required to show that the HEP is in compliance with the safety requirements of WHC-CM-2-14, *Hazardous Material Packaging and Shipping*. This manual requires that, for onsite transportation, the package provides a degree of safety that is equivalent to the safety provided by a fully certified package shipped in commerce.

2.0 PACKAGE CONTENTS

2.1 PHYSICAL DESCRIPTION

The HEP will transport contaminated K Basin water filters, inner container bagging, and absorbent. These items are as follows.

2.1.1 Filters

There are three different filter payloads. These filter payloads are as follows.

NOTE: Initial weights assume dry and uncontaminated filters. Final weights assume filters loaded to maximum capacity, with water drained to the maximum practicable extent.

2.1.1.1 Cartridge Filter Assembly. These are the original filters that were shipped in the K Area spent filter cartridge container. This assembly was used in the water purification system, upstream of the ion exchange modules. This design consists of a mounting cage constructed of 316 stainless steel.

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[2] Memtec is a trademark of Memtec America Corporation.

[3] Tri-Nuc is a trademark of Dover Corporation.

The cage is 74.61 cm (29.375 in.) in diameter by 93.66 cm (36.875 in.) tall (overall height). This cage assembly contains 88 filter cartridges. Each cartridge is 76.2 cm (30.0 in.) long and 6.35 cm (2.5 in.) in diameter. They are constructed of polypropylene fiber wound around a stainless steel core. The flow path through these filters was from the outside to the inside. The HEP will hold only one of the cartridge filter assemblies. K Basins has estimated a maximum initial weight of 233.2 kg (514.0 lb) and a maximum final weight of 255.8 kg (564.0 lb).

2.1.1.2 Memtec Filter Assemblies. Seven of the Memtec filter assemblies will serve as a replacement for a single cartridge filter assembly. Each assembly consists of a mounting cage constructed of 304 stainless steel. The cage has a maximum diameter of 19.46 cm (7.66 in.) and a maximum overall height of 63.5 cm (25.0 in.). This cage assembly contains a single, pleated, polypropylene filter cartridge. The cartridge is 56.45 cm (22.225 in.) long and approximately 15.2 cm (6.0 in.) in diameter. The flow path through these filters will be from the inside to the outside. Although the HEP could hold more, K Basins used seven of the Memtec filter assemblies; i.e., one complete filter change-out, as a basis to determine the source term for the filter shipments. K Basins has estimated, for seven assemblies, a maximum initial weight of 95.3 kg (210.0 lb) and a maximum final weight of 186.0 kg (410.0 lb). Since this is less than the worst case (i.e. Tri-Nuc Filters), K Basins may ship more than seven Memtec filters, provided that they do not exceed the established worst case source term (Table 1), and the maximum allowable weight (Table 7).

2.1.1.3 Tri-Nuc Filters. These filters are part of a portable filtration system that can be moved into different portions of the basin. This design is such that the filters are removed from the assembly, and only the filters will be shipped. The filters are 76.2 cm (30.0 in.) long and 15.2 cm (6.0 in.) in diameter. These are pleated filters constructed of polypropylene material. The flow path through these filters is from the inside to the outside. The HEP will hold as many as 19 Tri-Nuc filters. K Basins has estimated, for 19 filters, a maximum initial weight of 258.6 kg (570.0 lb) and a maximum final weight of 378.3 kg (834.0 lb).

2.1.2 Inner Container Bagging

The inner container may be placed inside a bag prior to being placed into the Ecorok container. The bag shall be constructed from polyvinyl chloride laminated woven polyester fabric, such as Pacifitex[4] 1009 (or other fabric meeting Mil-C-43006E, Type I1). The bag has a drawstring closure. Appropriate operational measures shall be taken to ensure that the bag closure will allow efficient venting of hydrogen gas.

[4]Pacifitex is a trademark of Lancs Industries.

2.1.3 Absorbent

A maximum of 12.3 kg (27.0 lb) of absorbent will be added to the inner container. The material will be Radsorb,[5] a sodium polyacrylate homopolymer.

2.2 RADIONUCLIDE COMPOSITION

The source term for this PDC was provided by K Basins (see Appendix A). This source term was developed from Dodd (1995), which is a study of inventory releases. This study provided quantities of ^{137}Cs, ^{90}Sr, and total TRU material in each of 13 different cartridge filter assemblies, as well as presenting a worst-case cartridge filter inventory.

The individual ^{137}Cs quantities were calculated from actual dose rate measurements from each of the 13 different cartridge filter assemblies.

The individual ^{90}Sr quantities were based on laboratory analyses of samples from five different cartridge filter assemblies. The analyses showed an average ^{137}Cs to ^{90}Sr ratio of approximately 10:1. For conservatism, the study assumed a ratio of 1:1.

The individual TRU quantities were also based on laboratory analyses of samples from five different cartridge filter assemblies. The analyses showed an average ^{137}Cs-to-TRU ratio of approximately 10:3. For conservatism, the study assumed a ratio of 10:6.

The study presented a worst-case cartridge filter inventory that was based on a statistical analysis of the 13 individual ^{137}Cs, ^{90}Sr, and TRU quantities. It was assumed that the worst-case cartridge filter assembly would contain the average ^{137}Cs, ^{90}Sr, and TRU quantities, plus two standard deviations. This works out to approximately 4.5 Ci of ^{137}Cs, 4.5 Ci of ^{90}Sr, and 2.7 Ci of TRU in the worst-case cartridge filter assembly.

To determine the ^{137}Cs, ^{90}Sr, and TRU quantities in the Memtec filter assemblies and the Tri-Nuc filters, K Basins performed an analysis of filter capacities (see Appendix A). This analysis indicated that the worst-case cartridge filter assembly would hold about 22.7 kg (50.0 lb) of material, that the seven Memtec filter assemblies would hold 90.7 kg (200.0 lb), and that the worst case would be the Tri-Nuc filters, with 119.8 kg (264.0 lb) of material. Based on these weights, it was assumed that the worst case inventory would be approximately five times the inventory in the worst cartridge filter assembly. This results in 22 Ci of ^{137}Cs and ^{90}Sr, as shown below in Table 1, and 13 Ci of TRU.

Rather than listing total curies of TRU, Table 1 lists the 13 Ci by individual isotope, based on the overall basin fuel distribution (2.1 Ci of ^{238}Pu, 3.7 Ci of ^{239}Pu, 2.1 Ci of ^{240}Pu, and 5.1 Ci of ^{241}Am).

The remaining isotopes were either based on decay information or derived from the overall basin fuel inventory.

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[5] Radsorb is a trademark of Environmental Scientific Inc.

Table 1. Maximum K Basin Water Filter Source Term.

Isotope	Curies	Isotope	Curies	Isotope	Curies
^{60}Co	0.5	^{151}Sm	2.8	^{238}Pu	2.1
^{90}Sr	22.0	^{154}Eu	2.1	^{239}Pu	3.7
^{90}Y	22.0	^{234}U	1.41 E-2	^{240}Pu	2.1
^{137}Cs	22.0	^{235}U	5.45 E-4	^{241}Pu	120.0
^{137m}Ba	21.0	^{236}U	2.04 E-3	^{241}Am	5.1
^{147}Pm	18.0	^{238}U	1.12 E-2	Other*	4.6

*May be treated as equal quantities of ^{85}Kr, ^{125}Sb and ^{134}Cs.

2.3 CHEMICAL COMPOSITION

It is expected that the polypropylene filters will contain residual water and miscellaneous debris that has accumulated in the basin water, including zirconium oxide, iron oxide, concrete grit, dust, insects, etc. There will also be as much as 12.3 kg (27.0 lb) of absorbent (Radsorb) and the polyvinyl chloride laminated woven polyester fabric inner container bagging.

2.4 TRANSPORTATION CLASSIFICATION

The payload is a fissile Type B quantity. The payload contains over 320 g of fissile material (mostly ^{235}U and ^{239}Pu [see Table 2]). The fissile classification will be specified by the SARP.

Table 2. Fissile Isotope Weights.

Isotope	Curies[1]	Curies per gram[2]	Grams
^{235}U	5.45 E-4	2.1 E-6	259.5
^{238}Pu	2.1	1.7 E+1	0.1
^{239}Pu	3.7	6.2 E-2	59.7
^{241}Pu	120.0	1.1 E+2	1.1

[1] From Table 1.
[2] From 10 CFR 71, Appendix A, Table A-1.

3.0 OPERATIONS

3.1 ORIGINATING FACILITY OPERATIONS

The originating facilities shall be either the K West Basin or the K East Basin. K Basins will supply rigging for lifting the Ecorok container. The Ecorok container rigging will be such that the weight of the HEP is distributed essentially evenly among all three of the lifting attachments.

The inner container body assembly (minus the drain plug) will be submerged in the basin water and lowered into place. The inner container rigging will be moved to the side so that the opening of the inner container is not obstructed. The contaminated filter assemblies will then be transferred into the submerged inner container body assembly. The inner container lid assembly (minus the Nuc-Fil filter) will be lowered, via its center lifting attachment, onto the body assembly. After proper alignment of the lid, the lid bolts will be remotely tightened (requirements to be identified in the SARP). When the inner container has been lifted out of the basin, water will then be allowed to exit through the drain hole to the maximum practicable extent. After drainage, the drain plug will then be replaced and tightened (requirements to be identified in the SARP). Absorbent (Radsorb) will then be introduced into the inner container, via the filter penetration, in quantities sufficient to ensure the absorption of any free-standing water. The Nuc-Fil filter will then be installed and properly tightened (requirements to be identified in the SARP). After decontamination and drying of the external surfaces of the inner container and the inner container rigging to the maximum practicable extent, the inner container may first be placed inside the inner container bagging (see 2.1.2 for bag venting requirements) and then will be placed inside the Ecorok container. At this point, the Ecorok container lid assembly (including the Nuc-Fil filter), will be installed, followed by proper torquing of the four closure bolts (requirements to be identified in the SARP).

3.2 SHIPPING OPERATIONS

K Basins has indicated that four existing cartridge filter assemblies will be shipped during the first month.

NOTE: These will be the only shipments in the existing 2-in.-thick steel liners--these shipments are subject to the additional restrictions of Appendix D.

After that, shipments are estimated at two per month on a continuing basis--these will be Memtec filter assemblies or the Tri-Nuc filters. The HEPs will be shipped either one or two at a time. The shipment route will be south from the K Basins, west on Route 1, south on Route 6, east on Route 11A, south to the gate 609 entrance into the 200 West Area, and into the CWC. The total distance for this route is approximately 16.1 km (10.0 mi).

Shipping shall be in compliance with WHC-CM-2-14 and the controls developed by the SARP (such as controls appropriate for the applicable fissile classification).

3.3 RECEIVING FACILITY OPERATIONS

The receiving facility shall be the CWC. The container will be transported to the CWC where it will be stored awaiting further processing.

4.0 DESIGN CRITERIA

4.1 PACKAGING DESIGN CRITERIA

4.1.1 General System Description

The HEP will consist of the following components.

4.1.1.1 Ecorok Container. The Ecorok container is shown in Figures 1 and 2. The Ecorok container is a standard Ecorok 25-11 container that has been modified to provide improved venting.

The Ecorok 25-11 is a cylindrical container consisting of a concrete body and lid reinforced with welded wire fabric. The container is approximately 178.4 cm (70.25 in.) in height by 152.4 cm (60.0 in.) in diameter and weighs approximately 5,624.6 kg (12,400 lb). The walls are approximately 27.9 cm (11 in.) thick, with a 30.5-cm- (12.0-in.-) thick base and lid. The body incorporates an integral 3/16-in.-thick polyethylene liner. The closure incorporates a ¼-in.-thick, 50-durometer neoprene gasket, and four 1-in. bolts attaching the lid to the body. There are three lifting/tiedown attachments evenly spaced around the circumference of the body, and there is a lifting eyebolt in the center of the lid (for lifting only the lid).

The lid assembly will be modified to incorporate a larger vent filter. Currently the cask is vented via a ¼-in.-outside-diameter tube and a ¼-in. NPT filter (General Polymeric part 30-1916, which is a porous, hydrophilic polyethylene filter with a 30-μm-nominal/5-μm-absolute filter). This filter will be replaced by a 0.87-in.-inside-diameter tube and 2-in. NPT filter (a Nuc-Fil-016, which is rated at 0.3 μm, and will flow over 1 L/min at a differential pressure of 2.54 cm [1.0 in.] of water).

4.1.1.2 Inner Container. The inner container is shown in Figures 3 and 4.

NOTE: The following information is based on the draft design. Appropriate measure will be taken to assure that the final design meets all of the requirements of this PDC and the applicable SARP.

The inner container wall, base, and lid are all constructed from 2-in.-thick ASTM A36 carbon steel.

Figure 1. Ecorok Container. (See Figure 2 for additional details and Appendix B for complete dimensions.)

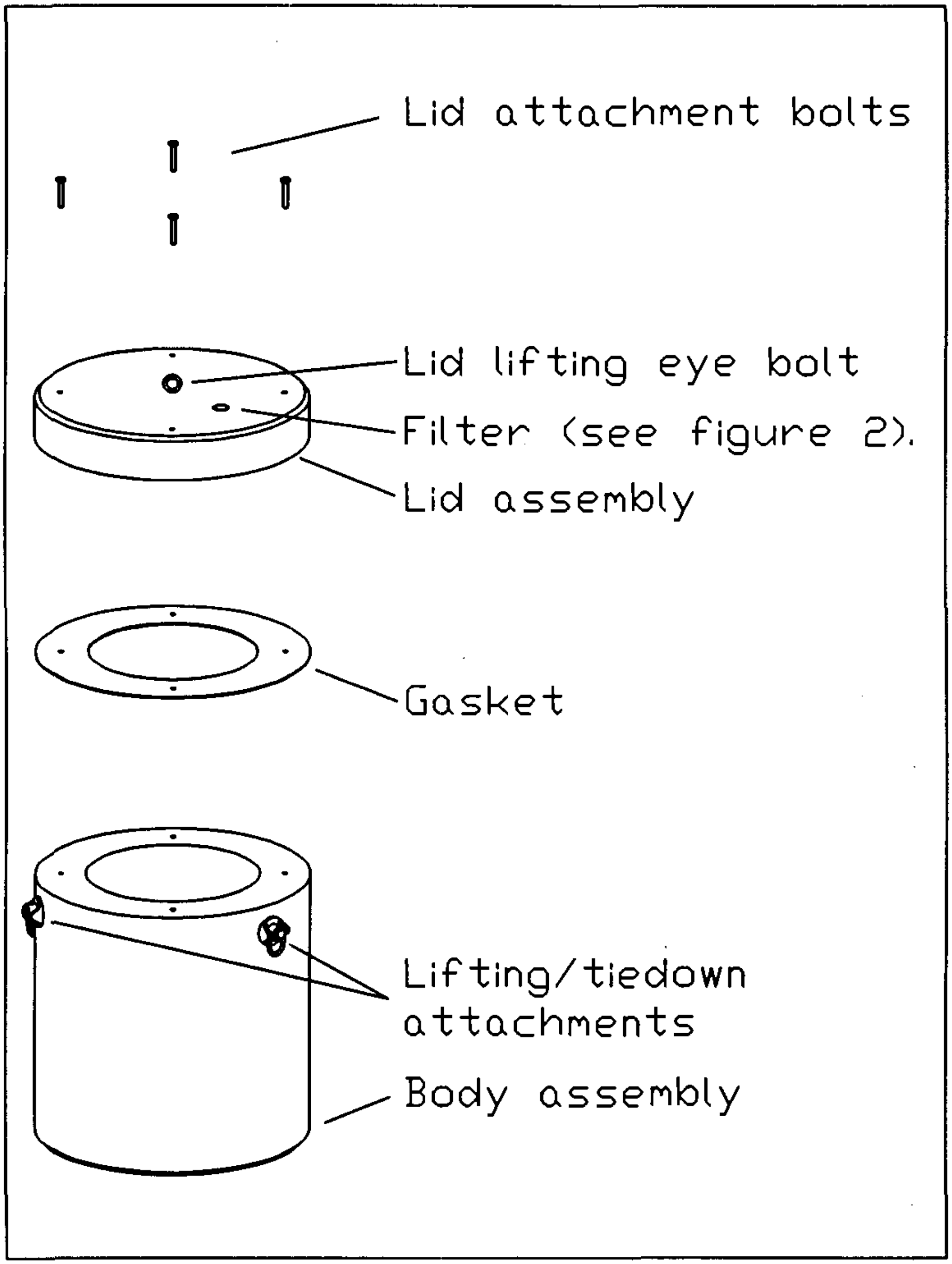


Figure 2. Ecorok Container Details.

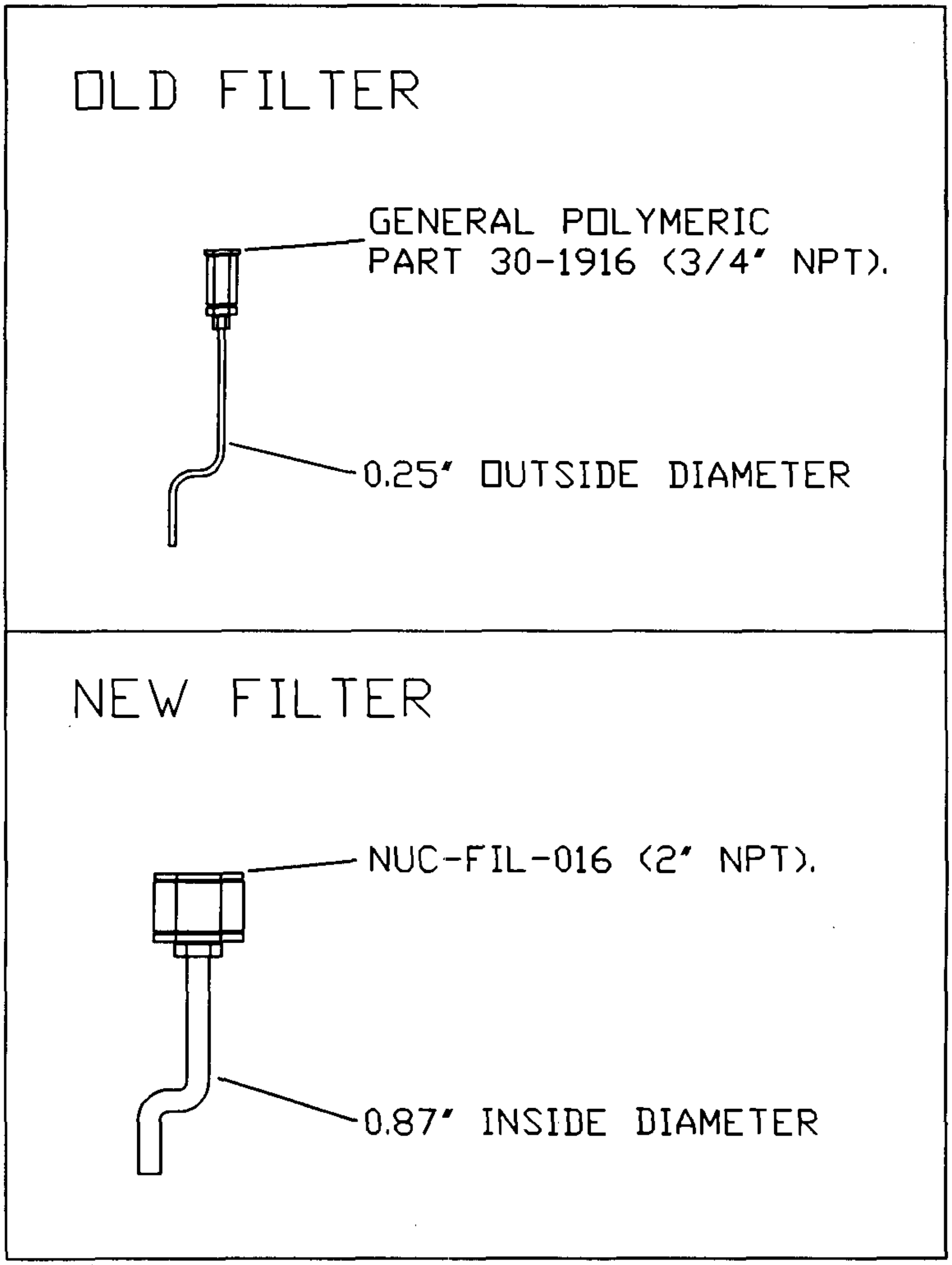


Figure 3. Inner Container. (See Figure 4 for additional details and Appendix B for complete dimensions.)

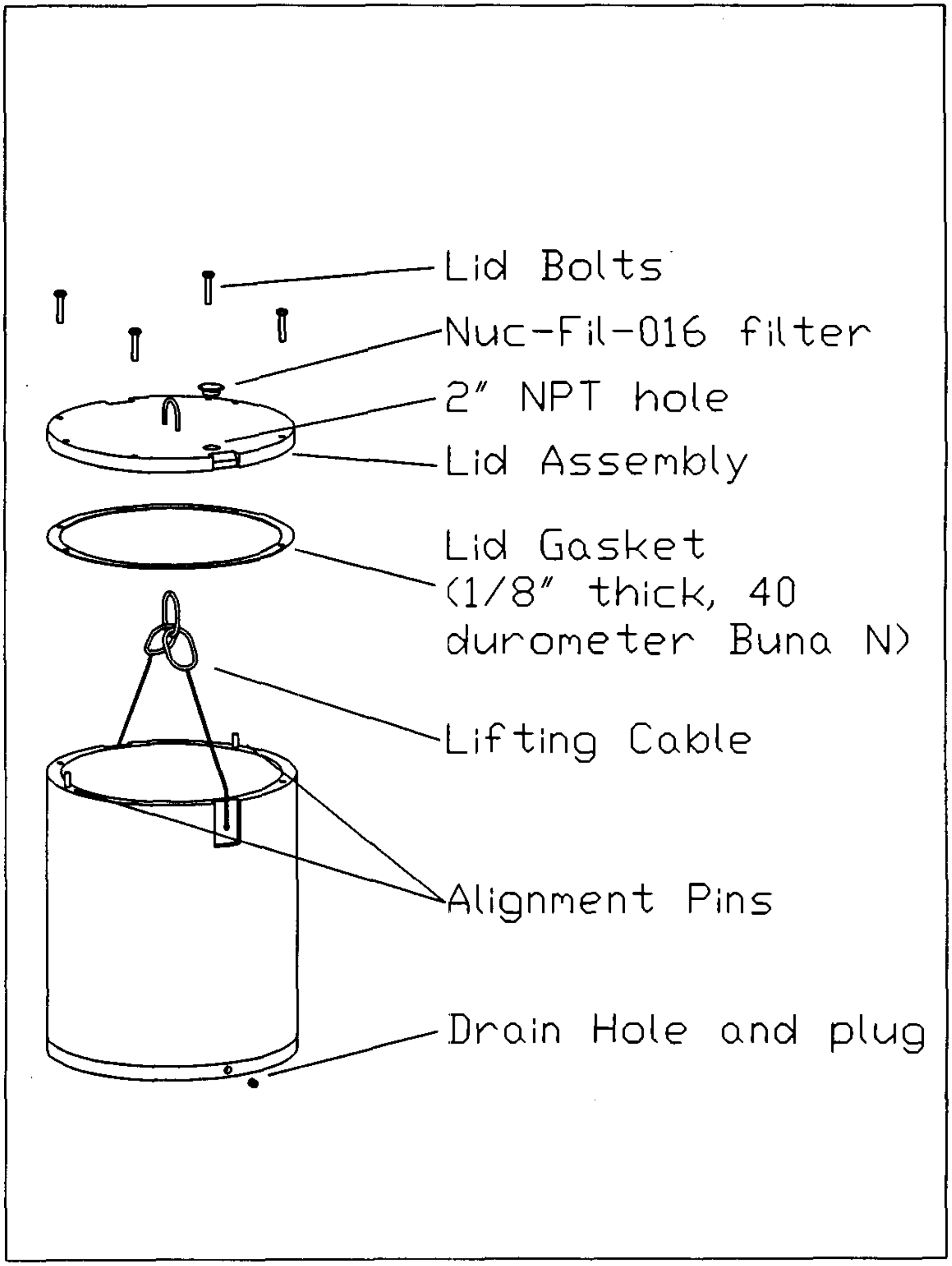
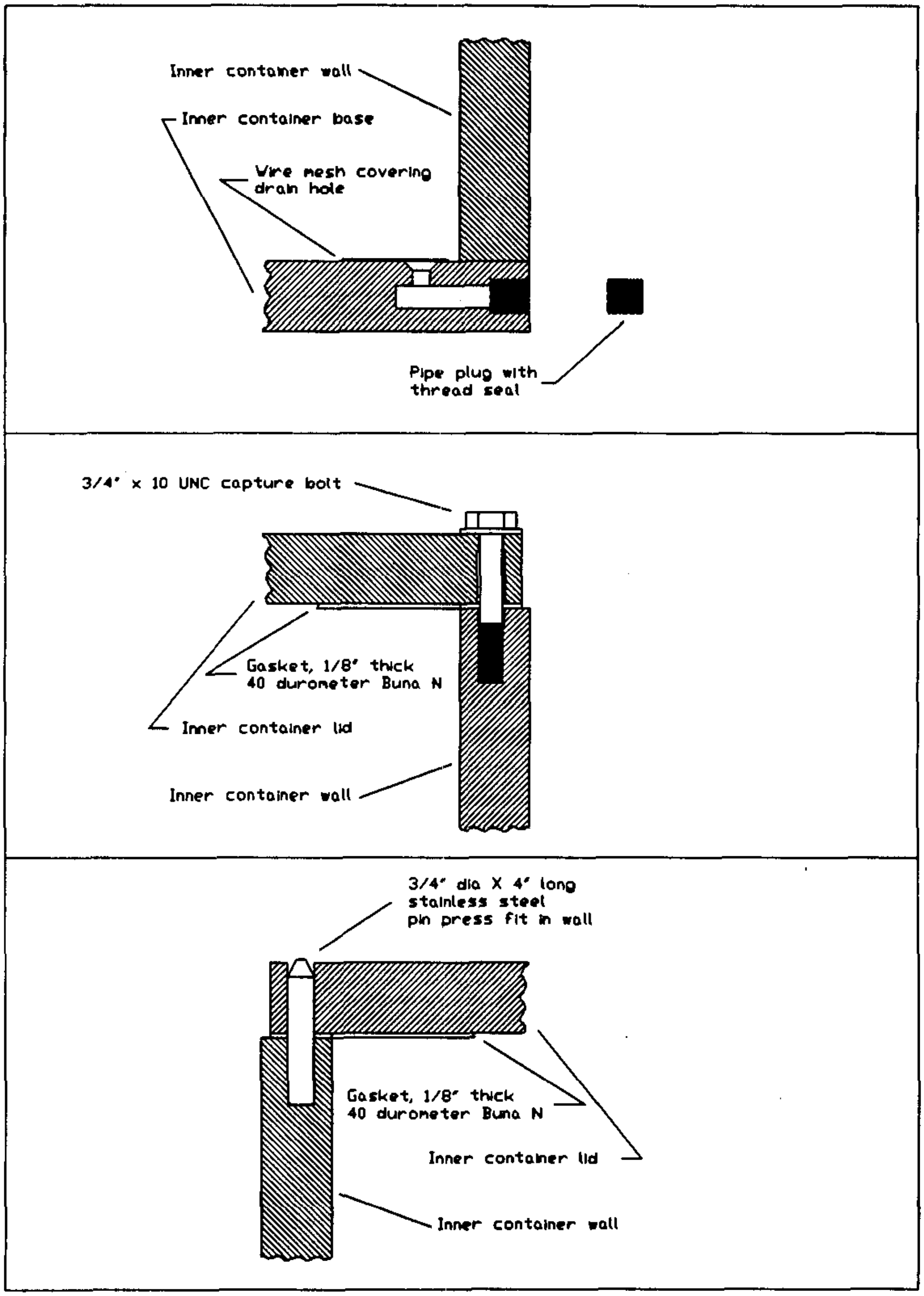


Figure 4. Inner Container Details.



The inner container is approximately 106.7 cm (42.0 in.) in height by 88.9 cm (35.0 in.) in diameter and weighs approximately 1,725 kg (3,803 lb). The base and wall are attached via a 0.64-cm (0.25-in.) circumferential fillet weld on the interior and a 0.64-cm (0.25-in.) circumferential groove weld on the exterior. There are two lifting attachments evenly spaced around the circumference of the wall, and there is a lifting attachment in the center of the lid (for lifting only the lid). The inner container also incorporates a 0.5-in.-diameter lifting cable assembly.

There are four ¾ x 10 unified national coarse thread (UNC) bolts to hold the lid to the body, and a ⅛-in.-thick, 40-durometer Buna N lid gasket. There is a 2-in. NPT through hole in the lid for a 2-in. NPT vent filter (a Nuc-Fil-016, which is rated at 0.3 μm, and will flow over 1 L/min at a differential pressure of 2.54 cm [1.0 in.] of water). There are also pins and holes for lid alignment, painted serial numbers, and a ⅝-in.-diameter drain port with ¾ NPT pipe plug.

4.1.2 Construction Materials

Tables 3 and 4 summarize the Ecorok container and inner container construction materials, and their properties.

Table 3. Ecorok Container Materials. (2 sheets total)

Item	Specification	Strength
Concrete	SEG STD-S-41-001	41,368.5 kPa (6,000 psi) compressive at 28-day cure
Welded wire fabric for concrete	SEG STD-S-41-001 ASTM A 185	413.7 MPa (60 ksi) yield
Lid lifting eye bolt	Richmond 1-in. lifting eye bolt, product code 9/46	Working loads (based on a 5:1 safety factor): 3401.9 kg (7,500.0 lb) straight pull 680.4 kg (1,500.0 lb) 45° pull 499.0 kg (1,100.0 lb) 90° pull
Threaded insert for lid lifting eye bolt	Richmond 1-in. LP-4 lifting insert, product code 9/27	Working loads (based on a 4:1 safety factor and 20,684.3 kPa [3,000-psi] concrete): 3,814.7 kg (8,410.0 lb) straight pull 2,032.1 kg (4,480.0 lb) shear
Lid attachment bolts	Richmond 1-in. lifting lag bolt	Working loads (based on a 3:1 safety factor): 5,806.0 kg (12,800.0 lb) straight pull 3,837.4 kg (8,460.0 lb) 45° pull 3,837.4 kg (8,460.0 lb) 90° pull
Threaded inserts for lid attachment bolts	Richmond 1-in. lifting tyloop, product code 9/40	Working loads (based on a 4:1 safety factor and 20,684.3 kPa [3,000-psi] concrete): 2,381.4 kg (5,250.0 lb) straight pull 1,530.9 kg (3,375.0 lb) shear
Lifting/tiedown attachments	Richmond 1¼-in. swivel lift plate, product code 8/72	Working load: 10,772.8 kg (23,750.0 lb)

Table 3. Ecorok Container Materials. (2 sheets total)

Item	Specification	Strength
Lifting/tiedown attachment bolts	Richmond 1¼-in. lifting lag bolt	Working load (based on a 3:1 safety factor): 9,843.0 kg (21,700.0 lb) straight pull 6,509.1 kg (14,350.0 lb) 45° pull 6,509.1 kg (14,350.0 lb) 90° pull
Threaded insert for lifting/tiedown attachment bolts	Richmond 1¼-in. LP-4 lifting insert, product code 9/27	Working loads (based on a 4:1 safety factor and 20,684.3 kPa [3,000-psi] concrete): 3,814.7 kg (8,410.0 lb) straight pull 2,154.6 kg (4,750.0 lb) shear

ASTM = American Society for Testing and Materials.
SEG = Scientific Ecology Group, Inc.

Table 4. Inner Container Materials.

Item	Specification	Strength
Lid and body steel	ASTM A 36	413.7 MPa (60 ksi) tensile
Lid bolts	ASTM A 325, ¾-10 UNC	827.4 MPa (120 ksi) tensile

ASTM = American Society for Testing and Materials.
UNC = Unified national coarse thread.

4.1.3 Packaging Dimensions

Tables 5 and 6 summarize the nominal dimensions of the Ecorok container and inner container (see Figures 1 and 2 for complete dimensions and tolerances).

Table 5. Nominal Dimensions of Ecorok Container.

Dimension	Measurement
Container height*	178.4 cm (70.25 in.)
Container diameter*	152.4 cm (60.0 in.)
Inside height	116.8 cm (46.0 in.)
Inside diameter	96.5 cm (38.0 in.)

*Does not include lifting/tiedown attachments.

Table 6. Nominal Dimensions of Inner Container.

Dimension	Measurement
Container height*	106.7 cm (42.0 in.)
Container diameter*	88.9 cm (35.0 in.)
Inside height	96.5 cm (38.0 in.)
Inside diameter	78.7 cm (31.0 in.)

*Does not include lifting/tiedown attachments.

4.1.4 Maximum Gross Weight

The maximum gross weight for the HEP is 8,164.7 kg (18,000.0 lb). The individual component weights are summarized Table 7.

Table 7. Component Weights.

Item	Maximum Weight
Ecorok container lid (1,156.7 kg [2,550.0 lb] nominal)	1,214.7 kg (2,678.0 lb)
Ecorok container body (4,467.9 kg [9,850.0 lb] nominal)	4,691.5 kg (10,343.0 lb)
Inner container lid (235.9 kg [520.0 lb] nominal)	247.7 kg (546.0 lb)
Inner container body (1,489.1 kg [3,283.0 lb] nominal)	1,563.5 kg (3,447.0 lb)
Contaminated water filters	378.3 kg (834.0 lb)
Rigging and bagging for inner container	56.7 kg (125.0 lb)
Absorbent	12.3 kg (27.0 lb)
Total	8,164.7 kg (18,000.0 lb)

4.1.5 Venting

The Ecorok container and the inner container are both vented through filters, as described in 4.1.1

4.1.6 Lifting and Tiedown Attachments

The inner container has two lifting attachments. The Ecorok container has three lifting/tiedown attachments. See 4.1.1 and 4.1.2 for specifics on the attachments. The Ecorok container rigging is described in Section 3.1. The inner container rigging is described 4.1.1.2 and 4.1.2.

4.1.7 Containment Boundaries

Both the inner container and the Ecorok container will provide containment boundaries. See 4.1.1 and 4.1.2 for specifics.

4.1.8 Shielding

Shielding is provided by the inner container steel and the Ecorok container concrete. See 4.1.3 for dimensions.

4.1.9 Service Life

The HEP is not intended to be reused.

4.2 TRANSPORT SYSTEM DESIGN CRITERIA

The Ecorok container is intended to be transported on a standard flatbed trailer of appropriate capacity. The maximum weight of the trailer shall be 4,989 kg (11,000 lb) and shall be pulled by a tractor weighing no more than 9,525 kg (21,000 lb).

5.0 PERFORMANCE CRITERIA

5.1 CHEMICAL AND GALVANIC REACTIONS

The HEP and its contents must be such that there will be no significant chemical, galvanic, or other reaction among the packaging components or between the packaging components and the package contents, including possible reaction resulting from inleakage of water to the maximum credible extent.

5.2 THERMAL

The HEP and its contents must be such that in still air at 100 °F and in the shade, no accessible surface will have a temperature exceeding 180 °F.

5.3 LIFTING ATTACHMENTS

When used for lifting in the intended manner (rigging and operation per 3.1, maximum weights per 4.1.4), the stress on the Ecorok container lifting/tiedown attachments and the inner container lifting attachments must be less than one-third of the yield strength.

The Ecorok container lifting/tiedown attachments and the inner container lifting attachments must be such that failure due to excessive lifting or tiedown loads would not impair the ability of the HEP to meet other requirements of this PDC.

The Ecorok container lid and the inner container lid must be clearly marked, and the operating procedures must clearly indicate that the lid lifting attachments (part 8 on the Ecorok container and part 8 on the inner container) are not to be used for container lifting or tiedown purposes.

5.4 TIEDOWN SYSTEM

The HEP shall be attached to the flatbed trailer with a system consisting of tiedown devices and/or blocking and bracing devices. The strength of the system shall be as follows.

5.4.1 Tiedown Attachments

The Ecorok container lifting/tiedown attachments shall be of sufficient strength and design such that, when subjected to a static force on the center of gravity of the HEP consisting of a vertical component of 2*g*, a component along the direction of vehicle travel of 10*g*, and a component perpendicular to the direction of vehicle travel of 5*g*, there will be no yielding of the lifting/tiedown attachment materials and no damage to the Ecorok container concrete.

5.4.2 Tiedown Devices

The tiedown devices (i.e., cables, chains, binders, attachment hardware) shall meet the requirements of 49 CFR 393, Subpart I.

5.5 SURFACE CONTAMINATION

During transfer conditions, removable contamination on the exterior surfaces of the Ecorok container and the inner container shall not exceed the U.S. Department of Transportation limits, as shown in Table 8, when measured per 49 CFR 173.443(a).

5.6 GAS GENERATION

Hydrogen gas shall not exceed a concentration of 2.5% by volume in any location within the HEP.

5.7 FREE-STANDING WATER

Absorbent shall be used in the inner container sufficient to absorb any free-standing water, and the external surfaces of the inner container and the inner container rigging shall be dried to the maximum possible extent prior to installation into the Ecorok container.

Table 8. Removable External Radioactive Contamination--Wipe Limits.

Contaminant	Maximum permissible limit (dpm/cm^2)
Beta-gamma emitting radionuclides; all radionuclides with half lives less than ten days; natural uranium; natural thorium; ^{235}U, ^{238}U, ^{232}Th, ^{228}Th, and ^{230}Th when contained in ores or physical concentrates.	22
All other alpha-emitting radionuclides.	2.2

5.8 NORMAL CONDITIONS OF TRANSFER

5.8.1 Definition of Normal Conditions of Transfer

Normal conditions of transfer are defined as follows.

5.8.1.1 Heat. An ambient temperature of 46 °C (115 °F) in still air and insolation as shown in Table 9.

Table 9. Insolation Requirements.

Form and location of surface	Total insolation for a 12-hour period (g cal/cm^2)
Flat surface transported horizontally Base Other surfaces	 None 714
Flat surfaces not transported horizontally	178.5
Curved surfaces	357

5.8.1.2 Cold. An ambient temperature of 0 °C (32 °F) in still air and shade.

5.8.1.3 Reduced External Pressure. An external pressure of 89.6 kPa (13 psi) absolute.

5.8.1.4 Increased External Pressure. An external pressure of 103.4 kPa (15 psi) absolute.

5.8.1.5 Vibration. Vibration normally incident to transport, per ANSI (1989).

5.8.1.6 Water Spray. A water spray that simulates exposure to rainfall of approximately 5 cm (2 in.) per hour for at least one hour.

5.8.1.7 Free Drop. Between 1.5 and 2.5 hours after the conclusion of the water spray test, a free drop from 0.9 m (3.0 ft) onto a flat, horizontal asphalt surface, landing flat on the bottom surface of the packaging.

5.8.1.8 Penetration. Impact of the hemispherical end of a vertical steel cylinder of 3.2-cm (1.25-in.) diameter and 6.0-kg (13.0-lb) mass, dropped from a height of 1.0 m (40.0 in.) onto the exposed surface of the package that is expected to be most vulnerable to puncture. The long axis of the cylinder must be perpendicular to the package surface.

5.8.2 Assumptions for Normal Conditions of Transfer

The following assumptions shall be made during evaluation of the HEP against the normal conditions of transfer.

5.8.2.1 Separate Packages. The evaluation shall assume that a single package is exposed to all of the normal conditions of transfer, in the order presented in 5.8.1, except that separate packages may be used for the free-drop and penetration conditions. If separate packages are used, they must first be exposed to the water spray condition.

5.8.2.2 Ambient Temperature. For each normal condition of transfer, the evaluation shall assume that the ambient temperature (both prior to and after exposure to that particular normal condition of transfer) is at a constant value between 0 °C (32 °F) and 46 °C (115 °F), which is the most unfavorable for the package.

5.8.2.3 Internal Pressure. For each normal condition of transfer, the evaluation shall assume that the initial internal pressure of the containment system is at that value no greater than the maximum normal operating pressure, no less than the lowest possible pressure that could actually be achieved during use, and most unfavorable for the package.

5.8.3 Criteria for Normal Conditions of Transfer

The HEP shall be evaluated against the following criteria during the normal conditions of transfer.

5.8.3.1 Containment. The HEP shall provide adequate containment, as shown by limiting the release rate to 1×10^{-6} A2's per hour (per 10 CFR 71.51 (a)(1)), or by limiting the maximum possible dose via ingestion and inhalation, as follows:

Calculated doses to transport workers due to release will be less than 1 mrem per transfer for systems which are to be transferred 200 or fewer times per year, and less than 1 mrem/d for systems which are transferred more than 200 times per year.

Calculated doses to members of the public will be less than 0.001 mrem per transfer for systems which are transferred 200 or fewer times per year, and less than 0.001 mrem/d for systems which are transferred more than 200 times per year.

5.8.3.2 Shielding. The HEP and its contents shall be such that the external dose rate does not exceed 200 mrem/h at any point on the external surface of the HEP, 10 mrem/h at 2 m from the surface of the HEP, and 2 mrem/h in any normally occupied position of the transport vehicle.

5.8.3.3 Criticality. The HEP and its payload must be such that subcriticality (K_{eff} < .95) is maintained, assuming the following conditions (or as necessary to ensure maximum reactivity is attained):

- Payload in its most reactive credible configuration consistent with its chemical and physical form and the physical condition of the HEP
- Moderation by water to the most reactive credible extent consistent with the chemical and physical form of the payload and the physical condition of the HEP
- Close reflection by water on all sides.

The newest issue of the fissile materials regulations (Federal Register dated Sptember 28, 1995) shall apply.

5.9 ACCIDENT CONDITIONS

5.9.1 Containment

The SARP shall evaluate possible accident scenarios for the shipping campaign and the performance of the HEP for those conditions. Those accidents that result in the release of radioactive material to the environment shall be evaluated to demonstrate that the packaging meets the following criteria.

- Incredible Events--Any unplanned event that has a probability less than 10^{-6} per year is incredible. Such events shall not result in an offsite dose greater than 25 rem effective dose equivalent (EDE). Onsite dose consequences do not require evaluation.
- Credible Events--Any unplanned event that has a probability between 10^{-6} and 10^{-3} per year shall not lead to a radiation dose greater than 5 rem EDE to an individual onsite or 500 mrem EDE offsite.
- Probable Events--Any unplanned event that has a probability of greater than 10^{-3} per year shall not lead to a radiation dose greater than 200 mrem EDE to an individual onsite or 10 mrem EDE

offsite. Any unplanned event that has an indeterminate probability greater than 10^{-6} per year shall be considered probable.

A risk evaluation will be performed on the HEP for the filter transportation campaign to show that the system meets the onsite transportation safety criteria (WHC-SD-TP-RPT-001).

5.9.2 Shielding

The contents of the packaging shall be limited so that the external dose rate shall not exceed 1 rem/h at 1.0 m (3.3 ft) from the surface of the container.

5.9.3 Criticality

The HEP and its payload must be such that subcriticality ($K_{eff} < .95$) is maintained, assuming the following conditions (or as necessary to ensure maximum reactivity is attained):

- Payload in its most reactive credible configuration consistent with its chemical and physical form and the physical condition of the HEP
- Moderation by water to the most reactive credible extent consistent with the chemical and physical form of the payload and the physical condition of the HEP
- Close reflection by water on all sides.

The newest issue of the fissile materials regulations (Federal Register dated Sptember 28, 1995) shall apply.

6.0 GENERAL REQUIREMENTS

6.1 AS LOW AS REASONABLY ACHIEVABLE (ALARA)

The design features of the packages shall be consistent with the requirements of WHC-CM-4-11, *ALARA Program Manual*, for the Hanford Site. Exposure of personnel to radiological and other hazardous materials associated with the loading, closure, tiedown, transfer, and off-loading of the package shall be minimized. Cost benefit analyses should be performed as needed to determine the best balance between exposure and economical design.

The contamination limits of paragraph 5.5 will be met prior to transport of the packaging.

6.2 QUALITY ASSURANCE (QA)

The QA program requirements shall be per WHC-IP-0705 (WHC 1995).

6.3 TRANSPORTATION SAFETY CLASS

The transportation safety classes are used to categorize the potential hazard presented by the material to be transported. For radioactive materials, the categories are based on inhalation doses to onsite and offsite receptors, according to the following definitions.

6.3.1 Transportation Safety Class Definitions

6.3.1.1 Transportation Safety Class 1. Components of a system or a system whose failure could result a significant impact on the health or safety of offsite persons. In the case of radioactive materials, the failure of a Transportation Safety Class 1 system/component could result in an offsite receptor receiving an EDE via inhalation equal to or greater than 500 mrem.

6.3.1.2 Transportation Safety Class 2. Components of a system or a system other than Transportation Safety Class 1 whose failure could result in a release of radioactive or hazardous material that could have a significant impact on onsite personnel. In the case of radioactive materials, the failure of a Transportation Safety Class 2 system/component could result in an onsite receptor receiving an EDE via inhalation equal to or greater than 5 rem.

6.3.1.3 Transportation Safety Class 3. Components of a system or a system other than Transportation Safety Class 1 or 2 whose failure could result in a release of radioactive material or hazardous material that could have an impact on onsite workers. In the case of radioactive materials, the failure of a Transportation Safety Class 3 system/component could result in a release of radioactive materials that would cause an onsite receptor to receive an EDE via inhalation less than 5 rem.

6.3.1.4 Transportation Nonsafety Class 4. Components of a system or a system whose failure will have no significant effect on safety, health, or environmental protection.

6.3.2 System Transportation Safety Class

The transportation safety class of the HEP system was determined by a transportation safety class analysis (see Appendix C). This analysis assumed the total failure of the packaging system and the release of its contents to the environment at the worst possible location on the transportation route. For the shipment of the K Basin contaminated water filter shipments, the worst-case release location is within the 100 K Area, just outside the basins.

The transportation safety class analysis determined that the maximum inhalation dose to an onsite receptor is 81 rem effective dose equivalent (EDE), and the maximum inhalation dose to an offsite receptor is 2.4 rem EDE. Therefore, the HEP is a Transportation Safety Class 1 system.

NOTE: This analysis assumed that the filters would be grouted in place, as in the past. The actual filters will not be grouted in place, however; because the analysis assumes a specific respirable release fraction of the radioactive material, the presence or absence of grout does not affect the transportation safety class.

Additionally, the analysis assumed 2.4 Ci of ^{60}Co. This is higher than the final quantity (0.5 Ci--see Table 1); however, a reduction in ^{60}Co would not significantly decrease the inhalation dose calculated for the offsite receptor. Most of the inhalation dose is due to alpha particles from ^{241}Am. Because the ^{60}Co does not produce alpha particles, it is not a significant contributor to the inhalation dose, and, therefore, this difference does not affect the transportation safety class.

Finally, the analysis did not include any of the uranium isotopes. Addition of these isotopes could result in an increase in inhalation dose, but this could not affect the transportation safety class (because the payload is already transportation Safety Class 1).

6.4 DESIGN FORMAT

Development of any design drawings, design changes, or other design documentation shall be in accordance with WHC-CM-6-1, *Standard Engineering Practices*, and WHC-CM-6-3, *Drafting Standards*.

6.5 ENVIRONMENTAL COMPLIANCE

Actions and conditions for the protection of the environment during transfer of the HEP shall comply with the requirements of WHC-CM-7-5, *Environmental Compliance*.

6.6 MAINTENANCE

Maintenance shall be performed, as necessary, to ensure that the HEP is undamaged prior to use.

7.0 REFERENCES

ANSI, 1989, *Design Basis for Resistance to Shock and Vibration of Radioactive Material Packages Greater Than One Ton in Truck Transport*, ANSI Standard 14.23, Draft, American National Standards Institute, New York, New York.

10 CFR 71, 1993, "Packaging and Transportation of Radioactive Material," *Code of Federal Regulations*, as amended.

49 CFR 173, 1994, "Shippers--General Requirements for Shipments and Packagings," *Code of Federal Regulations*, as amended.

49 CFR 393, Subpart I, 1994, "Protection Against Shifting or Falling Cargo," *Code of Federal Regulations*, as amended.

Dodd, E. N., 1995, *Safety Evaluation--Spent Water Treatment System Components Inventory Release*, WHC-SD-SNF-TA-005, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

HSRCM-1, *Hanford Site Radiological Control Manual*, Pacific Northwest Laboratory, Richland, Washington.

WHC-CM-2-14, *Hazardous Material Packaging and Shipping*, Westinghouse Hanford Company, Richland, Washington.

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

WHC-CM-4-11, *ALARA Program Manual*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-6-1, *Standard Engineering Practices*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-6-3, *Drafting Standards*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-7-5, *Environmental Compliance*, Westinghouse Hanford Company, Richland, Washington.

WHC, 1995, WHC-IP-0705, *Quality Assurance Program Plan for the Hazardous Materials Transportation and Packaging Program*, WHC-IP-0705, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Willis, N. P, 1993, *Hanford Site Solid Waste Acceptance Criteria*, WHC-EP-0063, Rev. 4, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A

SOURCE TERM INFORMATION

Westinghouse Hanford Company — **Internal Memo**

From:	K Basins Projects	FJM-95-007
Phone:	376-2619 X3-85	
Date:	October 4, 1995	
Subject:	MEMORANDUM OF UNDERSTANDING ACTIVITY A-1 CARTRIDGE FILTER REPLACEMENT, SOURCE TERM	

To:				
	S. P. Burke	X3-74	F. J. Muller	X3-85
	R. G. Cowan	R3-86	C. C. Pitkoff	R3-86
	R. M. Irwin	T4-03	D. L. Sherrell	R3-86
	M. A. Jensen	X3-79	D. S. Takasumi	X3-85
	M. S. Mercado	G2-02	M. J. Wiemers	X3-85

cc: FJM File/LB
K Basins Project Files X3-85

Transmitted herein is the Memorandum of Understanding for Activity A.1 Cartridge Filter Replacement, Source Term.

F. J. Muller
Project Engineer

at

Attachment

FJM-95-007
ATTACHMENT
Page 1 of 3

MEMORANDUM OF UNDERSTANDING
ACTIVITY A-1 CARTRIDGE FILTER REPLACEMENT,
SOURCE TERM

Prepared by:

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Project Engineer

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SWM Cognizant Engineer

Mark A Jensen
Standards and Requirements

**MEMORANDUM OF UNDERSTANDING
ACTIVITY A-1 CARTRIDGE FILTER REPLACEMENT,
SOURCE TERM**

This memorandum of understanding (MOU) has been prepared to document the source term to be used for shipping and storing spent cartridge filters for K East and West Basin.

Beginning in 1973, KE Basin was reactivated for the purpose of storing spent fuel from N Reactor. At that time, the basin was provided with a recirculated water treatment loop that included two cartridge filters and a heat exchanger.

The cartridge filters are presently out of service in both KE and KW Basins. Their operation became untenable due to high dose rates (ALARA considerations) and the fact that they typically exceed the limit that defines transuranic waste. KE and KW Basins each have 2 filters located in the current filter housing.

The filter assembly now installed in the cartridge filter system are approximately 32 inches in diameter and 34 inches tall. The assembly has 88 filter elements spring loaded in-between two carbon steel disc. The filter system has an outside in flow path for the basin water which captures the particulate on the outside of the filters. Removal of these filters results in some of the caking dropping into the filter housing.

The cartridge filter system is being upgrades. The housing for the existing system will be retro-fitted with an internal adaptor that will hold seven(7) filter cartridges. Each filter will be constructed out of a perforated stainless steel can with a polypropylene pleated filter inside. The flow will be directed from the inside out to retain the filter cake within the individual filter elements during filter change outs. This filter upgrade will increase the dirt loading capacity of the filter elements and the source term for used filters

The source term was determined using information from previous spent filters and sludge characterization data.

Assumptions:
- 800 sq ft of filter area vs. 150 sq ft for the old filters
- 264 pounds maximum dirt loading (approximately 5 X the maximum loading of the old string filters
- 5 X the quantity of Cs, Sr, and TRU in SD-SNF-TA-005 Safety Evaluation - Spent Water Treatment System Components Inventory Release. This has the source term for the old string filters
- The TRU constituents were estimated based on the mean percent abundances for the overall basin fuel inventory.
- ~21 Ci of Ba 137m associated with 22 Ci of CS 137

- ~22 Ci of Y 90 associated with 22 Ci of Sr 90
- Non TRU constituents were estimated by comparison of the ratios of those constituents to Cs 137 in the overall basin fuel inventory

Source Term for cartridge filters in K Basin

TRU - 13 Ci total

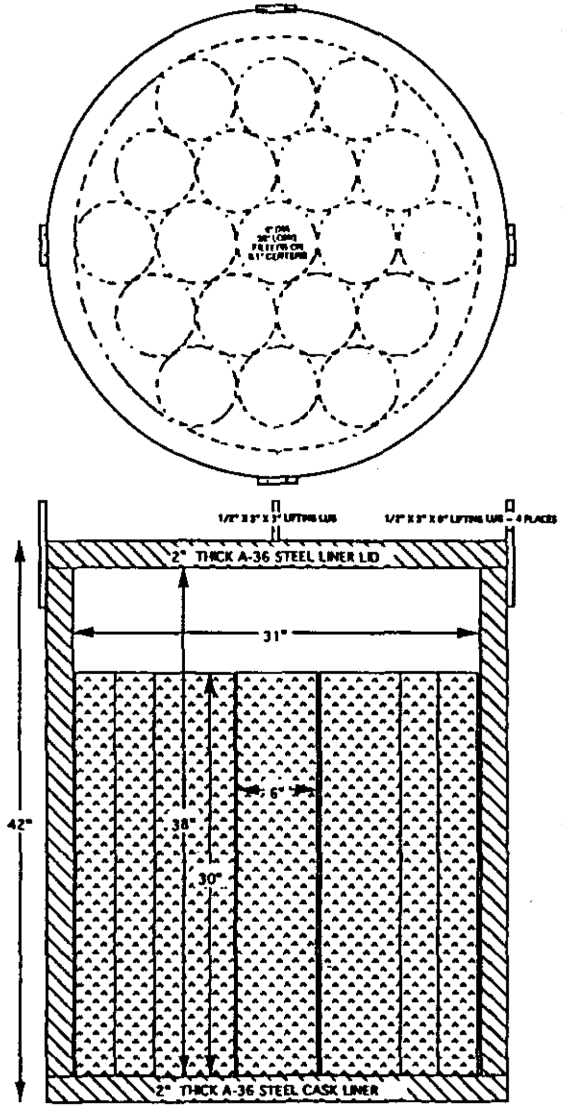
^{238}Pu - 2.1 Ci
^{239}Pu - 3.7 Ci
^{240}Pu - 2.1 Ci
^{241}Am - 5.1 Ci

Non TRU

^{137}Cs - 22 Ci
^{137m}Ba - 21 Ci
^{90} Sr - 22 Ci
^{90} Y - 22 Ci
^{60} Co - .5 Ci
^{147}Pm - 18 Ci
^{151}Sm - 2.8 Ci
^{154}Eu - 2.1 Ci
^{234}U - 0.0141 Ci
^{235}U - 0.000545 Ci - ~~0.75% enriched~~ JCP
^{236}U - 0.00204 Ci
^{238}U - 0.0112 Ci
^{241}Pu - 120 Ci

All other 4.6 Ci

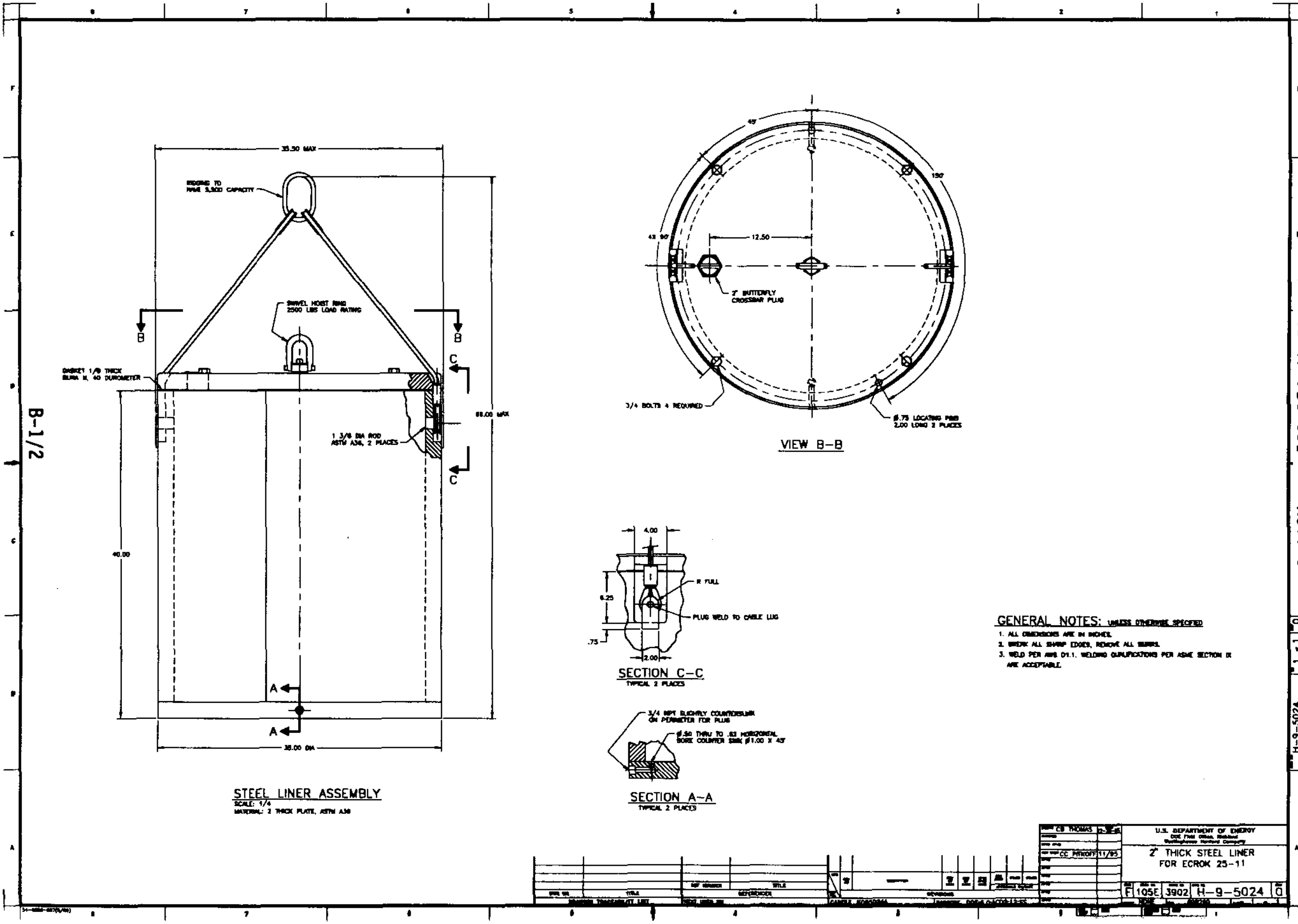
SOURCE TERM FOR ECO-ROK CASK/LINER SPENT FILTER ELEMENT LOADING

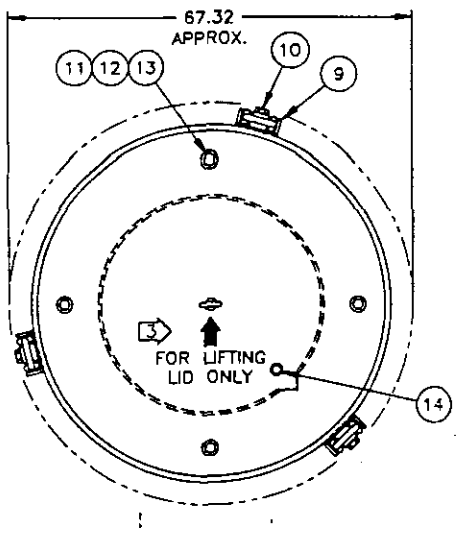


- The worst case is based on a "tight-fit" (6.1" triangular pitch) arrangement of 19 each, 6"diameter by 30 long, 43 sq ft, pleated media, filter housings from the filter pumps
- Total filter area = 43 sq ft X 19 ea = ~800 sq ft vs ~150 sq ft for the old filters
- The generally accepted dirt capacity for the old filter set (confirmed verbally by that vendor) is "around 50 lbs" of dirt (~150 g/sq ft) under our conditions – this is roughly three times the limit (50 g/sq ft) for string wound filters under a different vendor's (probably prejudiced) test conditions – the other vendor apparently doesn't sell string wound filters
- The other vendor's catalog claims that pleated filters are limited to less than 20 g/sq ft (they apparently don't sell conventional pleated filters either) – i.e., we should give the pleated filters credit for at least 60 g/sq ft (instead of 20) -- on the other hand, if we just use the same per-sq ft loading we have historically seen with the old string wound filters, then we should have a very conservative source term
- 800 sq ft X 150 g/sq ft = 120 kg = 264 pounds worst case maximum dirt loading, i.e. roughly five times the maximum total loading historically experienced with the old string wound cartridge filters (note-this is per shipment, not per filter housing – 600 sq ft/max capacity)
- From SD-SNF-TA-005, the worst case string wound filter assembly was estimated to contain less than 4.3 Ci of Cs, an assumed equal amount of Sr (very conservative assumption – the analyses summarized by the document indicate that the Sr_Y content of the filter cake will be about 10% of the Cs_Ba content), and less than 2.6 Ci of TRU (obtained by means of an estimate of the Cs_Ba content from gamma dose rate measurements on the grouted filter assemblies, coupled with the worst case TRU/Cs_Ba ratio from the available analytical data)
- If we take five times the SD-SNF-TA-005 values as our worst case, that gives us less than 22 Ci of Cs, less than 22 Ci of Sr, and less than 13 Ci of TRU
- Because the above values already represent a very conservative, rough estimate of the worst case curie content, it should be possible to use these aggregate values as a basis to estimate worst case values for individual isotopes without losing validity
- The following TRU constituents were estimated by allocation of the 13 Ci total, based on the mean percent abundances for the overall basin fuel inventory: 2.0 Ci of Pu-238; 3.7 Ci of Pu-239; 2.1 Ci of Pu-240; 5.2 Ci of Am-241
- About 21 Ci of Ba-137m would be associated with the 22 Ci of Cs-137 -- 22 Ci of Y-90 would be associated with the 22 Ci of Sr-90 (the Sr/Y estimate is probably a factor of ten too high)
- The remaining non-TRU constituents were estimated by comparison of the ratios of those constituents to Cs-137 in the overall basin fuel inventory, in light of the fact that the Cs-137 to TRU ratio indicated by the filter cake analyses listed in SD-SNF-TA-005 is a factor of ten lower than that ratio in the overall basin fuel inventory
- As an example, the ratio of Cs-137 to Co-60 is about 90 to 1 in the fuel inventory, such that 22 Ci of Cs-137 would indicate around 1/4 Ci of Co-60, whereas in the filter cake 22 Ci of Cs-137 indicate 2.4 Ci of Co-60.
- The following additional non-TRU constituents were estimated by the above method: 120.3 Ci of Pu-241; 17.6 Ci of Pm-147; 2.8 Ci of Sm-151; 2.1 Ci of Eu-154; and 4.6 Ci of "other"

APPENDIX B

ECOROK CONTAINER AND DRAFT INNER CONTAINER DRAWINGS


35.50 MAX
RIGGING TO HAVE 5,900 CAPACITY
SWIVEL HOIST RING 2500 LBS LOAD RATING
B
B
C
C
GASKET 1/8 THICK BUNA N, 40 DUROMETER
1 3/8 DIA ROD ASTM A36, 2 PLACES
40.00
A
A
38.00 DIA
STEEL LINER ASSEMBLY
SCALE: 1/4
MATERIAL: 2 THICK PLATE, ASTM A36
45°
12.50
2" BUTTERFLY CROSSBAR PLUG
3/4 BOLTS 4 REQUIRED
ø.75 LOCATING PINS 2.00 LONG 2 PLACES
VIEW B-B
4.00
R FULL
PLUG WELD TO CABLE LUG
6.25
.75
2.00
SECTION C-C
TYPICAL 2 PLACES
3/4 NPT SLIGHTLY COUNTERSUNK ON PERIMETER FOR PLUG
ø.50 THRU TO .63 HORIZONTAL BORE COUNTER SINK ø1.00 X 45°
SECTION A-A
TYPICAL 2 PLACES
GENERAL NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL DIMENSIONS ARE IN INCHES.
2. BREAK ALL SHARP EDGES, REMOVE ALL BURRS.
3. WELD PER AWS D1.1. WELDING QUALIFICATIONS PER ASME SECTION IX ARE ACCEPTABLE.
CB THOMAS
CC PITKOFF 11/95
U.S. DEPARTMENT OF ENERGY
2" THICK STEEL LINER FOR ECROK 25-11
F 105E 3902 H-9-5024 0
H-9-5024



PLAN VIEW

PROPRIETARY INFORMATION
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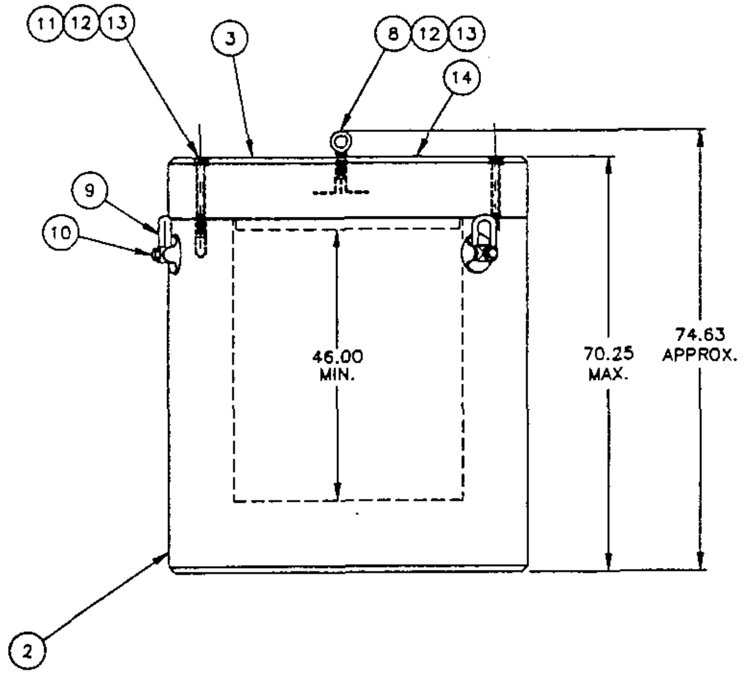

ELEVATION

1 ECOROK 25-11 ASSEMBLY

BILL OF MATERIAL

QTY REQD GR7	GR6	GR5	GR4	GR3	GR2	GR1	NOTE	ITEM	PART NAME/DESCRIPTION	PART NO OR REF DWG	MAT'L/VENDOR
						X		1	ECOROK 25-11 ASSEMBLY		
					X	1		2	BODY ASSEMBLY	SHT. 2 & 3	
				X		1		3	LID ASSEMBLY	SHT. 2 & 3	
			X	4				4	BOLT SLEEVE INSERT ASSEMBLY	SHT. 2	
		X		1				5	VENT FILTER INSERT ASSEMBLY	SHT. 2	
	X				1			6	BODY REBAR CAGE ASSEMBLY	SHT. 3	
X				1				7	LID REBAR CAGE ASSEMBLY	SHT. 3	
						1		8	LIFTING EYEBOLT, ø1 X 3 1/2 LG.	LEB	RICHMOND SCREW ANCHOR
						3		9	SWIVEL LIFT PLATE, ø1 1/4	LSLP	RICHMOND SCREW ANCHOR
						3		10	LIFTING LAG BOLT, ø1 1/4 X 6 1/2 LG.	LLAG	RICHMOND SCREW ANCHOR
						4		11	LIFTING LAG BOLT, ø1 X 12 LG.	LLAG	RICHMOND SCREW ANCHOR
						5		12	LOCK WASHER, SPLIT, ø1	93146A038	SS / McMASTER CARR
						5		13	FLAT WASHER, ø1, 1 1/16 I.D. X 2 O.D.	90107A038	SS / McMASTER CARR
						1		14	VENT FILTER, 3/4 NPT	STD-SD-03-089-2	POLYETHYLENE / GENERAL POLYMERIC
				AR	AR		1	15	CONCRETE		
					AR		6	16	LINING, BEKAPLAST, 3/16 THK.		POLYETHYLENE / ATLAS
					3			17	LIFTING INSERT, ø1 1/4 X 5 1/2 HIGH	LP-4	RICHMOND SCREW ANCHOR
					4			18	LIFTING TYLOOP, ø1 X 6 LG.	LTL-2	RICHMOND SCREW ANCHOR
				1				19	LIFTING INSERT, ø1 X 5 1/2 HIGH	LP-4	RICHMOND SCREW ANCHOR
			1					20	TUBING, 2 1/2 O.D. X 18 GA. X 1 1/8 LG.		SS / RYERSON
			1					21	TUBING, 1 1/2 O.D. X 20 GA. X 8 3/4 LG.		SS / RYERSON
			1					22	FLAT WASHER, ø1 1/4, 1 5/16 I.D. X 2 3/4 O.D.	90107A040	SS / McMASTER CARR
				AR				23	GASKET, 1/4 THK., DUROMETER 50	SHT. 2	NEOPRENE
AR	AR							24	WELDED WIRE FABRIC, 6 X 6, D11 X D11		CARBON STEEL
		1						25	COUPLING, FULL, 3/4 NPT		SS
		1						26	BUSHING, 3/4 NPT X 1/4 NPT		SS
		1						27	MALE CONNECTOR, 1/4 NPT X 1/4 FERRULE	SS-400-1-4	SS / SWAGELOK
		AR						28	TUBING, 1/4 O.D. X 22 GA.		SS / RYERSON

SEG granted permission to WHC to publish this drawing in this WHC public document.

CONTAINER WEIGHTS

LID WT.................... 2,550 LBS.
BODY WT.................. 9,850 LBS.
EMPTY WT................ 12,400 LBS.
GROSS WT................ 20,000 LBS.

NOTES:

1. SEE SPECIFICATION STD-S-41-001.
2. GASKET (ITEM 23) TO BE GLUED TO THE UNDERSIDE OF LID (ITEM 3). ENSURE THAT GASKET IS IN LINE WITH LID AT HOLES AND INDEXING NOTCH.
3. STENCIL IN 2" HIGH x 1/2" THK. SOLID RED LETTERS. LOCATE APPROXIMATELY AS SHOWN. ARROW TO BE SOLID RED ALSO.
4. FABRICATOR TO ENSURE THAT ALL BOLT SLEEVE INSERTS (ITEM 4) AND INDEXING NOTCH IN LID (ITEM 3) ARE IN LINE WITH LIFTING TYLOOPS (ITEM 8) AND INDEXING NOTCH IN BODY (ITEM 2) AT FINAL ASSEMBLY.
5. CUT AWAY WELDED WIRE FABRIC (ITEM 24) AS NECESSARY TO ACCOMMODATE ALL INSERTS.
6. LINING DIAMETER PRIOR TO PRECASTING MAY EXCEED FINISHED DIMENSION TO FACILITATE FABRICATION. FINISHED DIMENSION SHALL BE AS SPECIFIED.
7. PRIOR TO SHIPMENT, ALL HARDWARE AND GASKETS SHALL BE INSTALLED AND PROPERLY SECURED FOR SHIPMENT.

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FOR INFORMATION ONLY

REV STATUS OF SHEETS				
	REV	2	2	2
	SHEET	1	2	3

REVISIONS	ZONE	DESCRIPTION
1		REV PER DCN NO. 93-753 JNE 12-9-93 SKD 12-9-93 JAI 12-9-93
2		REV PER DCN NO. 94-023 CMC 2-1-94

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NEXT ASSY

INTERPRET DWG PER ANSI Y14
DIM. IN INCHES BASED ON 68°F
UNLESS OTHERWISE SPECIFIED TOLERANCES

2 PL DEC	3 PL DEC	ANGLES
± .15	± -	± .5°

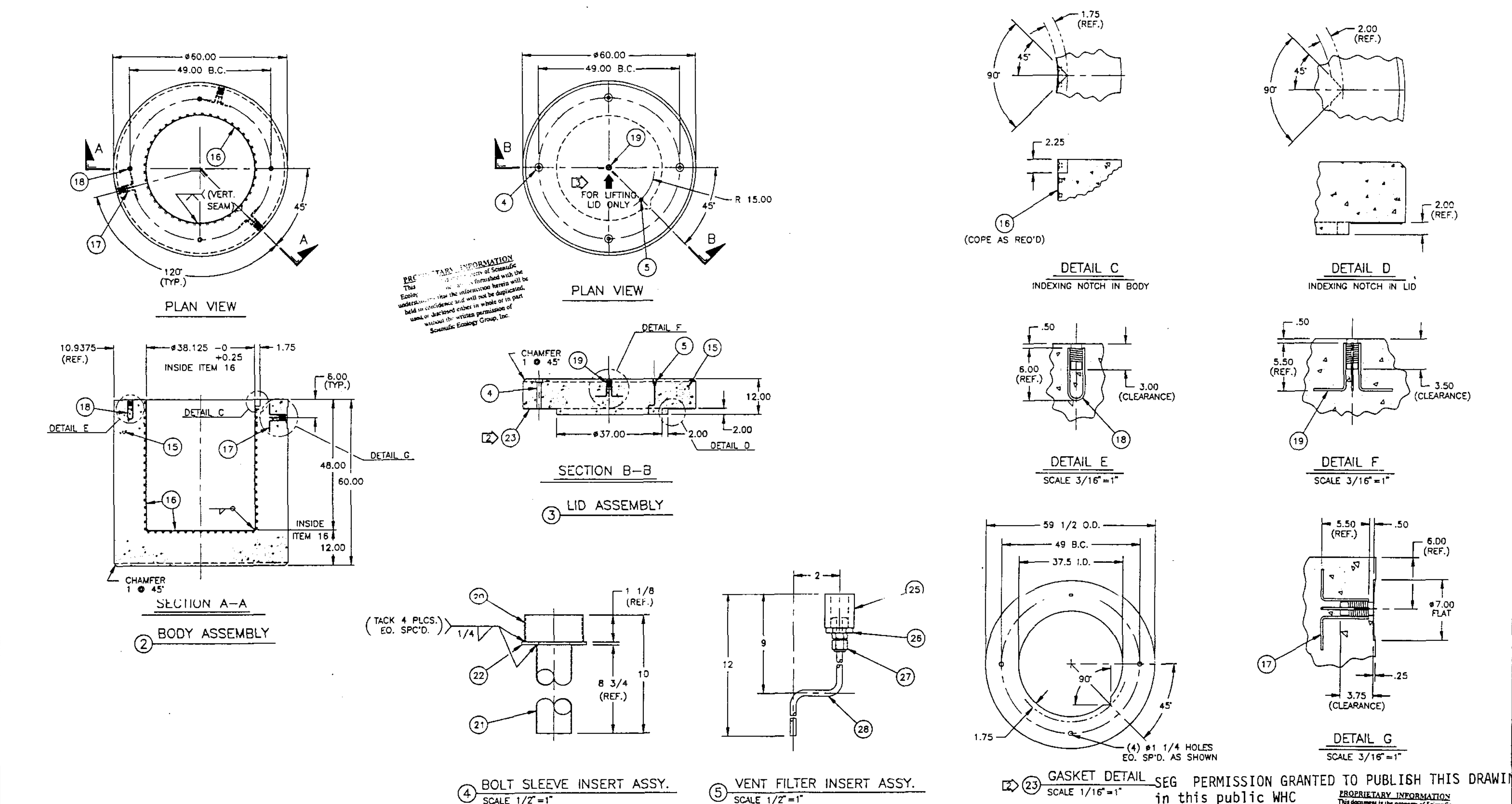
RADIUS OR CHAMFER ALL EDGES AS NOTED
FILLET RADII NA
THIRD ANGLE PROJECTION

	NAME	DATE
DFTR	TKO	8-30-93
CHKR	JJG	11-10-93
DSGN ENGR	JDI	11-15-93
DSGN MGR	SKD	11-15-93
MFG	NA	
QA	NA	
APPRVD	NA	

SEG Oak Ridge Engineering
Oak Ridge, Tennessee

ECOROK 25-11 ASSEMBLY B-3/4

SIZE D | DWG NO STD-41-001 | REV 2
SCALE 1\16" = 1" | SHEET 1 OF 3



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REVISIONS		
ZONE	DESCRIPTION	
	REV PER DCN NO. 93-753 JNE 12-9-93 SKD 12-9-93 JAI 12-9-93	1
	REV PER DCN NO. 94-029 CMC 2-1-94	2

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B-5/6

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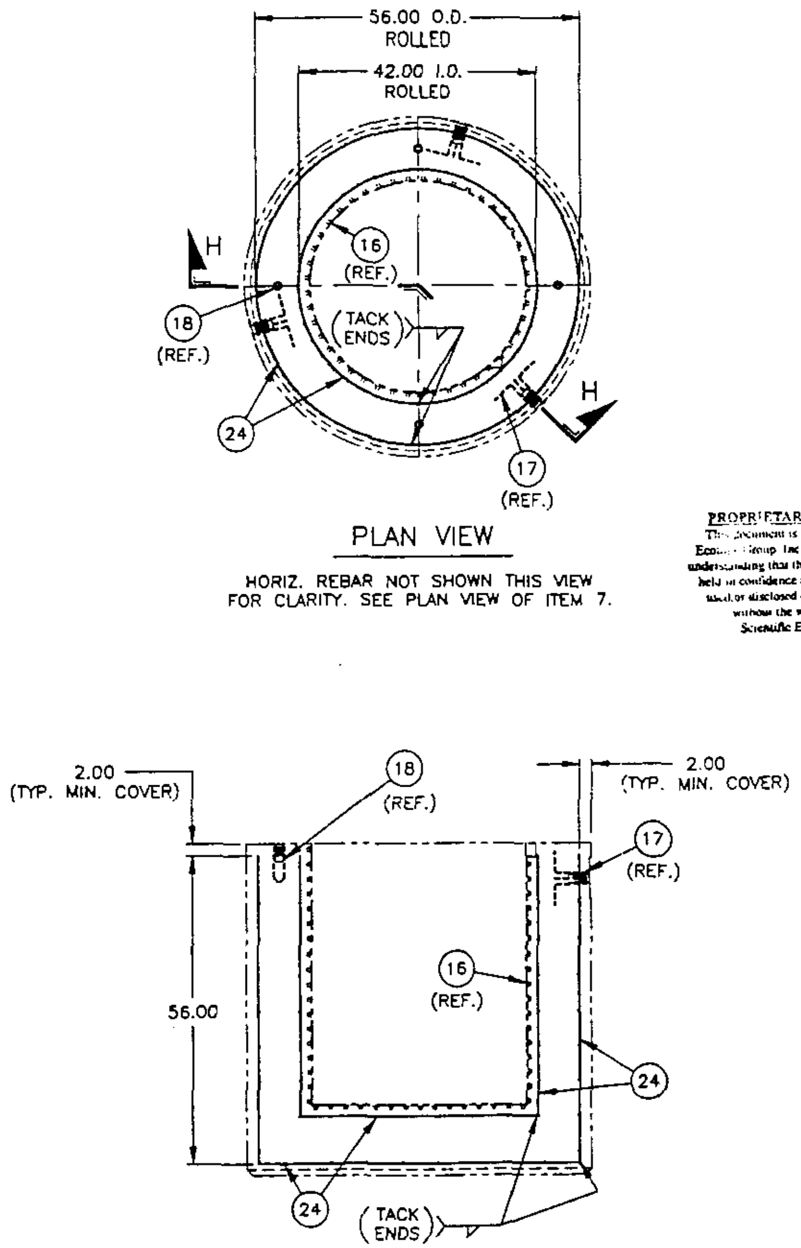
SIZE	DWG NO	REV
D	STD-41-001	2
DFTR TKO	DATE 8-30-93	SCALE 1\16" = 1"	SHEET 2

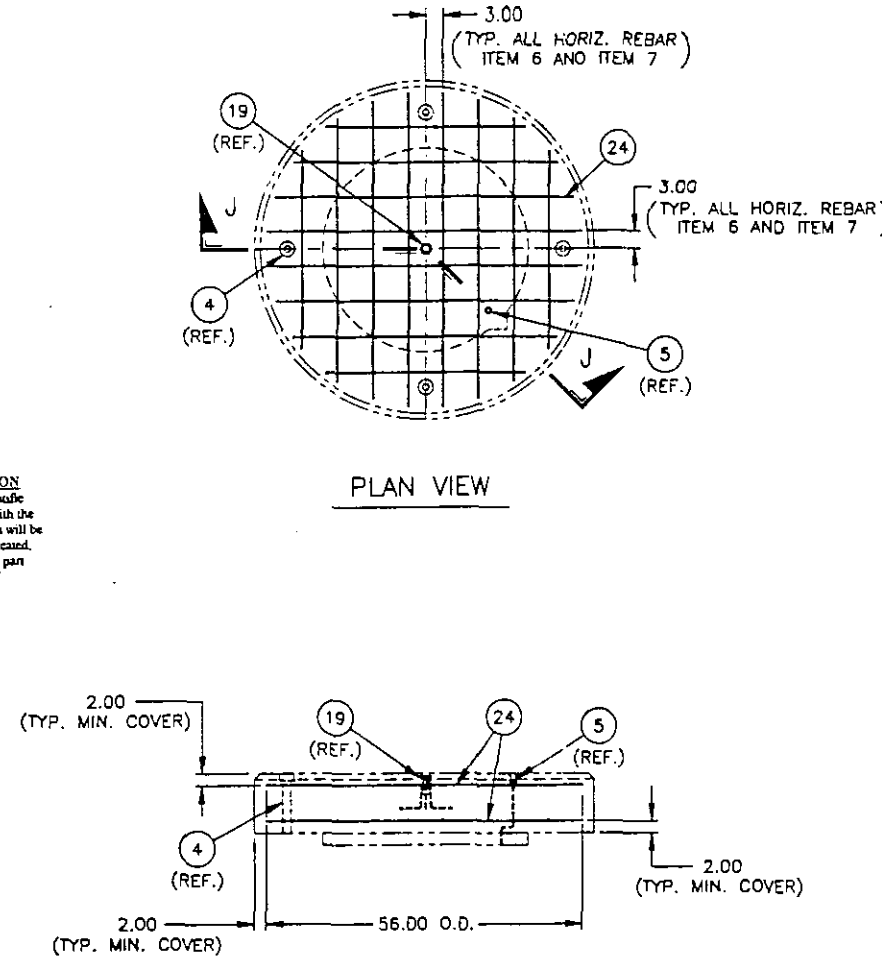


PLAN VIEW

HORIZ. REBAR NOT SHOWN THIS VIEW FOR CLARITY. SEE PLAN VIEW OF ITEM 7.

SECTION H–H

6 BODY REBAR CAGE ASSEMBLY



PLAN VIEW

SECTION J–J

7 LID REBAR CAGE ASSEMBLY

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REVISIONS		
ZONE	DESCRIPTION	
	REV PER DCN NO. 93-753 JNE 12-9-93 SKD 12-9-93 JAI 12-9-93	1
	REV PER DCN NO. 94-029 CMC 2-1-94	2

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B-7/8

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SEG SCIENTIFIC ECOLOGY GROUP, INC.

SIZE	DWG NO	REV
D	STD-41-001	2
DFTR TKO	DATE 8-30-93 SCALE 1/16" = 1"	SHEET 3

Westinghouse Hanford Company **Internal Memo**

From: Nuclear Physics & Shielding 8M730-JVN-95-006
Phone: 376-4480 H0-35 8M730-HJG-95-018
Date: August 24, 1995
Subject: SAFETY CLASS ANALYSIS FOR SHIPMENT OF K-BASIN FILTERS IN ECOROK CASKS

To: J. R. Green G2-02

cc: J. G. Field G2-02
J. Greenborg H0-35
JVN/HJG File/LB

References: 1. WHC-CM-6-1, *Westinghouse Hanford Company Standard Engineering Practices Manual*, EP-1.4, "Safety Classification Section", Rev. 1, dated December 1991.

2. B. E. Hey, WHC-SD-GN-SWD-30002, *GXQ 3.1 Users' Guide*, Rev. 0, dated November 1988.

3. B. A. Napier, D. L. Strenge, R. A. Peloquin and J. V. Ramsdell, *GENII - The hanford Environmental Dosimetry Software System*, PNL-6584, dated November 19B8.

4. J. Mishima, DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*, U. S. Department of Energy, dated December 1994.

Introduction

Spent filter cartridges from the K-Basin water treatment system have accumulated at the 100-K Area over a period of several years. During their use, these filters entrapped a significant quantity of radioactive material. Plans are to ship the filters in grout-filled packages within ECOROK casks to the 200 Area for disposal. The source term used in the following safety class analysis of the proposed shipments was based on a worst-case evaluation made by Dennis Sherrell. This source term is listed in Table 1.

Discussion and Results

As outlined in Reference 1, the event considered is an unmitigated release, which has been interpreted as release of 100 percent of the source from any packaging. The doses to be calculated are the Committed Effective Dose Equivalent (CEDE) to the maximally exposed offsite individual with only inhalation and external exposure considered, and the onsite individual located 100 m away from the release.

J. R. Green
Page 2
August 24, 1995

8M730-JVN-95-004
8M730-HJG-95-018

Table 1. Source Term for Spent K-Basin Filter Cartridges

Isotope	Curies	Isotope	Curies	Isotope	Curies
^{60}Co	2.4	^{147}Pm	18.0	^{239}Pu	3.7
^{90}Sr	22.0	^{151}Sm	2.8	^{240}Pu	2.1
^{90}Y	22.0	^{154}Eu	2.1	^{241}Pu	120.0
^{137}Cs	22.0	^{238}Pu	2.1	^{241}Am	5.1
^{137m}Ba	21.0				

The computer code GXQ (Ref. 2) was used to calculate the Ψ/Qs for a comprehensive set of distances and directions to the site boundary. The largest value that was not exceeded more than 0.5% of the time was selected. Since an offsite receptor could be floating in the river, the near bank of the Columbia River was considered as the boundary. For the onsite receptor, a distance from the release of 100 m was assumed.

The meteorological data used were the 1983 to 1991 averages for the respective areas and for each set of directions and their respective distances to the site boundary a value was chosen which was not exceeded more than 0.5% of the time. The worst case of these was then chosen for further use in this analysis. The worst case for the off-site maximally exposed member of the public turned out to be 480 m NW of the K-Basins. The Ψ/Q value used was 2.15×10^{-3} sec/m^3. For the onsite worker, the worst case was 100 m to the west of the release in the 100-K Area with a Ψ/Q value of 7.32×10^{-2}sec/m^3.

The computer code GENII (Ref. 3) was then used to calculate the dose to the affected individual. For assessment of the safety class, only the inhalation and direct radiation pathways for the maximally exposed member of the population are considered. The following libraries were accessed:

GENII Default Parameter Values (28-Mar-90 RAP)
Radionuclide Library - Times<100 years (23-July-93 PDR)
PNL Food Transfer Factor Library (by Z, with Fr&Os 7/19/93 PDR)
Bioaccumulation Factor Library - (30-Aug-88 RAP)
External Dose Factors for GENII in person Sv/yr per Bq/n (8-May-90 RAP)
Worst-Case Solubilities, Yearly Dose Increments (23-Jul-93 PDR)

Jofu Mishima, in his study of release fractions (Ref. 4), has a respirable release fraction of 5×10^{-4} for free fall and impaction stresses on enclosed HEPA filters. This release fraction was applied to the results obtained from GENII, which was run for the entire source term. The results are given in Table 2. These doses are, of course, fifty year committed doses. and the maximally exposed organ is the bone surfaces due to ^{241}Am.

J. R. Green
Page 3
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8M730-JVN-95-004
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Table 2. Expected Doses in mSv (rem)		
	CEDE	Organ Dose
Offsite Personnel	24 (2.4)	430 (43)
Onsite Personnel	810 (81)	14,600 (1460)

The offsite CEDE, 24 mSv (2.4 rem) is less than 25 rem, but greater than 0.5 rem. Thus, at least one Safety Class 1 (SC 1) barrier is required (Ref. 1) for using ECOROK casks to ship spent filter cartridges with the source term given in Table 1.

JV Nelson
J. V. Nelson, Principal Scientist
Nuclear Physics and Shielding

Harvey Goldberg
H. J. Goldberg, Principal Engineer
Nuclear Physics and Shielding

CONCURRENCE: Jos Greenborg
J. Greenborg, Manager
Nuclear Physics and Shielding

llp

Attachments

Sample Input Deck

```
######################### Program GENII Input File ############  8 Jul 88 ####
Title: Ecorok Cask - Worker
     \GENII\ecorok-w.in                              Created on 08-02-1995 at 08:46
OPTIONS======================== Default ====================================
F    Near-field scenario?      (Far-field)    NEAR-FIELD: narrowly-focused
F    Population dose?          (Individual)               release, single site
T    Acute release?              (Chronic)    FAR-FIELD:  wide-scale release,
     Maximum Individual data set used                     multiple sites
                                Complete                                  Complete
TRANSPORT OPTIONS============= Section   EXPOSURE PATHWAY OPTIONS===== Section
T  Air Transport                   1      F  Finite plume, external       5
F  Surface Water Transport         2      T  Infinite plume, external     5
F  Biotic Transport (near-field)  3,4     F  Ground, external             5
F  Waste Form Degradation (near)  3,4     F  Recreation, external         5
                                          T  Inhalation uptake            5,6
REPORT OPTIONS=======================     F  Drinking water ingestion     7,8
T  Report AEDE only                       F  Aquatic foods ingestion      7,8
F  Report by radionuclide                 F  Terrestrial foods ingestion  7,9
F  Report by exposure pathway             F  Animal product ingestion     7,10
F  Debug report on screen                 F  Inadvertent soil ingestion

INVENTORY ##################################################################

 4   Inventory input activity units: (1-pCi  2-uCi  3-mCi  4-Ci  5-Bq)
 0   Surface soil source units (1- m2  2- m3  3- kg)
     Equilibrium question goes here

     --------|----Release Terms------|----------Basic Concentrations---------|
     Use when| transport selected    | near-field scenario, optionally       |
     --------|-----------------------|---------------------------------------|
     Release |        Surface Buried |        Surface Deep    Ground  Surface|
     Radio-  |Air     Water   Waste  |Air     Soil    Soil    Water   Water  |
     nuclide |/yr     /yr     /m3    |/m3     /unit   /m3     /L      /L     |
     --------|------- ------- -------|------- ------- ------- ------- -------|
     CO60     2.4E+00
     SR90     2.2E+01
     Y 90     2.2E+01
     CS137    2.2E+01
     PM147    1.8E+01
     SM151    2.8E+00
     EU154    2.1E+00
     PU238    2.1E+00
     PU239    3.7E+00
     PU240    2.1E+00
     PU241    1.2E+02
     AM241    5.1E+00
     --------|----Derived Concentrations-----|
     Use when|  measured values are known    |
     --------|-------------------------------|
     Release |Terres. Animal  Drink   Aquatic|
     Radio-  |Plant   Product Water   Food   |
     nuclide |/kg     /kg     /L      /kg    |
     --------|------- ------- ------- -------|

TIME #######################################################################

1    Intake ends after (yr)
```

```
50    Dose calc. ends after (yr)
0     Release ends after (yr)
0     No. of years of air deposition prior to the intake period
0     No. of years of irrigation water deposition prior to the intake period

FAR-FIELD SCENARIOS (IF POPULATION DOSE) #####################################

0           Definition option: 1-Use population grid in file POP.IN
0                              2-Use total entered on this line

NEAR-FIELD SCENARIOS ########################################################

            Prior to the beginning of the intake period: (yr)
0             When was the inventory disposed?  (Package degradation starts)
0             When was LOIC?  (Biotic transport starts)
0           Fraction of roots in upper soil (top 15 cm)
0           Fraction of roots in deep soil
0           Manual redistribution: deep soil/surface soil dilution factor
0           Source area for external dose modification factor (m2)
TRANSPORT ###################################################################
            ====AIR TRANSPORT=====================================SECTION 1=====
                    0-Calculate PM              |0        Release type (0-3)
1           Option: 1-Use chi/Q or PM value     |F        Stack release (T/F)
                    2-Select MI dist & dir      |0        Stack height (m)
                    3-Specify MI dist & dir     |0        Stack flow (m3/sec)
1.0         Chi/Q or PM value                   |0        Stack radius (m)
0           MI sector index (1=S)               |0        Effluent temp. (C)
0           MI distance from release point (m)|0        Building x-section (m2)
F           Use jf data, (T/F) else chi/Q grid|0        Building height (m)

            ====SURFACE WATER TRANSPORT=========================SECTION 2=====
0           Mixing ratio model: 0-use value, 1-river, 2-lake
0           Mixing ratio, dimensionless
0           Average river flow rate for: MIXFLG=0 (m3/s), MIXFLG=1,2 (m/s),
0           Transit time to irrigation withdrawl location (hr)
            If mixing ratio model > 0:
0             Rate of effluent discharge to receiving water body (m3/s)
0             Longshore distance from release point to usage location (m)
0             Offshore distance to the water intake (m)
0             Average water depth in surface water body (m)
0             Average river width (m), MIXFLG=1 only
0             Depth of effluent discharge point to surface water (m), lake only

            ====WASTE FORM AVAILABILITY=========================SECTION 3=====
0           Waste form/package half life, (yr)
0           Waste thickness, (m)
0           Depth of soil overburden, m
```

```
          ====BIOTIC TRANSPORT OF BURIED SOURCE================SECTION 4=====
T         Consider during inventory decay/buildup period (T/F)?
T         Consider during intake period (T/F)?  | I-Arid non agricultural
0         Pre-Intake site condition.............| 2-Humid non agricultural
                                                | 3-Agricultural

EXPOSURE ####################################################################

          ====EXTERNAL EXPOSURE================================SECTION 5=====
          Exposure time:                 |  Residential irrigation:
0           Plume (hr)                   | T       Consider: (T/F)
0           Soil contamination (hr)      | 0       Source: 1-ground water
0           Swimming (hr)                |                 2-surface water
0           Boating (hr)                 | 0       Application rate (in/yr)
0           Shoreline activities (hr)    | 0       Duration (mo/yr)
0         Shoreline type: (1-river, 2-lake, 3-ocean, 4-tidal basin)
0         Transit time for release to reach aquatic recreation (hr)
I.0       Average fraction of time submersed in acute cloud (hr/person hr)

          ====INHALATION=======================================SECTION 6=====
8766.0    Hours of exposure to contamination per year
0         0-No resus-  I-Use Mass Loading           2-Use Anspaugh model
0           pension      Mass loading factor (g/m3)   Top soil available (cm)

          ====INGESTION POPULATION=============================SECTION 7=====
0         Atmospheric production definition (select option):
0           0-Use food-weighted chi/Q, (food-sec/m3), enter value on this line
            I-Use population-weighted chi/Q
            2-Use uniform production
            3-Use chi/Q and production grids (PRODUCTION will be overridden)
0         Population ingesting aquatic foods, 0 defaults to total (person)
0         Population ingesting drinking water, 0 defaults to total (person)
F         Consider dose from food exported out of region (default=F)

          Note below: S* or Source: 0-none, 1-ground water, 2-surface water
                                    3-Derived concentration entered above
          ==== AQUATIC FOODS / DRINKING WATER INGESTION=========SECTION 8====

F         Salt water? (default is fresh)

          USE        TRAN-  PROD-     -CONSUMPTION- |
          ?   FOOD   SIT    UCTION    HOLDUP   RATE |
          T/F TYPE   hr     kg/yr     da      kg/yr |       DRINKING WATER
          --- ------ -----  -------   ------  ----- |------------------------
          F   FISH    0.00  0.0E+00    0.00     0.0 | 0      Source (see above)
          F   MOLLUS  0.00  0.0E+00    0.00     0.0 | T      Treatment? T/F
          F   CRUSTA  0.00  0.0E+00    0.00     0.0 | 0      Holdup/transit(da)
          F   PLANTS  0.00  0.0E+00    0.00     0.0 | 0      Consumption (L/yr)
```

====TERRESTRIAL FOOD INGESTION=======================SECTION 9=====

USE ? T/F	FOOD TYPE	GROW TIME da	--IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m2	PROD-UCTION kg/yr	--CONSUMPTION-- HOLDUP da	RATE kg/yr
F	LEAF V	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0
F	ROOT V	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0
F	FRUIT	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0
F	GRAIN	0.00	0	0.0	0.0	0.0	0.0E+00	0.0	0.0

====ANIMAL PRODUCTION CONSUMPTION===================SECTION 10====

USE ? T/F	FOOD TYPE	---HUMAN---- CONSUMPTION RATE kg/yr	HOLDUP da	TOTAL PROD-UCTION kg/yr	DRINK WATER CONTAM FRACT.	-------------STORED FEED------------- DIET FRAC-TION	GROW TIME da	-IRRIGATION-- S *	RATE in/yr	TIME mo/yr	YIELD kg/m3	STOR-AGE da
F	BEEF	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
F	POULTR	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
F	MILK	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
F	EGG	0.0	0.0	0.00	0.00	0.00	0.0	0	0.0	0.00	0.00	0.0
						-------------FRESH FORAGE------------						
	BEEF					0.00	0.0	0	0.0	0.00	0.00	0.0
	MILK					0.00	0.0	0	0.0	0.00	0.00	0.0

##

CHECKLIST FOR INDEPENDENT TECHNICAL REVIEW

DOCUMENT REVIEWED
NUMBER: 8M730-JVN-95-006/8M730-HJG-95-018
TITLE: SAFETY CLASS ANALYSIS FOR SHIPMENT OF K-BASIN FILTERS IN ECOROK CASKS
Reviewer(s): P. D. Rittmann

I. Method(s) of Review

- (✓) Input data checked for accuracy
- (✓) Independent calculation performed
- (✓) Hand calculation
- ( ) Alternate computer code:
- ( ) Comparison to experiment or previous results
- ( ) Alternate method (define)

II. Checklist (either check or enter NA if not applied)

- (✓) Task completely defined
- (✓) Activity consistent with task specification
- (✓) Necessary assumptions explicitly stated and supported
- (✓) Resources properly identified and referenced
- (✓) Resource documentation appropriate for this application
- (✓) Input data explicitly stated
- (✓) Input data verified to be consistent with original source
- (na) Geometric model adequate representation of actual geometry
- (✓) Material properties appropriate and reasonable
- (na) Mathematical derivations checked including dimensional consistency
- (✓) Hand calculations checked for errors
- (✓) Assumptions explicitly stated and justified
- (✓) Computer software appropriate for task and used within range of validity
- (✓) Use of resource outside range of established validity is justified
- (✓) Software runstreams correct and consistent with results
- (✓) Software output consistent with input
- (✓) Results consistent with applicable previous experimental or analytical findings
- (✓) Results and conclusions address all points and are consistent with task requirements and/or established limits or criteria
- (✓) Conclusions consistent with analytical results and established limits
- (na) Uncertainty assessment appropriate and reasonable
- ( ) Other (define)

III. Comments:
May 1995 version of GXQ is now available

IV. REVIEWER: Paul Rittmann 8-30-95

HEDOP REVIEW CHECKLIST
for
Radiological and Nonradiological Release Calculations

Document Reviewed:.

SAFETY CLASS ANALYSIS FOR SHIPMENT OF K-BASIN FILTERS IN ECOROK CASKS

Submitted by: J. V. Nelson/H. J. Goldberg Date Submitted: August 24, 1995

Scope of Review: Entire Document

YES	NO*	N/A		
[✓]	[ ]	[ ]	1.	A detailed technical review and approval of the environmental transport and dose calculation portion of the analysis has been performed and documented.
[✓]	[ ]	[ ]	2.	Detailed technical review(s) and approval(s) of scenario and release determinations have been performed and documented.
[✓]	[ ]	[ ]	3.	HEDOP-approved code(s) were used.
[✓]	[ ]	[ ]	4.	Receptor locations were selected according to HEDOP recommendations.
[✓]	[ ]	[ ]	5.	All applicable environmental pathways and code options were included and are appropriate for the calculations.
[✓]	[ ]	[ ]	6.	Hanford site data were used.
[✓]	[ ]	[ ]	7.	Model adjustments external to the computer program were justified and performed correctly.
[✓]	[ ]	[ ]	8.	The analysis is consistent with HEDOP recommendations.
[ ]		[X]	9.	Supporting notes, calculations, comments, comment resolutions, or other information is attached. (Use the "Page 1 of X" page numbering format and sign and date each added page.)
[✓]	[ ]		10.	Approval is granted on behalf of the Hanford Environmental Dose Overview Panel.

* All "NO" responses must be explained and use of nonstandard methods justified.

Reviewer Name: Paul D. Rittmann, B.A., M.S., Ph.D., C.H.P.
(print or type)

Paul Rittmann Aug 30, 1995

HEDOP-Approved Reviewer (Signature) Date

APPENDIX D

EXCEPTIONS FOR HANFORD ECOROK PACKAGING WITH STEEL LINER

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDIX D

EXCEPTIONS FOR HANFORD ECOROK PACKAGING WITH STEEL LINER

D.1.0 INTRODUCTION

There are to be two configurations of the Hanford Ecorok[1] packaging (HEP). The initial configuration will use the existing steel liner with modifications. The final configuration will use an inner container. The purpose of this appendix is to document exceptions applicable to the HEP with the steel liner. The requirements within the body of this packaging design criteria (i.e., Sections 1.0 through 7.0) that apply to the inner container also apply to the steel liner, unless otherwise specified by this appendix.

D.2.0 PACKAGE CONTENTS

D.2.1 PHYSICAL DESCRIPTION

The HEP with steel liner will be used to transport contaminated cartridge filter assemblies, steel liner bagging, and absorbent. These items are as follows.

D.2.1.1 Cartridge Filter Assembly

These are the original filters that were shipped in the K Area spent filter cartridge container. This assembly was used in the water purification system, upstream of the ion exchange modules. This design consists of a mounting cage constructed of 316 stainless steel. The cage is 74.61 cm (29.375 in.) in diameter by 93.66 cm (36.875 in.) tall (overall height). This cage assembly contains 88 filter cartridges. Each cartridge is 76.2 cm (30.0 in.) long and 6.35 cm (2.5 in.) in diameter. They are constructed of polypropylene fiber wound around a stainless steel core. The flow path through these filters was from the outside to the inside. The HEP will hold only one of the cartridge filter assemblies. K Basins has estimated a maximum initial weight of 233.2 kg (514.0 lb) and a maximum final weight of 255.8 kg (564.0 lb).

NOTE: Initial weight assumes dry and uncontaminated filters. Final weights assume filters loaded to maximum capacity, with water drained to the maximum practicable extent.

[1]Ecorok is a trademark of Scientific Ecology Group, Inc.

D.2.1.2 Steel Liner Bagging

The steel liner shall be placed inside a bag prior to being placed into the Ecorok container. The bag shall be constructed from polyvinyl chloride laminated woven polyester fabric, such as Pacifitex[2] 1009 (or other fabric meeting Mil-C-43006E, Type II). The bag has a drawstring closure. Appropriate operational measures shall be taken to ensure that the bag closure will allow efficient venting of hydrogen gas.

D.2.1.3 Absorbent

A maximum of 12.3 kg (27.0 lb) of absorbent will be added to the steel liner bag. The material will be Radsorb[3], a sodium polyacrylate homopolymer.

D.2.2 RADIONUCLIDE COMPOSITION

The source term for the steel liners is was developed from Dodd (1995), which is a study of inventory releases. This study provided quantities of ^{137}Cs, ^{90}Sr, and total transuranic (TRU) material in each of 13 different cartridge filter assemblies, as well as presenting a worst-case cartridge filter inventory.

The individual ^{137}Cs quantities were calculated from actual dose rate measurements from each of the 13 different cartridge filter assemblies.

The individual ^{90}Sr quantities were based on laboratory analyses of samples from five different cartridge filter assemblies. The analyses showed an average ^{137}Cs-to-^{90}Sr ratio of approximately 10:1. For conservatism, the study assumed a ratio of 1:1.

The individual TRU quantities were also based on laboratory analyses of samples from five different cartridge filter assemblies. The analyses showed an average ^{137}Cs-to-TRU ratio of approximately 10:3. For conservatism, the study assumed a ratio of 10:6.

The study presented a worst-case cartridge filter inventory that was based on a statistical analysis of the 13 individual ^{137}Cs, ^{90}Sr, and TRU quantities. It was assumed that the worst-case cartridge filter assembly would contain the average ^{137}Cs, ^{90}Sr, and TRU quantities, plus two standard deviations. This works out to approximately 4.5 Ci of ^{137}Cs, 4.5 Ci of ^{90}Sr, and 2.7 Ci of TRU in the worst-case cartridge filter assembly.

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[2] Pacifitex is a trademark of Lancs Industries.

[3] Radsorb is a trademark of Environmental Scientific Inc.

The resultant source term is shown in Table D-1. Rather than listing total curies of TRU, Table D-1 lists the 2.7 Ci by individual isotope, based on the overall basin fuel distribution (0.4 Ci of ^{238}Pu, 0.8 Ci of ^{239}Pu, 0.4 Ci of ^{240}Pu, and 1.1 Ci of ^{241}Am).

The remaining isotopes were either based on decay information or derived from the overall basin fuel inventory.

Table D-1. Maximum Steel Liner Source Term.

Isotope	Curies	Isotope	Curies	Isotope	Curies
^{60}Co	0.1	^{151}Sm	0.6	^{238}Pu	0.4
^{90}Sr	4.5	^{154}Eu	0.4	^{239}Pu	0.8
^{90}Y	4.5	^{234}U	2.88 E-3	^{240}Pu	0.4
^{137}Cs	4.5	^{235}U	1.12 E-4	^{241}Pu	24.5
^{137m}Ba	4.3	^{236}U	4.17 E-4	^{241}Am	1.1
^{147}Pm	3.7	^{238}U	2.29 E-3	Other*	0.9

*May be treated as equal quantities of ^{85}Kr, ^{125}Sb and ^{134}Cs.

D.2.3 TRANSPORTATION CLASSIFICATION

The payload is a fissile Type B quantity. The payload contains over 66 g of fissile material (mostly ^{235}U and ^{239}Pu--see Table D-2). The fissile classification will be specified by the safety analysis report for packaging (SARP).

Table D-2. Fissile Isotope Weights.

Isotope	Curies[1]	Curies per gram[2]	Grams
^{235}U	1.12 E-4	2.1 E-6	53.3
^{238}Pu	0.4	1.7 E+1	2.3 E-2
^{239}Pu	0.8	6.2 E-2	12.9
^{241}Pu	24.5	1.1 E+2	0.2

[1]From Table D1.
[2]From 10 CFR 71, Appendix A, Table A-1.

D.3.0 OPERATIONS

D.3.1 ORIGINATING FACILITY OPERATIONS

The originating facilities shall be either the K West Basin or the K East Basin. K Basins will supply rigging for lifting the Ecorok container and the steel liner. The Ecorok container rigging will be such that the weight of the HEP is distributed essentially evenly among all three of the lifting attachments. The steel liner rigging will be such that its weight is distributed essentially evenly among two of its lifting attachments.

The steel liner body assembly (minus the drain plug) will be submerged in the basin water and lowered into place. The steel liner rigging will be moved to the side so that the opening of the steel liner is not obstructed. The contaminated filter assemblies will then be transferred into the submerged steel liner body assembly. The steel liner lid assembly will be lowered, via its center lifting attachment, onto the body assembly. After proper alignment of the lid, the lid bolts will be remotely tightened (requirements to be identified in the SARP). When the steel liner has been lifted out of the basin, water will then be allowed to exit through the drain hole to the maximum practicable extent. After decontamination and drying of the external surfaces of the steel liner and the steel liner rigging to the maximum practicable extent, the steel liner will be placed inside the steel liner bag (see D.2.1.2 for bag venting requirements). The bag will contain absorbent (Radsorb) in quantities sufficient to ensure the absorption of any free-standing water (water that may continue to drain through the drain port, which will remain open). The steel liner and bag will then be placed inside the Ecorok container. At this point, the Ecorok container lid assembly (including the Nuc-Fil filter), will be installed, followed by proper torquing of the four closure bolts (requirements to be identified in the SARP).

D.3.2 SHIPPING OPERATIONS

K Basins has indicated that four existing cartridge filter assemblies will be shipped during the first month. These will be the only shipments in steel liners.

D.4.0 DESIGN CRITERIA

D.4.1 Steel Liner Description

The steel liner is shown in Figures D-1 and D-2. The steel liner base and lid are constructed from 2-in.-thick ASTM A36 carbon steel. The liner wall is constructed from two 1-in.-thick sections of ASTM A36 carbon steel, seam welded along the top (see figures D-1 and D-2). The steel liner is approximately 106.7 cm (42.0 in.) in height by 88.9 cm (35.0 in.) in diameter and weighs approximately 1,725 kg (3,803 lb). The base and wall are attached via a 0.64-cm (0.25-in.) circumferential fillet weld on the interior and a 0.64-cm (0.25-in.) circumferential groove weld on the exterior. There are four lifting attachments evenly spaced around the circumference of the wall, and there is a lifting attachment in the center of the lid (for lifting only the lid).

There are four ¾ x 10 unified national coarse thread (UNC) bolts to hold the lid to the body, and a ⅛-in.-thick, 40-durometer Buna N lid gasket. There is a 2-in. NPT through hole in the lid. There are also pins and holes for lid alignment, painted serial numbers, and a ⅝-in.-diameter drain port.

D.4.2 Steel Liner Construction Materials

Table D-3 summarizes the steel liner construction materials and their properties.

Table D-3. Steel Liner Materials.

Item	Specification	Strength
Lid and body steel	ASTM A 36	413.7 MPa (60 ksi) tensile
Lid bolts	ASTM A 307 Grade A ¾-10 UNC	413.7 MPa (60 ksi) tensile

ASTM = American Society for Testing and Materials.
UNC = Unified national coarse thread.

D.4.3 Steel Liner Dimensions

Table D-4 summarizes the nominal dimensions of the steel liner (see Appendix E for complete dimensions and tolerances).

Table D-4. Nominal Dimensions of Steel Liner.

Dimension	Measurement
Liner height*	106.7 cm (42.0 in.)
Liner diameter*	88.9 cm (35.0 in.)
Inside height	96.5 cm (38.0 in.)
Inside diameter	78.7 cm (31.0 in.)

*Does not include lifting/tiedown attachments.

Figure D-1. Steel Liner. (See Figure D-2 for additional details and Appendix E for complete dimensions.)

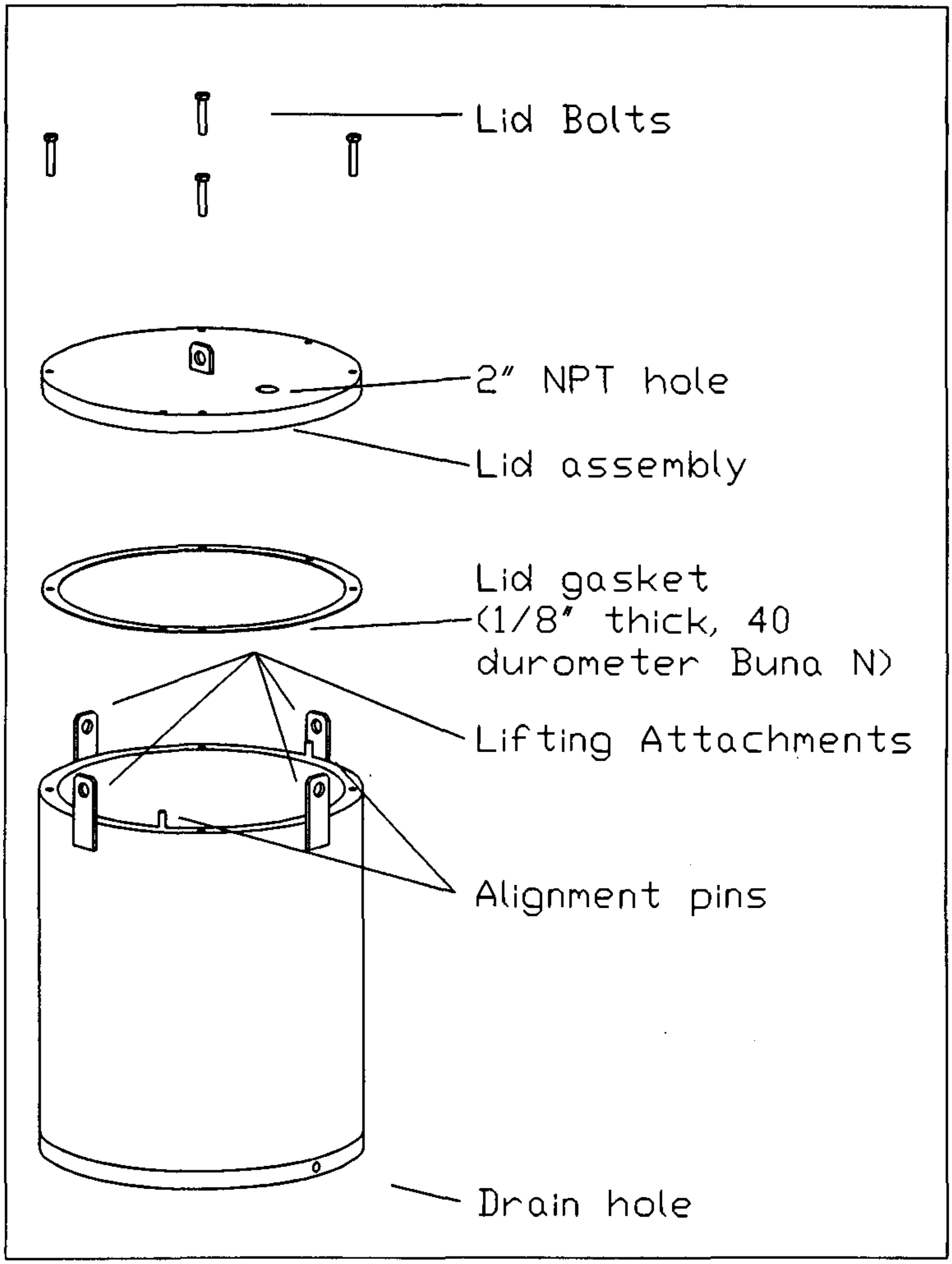
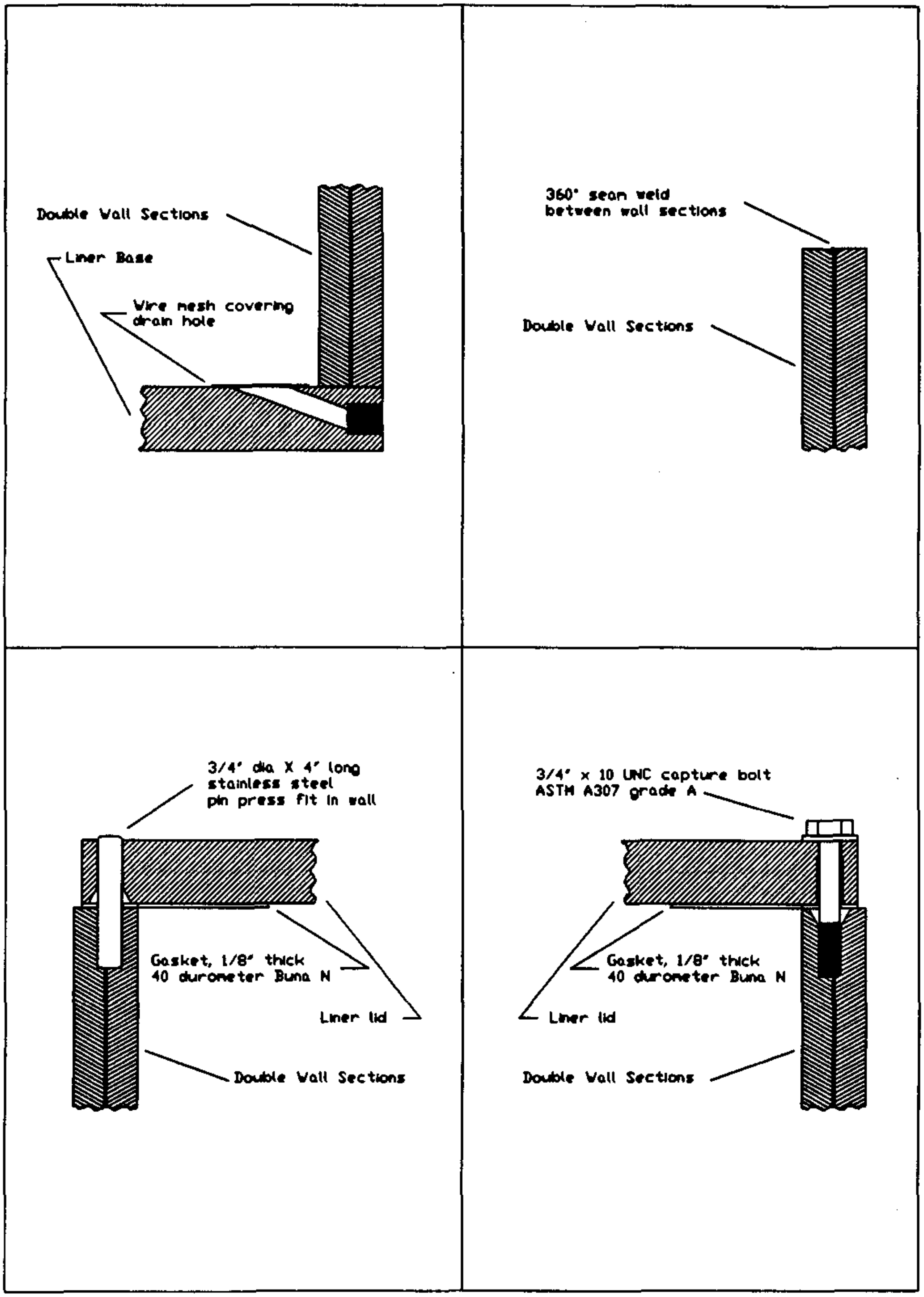


Figure D-2. Steel Liner Details.



D.4.4 Maximum Gross Weight

The maximum gross weight for the HEP with the steel liner is 8,042.2 kg (17,730.0 lb). The individual component weights are summarized Table D-5.

Table D-5. Component Weights.

Item	Maximum Weight
Ecorok container lid (1,156.7 kg [2,550.0 lb] nominal)	1,214.7 kg (2,678.0 lb)
Ecorok container body (4,467.9 kg [9,850.0 lb] nominal)	4,691.5 kg (10,343.0 lb)
Steel Liner lid (235.9 kg [520.0 lb] nominal)	247.7 kg (546.0 lb)
Steel Liner body (1,489.1 kg [3,283.0 lb] nominal)	1,563.5 kg (3,447.0 lb)
Contaminated water filters	255.8 kg (564.0 lb)
Rigging and bagging for steel liner	56.7 kg (125.0 lb)
Absorbent	12.3 kg (27.0 lb)
Total	8,042.2 kg (17,730.0 lb)

D.4.5 Steel Liner Venting

The steel liner is vented through the 2-in. NPT hole in the lid assembly. The bag has a drawstring closure. Appropriate operational measures shall be taken to ensure that the bag closure will allow efficient venting of hydrogen gas.

D.4.6 Steel Liner Lifting and Tiedown Attachments

The steel liner has two lifting attachments. See D.4.1 and D.4.2 for specifics on the attachments. The steel liner rigging is described in D.3.1.

D.4.7 Steel Liner Containment Boundaries

The steel liner does not provide any containment.

D.5.0 REFERENCES

10 CFR 71, 1993, "Packaging and Transportation of Radioactive Material," *Code of Federal Regulations*, as amended.

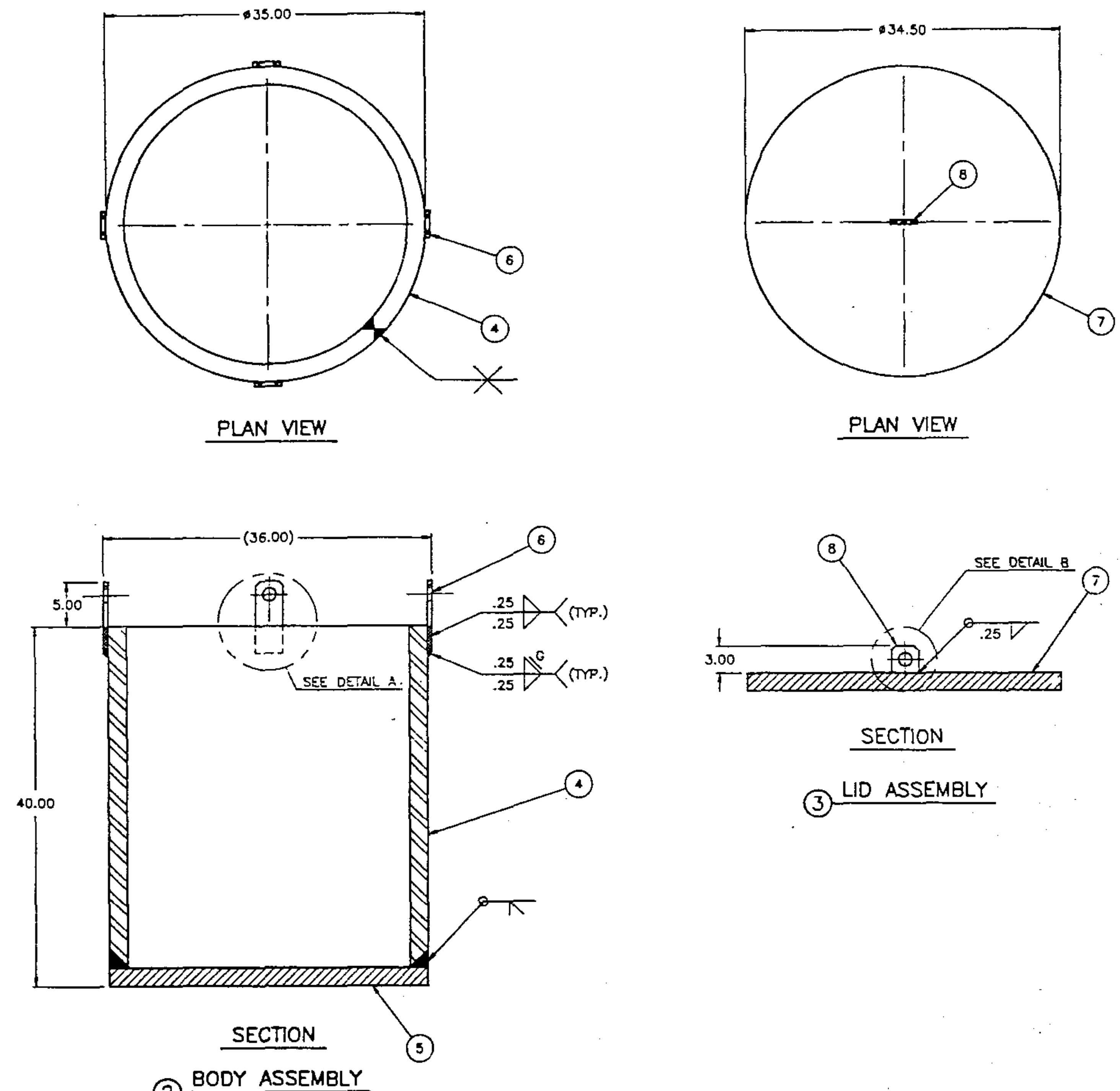
Dodd, E. N., 1995, *Safety Evaluation--Spent Water Treatment System Components Inventory Release*, WHC-SD-SNF-TA-005, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

APPENDIX E

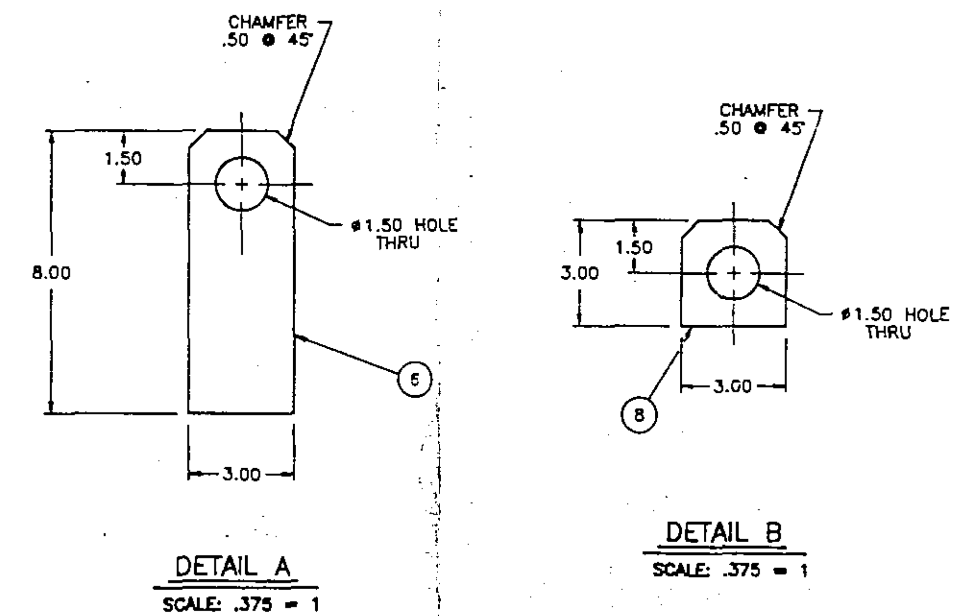
STEEL LINER DRAWING

BILL OF MATERIAL

QTY REQD GR3	GR2	GR1	NOTE	ITEM	PART NAME/DESCRIPTION	PART NO OR REF DWG	MAT'L/SPECIFICATION
		X		1	OPT. 2" THK STL LINER ECOROK 25-11		
	X	1		2	BODY ASSEMBLY		
X	–	1		3	LID ASSEMBLY		
–	1	–		4	PLATE, 2.00 THK ROLLED TO A 31.00 ID		ASTM A-36
–	1	–		5	PLATE, 2.00 THK		ASTM A-36
–	4	–		6	FLAT BAR, .50 THK		ASTM A-36
1	–	–		7	PLATE, 2.00 THK		ASTM A-36
1	–	–		8	FLAT BAR, .50 THK		ASTM A-36



OPTIONAL 2" THK. STEEL LINER FOR ECOROK 25-11



NOTES:

1. FABRICATOR TO ENSURE ALL PLATES ARE TRUE, SQUARE AND FREE FROM BURRS, WELD SPLATTER ETC.

NOTE: Permission granted from SEG, Inc. to include this drawing in this public document.

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REVISIONS ZONE	DESCRIPTION
1	REV PER DCN NO. 93-746
2	REV PER DCN NO. 93-755 JNE 12-13-93

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NEXT ASSY

INTERPRET DWG PER ANSI Y14
DIM. IN INCHES BASED ON SET
UNLESS OTHERWISE SPECIFIED TOLERANCES
2 PL DEC ±.10 | 3 PL DEC ±.- | ANGLES ±.5°
RADIUS OR CHAMFER ALL EDGES .03 MAX
FILLET RADII .03 MAX
THIRD ANGLE PROJECTION

		DATE
DFTR	TKO	10/14/93
CHKR	JJS	11/15/93
DSGN ENGR	JDI	11/15/93
DSGN MGR	SKD	11/15/93
MFG	NA	
QA	NA	
APPRVD	NA	

SEG — Oak Ridge Engineering, Oak Ridge, Tennessee

OPTIONAL 2" THICK STEEL LINER FOR ECOROK 25-11 E-1/2

SIZE D | DWG NO STD-27-008 | REV 2 | SCALE .125 = 1 | SHEET 1 OF 1

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	Packaging Engineering	Date 12/22/95
Project Title/Work Order		EDT No. 611669
Packaging Design Criteria for the Hanford Ecorok Packaging (WHC-SD-TP-PDC-031)		ECN No. N/A

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
J. G. Field	G1-11	X			
J. R. Green	G1-11	X			
C. R. Hoover	G1-11	X			
D. W. McNally	G1-11	X			
M. S. Mercado	G1-11	X			
F. J. Muller	X3-85	X			
C. C. Pitkoff	R3-86	X			
S. S. Shiraga	G1-11	X			
E. F. Votaw	G3-16	X			
Central Files	A3-88	X			
WHC-SD-TP-PDC-031 File	G1-11	X			