

THE CONTENTS OF THIS SECTION ARE  
THE HIGHEST QUALITY AVAILABLE

INITIAL gf DATE 11/27/01

PAGE NUMBERING SEQUENCE IS INCONSISTENT

**Attachment 9**

**Sand Filter Analysis**

Container ID # **INEEL Sand Filter**

Constants  
3.70E+10  
453.6  
1.00E-12  
1000.00  
1.00E+09  
Units  
Bq/Ci  
g/lb  
TBq/Bq or Ci/pCi  
g/kg  
nCi/Ci

**Section I. Waste Stream Information**

Container Type: N/A  
Description: 5 gal of Sand Filter media

Note: assume solid phase volume of 5 gallons with density of 1.02 g/cc

Container	Container	Container	Container	Waste	External Vol.	Est. Waste Vol.
Gross Wt (lb)	Gross Wt (kg)	Tare Wt (lb)	Tare Wt (kg)	Net Wt (kg)	(m3)	(m3)
42.56	19.31	0.00	0.00	19.31	N/A	0.019

Dose survey from Sxxxx on xx/xx/00 shows < > mrem/hr OC.  
**Sand Filter**

Note: Gross weight of contents = (5 gal.)x(1.02 g/cc)x(3785.412 cc/gal.)x(2.2046E-03 lb/g) = 42.56

**Section II. List the radionuclides and activities; perform DOT RAM, RQ, LTD QTY, and Type A Packaging checks**

Nuclide	Activity (Ci)	% of Total A2 Fraction	Activity (Bq)	Activity/gram (Bq/gram)	RQ limits (TBq)	RQ Ratios (amount/limit)	A2 Value (TBq)	LTD QTY Det. (amount/(10-3)A2)	Type A Pkg? (amount/A2)	DOT Fissile Mass (g)	TRU Conc. (nCi/g)	LSA-II Solids Frac	Activity/gram (pCi/g)
Cs-137	2.104E-03	9.18E-01	7.79E+07	4.03E+03	3.70E-02	2.10E-03	5.00E-01	1.56E-01	1.56E-04	0.00E+00	0.00E+00	8.07E-05	1.09E+05
Sr-90	1.988E-03	4.34E+00	7.36E+07	3.81E+03	3.70E-03	1.99E-02	1.00E-01	7.36E-01	7.36E-04	0.00E+00	0.00E+00	3.81E-04	1.03E+05
Co-60	6.989E-04	3.81E-01	2.59E+07	1.34E+03	3.70E-01	6.99E-05	4.00E-01	6.46E-02	6.46E-05	0.00E+00	0.00E+00	3.35E-05	3.62E+04
U-234	4.228E-04	9.22E+01	1.56E+07	8.10E+02	3.70E-03	4.23E-03	1.00E-03	1.56E+01	1.56E-02	0.00E+00	0.00E+00	8.10E-03	2.19E+04
Aq-110m	1.006E-04	5.48E-02	3.72E+06	1.93E+02	3.70E-01	1.01E-05	4.00E-01	9.30E-03	9.30E-06	0.00E+00	0.00E+00	4.82E-06	5.21E+03
Tc-99	2.490E-05	6.03E-03	9.21E+05	4.77E+01	3.70E-01	2.49E-06	9.00E-01	1.02E-03	1.02E-06	0.00E+00	0.00E+00	5.30E-07	1.29E+03
U-235	1.276E-05	0.00E+00	4.72E+05	2.45E+01	3.70E-03	1.28E-04	Unlimited	0.00E+00	0.00E+00	5.80E+00	0.00E+00	0.00E+00	6.61E+02
Eu-152	1.218E-05	2.95E-03	4.51E+05	2.33E+01	3.70E-01	1.22E-06	9.00E-01	5.01E-04	5.01E-07	0.00E+00	0.00E+00	2.59E-07	6.31E+02
Zn-65	4.556E-06	4.97E-04	1.69E+05	8.73E+00	3.70E-01	4.56E-07	2.00E+00	8.43E-05	8.43E-08	0.00E+00	0.00E+00	4.37E-08	2.36E+02
Eu-154	2.182E-06	9.51E-04	8.07E+04	4.18E+00	3.70E-01	2.18E-07	5.00E-01	1.61E-04	1.61E-07	0.00E+00	0.00E+00	8.36E-08	1.13E+02
Pu-241	1.97E-06	4.29E-02	7.28E+04	3.77E+00	3.70E-02	1.97E-06	1.00E-02	7.28E-03	7.28E-06	1.97E-08	0.00E+00	3.77E-06	1.02E+02
Ru-106	1.892E-06	2.06E-03	7.00E+04	3.63E+00	3.70E-02	1.89E-06	2.00E-01	3.50E-04	3.50E-07	0.00E+00	0.00E+00	1.81E-07	9.80E+01
U-238	1.751E-06	0.00E+00	6.48E+04	3.36E+00	3.70E-03	1.75E-05	Unlimited	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.07E+01
Th-234	1.75E-06	1.91E-03	6.48E+04	3.36E+00	3.70E+00	1.75E-08	2.00E-01	3.24E-04	3.24E-07	0.00E+00	0.00E+00	1.68E-07	9.07E+01
Aq-106m	1.124E-06	1.22E-02	4.16E+04	2.15E+00	3.70E-01	1.12E-07	2.00E-02	2.08E-03	2.08E-06	0.00E+00	0.00E+00	1.08E-06	5.82E+01
Pu-239	8.726E-07	9.51E-01	3.23E+04	1.67E+00	3.70E-04	8.73E-05	2.00E-04	1.61E-01	1.61E-04	1.41E-05	4.52E-02	8.36E-05	4.52E+01
Pu-238	8.128E-07	8.86E-01	3.01E+04	1.56E+00	3.70E-04	8.13E-05	2.00E-04	1.50E-01	1.50E-04	4.78E-08	4.21E-02	7.79E-05	4.21E+01
Nb-95	5.599E-07	1.22E-04	2.07E+04	1.07E+00	3.70E-01	5.60E-08	1.00E+00	2.07E-05	2.07E-08	0.00E+00	0.00E+00	1.07E-08	2.90E+01
Am-241	2.066E-07	2.25E-01	7.64E+03	3.96E-01	3.70E-04	2.07E-05	2.00E-04	3.82E-02	3.82E-05	0.00E+00	1.07E-02	1.98E-05	1.07E+01
Total	5.38E-03	100.00%	1.99E+08	1.03E+04		2.66E-02		1.70E+01	1.70E-02	5.80E+00	9.80E-02	8.79E-03	2.79E+05

DOT regulated as Hazard Class 7 Radioactive Material  
NOT an RQ amount of a Hazardous Substance  
< Type A quantity/package per 49 CFR 173.431(a); check if excepted quantity -> excepted packaging  
Does NOT meet LTD QTY Exception; Check if LSA  
Meets Low Specific Activity (LSA)-II material - Check <Type A quantity and use Radioactive material, LSA, n.o.s. as PSN  
Meets criteria for Fissile Excepted Package per 49 CFR 173.453  
This is a Low-level waste

Performed by: *Carol Harris*  
Reviewed by: \_\_\_\_\_

Date: 9/25/01  
Date: \_\_\_\_\_

103 of 105

**Section III: Check radionuclides for listing on labels and shipping papers; Check reportable radionuclides per NTS WAC**

Nuclide	Activity (Ci)	% of Total A2 Fraction	Cumulative A2 Fraction	Nuclide	Activity (Ci)	% of Total Activity	Source Material (kg)	SNM (g)	Activity Conc. (Ci/m <sup>3</sup> )
U-234	4.23E-04	9.22E+01	9.22E+01	Cs-137	2.10E-03	3.91E+01	Not applicable	Not applicable	1.11E-01
Sr-90	1.99E-03	4.34E+00	9.65E+01	Sr-90	1.99E-03	3.69E+01	Not applicable	Not applicable	1.05E-01
Pu-239	8.73E-07	9.51E-01	9.75E+01	Co-60	6.99E-04	1.30E+01	Not applicable	Not applicable	3.69E-02
Cs-137	2.10E-03	9.18E-01	9.84E+01	U-234	4.23E-04	7.85E+00	Not applicable	Not applicable	2.23E-02
Pu-238	8.13E-07	8.86E-01	9.93E+01	Ag-110m	1.01E-04	1.87E+00	Not applicable	Not applicable	5.31E-03
Co-60	6.99E-04	3.81E-01	9.97E+01	Tc-99	2.49E-05	4.63E-01	Not applicable	Not applicable	1.32E-03
Am-241	2.07E-07	2.25E-01	9.99E+01	U-235	1.28E-05	2.37E-01	Not applicable	5.80E+00	6.74E-04
Ag-110m	1.01E-04	5.48E-02	9.99E+01	Eu-152	1.22E-05	2.26E-01	Not applicable	Not applicable	6.44E-04
Pu-241	1.97E-06	4.29E-02	1.00E+02	Zn-65	4.56E-06	8.46E-02	Not applicable	Not applicable	2.41E-04
Ag-106m	1.12E-06	1.22E-02	1.00E+02	Eu-154	2.18E-06	4.05E-02	Not applicable	Not applicable	1.15E-04
Tc-99	2.49E-05	6.03E-03	1.00E+02	Pu-241	1.97E-06	3.65E-02	Not applicable	1.97E-08	1.04E-04
Eu-152	1.22E-05	2.95E-03	1.00E+02	Ru-106	1.89E-06	3.51E-02	Not applicable	Not applicable	1.00E-04
Ru-106	1.89E-06	2.06E-03	1.00E+02	U-238	1.75E-06	3.25E-02	Not applicable	Not applicable	9.25E-05
Th-234	1.75E-06	1.91E-03	1.00E+02	Th-234	1.75E-06	3.25E-02	Not applicable	Not applicable	9.25E-05
Eu-154	2.18E-06	9.51E-04	1.00E+02	Ag-106m	1.12E-06	2.09E-02	Not applicable	Not applicable	5.94E-05
Zn-65	4.56E-06	4.97E-04	1.00E+02	Pu-239	8.73E-07	1.62E-02	Not applicable	1.41E-05	4.61E-05
Nb-95	5.60E-07	1.22E-04	1.00E+02	Pu-238	8.13E-07	1.51E-02	Not applicable	4.78E-08	4.29E-05
U-235	1.28E-05	0.00E+00	1.00E+02	Nb-95	5.60E-07	1.04E-02	Not applicable	Not applicable	2.96E-05
U-238	1.75E-06	0.00E+00	1.00E+02	Am-241	2.07E-07	3.84E-03	Not applicable	Not applicable	1.09E-05

**Section IV: Waste Classification Determination for near surface disposal p**

Assume that H-3, Cs-137, Sr-90, Ni-63, and Co-60 are major nuclides driving wa

Radionuclide	Table 2 limit (Ci/m <sup>3</sup> )		Sand Filter
	Column 1	Column 2	
Cs-137	1	44	1.11E-01
Sr-90	0.04	150	1.05E-01
Co-60	700	*	3.69E-02
Class A Sum of Fractions:			2.74
Class B Sum of Fractions:			0.00
			<b>Class B</b>

501 to 101

The purpose of this spreadsheet is to convert the Sand Filter's radionuclide activities from pCi/g to Ci.

Note that the Sand Filter utilizes 1 sample set to determine the total activity.

Source of Data: Comprehensive remedial Investigation/Feasibility Study (RI/FS) for Test Area North Operable Unit1-10 at INEEEL, DOE/ID-10557

**Constants**

1gal	=	3.785E+03 cc
1pCi	=	1.000E-12 Ci
1gal	=	3.785E+00 L

**Conversion Formula:**

solid pCi/g -> Ci: (pCi/g)x(1Ci/1E12pCi)x(density[g/cc])x(#gallons)x(1cc/0.000264172gal)

Volume Input (gal): 5.0 (estimated)

Note: Shaded radionuclides below indicate that detection limits were used if the measurement result was less than the detection limit to be conservative.

**TV9001017A-RAD**

	pCi/g	Ci
Ag-106m	5.820E+01	1.124E-06
Ag-110m	5.210E+03	1.006E-04
Am-241	1.070E+01	2.066E-07
Co-60	3.620E+04	6.989E-04
Cs-137	1.090E+05	2.104E-03
Eu-152	6.310E+02	1.218E-05
Eu-154	1.130E+02	2.182E-06
Nb-95	2.900E+01	5.599E-07
Pu-238	4.210E+01	8.128E-07
Pu-239	4.520E+01	8.726E-07
Ru-106	9.800E+01	1.892E-06
Sr-90	1.030E+05	1.988E-03
Tc-99	1.290E+03	2.490E-05
U-234	2.190E+04	4.228E-04
U-235	6.610E+02	1.276E-05
U-238	9.070E+01	1.751E-06
Zn-65	2.360E+02	4.556E-06

The following daughter (decay) products are in secular equilibrium with the parent radionuclide and should be included for DOT determinations:

Th-234      9.070E+01    1.751E-06

Add Pu-241 at 9.52 times the activity of Am-241 per 49 CFR 173.433 requirements.

Pu-241      1.019E+02    1.967E-06

105 2 111

**Attachment 10**

**10 CFR 61 Land Disposal of Radioactive Waste**

[Code of Federal Regulations]  
[Title 10, Volume 2]  
[Revised as of January 1, 2001]  
From the U.S. Government Printing Office via GPO Access  
[CITE: 10CFR61.56]

[Page 173]

TITLE 10--ENERGY

CHAPTER I--NUCLEAR REGULATORY COMMISSION

PART 61--LICENSING REQUIREMENTS FOR LAND DISPOSAL OF RADIOACTIVE WASTE--Table of Cc

Subpart D--Technical Requirements for Land Disposal Facilities

Sec. 61.56 Waste characteristics.

(a) The following requirements are minimum requirements for all classes of waste and are intended to facilitate handling at the disposal site and provide protection of health and safety of personnel at the disposal site.

(1) Waste must not be packaged for disposal in cardboard or fiberboard boxes.

(2) Liquid waste must be solidified or packaged in sufficient absorbent material to absorb twice the volume of the liquid.

(3) Solid waste containing liquid shall contain as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume.

(4) Waste must not be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reaction with water.

(5) Waste must not contain, or be capable of generating, quantities of toxic gases, vapors, or fumes harmful to persons transporting, handling, or disposing of the waste. This does not apply to radioactive gaseous waste packaged in accordance with paragraph (a)(7) of this section.

(6) Waste must not be pyrophoric. Pyrophoric materials contained in waste shall be treated, prepared, and packaged to be nonflammable.

(7) Waste in a gaseous form must be packaged at a pressure that does not exceed 1.5 atmospheres at 20 deg.C. Total activity must not exceed 100 curies per container.

(8) Waste containing hazardous, biological, pathogenic, or infectious material must be treated to reduce to the maximum extent practicable the potential hazard from the non-radiological materials.

(b) The requirements in this section are intended to provide stability of the waste. Stability is intended to ensure that the waste does not structurally degrade and affect overall stability of the site through slumping, collapse, or other failure of the disposal unit and thereby lead to water infiltration. Stability is also a factor in limiting exposure to an inadvertent intruder, since it provides a recognizable and nondispersible waste.

(1) Waste must have structural stability. A structurally stable waste form will generally maintain its physical dimensions and its form, under the expected disposal conditions such as weight of overburden and compaction equipment, the presence of moisture, and microbial activity, and internal factors such as radiation effects and chemical changes. Structural stability can be provided by the waste form itself, processing the waste to a stable form, or placing the waste in a disposal container or structure that provides stability after disposal.

(2) Notwithstanding the provisions in Sec. 61.56(a) (2) and (3), liquid wastes, or wastes containing liquid, must be converted into a form that contains as little free standing and noncorrosive liquid as is

reasonably achievable, but in no case shall the liquid exceed 1% of the volume of the waste when the waste is in a disposal container designed to ensure stability, or 0.5% of the volume of the waste for waste processed to a stable form.

(3) Void spaces within the waste and between the waste and its package must be reduced to the extent practicable.



**Attachment 11**

**E-mail from Phil Strahm at Duratek, Inc.**

**Brennecke, Dan**

---

**From:** Kenneth E. Schaus [kenschau@bellsouth.net]  
**Sent:** Monday, July 02, 2001 7:44 AM  
**To:** Dan F. Brennecke  
**Subject:** Fw: Type "B" Cask Shipments

Dan,  
This is the explanation for water in Type B casks. This is the best that we can do for support our position. If you have any question call me.

Ken Schaus

----- Original Message -----

From: "Phil Strahm" <PSTRAHM@duratekinc.com>  
To: <Kenschau@bellsouth.net>  
Sent: Friday, June 29, 2001 10:15 AM  
Subject: Type "B" Cask Shipments

Ken,

The following information is provided in response to your question about shipping dewatered waste in Type "B" casks.

The CNSI 8-120 Type "B" shipping cask was originally licensed by the Nuclear Regulatory Commission (NRC) in the 1970s. The current Certificate of Compliance for the 8-120 cask specifically allows for the shipment of dewatered resin and filter media within a liner contained within this cask. No specific guidance is provided as to the amount of allowable residual water in the resin or filter media.

In the early 1980s, the NRC promulgated 10CFR61 describing acceptable disposal site criteria. Included in 10CFR61 are requirements for limiting the free-standing liquid in disposal containers. The Barnwell, SC disposal site currently requires that carbon steel liners received for disposal have a maximum of 0.5% (of the waste volume) as free-standing liquid. Similarly, the Barnwell site has a limit of 1.0% (of the waste volume) free-standing liquid in High Integrity Containers (HICs) received for disposal.

As you can see from the above background information, the regulations for Type "B" casks were implemented long before the disposal site liquid limits were established. It is a long-standing industry standard to ship dewatered resin and filter media in Type "B" shipping casks. I believe that the lack of a specific limitation on freestanding liquids inside Type "B" casks is not an oversight by the NRC. In fact the original 8-120-B Safety Analysis Report analyzed the effects of the water under the Fire Test Analysis to ensure that cask integrity is maintained. If additional restrictions on the amount of liquid authorized in a Type "B" cask were necessary, I feel confident that the NRC would issue more stringent controls.

Virtually every nuclear power plant in the United States ships dewatered resin and filter media inside Type "B" casks. In some cases, resin or filter media waste has been received at disposal sites with greater than the allowable amount of free-standing liquid present in the disposal container. Even in these cases, where the disposal site liquid limits are exceeded, I am not aware of any case where the NRC cited the shipper for improper shipping or violation of transportation regulations as a result of liquid in the shipment.

In closing, I think that it is important to keep in mind that shipping and disposal site regulations were written at different times and focus on different issues. It is probably not appropriate to attempt to interpret disposal site free-standing liquid requirements as applying directly to transportation regulations. Therefore, I am confident that shipment of dewatered resin and filter media inside Type "B" shipping casks has been

thoroughly reviewed by the NRC and is authorized under the existing regulations.

Please feel free to contact either me, or Mr. Martin Brownstein at (865) 376-8164 if you have further questions about this subject.  
Thank you.

Phil Strahm