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FLUOR

December 13, 2004

Fernald Closure Project
Letter No. SP:2004-0078

Mr. John M. Sattler
U. S. Department of Energy
Ohio Field Office - Fernald Closure Project
175 Tri-County Parkway
Cincinnati, Ohio 45246

Dear Mr. Sattler:

CONTRACT DE-AC24-01OH20115, FERNALD CLOSURE PROJECT RESPONSE TO NEVADA TEST SITE WASTE ACCEPTANCE REVIEW PANEL COMMENTS ON WASTE PROFILE ONLO-000000134, REVISION 1, SEALED SOURCES

Enclosed is the Fernald Closure Project response to comments on Waste Profile ONLO-000000134, Revision 1, Sealed Sources, received from the Nevada Test Site Waste Acceptance Review Panel. Resolution of these comments required minor revisions to the profile. Also enclosed is a signed copy of the modified profile and a detailed list of changes.

A suggested cover letter for transmitting these comment responses to Nevada is enclosed for your convenience. Should you have any questions, or require additional information, please contact Steve Heffron at (513) 648-5650.

Sincerely,

Dennis J. Carr

Dennis Carr
Senior Project Director
Silos Project

DC:DSA:kl
Enclosure(s)

c: David S. Adkins, MS52-3
Terri L. Binau, DOE Contracting Officer, DOE-OH
Reinhard Friske, MS52-3
Steve Heffron, MS52-3
Ralph E. Holland, DOE Contracting Officer, DOE-OH/FCP
Dennis Sizemore, Fluor Fernald, Inc. Prime Contract, MS02
File Record Subject - Submittal of Nevada Test Site Waste Profile ONLO-000000134, Revision 1, Sealed Sources
Project Number 40600/1.1
WM Letter log copy
Administrative Record, MS78

To: John B. Jones, NNSA/NSO

From: John Sattler

Subject: Submittal of Fernald Closure Project Responses to Nevada Test Site WARP Comments on Waste Profile ONLO-000000134, Revision 1, Sealed Sources

Enclosed is the Fernald Closure Project (FCP) responses to comments on Waste Profile ONLO-000000134, Revision 1, Sealed Sources, received from the Nevada Test Site (NTS) Waste Acceptance Review Panel. Resolution of these comments required minor revisions to the profile. Included with the responses is a signed copy of the modified profile and a detailed list of changes.

c: Without Enclosures
Reinhard Friske, MS52-3
Steve Heffron, MS52-3
John W. Samples, MS52-3

FCP Responses to Waste Acceptance Review Panel (WARP) Comments (dated 12/01/04) on:
Fernald Closure Project Waste Profile
Sealed Sources
ONLO-000000134, Rev. 01, 11/08/04

Specific Comments:

1. Section D.3: Please verify that these are the readings of the disposal package, if so refer to the NTSWAC requirement, 3.2.6 Handling. These packages may have to go thru an ALARA review and be considered for remote handling if they exceed 100 mR/hr dose at 30 cm. (Schwartzwalter)

   Generator Response:

   The estimated dose rates listed in Section D.3 were estimated on a prepackaging basis. Once the sources were placed in drums, the drums were then overpacked into boxes. This should be the packaging scenario for all remaining sources. The boxes in the first shipment of sealed sources under this profile had a maximum surface reading of 18 mR/hr and a maximum 1 meter reading of <0.5 mR/hr. The maximum estimated 30 cm value for that shipment is 5.25 mR/hr. The estimated dose rates have been changed on the profile as follows: Surface = 0.005 to 0.5 mSv/hr, 30 cm = 0 to 0.15 mSv/hr, 1 meter = 0 to 0.02 mSv/hr.

2. Section E.1: The drum, metal box, and intermodal sections all identify strong tight packages. This terminology has been removed from 49 CFR. (Geisinger)

   Generator Response:

   The reference to "strong tight" packages in Section E.1 has been changed to the new terminology of "excepted packaging".

3. Section E.1: An intermodal transport container is identified as a packaging for this waste stream. Will this waste stream be combined on the same shipment with another waste stream? (Geisinger)

   Generator Response:

   While it is unlikely that the sealed source waste stream would be combined in an intermodal container with another waste stream, it is possible. Therefore, we have listed the intermodal container in the profile.

4. Process Knowledge Narrative, page 1 of 9, Source Activity Less Than 100 µCi: This section addresses Pu-239 sealed sources. The potential exists that an accumulation of these sources could exceed 100 nCi/g. What are the methods used to ensure that TRU waste will not be shipped for disposal. (Geisinger)

   Generator Response:

As stated in the Process Knowledge Narrative, page 1 of 9, "The mass activity concentrations for sources containing transuranic radionuclides are calculated using only the mass of the source. None of the sources with transuranic nuclides to be disposed of under this profile exceed 100 nCi/g. The highest activity transuranic source contains approximately 80 nCi/g of Pu-239. The next highest activity source is approximately 8 nCi/g of Pu-239". All transuranic radionuclides, as defined in the NTSWAC, Revision 5, Section 3.1.1, are evaluated to ensure the total activity from transuranic radionuclides does not exceed 100 nCi/g. The maximum total activity from transuranic nuclides possible under this profile is 95.5 nCi/g. This is derived by adding the maximum values for all of the transuranic nuclides listed in Section D.6.

5. Process Knowledge Narrative, page 2 of 9, Source Activity Greater Than or Equal to 100 μCi: This section indicates that some sources, greater than 100 uCi, may contain circuit boards and lead solder joints. Since the lead in these boards is not providing radiation protection, provide either a totals or TCLP showing the instrument is non-hazardous if the circuit boards are left in place. The determination should be per discrete instrument and not per the whole waste stream. (McKinnon, Geisinger, Rosenman)

Generator Response:

The sources in question, 34 ionization vacuum gauges called "Alphatrons", remain in the inventory at Fernald and have been removed from the profile pending further evaluation of possible lead content.

6. Process Knowledge Narrative, page 7 of 9, Table 1: Co-60, source number 9204 is shown to have a concentration of 1.72E+11 Bq/m^3, however the concentration as listed in the waste profile is 7.0E+10. Which is the correct concentration? (Geisinger)

Generator Response:

The activity of 7.0E+10 Bq/m^3, as listed in Section D.5 of the profile for Co-60, is the correct activity. While an individual source activity may be greater than this value, when such a source is commingled in the same container with other sources that have much lower activities for Co-60, the activity for that container, in Bq/m^3, will be less than some of the individual sources. The source in question, 9204, has a volume of only 7.33E-05 m^3.

7. Process Knowledge Narrative, page 9 of 9, Table 2: Po-210 and Ru-106 are listed in Table 2, however, neither are listed in the waste profile Section D. Are these two sealed sources included in this waste stream? (Geisinger)

Generator Response:

Yes, these items are included in this waste stream. They are part of the Gubka component of this profile. Po-210 and Ru-106 are not listed in Section D.5 because they do not meet the reporting requirements specified in the NTSWAC, revision 5, Section E.1.

Fernald Closure Project Waste Profile
Sealed Sources
ONLO-000000134, Rev. 1
Detailed List of Changes in Response to NTS WARP Comments (dated 12/01/04)

1. Section D.3- Lowered estimated dose rates to better reflect readings on disposal packages.
2. Section E.1- Changed "strong tight" to "excepted packaging".
3. Process Knowledge Narrative- Removed 34 ionization vacuum gauges called "Alphatrons" from the document. These sources are no longer part of this profile.
4. Section B.2.b- Changed revision date to 12/13/04.

Waste Profile Sheet

☒ NTS Only ☐ Hanford Only ☐ Both NTS and Hanford

A. Generator Information

1. Company name: **Fernald Closure Project**
2. Address: **P. O. Box 538704, Cincinnati, OH 45253-8704**
3. Generator facility: **Various**

4. Primary Technical Contact: **David S. Adkins** email: **david.adkins@fernald.gov** Phone: **513-648-4364** Fax: **513-648-4925**

5. DOE Contact: **John Sattler** email: **john.sattler@fernald.gov** Phone: **513-648-3145** Fax: **513-648-3076**

6. Waste Certification Official: **Reinhard Friske** email: **reinhard.friske@fernald.gov** Phone: **513-648-5477** Fax: **513-648-5131**

7. Generator's EPA Identification Number (If profile involves hazardous materials): **N/A**

B. General Waste Stream Information

1. Waste stream name: **Sealed Sources**
2.a. NTS Waste stream identification number: **ONLO-000000134** N/A ☐
2.b. Hanford Profile Sheet Tracking Number:_____ N/A ☒

☐ New Profile
☒ Revised Profile (attach summary of changes) Revision Number: **1** Profile Revision Date: **12/13/04**

3. Waste generating process description: *Describe the process that generated the waste stream identified by this profile sheet. Attach process flow charts and other available information if helpful in explaining the generating process.* **See attached process knowledge narrative document.**

4. Waste management services requested:
☒ Disposal
☐ Storage (Available only at Hanford)
☐ Treatment (Available only at Hanford); describe:
☐ Other; describe:

5. Waste Category (Check all that apply)
☒ Low Level ☐ Mixed Low-Level
☐ Mixed Low-Level (Generated within Nevada Only)
☐ "Classified Waste" ☐ "Classified Waste" requiring protection from visual observation
☐ Asbestiform Low-Level Waste ☐ 11(e)2 By-product Material (Small Quantities)
☐ Transuranic Waste ☐ Hanford Category 1 LLW
☐ Hanford Category 3 LLW ☐ Exceeds Hanford Category 3 LLW
☐ DOE Equivalence GTCC ☐ Contains accountable nuclear material

6. Estimated volume: ☒On-going (m^3/yr):**5** Total remaining volume (m^3):**10**
☐One Time Only (m^3):

7. Estimated frequency of shipments per fiscal year: **2 shipments per fiscal year**

C. Physical/Chemical Characterization

1. Physical/Chemical process knowledge. Describe the process knowledge information used for physical/chemical characterization of this waste stream:

☐ Material Safety Data Sheets. Attach MSDSs used to designate this waste stream (Hanford Site users can list Hanford MSDS numbers below in lieu of providing MSDSs).

Waste Profile Sheet

☐ Mass balance from process inputs. Describe how process inputs are controlled and recorded:

☒ Historical process and analytical data. Describe: **Refer to Process Knowledge Narrative.**

☐ Inert debris characterized by inventory control. Check this box when the waste stream consists largely of inert debris items that are characterized by inventory control procedures and recorded on inventory sheets. Briefly list or describe inventory procedures:

☐ Other. Describe:
☐ Physical/chemical characterization varies. Check this box when the characterization strategy varies from container to container. Describe below the strategy used to meet the acceptable knowledge requirements of the waste acceptance criteria.

2. Physical/chemical analysis. Describe the sampling and analysis performed to characterize this waste stream:

☒ No analysis performed. **Refer to Process Knowledge Narrative.**
☐ Field screening performed. Describe the frequency and type of field screening performed:
☐ Laboratory analysis performed. Describe the sample source and sampling frequency and methods:

List the analytical methods used, including upper confidence limits and explanations of anomalies for all analytes analyzed. Attach representative analytical sample result summary. For NTS, attach Table B-1 and data validation summary.

3. Regulatory status. Check all boxes below that describe the regulatory status of the waste stream:

☐ Federally regulated (RCRA) hazardous waste (40 CFR 261). List all RCRA U, P, F, K or D waste codes that could apply to the waste stream; place waste codes that do not apply to all containers in parentheses:
☐ For Hanford only, Washington State dangerous waste (WaAdminCode173-303), excluding W001. List all Washington waste codes that apply; place waste codes that do not apply to all containers in parentheses:

☐ For Hanford only, Washington State dangerous PCB waste (Waste code W001 of WaAdminCode173-303): Describe PCB source and concentration:
☐ TSCA regulated PCB (40 CFR 761). Describe category of PCB (i.e. PCB waste, PCB bulk product waste, PCB remediation waste, PCB analytical waste, etc). Describe PCB source and concentration:
☒ Waste generated from cleanup activities conducted under CERCLA
☐ Waste is not regulated under any of the above regulations.
☐ Waste is hazardous per state-of-generation regulations? If yes, identify hazardous components and state regulations.

4. Federal land disposal restrictions. Check all boxes that apply:

☒ Waste stream is not subject to federal land disposal restrictions

☐ Waste stream requires treatment to meet land disposal restrictions of 40 CFR Part 268.
If checked, provide the following information:
☐ Wastewater ☐ Nonwastewater ☐ Hazardous debris
☐ Waste contains Underlying Hazardous Constituents (applicable UHCs must be included in Item C.9)
Was the waste treated after August 24, 1998? Yes ☐ No ☐

☐ Waste stream meets some of the applicable land disposal restrictions of 40 CFR 268. Check this box if the waste has been treated to meet some federal land disposal restrictions or if it meets some federal land disposal restrictions as generated. If checked, describe the treatment performed and analytical data to support LDR determination:

☒ Waste stream meets all applicable land disposal restrictions of 40 CFR 268. Check this box if the waste has been treated to meet all federal land disposal restrictions or if it meets the land disposal restrictions as generated. If checked, describe the treatment performed and analytical data to support LDR determination: **D002- Standards absorbed onto Gubka Component. See Process Knowledge Narrative discussion of Gubka component.**

Waste Profile Sheet

5. (For Hanford only) Waste characteristics. Check any of the boxes for regulated characteristics (WaAdminCode173-303-090) that apply to the waste stream:

- ☒ Flash point < 38°C
- ☐ Flash point 38°C - <60°C
- ☐ Flash point 60°C – 93.3°C
- ☒ Ignitable solid
- ☐ Oxidizer
- ☐ pH 2 or less
- ☒ pH 12.5 or greater
- ☐ Liquid that corrodes steel at a rate greater than or equal to 0.25 inches/year
- ☒ Reactive cyanide
- ☒ Reactive sulfide
- ☐ Water Reactive
- ☒ Explosive, unstable or pyrophoric
- ☐ Generates toxic gases, vapors or fumes

6. Physical state:

- ☒ Liquid
- ☒ Sludge
- ☐ Debris
- ☒ Solid
- ☐ Powder/Dust
- ☒ Sealed Source
- ☐ Encapsulated
- ☐ Solidified
- ☐ Other; describe:

7. Liquid form. If the waste stream contains liquid, check all that apply:

- ☒ Containerized liquid
- ☒ Absorbed Liquid **(Gubka component of waste)**
- ☐ Stabilized liquid

8. Other contents: Check any of the following that are components of the waste stream, and provide a description of how the waste acceptance criteria for each are met:

- ☒ Animal carcasses
- ☐ Infectious waste
- ☐ Vegetation
- ☐ Free liquids
- ☐ Chelating agents
- ☒ Organic liquids
- ☐ Asbestos waste
- ☐ Particulates
- ☐ Gases
- ☐ PCBs
- ☐ Explosives
- ☐ Pyrophorics
- ☐ Beryllium Dust
- ☐ Other

9. Waste composition. Describe the gross composition/component of the waste stream and all hazardous constituents that contribute to any waste codes or LDR treatment standards.
☐ If the chemical composition varies greatly from container to container, check this box and provide bounding values or ranges here. Further evaluation will occur on the specific package paperwork as it is provided for highly variable streams

CAS Number	Chemical constituent	Waste Component	Estimated weight percent ☐ Estimated volume percent ☒
		MEF 3857 Sealed sources	**95**
		MEF 3857 Gubka blocks	**5**

D. Radiological Characterization

1. Radiological process knowledge. Describe the source(s) of the radioactive material in this waste stream (i.e., the radiological processes that introduced the radioactive material into the waste stream).
This waste is comprised of sealed sources. Refer to Process Knowledge Narrative.

Waste Profile Sheet

2. Radiological characterization methods. Describe the analysis and characterization methods used to determine the radionuclide inventory of the waste stream. Check all that apply.

- ☒ Radionuclide material accountability. Describe the accounting methods used to help establish the radionuclide inventory:**See Process Knowledge Narrative.**
- ☐ Radiochemical analysis. Describe type and frequency of sampling and analysis:For NTS, attach Table B-1 and data validation summary
- ☒ Nondestructive assay. Describe type and frequency of assay performed:**Confirmatory Non-destructive Assay, one time on 5/15/03.**
- ☐ Field measurement instruments. Describe the type of instruments and how they are used to help establish the radionuclide inventory:
- ☐ Scaling factors. Explain how the scaling factors were derived and how they are used:
- ☐ Computer models. Describe the computer model used and how it is used to establish the radionuclide inventory:
- ☐ Other. Describe method:

If several methods are checked above, describe how the methods are used together to establish the radiological inventory of the waste stream. For complex or highly variable waste streams, explain the strategy used to meet the acceptable knowledge requirements of the waste acceptance criteria.

3. Estimated Radiation Dose of disposal package (mSv/hr):

Surface **0.005 to 0.5** 30 cm **0 to 0.15** One Meter **0 to 0.02**

4. (Section D4 need not be filled out for Hanford only profiles)
☒Yes ☐No Does the waste contain enriched uranium (^{235}U wt% ≥ 0.90), ^{233}U, ^{239}Pu, ^{241}Pu, ^{242m}Am, ^{243}Cm, ^{245}Cm, ^{247}Cm, ^{249}Cf, ^{251}Cf? If yes, answer the following and check those that apply for compliance with the criticality safety criteria of the NTSWAC. If no, skip to Section D.5.

4.1 ☒ Attach completed NTSWAC, Appendix E, Table E.3, ^{235}U FGE and ^{235}U Effective Enrichment, for each enrichment level or range.

4.2 ☒ Waste package contains 15 g of ^{235}U FGE or less.
Specify controlling document: **WM:CHAR-T-0001, waste contains natural uranium at 0.711% U-235 and small amounts of Pu-239. See Table E.3.**

4.3 ☐ Fissile material does not exceed 350 g of ^{235}U FGE per package nor does it exceed 2 g of ^{235}U FGE per kilogram of waste (mass of the package is not included in the mass of the waste) (graphite and beryllium must not exceed 1% of the mass of the waste).
Specify controlling document:

4.4 ☐ Waste complies with the limits and conditions as specified in NTSWAC, Appendix E, Table E.4.
Specify controlling document:

4.5 ☐ Graphite and beryllium exceeds 1% of the mass of the waste.

4.6 ☐ Waste complies with the limits and conditions as specified in NTSWAC, Appendix E, Tables E.5 and E.6. Specify controlling document:

4.7 ☐ A waste specific nuclear criticality safety evaluation (NCSE) was performed to show compliance with the NTSWAC, Section 3.2.1. Attach NCSE for review and specify controlling document.

5. Reportable radionuclides. List the radionuclides that could be reportable in the waste stream:
☒ If the nuclides vary greatly from container to container, check this box and provide bounding values or ranges here. Further evaluation will occur on the specific package paperwork as it is provided for highly variable streams. *Note: For the NTS, concentrations must be entered in Becquerel/cubic meter.*

Waste Profile Sheet

Isotope	Concentration Ci/m3 (Bq/m3); Range and Activity Representative of Final Waste Form			
	Activity Range			Representative
Co-60	**3.0E+01**	**to**	**7.0E+10**	**3.3E+10**
Ni-63	**4.0E+11**	**to**	**7.5E+12**	**6.5E+12**
Sr-90	**2.0E+02**	**to**	**1.5E+13**	**3.6E+12**
Tc-99	**3.0E+03**	**to**	**1.5E+05**	**1.0E+05**
Ba-133	**1.0E+08**	**to**	**1.8E+09**	**1.7E+09**
Cs-137	**1.0E+05**	**to**	**2.1E+12**	**3.0E+11**
Pm-147	**2.0E+11**	**to**	**3.0E+12**	**2.7E+12**
Cd-109	**2.0E+05**	**to**	**1.2E+06**	**1.1E+06**
Eu-152	**9.0E+05**	**to**	**5.0E+06**	**4.8E+06**
Tl-204	**3.0E+00**	**to**	**2.0E+12**	**1.3E+11**
Ra-226	**9.2E+02**	**to**	**1.3E+11**	**9.7E+09**
Th-229	**3.0E+04**	**to**	**3.5E+05**	**3.0E+05**
Th-230	**8.0E+02**	**to**	**7.5E+06**	**7.0E+06**
Np-237	**1.0E+05**	**to**	**2.0E+06**	**1.7E+06**
Pu-238	**1.0E+05**	**to**	**1.5E+06**	**1.0E+06**
Pu-239	**1.0E+02**	**to**	**3.0E+06**	**3.0E+05**
Am-241	**9.0E+02**	**to**	**2.0E+07**	**2.4E+06**
Am-243	**1.0E+05**	**to**	**1.5E+06**	**1.2E+06**
U-238	**1.0E+04**	**to**	**1.0E+10**	**5.0E+08**
U-234	**1.0E+04**	**to**	**1.0E+10**	**5.0E+08**

6. Does the waste contain any alpha-emitting transuranic radionuclides with a half-life greater than 5 years, ^{241}Pu, or ^{242}Cm? **YES** If yes, list below.

Transuranic Nuclide	Concentration (nCi/g); Range and Activity Representative of Final Waste Form			
	Activity Range			Representative
Am-241	**7.0E-03**	**to**	**5.0E+00**	**5.0E-01**
Am-243	**1.0E-02**	**to**	**5.0E-01**	**5.0E-02**
Np-237	**7.0E-02**	**to**	**5.0E+00**	**5.0E-01**
Pu-238	**5.0E-02**	**to**	**5.0E+00**	**1.0E+00**
Pu-239	**1.0E-02**	**to**	**8.0E+01**	**1.0E+00**

7. Are there any packages in this waste stream that exceed the Plutonium Gram Equivalent limits specified in NTSWAC, Section 3.2.2? Yes ☐ No ☒
   Provide container type(s), quantity, and supporting PGE calculations. **PGE calculations attached.**

8. For Hanford only, Total FGE as defined in Hanford Site Solid Waste Acceptance Criteria, HNF-EP-0063.

E. Packaging

1. Packaging used. Check the applicable boxes.
   - ☒ Drum; describe size(s), type, and weight range: **30 gal, metal drum, 21 kg to 227 kg; 55 gal, metal drum, 45 kg to 440 kg; 85 gal, metal drum, 45 kg to 441 kg; 110 gal, metal drum, 50 kg to 408 kg; all drums are either excepted packaging, IP2 or 7A packages**
   - ☒ Metal box; describe size(s), type, and weight range **Nominal 4'x4'x8', 200 kg to 4082 kg, boxes are either excepted packaging, IP2 or 7A packages**
   - ☐ Wood box; describe size(s), type, and weight range:
     Do the Metal or Wood boxes meet the 3,375 lb/ft^2 strength test? Yes **X** No ☐ N/A ☐
   - ☐ High integrity container; describe size(s), type, and weight range:

- ☒ Intermodal transport container; describe size(s), type, and weight range: **8'x8.5'x20', ISO cargo container, 4500 kg to 19048 kg, excepted packaging**
- ☐ Other container; describe size(s), type, and weight range:
- ☐ Bulk waste – bulk package and shipment dimensions and weight ranges – describe (supersack, burrito wraps, equipment, etc.):
- ☒ Vented; describe type of venting: **As required, 3/4" to 2" NucFil for drums, 2" NucFil for boxes, industry standard for ISO containers.**
- ☐ Shielded; describe type of shielding:
- ☒ Sorbents; describe type and amount used: **As required in procedure PT-0011 and/or WM:PKGG-A-0002. Three types of absorbents acceptable:lime (8-104 lbs.), QuikSolid granular (1-12 lbs.) or Stergo pads (2 layers).**
- ☐ Radiologically stabilized in concrete or other stabilization agent; describe type and amount of material used and provide data to demonstrate waste meets stabilization criteria:

2. Maximum container size: **2.44m x 2.59m x 6.1m**

3. Maximum container gross weight: **19048 kg**

4. Describe any liners/protective coatings used to ensure that the container is compatible with the waste: **NA**

5. Does each container meet each of the package criteria as defined in the waste acceptance criteria?
   ☒ Yes ☐ No
   List documentation that demonstrates compliance with waste acceptance criteria.

The Fernald controlling document is PT-0014, Procurement of Storage and Shipping Containers. Container specific test data is available upon request.

6. Reference any special handling procedures and ALARA documentation, if applicable. **NA**

F. Additional Information

1. Comments: **NA**

2. Exception or Deviation Request to waste acceptance criteria: Complete if needed
   a) Identify specific requirement for which an exception or deviation is desired:
   b) Provide reason an exception or deviation is needed:
   c) Describe any proposed alternative methods to meet the general intent of the requirement:

3. Attachments. List any attachments provided with this profile: **Document Reference List, Table E.3, PE-g Calculations, Process Knowledge Narrative**

G. Generator Signatures

To the best of my knowledge, the information provided on this form and the attached documentation is a full, true and accurate description of the waste stream. Willful and deliberate omissions have not been made. All known and suspected hazardous materials have been disclosed.

Technical Contact Name: **David S. Adkins** Date: 12/13/04

Signature: David S. Adkins

Waste Certification Official Name: **Reinhard Friske** Date: 12-13-04

Signature: Friske

Profile ONLO-000000134, Revision 1

Table E.3: Calculation of U^{235} Fissile Gram Equivalence and Effective U^{235} Enrichment for LLW Packages

Nuclide (A)	High Activity Conc. (Bq/m3) (B)	Volume of Package (m^3) (C)	Activity (Bq) (D)	Specific Activity (Bq/g) (E)	Mass of Isotope (g) (D/E=F)	U^{235} FGE Factors (G)	U^{235} FGE (FxG=H)	If FGE is >1% of U^{235} Mass, then include (I)
U^{233}			0.0E+00	3.6E+08	0.0E+00	1.4E+00	0.0E+00	
U^{235}			0.0E+00	8.1E+04	0.0E+00	1.0E+00	0.0E+00	
Pu^{239}	3.00E+06	2.00E-02	6.0E+04	2.3E+09	2.6E-05	1.6E+00	4.2E-05	4.2E-05
Pu^{241}			0.0E+00	3.8E+12	0.0E+00	3.5E+00	0.0E+00	
Am^{242m}			0.0E+00	3.6E+11	0.0E+00	5.4E+01	0.0E+00	
Cm^{243}			0.0E+00	1.9E+12	0.0E+00	7.8E+00	0.0E+00	
Cm^{245}			0.0E+00	6.4E+09	0.0E+00	2.3E+01	0.0E+00	
Cm^{247}			0.0E+00	3.5E+06	0.0E+00	7.8E-01	0.0E+00	
Cf^{249}			0.0E+00	1.5E+11	0.0E+00	7.0E+01	0.0E+00	
Cf^{251}			0.0E+00	5.9E+10	0.0E+00	1.4E+02	0.0E+00	
Effective U^{235} Enrichment =			**Total U^{235} FGE/Total grams uranium**				**TOTAL U^{235} FGE**	**4.2E-05**
					Effective U235 Enrichment =	**0.71**		
Waste volume of 0.02 m3 represents loading all Pu-239 sources in one 5 gallon container. Uranium in this waste is natural at 0.711% U-235.								

Plutonium Gram Equivalent Calculations for
Reportable Isotopes included in NTS Profile ONLO-000000134, Rev.1

Isotope	Package Activity, Bq/m3	PE-g Conversion Factors	PE-g/m3
Am-241	2.00E+07	4.44E-10	8.88E-03
Am-243	1.50E+06	4.44E-10	6.66E-04
Ba-133	1.80E+09	6.64E-15	1.20E-05
Cd-109	1.20E+06	9.73E-14	1.17E-07
Co-60	7.00E+10	1.86E-13	1.30E-02
Cs-137	2.10E+12	2.72E-14	5.71E-02
Eu-152	5.00E+06	1.88E-13	9.40E-07
Ni-63	7.50E+12	5.35E-15	4.01E-02
Np-237	2.00E+06	4.60E-10	9.20E-04
Pm-147	3.00E+12	3.34E-14	1.00E-01
Pu-238	1.50E+06	3.90E-10	5.85E-04
Pu-239	3.00E+06	4.35E-10	1.31E-03
Ra-226	1.30E+11	7.30E-12	9.49E-01
Sr-90	1.50E+13	1.11E-12	1.67E+01
Tc-99	1.50E+05	7.08E-15	1.06E-09
Th-229	3.50E+05	1.83E-09	6.41E-04
Th-230	7.50E+06	2.77E-10	2.08E-03
Tl-204	2.00E+12	2.05E-15	4.10E-03
U-234	1.00E+10	1.13E-10	1.13E+00
U-238	1.00E+10	1.02E-10	1.02E+00
		PE-g/m^3 =	**2.00E+01**
			<< 190.5 PE-g/m^3
Drum Waste Volume (m^3) =	2.08E-01	**Drum Total PE-g =**	**4.16E+00**
			<< 300 PE-g total
Box Waste Volume (m^3) =	3.55E+00	**Box Total PE-g =**	**7.09E+01**
			< 300 PE-g total
Intermodal Waste Volume (m^3) =	1.00E+01	**Box Total PE-g =**	**2.00E+02**
			< 300 PE-g total
Used profile max and container max. Intermodal volume is entire profile inventory. Cannot exceed 750 PE-g per shipment.			
Meets package activity limits in 3.2.2 of NTSWAC, rev.5.			

Procedures Reference List
for Profile ONLO000000134, Revision 1

EW-0001	MEF Characterization Process Procedure
EW-1016	Waste Management Work Authorization Program
PT-0014	Procurement of Storage and Shipping Containers
PT-0018	Preparation of Documentation of Off-Site Shipment of Hazardous Material
RM-0053	Waste Characterization Information Manual
WM:CHAR-T-0001	Radiological Characterization for Waste Disposal
WM:PKGG-A-0001	Certification of Low Level Radioactive Waste and Supporting Paperwork
WM:PKGG-A-0002	Absorbent Determination
WM:SHIP-T-0003	Inspection of Waste Packages and Loaded Transport Vehicles

PROCESS KNOWLEDGE NARRATIVE
PROFILE ONLO-000000134, REVISION 1
Sealed Sources

Radiological sealed sources were utilized throughout the FCP, for a wide variety of functions such as check sources for radiological instrumentation/monitors, laundry monitors, moisture gauges, and level gauges. They were comprised of various radionuclides with a wide range of activity levels. This profile addresses sources currently considered excess and sources that remain in use that will be disposed of as the site closure progresses. In order to facilitate the development of this profile, they were divided into three categories: Less than 100 microcuries (μCi) per source, greater than or equal to 100 μCi, and a unique waste called "Gubka." Each of these is discussed separately below.

Source Activity Less than 100 μCi

This waste stream component consists of sealed sources used as instrument check sources, gamma spectroscopy reference standards, dose calibrators, dew point gauges and laundry monitors. The sources include a wide range of activities as high as approximately 10 μCi and as low as fractional picocuries (pCi). These sources also include a variety of radionuclides. Major radionuclides include, but are not limited to, Am-241, Am-243, Co-60, Cs-137, Eu-152, Pu-239, Sr-90, Th-230, and U-238. The largest subset of this inventory contains one hundred eighty nine metal electroplated Th-230 check sources with a mean activity of 0.009 μCi. Sources in this category may be packaged with the higher activity sources (i.e., those equal to or greater than 100 μCi), or packaged separately with void spaces filled using vermiculite.

The volume activity concentrations for the sources with an activity less than 100 μCi are calculated by averaging the activities of these sources over the total waste volume in the containers. The mass activity concentrations for sources containing transuranic radionuclides are calculated using only the mass of the source. None of the sources with transuranic nuclides to be disposed of under this profile exceed 100 nCi/g. The highest activity transuranic source contains approximately 80 nCi/g of Pu-239. The next highest activity source is approximately 8 nCi/g of Pu-239.

Source Activity Greater than or Equal to 100 μCi

This category includes a number of different types of sources. These are discussed separately below and the inventory is listed in Table 1.

Texas Nuclear TN5192 and TN5200

A subset of this inventory consists of eleven items from Texas Nuclear. Nine items are source Model 5192 with an initial activity of 20 millicuries (mCi) of Cs-137 and two items are Model 5200 with initial activities of 100 mCi of Cs-137. Model 5192 has dimensions of 4.75 inches in diameter and 5.5 inches in height, lead filled for shielding, and weighs approximately 60 pounds. They were used as level gauges. This information is based on Source Registry Number TX634D105B. Model 5200 was utilized to check flow through

pipes. It has dimensions of 4.75 inches in diameter and 6 inches in height, lead filled for shielding, and weighs approximately 28 pounds.

Ronan Engineering, Model SA8 C10

Another subset of this inventory contains twenty-eight items from Ronan Engineering, Model SA8 C10 with initial activities ranging between 5 and 20 mCi (Cs-137) utilized as a level gauge with dimensions of 7 inches in diameter by 7.87 inches based on drawing B-2208-K. The Source Registry Number is KY 576D105B.

Victoreen 848-8

The Victoreen Model number 848-8 is a field calibration kit that utilizes a Cs-137 source with an initial activity of 100 mCi. The Model 848-8 field calibration kit is a portable, self-contained unit designed as a means for checking the calibration of the Victoreen area monitoring system. The kit is 13.25-inches long by 8.875-inches wide by 6.625-inches high and weighs 24 pounds. This information is based on Source Registry Number NR-666-D-808-S.

Hewlett-Packard Electron Capture Detectors

Three items are ionization sources that utilized 15 mCi (initial activity) Ni-63 sources. These devices are commonly called electron capture detectors (ECDs). These devices are designed to produce an ionized atmosphere for quantitative or qualitative measurements in gas streams when used as a component of Hewlett-Packard gas chromatographs.

Miscellaneous Sources

The remaining inventory of approximately twelve items includes radioactive sealed sources in miscellaneous geometries and uses. Four items, inventory numbers 102 (Pm-147), XT (Sr-90), 91(Tl-204), and 182 (Tl-204) were used for dosimetry calibrations. One item, inventory number 9204 (Co-60) is a cylindrical sealed source attached to rod used as check sources for area radiation monitors. Three items, inventory numbers SER34 (Cs-137), SER35 (Cs-137), and SER412 (Cs-137) were used as level gauges. Two items (E1173 and 9107) containing Ra-226 were identified as being used as dew-point monitors.

Many of the sources in this category contain lead shielding within their housings. The RWAP document "Position Paper on the Proper Characterization and Disposal of Sealed Radioactive Sources", Rev. 2, October 1997, notes that, "It is EPA's position in guidance to all NRC Licensees that containers or container liners which are still serving their intended use, for shielding in low-level waste disposal operations, are not considered waste and, thus, are not subject to the hazardous waste rules. The paper further states that "...lead shielding which is integral or external to the construction of a sealed source and is being used to reduce radiation exposure would meet the certification requirements for LLW". Consequently, the lead shielding contained in the housings is not considered to be RCRA hazardous. Sources that contain lead shielding within their housings and in which the unshielded exposure rate at 30 cm in standard packaging would exceed 5 mR/hr are included as part of the profile inventory. Also included as part of this profile are sources that contain lead shielding within their housings, which is integral to the construction of the sealed source and cannot be readily removed, and in which the unshielded exposure rate at 30 cm in standard packaging is less than 5 mR/hr. Consistent

with the RWAP position paper, the NTSWAC on lead shielding (section 3.2.3) and a discussion with RWAP personnel at Fernald on 10/27/04, these sources will not be dismantled for shipping and the lead will continue to serve its original purpose as shielding to limit the radiation dose. Source activity concentrations for these sources are calculated on the basis of the volume of the source, shielding, and housing.

Finally, source activities for sources in this category are decay-corrected from the assay. When the assay date is unknown, the activity is conservatively assumed to be equal to the original activity.

Gubka

Radionuclide solutions previously used as laboratory standards were volume-reduced using a material called Gubka. The "Gubka" ("sponge" in Russian) material was developed by the Institute of Chemistry and Chemical Technology (Siberian Branch of the Russian Academy of Sciences) from coal power plant fly ash. It consists of sintered glass-ceramic microspheres, or cenospheres, of mainly calcia-silica-alumina compositions formed into blocks. This results in highly porous blocks that have a high internal surface area. These can be used for volume reduction of a solution by simply placing a Gubka block on the surface of the liquid in an open container. The Gubka will float and absorb the solution by drawing the liquid into the interstitial voids via capillary action. The liquid will evaporate leaving the radionuclide and any dissolved salts adsorbed onto the surfaces of the Gubka within the interstices. The high internal surface area enhances the rate of evaporation and effectiveness of the adsorption. At the completion of the processing, the radionuclide-loaded Gubka block will be a dry solid block that meets the waste acceptance criteria for disposal at NTS.

A total volume of approximately 24 liters of laboratory standard solution was processed using the Gubka technology. These standards consisted of solutions of Np-237, Pu-238, Pu-239, Cs-137, Ba-133, Ru-106, Po-210, Ra-226, Th-229, Sr-90, Am-241, and Am-243 in 1-2 Molar (M) Nitric Acid or 0.1M Hydrochloric Acid. The standard solutions were carrier free, so there are no hazardous materials present in the final waste form. Because the standards were in acidic solutions, they were characterized as characteristically hazardous (D002). Treatment of the waste was conducted as a part of a RCRA treatability study. The solutions were processed using a total of 93 Gubka blocks with a volume of 300 cm^3 each. As discussed in the preceding paragraph, after processing the Gubka is a dry solid block with the radionuclides adsorbed onto its interstitial surfaces. Consequently, the treated waste form can no longer exhibit the D002 hazardous characteristic. Table 2 summarizes the total activity of each radionuclide, and the activity volume concentration (Bq/m^3) contained within the Gubka blocks.

Plutonium Gram Equivalent Calculations

Plutonium gram equivalent (PE-g) calculations were performed for the wastes included in this profile for comparisons against limits in the NTSWAC. The results of these calculations are summarized in the attached Plutonium Gram Equivalent table.

Calculations were performed using worst case scenarios. All results were well below the requirements of the NTSWAC.

The estimated volume of waste listed in Section B.6 is based on the volume of the sources. Void space within the containers is filled with an inert void filler material such as vermiculite. Activity concentrations in Sections D.5 and D.6 are based on the volume of the sources alone.

Table 1: Excess Sources with Activities Greater than or Equal to 100 microcuries

Inventory Number	Radionuclide	Activity (uCi)	Manufacturer	Model No.	Use	Source Volume (m3)	Concentration (Bq/m3)
M2564	Ni-63	1.38E+04	Hewlett Packard		Electron capture detector	7.04E-05	7.27E+12
M2565	Ni-63	1.38E+04	Hewlett Packard		Electron capture detector	7.04E-05	7.28E+12
S10082	Ni-63	1.32E+04	Hewlett Packard		Electron Capture Detector	9.80E-05	4.99E+12
E1173*	Ra-226	9.06E+03	-	-	-	4.22E-03	7.94E+10
9107	Ra-226	20E+03	-	-	-	5.82E-03	1.27E+11
A-48	Sr-90	1.00E+03	Nuclear Chicago	-	-	2.51E-06	1.47E+13
2002-11	Co-60	9.10E+03	Nuclear Chicago	-	-	5.05E-03	6.67E+10
M1076*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M1081*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M1095*	Cs-137	6.86E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	8.22E+10
M1077*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M1084*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M1089*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M0456*	Cs-137	3.46E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.15E+10
M1078*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M1087*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M1079*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M1080*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M1096*	Cs-137	6.86E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	8.22E+10
M1099*	Cs-137	1.37E+04	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	1.64E+11
M2208*	Cs-137	1.42E+04	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	1.69E+11
M2209*	Cs-137	1.42E+04	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	1.69E+11
M1085*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M1086*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M1090*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
74740*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M1100*	Cs-137	1.37E+04	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	1.64E+11

Table 1: Excess Sources with Activities Greater than or Equal to 100 microcuries

M3638*	Cs-137	1.44E+04	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	1.73E+11
M1083*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M1088*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M1097*	Cs-137	6.86E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	8.22E+10
M1101*	Cs-137	1.37E+04	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	1.64E+11
M1082*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M1091*	Cs-137	3.43E+03	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	4.11E+10
M2121*	Cs-137	1.41E+04	Ronan Engineering	SA8 C10	Level Gauge	3.09E-03	1.69E+11
B4971*	Cs-137	1.28E+04	Texas nuclear	5192*	Level Gauge	1.60E-03	2.97E+11
B4973*	Cs-137	1.28E+04	Texas nuclear	5192*	Level Gauge	1.60E-03	2.97E+11
B5084*	Cs-137	1.28E+04	Texas nuclear	5192*	Level Gauge	1.60E-03	2.97E+11
B4969*	Cs-137	1.28E+04	Texas Nuclear	5192	Level Gauge	1.60E-03	2.97E+11
B4970*	Cs-137	1.28E+04	Texas Nuclear	5192	Level Gauge	1.60E-03	2.97E+11
B5085*	Cs-137	1.32E+04	Texas Nuclear	5192	Level Gauge	1.60E-03	3.06E+11
B813*	Cs-137	6.71E+04	Texas Nuclear	5200	Check flow thru pipes	1.24E-03	2.01E+12
B814*	Cs-137	6.71E+04	Texas Nuclear	5200	Check flow thru pipes	1.24E-03	2.01E+12
B4968*	Cs-137	1.28E+04	Texas Nuclear	5192	Level Gauge	1.60E-03	2.97E+11
B4972*	Cs-137	1.28E+04	Texas Nuclear	5192	Level Gauge	1.60E-03	2.97E+11
B5245*	Cs-137	1.32E+04	Texas Nuclear	5192	Level Gauge	1.60E-03	3.06E+11
25833	Cs-137	7.16E+04	TN Technologies	7062 BP	Level Gauge	3.28E-03	8.08E+11
189*	Cs-137	1.00E+05	Victoreen	848-8	Field Calibrator	3.28E-03	1.13E+12
9204	Co-60	3.40E+02	-	-	Calibration Source	7.33E-05	1.72E+11
SER34*	Cs-137	4.50E+05	-	-	Level Gauge	2.07E-02	8.03E+11
SER412*	Cs-137	4.50E+05	-	-	Level Gauge	2.07E-02	8.03E+11
SER35*	Cs-137	4.50E+05	-	-	Level Gauge	2.07E-02	8.03E+11
0-12*	Cs-137	5.00E+03	-	-	Calibration Source	1.26E-02	1.47E+10
102	Pm-147	1.42E+03	Amersham/Buchler	-	Calibration Source	1.93E-05	2.73E+12
XT-64	Sr-90	1.62E+03	Amersham/Buchler	-	Calibration Source	1.93E-05	3.11E+12
91	Tl-204	1.03E+02	Amersham/Buchler	-	Calibration Source	1.93E-05	1.97E+12
182	Tl-204	1.03E+02	Amersham/Buchler	-	Calibration Source	1.93E-05	1.97E+12

***denotes sealed sources with lead housings**

Table 2: GUBKA RADIONUCLIDE CONCENTRATIONS

Nuclide	Total Activity (uCi)	Volume (m3)	Activity Conc. Bq/m3	Mass Conc. (nCi/g)
Ba-133	5.83E+02	1.26E-02	1.71E+09	7.71E+01
Cs-137	9.02E+02	1.26E-02	2.65E+09	1.19E+02
Cs-137	8.97E-03	2.40E-03	1.38E+05	6.23E-03
Am-241	5.42E-01	1.20E-03	1.67E+07	7.53E-01
Am-243	3.73E-02	1.20E-03	1.15E+06	5.18E-02
Th-229	9.70E-03	1.20E-03	2.99E+05	1.35E-02
Sr-90	8.40E+00	1.20E-03	2.59E+08	1.17E+01
Po-210	3.34E-08	1.20E-03	1.03E+00	4.64E-08
Ra-226	9.60E-03	1.20E-03	2.96E+05	1.33E-02
Ru-106	5.46E-08	1.20E-03	1.68E+00	7.58E-08
Pu-239	4.01E-01	5.40E-03	2.75E+06	1.24E-01
Pu-238	1.50E-01	5.40E-03	1.03E+06	4.63E-02
Np-237	2.50E-01	5.40E-03	1.71E+06	7.72E-02