Waste Inventory Principles and Techniques

KHNP Training Program
Module 6: Assembly of a Safety Case

August 15, 2007

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SAND 2007-XXXP

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Outline

I. **Waste Inventory Principles and Techniques**
(August 15)

II. **Development of the Waste Inventory for WIPP**
(August 16)

III. **Inventory Case Studies (YMP and GTCC LLW EIS)**
(August 17)

Introduction

- What do we really need to know about the waste?
  - (i.e., Inventory Characteristics that Affect Our Analyses)
- How can we gather the information that is needed?
  - (i.e., Waste Characterization)
- How can we keep track of what we know?
  - (i.e., Inventory Data Management)

Background – Waste Terminology

- **Physical Characteristics**
  - **Solid, liquid, gas**
- **Radiological Characteristics**
  - **Alpha, beta, gamma**
- **Hazardous Characteristics**
  - **Ignitable, corrosive, toxic**

Formulating a Waste Inventory

- **What do we really need to know about the waste?**
  (i.e., Inventory Characteristics that Affect Our Analyses)

  – **What waste characteristics do we need to know in order to handle and transport the waste safely**

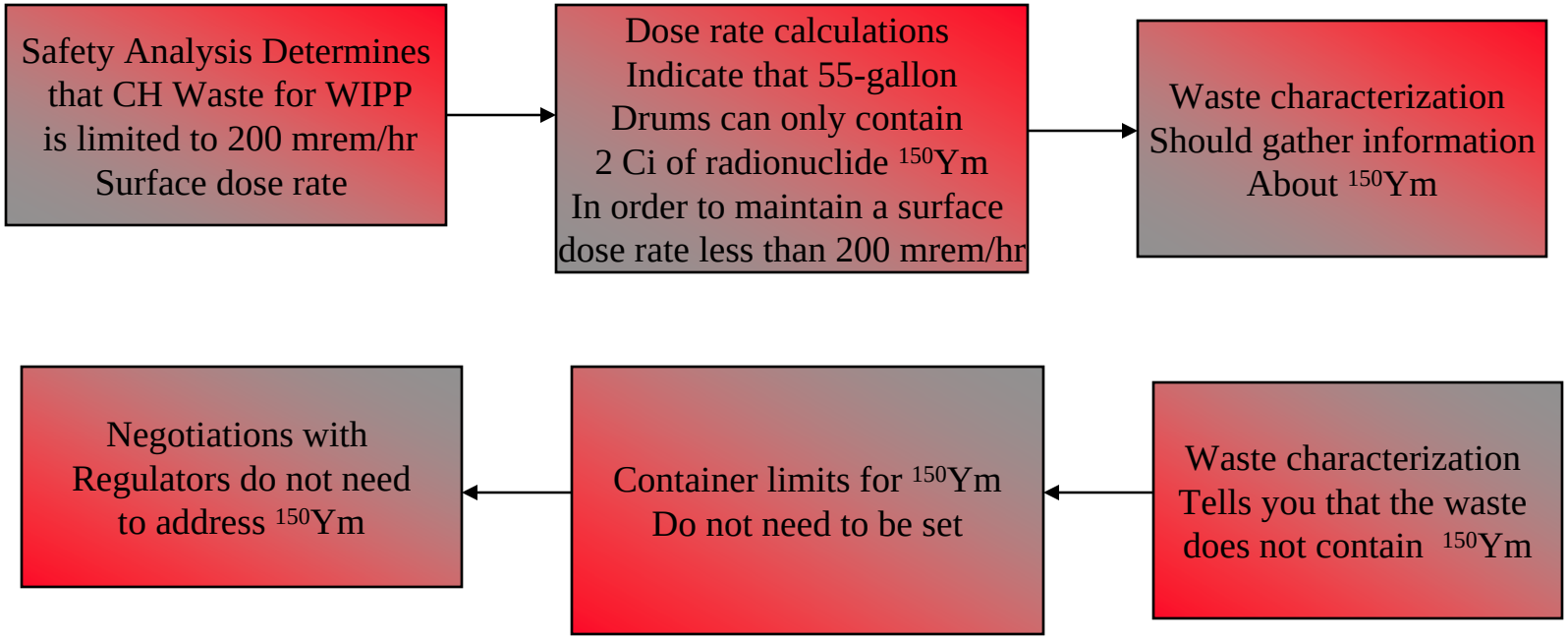
  – **What waste characteristics do we need to know in order to show that we are disposing of the waste safely?**

Safe Waste Handling

- **Safety Analysis is used to determine what waste characteristics are important to know for safe handling of the waste**

- ***Background Reference: WIPP CH DSA DOE/WIPP-95-2065, REV. 9***

Safe Waste Handling – Example

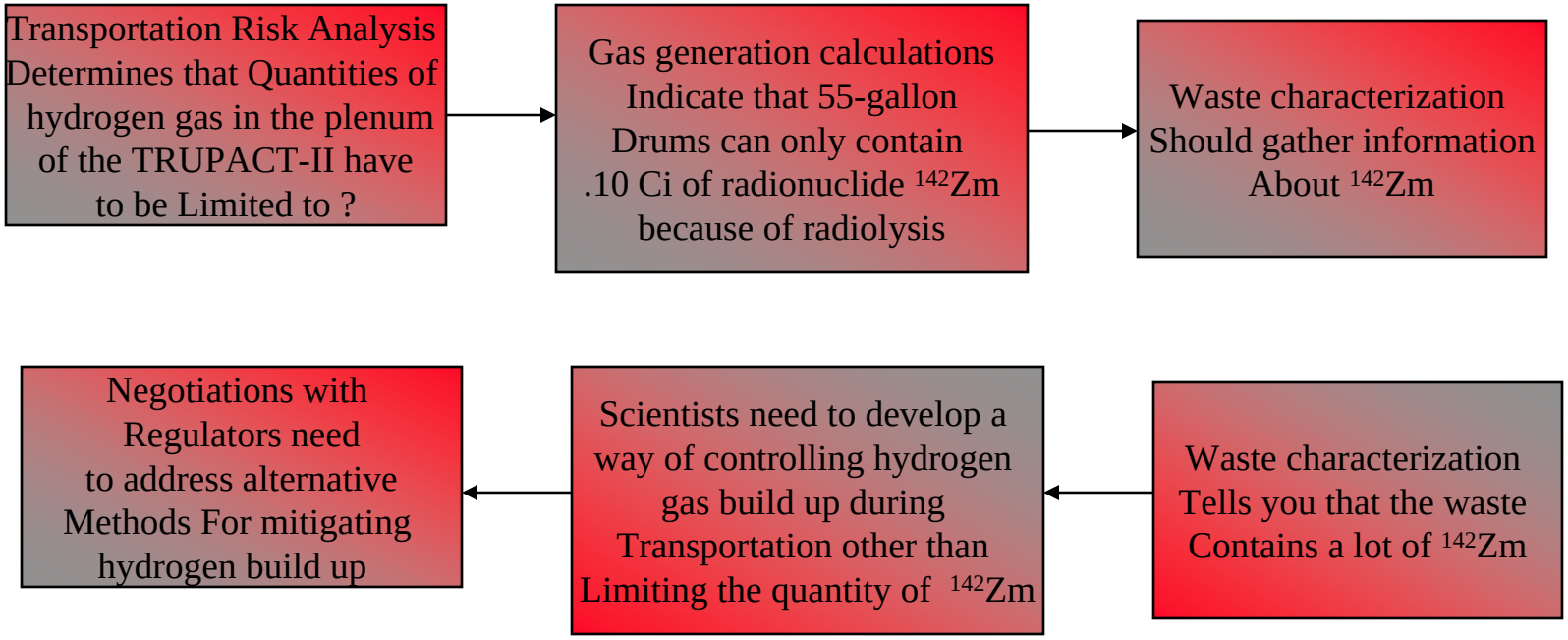


Safe Waste Transportation

- **Transportation Risk Analysis is used to determine what waste characteristics are important to know for safe transportation of the waste**

- ***Background Reference: CH TRAMPAC, Revision 2***

Safe Waste Transportation – Example

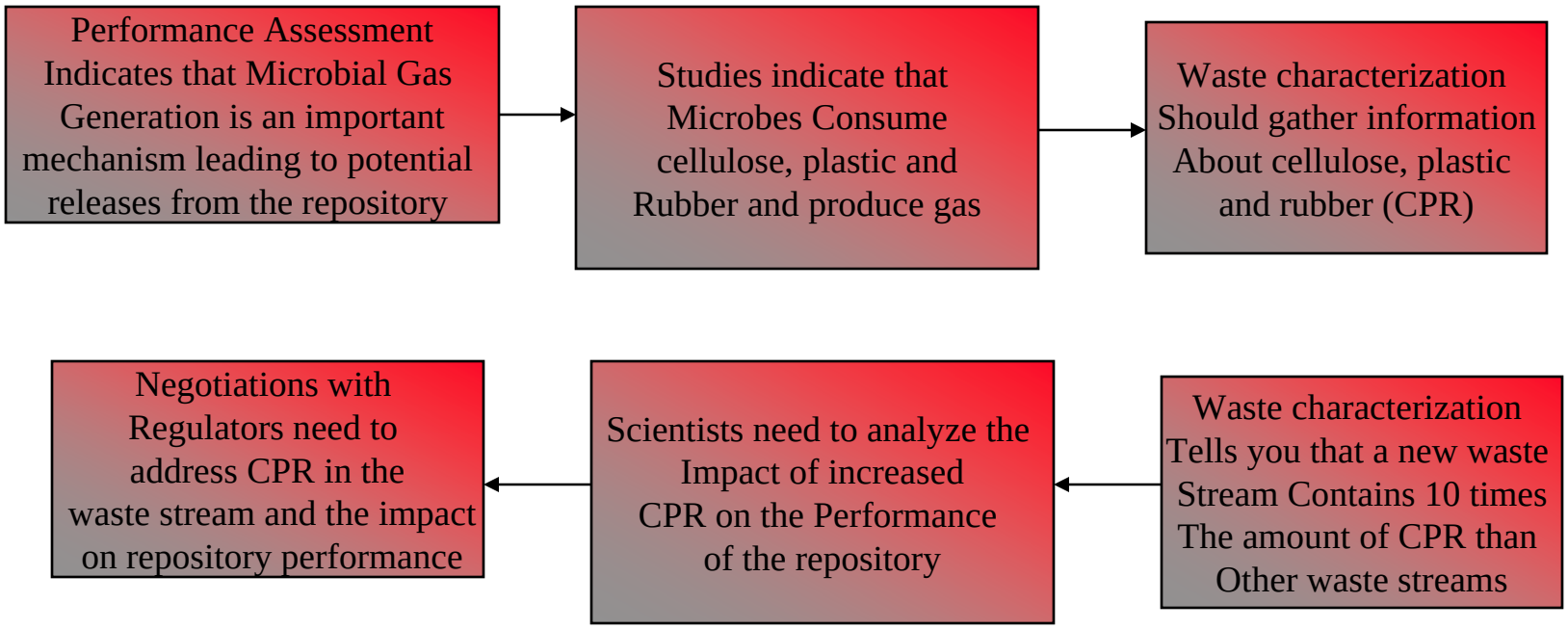


Safe Waste Disposal

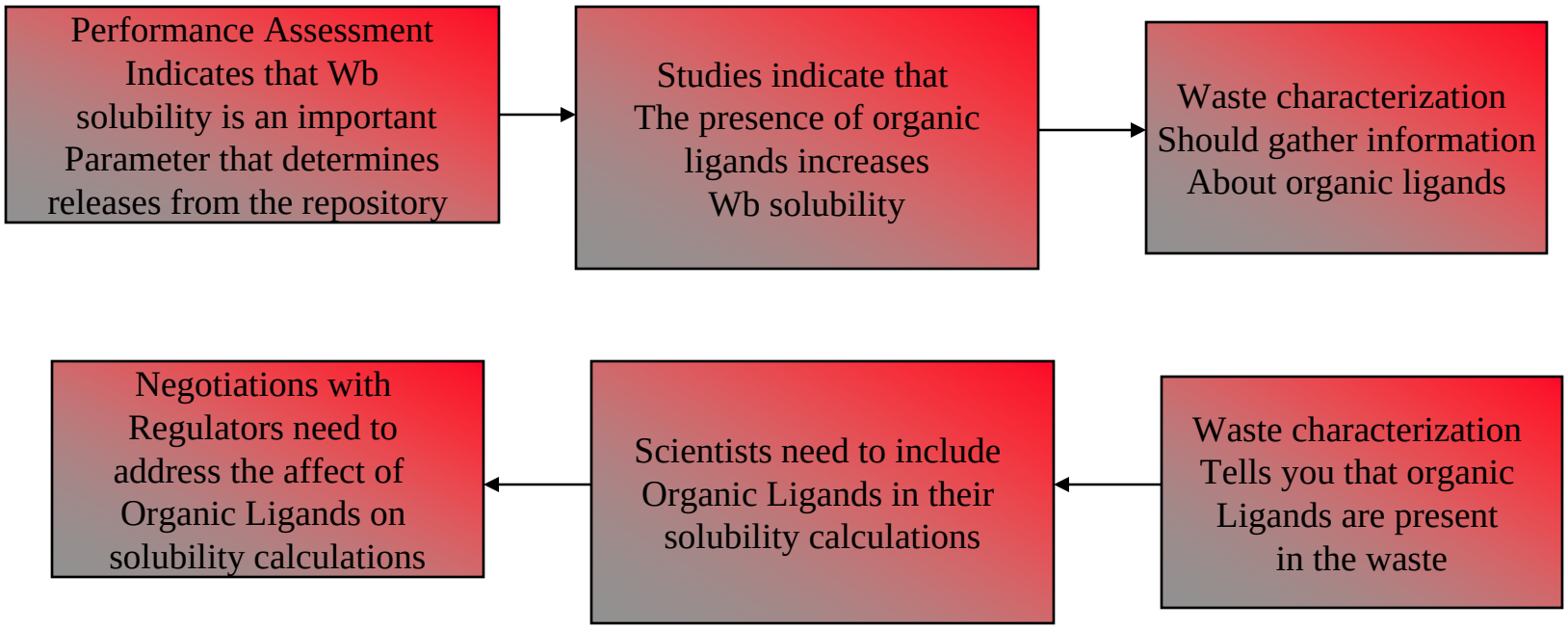
- **Performance Assessment is used to determine what waste characteristics are important to know for safe disposal of the waste**

Background Reference: Radionuclides Expected to Dominate Potential Releases in the Compliance Recertification Application

Safe Waste Disposal – Example



Safe Waste Disposal – Example



Waste Characteristics Needed

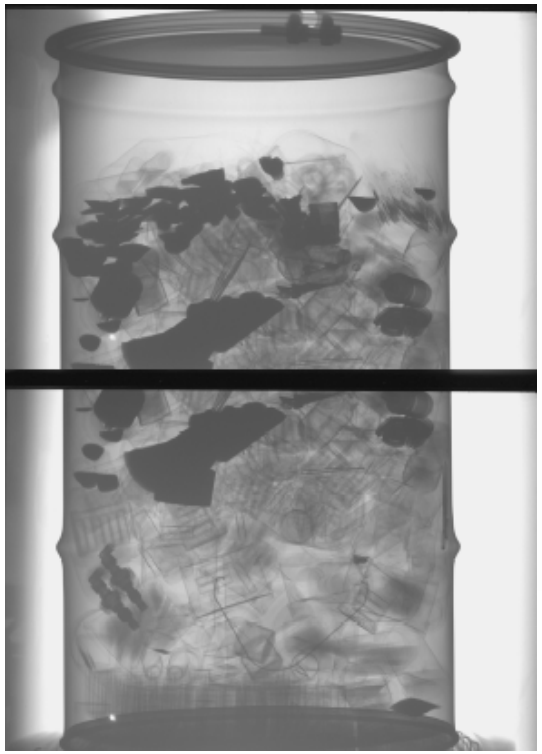
- **Physical Characteristics**
  - **How much CPR**
- **Radiological Characteristics**
  - **How much ^{142}Zm**
- **Chemical Characteristics**
  - **How much organic ligands**

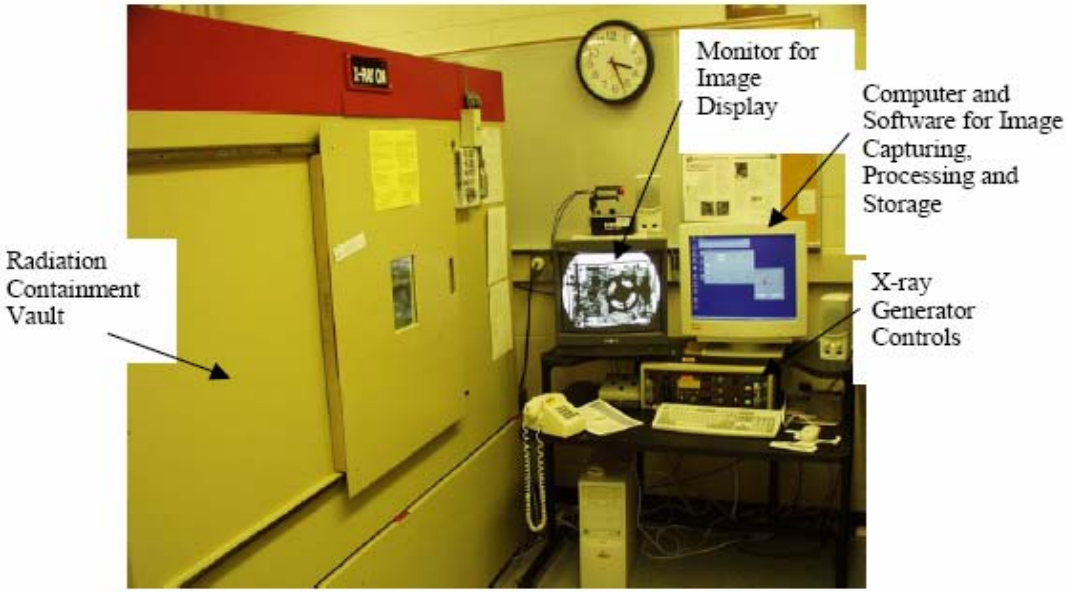
Formulating a Waste Inventory

- **How can we gather the information that is needed?*(i.e., Waste Characterization)***
  - **Physical, chemical, radiological measurements**
  - **Estimation of physical, chemical, radiological properties**

Physical Measurements, Real-Time Radiography

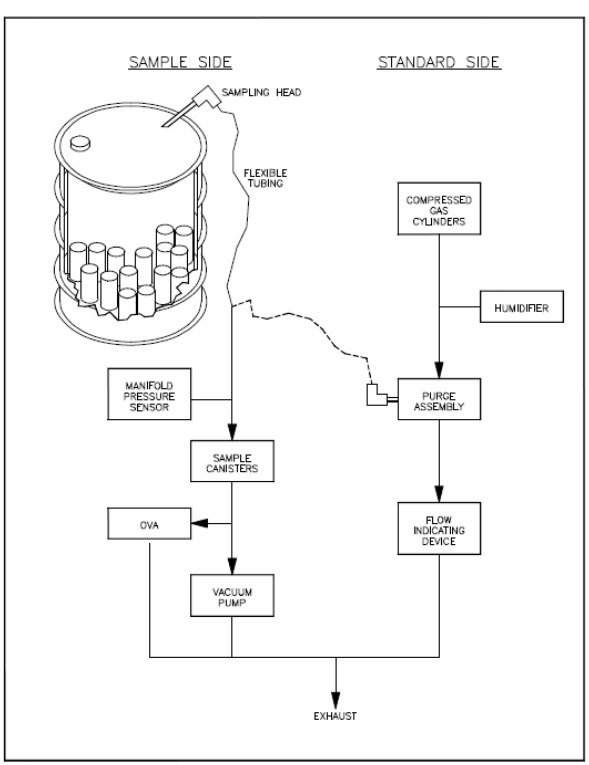
Real-time radiography enables you to determine what is inside an unknown waste package without opening it. For example, you may need to know if the package contains free liquid, so it can be stabilized for disposal.

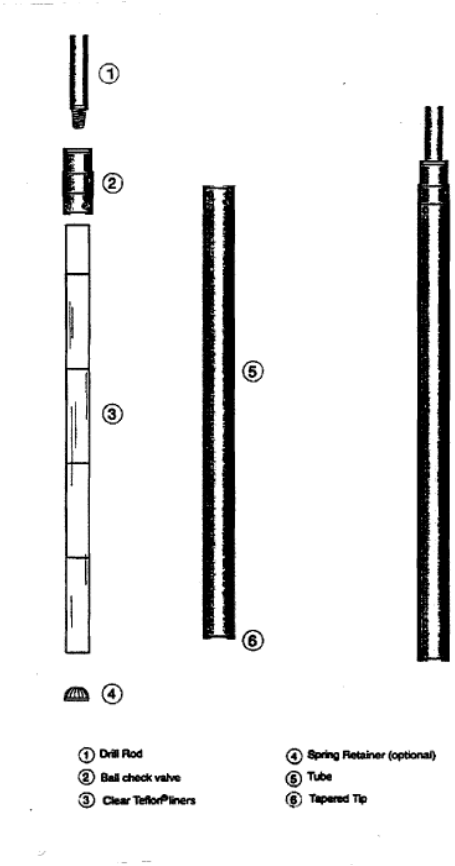
- 



Chemical Measurements, Sampling

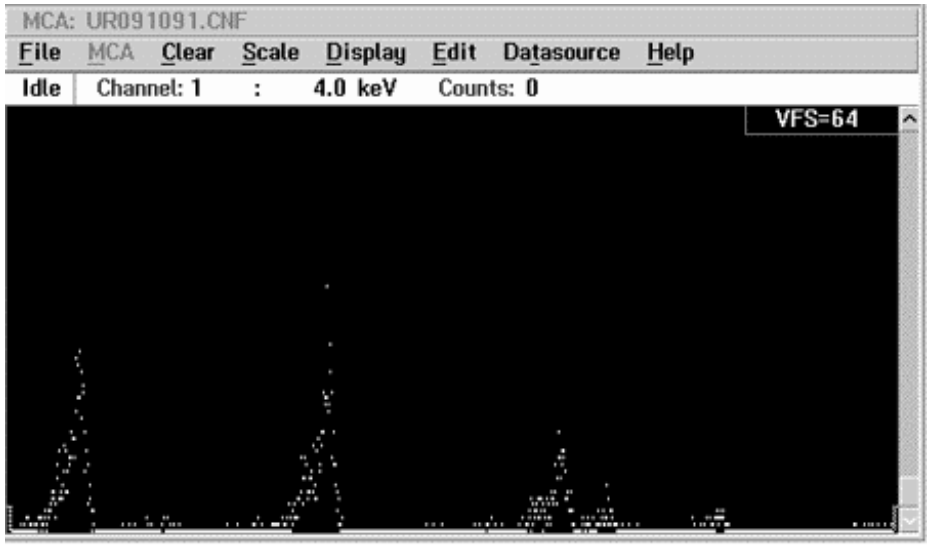
Sampling involves invading the drum

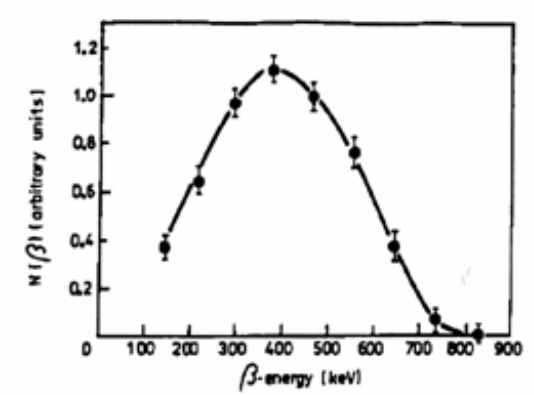


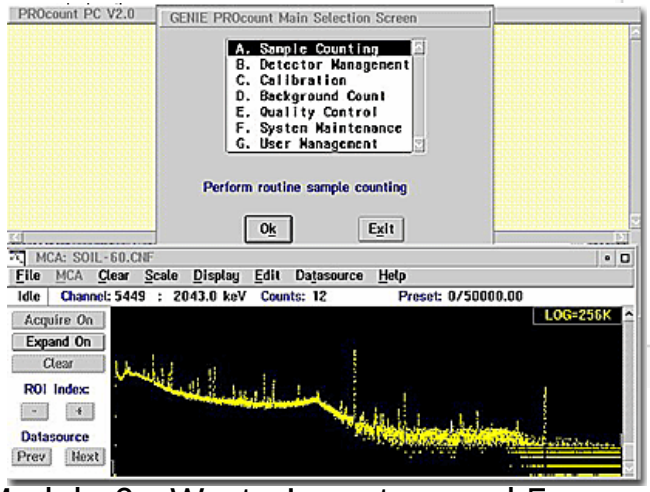


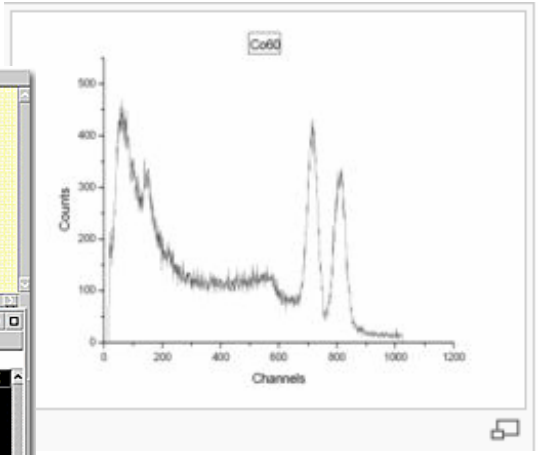
Background Reference: Waste Isolation Pilot Plant Hazardous Waste Permit - ATTACHMENT B1 WASTE CHARACTERIZATION SAMPLING METHODS

Radiological Measurements, Alpha, Beta, Gamma Spectroscopy









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Estimation of Physical Characteristics

- We needed to know the mass ferrous metal coming to WIPP
- Most of the ferrous metal coming to WIPP is in the form of the packaging that is used for the waste
- Analysis of waste packaging gives an estimate of the ferrous metal per 55-gallon drum and other waste containers
- This per package amount of ferrous metal is applied to all containers coming to WIPP to obtain en estimate of the total mass

Estimation of Chemical Characteristics

- We needed to know the mass of organic ligands in waste coming from RFETS
- There was no way to obtain an actual measurement of this
- Historical records of purchases at RFETS gave us the total amount purchased over the history of operations at RFETS
- We decided to make a conservative assumption that all of that material ended up in the waste
- This gave us the total mass of organic ligands in the waste

- ***Background Reference: Estimation of Organic Ligands***

Estimation of Radiological Characteristics

- **For YM they need to know the radionuclide inventory in spent fuel**
- **The fuel is hot and not easily available for measurement**
- **There is data on the type of fuel and the history of operations for the power plants**
- **Using the ORIGEN code, one can estimate fissions products, activation products, etc in the fuel**
- **This is the basis of the radiological inventory for YM**

- ***Background Reference: YM Inventory Document; ORIGEN code***

Formulating a Waste Inventory

- **How can we keep track of what we know?**
  (i.e., Inventory Data Management)
  - **Generator Site Databases**
  - **Waste stream profile database**
  - **Waste certification database**

Generator Site Databases

- **Maintained at the Generator Site**
  - **Record measurements taken at the site**
  - **Document process knowledge**

Generator Site Databases - Example

Classroom Discussion

Waste Stream Profile Database

- **Maintained at analysts using the data**
  - **Data obtained through inquiries to the sites**
  - **Data obtained through analyses**

Waste Stream Profile - Example

Waste Stream ID: LA-TA-55-49

Appendix J

TRU WASTE BASELINE INVENTORY WASTE PROFILE

HQ ID	N/A	Stream Name	Cemented Inorganics containing 238Pu (mixed)					Inventory Date	9/30/2002
Local ID	TA-55-49	Handling	CH	Final Waste Form	Solidified Inorganics	Waste Matrix Code	S3100	Activity Concentrations Decayed to CY	2002

Final Waste Form Descriptors

Category: Defense TRU Waste Source: N/A

Waste Volume Detail (m3)

As-Generated Volumes			
ContainerType	Stored	Proj.	Total
55 Gallon Drum	15.6	0.0	15.6
Drum / 30-gallon / Pit	1.5	0.0	1.5
As-Generated Total	17.1	0.0	17.1

Final Form Volumes			
ContainerType	Stored	Proj.	Total
55 Gallon Drum	15.6	0.0	15.6
55 Gallon Drum/Overpack 30 Gallon	2.7	0.0	2.7
Final Form Total	18.3	0.0	18.3

Waste Material Parameters

Material Parameter	Average Density (kg/m3)
Iron-Base Metal/Alloys	205.73
Aluminum-Base Metal/Alloys	0.18
Other Metal/Alloys	116.57
Other Inorganic Materials	14.16
Cellulosics	28.21
Rubber	0.48
Plastics	2.34
Solidified, Inorganic Matrix	91.36
Cement (Solidified)	102.54
Vitrified	0.00
Solidified, Organic Matrix	0.00
Soils	0.00
Packaging Material, Steel	142.23
Packaging Material, Plastic	37.00
Packaging Material, Lead	0.00
Packaging Material, Steel Plug	0.00

Final Form Radionuclides

Isotope	Typical Concentration (Ci/m3)
Am-241	9.14E-01
Np-237	6.21E-06
Pu-238	1.83E+02
Pu-239	1.69E+00
Pu-240	4.77E-01
Pu-241	3.47E+00
Pu-242	1.05E-04
Th-229	2.09E-13
Th-230	1.40E-06
Th-232	2.01E-16
U-233	2.96E-10
U-234	1.31E-02
U-235	3.46E-06
U-236	3.39E-07
U-238	2.26E-05

Waste Stream Description

Solidified inorganic process solids from plutonium processing operations to fabricate heat sources using 238Pu supplied by Savannah River Site. This waste includes process leached solids, salts, and metal oxides.

Management Comments

Former WS IDs: LAM006, LAM009, LAT004, LAT005, LAT006, LAT009, also containes containers not previously associated with an identified BIR WS

Waste Stream Profile - Example

Waste Stream ID: RF-MT0803

Appendix J

TRU WASTE BASELINE INVENTORY WASTE PROFILE

HQ ID	RF-W010	Stream Name	Solidified Sludge - Bldg 374 / TRM					Inventory Date	9/30/2002
Local ID	None	Handling	CH	Final Waste Form	Solidified Inorganics	Waste Matrix Code	S3190	Activity Concentrations Decayed to CY	2002

Final Waste Form Descriptors

Category: Defense TRU Waste Source: Pollution Control or Waste Treatment Process

Waste Volume Detail (m3)

As-Generated Volumes			
ContainerType	Stored	Proj.	Total
Drum / 55 gallon	2.3	0.0	2.3
As-Generated Total	2.3	0.0	2.3

Final Form Volumes			
ContainerType	Stored	Proj.	Total
55 Gallon Drum	2.3	0.0	2.3
Final Form Total	2.3	0.0	2.3

Waste Material Parameters

Material Parameter	Average Density (kg/m3)
Iron-Base Metal/Alloys	0.00
Aluminum-Base Metal/Alloys	0.00
Other Metal/Alloys	0.00
Other Inorganic Materials	801.46
Cellulosics	0.00
Rubber	0.00
Plastics	17.18
Solidified, Inorganic Matrix	826.31
Cement (Solidified)	0.00
Vitrified	0.00
Solidified, Organic Matrix	0.00
Soils	0.00
Packaging Material, Steel	138.52
Packaging Material, Plastic	36.17
Packaging Material, Lead	0.00
Packaging Material, Steel Plug	0.00

Final Form Radionuclides

Isotope	Typical Concentration (Ci/m3)
Am-241	1.24E+00
Np-237	4.76E-06
Pu-238	3.16E-02
Pu-239	7.43E-01
Pu-240	1.69E-01
Pu-241	2.43E+00
Pu-242	2.14E-05
Th-229	4.59E-14
Th-230	6.19E-11
Th-232	1.79E-17
U-233	1.23E-10
U-234	1.13E-06
U-235	8.79E-09
U-236	6.03E-08
U-238	3.86E-14

Waste Stream Description

This waste stream is a solid cemented sludge. It could have small amounts of free liquids in the bottom of the container.

Management Comments

Waste is packaged in 55 gallon DOT 7A Type A Drums. The drums are lined with one rigid polyethylene liner and two bag liners.

Waste Stream Profile - Example

Waste Stream ID: **RL-T122**

Appendix J

TRU WASTE BASELINE INVENTORY WASTE PROFILE

HQ ID	RL-W254	Stream Name	105-C, 105KE, and 105-N Bldg TRU Waste			Inventory Date	9/30/2002
Local ID	N/A	Handling	CH	Final Waste Form	Heterogeneous Debris	Waste Matrix Code	S5440	Activity Concentrations Decayed to CY	2002

Final Waste Form Descriptors

Category: Defense TRU Waste Source: Facility/Equipment Operation and Maintenance Waste

Waste Volume Detail (m3)

As-Generated Volumes

ContainerType	Stored	Proj.	Total
55 Gallon Drum	2.7	0.0	2.7
Standard Waste Box	26.6	0.0	26.6
As-Generated Total	29.3	0.0	29.3

Final Form Volumes

ContainerType	Stored	Proj.	Total
55 Gallon Drum	2.7	0.0	2.7
Standard Waste Box	26.6	0.0	26.6
Final Form Total	29.3	0.0	29.3

Waste Material Parameters

Material Parameter	Average Density (kg/m3)
Iron-Base Metal/Alloys	692.43
Aluminum-Base Metal/Alloys	161.34
Other Metal/Alloys	0.00
Other Inorganic Materials	39.73
Cellulosics	20.04
Rubber	4.41
Plastics	31.84
Solidified, Inorganic Matrix	5.38
Cement (Solidified)	0.00
Vitrified	0.00
Solidified, Organic Matrix	0.00
Soils	1.66
Packaging Material, Steel	151.88
Packaging Material, Plastic	4.50
Packaging Material, Lead	0.00
Packaging Material, Steel Plug	0.00

Final Form Radionuclides

Isotope	Typical Concentration (Ci/m3)
Cs-137	3.06E-01
Pu-238	5.22E-03
Pu-239	1.85E-01
Pu-240	4.17E-02
Pu-241	8.39E-01
Pu-242	2.50E-06
Sr-90	2.85E-01
Th-232	3.76E-06
U-234	4.96E-02
U-235	5.13E-03
U-238	5.52E-05

Waste Stream Description

Typically, 70 to 80% of waste in drums is combustible items such as wood, plastics, paper, absorbents, rubber, rags. Approximately 20 to 30 % of waste in drums is noncombustible waste, such as failed machinery, tools, glass, concrete, plumbing and fixture and soil. Boxes typically contain whole and sectioned glove boxes, hoods, ducting, conduit, lathes, pumps, piping, fans, light fixture, instrumentation, tools, conveyor sections, wire, etc. The combustible materials in boxes may include cotton rags and clothing, plastic sheeting, plastic pipe, tape, ladders, plexiglass, step benches, polyethylene bottles, gloves and rubber. Absorbed combustible liquids such as oils have also been placed in some drums and boxes. Drums and boxes are also used for disposal of high-efficiency particulate air filters. Several boxes contain only high-efficiency particulate air filters, while others contain these filters and other waste forms.

Management Comments

Inventory is from the site's record solid waste tracking system, a requirement of DOE Order 5820.A, Radioactive Waste Management. Of the TRU waste stored from May 1970 to December 1986 that has not been assayed and redesignated as low level waste (by December 1993), 50% of the waste stored in 55-gallon drums, and 65% of the waste stored in boxes are expected to be TRU waste upon assaying. The remainder is expected to be low-level waste upon assaying. The reported volumes and radionuclides have been adjusted to take this assumption into account. Waste in drums will be opened, examined to remove non-certifiable waste, and then packaged into new drums. The projection is that repackaging will result in a 35% increase in the volume of TRU-certified wastes in drums (WHC-SD-W026-SDRD-001, Rev. 3). Waste in boxes will be opened, and size-reduced to fit into TRUPACT-II SWBs. No volume reduction is projected. Upper and lower weights for final waste form are unknown.

Waste in drums will be opened, examined to remove non-certifiable waste, and then packaged into new drums. The projection is that repackaging will result in a 35% increase in the volume of TRU-certified wastes in drums (WHC-SD-W026-SDRD-001, Rev. 3). Upper and lower weights for final waste form are unknown.

Waste Certification Database

- **Maintained at the disposal site**
  - **Data obtained for actual shipments to the disposal site as part of the certification process**
  - **Data used to demonstrate compliance to the regulators compliance**
  - **Data used to validate the waste stream profile database**

Waste Certification Database - Example

WIPP Waste Information System

Waste Container Data Report

Report	***RP0360***
Version	***2.3***
Instance	***PRD01***
Run by	***SPEEDD***
Report Date	***01/12/2006 15:03***
Total Pages	***6***

Selection Criteria -

Container Number	***10010133***
Site Id	***%***
Waste Stream	***%***
Data Status Code	***%***

Summary

- What do we really need to know about the waste?
  - (i.e., Inventory Characteristics that Affect Our Analyses)
- How can we gather the information that is needed?
  - (i.e., Waste Characterization)
- How can we keep track of what we know?
  - (i.e., Inventory Data Management)

Development of the Waste Inventory for WIPP

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(August 16)

III. **Inventory Case Studies (YMP and GTCC LLW EIS)**
(August 17)

Historical Perspective

- The first version of an inventory for WIPP was the Integrated Database (1970s – 1980s)
- Congress mandated the Mixed Waste Inventory Report (late 1980s)
- Transuranic Waste Baseline Inventory Report (TWBIR) Revision 0 – 1994
- WIPP Transuranic Waste Baseline Inventory Report (WTWBIR Revision 1) - 1994
- Transuranic Waste Baseline Inventory Report (TWBIR) Revision 2 – 1995
- Transuranic Waste Baseline Inventory Report (TWBIR) Revision 3 – 1996
-
-
-
- Transuranic Waste Inventory Update Report – 2003
- CRA 2004 Appendix DATA, Attachment J
- TRU Waste Inventory for the 2004 Compliance Recertification Application Performance Assessment Baseline Calculation

Introduction

- What do we really need to know about the waste?
  - (i.e., Inventory Characteristics that Affect Our Analyses)
- How can we gather the information that is needed?
  - (i.e., Waste Characterization)
- How can we keep track of what we know?
  - (i.e., Inventory Data Management)

Formulating a WIPP Waste Inventory

- **What do we really need to know about the waste?**
  (i.e., Inventory Characteristics that Affect Our Analyses)

  – **What waste characteristics do we need to know in order to handle and transport the waste safely**

  – **What waste characteristics do we need to know in order to show that we are disposing of the waste safely?**

Regulating Entities

- New Mexico Environment Department (NMED)
  - Hazardous Waste Disposal Requirements
  - RCRA requirements at 40 CFR 270
- Environmental Protection Agency (EPA)
  - Radioactive Waste Disposal Requirements
  - Requirements at 40 CFR 191 and 194
- Nuclear Regulatory Commission
  - Radioactive Waste Transportation Requirements
  - Requirements at 10 CFR 71

WIPP Waste Characteristics That Affect Safe Handling

Characteristic	Why Is It Important
Fissile Gram Equivalent	Prevention of inadvertent criticality
Combustible loading	Prevention of Fires
Surface dose rates	Prevention of over exposure of workers
Volatile Organic Compounds	Prevention of over exposure of workers

Background Reference: WIPP CH DSA DOE/WIPP-95-2065, REV. 9

WIPP Waste Characteristics That Affect Transportation

Characteristic	Why Is It Important
Residual Liquids	Liquids disperse in a transportation accident
Pyrophoric Materials	Spontaneous ignition of materials can cause damage to transportation container
Headspace Gas Concentrations	Gases in the headspace of a closed transportation container can cause an explosion
Explosives, Corrosives, and Compressed Gases	Corrosives can damage the transportation container and cause a release
Chemical Compatibility	Two waste types when mixed together can cause damage to the transportation container
Polychlorinated Biphenyls	Release of in a transportation accident

Background Reference: TRANSURANIC WASTE ACCEPTANCE CRITERIA FOR THE WASTE ISOLATION PILOT PLANT Revision 6.0

WIPP Waste Characteristics That Affect Repository Performance

Characteristic	Why Is It Important
Radionuclide Activity for ^{241}Am, ^{244}Cm, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu ^{234}U	Could be released through cuttings/cavings/spallings and direct brine release
^{90}Sr, ^{99}Tc, ^{137}Cs	Could be released through cuttings/cavings/spallings and direct brine release
Cellulose, plastic, rubber	Affects gas pressure because it is a nutrient for microbes which upon consumption generates gas
Ferrous Metals	Affects pH and ultimately solubility
Sulfate, nitrate, oxylate	Affects gas pressure because it is a nutrient for microbes which upon consumption generates gas
Organic ligands	Affects solubility

- ***Background Reference: CRA 2004 Appendix TRU Waste***

Formulating a Waste Inventory

- **How can we gather the information that is needed?*(i.e., Waste Characterization)***
  - **Physical, chemical, radiological measurements**
  - **Estimation of physical, chemical, radiological properties**

Radionuclide Activity

How do we determine radionuclide activity for ^{241}Am, ^{244}Cm, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{234}U, ^{90}Sr, ^{99}Tc, ^{137}Cs?

- **Activity measurements taken at the site (stored waste)**
  - **Alpha, Beta, Gamma Spectroscopy or process knowledge**
- **Activity estimates made by the site (projected waste)**
  - **Analogy to existing waste or process knowledge**
- **Decay calculations to determine current level of activity**
  - **ORIGEN2**
- **Decay calculations to determine activity at the time of repository closure**
  - **ORIGEN2**
- **Scaling calculations to fill the repository**
  - **TWBID – now called CID**

Cellulose, Plastic, Rubber

How do we determine masses of cellulose, plastic, and rubber?

- **Measurements taken at the site (stored waste)**
  - **RTR or process knowledge**
- **Estimates made by the site (projected waste)**
  - **Analogy to existing waste or process knowledge**
- **Scaling calculations to fill the repository**
  - **TWBID – now called CID**
- **Estimates of emplacement materials**
  - **Analysis of operations**

Ferrous Metals

How do we determine masses of ferrous metals?

- **Measurements taken at the site (stored waste)**
  - **RTR or process knowledge**
- **Estimates made by the site (projected waste)**
  - **Analogy to existing waste or process knowledge**
- **Scaling calculations to fill the repository**
  - **TWBID – now called CID**
- **Estimates of ferrous metals in packaging**
  - **TWBID – now called CID**

Sulfate, Nitrate, Oxylate

How do we determine masses of sulfate, nitrate, and oxylate?

- **Measurements taken at the site (stored waste)**
  - **Sampling or process knowledge**
- **Estimates made by the site (projected waste)**
  - **Analogy to existing waste or process knowledge**
- **Scaling calculations to fill the repository**
  - **TWBID – now called CID**
- **Estimates of emplacement materials**
  - **Analysis of operations**

Organic Ligands

How do we determine masses of organic ligands?

- **Measurements taken at the site (stored waste)**
  - **Sampling or process knowledge**
- **Estimates made by the site (projected waste)**
  - **Analogy to existing waste or process knowledge**
- **Scaling calculations to fill the repository**
  - **TWBID – now called CID**

Formulating a Waste Inventory

- **How can we keep track of what we know?**
  (i.e., Inventory Data Management)
  - **Generator Site Databases (RFETS, INL, LANL…)**
  - **Waste stream profile database (SNL, LANL-CO)**
  - **Waste certification database (Westinghouse)**

Generator Site Databases

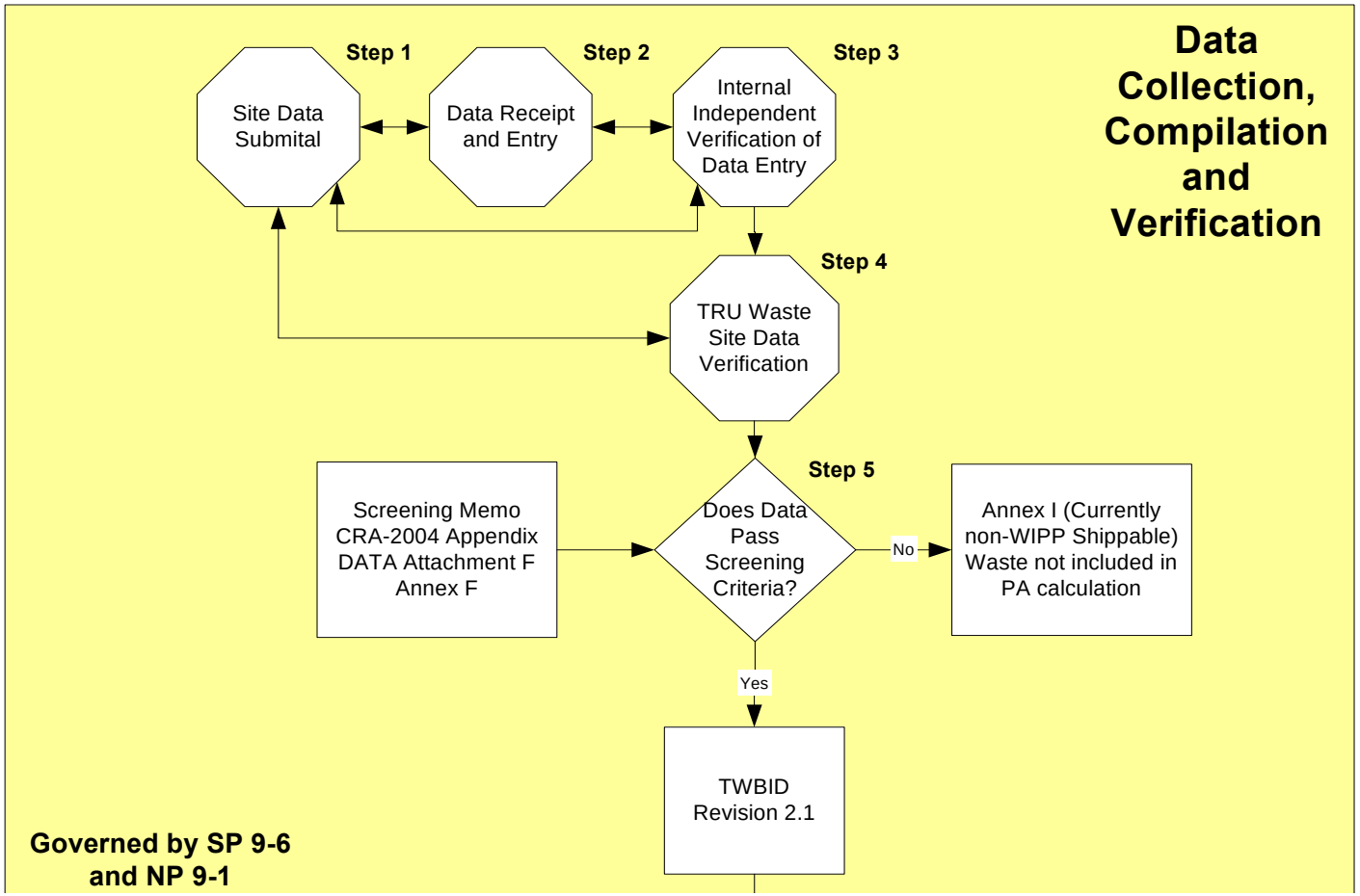
- **TRU waste sites are affected by**
  - **regulations on the federal and state level,**
  - **waste program management decisions at the site, at the WIPP and on the national level,**
  - **funding for waste management on site,**
  - **availability and confidence in supplemental characterization information or process knowledge, and**
  - **the forecast for upcoming programs on site.**

Background Reference: TRU Waste Inventory for the 2004 Compliance Recertification Application Performance Assessment Baseline Calculation

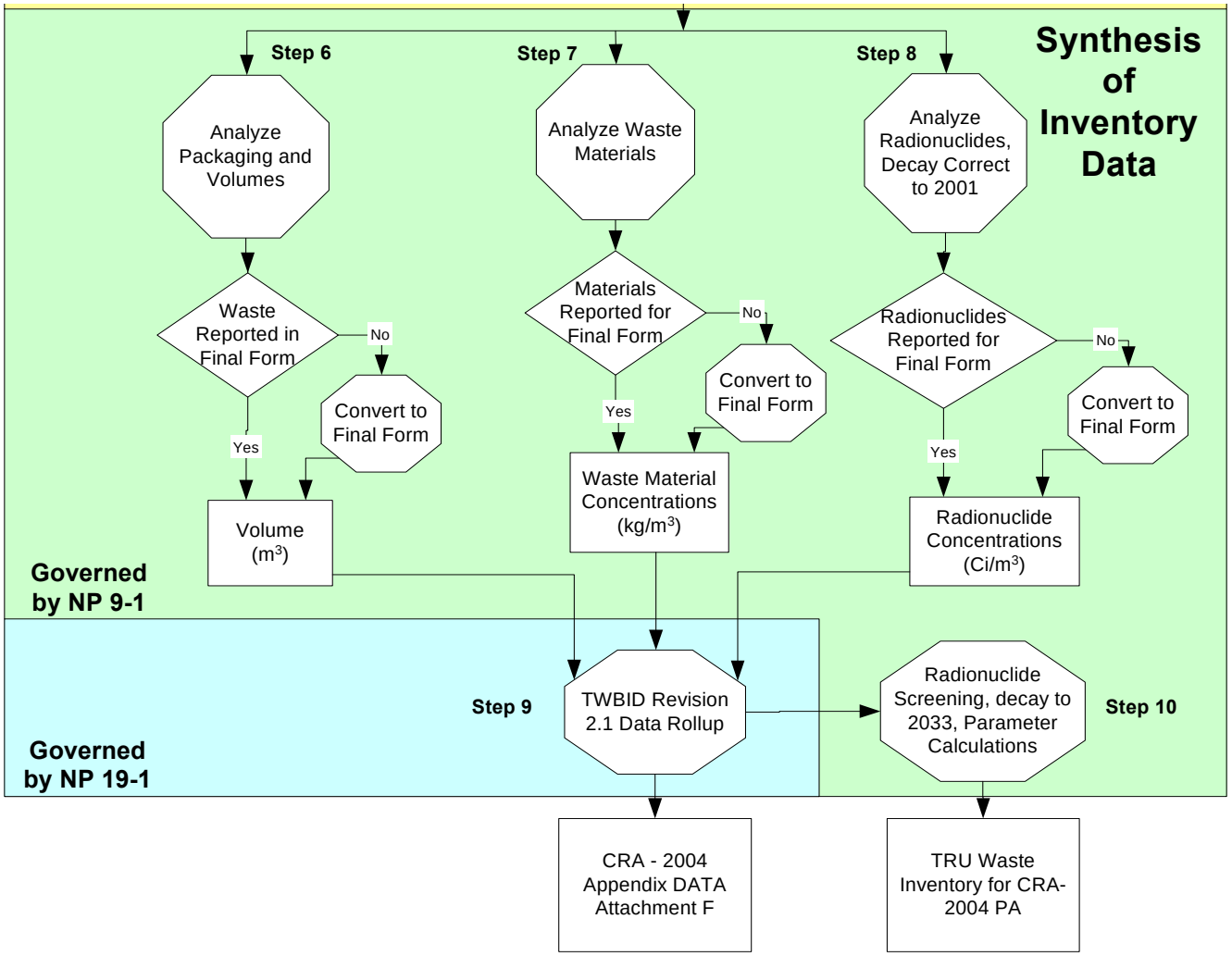
Generator Site Databases

TRU Waste Site	Database	Application
Hanford RL	SWITS(a)	Used to obtain volumes, radionuclide activities and waste material masses for stored inventory
	SWIFT(b)	Used to obtain volumes, radionuclide activities and waste material masses for projected waste
Hanford RP	BBI-TWINS(c)	Used to obtain volumes, radionuclide activities and waste material masses for both stored and projected waste
INEEL	Ravio(d)	Used to obtain volumes, radionuclide activities and waste material masses for both stored and projected waste for the Advanced Mixed Waste Treatment Project.
	WILD(e)	Used to obtain volumes and radionuclide activities for Pre-1970 TRU waste for the Idaho Cleanup Project.
LANL	TRU DB(f)	Used to obtain volumes, containers, radionuclide activities and waste material masses for both stored and projected waste
ORNL	WITS(g)	Used to obtain waste container counts and radionuclide activities for both stored and projected waste
RFETS	WEMS(h)	Used to obtain volumes, containers, radionuclide activities and waste material masses for stored and projected waste
SRS	COBRA(i)	Used to obtain waste container counts, radionuclide activities, and physical characteristics of TRU waste generated from 1961 to 1998
	TWC(j)	Used for waste generated from 1998 to the present.

Data Collection, Compilation & Verification



Synthesis of Inventory Data



Waste Certification Database

- **Maintained at the disposal site**
  - **Data obtained for actual shipments to the disposal site as part of the certification process**
  - **Data used to demonstrate compliance to the regulators compliance**
  - **Data used to validate the waste stream profile database**

Waste Certification Database - Example

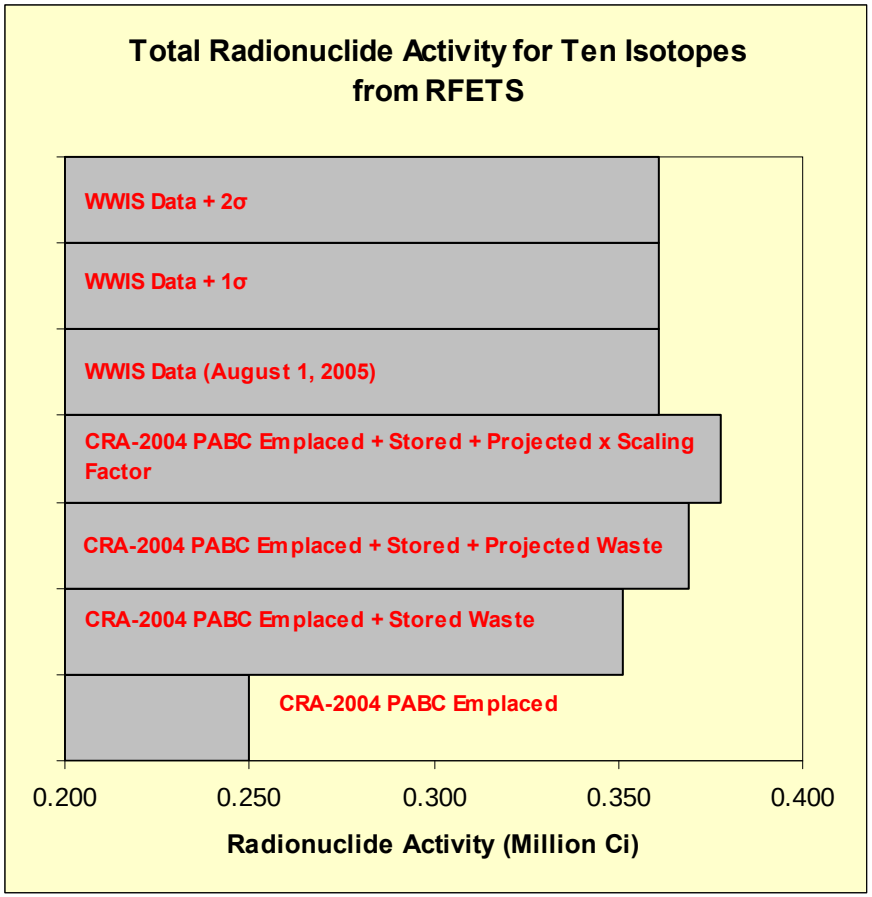


Figure 1. Total Radionuclide Activity from CRA-2004 PABC (decay corrected to 2001) and WWIS for Ten Radionuclides from RFETS

Background Reference: Incorporation of Inventory Uncertainty in the CRA-2004 Performance Assessment Baseline Calculation

Summary

- What do we really need to know about the waste?
  - (i.e., Inventory Characteristics that Affect Our Analyses)
- How can we gather the information that is needed?
  - (i.e., Waste Characterization)
- How can we keep track of what we know?
  - (i.e., Inventory Data Management)

Inventory Case Studies: WIPP, YMP, and GTCC LLW EIS

KHNP Training Program
Module 6: Assembly of a Safety Case

August 16, 2007

Christi D. Leigh, Ph.D.
Sandia National Laboratories
Carlsbad Programs Group

SAND 2007-XXXP

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

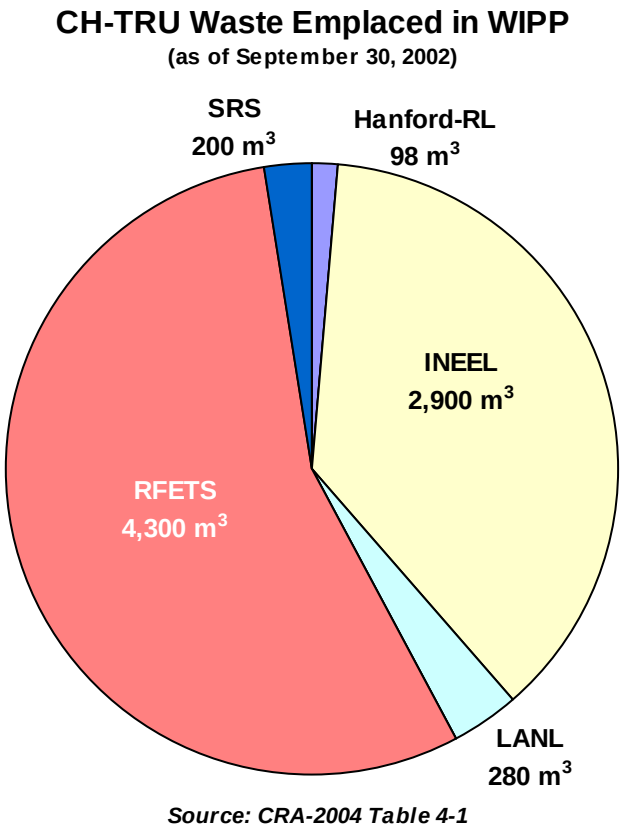
Outline

I. **Waste Inventory Principles and Techniques**
(August 15)

II. **Development of the Waste Inventory for WIPP**
(August 16)

III. **Inventory Case Studies (WIPP, YMP and GTCC LLW EIS)**
(August 17)

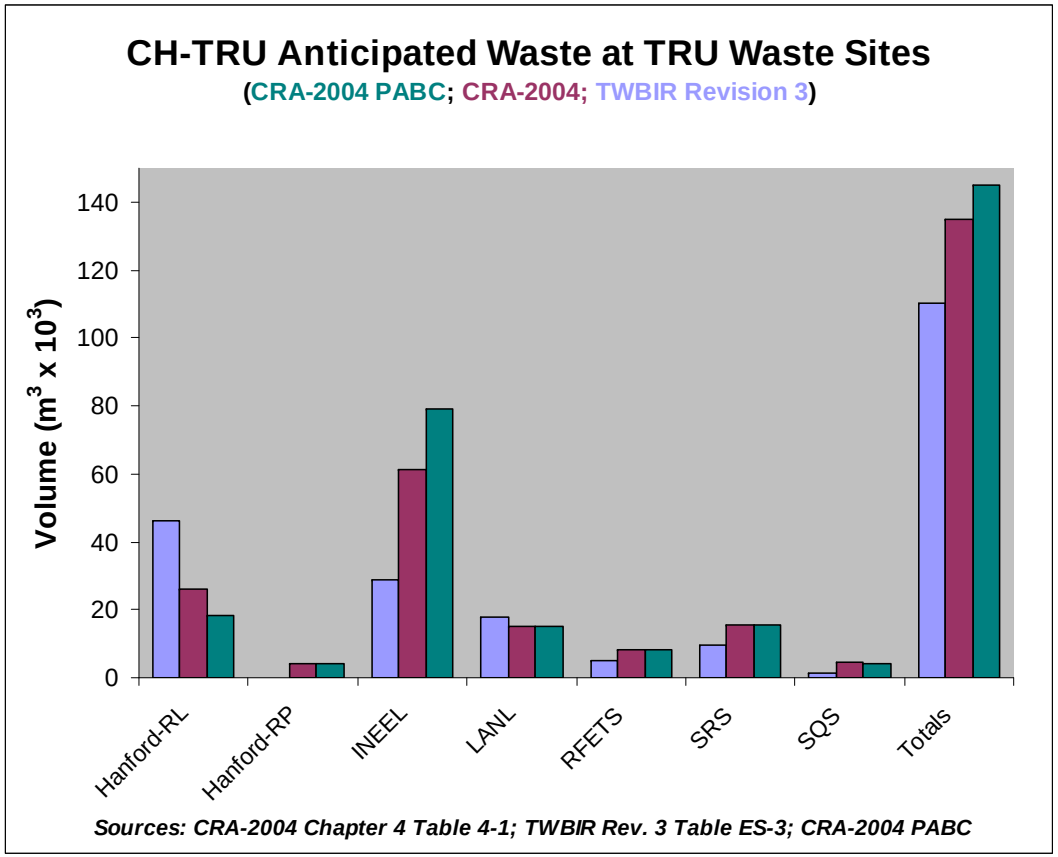
CH-TRU Waste Emplaced in WIPP



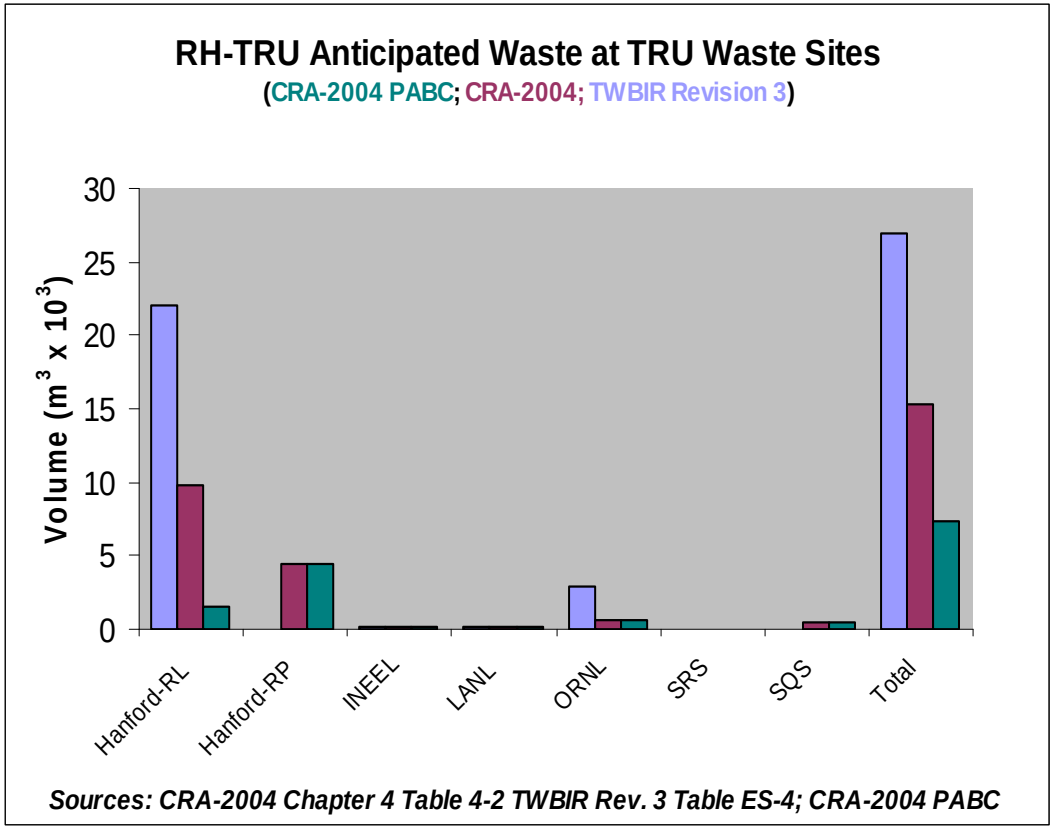
Source: CRA-2004 Table 4-1

Total emplaced CH-TRU volume is 7,700 m^3.

CH-TRU Anticipated Waste

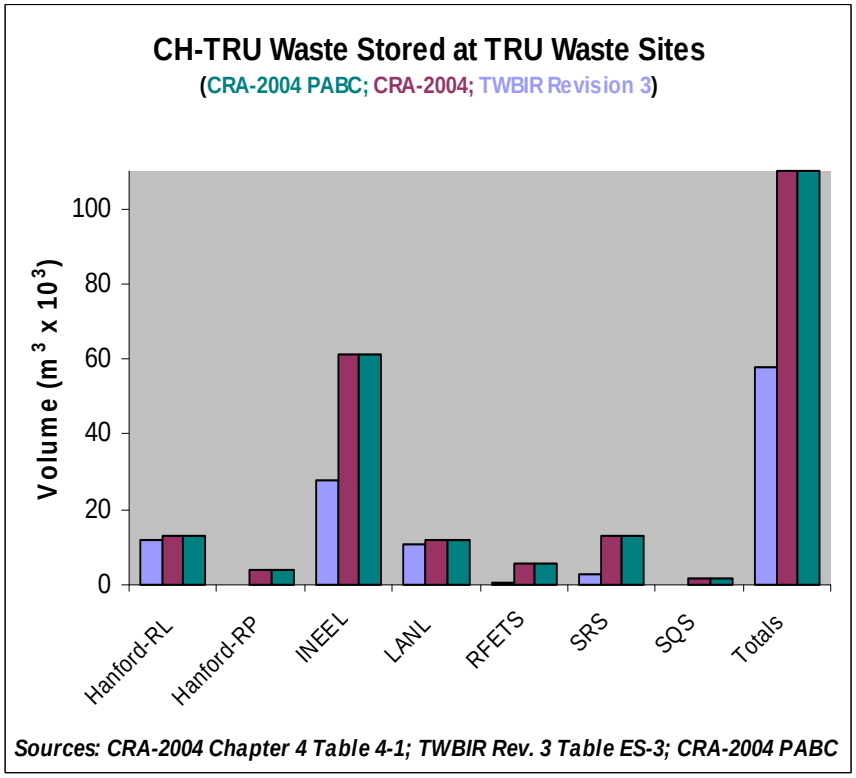


RH-TRU Anticipated Waste

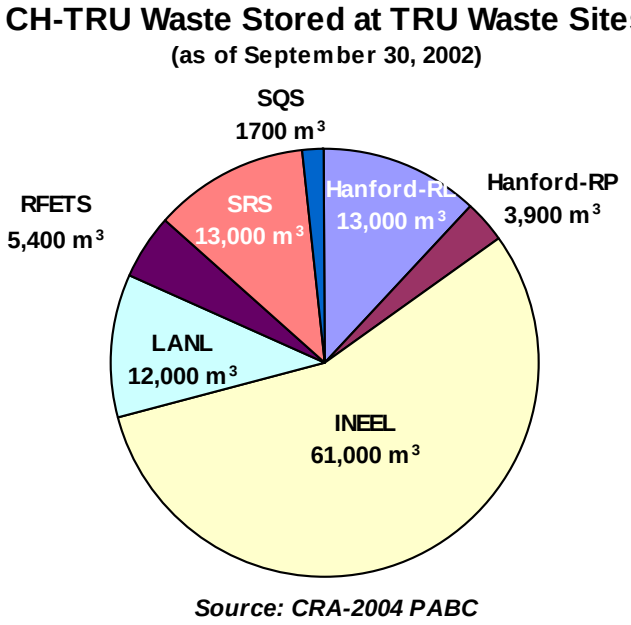


Sources: CRA-2004 Chapter 4 Table 4-2 TWBIR Rev. 3 Table ES-4; CRA-2004 PABC

CH-TRU Waste Stored at TRU Waste Sites



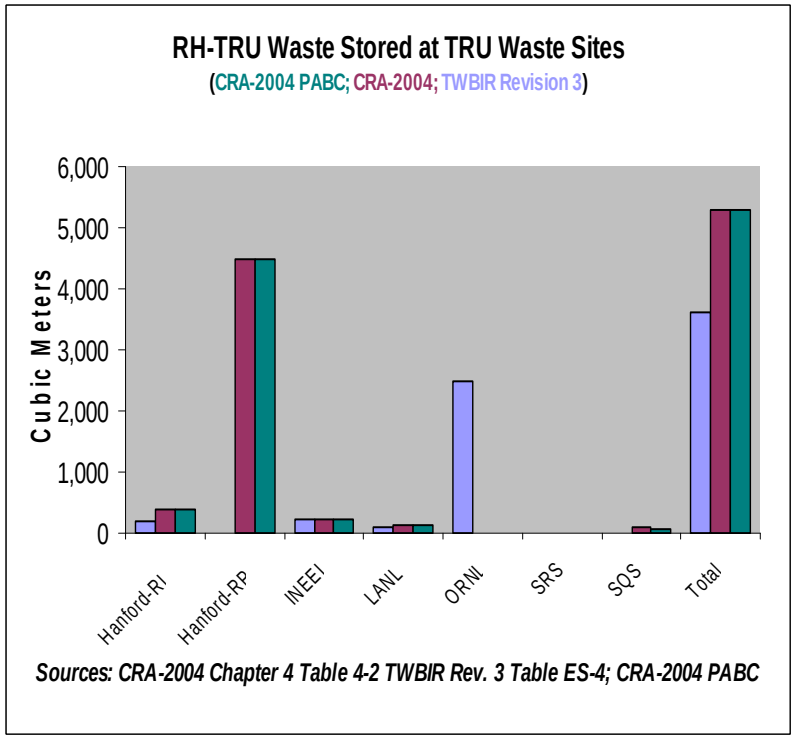
Sources: CRA-2004 Chapter 4 Table 4-1; TWBIR Rev. 3 Table ES-3; CRA-2004 PABC

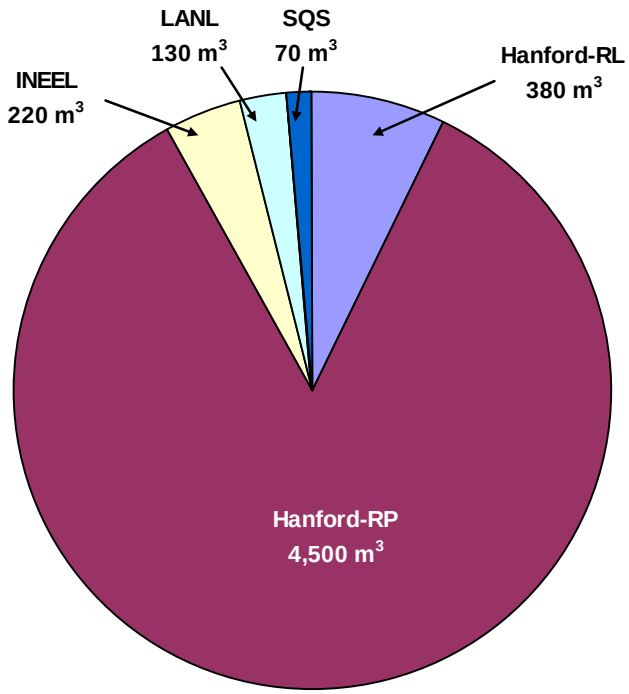


Source: CRA-2004 PABC

Total Stored CH-TRU volume is 110,000 m³.

RH-TRU Waste Stored at TRU Waste Sites

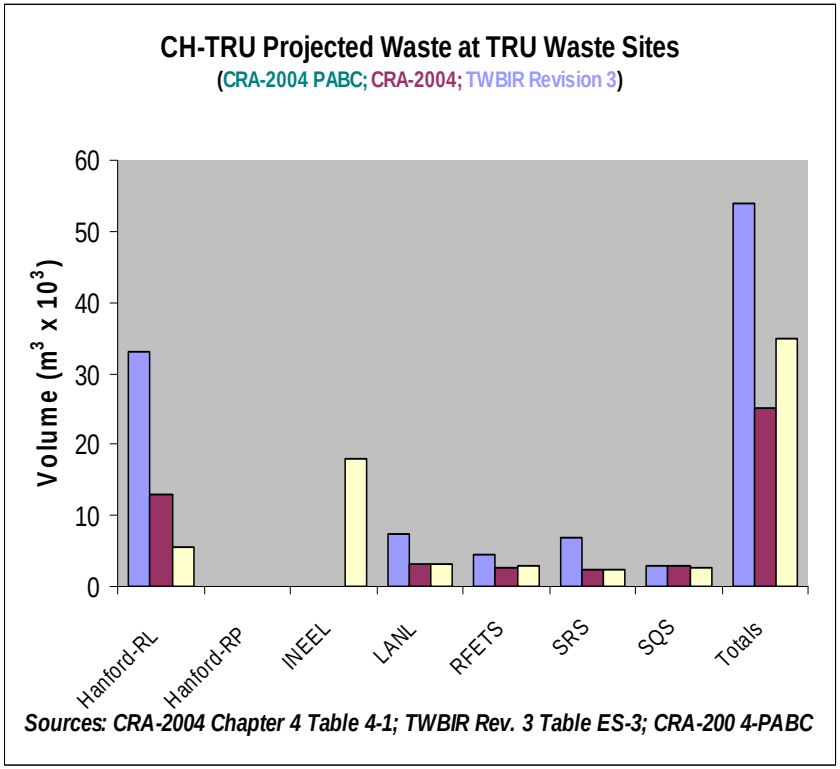




Source: CRA-2004 PABC

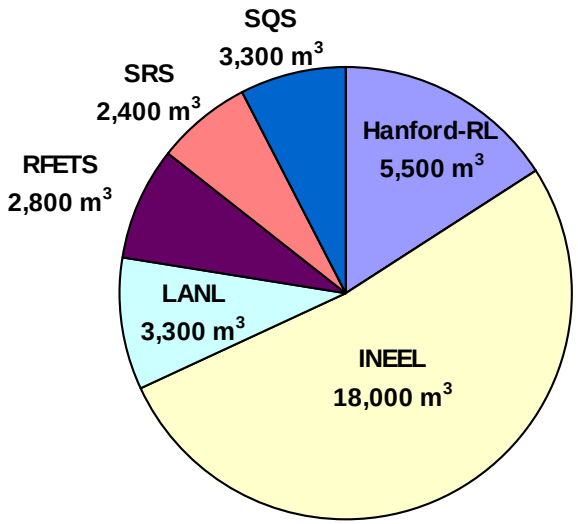
Total Stored RH-TRU volume is 5,300 m³.

CH-TRU Projected Waste at TRU Waste Sites



Sources: CRA-2004 Chapter 4 Table 4-1; TWBIR Rev. 3 Table ES-3; CRA-200 4-PABC

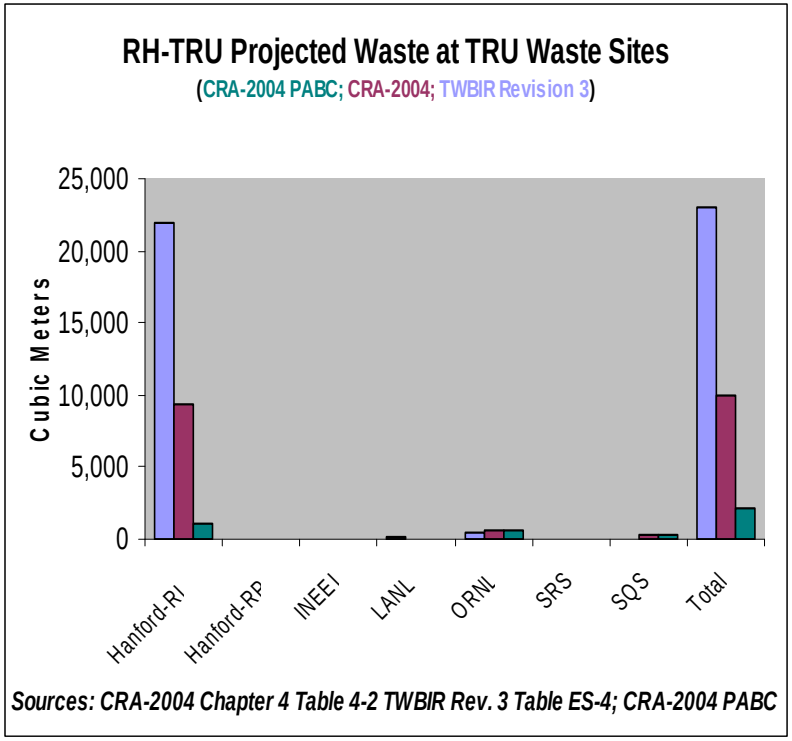
CH-TRU Projected Waste from TRU Waste Sites

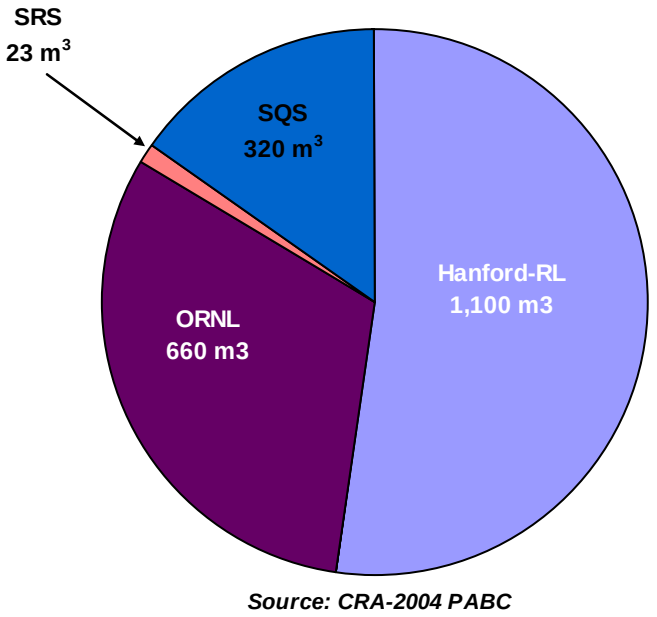


Source: CRA-2004 PABC

Total Projected CH-TRU volume is 35,000 m³.

RH-TRU Projected Waste at TRU Waste Sites





Total Projected RH-TRU volume is 2,100 m^3.

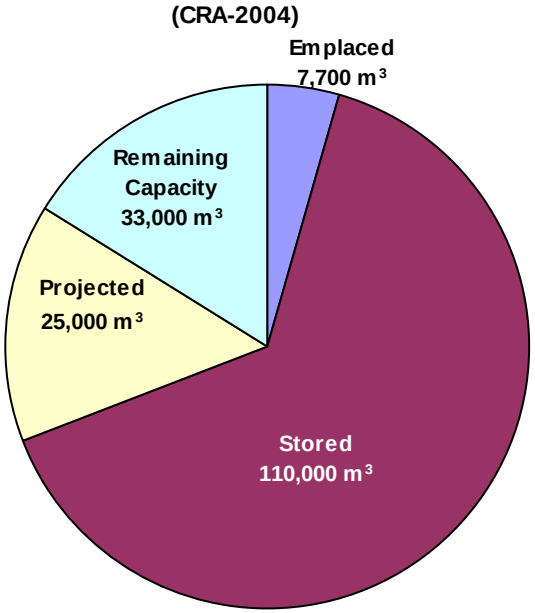
Disposal Inventory Volume

The inventory volume defined for waste emplacement in the WIPP to be used for CRA-2004 PA calculations. The LWA identifies the total amount of TRU waste allowed in the WIPP as approximately 175,540 m^3. The "Agreement for Consultation and Cooperation" limits the RH inventory to approximately 7,079 m^3.

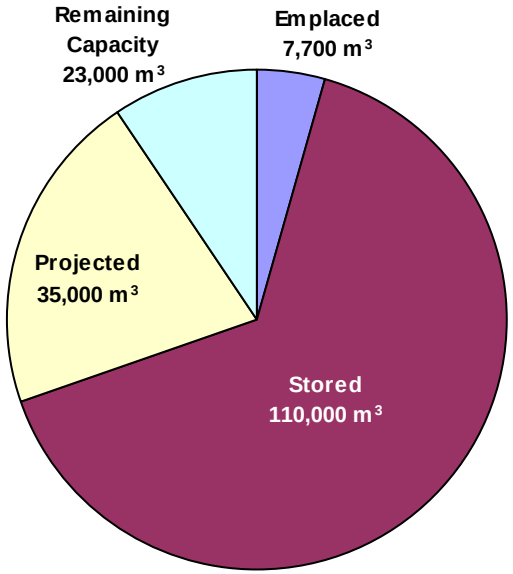
The resulting CH-TRU waste volume allowed would be 168,485 m^3.

CH-TRU Scaling Factor for CRA-2004 was 2.11; 1.48 for CRA-2004 PABC
RH-TRU Scaling Factor for CRA-2004 was 0.0172; 0.861 for CRA-2004 PABC

CH-TRU Waste Identified for Disposal at WIPP



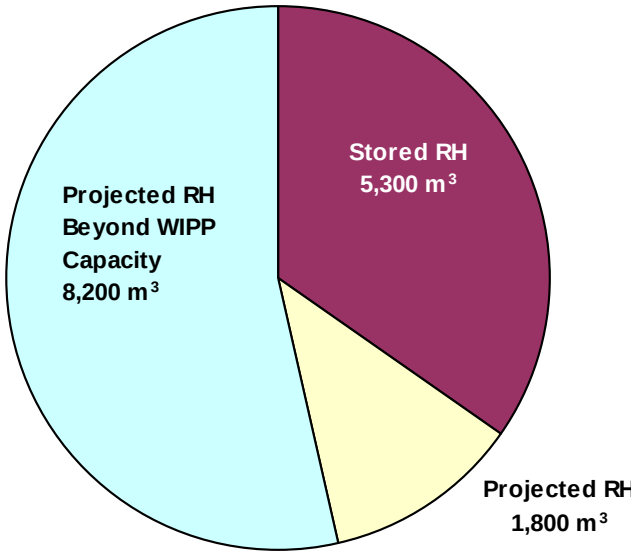
Source: CRA-2004 Table 4-1



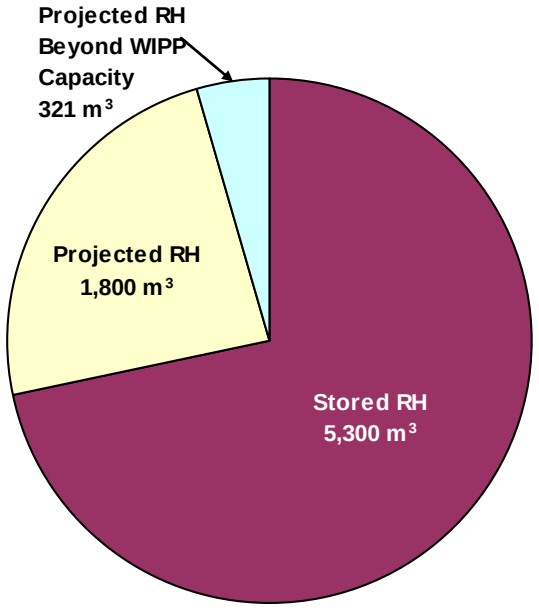
Source: CRA-2004 PABC

The CH-TRU waste volume allowed is 168,485 m^3.

RH-TRU Waste Identified for Disposal at WIPP



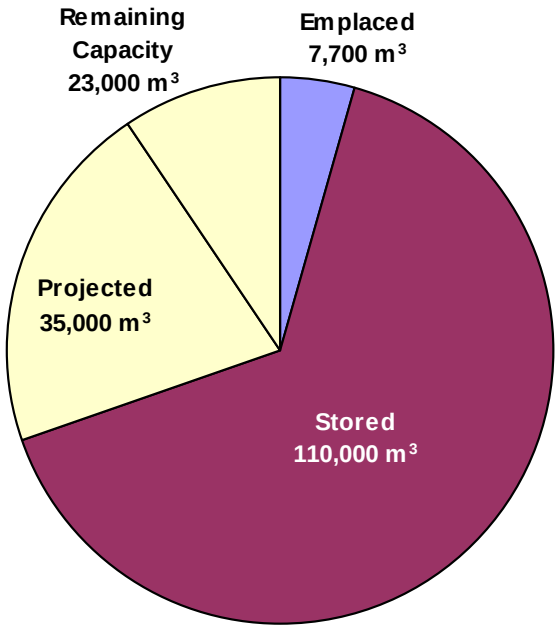
Source: CRA-2004



Source: CRA-2004 PABC

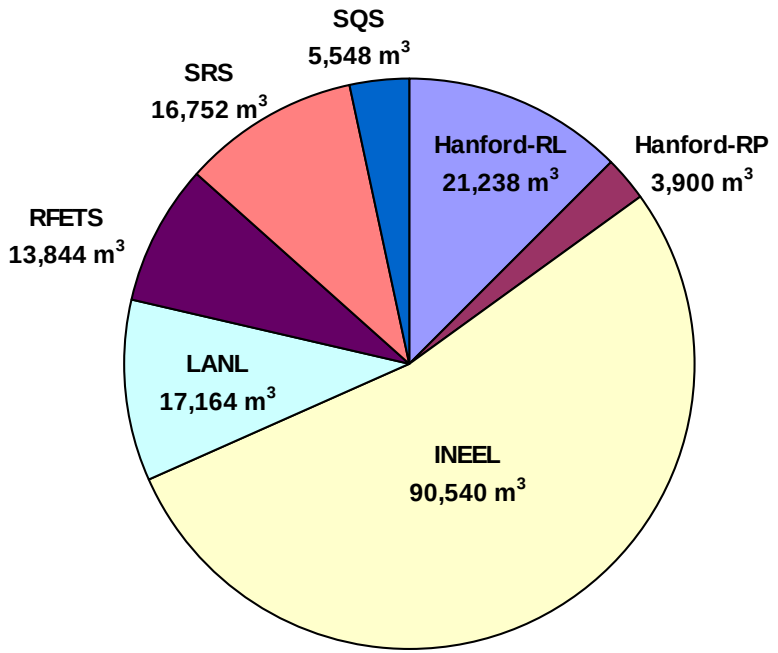
The RH-TRU waste volume allowed is 7,079 m^3.

CH-TRU Waste for Performance Assessment



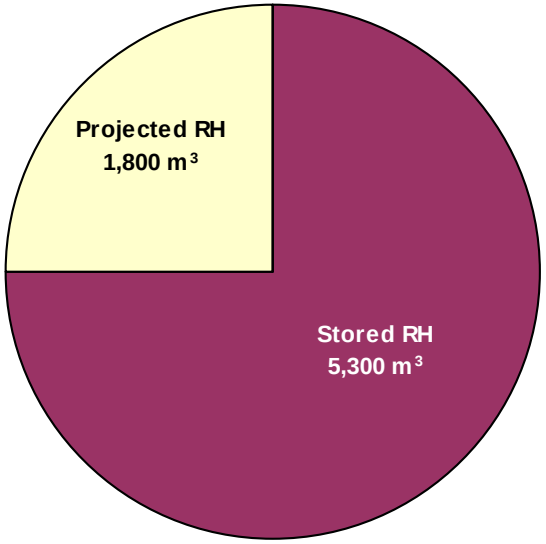
Source: CRA-2004 PABC

CH-TRU Waste Disposal Inventory for WIPP



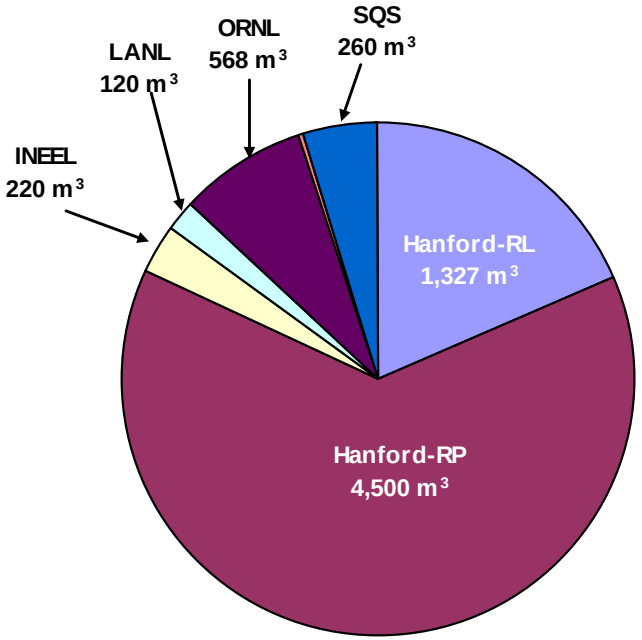
Source: CRA-2004 PABC

RH-TRU Waste for Performance Assessment



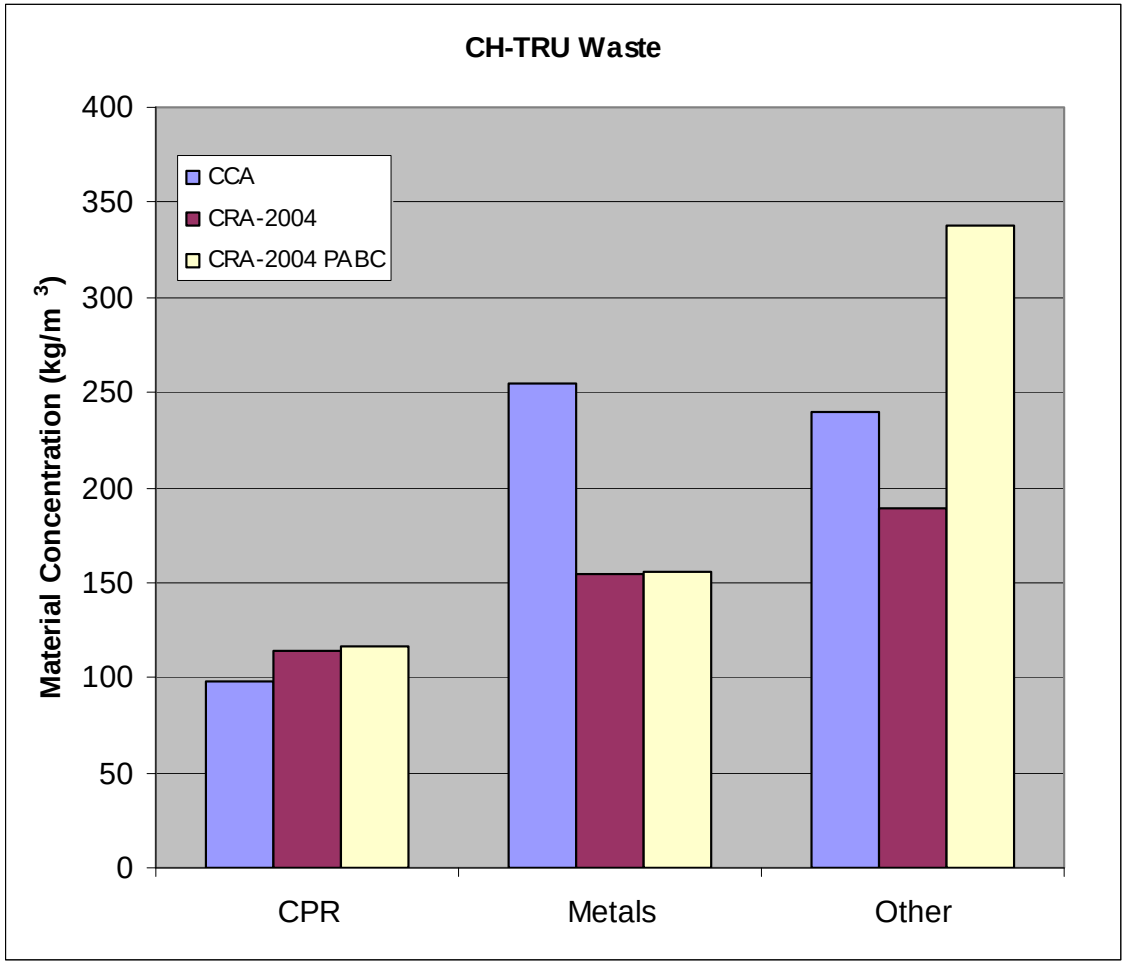
Source: CRA-2004 PABC

(Scaled to Disposal Capacity)

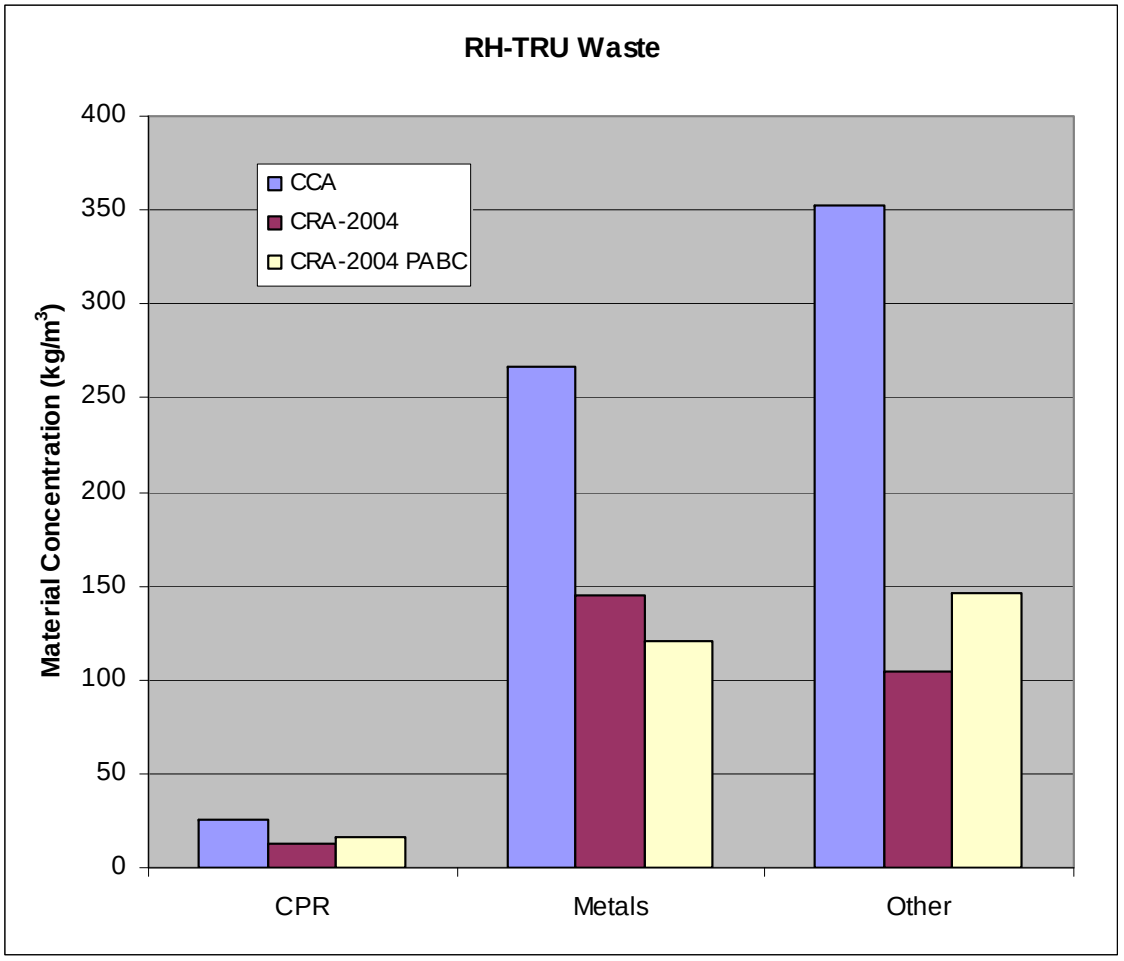


Source: CRA-2004 PABC

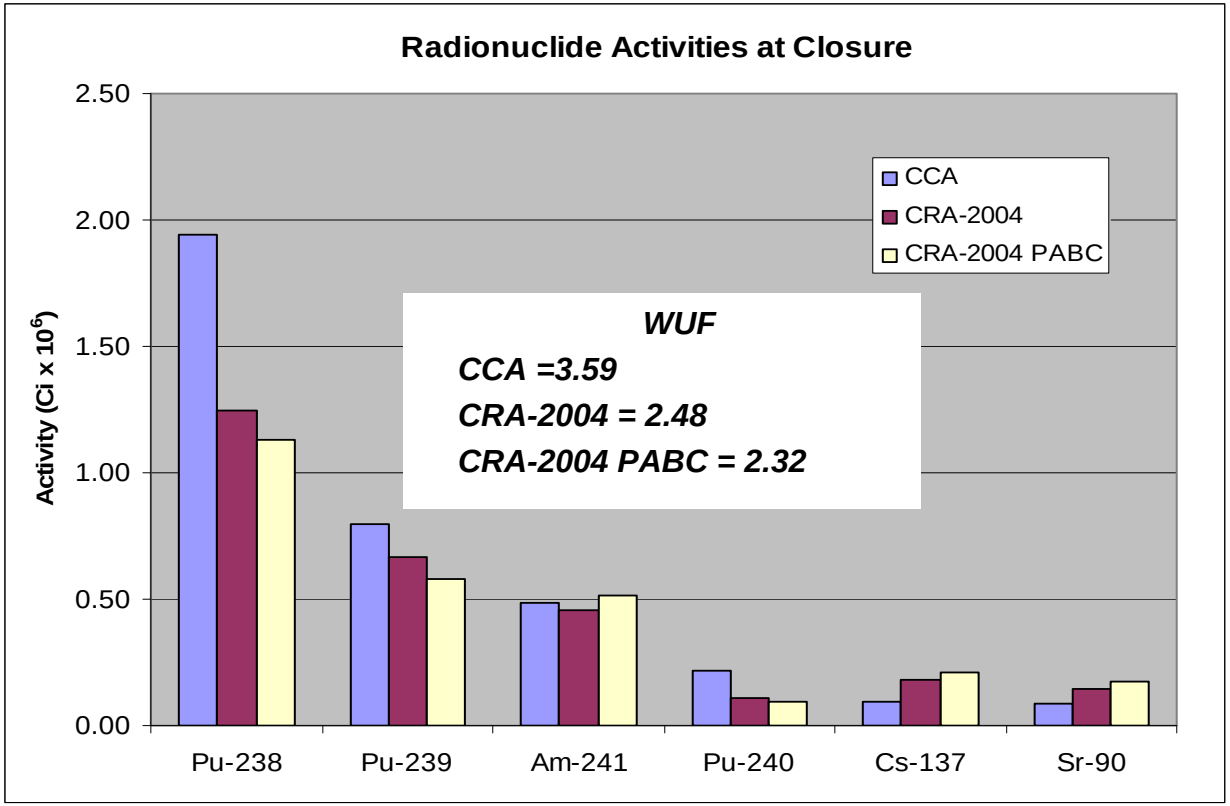
CH-TRU Waste Material Densities



RH-TRU Waste Material Densities



Radionuclide Activities in TRU Waste



Radionuclide Activities Decayed to Closure and Scaled for PA

Yucca Mountain Case Study

- **Review DOE YM Document - Scientific Analysis for Radionuclide Screening**

GTCC LLW EIS Case Study

- **Sandia was tasked with developing an inventory for GTCC LLW and DOE GTCC-like waste to support the upcoming GTCC LLW EIS**

GTCC LLW EIS Case Study

- **What do we really need to know about the waste?**
  - **What is needed for an EIS?**

How hot is it? (alpha, beta, gamma emitters)

How long-lived are the radionuclides?

Are there hazardous components?

How is the waste packaged or would be packaged?

How much will the packages weigh?

GTCC LLW EIS Case Study

- **How can we gather the information that is needed?**
  - **What is information sources are available**

Nuclear Utilities GTCC LLW – had to estimate (Schelling, Leigh, and Trone 2007)

Sealed Sources – used several databases and a budgeting forecast to get information (Schelling and Trone 2007)

DOE Activated Metals – site data calls

GTCC LLW and DOE GTCC-like process waste – site data calls

GTCC LLW EIS Case Study

- **How can we keep track of what we know?**
  - **What tools are available?**

Administrative Record
Sandia Records Center

Summary

- What do we really need to know about the waste?
  - (i.e., Inventory Characteristics that Affect Our Analyses)
- How can we gather the information that is needed?
  - (i.e., Waste Characterization)
- How can we keep track of what we know?
  - (i.e., Inventory Data Management)