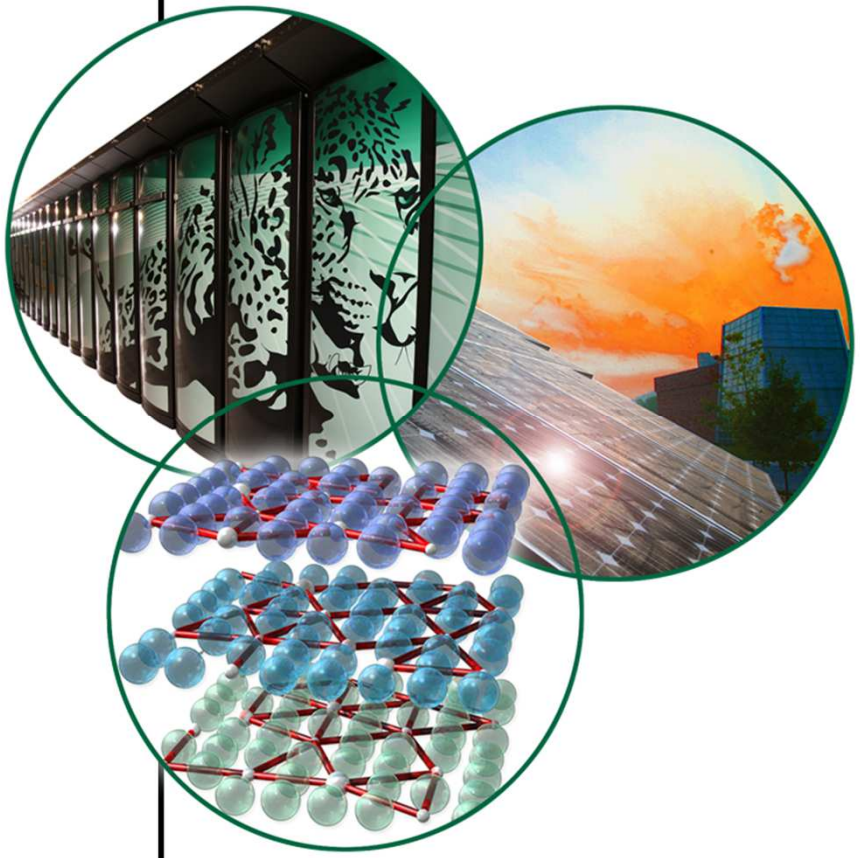
ORNL Enduring Waste Strategy Update

WM2013 EFCOG Session



Tim Forrester

February 27, 2013

U.S. DEPARTMENT OF ENERGY

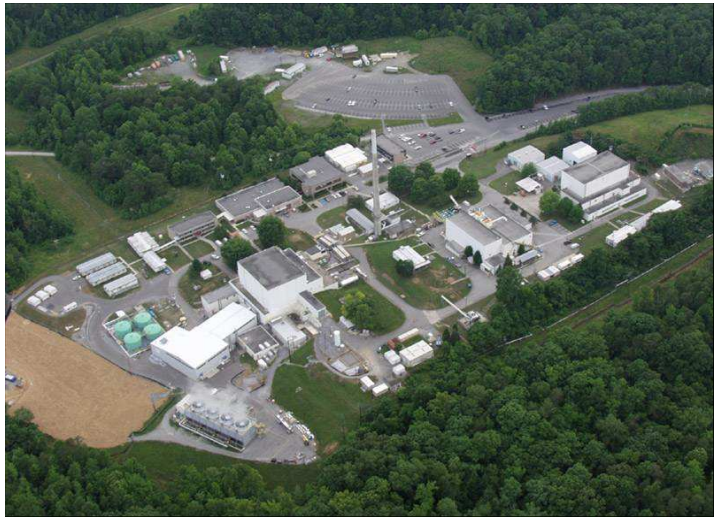
OAK RIDGE NATIONAL LABORATORY

MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

ORNL Future TRU Waste

ORNL will generate TRU waste into the future

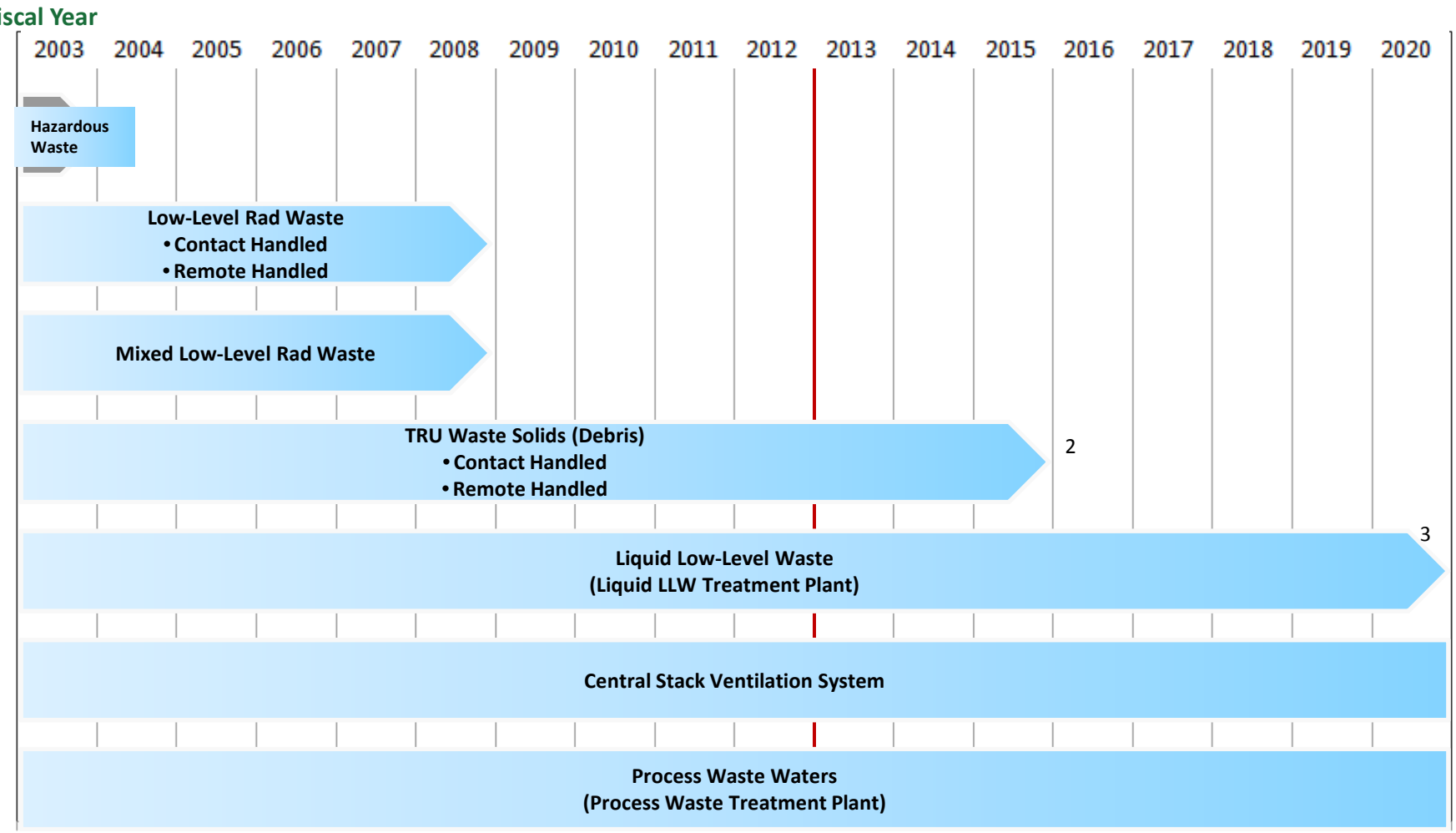
- **Contaminated hot cell and glove box debris**
- **Liquid waste with high levels of transuranic isotopes**



Location of generation:

- **Radiochemical Engineering Development Center (Buildings 7920 and 7930)**
- **Irradiated Fuels Examination Laboratory (Building 3525)**

Responsibilities for ORNL Newly Generated Waste Is Transferring from DOE-EM to DOE-SC



1 – Transfer per Hazardous Waste Pilot Project (EM still funded through FY 2008, but ORNL performed work via Work Authorization)

2 – Planning Date per 1/12/12 memo from Johnny Moore to Scott Branham

3 - Estimated

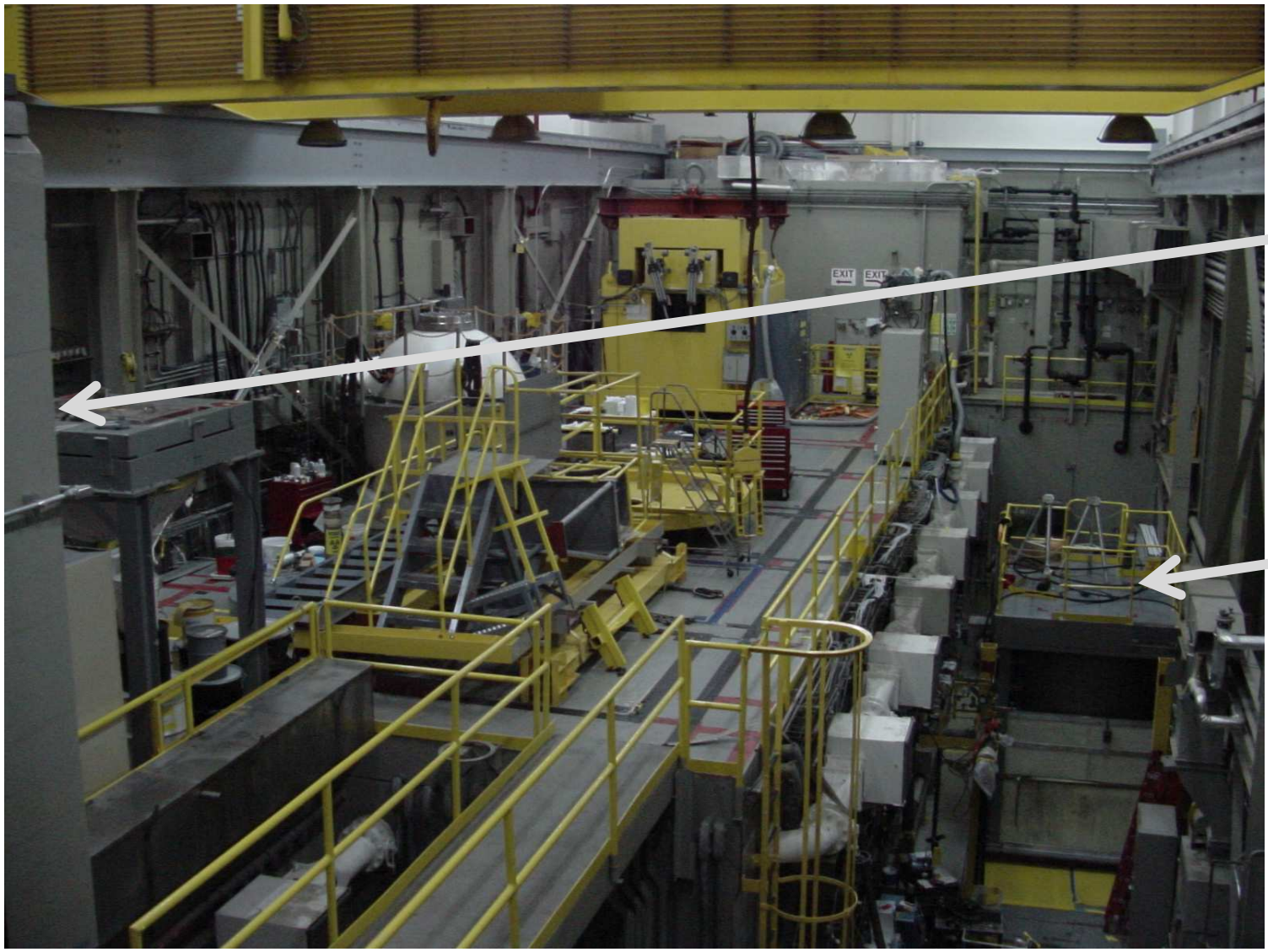
Future ORNL TRU Waste Generation

- Most of the future TRU debris will be generated at the Radiochemical Engineering Development Center (REDC)
  - Isotope separation of activated curium targets in the High Flux Isotope Reactor (HFIR) to produce ^{248}Cm, ^{249}Bk, ^{249}Cf, ^{252}Cf, ^{253}Es, ^{254}Es, ^{255}Fm, and ^{257}Fm
  - ^{238}Pu heat sources
- Some TRU debris from spent fuel examination at other hot cells
- Potential TRU solids from the processing of the liquid waste tanks
- Packaging CH TRU into 55 gallon drums to meet DOE N435.1 requirements will require process changes and modest facility enhancements. Overall, not a problem.
- Packaging RH TRU will require significant process changes and facility modifications

REDC Facility

RH TRU DEBRIS

REDC Facility Limited Access Area



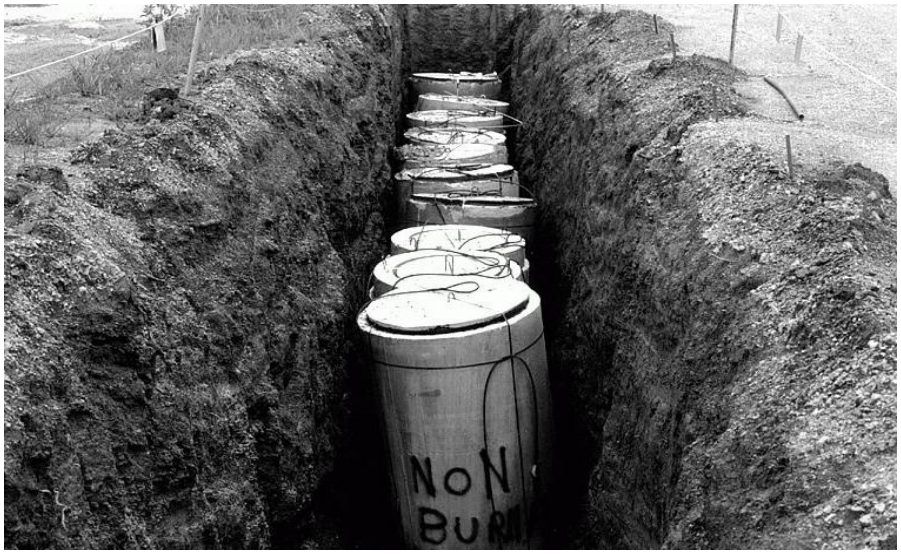
RH TRU Debris Packaging at REDC

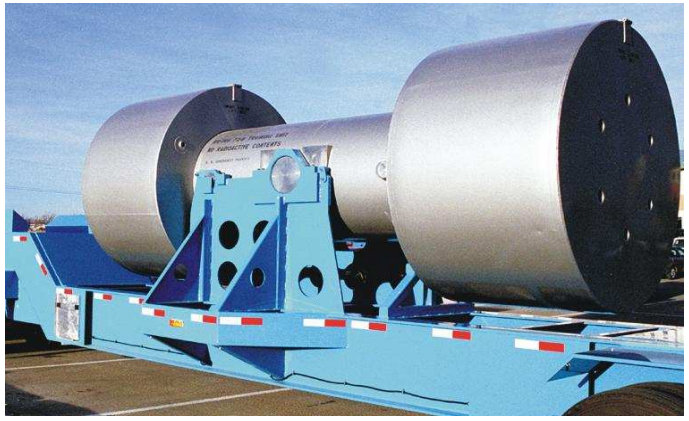
RH TRU Debris Packaging at REDC

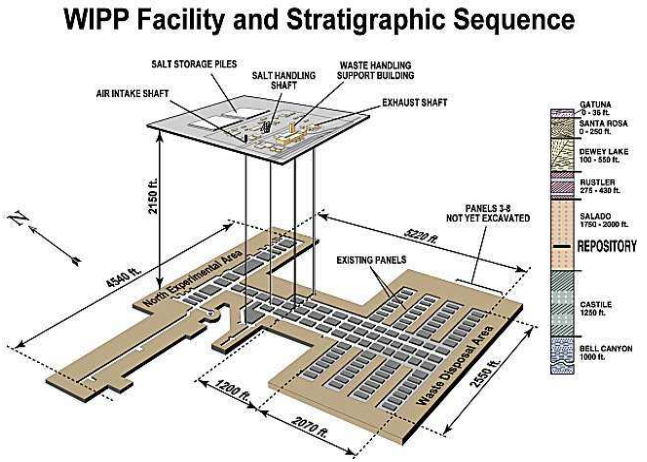
Attaching Transfer Case to Cell 9

Lifting Waste from Cell 9 into Transfer Case

Where we were, where we are going



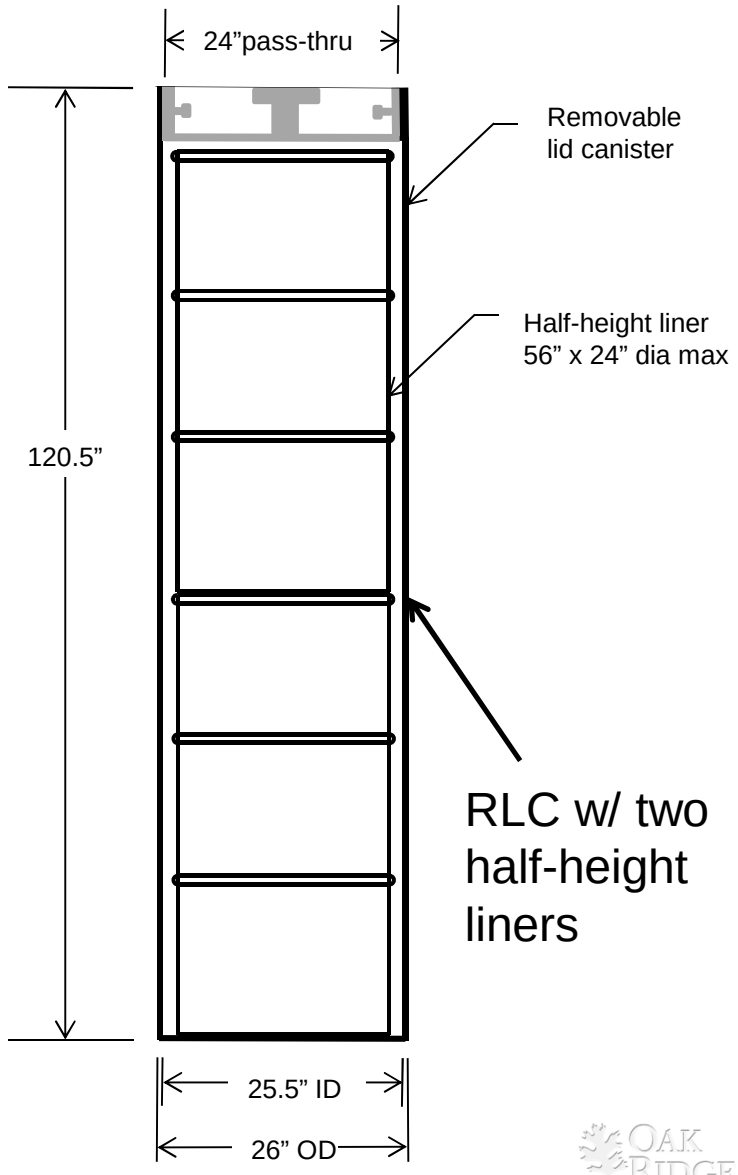




Half-height liner

The half-height liner:

- Improves the efficiency of packaging and loading operations, relative to using 55-gal drum
  - Reduces number of waste transfers from hot cells, which lessens impacts on facility production and R&D activities
  - Accommodates larger waste items, decreasing the need for size reduction
  - Reduces number of containers needed
  - Reduces personnel exposure during waste packaging and transfer operations
- Is compatible with size of bagged waste that can be loaded at generating facility using existing equipment
- Facilitates vertical handling and storage of loaded liners in shielded overpacks



Half-Height Liner Requirements

Dimensional envelope

- Overall height: 56” max.
- OD: 24” max.
- Note: Dimensional envelope is measured to highest point and greatest diameter including attachment ring/closure lugs and lifting features, if any

Payload weight

Liners shall be provided with two payload capacities:

- Model 1: 400 lb payload
- Model 2: 1500 lb payload
- Integral lifting features rated for the payload of each model shall be provided

Certification

- Containers shall be DOT 7A Type A certified

Material of construction

- Carbon steel

Other requirements

- Standard ¾” bung
- Liners shall be stackable (2 high)
- Attachment ring/closure lugs/lifting features do not impair ability to stack 2 high

UF_6 Cylinder Overpack

UF_6 cylinder overpack:

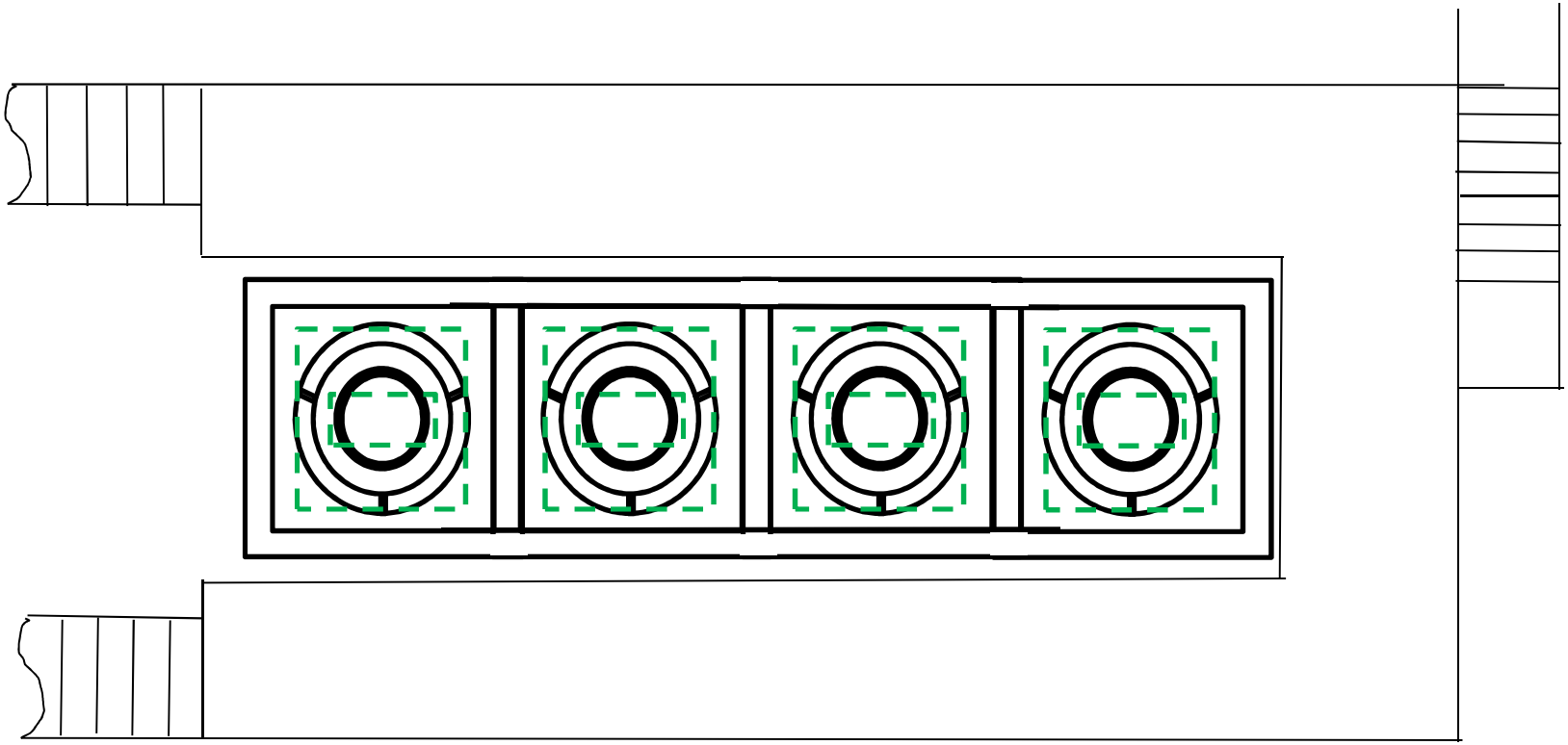
- Design and fabrication methods may be applicable to design and fab of half-height liners
- Controls costs by utilizing standard drums as basis for overpack fabrication
- Further study needed to determine if overpack lifting method can be used for liners

ANL Preuss Device/Closure Ring

ANL Preuss Device/Closure Ring:

- **Enables remote placement and closure of ring**
- **Inboard closure lugs allow loading of 55-gal drum into RH-TRU 72-B RLC**
- **Passed performance tests for DOT Type A package**
- **Reduces worker exposure during shipping operations**

Concept 1: Multiple Stations



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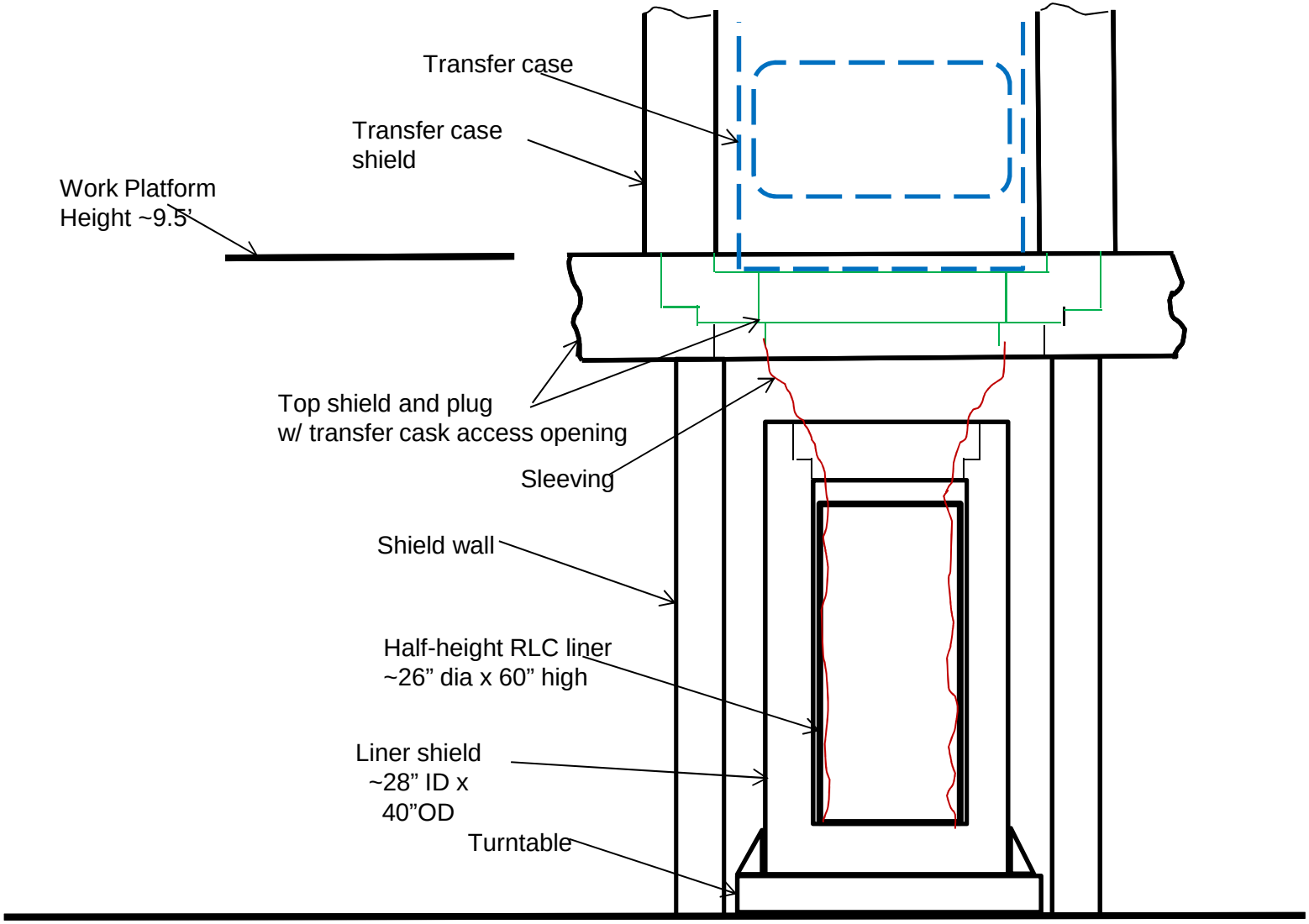


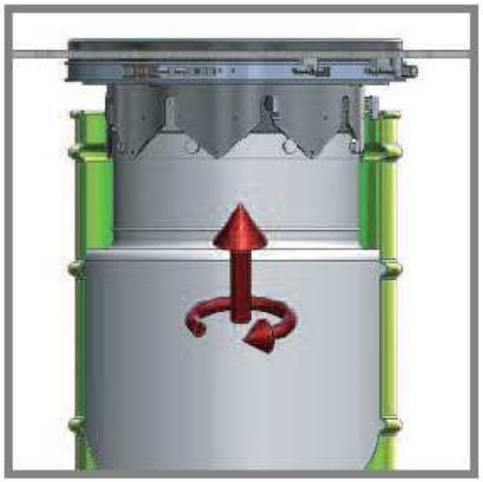
55-gal Drum Waste Transfer System
Central Research Laboratories

- Offers method to transfer waste into half-height liners without sealing waste in plastic bags in liners
- Applicability in high-alpha environment is to be determined
- System is commercially available and has been deployed at DOE/NNSA sites

55-gal Drum Waste Transfer System
Central Research Laboratories

Step 1: Drum Centered

Step 2: Drum Liner Aligned



Step 3: Full Insertion

Step 4: System Docked

RH TRU SOLIDS

Existing LLLW Tank Could Be Considered for Feed/Storage Tank

- 10,000 gal LLLW tank
- Tank needs to be upgraded with safety-significant controls

Future LLLW Generation Estimates for REDC

	Cs-137 (Ci/y)	Sr-90 (Ci/y)	Pu-238 (Ci/y)	Ru-106 (Ci/y)	Cf-252 (Ci/y)	Ce-144 (Ci/y)	Cm-244 (Ci/y)	Am-241 (Ci/y)	Sr-90 Eq (Ci/y)	TRU (nCi/g)
2007–2010 (Fuel Cycle R&D)	32	56	2	35	0.1	69	3	0.3	3,700	237
Cf-252 Production*	176	8	2	1,786	0.7	2,271	14	0.4	8,600	60-240
Mk-42 Segments*	15,126	2,841	1	4	0.3	-	116	2.5	50,700	90-400
Pu-238* 0.2 kg/yr (98% recovery)	43	15	61	437	-	460	0.02	0.06	42,600	1,250-5,400
Pu-238* 0.5 kg/yr (98% recovery)	110	38	150	1,090	-	1,150	0.05	0.2	106,500	3,130-13,500
Pu-238* 2 kg/yr (98% recovery)	428	151	612	5,240	-	5,500	0.2	0.6	426,000	10,400–45,000
Pu-238* 2 kg/yr (99.9% recovery)	428	151	31	5,240	-	5,500	0.2	0.6	26,000	530–2,300
EOI	2,090	457	613	5,690	0.2	6,070	16	1.0	434,000	12,500

* Range based on 3,000-13,000 gal/year LLLW generated at REDC

Small-Scale Evaporation Tests of REDC LLLW Simulant

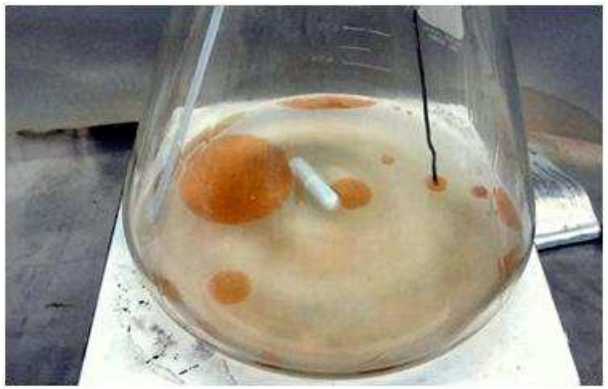
Composition of LLLW Simulant

Chemical	Concentration (*M*)
Na_2CO_3	0.13
NaOH	0.22
$NaNO_3$	0.46
NaCl	0.18
$Al(NO_3)_3$	0.02

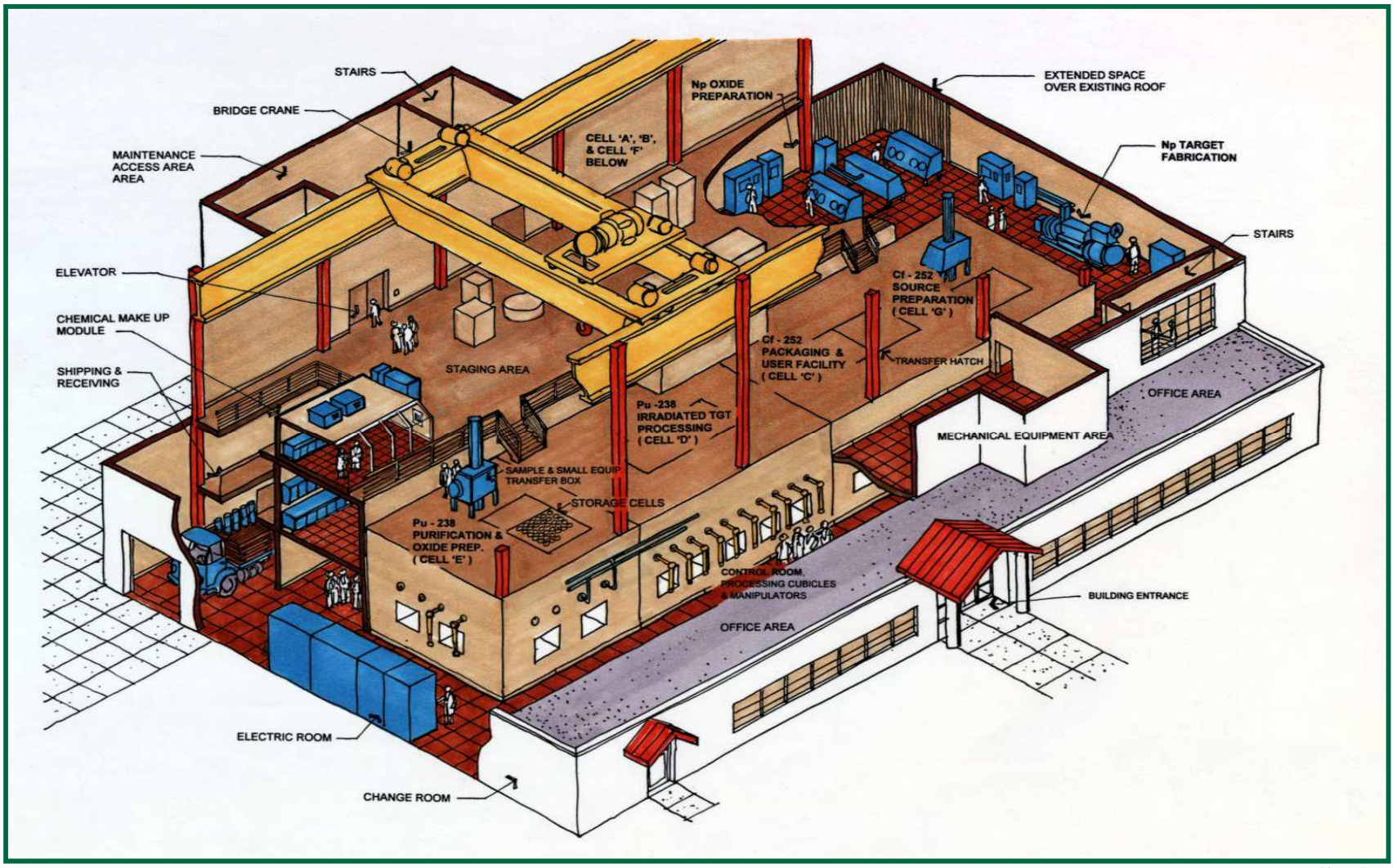
Tests conducted in 2-L flask on hot plate.
Started with 500 mL simulant, 500 mL water,
and 12.5 mL of organic mixture.
Volume reduction was 5.3X (2.6X for just REDC simulant).
Condensate contained about 40% of starting organics.
DF = 2500 and >12,500
0.025 wt% solids in concentrate

Organics – a mix of D-60, ULN-150, TBP, HDEHP, 2-E-1-H, etc.

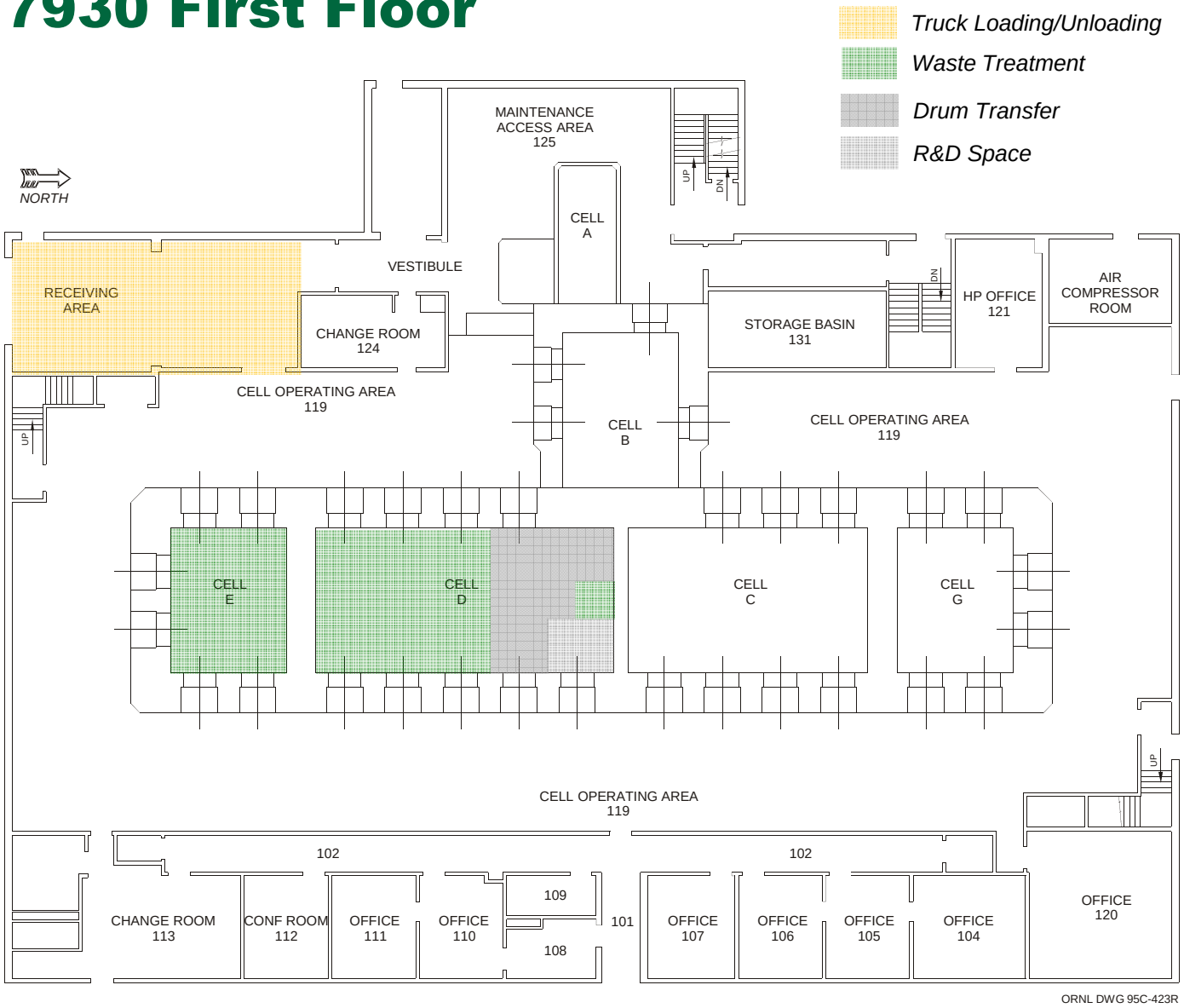
Concentrate after evaporation



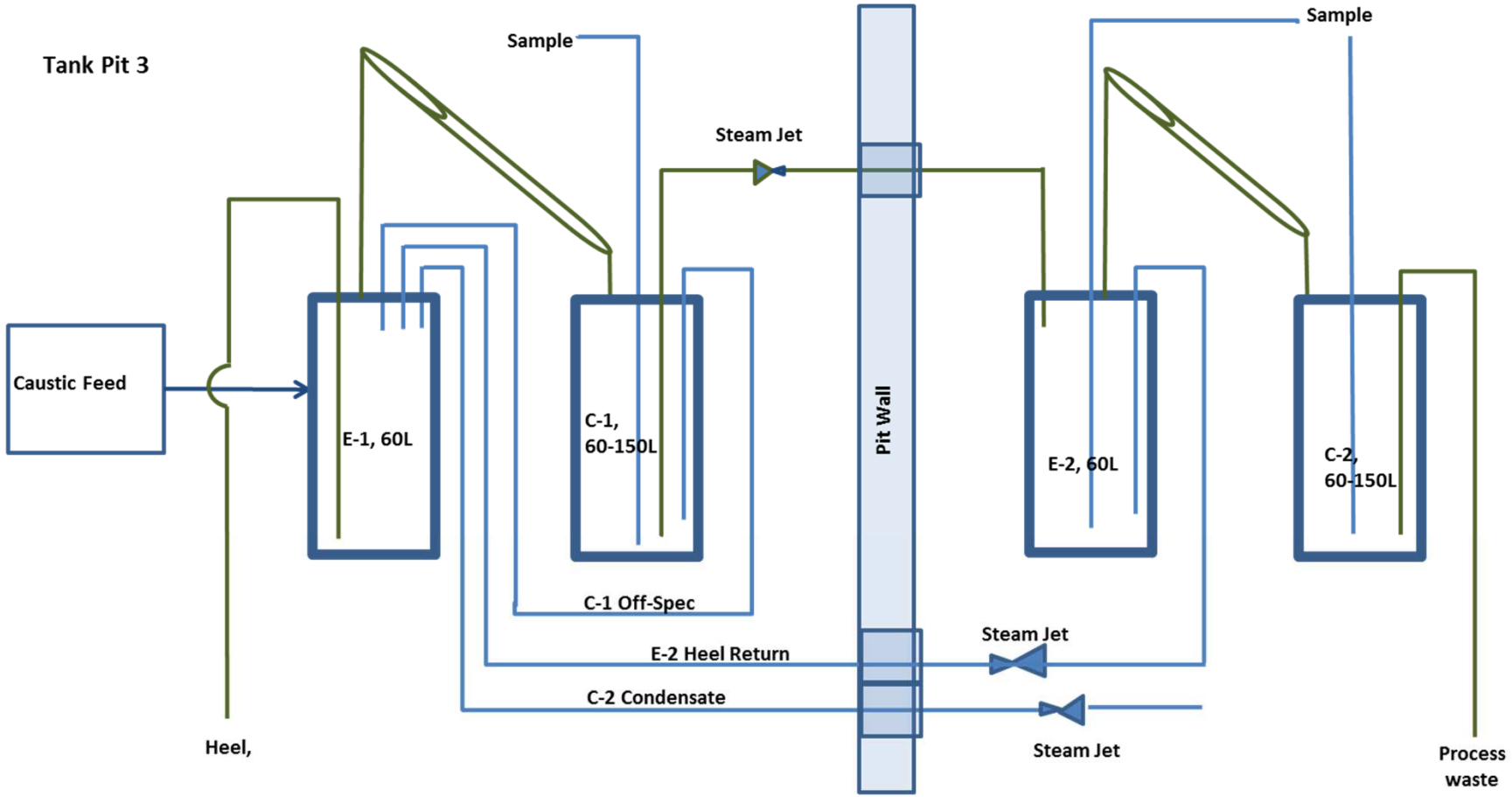
Existing Facility Being Considered to House LLLW Processing Equipment



Previous LLLW and RH Solids Treatment Studies
Building 7930 First Floor

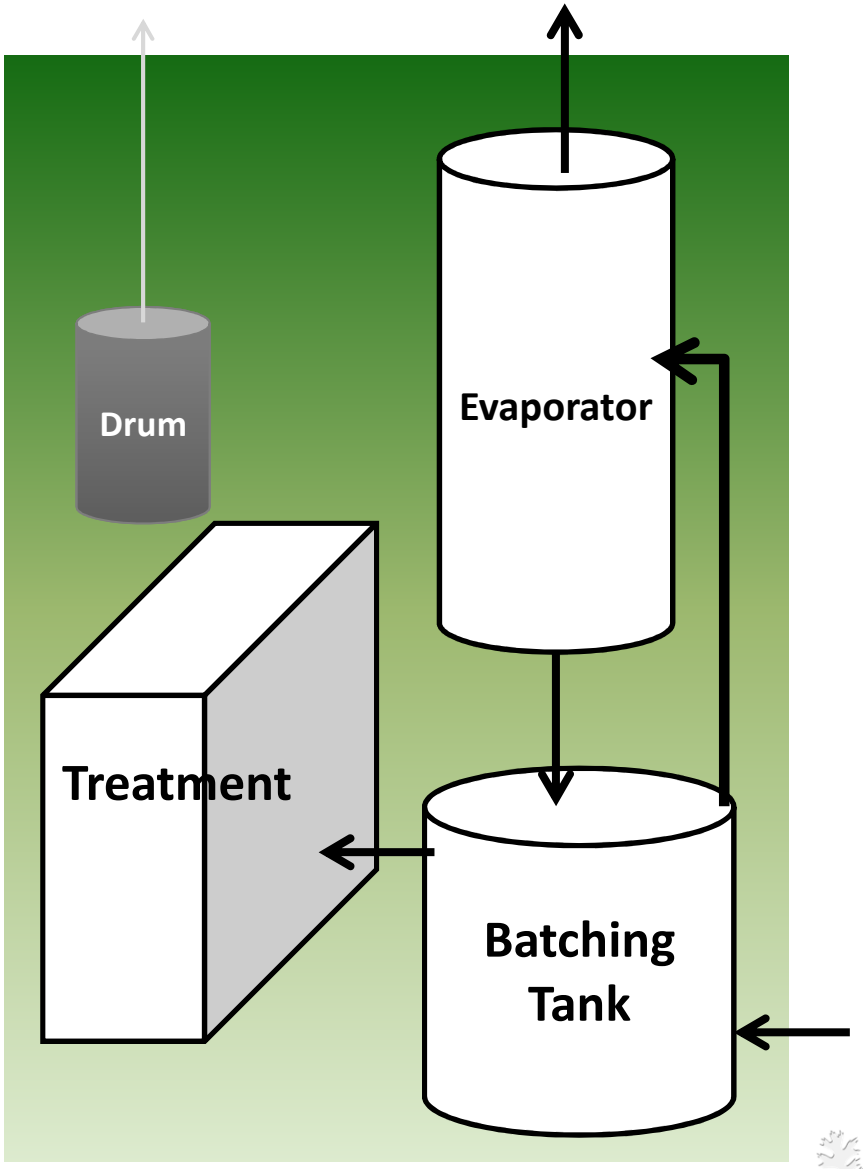


Potential Evaporator System if Installed in Tank Pits



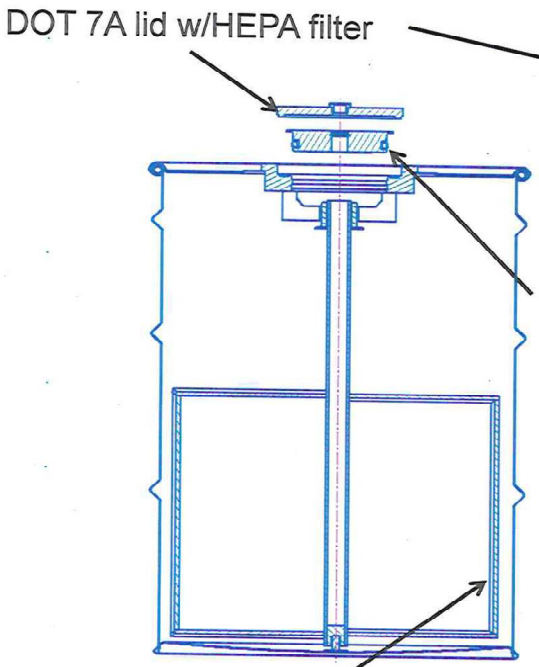
In-Cell Processing Concept Under Consideration

- Early in conceptual design phase
- Accepts liquids in batches then concentrates via evaporation to reduce storage requirements
- Tank content sampled per CCP requirements
- Treatment with grout into drums
- Drums of solid waste removed and shipped in 72-B to WIPP



SRS WSB Grouting System Concept

WSB DOT 7A 55-gallon Drums



Drum is received at SRS with cement and paddle

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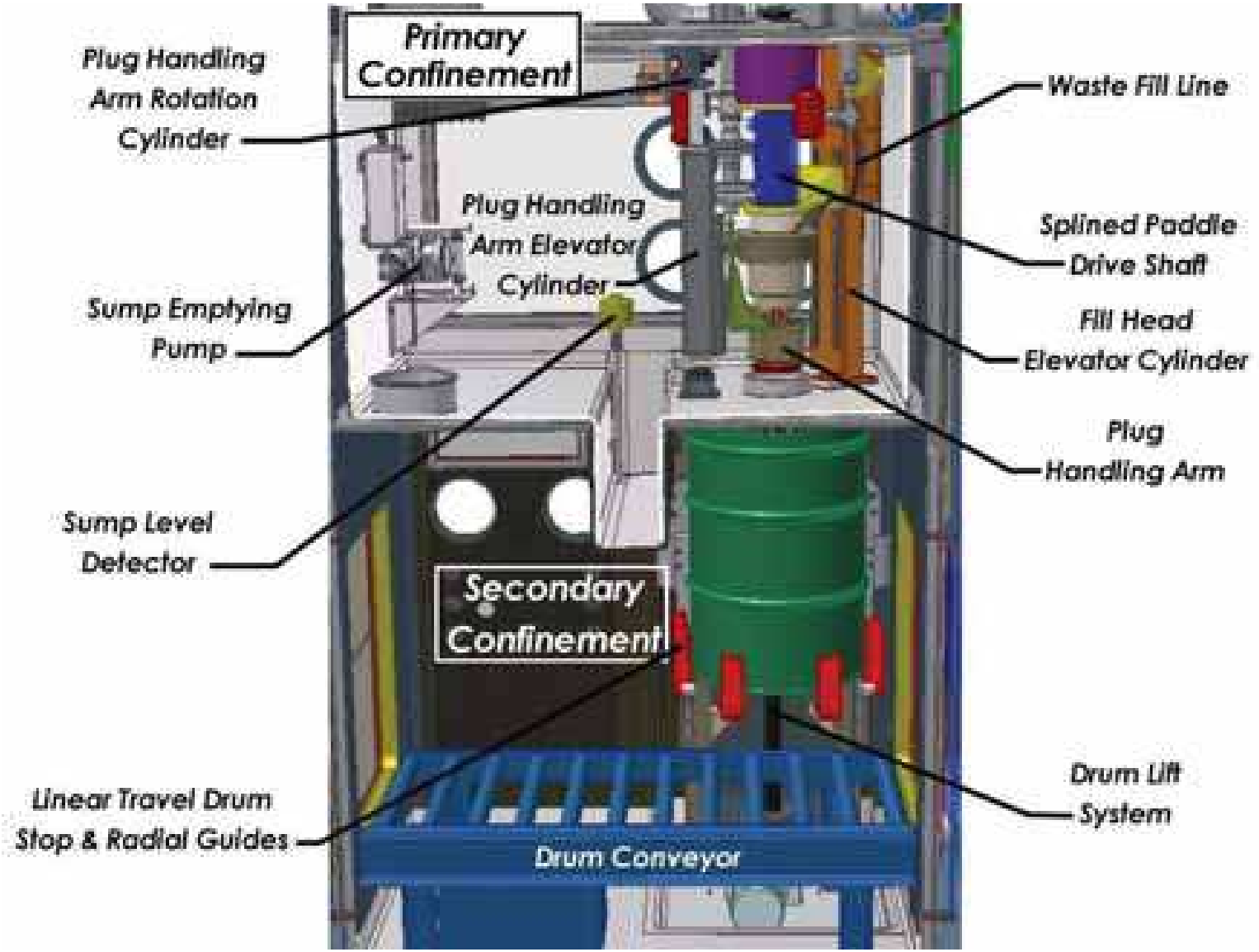
SRS WSB Grouting System Concept



Remote RH TRU Loading

- Remote loading of the RLC with inner packages (i.e., drums or liners)
- Storage of loaded and certified RLC pending 72B cask availability
- Loading of RLC into the 72B

QUESTIONS ?