CONCEPTUAL DESIGN REPORT FOR REMEDIAL ACTION AT THE CHEMICAL PLANT AREA OF THE WELDON SPRING SITE, VOLUME II TECHNICAL INFORMATION DOCUMENT BOOK 3 OF 5

Weldon Spring Site Remedial Action Project
Weldon Spring, Missouri

JANUARY 1994

REV. 0

U.S. Department of Energy
Oak Ridge Operations Office
Weldon Spring Site Remedial Action Project

Book 1 of 5 contains Sections 1-5

Book 2 of 5 contains Sections 6-12

Book 3 of 5 contains the figures for all sections

Book 4 of 5 contains the tables for all sections

Book 5 of 5 contains Appendix A, Unpublished Documents, and Appendix B, Acronyms
Weldon Spring Site Remedial Action Project


Figures
Book 3 of 5

Revision 0

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U.S. DEPARTMENT OF ENERGY
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SITE LAYOUT PRIOR TO REMEDIATION ACTIVITIES

FIGURE 1-3

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EXHIBIT NO.: A/CP/061/0693
ORIGINATOR: RJS
DRAWN BY: GLN
DATE: 6/29/93
PRIMARY SUBSURFACE DATA COMPONENTS

FIGURE 2-2
LEGEND

---

EXISTING OR PROPOSED DIRTY ROADS
EXISTING OR PROPOSED CLEAN ROADS
OUTLINE OF DISPOSAL CELL TO BE CONSTRUCTED LATER
REMOVING STOCKPILE MATERIAL AND PLACING INTO DISPOSAL CELL
WASTE PLACEMENT IN CELL
DREDGE WASTE FROM RAFFINATE PITS
TOP & BOTTOM LINER REMOVAL OF RAFFINATE PITS
CELL CLOSURE (COVER)

MATERIAL REMOVAL
SEQUENCE 3

FIGURE 5.1.2-8

DOE/OR/21548-411

3840/FRAN3.DGN

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* MATERIAL REMOVAL & TRANSPORTATION

**WINTER SHUTDOWN PERIOD**

REFERENCE: REPPOND D., 1992
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* MATERIAL REMOVAL & TRANSPORTATION

WINTER SHUTDOWN PERIOD
REFERENCE: REPPOND D., 1992

VIT SCHEDULE

FIGURE 5.1.2-12
NOTE:
SEE FIGURE 5.1.4–3(3 of 3)
FOR DESCRIPTION OF AREA NUMBERS

PROPOSED CONSTRUCTION MATERIALS
STAGING AREA (CMSA) LOCATIONS
(1 OF 3)

FIGURE 5.1.4–1

REPORT NO: DOE/OR/21548-411 DRAWING NO: 
ORIGINATOR: MLB DRAWN BY: HK DATE: NOV. 92
NOTE:
SEE FIGURE 5.1.4-3 (3 of 3)
FOR DESCRIPTION OF
AREA NUMBERS

PROPOSED CONSTRUCTION MATERIALS
STAGING AREA (CMSA) LOCATIONS
(2 of 3)

FIGURE 5.1.4-2

REPORT NO: DOE/OR/21548-411 DRAWING NO:
ORIGINATOR: MLB DRAWN BY: HK DATE: NOV. 92
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<td>QUARRY HAUL ROAD EASEMENT. AREA WITHIN QUARRY HAUL ROAD 100-FT. EASEMENT.</td>
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CONSTRUCTION MATERIALS STAGING AREA (CMSA) SITE LAYOUT

FIGURE 5.1.4-4

REPORT NO: DOE/OR/21548-41 | DRAWING NO:
ORIGINATOR: MLB | DRAWN BY: HK | DATE: NOV. 92
AREAS OF CONTAMINATION
PRIOR TO DISPOSAL CELL CONSTRUCTION

FIGURE 5.1.5-2
CONSTRUCTION OF DISPOSAL CELL (SEQUENCE 1)

FIGURE 5.1.5-3

LEGEND

- Existing or proposed dirt roads
- Existing or proposed clean roads
- Outline of disposal cell to be constructed later
- Excavation of contaminated materials, soil, concrete, metal & piping
- Contaminated soil and/or concrete
- Stockpile contaminated material from quarry to be removed later
- Stockpile of clean soil from the chemical plant area
- Existing contaminated material to be removed later

NOTE:
Clean fill dikes will be built after the chemical plant area is cleaned up.
CONSTRUCTION OF DISPOSAL CELL (SEQUENCE 3)

FIGURE 5.1.5-5
VIT ALTERNATIVE CONSTRUCTION OF DISPOSAL CELL
1 MILLION C.Y. OF WASTE (CLOSURE PHASE)

FIGURE 5.1.5-9

LEGEND

CELL CLOSURE (COVER)
CLEAN ROADS

SCALE
0 100 200 300 400
30.5 61.7 182.9 550.8 METERS

FEET

REPORT NO.
DOE/OR/21548-411

DRAWING NO.
384081/SE07.DGN

ORIGINATOR
NLB / FJG

DRAWING BY
AMF

DATE
09/07/93
NOTES:
1. EXISTING UTILITIES ALONG M.S.R. 94 TO BE RELOCATED AS NECESSARY.
2. SEE FIGURE 5.1.5-16 FOR SECTION B-B
3. SEE FIGURE 5.1.5-15 FOR SECTION A-A
4. ACCESS ROADS FROM HIGHWAY 94 TO BE PROVIDED, AS SHOWN, FOR DELIVERY TRUCKS TO EXIT OFF OF HIGHWAY 94 AND ENTER ONTO THE HAUL ROAD

ALTERNATIVE NO.2
TRUCK ALIGNMENT
MISSOURI STATE ROUTE 94
BORROW HAUL ROAD CROSSING

FIGURE 5.1.5-14
BORROW HAUL ROAD
TYPICAL CROSS SECTIONS
HIGHWAY & OFF-HIGHWAY TRUCKS
(SECTION A-A)

FIGURE 5.1.5-15

REPORT NO. DOE/OR/21548-411 DRAWING NO. 1
ORIGINATOR: MLB DRAWN BY: KSR DATE: SEPT. 92
TWO-WAY OFF-HIGHWAY TRUCK UNDERCROSSING

ONE-WAY OFF-HIGHWAY TRUCK UNDERCROSSING

NO SCALE

MISSOURI STATE ROUTE 94/BORROW HAUL
ROAD CROSSING - SECTION B-B

FIGURE 5.1.5-16
TYPICAL OVERLAND CONVEYOR INSTALLATION AT GRADE

CONVEYOR SYSTEM UNDERCROSSING AT MISSOURI STATE ROUTE 94

NOT TO SCALE

CONVEYOR SYSTEM TYPICAL CROSS SECTIONS

FIGURE 5.1.5-17

REPORT NO.: DOE/OR/21548-411
DRAWING NO.:

ORIGINATOR: MLB
DRAWN BY: KSR
DATE: SEPT. 92
SURFACE WATER FEATURES AND DRAINAGES AT THE WSS

FIGURE 5.1.6-1

REPORT NO.: DOE/OR/21548-411 DRAWING NO.: 
ORIGINATOR: S.B. DRAWN BY: K.W. DATE: NOV., 1992
STORM DRAINAGE DITCH
(UNCONTAMINATED RUNOFF)

ROAD DRAINAGE DITCH
(POTENTIAL CONTAMINATED RUNOFF)

DRAINAGE ON DIRTY
HAUL ROADS
NOT TO SCALE

FINISHED GRADE
FILTER FABRIC

Yn + FREE BOARD

INVERT ELEVATION
COMPACTED SUBGRADE

TYPICAL RIPRAP DIVERSION DITCH SECTION
NOT TO SCALE

VARIABLES
Yn = NORMAL DEPTH

SITE DRAINAGE DETAILS—DITCHES

FIGURE 5.1.6-3
SITE DRAINAGE SYSTEM DURING DISPOSAL CELL CONSTRUCTION
(END OF SEQUENCE ONE)

FIGURE 5.1.6-4

REPORT NO. DOE/OR/21548-411 DRAWING NO. 384001/564-10
ORIGINATOR: SCB DRAWN BY: Cwf DATE: 09/01/93
SITE DRAINAGE SYSTEM DURING DISPOSAL CELL CONSTRUCTION
(END OF SEQUENCE TWO)

FIGURE 5.1.6-5

LEGEND:

A-Z, AA, AB: WATERSHED
---: WATERSHED BOUNDARY
→: OVERLAND FLOW DIRECTION
----: DIRECTED FLOW
↑: CONTAMINATED DISCHARGE LOCATION
○: UNCONTAMINATED DISCHARGE LOCATION
△: CULVERT

SCALE:
0 200 400 600 800 FEET
0 62.5 125 250 500 METERS

REPORT NO.: DOE/OR/21548-411
DRAWING NO.: 384001/564-1b
ORIGINATOR: SCB
DRAWN BY: Cwf
DATE: 09/02/93
SITE DRAINAGE SYSTEM DURING DISPOSAL CELL CONSTRUCTION
(END OF SEQUENCE THREE)

LEGEND:

- A, S, AA, AB: WATERSHED
- Dashed Line: WATERSHED BOUNDARY
- Arrows: OVERLAND FLOW DIRECTION
- Solid Line: DIRECTED FLOW
- Circle with Cross: CONTAMINATED DISCHARGE LOCATION
- Circle with Cross Outline: UNCONTAMINATED DISCHARGE LOCATION
- Chevron: CULVERT

FIGURE 5.1.6-6

REPORT NO.: DOE/OR/21548-411
DRAWING NO.: 384001/564-1c
ORIGINATOR: SCB
DRAWN BY: Cwf
DATE: 09/02/93
SITE DRAINAGE SYSTEM DURING DISPOSAL CELL CONSTRUCTION (END OF SEQUENCE FOUR)

FIGURE 5.1.6-7

LEGEND:
- A-Z, AA, AB: WATERSHED
- Dashed line: WATERSHED BOUNDARY
- Arrows: OVERLAND FLOW DIRECTION
- Solid line: DIRECTED FLOW
- Arrowhead: CONTAMINATED DISCHARGE LOCATION
- Circle: UNCONTAMINATED DISCHARGE LOCATION
- Triangle: CULVERT

REPORT NO.: DOE/OR/21548-411
DRAWING NO.: 384001/564-1d
ORIGINATOR: SCB
DRAWN BY: Cwf
DATE: 09/02/93
SITE DRAINAGE SYSTEM DURING DISPOSAL CELL CONSTRUCTION (END OF SEQUENCE FIVE)

FIGURE 5.1.6-8

LEGEND:
- W - WATERED BOUNDARY
- O - OVERLAIN FLOW DIRECTION
- D - DIRECTED FLOW
- L - CONTAMINATED DISCHARGE LOCATION
- U - UNCONTAMINATED DISCHARGE LOCATION
- C - CULVERT

REPORT NO.: DOE/OR/21548-411
DRAWING NO.: 384001/564-1e

ORIGINATOR: SCB
DRAWN BY: Cwf
DATE: 09/02/93
TYPICAL RETENTION POND
NOT TO SCALE

TYPICAL PERMANENT CHANNEL
NOT TO SCALE

VARIABLES
$\gamma_h =$ NORMAL DEPTHS
$B =$ BOTTOM WIDTH
$T =$ TOP WIDTH
$D_{50} =$ MEDIAN RIPRAP SIZE
$\rightarrow =$ RUNOFF

SITE DRAINAGE DETAIL RETENTION PONDS
AND PERMANENT CHANNELS

FIGURE 5.1.6-9

REPORT NO.: DOE/OR/21548-411DRAWING NO.:  
ORIGINATOR: S.B. DRAWN BY: K.W. DATE: NOV., 1992
TYPICAL LINED (EROSION PROTECTION MAT) TEMPORARY CHANNEL
NOT TO SCALE

TYPICAL GRASS LINED TEMPORARY CHANNEL
NOT TO SCALE

VARIABLES

\( Yn \) = NORMAL DEPTH
\( B \) = BOTTOM WIDTH

SITE DRAINAGE DETAILS
TEMPORARY CHANNELS

FIGURE 5.1.6-10

REPORT NO.: DOE/OR/21548-411
DRAWING NO.: 1
ORIGINATOR: S.B.
DRAWN BY: K.W.
DATE: NOV., 1992
ROCK RIPRAP DROP STRUCTURE
(PROTECTION UPSTREAM AND DOWNSTREAM)
NOT TO SCALE
Section A-A
(from 5.1.7-3)

Typical Soil Profile at the Weldon Spring Wildlife Area (WSWA) Site

Figure 5.1.7-5

Legend:
GTBS - Geotechnical Borehole, Borrow Source
BOH - Bottom of Hole

Auger refusal (probable top of weathered bedrock)
LEGEND
OUTLINE OF DISPOSAL CELL
(To be constructed)

ELECTRICAL DISTRIBUTION SYSTEM

FIGURE 5.1.8-1

DOE/OR/21548-411

E.G.C.  G.V.R  APRIL 1993
TYPICAL PLAN VIEW

QC/PHYSICAL TESTING TRAILER

FIGURE 5.1.8-6
NOTES
1. APPROXIMATE SIZE - 2 ACRES
2. SURFACING IS AGGREGATE
3. SEE FIGURE 5.1.8.9 FOR LOCATION

CONTAMINATED CONSTRUCTION EQUIPMENT
MAINTENANCE AREA

FIGURE 5.1.8-10

REPORT NO. DOE/OR/21548-411
DRAWING NO. W03840/ECS101.DGN
ORIGINATOR E.G.C.
CHECKED BY G.W.R.
DATE APRIL 1993
PLAN VIEW

(SEE FIGURE 5.1.8-9 FOR PROPOSED TRAINING CENTER LOCATION)

RADIiological TRAINING CENTER

FIGURE 5.1.8-12

<table>
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<td>E.G.C.</td>
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<tr>
<td>DRAWING BY</td>
<td>G.W.R</td>
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<td>DATE</td>
<td>MARCH 1993</td>
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VEGETATIVE TOP COVER
ROOTING MEDIUM 1 AND 2
FILTER
BIOINTRUSION LAYER
DRAIN/BEDDING LAYER
FML
GCL (CLAYMAX TYPE LINER) (OPTIONAL)
INFILTRATION BARRIER (OPTIONAL)
COVER FAILURE LEAK DETECTION SYSTEM (GEORED AND GEOFABRIC COMPOSITE) (OPTIONAL)
RADON BARRIER

1 in 2% SLOPE

EROSION PROTECTION LAYER
(RIP RAP)
FILTER

CLEAN-FILL DIKE

GCL (CLAYMAX TYPE LINER)
3 FT. CLAY LINER
FML

SOLID PIPE SURROUNDED
BY 3 IN. THICK GRAVEL BEDDING
AND LINED WITH FML AND GCL

LEACHATE COLLECTION MANHOLE/SUMP
CONNECTOR PIPE
TO OTHER COLLECTION MANHOLE AND FINALLY
TO RETENTION BASIN

NOTES:
1. ANCHOR DETAILS FOR FMLs AND
GEOSYNTHETIC PRODUCTS NOT SHOWN.
2. DETAILS ALSO APPLY TO SECTIONS ON THE
SOUTH, EAST AND WEST SIDE OF DISPOSAL
CELL, EXCEPT THERE ARE NO COLLECTION
PIPES AND COLLECTION SUNKS UNDERNEATH
AND OUTSIDE THE CLEAN FILL DIKE.

DETAILS OF DISPOSAL CELL
CROSS SECTION
NORTH SIDE

FIGURE 5.2.1-1
NOTE:
THE LIMIT OF 300-FOOT BUFFER ZONE IS THE TOE LINE OF AN IMAGINARY 3H:1V SLOPE PROJECTED OUTWARD FROM THE OUTERMOST LIMIT OF THE WASTE.

LEGEND

GEOLeGIC CROSS SECTION

FEET 400 0 400
METERS 121.9 0 121.9

SCALE

CELL SITING LAYOUT

FIGURE 5.2.2-2

REPORT NO: DOE/OR/21548-411
DRAWING NO: 
ORIGINATOR: KWL
DRAWN BY: AMA
DATE: 
CSS DISPOSAL CELL FOUNDATION PLAN
PARTIALLY BELOW GRADE OR DEEP EXCAVATION CONFIGURATION

FIGURE 5.2.3-2

LEGEND

AREA WITH LESS THAN 20 FEET OF FERRELLVIEW CLAY AND CLAY TILL

REPORT NO: DOE/OR/21548-411
DRAWING NO:

ORIGINATOR: KWL
DRAWN BY: AMA
DATE:
WASTE THICKNESS VERSUS WASTE STORAGE VOLUME FOR CSS DISPOSAL CELL

FIGURE 5.2.3-3

NOTE: WASTE THICKNESS BASED ON THE EASTERN HALF OF THE DISPOSAL CELL
NOTES:

\( T_1 = \) total disposal cell thickness for minimum excavation cell configuration

\( T_{2a} = \) total disposal cell thickness for the east side of partially below grade cell configuration

\( T_{2b} = \) total disposal cell thickness for the west side of partially below grade cell configuration

FIGURE 5.2.3-4

COMPARISON OF TOTAL DISPOSAL CELL THICKNESS

REPORT NO.: DOE/OR/21548-411
DRAWN BY: AMA
ORIGINATOR: KWL
DATE:
NOTES:
1. SEE DETAILS IN FIGURE 5.2.5-3
2. THE MINIMUM 20 FT. THICKNESS SHOWN \((a + b)\) IS EQUIVALENT TO 30 FT. OF \(1 \times 10^7 \text{ cm/s}\) PERMEABILITY MATERIAL AND IS INCLUDED IN THE SUM OF THE COMPACTED LOW-PERMEABILITY FILL BEneath THE ENGINEERED LINER AND EXISTING LOW-PERMEABILITY SOIL ABOVE THE UPPERMOST REGIONAL AQUIFER.

DETAILS OF WASTE AND CLEAN-FILL DIKE INTERFACE (SCHEMATIC)

FIGURE 5.2.3-5
**NOTES:**

$T_1$ = TOTAL CELL THICKNESS FOR MINIMUM EXCAVATION CELL CONFIGURATION = 43 FT.

$T_2$ = WASTE THICKNESS FOR MINIMUM EXCAVATION CELL CONFIGURATION = 28 FT.

**LEGEND:**

1. COVER & CLEAN FILL DIKE (CFD) ENCAPSULATION SYSTEM
2. BASED TILL AND OR RESIDUUM
3. WEATHERED BEDROCK (LIMESTONE)
4. EXCAVATION REQUIRED FOR CONTAMINATED SOILS AND BUILDING FOUNDATIONS DEMOLITION
5. EXISTING FILL AND OR LOESS
6. FERRELVIEW CLAY
7. CASON CLAY
8. FOUNDATION FILL
9. LINER & LEACHATE COLLECTION REMOVAL SYSTEM
10. WASTE

**DISPOSAL CELL CONFIGURATION MINIMUM EXCAVATION:**

**SECTION L**

**FIGURE 5.2.3-7**

SCALE: 1/2000
NOTE:
FOR VIT CELL, THE LEACHATE COLLECTION RETENTION BASIN MAY BE RELOCATED, AND EXCAVATED DITCH OR BURIED PIPE WILL BE REQUIRED TO DIVERT LEACHATE TO A POSITIVE DRAIN AREA WHERE THE RETENTION BASIN WILL BE LOCATED.

LEGEND:
1. COVER & CLEAN FILL DIKE (CFD) ENCAPSULATION SYSTEM
2. WASTE
3. LINER & LEACHATE COLLECTION REMOVAL SYSTEM
4. FOUNDATION FILL
5. EXISTING FILL AND/OR LOESS
6. FERRALVIEW CLAY
7. CLAY TILL
8. BASAL TILL AND/OR RESIDUUM
9. WEATHERED BEDROCK (LIMESTONE)
10. EXCAVATION REQUIRED FOR CONTAMINATED SOILS AND BUILDING FOUNDATIONS DEMOLITION.
11. COLLECTION PIPES
12. COLLECTION SUMP
13. CONNECTOR PIPE
14. POTENTIAL AREA FOR LEACHATE COLLECTION
15. RETENTION BASIN FOR CSS CELL (PROJECTED APPROX 200 FT. FROM WEST) (SEE NOTE FOR VIT CELL)

DISPOSAL CELL CONFIGURATION
MINIMUM EXCAVATION:
SECTION O

FIGURE 5.2.3-10

DRAWN BY
CHECKED BY
DATE
**NOTES:**
- T12a = TOTAL CELL THICKNESS FOR THE EAST SIDE OF PARTIALLY BELOW GRADE CELL CONFIGURATION = 30 FT.
- T2a = WASTE THICKNESS FOR THE EAST SIDE OF PARTIALLY BELOW GRADE CELL CONFIGURATION = 22 FT.
- T12b = TOTAL CELL THICKNESS FOR THE WEST SIDE OF PARTIALLY BELOW GRADE CELL CONFIGURATION = 45 FT.
- T2b = WASTE THICKNESS FOR THE WEST SIDE OF PARTIALLY BELOW GRADE CELL CONFIGURATION = 28 FT.

**LEGEND:**
- COVER & CLEAN FILL DIKE (CFD) ENCAPSULATION SYSTEM
- WASTE
- LINER & LEACHATE COLLECTION REMOVAL SYSTEM
- FOUNDATION FILL
- EXISTING FILL AND/OR LOESS
- FERRELVIEW CLAY
- CLAY TILL
- BASAL TILL AND/OR RESIDUUM
- WEATHERED BEDROCK (LIMESTONE)
- EXCAVATION REQUIRED FOR CONTAMINATED SOILS AND BUILDING FOUNDATIONS DEMOLITION

**DISPOSAL CELL CONFIGURATION**
**PARTIALLY BELOW GRADE: SECTION L**

**FIGURE 5.2.3-11**

**DIMENSIONS:**
- HORIZ SCALE: FEET
- 0 200 200

**DRAWING NO:**
- DODC021549111

**DRAWN BY:**
- AMA DATE
NOTE:
FOR VIT CELL, THE LEACHATE COLLECTION RETENTION BASIN MAY BE HILOATED, AND EXCAVATED DITCH OR BURIED PIPE WILL BE REQUIRED TO DIVERT LEACHATE TO A POSITIVE DRAIN AREA WHERE THE RETENTION BASIN WILL BE LOCATED.

LEGEND:
1. COVER & CLEAN FILL DIKE (CFD) ENCAPSULATION SYSTEM
2. WASTE LINER & LEACHATE COLLECTION REMOVAL SYSTEM
3. FOUNDATION FILL
4. EXISTING FILL AND/OR LOESS
5. FERRELVIEW CLAY
6. CLAY TILL
7. BASAL TILL AND/OR RESIDUUM
8. WEATHERED BEDROCK (LIMESTONE)
9. EXCAVATION REQUIRED FOR CONTAMINATED SOILS AND BUILDING FOUNDATIONS DEMOLITION
10. COLLECTION PIPES
11. COLLECTION SUMP
12. CONNECTOR PIPE
13. POTENTIAL AREA FOR LEACHATE COLLECTION RETENTION BASIN FOR CSS CELL (PROJECTED APPROX 200 FT. FROM WEST) (SEE NOTE FOR VIT CELL)
NOTE: CLEAN-FILL DIKE (CFD) TOE LINE SHOWN HERE IS BASED ON EXISTING TOPOGRAPHY.
NOTE: CLEAN-FILL DIKE (CFD) TOE LINE SHOWN HERE IS BASED ON EXISTING TOPOGRAPHY.
FIGURE 5.2.3-17

LEGEND

= AREA WITH LESS THAN 20 FEET OF FERRELL VIEW CLAY AND CLAY TILL

VIT DISPOSAL CELL FOUNDATION PLAN
MINIMUM EXCAVATION CONFIGURATION
NOTE: CLEAN-FILL DIKE (CFD) Toe Line Shown Here is Based on Existing Topography.

PLAN VIEW OF VIT DISPOSAL CELL
MINIMUM EXCAVATION CONFIGURATION

FIGURE 5.2.3-19

REPORT NO.: DOE/OR/21548-411
DRAWING NO.: 
ORIGINATOR: KWL
DRAWN BY: AMA
DATE: 
NOTE: CLEAN-FILL DIKE (CFD) TOE LINE SHOWN HERE IS BASED ON EXISTING TOPOGRAPHY.
LIMIT OF LINER SYSTEM
(WASTE LIMIT)

DISPOSAL CELL

2% (Typ.)
Varies

1-1 1/2% SLOPE

PLAN
NOT TO SCALE

COVER
WASTE

LINER SYSTEM

SECTION
NOT TO SCALE

LEGEND
CFD = CLEAN FILL DIKE
= CROSS SECTION
X X

LINER SYSTEM
SCHEMATIC PLAN and SECTION
CSS CELL

FIGURE 5.2.5-1

REPORT NO.: DOE/OR/21548-411
DRAWING NO.: 
ORIGINATOR: K.O.
DRAWN BY: roy
DATE: AUG., 1992
LINER SYSTEM
SCHEMATIC PLAN and SECTION
VIT CELL

FIGURE 5.2.5-2

REPORT NO.: DOE/OR/21548-411
DRAWING NO.: 
ORIGINATOR: K.O.
DRAWN BY: ray
DATE: DEC., 1992
**PLAN**

*Not to scale*

**SECTION A-A’**

*Not to scale*

**LEGEND**

*Note: Refer to Figure 5.8.5-5 LCRS Details for Section B-B’*

A → A’ = CROSS SECTION

**LINER SYSTEM**

**SCHEMATIC PLAN and SECTION**

**CSS CELL**

**FIGURE 5.2.5-4**
PLAN
NOT TO SCALE

SECTION A-A'
NOT TO SCALE

LEGEND
NOTE: REFER TO FIGURE 5.8.5-5
LCRS DETAILS FOR SECTION B-B'
A  A' = CROSS SECTION

LINER SYSTEM
SCHEMATIC PLAN and SECTION
VIT CELL

FIGURE 5.2.5-6

REPORT NO.: DOE/OR/21548-411
DRAWING NO.: DATE: DEC., 1992
ORIGINATOR: K.O. DRAWN BY: DONG DATE: DEC., 1992
Clean-Fill Dike

Legend

- Metal Waste
- Metal Entombed w/ CSS Grout
- Concrete Rubble
- Concrete Entombed w/ CSS Grout
- Contaminated Soil
- Dashed Line = Active Placement Zone

SCHEMATIC SECTION OF CSS WASTE PLACEMENT SEQUENCE

FIGURE 5.2.6-5
LEGEND: CELL COMPONENTS

1. TOP COVER
2. PERIMETER ENCAPSULATION SYSTEM (CLEAN-FILL DIKES)
3. WASTE
4. BASAL LINERS AND LEACHATE COLLECTION AND REMOVAL SYSTEM
5. FOUNDATION
6. VADOSE ZONE
7. GROUNDWATER

WASTE ENCAPSULATION SYSTEM COMPONENTS
The essential parts of a waste encapsulation system which isolate waste and its emanation products from the environment are the cover, dikes, basal liners, drains, foundation soils and rocks.

FIGURE 5.2.7-1

REPORT NO.
DOE/OR/21548-411

ORIGINATOR
JC

DRAWN BY
MD

DATE
05-04-93
VEGETATION

1.0' SOIL ①

3.0' FROST PROTECTION AND ROOTING ZONE ②

INfiltration barrier: geomembrane ③

1.5 - 2.0' INfiltration/Radon barrier ④

WASTE

① MATERIALS: alternative top components
   * 0.5' erosion resistant rock
   * 1.0' erosion rock with soil in voids
   * 1.0' gravel mulch (soil/rock mix)

② Mixed clay, silt, and sand

③ A geosynthetic such as pvc or hdpe

④ Low-permeability clay or silty clay

NOTE: THIS COVER HAS BEEN USED ON SANITARY LANDFILL

ALTERNATIVE COVER 1:
THE SIMPLE VEGETATED/ROCK COVER

FIGURE 5.2.7-2

REPORT NO.
DOE/OR/21548-411

ORIGINATOR
JC

DRAWN BY
MD

DATE
05-04-93
VEGETATION

2.5' SOIL: Random or selected*

1.0' FILTER/DRAIN/BEDDING: Sand
INfiltration BARRIER: Geomembrane

2.0' RADON/INFILTRATION BARRIER: Silt & clay
WASTE

*These may be covered with rock mulch.
Alternatively, the upper 0.5' may be coarser grained gravel.

Note: This cover complies with EPA regulations for a cover
for a hazardous waste facility

*ALTERNATIVE COVER 2: THE RCRA COVER

FIGURE 5.2.7-3

REPORT NO
DOE/OR/21548-411

ORIGINATOR
JC

DRAWN BY
MD

DATE
05-04-93
1.0' EROSION BARRIER: Coarse gravel
0.5' FILTER/DRAIN/BEDDING: Sand
2.0' FROST PROTECTION: Random soil
1.0' FILTER/DRAIN/BEDDING: Fine-to-medium sand
1.5 - 2.0' RADON/INfiltrATION BARRIER (OPTIONAL): Geomembrane
WASTE

'NOTE: ALTERNATIVE TOP COMPONENTS
'1.0' SOIL FOR VEGETATION
'1.0' COARSE GRAVEL WITH SOIL IN Voids
'1.0' GRAVEL MULCH

NOTE: THIS COVER HAS BEEN USED ON THE SIDE SLOPE OF A URANIUM MILL TAILINGS PILE. THE UPPER COMPONENT WAS ROCK.
VEGETATION

EROSION BARRIER: Gravelly silty sand *

2.0'

FROST PROTECTION: Random soil

0.5'

FILTER/DRAIN/BEDDING: Sand **

1.0'

DRAIN/BIOBARRIER: Gravel

0.5'

FILTER/DRAIN/BEDDING: Sand

INfiltration BARRIER: Geomembrane and Geomat

1.5

INfiltration BARRIER: Silt and clay

LEAK DETECTION SYSTEM: Geogrid
(Optional Design Component)

1.5

RADON BARRIER: Silt and clay

WASTE

NOTE: ALTERNATE EROSION BARRIERS

* 1.0' ROCK OVER BEDDING
* 1.0' ROCK WITH SOIL IN VOIDS
* 1.0' SOIL

** OPTIONAL: NOT NEEDED IF ROCK IS CHOKE.

NOTE: THIS IS THE MOST COMPLEX COVER CONSIDERED IN THIS
REPORT. IT IS THE SELECTED COVER. VARIANTS HAVE BEEN USED
TO COVER URANIUM MILL TAILINGS PILES.

ALTERNATIVE COVER 4:
THE MULTI-COMPONENT COVER

FIGURE 5.2.7-5

REPORT NO: DOE/OR/21548-411

ORIGINATOR MD/BM

DRAWN BY 05-19-93

JC
VEGETATION

0.5' - 1.5' SOIL

1.0' - 2.0' EROSION BARRIER: Coarse gravel

0.5' - 1.0' FILTER/DRAIN/BEDDING: Sand

2.0' FROST PROTECTION: Selected soil

INfiltration BARRIER: Geomembrane

0.5 - 1.0' RADON/INfiltration BARRIER: Silt and clay

WASTE

*THIS SOIL MAY BE ENHANCED WITH GRAVEL TO INCREASE EROSION RESISTANCE ALTERNATIVELY. THIS COULD BE A LAYER OF ROCK WITH SOIL IN THE Voids.

ALTERNATIVE COVER 5:
THE EROSION RESISTER

FIGURE 5.2.7-6

REPORT NO.
DOE/OR/21548-411

ORIGINATOR
JC

DRAWN BY
MD/BM

DATE
05-05-93
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<th>FUNCTION</th>
<th>MATERIAL</th>
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<td>VEGETATION</td>
<td>• Aesthetics</td>
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<td>• Erosion Control</td>
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<tr>
<td>TOP SOIL</td>
<td>• Support Vegetation</td>
<td>Gravelly Soil</td>
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<td>• Control Erosion</td>
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<td>SOIL</td>
<td>• Frost Protection</td>
<td>Mixed Clay,</td>
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<tr>
<td></td>
<td>• Root Zone</td>
<td>Silt and Sand</td>
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<td>FILTER</td>
<td>• Control Piping</td>
<td>Clean Sand</td>
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<td>BIOINTRUSION</td>
<td>• Inhibit Roots</td>
<td>Cobbles and Boulders</td>
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<td></td>
<td>• Control Burrowing Animals</td>
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<tr>
<td>BEDDING</td>
<td>• Protect Geomembrane</td>
<td>Clean Sand</td>
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<td></td>
<td>• Shed Water</td>
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<td>INFILTRATION</td>
<td>• Reduce and Control Infiltration</td>
<td>(a) FML: Geomembrane</td>
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<td>BARRIER</td>
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<td>(b) GLC: Bentonite Mat</td>
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<td></td>
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<td>(c) Soil: Clay-Silt</td>
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<td>*LEAK DETECTION</td>
<td>• Monitor Infiltration</td>
<td>Geogrid</td>
</tr>
<tr>
<td>RADON BARRIER</td>
<td>• Control Radon Flux</td>
<td>Silty/Clay</td>
</tr>
</tbody>
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*Design Option

TOP SLOPE COVER:
A typical disposal cell multi-component cover provides multiple protection of the waste

FIGURE 5.2.7-7

REPORT NO
DOE/OR/21548-411

ORIGINATOR
JC

DRAWN BY
BR/MD/BM

DATE
05-05-93
AS BUILT COVER

BIOACCUMULATION
Vegetation and debris accumulates on surface and builds up cover

TIME

SHEET EROSION
The surface of the soil is lowered by uniform removal of soil
(a) original surface
(b) reduced surface

TIME

GULLY EROSION
Deep gully is eroded into soil. The bioturbation cobbles prevent further gully development

LEGEND
1 GRAVELLY SOIL
2 RANDOM SOIL
3 BIOTRUSION COBBLES
4 SAND DRAIN
5 INFILTRATION BARRIER
6 RADON BARRIER

TOP COVER EROSION - ALTERNATIVE PERFORMANCE SCENARIOS
With time the upper surface of the cover may be affected by bioaccumulation, sheet erosion, or gully erosion

FIGURE 5.2.7-8

REPORT NO.
DOE/OR/21648-411

ORIGINATOR
JC

DRAWN BY
DJK/BC

DATE
05-05-93
NORMAL SITUATION:
Roots grow in upper random soil. Downward advance impeded by bioinvasion rock, lack of moisture in voids, grass type.

FAILURE SCENARIO I:
Roots penetrate bioinvasion and drain. Shedding of water in drains is impeded and infiltration increased. Further root advance impeded by geomembrane, bentonite, and compacted clay.

COVER FEATURES TO PRECLUDE FAILURE
- Thick soils for root growth
- Bioinvasion barrier cobbles
- Low moisture content of cobbles and sand
- Geomembrane and bentonite
- Compacted clay
- Grass mowing and burning

FAILURE SCENARIO II:
Roots penetrate waste. Increased infiltration and radon flux. Physical degradation of cover components.

LEGEND
1 GRAVELY SOIL
2 RANDOM SOIL
3 COBBLES
4 SAND
5 GEOMEMBRANE AND GEOMAT
6 SILT AND CLAY
7 GRASS
8 GRASS AND BUSHES
9 BUSHES AND TREES
10 WASTE

VEGETATION PENETRATION FAILURE SCENARIOS
Root penetration is impeded by the multicomponents of the cover

FIGURE 5.2.7-9

REPORT NO DDE/OR/21548-411
ORIGINATOR JC DRAWN BY MD DATE 05-05-93
ANIMAL INTRUSION
A burrowing animal's progress is impeded by the cobbles of the biointrusion barrier.

HUMAN INTRUSION
Inadvertent human intrusion may be impeded or slowed by the cobbles of the biointrusion barrier.

LEGEND

1. RANDOM SOIL
2. BIOINTRUSION COBBLES
3. DRAIN SAND
4. INFILTRATION BARRIER
5. RADON BARRIER

ANIMAL AND HUMAN INTRUSION FAILURE SCENARIOS
The large cobbles of the biointrusion barrier may intercept and impede animals and humans and hence protect the remainder of the cover and the wastes.

FIGURE 5.2.7-10
DOE/OR/21548-411

REPORT NO.

ORIGINATOR
JC

DRAWN BY
DJK

DATE
05-05-93
COVER PROTECTION LAYERS ABOVE INFILTRATION BARRIER

1) VEGETATION: Control erosion and increase evapotranspiration

2) GRAVELLY SOIL: Control erosion

3) RANDOM SOIL: Freeze/Thaw protection; rooting medium

4) FILTER: Control particle migration into bioinvasion layer

5) BIOINTRUSION COBBLES: Animal, human, and root intrusion control

6) DRAIN SAND: Bedding to preclude cobble punching and deformation

INfiltration Barrier Components

11) GEOMEMBRANE: Very low permeability; may deteriorate with time

12) BENTONITE LAYER (IN GEOMAT): Very low permeability; long-term durable natural material; also seals geomembrane pinhole leaks.

13) RADON BARRIER CLAY/SILT: Low permeability. Seepage not sensitive to water ponding. Long-term functioning and effectiveness may be affected by deformation, freeze/thaw, or dessication.

INfiltration Barrier Monitoring

14*) GEOGRID: Intercepts and directs infiltration barrier seepage to monitoring stations. *(Design Option)

Back-Up Infilt ration Barrier

15) RADON BARRIER: Low-permeability soil may function as a back-up or secondary infiltration barrier

Infilt ration Barrier Components: Their Nature and Function

Each component of the cover plays a part in protecting the infiltration barrier and limiting infiltration

Figure 5.2.7-11

Report NO. DOE/OR/21548-411

Originator: JC Drawn By: DJK/SM Date: 05-19-93
NORMAL PERFORMANCE

Seepage through soil and cobbles flows into drain sand and flows laterally in drain layer above infiltration barrier.

FEATURES THAT PRECLUDE MALPERFORMANCE

The very high-permeability biointrusion cobbles are not susceptible to clogging. Loss of flow capacity in the drain can be augmented by cobble layer flow capacity.

1. RANDOM SOIL
2. BIOINTRUSION COBBLES
3. DRAIN SAND
4. INFILTRATION BARRIER
5. RADON BARRIER

FAILURE SCENARIO: BLOCKED OR CLOGGED DRAIN

Seepage through soil and cobbles flows laterally in cobble layer above clogged drain.

COVER DRAIN CLOGGING SCENARIO ANALYSIS

Blocking or clogging of the cover drain by physical or chemical processes will not impair the cover's ability to shed water

FIGURE 5.2.7-12

REPORT NO: DOE/OR/21548-411
ORIGINATOR: JC
DRAWN BY: DJK
DATE: 05-18-93
SECTION OF VERTICAL INNER FACE CLEAN-FILL DIKE

FUNCTION OF VERTICAL DRAIN
SEEPAGE FROM THE WASTE INTO THE VERTICAL DRAIN WILL FLOW DOWN TO THE BASAL LEACHATE COLLECTION SYSTEM. DIKE INFILTRATION WILL BE IMPEDED FROM ENTERING THE DRAIN BY THE LOW PERMEABILITY CLAY ZONE.

VERTICAL FACE CLEAN-FILL DIKE
To achieve all the advantages of a clean-fill dike, and increase cell capacity, the inner face of the dike may be vertical.

FIGURE 5.2.7-14

REPORT NO: DOE/OR/21548-411

<table>
<thead>
<tr>
<th>ORIGINATOR</th>
<th>DRAWN BY</th>
<th>DATE</th>
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<tbody>
<tr>
<td>JC</td>
<td>MD</td>
<td>05-17-93</td>
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LEGEND

1. SHALLOW-ROOTING VEGETATION
2. OCCASIONAL DEEP-ROOTING VEGETATION
3. EROSION BARRIER
4. CLEAN-FILL DIKE
5. DRAINS AND LINER
6. BIOINTRUSION LAYER
7. WASTE

VEGETATION GROWTH & ROOTING PATTERNS
To inhibit root penetration, the top cover includes a biointrusion barrier, and the side slope clean-fill dikes provide volume for root growth

FIGURE 5.2.7-15

REPORT NO: DOE/OR/21548-411

ORIGINATOR: JC
DRAWN BY: EBR
DATE: 05-17-93
LEGEND

1 WASTE
2 CLEAN-FILL DIKE
3 SHALLOW GULLY
4 DEEP GULLY

CLEAN-FILL DIKE EROSION GULLY GEOMETRY
Even significant gully formation by erosion of the clean-fill dike will not expose the encapsulated wastes

FIGURE 5.2.7-17

REPORT NO.
DOE/OR/21548-411

ORIGINATOR.
JC

DRAWN BY.
MD

DATE
05-17-93
CLEAN-FILL DIKE SECTION WITH FLOW COMPONENTS

FLOW COMPONENTS

1. TOP COVER RUNOFF
2. SIDE SLOPE INCIDENT PRECIPITATION
3. SIDE SLOPE RUNOFF
4. SIDE SLOPE EVAPOTRANSPIRATION
5. TOTAL CELL RUNOFF
6. DIKE INFILTRATION
7. SEEPAGE TO VADOSE ZONE

CLEAN-FILL DIKE WATER BALANCE MODEL FOR ROCK COVER
Some incident precipitation on the dike runs off and some infiltrates to seep to the groundwater

FIGURE 5.2.7-18

REPORT NO: DOE/OR/21548-411

ORIGINATOR: JC
DRAWN BY: MD/BM
DATE: 05-17-93
Legend
FML Flexible Membrane Liner
LCRS Leachate Collection and Removal System

Note: Figure is schematic and not drawn to scale.
Legend
FML Flexible Membrane Liner
LCRS Leachate Collection and Removal System

Note: Figure is schematic and not drawn to scale.

Drainage Collection
Edges of Phases I & II
(Alternative D-D)

Figure 5.2.8-2
Legend

- CFD: Clean-Fill Dike
- Area of Clean Cover Placement
- Area of In-Place Clean Cover

Note: Figure is schematic and not drawn to scale.
### CSS Simplified Schedule

**FIGURE 5.2.9-1**

**NOTE:** FOR MORE DETAILED SCHEDULE, MVE SESSION: INTEGRATED SCHEDULE FOR EXCAVATION, TREATMENT, PLACEMENT AND CELL CONSTRUCTION
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**VIT Simplified Schedule**

*Page 1 of 2: 1993-1999*

**FIGURE 5.2.9-2**

*NOTE: FOR MORE DETAILED SCHEDULE, MVE SESSION: INTEGRATED SCHEDULE FOR EXCAVATION, TREATMENT, PLACEMENT AND CELL CONSTRUCTION*
FIGURE 5.3.1-1

MAJOR COMPONENTS OF THE WSS WASTE TREATMENT PROCESS
THIS DIAGRAM DEPICTS THE PRODUCTION OF A GROUT-LIKE PRODUCT BASED ON THE RAFFINATE + BINDER MIX. TWO-STEP MIXING IS RECOMMENDED. NO ADDITIONAL WATER IS REQUIRED.

NOTE: BASED ON WTG MATERIAL BALANCE
THIS DIAGRAM DEPICTS THE PRODUCTION OF A SOIL-LIKE PRODUCT BASED ON THE RAFFINATE + SOIL + BINDER MIX. TWO-STEP MIXING IS RECOMMENDED. NO ADDITIONAL WATER REQUIRED.

NOTE: BASED ON WTG MATERIAL BALANCE
SEPARATED WATER INTO WATER TREATMENT

RAFFINATE SLUDGE AVERAGE 73% WATER

DREDGING @ 85% H₂O

DEWATERING 80 TPH MAX @ 70-75% H₂O

CSS 80 TPH ACTUAL 100 TPH DESIGN

SOIL HANDLING CAPACITY 50 TPH EFFECTIVE TIME 8 HRS TOTAL DAY 5 DAYS/WEEK

CLAY HANDLING CAPACITY 80 TPH EFFECTIVE TIME 8 HRS TOTAL DAY

CLAY HANDLING

FLY ASH, CLAY

CLAY PROCESSING

14.5 HRS/DAY EFFECTIVE TIME 5 DAYS/WEEK 9 MONTHS/YEAR

UTILITY OR PROCESS WATER

80 TPH 100 TPH DESIGN

CSS - RELATED PROCESS CAPACITIES AND TIMING

FIGURE 5.3.2-3
SPOILS PILE MATERIAL

QUARRY SOILS

SURFACE SOILS

RADON CONTROL SYSTEM

CLAY (IF APPLICABLE BY MOISTURE CONTENT)

SCREENING

MATERIAL HANDLING

COVERED MATERIAL STORAGE

RADON CONTROL SYSTEM

+2"

-2"

DIRTY WATER INTO CSS OR WATER TREATMENT FACILITY

OVERSIZED MATERIAL WASHING

PROCESS WATER

WASHED MATERIAL INTO CELL

MATERIAL HANDLING

INTO CSS PLANT

SOLID MATERIAL PREPARATION (SOIL-LIKE PRODUCT)

FIGURE 5.3.2-7
LIQUID MATERIAL PREPARATION (GROUT-LIKE PRODUCT)

FIGURE 5.3.2-8
PRODUCT STORAGE SYSTEM
(FUNCTIONAL DIAGRAM)

FIGURE 5.3.2-10
MECHANICAL FEED SYSTEM
(FUNCTIONAL DIAGRAM)

FIGURE 5.3.2-11
CONCEPTUAL FLOW CHART
FOR VITRIFICATION
TREATMENT SYSTEM

FIGURE 5.3.3-1
GENERAL FLOW DIAGRAM OF MELTER CIRCUITS

FIGURE 5.3.3-5
GENERAL FLOW DIAGRAM OF SOIL/CLAY PRETREATMENT CIRCUIT

FIGURE 5.3.3-7
GENERAL FLOW DIAGRAM
OF WASTE STORAGE, MIXING
AND FEEDING CIRCUITS

FIGURE 5.3.3-8
GENERAL FLOW DIAGRAM FOR OFF-GAS TREATMENT CIRCUITS

FIGURE 5.3.3-10
FIGURE 54-2

WELDON SPRING SITE
FINISHED LAYOUT
(CSS CELL - 15 MILLION CY. WASTE)
NOT TO SCALE

LEGEND
1 RAFFINATE PIT 1
2 RAFFINATE PIT 2
3 RAFFINATE PIT 3
4 RAFFINATE PIT 4
5 FROG POND
6 ASH POND
--- ---- GROUNDWATER DIVIDE
--- ---- FENCE
(from Supporting Study 4 B)

SURFACE OF THE SHALLOW GROUNDWATER TABLE

FIGURE 5.4-4

REPORT NO: DOE/OR/21548-411
DRAWING NO:
ORIGINATOR: U.C.
DRAWN BY: K.W.
DATE: NOV., 1992
NOT TO SCALE

LEGEND
1. RAFFINATE PIT 1  • MONITORING WELL
2. RAFFINATE PIT 2
3. RAFFINATE PIT 3  605- POTENTIOMETRIC SURFACE
4. RAFFINATE PIT 4
5. FROG POND
6. ASH POND
--- GROUNDWATER DIVIDE
--- Doe Fence Line

LOCATION OF MONITORING WELLS TO REMAIN FOR POST-CLOSURE MONITORING

FIGURE 5.4-6

REPORT NO.: DOE/OR/21548-411
DRAWING NO.: "
ORIGINATOR: U.C.
DRAWN BY: K.W.
DATE: NOV., 1992
LOCATIONS OF ADDITIONAL POST-CLOSURE MONITORING WELLS

FIGURE 5.4-7

REPORT NO.: DOE/OR/21548-411
DRAWING NO.: 
ORIGINATOR: U.C
DRAWN BY: K.W
DATE: NOV, 1992

SCALE

LEGEND

MONITORING WELL IN WEATHERED ZONE OF SHALLOW BEDROCK AQUIFER

MONITORING WELL IN WEATHERED ZONE OF SHALLOW BEDROCK AQUIFER
TYPICAL MONITORING WELL CONSTRUCTION

FIGURE 5.4-8

NOT TO SCALE

SOURCE: (MKF AND JEG, 1988)
LEGEND

- DRAINAGE BOUNDARY
- - - - LONGEST FLOW PATH
② DRAINAGE AREA

SURFACE RUNOFF
DRAINAGE PLAN

FIGURE 5.4- 10

REPORT NO.: DOE/OR/21548-411
DRAWING NO.: 

ORIGINATOR: U.C.
DRAWN BY: K.W.
DATE: NOV., 1992
INITIATE ROUTINE SITE INSPECTION

PROBLEM IDENTIFIED

PREPARE SITE INSPECTION REPORT

REVIEW AND APPROVE

SEE FIGURE 5.5-1

YES

PRELIMINARY INSPECTION/ASSESSMENT REQUIRED?

REPAIR OR CUSTODIAL MAINTENANCE REQUIRED?

SEE FIGURE 5.5-4

NO

CONDUCT PRELIMINARY INSPECTION/ASSESSMENT

DEFINE PROBLEM

RESPONSE REQUIRED

SEE FIGURE 5.5-6

LEGEND

☐ U.S. DEPARTMENT OF ENERGY (DOE)

☐ DOE CONTRACTOR

SURVEILLANCE AND MONITORING:

ROUTINE SITE INSPECTION

FIGURE 5.5-2
INITIATE RESPONSE ACTION

DISPOSAL CELL DESIGN FAILURE

YES

IMMEDIATE RESPONSE REQUIRED

NO

ADDITIONAL CHARACTERIZATION REQUIRED

NO

EVALUATIVE MONITORING REQUIRED

YES

NO

CUSTOM MAINTENANCE OR REPAIR REQUIRED

SEE FIGURE 5.5-1

CERTIFICATE CORRECTIVE ACTION

CONCUR IN CERTIFICATION

SEE FIGURE 5.5-1

DEVELOP RESPONSE PLAN

REVIEWS AND APPROVE

IMPLEMENT RESPONSE PLAN

PERFORM/ASSIGN CORRECTIVE ACTION CONTRACT

CONDUCT CORRECTIVE ACTION

OVERSEE/ CERTIFY CORRECTIVE ACTION

SURVEILLANCE AND MONITORING:
CORRECTIVE ACTION

FIGURE 5.5-6

LEGEND

U. S. DEPARTMENT OF ENERGY (DOE)

DOE CONTRACTOR
NOTES

1. WHEN THE MATERIAL STORAGE AISLE WIDTH IS REDUCED TO 20 FEET, THE PMC WILL EVALUATE MATERIAL QUANTITIES TO BE PLACED. A DECISION WILL BE MADE WHETHER TO PLACE THE REMAINING MATERIAL USING THE PHASE II OR THE OPTIONAL PHASE II CONFIGURATION AS SHOWN IN SECTION A AND B.

3. PHASE I A AND I I CONFIGURATIONS TO BE USED IF REQUIRED AFTER EVALUATION OF MATERIAL QUANTITIES TO BE PLACED.

5. IF PHASE II IS NOT NEEDED FOR PLACING RECLAIMABLE MATERIAL, PMC WILL DETERMINE MATERIAL TYPE TO BE PLACED HERE, IF ANY.

LEGEND

1. PHASE I PLACEMENT
2. PHASE I A PLACEMENT
3. PHASE II PLACEMENT
4. PHASE II OPTION PLACEMENT

MATERIAL STAGING AREA
STOCKPILE CROSS-SECTION VIEW

FIGURE 6.1.2-5

REPORT NO. DOE/OR/21548-411
DRAWING NO. DATE
DEPARTMENT OF ARMY PROPERTY 2
EXCAVATION LIMITS

FIGURE 6.1.2 - 7
MISSOURI DEPARTMENT OF CONSERVATION
(BUSCH) PROPERTY 5 EXCAVATION LIMITS

FIGURE 6.1.2-13
RAFFINATE PIT SLUDGE FLOW DIAGRAM

FIGURE 6.1.3-1
NOT TO SCALE

ORDER OF CONSTRUCTION OF SEDIMENTATION BASINS AND RETENTION Ponds

LEGEND
(A)-(D) ORDER OF CONSTRUCTION

FIGURE 6.1.6-1

REPORT NO.: DOE/OR/21548-411
DRAWING NO.: 6.1.6-1
ORIGINATOR: S.B.
DRAWN BY: K.W.
DATE: NOV, 1992
LEGEND

- Initial Dike Height
- Increase in Dike Height
- Initial Cell Volume
- Increase in Cell Volume

CLEAN-FILL DIKE CONSTRUCTION: ALTERNATIVE PHASES

In order to provide for immediate waste volume, and possible increased waste volumes, the dike construction may be phased.

FIGURE 6.2.6-1

REPORT NO:
DOE/OR/21548-411

ORIGINATOR:
JC

DRAWN BY:
EBR

DATE:
05-17-93
NOTE:
RADON EMISSION CONTROL IS APPLICABLE ONLY AS DEVIATION OF CENTRAL RADON REMOVAL BEFORE Dewatering PLANT

CSS PLANT OPERATIONS

FIGURE 6.3.2-1
CSS PLANT CAPACITY CHART
(Parallel plant not included)

FIGURE 6.3.2-2

NOTE:
MONOLITHIC PRODUCT 203,000 TONS
SOIL-LIKE PRODUCT 167,000 TONS
TOTAL 370,000 TONS

REF. ONLY PARALLEL PLANT
SOIL-LIKE PRODUCT 90,000 TONS

REPORT NO. DOE/OR/21548-411
PREPARED 1/30/80
RAFFINATE SLUDGE
222,000 TONS

RAFFINATE SLUDGE USED FOR SOIL-LIKE PRODUCT
76,000 TONS

CLAY
77,000 TONS

RAFFINATE SLUDGE USED FOR GROUT-LIKE PRODUCT
146,000 TONS

CEMENT FOR GROUT-LIKE PRODUCT
23,214 TONS

CEMENT FOR SOIL-LIKE PRODUCT
6048 TONS

FLY ASH FOR GROUT-LIKE PRODUCT
34,954 TONS

FLY ASH FOR SOIL-LIKE PRODUCT
9100 TONS

FLY ASH FOR PARALLEL PLANT

CSS PLANT
80 TPH CAPACITY
14.5 HRS/DAY OPERATION

TOTAL GROUT-LIKE PRODUCT
204,168 TONS

TOTAL SOIL-LIKE PRODUCT
167,148 TONS

SOIL-LIKE PRODUCT
90,000 TONS
78 DAYS OPERATION

320 DAYS OPERATION

TOTAL CSS AND PARALLEL PLANT PRODUCT IS 461,316 TONS
PRODUCED IN 320 WORK DAYS @ 14.5 HOURS/DAY AND 80 TPH CAPACITY

CSS MATERIAL BALANCE

FIGURE 6.3.2-3
DECONTAMINATION FLOW DIAGRAM
(Process rate per day)

FIGURE 6.3.6-1
NOTE: CFD TOE LINE SHOWN HERE IS BASED ON EXISTING TOPOGRAPHY.

CELL VOLUME = 1.5 M CY

DASHED LINES SHOW NORTHERN LIMIT AND TOP COVER FOR 1.0 M CY

PLAN VIEW OF CSS CELL CONFIGURATION

FIGURE 8.1
DISPOSAL CELL SECTION
SCALE: 1" = 40' VERT.
1" = 300' HORIZ.

LEGEND
1 COVER
2 WASTE
3 LINER & LEACHATE COLLECTION REMOVAL SYSTEM
4 FOUNDATION
5 CLEAN-FILL DIKE

DISPOSAL CELL CONFIGURATION

FIGURE 8-2
DISPOSAL FACILITY PERFORMANCE PERIODS

The disposal facility is designed to perform for 1,000 years to the extent reasonably achievable.

FIGURE 8-3

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<thead>
<tr>
<th>REPORT NO.</th>
<th>DOE/OR/21548-411</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORIGINATOR</td>
<td>JC</td>
</tr>
<tr>
<td>DRAWN BY</td>
<td>MD/DJK</td>
</tr>
<tr>
<td>DATE</td>
<td>06/03/93</td>
</tr>
</tbody>
</table>
### LEGEND

<table>
<thead>
<tr>
<th>Quantity Description</th>
<th>Average (m³/yr)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 PRECIPITATION</td>
<td>$x_1$</td>
<td></td>
</tr>
<tr>
<td>2 EVAPOTRANSPIRATION</td>
<td>$x_2$</td>
<td></td>
</tr>
<tr>
<td>3 RUNOFF</td>
<td>$x_3$</td>
<td></td>
</tr>
<tr>
<td>4 COVER INFILTRATION</td>
<td>$x_4$</td>
<td></td>
</tr>
<tr>
<td>5 SEEPAGE THROUGH WASTE</td>
<td>$x_5$</td>
<td></td>
</tr>
<tr>
<td>6 LEACHATE COLLECTION SYSTEM FLOW</td>
<td>$x_6$</td>
<td></td>
</tr>
<tr>
<td>7 SEEPAGE FROM CELL</td>
<td>$3979 \text{ (2gpm)}$</td>
<td>$x_6$</td>
</tr>
<tr>
<td>8 SEEPAGE THROUGH LINER</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Quantities refer only to the top cover

---

**DISPOSAL CELL TOP COVER HYDROLOGIC MODEL**

A small fraction of precipitation infiltrates the top cover, and leaves the cell via drains.

**FIGURE 8-4 REV-B**

**REPORT NO:**

DOE/OR/21548-411

**ORIGINATOR:**

JC

**DRAWN BY:**

MD

**DATE:**

08/05/92
A) ROCK COVERED CLEAN-FILL DIKE SECTION WITH FLOW COMPONENTS

B) VEGETATED COVERED CLEAN-FILL DIKE SECTION WITH FLOW COMPONENTS

FLOW

1. TOP COVER RUNOFF
2. SIDE SLOPE INCIDENT PRECIPITATION
3. SIDE SLOPE RUNOFF
4. SIDE SLOPE EVAPOTRANSPIRATION
5. TOTAL CELL RUNOFF
6. DIKE INFILTRATION
7. SEEPAGE TO VADOSE ZONE

CLEAN-FILL DIKE WATER BALANCE MODEL FOR ROCK COVER
Some incident precipitation on the dike runs off and some infiltrates and seeps to the groundwater.

FIGURE 8-5

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ORIGINATOR: JC
DRAWN BY: DJK
DATE: 06/03/93
SOIL SLOPE EROSION MODEL 1:
PARALLEL SLICE EROSION

SOIL SLOPE EROSION MODEL 2:
SLOPE FLATTENING MASS BALANCE

Detailed protection includes riprap, large depth to waste

LEGEND

$R_{1000}$ - SLOPE FACE RETREAT IN 1,000 YEARS

$R_{\text{max}}$ - MAXIMUM FACE RETREAT FOR WASTE EXPOSURE: TIME OF RETREAT > 1,000 YEARS

$\alpha_{1}$ - INITIAL SLOPE ANGLE

$\alpha_{1000}$ - SLOPE ANGLE AT 1,000 YEARS

$\alpha_{\text{max}}$ - MAXIMUM SLOPE ANGLE FLATTENING FOR WASTE EXPOSURE: TIME > 1,000 YEARS

SOIL CLEAN-FILL DIKE EROSION MODELS
Face retreat in slope flattening of soil dike may occur depending on surrounding area geomorphologic change.

FIGURE 8-6

REPORT NO:
DOE/OR/21548-411

ORIGINATOR
JC

DRAWN BY
BR/DJK

DATE
06/02/93
LONG-TERM THROUGH FLOW MODEL I
Cover infiltration exceeds basal liner seepage. Outlet drains blocked, liner system still intact. Saturated zone develops at cell low point. Increased hydraulic head increases seepage through foundation and dike. Saturated zone depth at equilibrium in \( X_{1m} \).

LONG-TERM THROUGH FLOW MODEL II
Cover infiltration exceeds basal liner seepage through slightly degraded FML. Small saturated zone develops at cell low point. Seepage occurs primarily through high-permeability materials placed in lower part of dike. Seepage emerges primarily as surface flow.

LONG-TERM THROUGH FLOW MODEL III
The potential seepage through the basal liner (degraded FML) equals or exceeds cover infiltration or seepage from the waste. Accordingly flow is essentially vertically downward through the cell.

LEGEND
1. COVER INFILTRATION
2. SEEPAGE THROUGH BASAL LINERS
3. SURFACE SEEPAGE FROM CELL
4. BASAL LINERS
5. HIGHLY POROUS ZONE AT LEACHATE COLLECTION PIPES

LONG-TERM THROUGH FLOW MODELS
After cell abandonment, and possible failure of geomembranes and leachate collection system, the cover infiltration may flow to the groundwater or the surface, depending on cell layout features.

FIGURE 8-7

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ORIGINATOR
JC

DRAWN BY
MD/DJK

DATE
06/03/93
FEATURES THAT PRECLUDE FAILURE
- Dense or compacted wastes
- Avoiding discontinuities in waste type
- Thick cover components
- Overburden stress on radon barrier to prevent crack opening
- Soil with higher plasticity in radon barrier

FAILURE SCENARIO I: CONVEX DEFORMATION
Convex deformation induces cracking of radon barrier and:
(a) FML and GCL bridge crack.
(b) Bentonite falls into crack and seals it.
(c) Sand falls into crack through breached FML and GCL.
Sands and cobbles do not crack. Random soil cracks by heat and by soil movement process.

FAILURE SCENARIO II: CONCAVE DEFORMATION
Concave deformation cracks bottom of radon barrier. Other soils placed into compression and do not crack. Increased radon flux through crack is stopped by GCL and FML layer.

FAILURE SCENARIO III: SHEAR DEFORMATION
Shear crack develops. GCL is disrupted. FML stretches. Sands and cobbles deform. Minor potential additional radon and water flux through deformation plane.

DEFORMATION-INDUCED CRACKING OF THE RADON BARRIER
Uneven settlement of the cell foundation and waste could deform and crack the radon barrier.

FIGURE 8-8

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DRAWN BY: DJK/MD/EBR
DATE: 06/03/93
NOTE: SEE FIGURE 8.7.2-2 FOR COVER AND LINER DETAILS

SCALE: 1" = 100'

LEGEND

1. COVER
2. WASTE
3. LINER & LEACHATE COLLECTION REMOVAL SYSTEM
4. FOUNDATION
5. CLEAN-FILL DIKE

NEIS DESIGN
DISPOSAL CELL SECTION

FIGURE 8-9
MOVING AVERAGE MONTHLY DISCHARGE FROM PRIMARY LEACHATE COLLECTION SYSTEM

FIGURE 8–11

Discharge rate, gallons

Precipitation, inches

- Primary LCRA
- Precipitation

Sep-88 Jan-89 May-89 Sep-89 Jan-90 May-90 Sep-90