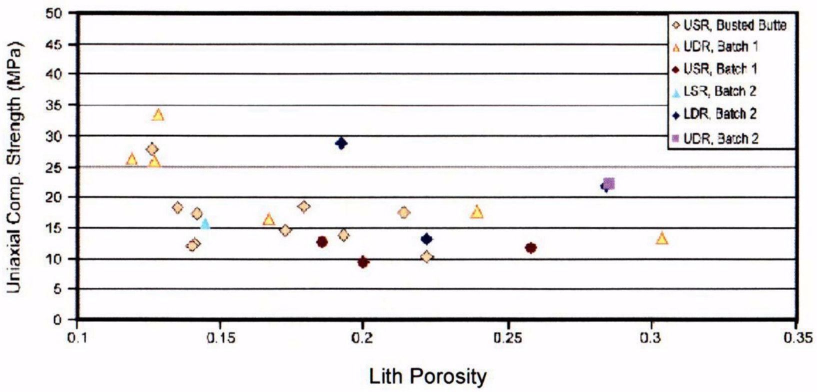
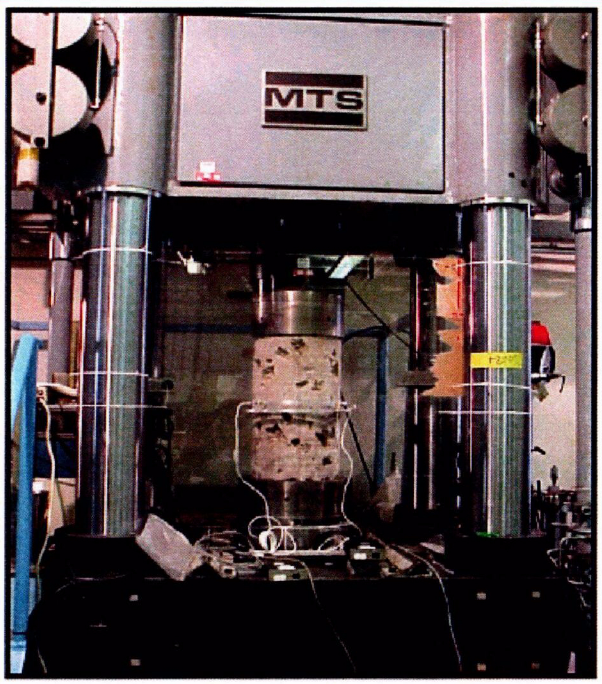
Rock Mass Properties - Lithophysal Rock





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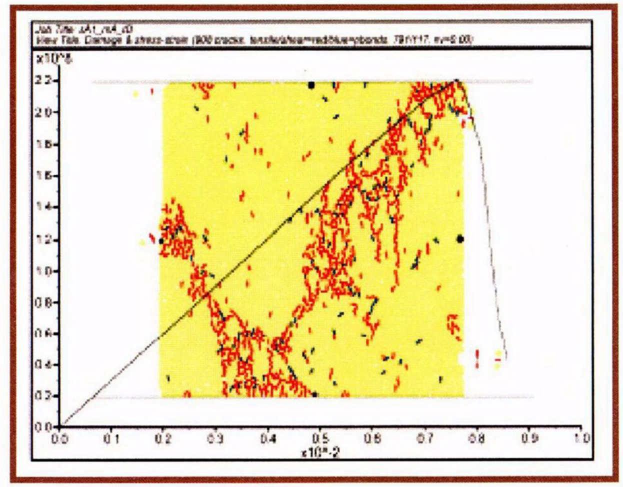
- **Porosity has greatest impact on mechanical properties**
- **For design and analysis purposes:**
  - **Subdivide range of properties into strength categories that cover range of lithophysal porosities observed from mapping**

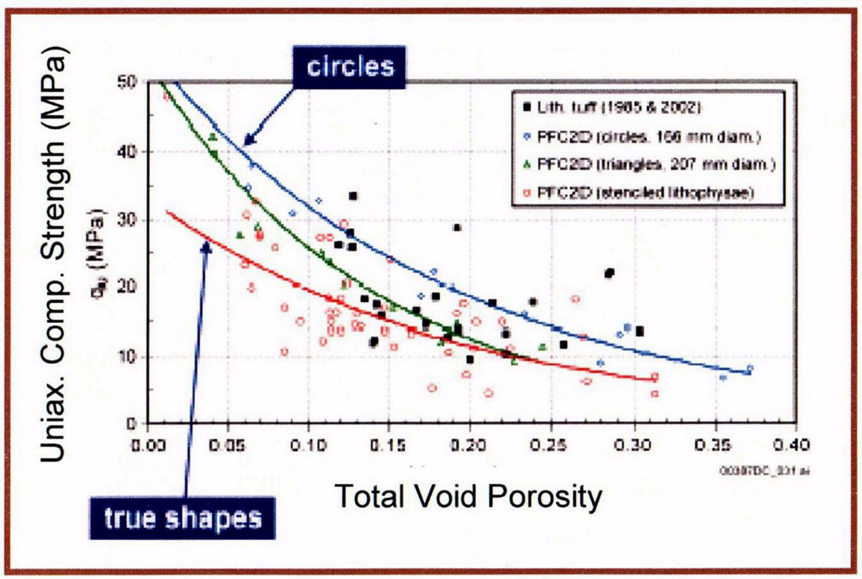
YUCCA MOUNTAIN PROJECT

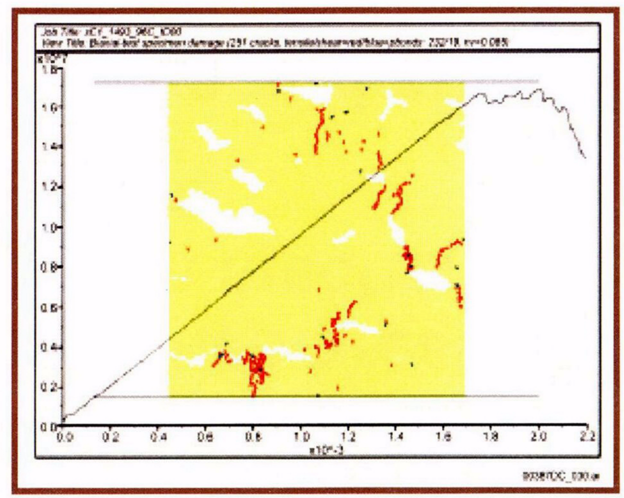
C20

Generalization of Lithophysal Rock into Numerical Modeling Approach

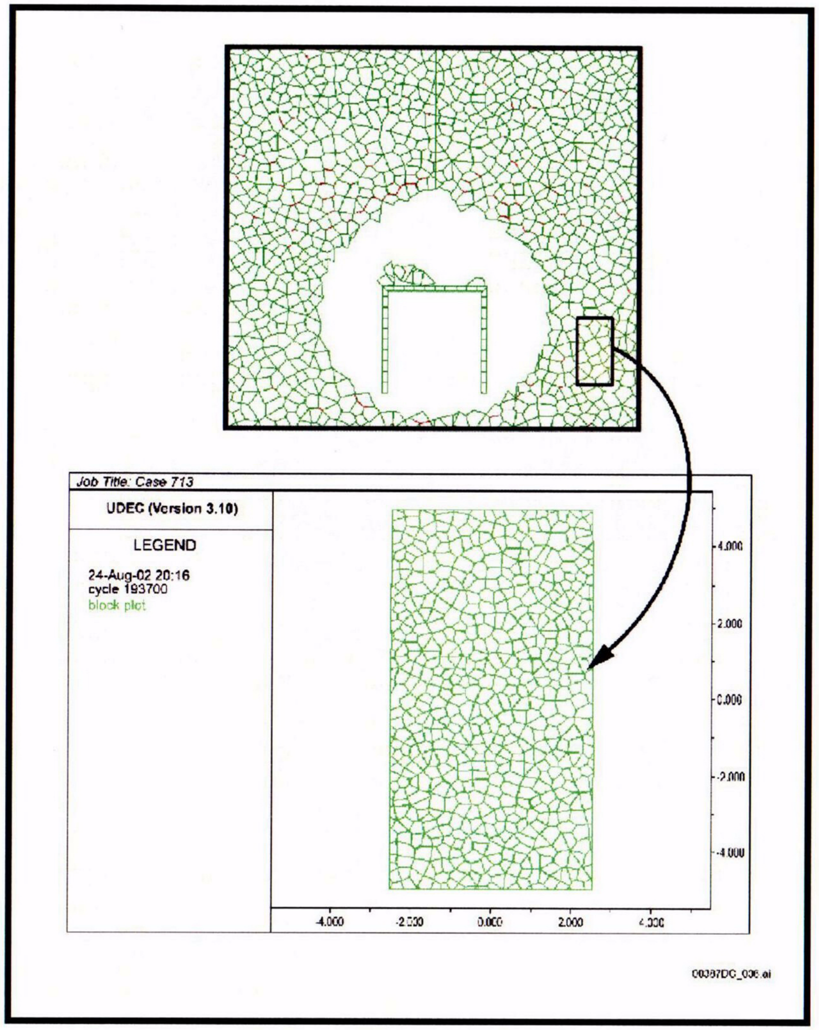
- Use Particle Flow Code "Micromechanical" model to understand basic mechanical response
- Calibrated model used for extrapolation to define range of variability of lithophysal rock properties







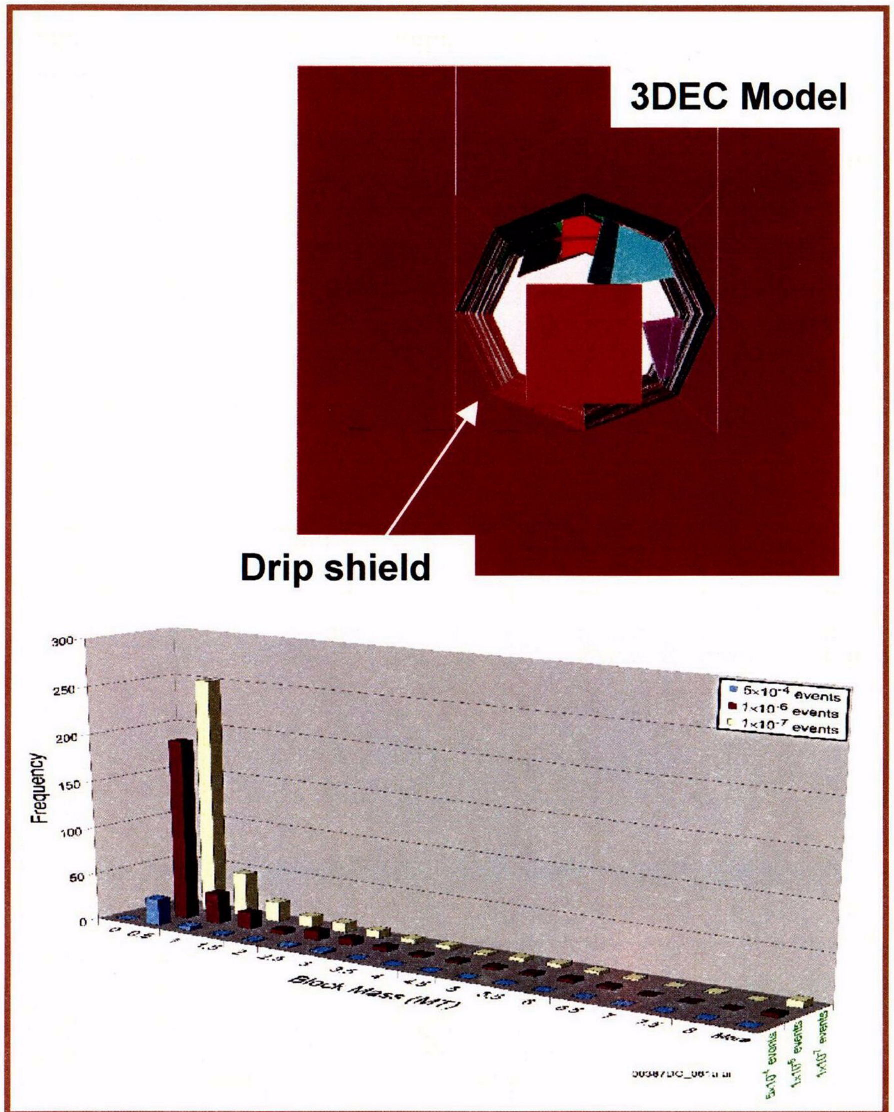
Drift Scale Lithophysal Model



- Encapsulate the material behavior of lithophysal rock into a discontinuum model
- Model capable of reproducing basic mechanical response
- Model capable of simulating fracture and rockfall

C21A

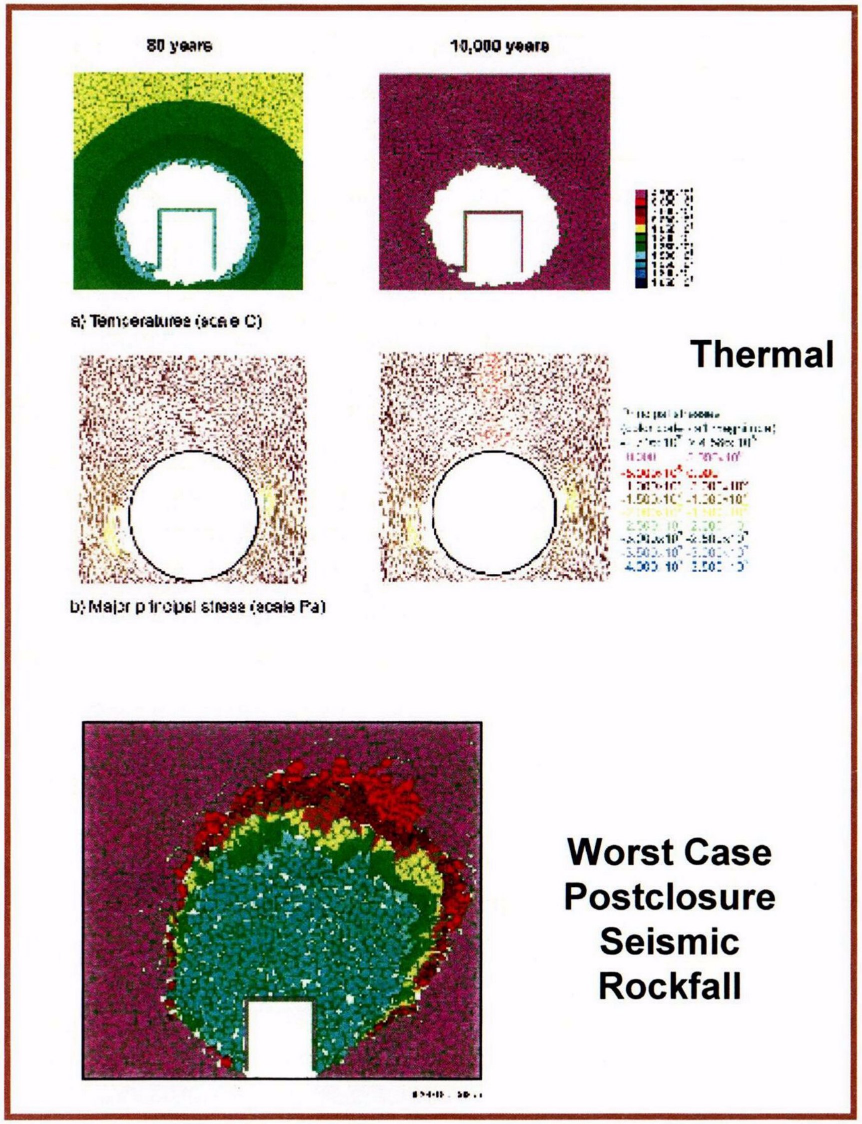
Results of Rockfall Calculations - Non-Lithophysal Rock



- **Stable conditions under in situ and thermal loading - little or no rockfall**
- **Seismic loading produces relatively small blocks with approximately 90 percent less than 1 meter cubed in volume**
- **Results fed to dynamic calculations of drip shield stability**

CZZ

Results of Rockfall Calculations - Lithophysal Rock

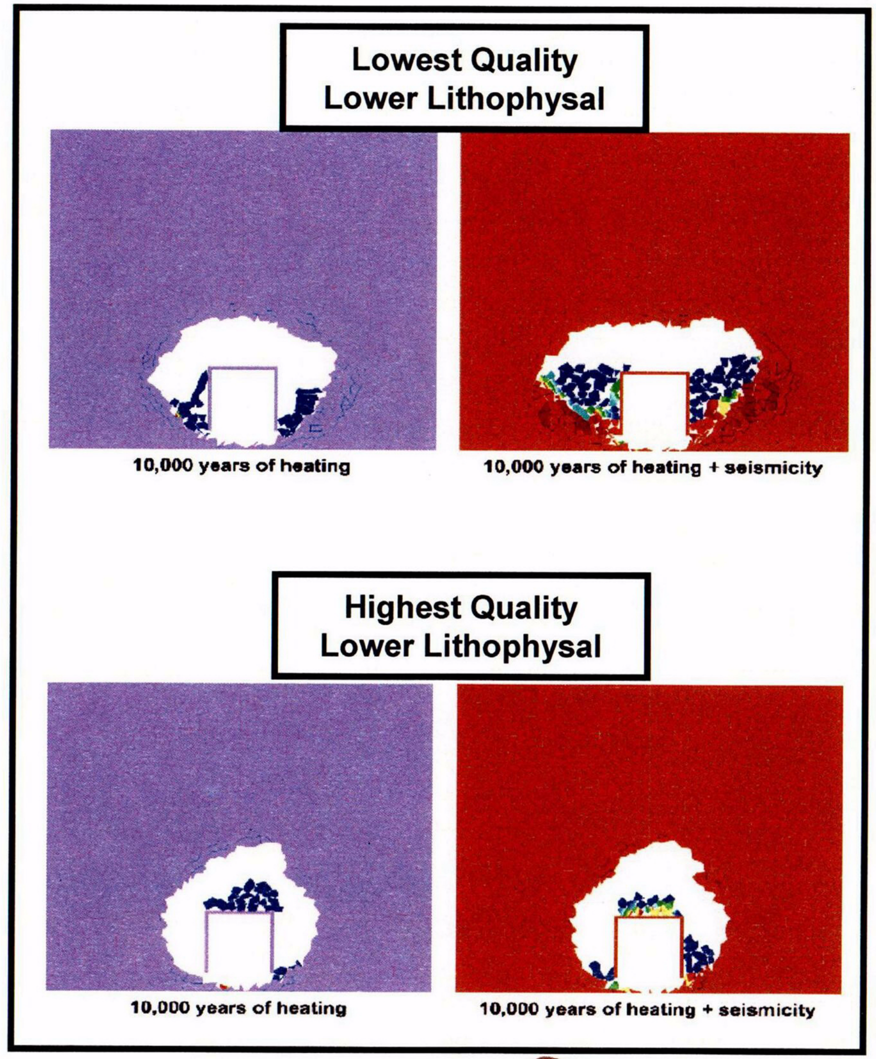


- Bounding study done for all range of rock mass quality categories
- Stable conditions under in situ and thermal loads
- Minor damage at springline (<0.5m depth) from in situ or thermal load
- Large acceleration postclosure ground motions cause self-filling of drifts
- Rock particles small - on order of 10 cm on a side

c23

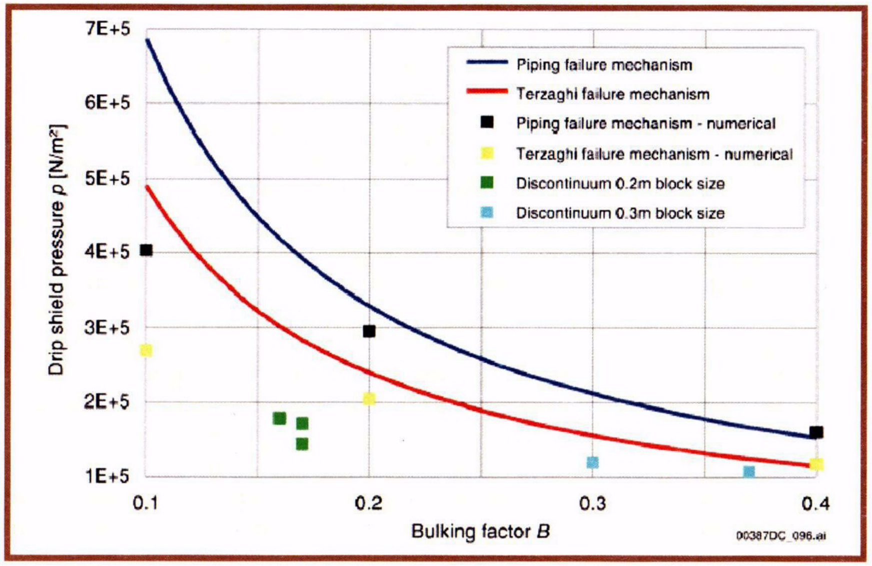
Time-Dependent Degradation

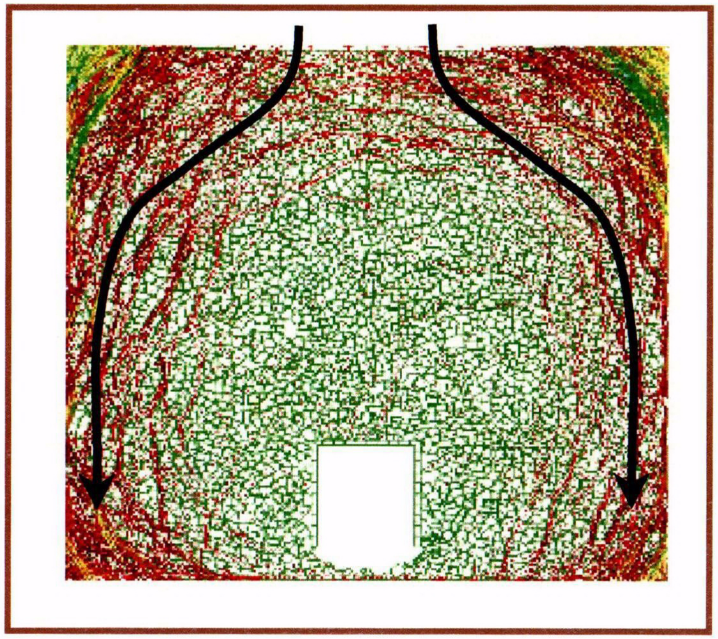
- Time-dependency estimate in hard rocks has not been extensively studied
- Complete collapse of tunnels is *not* inevitable
- Many tunnels and natural excavations (large lithophysae, caves, slopes) stand for millions of years without collapse
- Use of empirical "stand-up" time to predict degradation is not relevant
- Degradation rate is stress corrosion process, based on stress state and rock strength in presence of moisture
- Use static fatigue testing to estimate the "time-to-failure" as a function of stress state - incorporate in mechanics-based numerical model



Static Loading on Drip Shield from Rockfall

- Most conservative case is full collapse of tunnels - estimate drip shield load for this case
- Used several different methods, including analytical kinematic solutions and modeling of progressive degradation and load development
- Most reasonable is discontinuum approach where load develops naturally and some arching occurs





C25

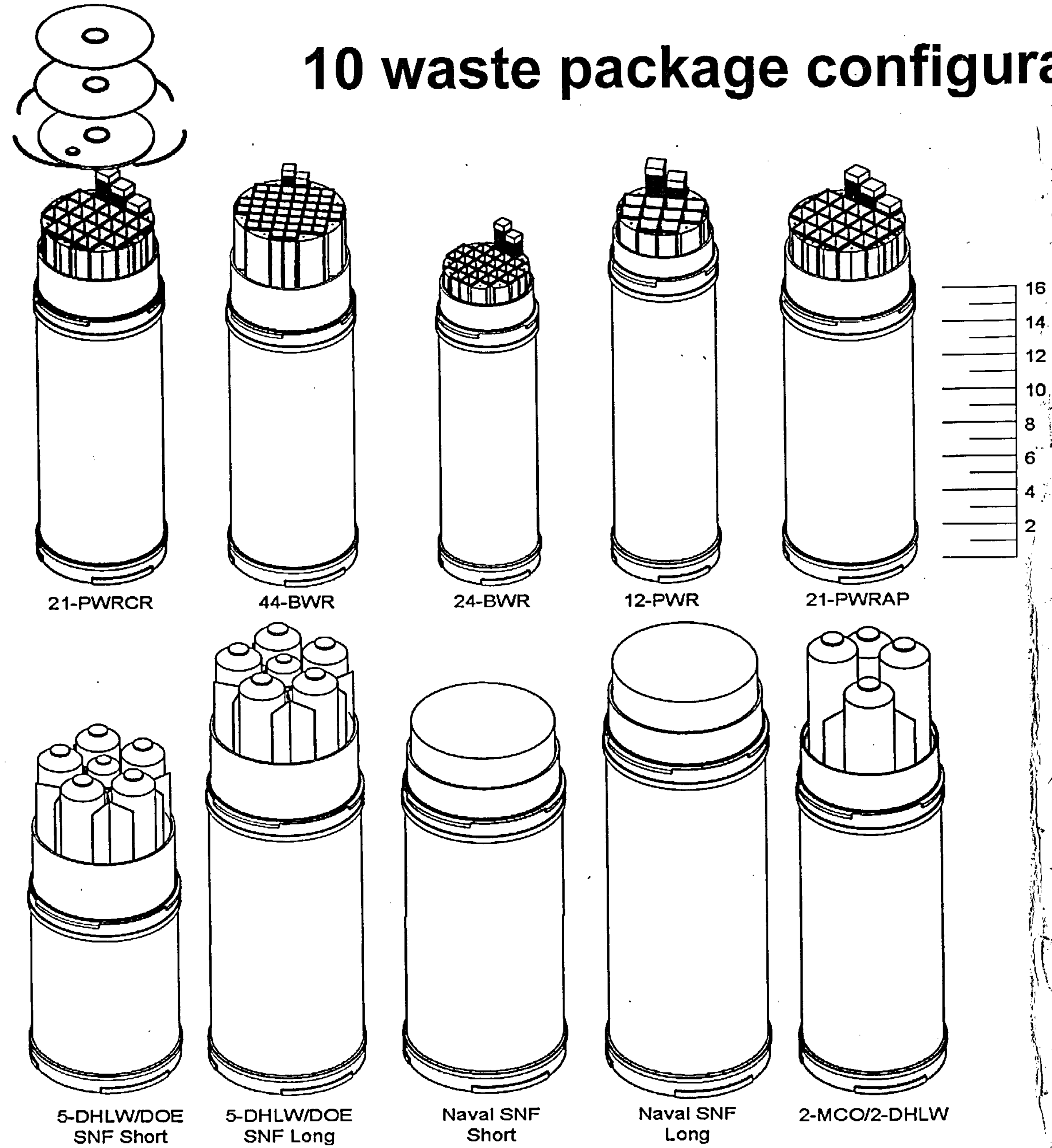
Conclusions

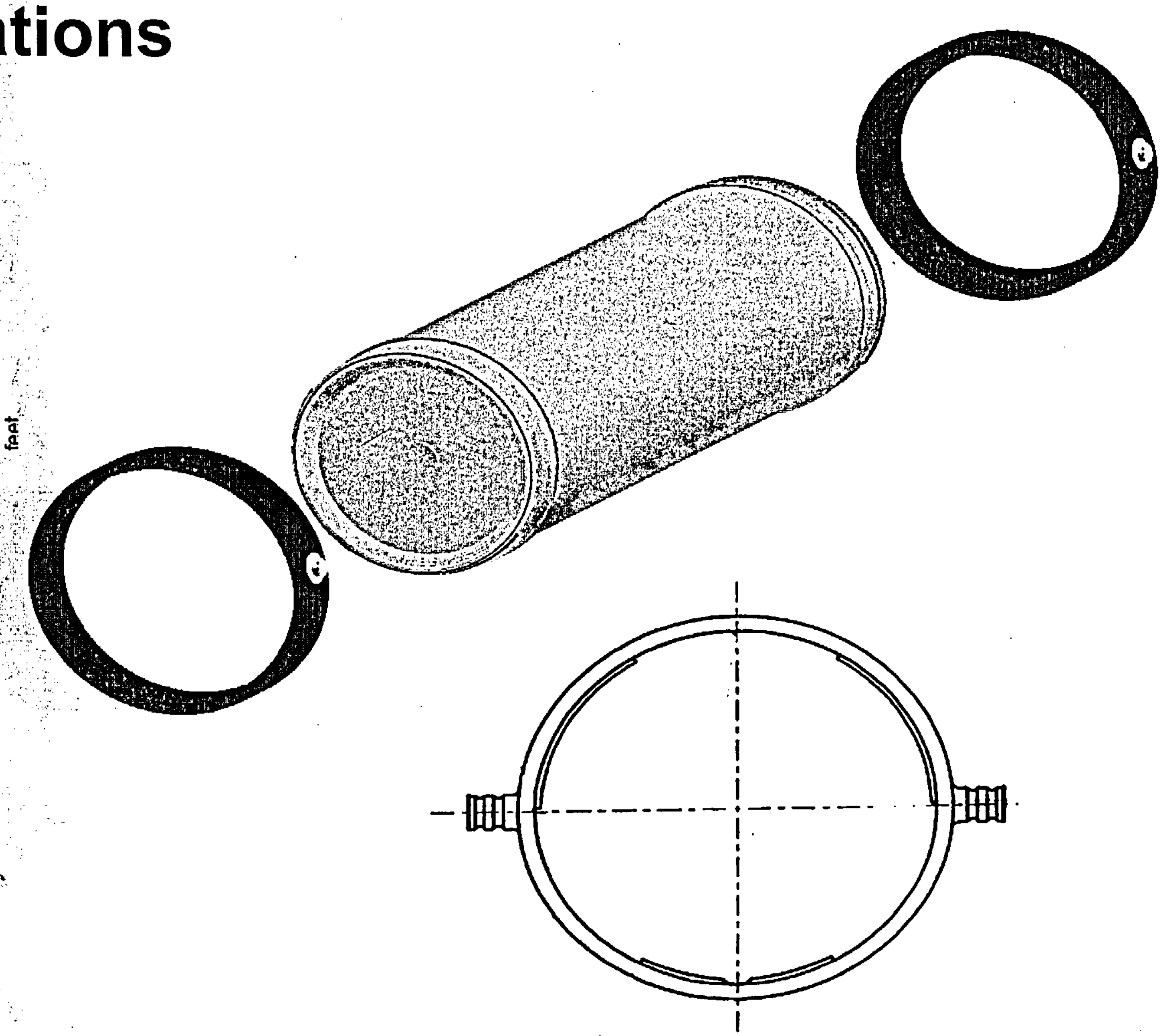
- Drift degradation studies based on site-specific geologic mapping, in situ stress measurements and rock properties determination
- Appropriate discontinuum models used to extend testing to examine variation in properties
- Drift degradation studies conducted for applied in situ, thermal and seismic stressing. Calculations made for conservative range in material properties
- Time-dependent strength degradation estimated based on static fatigue testing of tuff and compared to granite

Conclusions
(Continued)

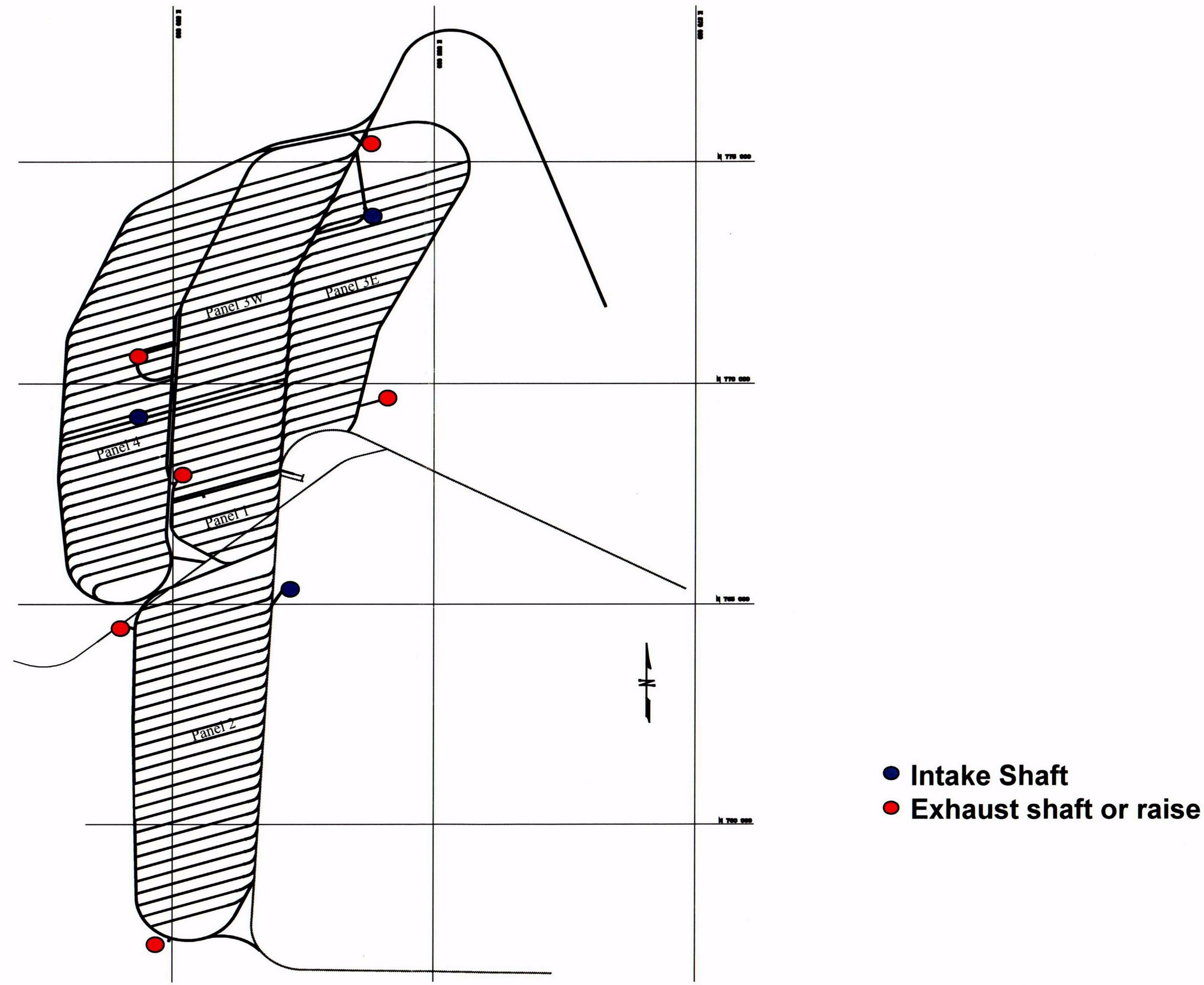
- Non-lithophysal rock
  - Elastic conditions for in situ and thermal loading conditions
  - Rockfall size under seismic loading is typically small with mean block size of approx. 0.5 tonne. Most energetic rock block is 14 tonne
- Lithophysal rock
  - Minor sidewall yielding for in situ and thermal loading conditions for all strength categories
  - Time-dependent damage under action of in situ, thermal and seismic loading results in some sidewall yield shakedown
  - Large postclosure seismic events (likely not physically realizable) result in significant small rockfall in tunnels with associated quasi-static loading

10 waste package configurations



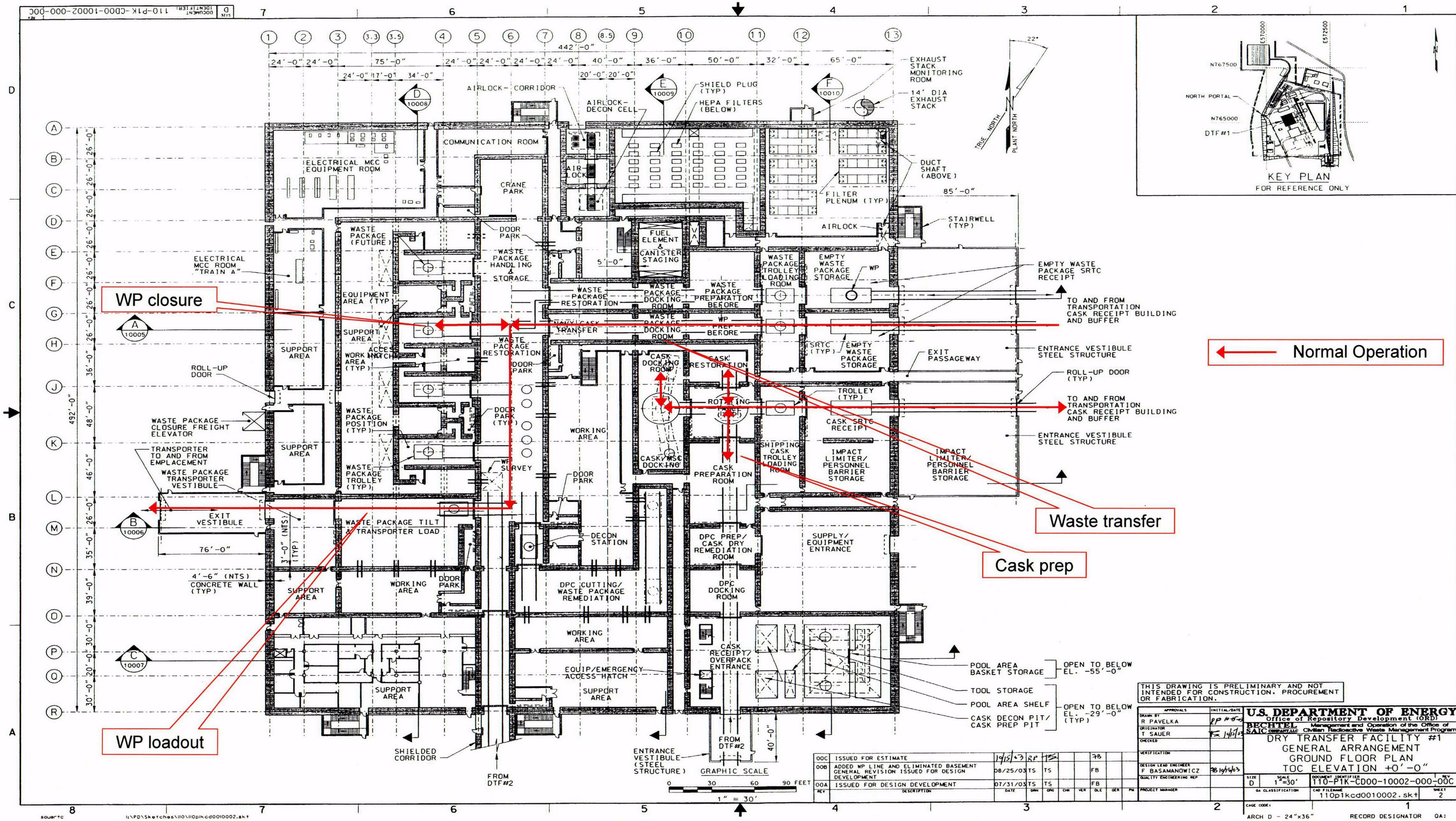


This drawing is preliminary and not intended for construction, procurement, or fabrication.

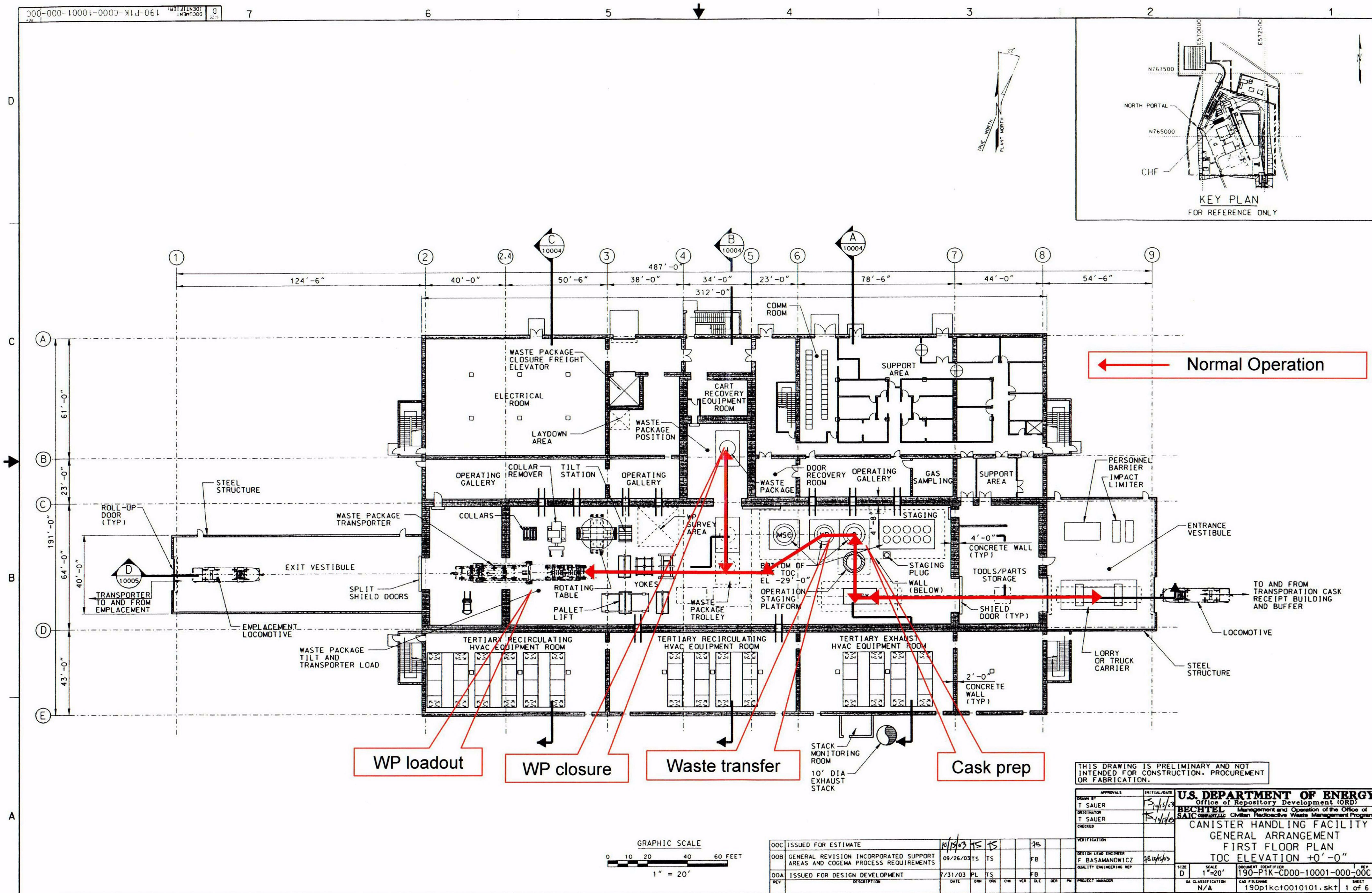


This drawing is preliminary and not intended for construction, procurement, or fabrication.

c26


WP closure
Normal Operation
Waste transfer
Cask prep
WP loadout
COMMUNICATION ROOM
ELECTRICAL MCC EQUIPMENT ROOM
CRANE PARK
AIRLOCK-CORRIDOR
AIRLOCK-DECON CELL
SHIELD PLUG (TYP)
HEPA FILTERS (BELOW)
EXHAUST STACK MONITORING ROOM
14' DIA EXHAUST STACK
DUCT SHAFT (ABOVE)
FILTER PLENUM (TYP)
AIRLOCK
STAIRWELL (TYP)
KEY PLAN
FOR REFERENCE ONLY
NORTH PORTAL
DTF #1
TRUE NORTH
PLANT NORTH
ELECTRICAL MCC ROOM "TRAIN A"
WASTE PACKAGE (FUTURE)
WASTE PACKAGE HANDLING & STORAGE
DOOR PARK
FUEL ELEMENT & CANISTER STAGING
WASTE PACKAGE TROLLEY LOADING ROOM
EMPTY WASTE PACKAGE STORAGE
EMPTY WASTE PACKAGE SRTC RECEIPT
TO AND FROM TRANSPORTATION CASK RECEIPT BUILDING AND BUFFER
EQUIPMENT AREA (TYP)
WASTE PACKAGE RESTORATION
WASTE PACKAGE DOCKING ROOM
WASTE PACKAGE PREPARATION BEFORE
WP PREP BEFORE
SUPPORT AREA
WORK ACCESS HATCH AREA (TYP)
WASTE PACKAGE RESTORATION
CASK DOCKING ROOM
CASK RESTORATION
ROTATING
SRTC (TYP)
EMPTY WASTE PACKAGE STORAGE
EXIT PASSAGEWAY
ENTRANCE VESTIBULE STEEL STRUCTURE
ROLL-UP DOOR (TYP)
TROLLEY (TYP)
CASK SRTC RECEIPT
ROLL-UP DOOR
WASTE PACKAGE CLOSURE FREIGHT ELEVATOR
WASTE PACKAGE POSITION (TYP)
WORKING AREA
CASK/MSC DOCKING
SHIPPING CASK TROLLEY LOADING ROOM
IMPACT LIMITER/ PERSONNEL BARRIER STORAGE
TRANSPORTER TO AND FROM EMPLACEMENT
WASTE PACKAGE TRANSPORTER VESTIBULE
WASTE PACKAGE TROLLEY (TYP)
WP SURVEY
CASK PREPARATION ROOM
EXIT VESTIBULE
WASTE PACKAGE TILT & TRANSPORTER LOAD
DECON STATION
DPC PREP/ CASK DRY REMEDIATION ROOM
SUPPLY/ EQUIPMENT ENTRANCE
4'-6" (NTS) CONCRETE WALL (TYP)
WORKING AREA
DPC CUTTING/ WASTE PACKAGE REMEDIATION
DPC DOCKING ROOM
EQUIP/EMERGENCY ACCESS HATCH
CASK RECEIPT/ OVERPACK ENTRANCE
POOL AREA BASKET STORAGE
OPEN TO BELOW EL. -55'-0"
TOOL STORAGE
POOL AREA SHELF
CASK DECON PIT/ CASK PREP PIT
OPEN TO BELOW EL. -29'-0" (TYP)
SHIELDED CORRIDOR
FROM DTF#2
ENTRANCE VESTIBULE (STEEL STRUCTURE)
GRAPHIC SCALE
1" = 30'
THIS DRAWING IS PRELIMINARY AND NOT INTENDED FOR CONSTRUCTION, PROCUREMENT OR FABRICATION.
U.S. DEPARTMENT OF ENERGY
Office of Repository Development (ORD)
BECHTEL SAIC COMPANY, LLC
DRY TRANSFER FACILITY #1
GENERAL ARRANGEMENT
GROUND FLOOR PLAN
TOC ELEVATION +0'-0"
110-P1K-CD00-10002-000-00C
110p1kcd0010002.skt
00C ISSUED FOR ESTIMATE
00B ADDED WP LINE AND ELIMINATED BASEMENT GENERAL REVISION ISSUED FOR DESIGN DEVELOPMENT 08/25/03
00A ISSUED FOR DESIGN DEVELOPMENT 07/31/03
R PAVELKA
T SAUER
F BASAMANOWICZ
ARCH D - 24"x36"
RECORD DESIGNATOR

C27



THIS DRAWING IS PRELIMINARY AND NOT INTENDED FOR CONSTRUCTION, PROCUREMENT OR FABRICATION.

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00C	ISSUED FOR ESTIMATE	10/15/03
00B	GENERAL REVISION INCORPORATED SUPPORT AREAS AND COGEMA PROCESS REQUIREMENTS	09/26/03
00A	ISSUED FOR DESIGN DEVELOPMENT	7/31/03

U.S. DEPARTMENT OF ENERGY
Office of Repository Development (ORD)
BECHTEL SAIC COMPANY, LLC — Management and Operation of the Office of Civilian Radioactive Waste Management Program

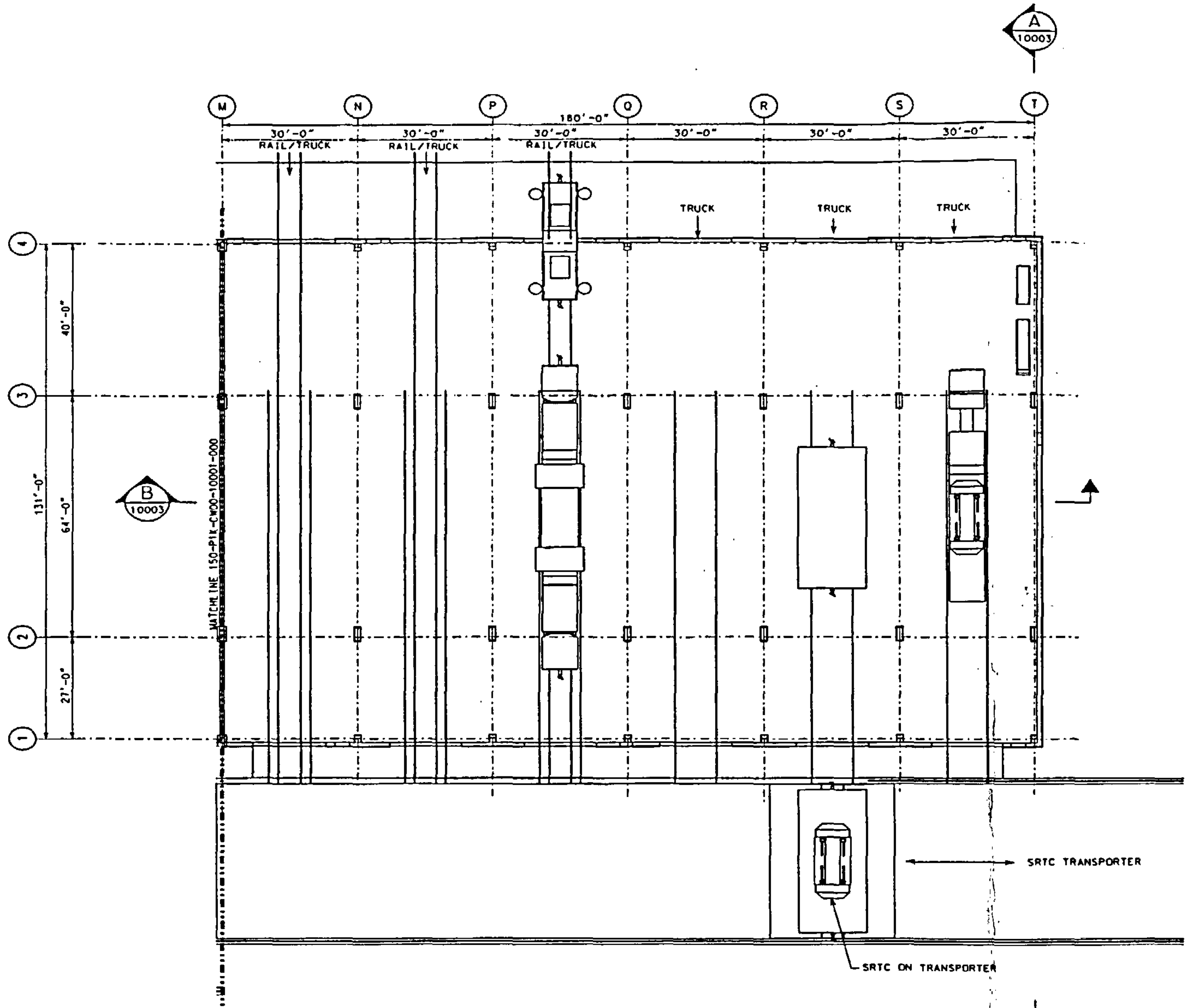
CANISTER HANDLING FACILITY
GENERAL ARRANGEMENT
FIRST FLOOR PLAN
TOC ELEVATION +0'-0"

DRAWN BY: T SAUER
ORIGINATOR: T SAUER
DESIGN LEAD ENGINEER: F BASAMANOWICZ

SIZE: D | SCALE: 1"=20' | DOCUMENT IDENTIFIER: 190-P1K-CD00-10001-000-00C
QA CLASSIFICATION: N/A | CAD FILENAME: 190p1kct0010101.skt | SHEET 1 of 6

ARCH D - 24"x36" RECORD DESIGNATOR QA: N/A

C28



PLAN ON GROUND FLOOR
TOC EL 3670'-0"

GRAPHIC SCALE
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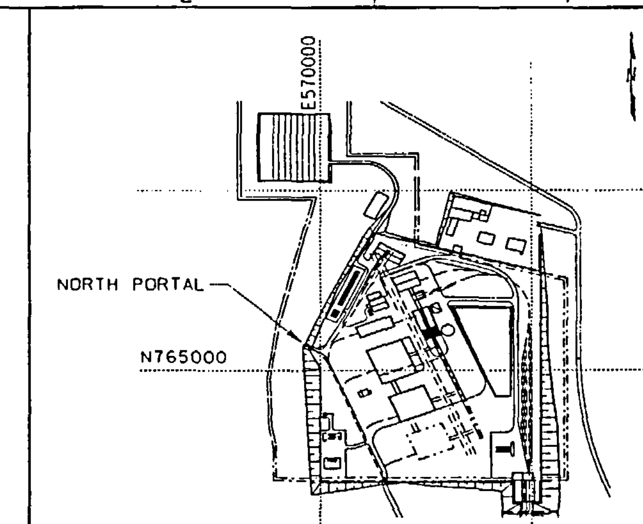
1/16" = 1'-0"



KEY PLAN
FOR REFERENCE ONLY

THIS DRAWING IS PRELIMINARY AND NOT INTENDED FOR CONSTRUCTION, PROCUREMENT OR FABRICATION.

REV	DESCRIPTION	DATE	DRN					
A	ISSUED FOR DESIGN DEVELOPMENT	10/22/03						

APPROVALS	INITIAL/DATE
DRAWN BY S GODEAUX	10/22/03
ORIGINATOR A. EDMONSTONE	
CHECKED	
VERIFICATION	
DESIGN LEAD ENGINEER	10/22/03
QUALITY ENGINEERING REP	
PROJECT MANAGER	

U.S. DEPARTMENT OF ENERGY
Office of Repository Development (ORD)
BECHTEL SAIC COMPANY, LLC — Management and Operation of the Office of Civilian Radioactive Waste Management Program

TRANSPORTATION CASK BUFFER AREA GENERAL ARRANGEMENT PLAN GROUND FLOOR

SIZE D | SCALE 1/16" = 1' | DOCUMENT IDENTIFIER 140-P1K-CC00-10001-000-00A
QA CLASSIFICATION | CAD FILENAME 140P1K1001.DGN
CASE CODE:
ARCH D - 24"x36"
RECORD DESIGNATOR OA:

22-OCT-2003 13:04

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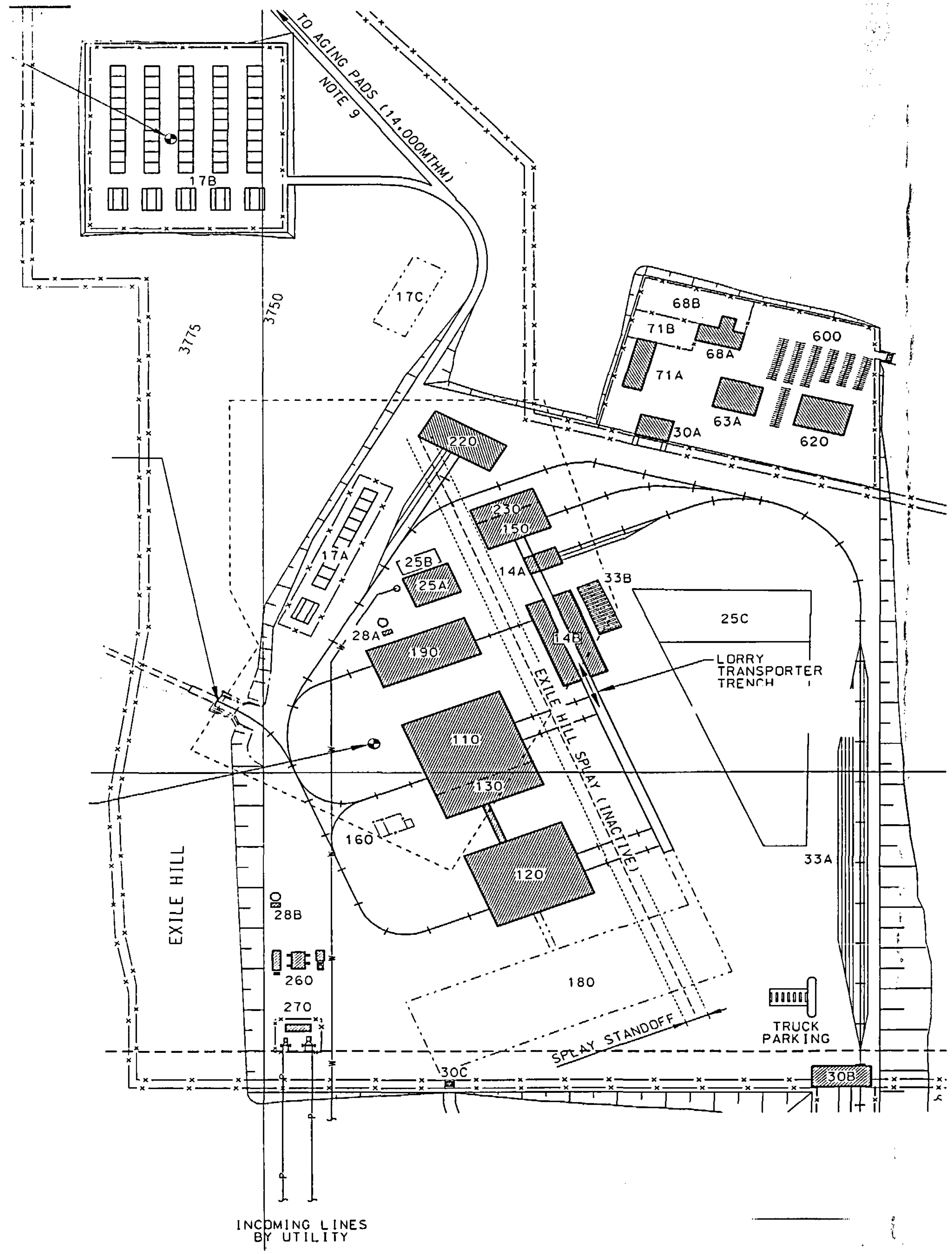
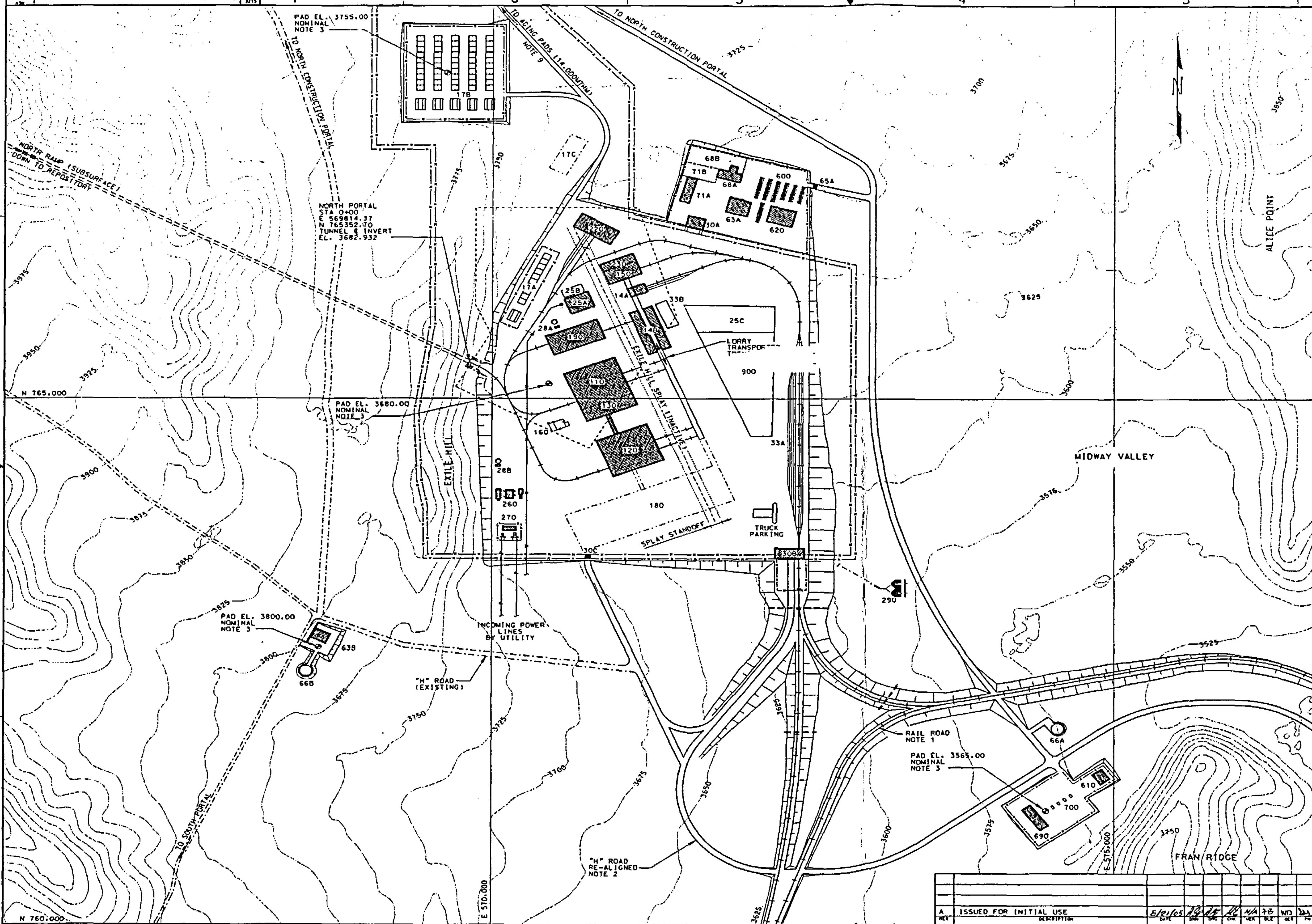


AREA No.	DESCRIPTION
110	DRY TRANSFER FACILITY #1 (DTF-1)
120	DRY TRANSFER FACILITY #2 (DTF-2)
130	REMEDIATION BLDG (RB)
14A	TRANSPORTATION CASK RECEIPT BUILDING (TCRB)
14B	TRANSPORTATION CASK BUFFER AREA
150	WASTE PACKAGE RECEIPT BUILDING (WPRB)
160	LOW LEVEL WASTE HANDLING (LLWH)
17A	AGING (1000 MTHM)
17B	AGING (5,000 MTHM)
17C	SHIELDED CANISTER FACILITY (SCF) FUTURE
180	SPACE FOR FUTURE WASTE PROCESSING FACILITIES
190	CANISTER HANDLING FACILITY (CHF)
220	HEAVY EQUIPMENT MAINTENANCE BUILDING (HEMB)
230	EQUIPMENT MAINTENANCE/WAREHOUSE BUILDING (EMWB)
25A	UTILITY BUILDING
25B	COOLING TOWER
25C	EVAPORATION POND
260	ELECTRICAL GENERATORS AND SWITCH HOUSE
270	MAIN SWITCHYARD
28A	FIRE WATER FACILITY
28B	FIRE WATER FACILITY
290	SEPTIC TANK & LEACH FIELD (EXISTING)
30A	CENTRAL SECURITY STATION
30B	CASK RECEIPT SECURITY STATION
30C	SOUTH PERIMETER SECURITY STATION
33A	RAIL CAR STAGING AREA
33B	TRUCK STAGING
600	NORTH CENTRAL PARKING
610	VISITOR CENTER
620	ADMINISTRATION BUILDING
63A	FIRE, RESCUE AND MEDICAL BUILDING
63B	FIRE, RESCUE AND MEDICAL BUILDING (CONSTRUCTION/REMOTE)
65A	ADMINISTRATION SECURITY STATION
66A	HELICOPTER PAD
66B	HELICOPTER PAD (CONSTRUCTION/REMOTE)
68A	WAREHOUSE/CENTRAL RECEIVING
68B	MATERIALS/YARD STORAGE
690	SMALL VEHICLE REPAIR SHOP
700	FUEL DEPOT
71A	CRAFT SHOPS
71B	EQUIPMENT YARD STORAGE
900	STORM WATER / RETENTION POND

- EXISTING
- FENCE
- FUTURE
- 3625 25' CONTOURS
- CHARACTERIZED AREA (EXISTING)
- WATER
- POWER
- RAILROAD
- ROAD
- SECURITY FENCE
- BUILDING/STRUCTURE

This drawing is preliminary and not intended for construction, procurement, or fabrication.



LEGEND

ENG.20030820.0012

AREA No.	DESCRIPTION
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120	DRY TRANSFER FACILITY #2 (DTF-2)
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14A	TRANSPORTATION CASK RECEIPT BUILDING (TCRB)
14B	TRANSPORTATION CASK BUFFER AREA
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17B	AGING (5,000 MTHM)
17C	SHIELDED CANISTER FACILITY (SCF) FUTURE
180	SPACE FOR FUTURE WASTE PROCESSING FACILITIES
190	CANISTER HANDLING FACILITY (CHF)
220	HEAVY EQUIPMENT MAINTENANCE BUILDING (HEMB)
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700	FUEL DEPOT
71A	CRAFT SHOPS
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900	STORM WATER / RETENTION POND

EXISTING
FENCE
FUTURE
3625 25' CONTOURS
CHARACTERIZED AREA (EXISTING)
WATER
POWER
RAILROAD
ROAD
SECURITY FENCE
BUILDING/STRUCTURE

NOTES:

1. RAILROAD ALIGNMENT SHOWN IS CONCEPTUAL. FINAL ALIGNMENT TO BE DETERMINED BY TRANSPORTATION STUDY AS THE DESIGN DEVELOPES.
2. ROAD ALIGNMENT SHOWN IS CONCEPTUAL AND IS SUBJECT TO CHANGE AS THE FACILITY DESIGN DEVELOPES.
3. ALL NOMINAL PAD ELEVATIONS ARE PRELIMINARY AND ARE SUBJECT TO CHANGE AS THE FACILITY DESIGN DEVELOPES
4. ALL COORDINATES AND ELEVATIONS SHOWN ARE IN FEET.
5. GRID IS BASED ON NEVADA STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NORTH AMERICA DATUM OF 1927 (NAD 27).
6. ELEVATIONS ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
7. LAYOUT REPRESENTS FINAL NORTH PORTAL OPERATIONS AREA BUILDING CONFIGURATION.
8. THE SAFETY CATAGORIES OF THE SYSTEMS, STRUCTURES AND COMPONENTS (SSC) HAVE NOT BEEN DETERMINED AND THEREFORE FLAGS AND BOUNDARIES HAVE NOT BEEN IDENTIFIED.
9. ADDITIONAL AGING PAD WITH SPACE FOR 14,000 MTHM IS REQUIRED NORTH OF 17B. THIS IS NOT SHOWN AS IT FALLS OUTSIDE THE LIMITS OF THIS DRAWING.
10. FACILITY SIZES AND LOCATIONS SHOWN ON THIS DRAWING ARE APPROXIMATE AND SUBJECT TO CHANGE BASED ON DEFINITIVE DESIGN INFORMATION AS IT IS DEVELOPED.
11. DRAWING 100-P00-MGR0-00101-000 SUPERCEDES DRAWING DWG-MSL-CI-000002 REV A.

400 200 0 400 800 FT
1" = 400'-0"

THIS DRAWING IS PRELIMINARY AND NOT INTENDED FOR CONSTRUCTION, PROCUREMENT OR FABRICATION.

DESIGN INPUTS
SEE DOCUMENT INPUT REFERENCE SYSTEM (DIRS)

REV	DESCRIPTION	DATE							
A	ISSUED FOR INITIAL USE	8/21/03				N/A		WD	

APPROVALS	INITIAL/DATE
DRAWN BY: A. EDMONSTONE	8/21/03
ORIGINATOR: A. EDMONSTONE	8/21/03
CHECKED: U. EKS	8/21/03
VERIFICATION: N/A	N/A
DESIGN LEAD ENGINEER: F. BASAMANOWICZ	8/21/03
QUALITY ENGINEERING REP: W. DOCKERY	WD 8-21-03
PROJECT MANAGER: S. SETHI	8/21/03

U.S. DEPARTMENT OF ENERGY
Office of Repository Development (ORD)
BECHTEL SAIC COMPANY, LLC Management and Operation of the Office of Civilian Radioactive Waste Management Program

GEOLOGICAL REPOSITORY OPERATIONS AREA NORTH PORTAL - SITE PLAN

SIZE: D | SCALE: 1"=400'-0" | DOCUMENT IDENTIFIER: 100-P00-MGR0-00101-000-00A | REV
QA CLASSIFICATION: QA | CAD FILENAME: 100P00MGR000101.DGN | SHEET: 1of1
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RECORD DESIGNATOR 0A10A

21-AUG-2003 13:51

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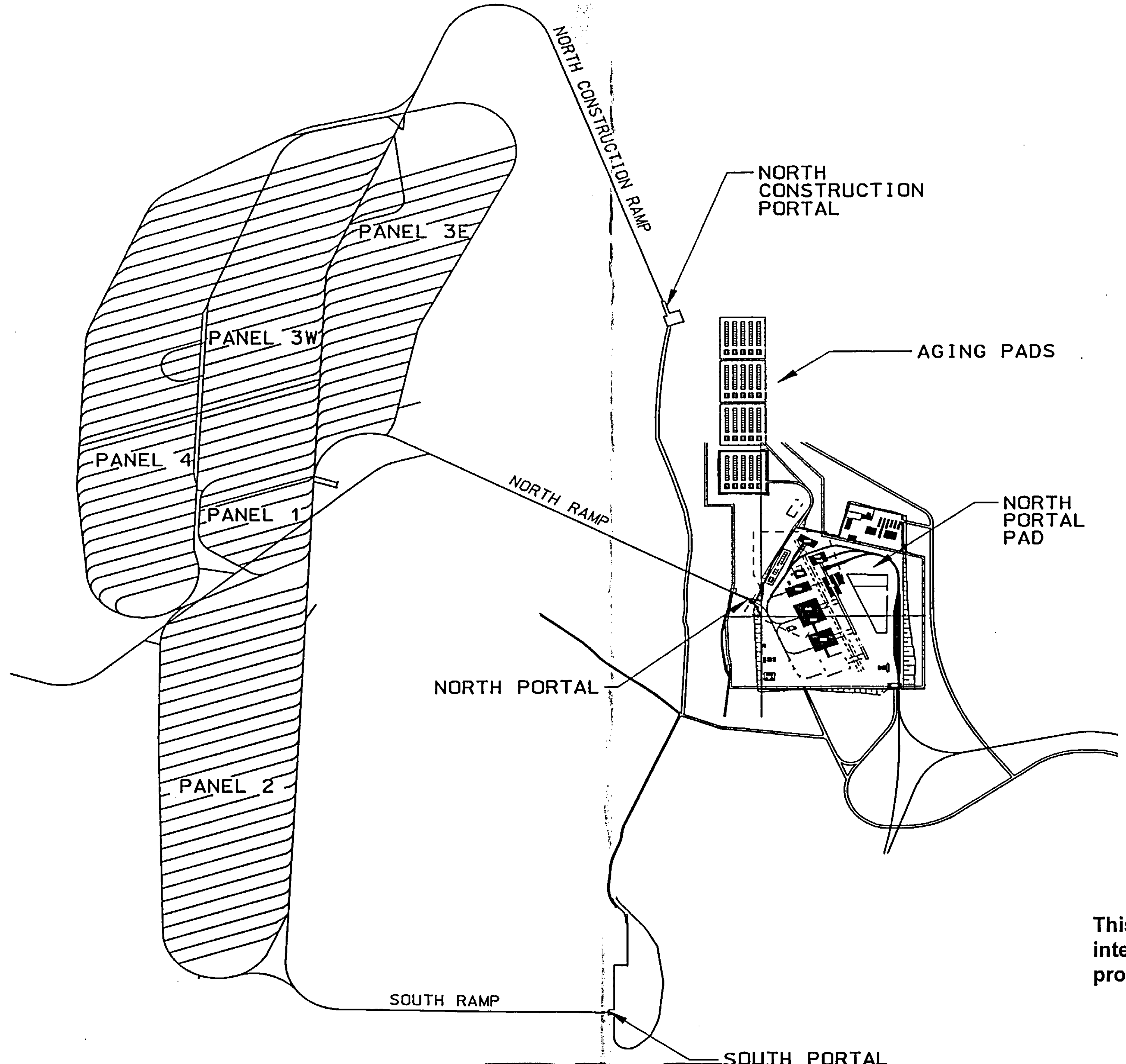

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