EQUIPMENT DESCRIPTIONS

TRANSPORT AND EMBLACEMENT
EQUIPMENT, FY1997

1.0 OBJECTIVE AND SCOPE

1.1 The objective and the scope of this document are to list and briefly describe the major mobile equipment necessary for waste package (WP) Transport and Emplacement in the proposed subsurface nuclear waste repository at Yucca Mountain. Primary performance characteristics and some specialized design features of the equipment are explained and summarized in the individual subsections of this document.

The Transport and Emplacement equipment described in this document consists of the following:

1. WP Transporter
2. Reusable Rail Car
3. Emplacement Gantry
4. Gantry Carrier
5. Transport Locomotive

2.0 INPUTS

This equipment description is based on the design analysis as stated below. All design assumptions and technical references as stated in this document originate from that analysis. The method to prepare this document is to summarize the technical features and data of the major equipment discussed in the design analysis.

2.1 Design Parameters

Refer to CRWMS/M&O (Civilian Radioactive Waste Management System Management and Operating Contractor), Preliminary Waste Package Transport and Emplacement Equipment Design, DI:BCA00000-01717-0200-00012, Rev 00, Section 4.1

2.2 Criteria

Refer to CRWMS/M&O (Civilian Radioactive Waste Management System Management
2.3 Assumptions

Refer to CRWMS/M&O (Civilian Radioactive Waste Management System Management and Operating Contractor), Preliminary Waste Package Transport and Emplacement Equipment Design, DI:BCA000000-017-0200-00012, Rev 00, Section 4.3

2.4 Codes and Standards

Refer to CRWMS/M&O (Civilian Radioactive Waste Management System Management and Operating Contractor), Preliminary Waste Package Transport and Emplacement Equipment Design, DI:BCA000000-017-0200-00012, Rev 00, Section 4.4

2.5 References

Refer to CRWMS/M&O (Civilian Radioactive Waste Management System Management and Operating Contractor), Preliminary Waste Package Transport and Emplacement Equipment Design, DI:BCA000000-017-0200-00012, Rev 00, Section 5.0

3.0 INTERFACES

3.1 Refer to CRWMS/M&O (Civilian Radioactive Waste Management System Management and Operating Contractor), Preliminary Waste Package Transport and Emplacement Equipment Design, DI:BCA000000-017-0200-00012, Rev 00, throughout Section 7

4.0 EQUIPMENT DESCRIPTIONS

4.1 Waste Package Transporter

The transporter is designed to carry waste packages, which have been placed on an integral reusable rail car from the waste handling building (WHB) to the underground emplacement drifts. It is depicted in Figures 4.1.1 and 4.1.2. The design must contain the necessary flexibility to transport waste packages of varying sizes and weights up to, and including WPs having dimensions of 2.0 m diameter by 5850 mm long, weighing up to 69 Metric Ton (MT). Note: Recent changes to the Controlled Design Assumptions Document have both increased the overall length and weight by small amounts. These changes have not impacted the validity of the concepts shown. The basic features and components of the transporter include the radiation shielding, under frame, undercarriage, couplers and connectors, brake systems, transporter door openers, reusable rail car restraint, reusable rail car unloader system, wiring, interlocks and instrumentation.
The shielding shall be designed to reduce the radiation from the WP inside the transporter to an acceptable safety level compatible with the operations in the subsurface repository. The shielding material shall be a composite of stainless steel, carbon steel, and a borated (1.5%) polyethylene material with a total thickness of 264 mm (10.4 in.). The carbon steel shield faces the inside of the transporter providing the gamma shielding and serving as the shielding structure. The 1.5% B-poly neutron shielding material is attached to the outside surface of the carbon steel and provides neutron shielding. The 1.5% B-poly shall be covered on the outside with stainless steel. Two principal reasons for the selection of the stainless steel siding on the transporter are:

- on the outside, for containment of neutron shielding materials.
- on the inside, for the ease of decontamination, if required.

The transporter has two swinging doors, constructed of the composite material, to provide for rail car transfer. The doors will swing 270 degrees out and around to the side of the transporter. The carbon steel inner shield material will be fabricated and machined into the required features, such as the door hinges.

The under-frame will be fabricated of structural steel sections and plates with welded or bolted connections. Two under-frames are be required, a front and rear, which are connected and held in relation to the underside of the shielding floor. The front under frame shall include the front coupler, front bolster plate, and an equipment platform for the WP rail car unloader. The rear under-frame shall include the rear coupler, the truck bolster plate, and the door operator drive.

The undercarriages, which include the trucks and wheels, shall be a standard rail car configuration adapted to this specific application. The trucks include wheels, axles, bearings, brakes, and springs, which are incorporated into the truck frame, and bolster, which transmits the load from the truck to the bolster plate of the under frame. The truck bolster shall include a bolster pin, which centers the truck in a corresponding hole in the bolster plate and allows for the trucks to pivot and the transporter to negotiate curves in the track. The truck capacity shall be based on the maximum operating load, which is the maximum operating weight divided over the 8 wheels on the two trucks. The maximum operating weight is 233 MT and the design wheel load is 43,406 kg. These values corresponded to the wheel selection of 762 mm (30 in.) diameter and 57.0 kg/m (115 lb/yd) AREA rails. The wheels, commonly used in bridge crane service, are heat treated to a hardness of 615 BHN and the rails to a hardness of 320 BHN.

The transporter will be equipped with two Willison-type couplers, like those common to underground mining and tunneling rail equipment, with automatic release. This provides for locomotive connections at the front and the rear of the transporter during the travel from the surface, and a more positive braking action in the downgrade descent to the emplacement level.
Figure 4.1.1, WP Transporter Arrangement
Figure 4.1.2, WP Transporter Rail Car Unloader System
The transporter will be equipped with a fail-safe air brake system that is interconnected and operates in conjunction with the primary locomotive, similar to rail industry practice. The system will utilize spring set air release brakes and includes the brake shoes, air cylinders, and operating linkage installed on the trucks with the air reservoir, piping and miscellaneous equipment located on the under-frame. The air brakes will be connected to the lead locomotive with rail industry standard manual connections.

The transporter will have automatic door operators, controlled from the primary locomotive. Each door will have an operator and both, working in unison, will open and close the shielded doors for WP transfer on a reusable rail car. Each door will be fixed to a hinge pin which allows it to swing 270 degrees. The 178 mm (7 in.) diameter door hinge will include a thrust bearing to support the vertical load of the door. It will be connected through a spline joint to a low speed (1 rpm) motor gear reducer. The motor gear reducers will be right angle helical-worm units, flange mounted on the underside of the shielded floor. The doors will also be equipped with a locking device to secure the closed doors against the body of the transporter.

The transporter will be equipped with a remotely controlled rail car restraint mechanism to restrict horizontal movement of the reusable rail car in the transporter when it is in the transit mode.

The transporter will be equipped with a loading/unloading mechanism, which utilizes a proprietary rigid chain design, to move the WP reusable rail car. The main chain components are the storage magazines, right-angle chain drives, and guides for the chain in the rigid state. The two drives will be connected to a common gear motor for synchronous operation. Inside the transporter, the rigid chain will run in a chain guide installed on the floor where it is connected to a pusher bar, which engages the rail car and moves it through the open doors of the transporter and out onto the emplacement drift transfer dock. The pusher bar is supported by the two rail car rails on equipment rollers with vertical guide rollers to maintain alignment. The pusher bar will be equipped with a counter-weighted self-latching engagement hook that serves to maintain contact between the bar and the rail car front plate and draws the rail car from the unloader in the WHB.

The transporter will be pre-wired in a rigid conduit for power and control systems, which will be located outside the transporter shielding for ease in maintenance and/or repair.
4.1.1 Transporter Data Sheet

A. Equipment Name: Waste Package Transporter

B. Service: To transport WPs on a Reusable Rail Car from the surface WHB to the emplacement drift entrance.

C. Operating Conditions:

1. Working Environment: Above surface and below surface in tunnels and emplacement drift turnouts,
2. Temperature Range: 27°C to 50°C below surface, (-) 7°C to 42°C above surface
3. Elevation: Approximately 1000 m to 1200 m above sea level
4. Tunnel/Drift Clearances:
   a. Mains: 4.10 m wide x 5.25 m high
   b. Emplacement: 5.1 m maximum (with 200 mm ground support in place)
   c. Main Grade: +3% to -3%
   d. Drift Grade: ±0.75%
5. Loads:
   a. Waste Packages:
      1. Diameter: 1298 mm to 2000 mm maximum
      2. Length: 5335 mm to 5850 mm maximum
      3. Weight: 32,236 kg to 69,000 kg maximum
   b. Reusable Rail Car
      1. Overall Length: 6.76 m
      2. Overall Width: 1.62 m
      3. Overall Height: 0.64 m
      4. Overall Weight: 11 MT estimated
6. Track Radius: 20 m (in emplacement drift turnout)
7. Track Gage: 1.44 m
8. Rail: 57 kg/m (115 lb/yd) AREA rail
9. Rail Condition: above ground varies with weather, below ground: dry and good condition
10. Power Source: 600 V DC
11. Operation: Two round trips per 8-hour day
12. Travel Distance: 10,000 m to 16,000 m per round trip

D. Equipment Requirements:

1. Construction:
Transporter Frame: Shielding fabricated from a composite of stainless steel, carbon steel, and borated (1.5%) polyethylene, with a total thickness of 264 mm.

Under frame: Fabricated of structural steel sections and plates with welded or bolted connections.

Truck:
- Mounting: Pivoted
- Number of Wheels: Four each
- Wheel Diameter: 762 mm (30 in.)
- Wheel Hardness: Heat treated to a hardness of 58 RC (615 BHN)
- Coupler Weight: 80 kg (175 lbs each)
- Truck Bolster Weight: 664 kg (1,460 lbs each)

Coupler Weight: 80 kg (175 lbs each)

Rail Car Unloader System:
- Gear motor:
  1. Type: SEW-Eurodrive helical-bevel Model K106 with DT100L4 motor
  2. Rated Motor hp: Reversible 5 hp @ 1750 rpm
  3. Output Speed: 13 rpm
  4. Torque: 23.23 kg-m (24,200 in-lb)
  5. Mounting: Foot mounted
  6. Weight: 320 kg
- Rigid Chain Magazine Storage:
  1. Total Length: 6.29 m
  2. Total Weight: 1252 kg
- Rigid Chain Weight: 384 kg

Door Operator:
- Gear motor:
  1. Type: SEW-Eurodrive right angle helical-worm Model S92R62 with DT80K4 motor
  2. Rated Motor Hp: 3/4 hp @ 1750 rpm
  3. Output Speed: 1 rpm
  4. Torque: 22.27 kg-m (23,200 in-lb)
  5. Mounting: Flange mounted with keyed or spline output shaft
  6. Weight: 200 kg
- Hinges:
  1. Type: Carbon Steel door hinges
  2. Number of hinges: Three
  3. Total Weight: 863.4 kg
- Pin:
1. Weight: 374 kg
2. Diameter: 177.8 mm (7 in.)

E. Power and Controls:

1. Power: 600 VDC
2. Controls: Remote

Note: Control features for the WP transporter will be summarized in a separate equipment description document.

F. Approximate Dimensions and Weight:

1. Overall Length: 9.47 m, over coupler
2. Overall Width: 3.47 m, over hinges
3. Overall Height: 4.07 m, from top-of-rails
4. Overall Weight: 164 MT, unloaded, with reusable rail car

G. Other Features:

1. Braking: Fail-safe air brake system

4.1.2 Transporter Suppliers:

A. Kasgro Rail Corp.
   (412) 858-8061 Fax (412) 658-7638
   Contact: Gabe M. Kassab

4.2 Reusable Rail Car

The reusable rail car will be designed to support and move the WP into the transporter, to support and secure it inside the transporter, to move it from the transporter to the emplacement drift, and to function with the WP loading/unloading system. The rail car is depicted in Figure 4.2. The WP will be transported on a V-shaped WP support, or cradle, installed on the rail car. The WPs can vary in diameter and length and can weigh up to 69 MT, but the design of the rail car’s cradle will be based on the longest WP measuring 5.85 m. Removable spacers will be used to center shorter waste packages on the cradle. They prevent axial shifting of the WP in transit and position the WP in the rail car for engagement by the emplacement gantry lifting heads. The rail car will be equipped with a towing eye on both ends for connection with a prime mover when detached from the unloader. The rail car will have four equally spaced wheel and axle assemblies. An assembly will consist of an axle with supporting brackets for attachment to the under
frame and wheels with integral bearings attached to each end of the axle. The selected unit utilizes 355.6 mm (14 in.) dia. single-flange rail wheels with a rated capacity of 13.6 MT (15 tons). The rail car will travel on 44.6 kg/m (90 lb/yd) ASCE rails.
4.2.1 Rail Car Data Sheets

A. Equipment Title: Reusable Rail Car

B. Service: To support and move WPs to and from the transporter, to support and secure each WP inside transporter, to transfer WPs from transporter to emplacement drift and function with the WP unloader system.

C. Operating Conditions:

1. Working Environment: Inside the WP Transporter, in the emplacement drift entrance, in the WHB.
2. Temperature Range: 27°C to 50°C
3. Elevation: Approximately 1000 m to 1200 m above sea level
4. Transporter Dimensions:
   a. Inside Length: 6.84 m
   b. Inside Width: 2.41 m
   c. Maximum Inside Height: 2.67 m
5. Load:
   a. Diameter: 2.0 m maximum
   b. Length: 5335 mm to 5850 mm
   c. Weight: 32,236 kg to 69,000 kg
6. Minimum Turning Radius: None, track is straight
7. Track Gage: 1.44 m
8. Rail: 44.6 kg/m (90 lb/yd) ASCE rail
9. Rail Condition: Dry and in good condition
10. Operation: Two loads per 8-hour day
12. Travel Distance: 12 m one-way per transfer

D. Equipment Requirements:

1. Construction:
   a. Rail Car Frame
      The rail car will be fabricated from ASTM A36 structural steel plate welded per AWS D1.1
NOTE:
SPACERS ARE USED TO CENTER AND
RESTRAIN THE VARIOUS LENGTHS OF
WPS IN THE SUPPORT CRADLE

Figure 4.2, Reusable Rail Car
2. Wheel and Axle Assembly:
   a. Number of Axles: Four each
   b. Number of Wheels: Eight each, two on each axle
   c. Type of Wheel: 355.6 mm (14 in.) diameter single-flange rail wheels with rated capacity of 13.6 MT (15 tons)
   d. Axle Accessories: Supporting brackets for attachment to under frame
   e. Wheel Accessories: Integral bearings attached to each end of axle

E. Approximate Dimensions and Weight:

1. Overall Length: 6.76 m, end to end
2. Overall Width: 1.62 m
3. Overall Height: 0.64 m
4. Overall Weight: 11 MT, without load

F. Other Features:

1. Towing Eye: Located on both ends for connection to a prime mover when detached from unloader.
2. Restraining Spacers: Used to center and restrain various lengths of WP in support cradle.

4.2.2 Reusable Rail Car Suppliers:

A. Kasgro Rail Corp.
   (412) 858-8061    Fax (412)658-7638
   Contact: Gabe M Kassab

4.3 Emplacement Gantry

The emplacement gantry will be designed to lift waste packages of varying diameters and lengths, weighing up to 69 MT, to transport them to pre-assigned storage locations, and place them onto pedestals, secured on the emplacement drift invert sections. This gantry, depicted in Figure 4.3, will be composed of several major assemblies including the gantry frame, with traversing bogies and lifting screws, hoisting frame, and lifting head trolleys. The machine will be designed to lift one 2.0 m diameter WP over another 2.0 m diameter WP resting on pedestals in an emplacement drift. Maximum lifting height of the gantry will be 2226 mm. The lifting height of the hoisting frame will be accomplished by four,
102 mm (4 in.) ball screws. One of these ball screws will be located at each corner of the gantry frame and one pair at each end of the gantry will be powered by a gear motor and chain drive on the upper cross member of the gantry frame. Traversing power will be supplied by four gear motors; one gear motor will be mounted on each trolley and will supply power to one of the trolley wheels through a chain drive. The lifting head trolleys will provide adjustment for variation in the length of the WPs. These trolleys will move inward or outward in unison so that the centerline of the lifted WP will always be aligned with the centerline of the Gantry; therefore, the WP load will be evenly distributed to the bogie wheels. The lifting head trolleys will rest on the top of the hoisting frame beam. These ball screws will be fabricated with right hand and left hand threads so that the trolleys move in unison. Power to operate the lifting head ball screws will be supplied by two shaft mounted gear motors.

Each bogie will be supplied with two, 400 mm wheels which will be hardened to 320 BHN to support the concentrated high loads imposed by the WPs. Additional gantry components will include towing lugs and jacking pads. Other features will include electrical cabinets, control systems and sensing devices for the remote control of the gantry.
Figure 4.3, Emplacement Gantry
4.3.1 Gantry Data Sheet

A. Equipment Title: Emplacement Gantry

B. Service: To lift, transport, and place WPs center in-drift onto preset pedestals in the emplacement drift.

C. Operating Conditions:

1. Working Environment: In drift underground
2. Temperature Range: 27° C to 50°
3. Elevation: Approximately 1000 m to 1200 m above sea level
4. Drift Dimension
   a. Emplacement: 5.1 m dia. with 200 mm of ground support installed
   b. Clearance: 100 mm maximum to ground support
   c. Grade: ±0.75%
5. Load:
   a. Diameter: 2.0 m maximum
   b. Length: 5335 mm to 5850 mm
   c. Weight: 32,236 kg to 69,000 kg
6. Minimum Turning Radius: None, track is straight
7. Track Gage: 2.58 m
8. Rail: 44.6 kg/m (90 lb/yd) ASCE continuously supported on invert haunches (concrete) and steel beams
9. Rail Condition: Dry and in good condition
10. Power Source: Electric third rail mounted in invert haunch, 600 VDC
11. Operation: Two (2) round trips per day
12. Travel Distance: 1200 m per one (1) round trip

D. Equipment Requirements:

1. Construction:
   a. Gantry Frame: The gantry will be fabricated of structural steel with built-up structural shapes and welded construction
   b. Hoisting Frame: Similar construction
   c. Lifting Head Trolley: Similar construction
2. Wheel Bogies:
   a. Mounting: Pivoted
   b. Number of Wheels: Two each
   c. Wheel Diameter: 400 mm
   d. Wheel Hardness: 320 BHN
3. Traversing Drives:
   a. Rated Motor Hp: 5 @ 1750 rpm
   b. Gear motor: Right angle, helical, 50:1 ratio
   c. Output Speed: 35 rpm
   d. Gantry Speed: 0.732 m/sec (144 ft/min)
4. Hoisting Screws:
   a. Diameter: 101.6 mm (4 in.)
   b. Lead: 25.4 mm (1 in.)
   c. Screw Speed: 28 rpm
   d. Maximum Lifting Height: 2226 mm
5. Hoisting Screw Drive:
   a. Rated Motor Hp: 7.5 @ 1750 rpm
   b. Gear motor: Right angle, helical, 63:1 ratio
   c. Output Speed: 28 rpm
6. Lifting Head Trolley Screws:
   a. Diameter: 57 mm (2.25 in.)
   b. Lead: 25.4 mm (1.0 in.)
   c. Screw Speed: 188 rpm
7. Lifting Screw Drive:
   a. Rated Motor Hp: 1/3 @ 1750 rpm
   b. Gear motor: Shaft mounted, helical, 9:1 ratio
   c. Output Speed: 188 rpm

E. Power and Controls:

1. Power: 600 VDC
2. Controls: Remote
3. Electric Panels: Steel Plate, 51 mm thick

Note: Control features for the emplacement gantry will be summarized in a separate equipment description document.

F. Approximate Dimensions and Weight:

1. Overall Length: 11.72 m
2. Overall Width: 3.51 m
3. Overall Height: 3.58 m
4. Operating Weight: 114 MT, with maximum load of 69 MT

G. Other Features:

1. Braking: Integral motor
2. Stability: Rail clamping
3. Load Stability: Solenoid Locks on Hoist Frame
4. Operational Monitoring: Closed Circuit TV
5. Visual Monitoring: Lighting

4.3.2 Gantry Suppliers:

A. Downs Cranes
   (213) 589-6061
   Contact: John Downs

B. Demag Material Handling Equipment
   (206) 883-4828   Fax (206) 883-4668
   Contact: John Ward

C. Ederer Inc.
   (206) 622-4421   Fax (206) 623-8593
   Contact: Gust W. Erickson

4.4 Gantry Carrier

The gantry carrier is a railroad flat car designed to transport the gantry from the surface facilities to the underground drifts and between drifts in the repository. It is depicted in Figure 4.4. On its flat deck it will be provided with 44.6 kg/m (90 lb/yd) rails so that the gantry can be transferred onto the carrier. In addition, it will also be equipped with an electric third rail to supply power to the gantry. Power supply to the third rail comes from the transport locomotive through an electrical cable connection. The gage of the gantry rails is 2580 mm, which is consistent with the gage of the rails in the emplacement drift. The gantry carrier will be equipped with pivoting trucks. The trucks will have a capacity based on the maximum operating load to be distributed over 8 wheels, 4 wheels on each truck. The wheels will have a diameter of 762 mm (30 in.) and will be compatible with 57.0 kg/m (115 lb/yd) AREA rails, both hardened to 320 BHN. The gage of these rails will be 1.44 m. Since the gantry carrier interfaces with the transport locomotives, a coupler will also be provided on one end of the carrier. The coupler will be a Willison-type coupler, like those common to underground mining and tunneling rail equipment, and will have automatic release. The gantry carrier will be equipped with a fail-safe air brake system, similar to those installed on the transporter. In order to prevent the gantry
Figure 4.4, Gantry Carrier
from moving once the carrier is in motion, wheel stops will be installed on the gantry rails at the rear of the carrier. Rail clamps, mounted on the gantry, will secure the gantry against movement in all directions.
4.4.1 Gantry Carrier Data Sheet

A. Equipment Title: Gantry Carrier

B. Service: To transport the emplacement gantry from the surface facility to underground drifts, and from drift to drift during normal operation of the repository.

C. Operating Conditions:

1. Working Environment: Surface storage facility and in access ramps underground.
2. Temperature Range: 27° C to 50°
3. Elevation: Approximately 1000 m to 1200 m above sea level.
4. Tunnel Ramps Dimension:
   a. Diameter: 4.10 m wide x 5.25 m high
   b. Clearance: 100 mm minimum
   c. Grade ±1.5 % to -2.5%
5. Load: Weight of the Gantry, 45 MT
6. Minimum Turning Radius: 20.0 m, radius of the turnouts
7. Track Gage: 1.44 m
8. Rail:
   a. Carrier Rail: 57 kg/m (115 lb/yd) AREA rail
   b. Gantry Rail: 44.6 kg/m (90 lb/yd) ASCE rail
9. Rail Condition:
   a. On Surface: varies with weather
   b. In Tunnel: Dry and in good condition
10. Power Source: 600 VDC
11. Operation: Infrequent, as required
12. Travel Distance: 10,000 m to 16,000 m per round trip

D. Equipment Requirements:

1. Construction:
   a. Carrier Frame: The Carrier will be fabricated of structural steel with built-up structural shapes and welded construction.
2. Trucks:
   a. Mounting: Pivoted
### Equipment Descriptions

#### B. Number of Wheels: Four each truck
#### c. Wheel Diameter: 400 mm (30 in.)
#### d. Wheel Hardness: 320 BHN

#### 3. Coupler: Weight will be 80 kg (175 lbs)

#### 4. Operating Speed: 8 km/hr (5 mph)

### E. Power:

1. **Power:** 600 VDC

### F. Approximate Dimensions and Weight:

1. **Overall Length:** 11.90 m
2. **Overall Width:** 3.55 m
3. **Overall Height:** 1.22 m
4. **Overall Weight:** 36.0 MT, estimated

### G. Other Features:

1. **Braking:** Fail-safe air brake system

#### 4.4.2 Gantry Carrier Suppliers:

A. Kasgro Rail Corp.
(412) 858-8061 Fax (412) 658-7638
Contact: Gabe M. Kassab

#### 4.5 Transport Locomotive(s)

Transport locomotives will be designed to transport WPs from the WHB to the underground emplacement drifts. A typical electric power driven locomotive is depicted in Figure 4.5. The locomotives will also be compatible with the gantry carrier for transporting the gantry to the underground drifts. Locomotives will be furnished with the following features:

- The overhead trolley power connector will be a pantograph mounted on the locomotive and will be a single conductor sized to receive 600 V DC.
- The tractive power system will consist of a minimum of two (2) 600 V DC motors, transmissions, and wheel sets with axles, bearings and load springs.
The locomotive frame will be the manufacturer's standard design and will provide the structural integrity for operator safety, component alignment, and proper transfer of drawbar trailing loads to wheels.

Couplers will be the Willison type standard mine equipment couplers, with automatic release, compatible with the transporter and the gantry carrier.

The brake system will be an automatic fail-safe air brake system which applies the brakes by letting air out of the system. It will function as both a speed control device during downhill transport of WPs and a stopping device. The primary locomotive will control the brakes on both the transporter and the gantry carrier through the air brake connection between the two. The brakes of the secondary locomotive will be wireless controlled from the primary locomotive in the case of transporter application.

The locomotives will be controlled manually or remotely, when conditions prevent on-board operators. Both, the lead and trailing locomotives will have identical features. However, only one locomotive, the one coupled to the back of the transporter, will have cable connections to the transporter for electric power and all remotely controlled operating functions.

The selected locomotive type will be a modification of a standard locomotive as typically used in subsurface mining services, to operate effectively in the mains and the narrow emplacement drift turnouts with operating requirements for a 40.8 MT (45 tons) locomotive. The locomotive will have 762 mm (30 in.) diameter wheels on 2.54 m (100 in.) centers to negotiate the 20.0 m curve/radius in each drift turnout.
Figure 4.5, Transport Locomotive
## 4.5.1 Locomotive Data Sheet

### A. Equipment Title:
Transport Locomotive

### B. Service:
Two locomotives to move a loaded WP Transporter to and from the WHB (above surface) to the emplacement drifts (below surface). A single locomotive to move the loaded WP transporter to and from the emplacement drift turnout area.

### C. Operating Conditions:

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<tr>
<td>1.</td>
<td>Above surface and below surface in tunnels and drifts.</td>
<td>(-) 7°C to 42 °C above surface</td>
<td>Approximately 1000 m to 1200 m above sea level</td>
<td>4.10 m wide x 5.25 m high</td>
<td>WP Transporter with two truck suspension</td>
<td>20 m</td>
<td>1.44 m</td>
<td>57.0 kg/m (115 lb/yd) AREA rail on concrete supports</td>
<td>above surface varies with weather, below surface dry and good condition</td>
<td>600 VDC single conductor power through a pantograph mounted on the locomotive</td>
<td>Two round trips per 8-hour day</td>
<td>10,000 m to 16,000 m per round trip</td>
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E. Equipment Requirements:

1. Description: Two electric mine service type locomotives for both trolley and battery back-up system operation with provisions for single or tandem operations.

2. Maximum Design Grade: Single locomotive ±2% to -3%
   Tandem locomotives ±3%

3. Operating Speed: 8 km/hr (5 mph)
4. Control: Manual and remote for operation in areas of high radioactivity

5. Coupler Weight: 79.4 kg (175 lbs) each
6. Motors:
   a. Number of Motors: two (2) (minimum)
   b. Rated Motor hp: 170 hp each
   c. Total Locomotive hp: 340 hp

F. Approximate Dimensions and Weight:

1. Number of Wheels: Four each
2. Wheelbase: 2.54 m
3. Coupler to Coupler Center: 7.73 m
4. Overall Length: 6.71 m
5. Overall Width: 2.40 m
6. Overall Height: 2.41 m above rail to top cab
7. Coupler Height: 0.79 m above rail
8. Operating Weight: 40.8 MT (45 tons)

G. Features:

1. The locomotives will include features for both, manual and remote controlled operations.
   Note: Control features for the transport locomotives will be summarized in a separate equipment description document.

4.5.2 Locomotive Suppliers:

A. Goodman Equipment Corporation
   (708) 496-1188 Fax (708) 496-3939
   Contact: Scott Rife
5.0 CONCLUSION

The equipment as described in this document has been identified in a related design analysis during fiscal year 1997. The equipment and the handling concept were found to be most suitable for the transport and emplacement of various sizes of waste packages containing high level radioactive waste. All of the recommended mobile equipment will be one-of-a-kind for this application. However, the basic concept of rail transportation and the handling of radioactive materials in a shielded, remotely controlled environment has been determined to be reliable, proven technology. Rail systems are used in a variety of related industries and a great number of basic mechanical components and materials for the manufacture of the mobile equipment are commercially available.