



Department of Energy
Office of Civilian Radioactive Waste Management
Yucca Mountain Site Characterization Office
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DEC 01 1995

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Division of Waste Management
Office of Nuclear Material Safety
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U.S. Nuclear Regulatory Commission
Washington, DC 20555

EXPLORATORY STUDIES FACILITY (ESF) TITLE II DESIGN EXTERNAL
REVIEW (SCPB: N/A)

Reference: Ltr, Brocoum to Holonich, dtd 6/8/95

Enclosed are the following design products that are part of the
ESF Title II Main Drift design (Design Package 8A):

1. Rockbolts, Accessories and Associated Ground Support
Material Specification, BABEE0000-01717-6300-02165,
Revision 00
2. Alcove Rockbolts & Shotcrete Plan, Section & Elevation
Drawing, BABEE0000-01717-2100-40161, Revision 00
3. ESF 7.62m Tunnel Ground Support Drawings (package of seven
drawings)

As in previous design reviews, we encourage your participation as
an observer and ask that any observations be forwarded to us
within one week of receipt of this letter.

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Joseph J. Holonich

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If you have any questions, please contact either Thomas W. Bjerstedt of my staff at (702) 794-7590 or Jeffrey D. Weaver of the Civilian Radioactive Waste Management System Management and Operating Contractor at (702) 295-9387.



Stephen J. Brocoum
Assistant Manager for
Suitability and Licensing

AMSL:TWB-580

Enclosures: (NOT RECORD MATERIAL)

1. Rockbolts, Accessories and Associated Ground Support Material Specification
2. Alcove Rockbolts & Shotcrete Plan, Section & Elevation Drawing
3. Seven ESF 7.62m Tunnel Ground Support Drawings:
 - BABEE0000-01717-2100-40151, Revision 00, 7.62m Tunnel Ground Support Master Sections
 - BABEE0000-01717-2100-40152, Revision 00, 7.62m Tunnel Ground Support Class I and I-A Sections
 - BABEE0000-01717-2100-40153, Revision 00, 7.62m Tunnel Ground Support Class II and II-A Sections
 - BABEE0000-01717-2100-40154, Revision 00, 7.62m Tunnel Ground Support Class III and III-A Sections
 - BABEE0000-01717-2100-40155, Revision 00, 7.62m Tunnel Ground Support Class IV Section
 - BABEE0000-01717-2100-40156, Revision 00, 7.62m Tunnel Ground Support Class V Section
 - BABEE0000-01717-2100-40157, Revision 00, Ground Support Rockbolts and Accessories Details

DEC 01 1995

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Specification Cover Sheet

Complete only applicable items.

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QA: *LN*

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QCR 11-28-95

2. TITLE ROCKBOLTS, ACCESSORIES AND ASSOCIATED GROUND SUPPORT MATERIAL		
3. DOCUMENT IDENTIFIER (Including Rev. No.) BABEE0000-01717-6300-02165 REV 00C		4. REV. NO. 00C
5. QA CLASSIFICATIONS This specification section covers items classified QA-1, QA-5, MC and N/A . Certain items and activities in this specification section are subject to QA controls. See Subsection 1.04 for specific information. See Block 8 for TBV and TBD information.		
6. Rev. No.	7. Total Pages	8. Description of Revision
00C	17	<p>This specification section supersedes BABEAB000-01717-6300-02165 REV 06. This specification expands the scope from the TS north Ramp to encompass the Ramps and main drift. This revision has the following TBV and TBD on the design:</p> <p>TBV-193-ESF Seismic design values need to be verified. TBD-147-ESF Thermal stress values have yet to be determined. TBV-069-DD Rock mass strength estimates for TSw1 and TSw2 need to be verified. TBD-146-ESF Thermal stress values have yet to be determined.</p> <p>This specification section incorporates in entirety the following Engineering Change Requests (ECRs) and Field Baseline Change Proposals (BCPs) and closes these interim changes:</p> <p>BCP-02-95-0050 BCP-02-95-0056 BCP-02-95-0066 BCP-02-95-0133 BCP-02-95-0170 ECR # E95-02-0074 ECR # E96-02-0006 ECR # E96-02-0014</p> <p>Issued for External Review</p>
9. ORIGINATOR		Date
10. CHECKER		Date
11. LDE		Date
12. VERIFIER		Date
13. QUALITY ASSURANCE		Date
14. DEPARTMENT MANAGER		Date

SECTION 02165

ROCKBOLTS, ACCESSORIES AND ASSOCIATED GROUND SUPPORT MATERIAL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. The work covered by this Specification Section includes the furnishing of materials, tools, equipment and labor necessary to install rockbolts and welded wire fabric for reinforcement of underground excavations as specified herein and as indicated on the Drawings.
- B. Materials covered include rockbolts, steel plates, nuts, washers, anchoring systems, encapsulating grout, welded wire fabric, interlocking steel mesh, rolled steel channel and mine roof straps.

1.02 RELATED SECTIONS

Division 1 General Requirements

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A185-94 Specification for Steel Wire Welded Fabric, Plain, for Concrete Reinforcement
 - 2. ASTM A615/A615MB-92 Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement
 - 3. ASTM C109-94 Standard Test Method for Compressive Properties of Hydraulic Cement Mortars
 - 4. ASTM C845-90 Standard Specification for Expansive Hydraulic Cement
 - 5. ASTM F432-94 Standard Specification for Roof and Rockbolts and Accessories
- B. Code of Federal Regulations (CFR):
 - Title 30, Part 57.3203 Federal Metal and Nonmetallic Mine Safety and Health Regulations. (30 CFR 57)
- C. International Society for Rock Mechanics (ISRM):
 - Suggested Test Method Rock Characterization Testing and Monitoring
for Rockbolt Testing Pergamon Press, 1981

D. Electric Power Research Institute (EPRI):

EPRI NP-7218 (6/92) Guideline for Utilization of Sampling Plans for Commercial-Grade Items Acceptance (NCIG-19)

E. Yucca Mountain Site Characterization Project (YMP) Documents

1. YAP-2.8Q Rev: 0 ICN: 0 Tracers, Fluids, and Materials Data Reporting and Management
2. Specification inputs list Rockbolts, Accessories and Associated Ground Support Material DI: BABEE0000-01717-6300-02165 REV 00.

1.04 QUALITY ASSURANCE

A. QA shall be conducted in accordance with Specification Section 01400 and applicable controls from other Specification Sections.

B. This Specification Section covers permanent, temporary and temporary function items installed for ground support in TS Ramps, Main Drift and associated Alcoves. The QA Classification associated with the specification are as follows:

1. All material listed in Section 2.01 A - K which are installed in the TS Ramps and Main Drift have been classified QA-1 and QA-5, except as allowed in 1.04 D.
2. Permanent ground support item(s) as identified in the applicable alcove drawings and installed in the transition zone are classified QA-1 and QA-5. Ground support installed in the transition zone which is not designated as permanent on the drawings are considered temporary or temporary function but shall meet the same installation requirements as designated for MC ground support.
3. Permanent ground support item(s) as identified in the applicable alcove drawing and installed beyond the transition zone have been determined not to be QA items and are designated MC.
4. Temporary items or Temporary function items not listed in Section 2.01 A - K which are installed in the TS Ramps and Main Drift, and within the transition zone, have been determined not to be QA items (N/A).
5. All permanent and temporary ground support items are subject to applicable controls labeled "QA Control" on associated activities.

Individual Quality Assurance (QA) controls are designated "QA Control" or "QA 1,5 Control" and are underlined.

- C. Applicability of the QA controls are as follows: Specification requirements that are designed QA 1,5 Control and underlined are applicable only to QA-1 and QA-5 items, and are not required to be followed for other items. Where "MC" is identified, including identification with QA 1,5 Control, the specification requirement is applicable to MC items but the items and associated requirements are non Q.
- D. The QA requirements associated with the re-classification of previously unclassified ground support items to QA-1 and QA-5 for welded wire fabric, mine roof straps, superswellex rockbolts and plates, standard swellex rockbolts and plates, split set rockbolts and plates, rolled steel channel and interlocking steel mesh in this Specification Section and the Drawings shall be come effective;
1. New construction: The installation of item shall be QA-1 and QA-5 upon issuance of the constructor's implementing QA procedures and completion of associated QA training.
 2. Back fit of previous installed items: The constructor shall submit a plan for backfitting items as QA-1 and QA-5 that have not been installed as QA-1 and QA-5. The constructor may proposed alternative methods for acceptance of items. Items shall not be backfit prior to the acceptance of the plan. (HOLD POINT)
- E. Acceptance of Product
1. QA 1,5 Control: Receipt Verification of Items Classified QA-1 and QA-5 that are purchased from a qualified source shall include:
 - a. Dimensional/visual inspection for conformance with Purchasing Documents which impose the requirements of this Specification Section and applicable Drawings.
 - b. Verification that Certification Documents required by the Purchasing Documents are received, acceptable and in accordance with the requirements of this Specification Section.
 2. QA 1,5 Control: Receipt Verification of Items Classified QA-1 & QA-5 that are purchased as commercial grade items shall include:
 - a. Dimensional/visual inspection for conformance with Purchasing Documents which impose the requirements of this Specification Section and applicable Drawings and in accordance with Paragraph 3.03F.
 - b. Verification of received materials in accordance with material dedication requirements stipulated in Paragraph 3.03F.
 3. Receipt Verification: Items without QA Classifications
 - a. Dimensional/visual inspection for conformance to Purchasing Documents which impose the requirements of this Specification Section and applicable Drawings.

- b. Documentation, as applicable, that the item was received and is in conformance with the Purchasing Documents and the requirements of this Specification Section.

F. Field Verification

1. QA 1.5 Control (MC): Verify that storage of materials is in accordance with approved storage procedures. Note: Storage procedures are to be submitted as specified in Specification Section 01600 3.02 F5.
 2. QA 1.5 Control (MC): Ensure that materials received are controlled to preclude inadvertent use of items prior to receipt verification.
 3. QA 1.5 Control : Ensure materials that are purchased and accepted for use in QA applications are segregated from those like items purchased and accepted for use in Non-Q applications.
 4. QA 1.5 Control: Ensure materials that are purchased and accepted for use in QA applications are identified to distinguish them from those like items purchased and accepted for use in Non-Q applications. This control does not preclude the constructor from using materials which are qualified as QA materials in a non-Q applications.
- G. QA 1.5 Control: Material dedication shall be conducted in accordance with applicable paragraphs included in this Specification Section.

1.05 DEFINITIONS

- A. Standard Swellex Rockbolt: A proprietary rockbolt system of Atlas Copco Tunneling and Mining AB, S-105 23, Stockholm, Sweden.
- B. Super Swellex Rockbolt: A proprietary rockbolt system of Atlas Copco Tunneling and Mining AB, S-105 23, Stockholm, Sweden.
- C. Thixotropic Grout: A thick cementitious grout that is pumpable as a fluid and will increase in apparent viscosity upon standing to prevent the grout from migrating from the borehole after installation so that no special packers are required.
- D. Permanent or Permanent Function Items - Ground support installed in accordance with the design drawings and this specification section that will become part of the potential licensed repository.
- E. Temporary Function and Temporary Items - Supplemental ground support installed for personnel safety, or to address other constructability concerns, which is considered to have completed its function after the permanent ground support is installed. Those items which will be removed from the ESF are considered temporary, and those items which will not be removed, are considered temporary function.

- F. Pins - Rockbolts that are used to supplement the pattern rockbolts in the installation of the Welded Wire Fabric, and other utility functions. Pins are considered as fasteners and are not considered as reinforcement to the ground.
- G. Certificate of Compliance: Documentation provided by a manufacturer that certifies an item(s) furnished conforms to a referenced standard, and that is signed by an officer of the manufacturer's company.
- H. Split Set Rockbolt : A proprietary rockbolt system of Ingersoll-Rand.
- I. "QA 1,5 Control" and "QA Control": "QA 1,5 Control" is a QA control that is applicable to materials and activities associated with permanent items classified as QA-1 and QA-5. "QA Control" is a QA control requirement identified by Determination of Importance analysis and is applicable to all materials and/or activities. The distinction is used to identify the source and applicability of the QA controls.
- J. Transition Zone - The area along an alcove from the tunnel intersection to 20 m as measured perpendicular from the as built tunnel center line.
- K. Williams rockbolts - Rockbolts and accessories available from Williams Form Engineering Corporation.

1.06 SYSTEM DESCRIPTION

The rockbolts and accessories, including both permanent function and temporary function items, provide immediate support for personnel safety after installation. The permanent function rockbolts are designed to provide a stable opening for up to 100 years. Additional rockbolts can be installed to replace or supplement rockbolts that are deemed to be partially effective due to deterioration, as part of the opening maintenance program.

1.07 ENVIRONMENTAL CONDITIONS

Division 1 General Requirements

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. QA 1.5 Control: Permanent function ground support items shall be purchased as commercial grade if subsequently qualified by the material dedication requirements included in this Specification Section or shall be purchased from a qualified source.

B. Furnishing of Solid Bar Rockbolt and Accessories with Thixotropic Grout:

1. Rockbolts and accessories shall be furnished with a Certificate of Compliance that confirms conformance with the minimum requirements of applicable ASTM standards as included in this Specification Section. The certificate should be kept on file to provide objective evidence of compliance to 30 CFR 57.3202. The certificate is not considered to be a QA document.
2. QA 1.5 Control (MC): Rockbolts shall be #8 solid deformed bar complying with ASTM A615 grade 75 and shall be manufactured in accordance with ASTM F432. Length shall be as shown on the Drawings. The bolts shall accommodate the installation of a nut by complying with one of the following:
 - a. A machined threaded section on one end of a standard deformed bar.
 - b. A deformed bar having a continuous hot rolled pattern of intermittent threadlike deformations along its entire length allowing nuts and couplers to be threaded onto the bar at any point.
 - c. An all-thread bar.
3. QA 1.5 Control (MC): Bearing plates for rockbolts shall have a center hole configured to accommodate up to 30 degrees of skewing and shall conform to ASTM F432 .
4. QA 1.5 Control (MC): Nuts shall be compatible with the rockbolts. Nuts with at least one flat bearing surface shall be used. Nuts shall conform to the requirement of ASTM F432.
5. QA 1.5 Control (MC): Williams R8M beveled washers or equal, shall be provided in sufficient number for skewing up to 30 degrees.
6. QA 1.5 Control (MC): Grout shall be a thixotropic type recommended by the rockbolt manufacturer for the intended use.
7. QA Control: The use of organic or chlorine compounds shall not be permitted.
8. QA 1.5 Control (MC): A minimum of (two) 2 centralizers shall be used to maintain the position of the bar in the approximate center of the hole.
9. QA Control: The centralizer shall be fabricated from steel.

C. Furnishing of Hollow Core Rockbolts and Accessories with Mechanical Anchor and Thixotropic Grout:

1. Rockbolts and accessories shall be furnished with a Certificate of Compliance that confirms conformance with the minimum requirements of applicable ASTM standards as included in this Specification Section. The certificate should be kept on file to provide objective evidence of compliance to 30 CFR 57.3202. The certificate is not considered to be a QA document.
2. QA 1.5 Control (MC): Hollow core rockbolts shall be hollow, all-thread bar, such as Williams hollow core bar B7X 1-1/8 inch diameter or equal, and shall be manufactured in accordance with ASTM F432.
3. Anchor assembly shall consist of Williams C-18 Spin Lock Head assembly or equal meeting the following requirements:
 - a. A Williams cone or equal, minimum length 100 mm, sized for a borehole of nominal 57 mm diameter and in threaded engagement with the inner end of the bolt. The cone shall be configured to deliver bearing pressure radially throughout a sector of 360 degrees measured perpendicular to the axis of the rockbolt, and shall have a raised axial key to stop rotation of the cone inside of the expansion shell.
 - b. A Williams expansion shell or equal, with a conical inner surface bearing on the cone, the outer surface of the shell being initially of cylindrical curvature and continuous in cross-section over a sector of at least 300 degrees throughout the length of the shell.
 - c. A thrust ring in threaded engagement with the bolt.
 - d. Two slip rings between the thrust ring and the shell.
4. QA 1.5 Control (MC): Bearing plates and nuts shall conform to the following requirements:
 - a. Center hole shall be configured to accommodate up to 30 degrees of skewing. The plate shall have sufficient strength to meet the minimum deflection load test requirement of ASTM F432. Plates shall be as recommended by the manufacturer for the intended application.
 - b. Williams heavy H hex nut or equal, for threaded engagement with the outer end of the bolt rod. Nut with at least one flat bearing surface shall be used.
5. QA 1.5 Control (MC): Williams R8M beveled washers or equal, shall be provided in sufficient number for skewing up to 30 degrees.
6. QA 1.5 Control (MC): Grout shall be a thixotropic type recommended by the rockbolt manufacturer for the intended use.

7? QA Control: The use of organic or chlorine compounds shall not be permitted.

D. Super Swellex Rockbolts (Proprietary System)

1. QA 1.5 Control (MC): Rockbolts and accessories shall be furnished to the minimum standards included in the manufacturer's published information.
2. QA 1.5 Control (MC): Plates for Super Swellex rockbolts shall be Swellex dome face plates having an elliptical bolt hole with 39 mm x 44 mm nominal dimensions to accommodate 30 degrees of skewing. Plates shall be as recommended by the manufacturer for the intended application.
3. A Certificate of Compliance shall be furnished for rockbolts to ASTM F432. The certificate should be kept on file to provide objective evidence of compliance to 30 CFR 57.3202. The certificate is not considered to be a QA document.

E. QA 1.5 Control (MC): Welded Wire Fabric (WWF): WWF (6 x 6 x W 2.9 x W 2.9 and 3 x 3 x W 1.9 x W 1.9) shall be manufactured in accordance with ASTM A185. WWF may be cut and rolled to approximate tunnel radius for ease of installation.

F. Standard Swellex Rockbolts (Proprietary System)

1. QA 1.5 Control (MC): Rockbolts and accessories shall be furnished to the minimum standards included in the manufacturer's published information.
2. QA 1.5 Control (MC): Plates for Standard Swellex rockbolts shall be Swellex dome face plates having an elliptical hole with 29 mm x 39 mm nominal dimensions to accommodate up to 30 degrees of skewing. Plates shall be as recommended by the manufacture for the intended application.
3. QA 1.5 Control (MC): Standard Swellex rockbolts minimum of .9 m may be used as pins to fasten WWF.
4. A Certificate of Compliance shall be furnished for rockbolts to ASTM F432. The certificate should be kept on file to provide objective evidence of compliance to 30 CFR 57.3202. The certificate is not considered to be a QA document.

G. Substitution of rockbolts and accessories meeting standards different from those specified in this Specification Section is allowable provided the items meet the specified criteria: the substituted item must be of equal or better quality; must be recommended by the manufacturer for the intended use; and shall be approved by the Architect/Engineer (A/E).

H. Split Set Rockbolts

1. QA 1.5 Control (MC): Split Set rockbolts SS-39 or SS-46 series minimum of .9 m may be used as pins to fasten WWF.

2. QA 1.5 Control (MC): Rockbolts and accessories shall be furnished to the manufactures published information. Certificate of Compliance shall be furnished to ASTM F 432.
3. QA 1.5 Control (MC): Plates shall be as recommended by the manufacture for the intended application.

- I. QA 1.5 Control: Rolled steel channel shall be AISC C10 X 15.3 channel with nominal dimensions as shown on the drawings. The channel shall be rolled with the flanges on the inside of the roll to a radius that will allow the channel to be installed in the tunnel in accordance with the drawings. Additional holes may be cut in the flanges to facilitate handling and installation.
- J. QA 1.5 Control (MC): The interlocking steel mesh (ISM) shall meet the wire spacing, wire diameter, and connection configuration as shown on the drawings. The ISM shall be manufactured in accordance with ASTM A 185. The panel size (perimeter length and width) shall be determined by the constructor.
- K. QA 1.5 Control (MC): Mine Roof Mats shall be a commercially available ground support item and shall be fabricated from steel sheet metal. The straps shall have two corrugated stiffening ridges along the length on the outside edges of the mat. The length, width, hole shape, hole size, hole spacing, thickness, shape and location of the ridges, shall be selected by the constructor in accordance with the manufacturers published information.

2.02 FABRICATION AND MANUFACTURE

(NOT USED)

2.03 EQUIPMENT

QA 1.5 Control: The Constructor shall submit to the A/E, prior to use, Supplier manuals, and video tapes (if available), for the rockbolt grout injection system and for the Swellex rockbolt installation equipment, including the injection pump and the water recovery system (if used). (HOLD POINT)

2.04 MATERIAL SUBMITTALS

(NOT USED)

2.05 GROUT MIX TESTS

QA 1.5 Control (MC): The Constructor shall submit to the A/E prior to installation, for review and acceptance, a proposed field mix design for rockbolt grout. The mix design shall include a complete list of all mix ingredients, including quantities. The submittal shall also include: ASTM standards governing manufacture of the grout; copies of manufacturer's test reports showing the mix has been successfully tested to produce rockbolt grout with properties as published by the manufacturer; manufacturer's recommended minimum design strength for use in this application; manufacturer's recommendations for storage prior to mixing; other control requirements including suggested mix proportions; allowable

temperature range of mixed grout; mixing and handling instructions for the grout; set-up time; and recommended mixing and pumping equipment. Prior to acceptance of grout by the A/E, the Constructor shall submit test results for the proposed grout field mix design. These tests (compressive strength tests only) shall be performed in accordance with ASTM C109 for non-expansive grout, or ASTM C845 for expansive grout. A minimum of three samples shall be tested. (HOLD POINT)

PART 3 EXECUTION

3.01 PREPARATION

- A. QA 1.5 Control (MC) : At the direction of the A/E, the Constructor shall install rockbolts in selected areas and shall perform in-place anchorage load tests in accordance with Paragraph 3.03D1. (WITNESS POINT) The purpose of this test program is to demonstrate and verify the anchorage capacity of the stratigraphic rock unit. Depending upon the test results, the A/E may direct that changes be made in the proof load and the allowable displacement used for rockbolt testing carried out in accordance with Paragraphs 3.03D2-D3. (HOLD POINT)

3.02 INSTALLATION

- A. Rockbolts shall be located and installed in accordance with the applicable Drawings and this Specification Section.
- B. QA 1.5 Control (MC): Only specified or otherwise approved rockbolt systems shall be used in the Topopah Spring (TS) Ramps, Main Drift and associated alcoves. Rockbolts as described in Paragraph 2.01 C&D shall be used, but, with the concurrence of the A/E, the Constructor may use the solid bar rockbolts and grout as described in Paragraph 2.01B in applications where immediate effective ground support is not essential.
- C. Not used.
- D. QA 1.5 Control (MC): Rockbolts and accessories shall be installed in accordance with manufacturer's recommendations. Threaded rockbolts shall be installed to accommodate the bearing plate, beveled washer(s) and a fully threaded hex nut. The exposed portion of the rockbolt, inclusive of all accessories shall not exceed 12 inches from the rock surface.
- E. Installation of Rockbolts in Alcove Excavations:
1. The Constructor shall install the rockbolts in accordance with the drawings as soon as practical after excavated rock surfaces are exposed and scaled. Ground support installed for personnel safety may be installed prior to the above rockbolts as required.
 2. Not used.
 3. Effort shall be made to provide a reasonably flat surface on which to locate the rockbolt plate.

4. In addition to ground support shown on the drawings for alcoves, the constructor may install temporary function ground support, including the use of material other than described herein, where necessary to address personnel safety concerns and test interference constraints. The following controls shall apply to the installation of the temporary supports and are in addition to controls imposed elsewhere in this and other Specification Sections:
 - a. QA 1.5 Control: Plans describing the use of materials, products, or methods other than those specified herein or as indicated on the Drawings, shall be submitted to the A/E for review and acceptance prior to implementation in the alcove. (HOLD POINT)
 - b. QA 1.5 Control: Under no circumstance shall the installed position of the temporary supports interfere in a manner that ultimately precludes installation of the permanent function ground support as shown on the Drawings.
5. QA Control: Any temporary function ground support materials that are not removed shall be recorded as required under paragraph 3.03A and shall be reported in accordance with the Tracer, Fluids and Materials Data Reporting and Management (TFM) Procedure.

F. Installation of Rockbolts behind TBM

1. QA 1.5 Control: Location of rockbolts shall be in accordance with the pattern, and any adjustment thereto, as indicated on the Drawings. Additional rockbolts may be installed as needed for safety.
2. Compacted TBM cutter scale under the plate shall be removed prior to tightening the nut or expanding the Swellex bolt.
3. In addition to permanent function rockbolts installed in the TBM tail shield area, the Constructor may install temporary function ground support, including the use of materials other than described herein, where necessary to address personnel safety concerns in the area until the permanent function ground support is installed. The following controls shall apply to the installation of the temporary supports and are in addition to controls imposed elsewhere in this and other Specification Sections:
 - a. QA 1.5 Control: Plans describing the use of materials, products, or methods other than those specified herein or as indicated on the Drawings, shall be submitted to the A/E for review and acceptance prior to implementation in the tunnel. (HOLD POINT)

NOTE: Submittals which include proposals for the addition of appurtenance(s) to the permanent function rockbolts, must also satisfy the submittal requirements of Specification Section 01501 Paragraph 3.01K.

- b. QA 1.5 Control: Under no circumstances shall the installed position of the temporary supports interfere in a manner that precludes installation of the permanent function rockbolts as shown on the Drawings.
4. QA Control: Any temporary function ground support materials that are not removed shall be recorded as required under Paragraph 3.03A and shall be reported in accordance with the TFM procedure.

G. QA 1.5 Control: Installation of Welded Wire Fabric and Rolled Channel

1. WWF may be installed at the TBM tail shield using the pattern rockbolts, where immediate installation is required for personnel safety. Standard Swellex or Split set pins may be added to tighten the fabric to the rock.
2. If WWF is installed after installation of the pattern rockbolts, wires may be cut to avoid interference and the fabric tightened to the rock using pins. The A/E may direct the installation of additional pins if considered necessary for adequate tightening.
3. Rolled channel shall be installed against the rock or the WWF. Pattern rockbolts or pins may be used to secure the channel. Local gaps between the channel and rock surface are permissible.

H. Special Instructions

1. The Constructor shall remove the water from Swellex rockbolts (within the limits of the water recovery system) if necessary to minimize water usage to meet water limits.
2. QA Control: Grouting of the rockbolts in the test alcoves requires Test Coordination Office concurrence.
3. QA 1.5 Control: Manufacturer's recommended installation procedures for rockbolts and accessories shall be submitted to the A/E and shall be retained as QA records. (HOLD POINT)

3.03 FIELD QUALITY CONTROL

- A. QA Control: The Constructor shall be responsible for construction records, installation inspecting, and test documentation in accordance with this Specification Section and Specification Section 01501. The Constructor's responsibility shall include as a minimum:
 1. The constructor shall develop a ground support location identification system which references tunnel or alcove station and which is sufficiently accurate to permit subsequent identification of individual rockbolts, WWF sheets, ISM panels, pins, rolled steel channels and mine roof mats in the tunnel and associated alcoves at any time following installation.

2. QA Control: The constructor shall record types and quantity of items installed in the tunnel and associated alcoves and shall record location of installations. The constructor is not required to document location for each item installed but is required to document the confining locations between alike groups.

Note: The site characterization mapping of the installed ground support is considered sufficient to produce "as built" ground support locations. Documenting individual component locations is not necessary except as describe in 3.03 A3.

3. QA Control: The following items require the individual locations to be identified and documented in accordance with related implementing procedures:
 - a. Non-Conformance or Field Deviation Items
 - b. Rockbolts that are proof load tested.
 - c. Items that are post-installation tested or post-installation inspected (sample population only) as part of the material dedication requirements.

B. Hollow Core Rockbolt with Mechanical Anchor

QA 1.5 Control (MC): Grout injection shall be surveilled at least once per shift to ensure that return of grout is observed at the bearing plate prior to completion of pumping.

C. Not used.

D. QA 1.5 (MC) Control: Rockbolt Load Tests: Perform In-Place Anchorage and Proof Load Test on Selected Rockbolts as follows:

1. The Constructor shall prepare and shall submit to the A/E for review and acceptance an In-Place Anchorage test procedure that will establish rockbolt anchorage capacity and allowable displacement under load. This procedure shall use the ISRM test method. This test procedure shall address the number of rockbolts to be installed for testing and the procedure for testing of the non-pattern rockbolts. (HOLD POINT)
 - a. The constructor shall install and test non-pattern rockbolts as directed by the A/E in accordance with their approved In-Place Anchor test procedure. The constructor may be directed to install and test additional rockbolts by the A/E. (WITNESS POINT)
 - b. The test results shall be documented.
 - c. The tests conducted shall be used to establish the values for proof loads and allowable displacements for rockbolts. (HOLD POINT)

2. The Constructor shall prepare and submit to the A/E for review and acceptance a Proof Load test procedure to be used for conducting the proof load test. It should follow the ISRM test method. (HOLD POINT)
 - a. Proof loads and allowable displacements for rockbolts to be tested shall be as directed by the A/E , except for dedication tests specified in 3.02F.
 - b. The Constructor shall perform a minimum of 20 load tests out of the first 100 rockbolts installed and on at least 5 out of every 100 thereafter for each rockbolt type, unless directed by the A/E, and except for dedication tests specified in 3.02F.
 - c. The A/E shall select which rockbolts are to be tested.
 - d. Grouted rockbolts shall not be tested earlier than 72 hours after grout installation unless directed by the A/E. (WITNESS POINT)
 - e. Test results shall be documented.
3. For purposes of the proof load testing, the rockbolt shall be considered failed when the measured displacement exceeds that allowable for the proof load or directed as by the A/E in accordance with Paragraph 3.03D2a.

E. QA 1.5 Control: Construction Testing of Grout

1. Grout samples, obtained from a batch to be used for rockbolt installation, shall be collected for testing during each shift when grouting is being performed or as directed by the A/E.
2. The Constructor shall prepare and shall submit to the A/E for review and acceptance a procedure to prepare and test grout samples (compressive strength tests only) in accordance with ASTM C109 for non-expansive grout, or ASTM C845 for expansive grout. (HOLD POINT)
3. Documentation of grout tests shall include: test results; the quantity of mix water used; the temperature of the grout mix; amounts of any admixtures used that are varied to suit the field condition; and references to records created in accordance with Paragraph 3.03A that identify specific bolts installed using grout represented by the test.

F. QA 1.5 Control: Receipt Verification of Commercial Grade Items

1. Testing of permanent function rockbolts and accessories shall be performed in accordance with the following requirements:
 - a. Rockbolts and coupler (if used) specified in Section 2.01 B & C shall be load tested in accordance with ASTM F 432 Sections 9.4, 10.1 through 10.2.1.2. Rockbolt specified in Section 2.01 D shall be load tested similar to the above ASTM F432 as

modified using the manufacturer's test procedures "Tensile Testing of Super Swellflex bolts". Rockbolts shall meet the manufacturer's catalog and/or information bulletins for the full cross sectional area. Tests shall be performed on one per 100 sample lot. The tests' sample population may be increased to 1000 (1 per 1000) after 32 consecutive tests where each result conforms to the manufacturer's publications.

- b. No special dedication testing has been identified for the following items: Nuts, bearing plates, face plates, beveled washers, Welded Wire fabric, Interlocking Steel Mesh (ISM), Rolled channels and Mine Roof Mats.
- c. Pins (rockbolts specified in section 2.01 F & H) and accessories. No special dedication testing is required where the pins are installed to QA installation procedures and are installed in areas designated Class I, II or III ground support per the drawings and specifications.

Pins that do not meet the above criteria shall be dedicated by post-installation testing of the rockbolt system in accordance with section 3.03D2. Non-destructive test loads shall be 1800 kg. Test population shall be in accordance with the normal sampling plan per table 2.1 of EPRI NP-7218.

2. Inspection

- a. Inspection of dimension rockbolts and pins (section 2.01 , B, C, F & H) in accordance with the manufacturer's published information and length in accordance with the procurement documents. Inspect in accordance with the normal sampling plan per table 2.1 of EPRI NP-7218 per shipment lot.
- b. Inspect the WWF and ISM dimensions in accordance with section 2.01 (E & J) and in accordance with the ASTM A 185 for wire spacing dimensions, wire diameter and welds. In addition, inspect the ISM connection bends for dimensions and cracking. The constructor shall select inspection lots using any of the following: wire from common heat lots, production number, or production line item lots from a single product manufacturer. Where lot sizes are large, greater than 1000 items, the constructor may form smaller lots. Acceptance of each lot requires all samples conforming to the above special inspections using test populations in accordance with the normal sampling plan per table 2.1 of EPRI NP-7218.
- c. Inspect the rolled steel channel to ensure dimensional conformance of the channel to C10 X 15.3 at receipt. Other dimensions shown on the drawings are to be considered acceptable on the basis of satisfactory installation as evidenced by the channel being held uniformly against the rock surface. Local gaps are permissible. Slot dimensions are considered satisfactory if a rockbolt is able to pass through the slot but the bearing (face) plate will not. Inspect in accordance with the normal sampling plan per table 2.1 of EPRI NP-7218.
- d. Inspect the mine roof mats (section 2.01K) in accordance with the manufacturer's published information and in accordance with the procurement documents.

3.04 PERSONNEL QUALIFICATION

QA 1.5 Control: The Constructor shall maintain as QA records, documentation of personnel training to manufacturer's recommended rockbolt installation procedures for rockbolt installation personnel, and to Constructor's testing procedures that are developed in accordance with this Specification Section for testing personnel.

PART 4 SUBMITTALS AND NOTIFICATION

4.01 SUBMITTALS

- A. Submittals shall be in accordance with Specification Section 01300 and the attached Submittal and Notification Requirements Sheet.
- B. Any revision to submittals prepared in accordance with this Specification Section shall be forwarded to the A/E for action as specified in the original submittal.

4.02 NOTIFICATION

Should any change in this Specification Section be required to comply with these requirements, the Constructor shall notify the A/E in writing for review.

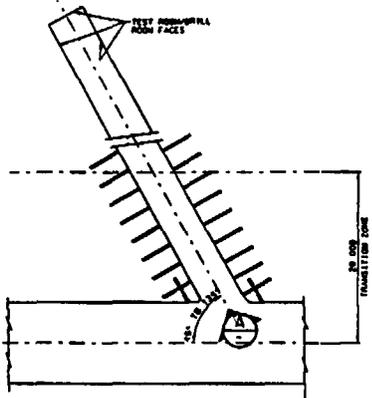
SUBMITTAL AND NOTIFICATION REQUIREMENTS

ONLY APPLICABLE ITEMS ARE TO BE COMPLETED

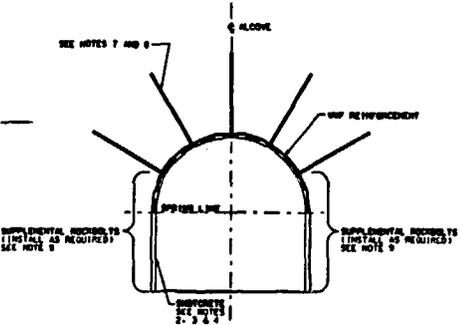
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	INFORMATION	REVIEW	CERTIFICATION	RECORD	PRIOR TO TESTING	DAYS AFTER AWARD	PRIOR TO FABRICATION	PRIOR TO SHIPMENT	WITH SHIPMENT	PRIOR TO INSTALLATION	DAILY REPORT	AS DIRECTED	PRIOR TO FINAL ACCEPTANCE	WITNESS (DAYS)	HOLD (DAYS)	
TITLE: Rockbolts and Accessories	Requirements	Paragraph														
Backfit Plan	1.04 D2		X												X	
Supplier Manuals	2.03	X								X					X	
Grout Mix Design/Tests	2.05		X							X					5	
Anchorage Test	3.01A											X			X	
Proof Load Changes	3.01A				X										X	
Temporary Ground Support	3.02E4a		X							X					X	
Temporary Ground Support	3.02F3a		X							X					X	
Mfg. Rockbolt Instal. Procedure	3.02H3	X								X					X	
Rockbolt Anchorage Test Procedure	3.03D1		X		X										5	
Rockbolt Proof Load Test Procedures	3.03D2		X		X									X	5	
Test Grout Sample Procedure	3.03E2		X		X										5	

COMMENTS:
 "X" in the Notification Columns denotes a Hold or Witness point is required in the specification subsection, but prior notification of the A/E is not necessary.

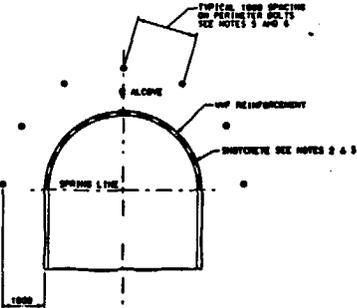
END OF SPECIFICATION SECTION



GENERAL ARRANGEMENT PLAN-ALCOVE
SCALE: NONE



CROSS SECTION
SCALE: NONE
NOTE: FOR EXCAVATION CONFIGURATION/DETAILS SEE APPLICABLE ALCOVE LAYOUT DRAWINGS



ELEVATION
SCALE: NONE

- NOTES:**
1. THE PERMANENT FUNCTION GROUP SUPPORT BY THE MAIN ACCESS AT THE ALCOVE MAIN ACCESS INTERSECTION IS TO BE CLASSIFIED CLASS III OR HIGHER UNLESS TO SHOOTING WEAPON APPLICATION OR PERMANENT FUNCTION SHOTCRETE MAY BE PERFORMED UNLESS OTHERWISE DIRECTED BY THE A.E.
 2. SHOTCRETE IS THE ONLY PERMANENT FUNCTION GROUP SUPPORT WITHIN THE TRANSITION ZONE. THE ALCOVE SHOTCRETE SHALL BE APPLIED TO A MINIMUM 150 mm (6") MINIMUM THICKNESS. SHOTCRETE IN THE TRANSITION ZONE IS CLASSIFIED CLASS III AND CLASS II. SHOTCRETE APPLICATION MAY BE DEFERRED UNLESS OTHERWISE DIRECTED BY THE A.E.
 3. SHOTCRETE SHALL NOT BE APPLIED TO THE ALCOVE UP TO THE A.E. CONTAINING THE APPROVAL. SHOTCRETE AND REINFORCING SHALL BE INSTALLED OVER PREVIOUSLY APPLIED SHOTCRETE.
 4. PERMANENT GROUP SUPPORT, INCLUDING SHOTCRETE, WITHIN THE ALCOVE BEYOND THE TRANSITION ZONE IS CLASSIFIED CLASS II. SHOTCRETE SHALL BE INSTALLED IN ACCORDANCE WITH NOTE 2, BUT SHALL NOT BE CONSIDERED CLASS III OR CLASS II.
 5. INSTALL 3000 mm MINIMUM LENGTH PERMANENT REINFORCING OUTSIDE THE ALCOVE 45° LINE PRIOR TO THE EXCAVATION OF THE ALCOVE.
 6. REINFORCING RODS SHALL BE EITHER EPSTEIN OR OTHER EQUAL OR EQUIVALENT. REINFORCING RODS SHALL BE COVERED AT LEAST 75 mm TO THE ALCOVE EXCAVATION.
 7. REINFORCING TO BE INSTALLED IN THE ALCOVE SHALL BE 3 MINIMUM 4000 mm LENGTH. WHEN THE ALCOVE WIDTH IS GREATER THAN 3000 mm OR GREATER THAN 3000 mm MINIMUM RODS SHALL BE COVERED AT LEAST 75 mm TO THE ALCOVE EXCAVATION. SUPER REINFORCING SHALL BE INSTALLED IN THE ALCOVE ONE TO BE INSTALLED ON A MINIMUM 1000 mm BY 1000 mm SQUARE PATTERN. CONSTRUCTION MAY ADJUST LOCATION, ORIENTATION AND SPACING TO ADDRESS GEOLOGIC STRUCTURES.
 8. THE SHOTCRETE SHALL COMPRESSIVE TEST THE A.E. THE INSTALLATION OF GROUP SUPPORT SHALL BE VERIFIED PER THE A.E. THE INSTALLATION OF GROUP SUPPORT SHALL BE VERIFIED PER THE A.E. THE INSTALLATION OF GROUP SUPPORT SHALL BE VERIFIED PER THE A.E. THE INSTALLATION OF GROUP SUPPORT SHALL BE VERIFIED PER THE A.E.
 9. GROUP SUPPORT SHALL BE INSTALLED PER SPECIFICATION SECTIONS 03165, 03162, AND 03161.

700-193-ESF SEISMIC DESIGN VALUES NEED TO BE VERIFIED.
700-146-ESF & 700-147-ESF THERMALLY INDUCED STRESSES HAVE YET TO BE DETERMINED.
700-000-00 ROCK MASS STRENGTH ESTIMATES FOR T501 AND T502 NEED TO BE VERIFIED.

NOTICE OF OTHER SERVICE CONTRACTS	
CONTRACT NUMBER	DATE

DESIGN CHECKS
SEE DRAWING SHEET 5107

NO.	DESCRIPTION	DATE	BY	CHECKED

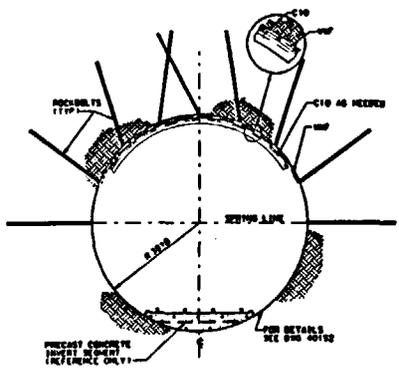
U.S. DEPARTMENT OF ENERGY
Nuclear Materials and Chemicals Research Program
MCO Management & Operations Construction
EXPLORATORY STUDIES FACILITY
AL COVES
ROCK BOLTS & SHOTCRETE
PLAN, SECTION & ELEVATION
DATE: 08/08/00
DRAWN BY: J. BLAY
CHECKED BY: J. BLAY
SCALE: SEE NOTES 1, 2, & 3
MINE-100161.DWG

ALL DIMENSIONS ARE SHOWN IN MILLIMETERS UNLESS OTHERWISE NOTED

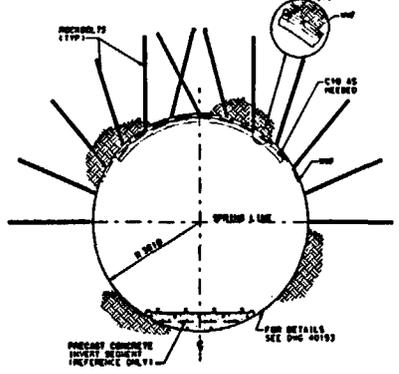
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NOT FOR CONSTRUCTION
DATE: 08/08/00
BY: J. BLAY
CHECKED BY: J. BLAY

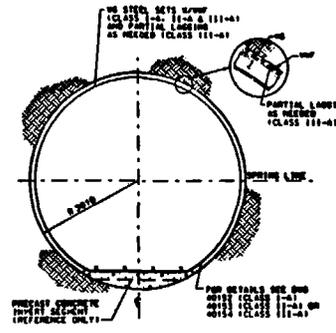
PRELIMINARY



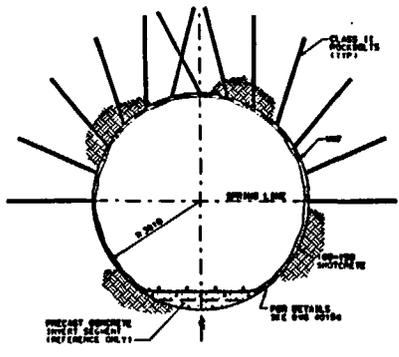
CLASS I
SCALE: 1:75 (REFERENCE ONLY)



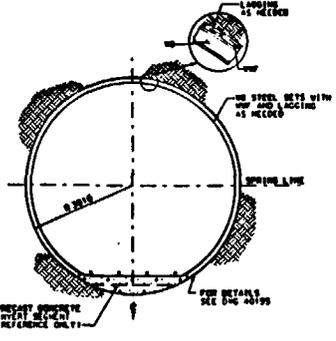
CLASS II
SCALE: 1:75 (REFERENCE ONLY)



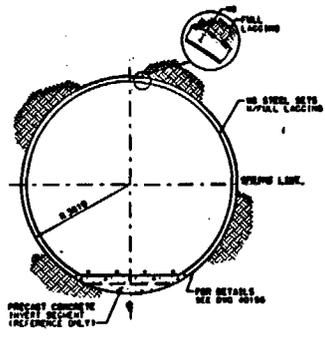
CLASS I-A, II-A & III-A
SCALE: 1:75 (REFERENCE ONLY)



CLASS III
SCALE: 1:75 (REFERENCE ONLY)



CLASS IV
SCALE: 1:75 (REFERENCE ONLY)



CLASS V
SCALE: 1:75 (REFERENCE ONLY)

GROUND SUPPORT CLASS	DIAMETER	EXPLORATORY STUDIES FACILITY GROUND SUPPORT RECOMMENDATIONS
I	>10	CLASS I: ROCKBOLT SPACING 1200 x 1200 OR SPACING WITH WIP SPOT SET AS NECESSARY. FIRE AND CORROSION WIP AS WIP AS NECESSARY. CLASS I-A: ALTERNATIVE: NO STEEL SETS SPACED 1200 ON 1200 WITH WIP.
II	4.0 TO 10.0	CLASS II: ROCKBOLT SPACING 1200 x 1200 OR SPACING WITH WIP TO BE WIP AS NECESSARY. FIRE AND CORROSION WIP AS WIP AS NECESSARY. CLASS II-A: ALTERNATIVE: NO STEEL SETS SPACED 1200 ON 1200.
III	0.4 TO 4.0	CLASS III: ROCKBOLT SPACING 1200 x 1200 OR SPACING WITH WIP. SPOT SET AS NECESSARY. FIRE AND CORROSION WIP AS WIP AS NECESSARY. CLASS III-A: ALTERNATIVE: NO STEEL SETS SPACED 1200 ON 1200 WITH WIP AND PARTIAL LAGGING AS NEEDED.
IV	0.1 TO 0.4	CLASS IV: NO STEEL SETS SPACED 610-1200 ON WIP WIP AND LAGGING AS NECESSARY.
V	0.01 TO 0.1	CLASS V: NO STEEL SETS SPACED 610 ON WIP FULL LAGGING.

WIP - SPACES WIP (LACING OR INTERMEDIATE SETS) USED AS MANUFACTURED BY THE BAYWEL CO. OF SPANISH CANYON. SEE SPECIFICATION SECTION 0105.
 WIP - THE ALTERNATIVE GROUND SUPPORT FOR PDA UNIT IS NO STEEL SETS FOR ALL GROUND SUPPORT CLASSES.



NOTES

1. THE GROUND SUPPORT IS CLASSIFIED AS... SEE SPECIFICATION SECTION 0105.
2. GROUND SUPPORT RECOMMENDATIONS AND ESTIMATES BASED UPON PROJECTED... THE SELECTION OF A PARTICULAR SUPPORT CLASS SHALL BE BASED UPON... RECOMMENDATIONS. SEE SPECIFICATION SECTION 0105.
3. GROUND SUPPORT CLASSES WERE PREVIOUSLY CALLED GROUND SUPPORT CATEGORIES.
4. DETAILS OF ROCKBOLTS AND ACCESSORIES ARE FOUND ON DRAWING 40191.
5. SEE SPECIFICATION SECTION 0241 FOR FABRICATION AND INSTALLATION OF STEEL SETS.

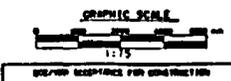
700-100-037 SEISMIC DESIGN VALUES NEED TO BE VERIFIED.
 700-100-037, 700-147-037 THERMAL STRESS VALUES HAVE YET TO BE DETERMINED.
 700-009-00 ROCK MASS STRENGTH ESTIMATES FOR T501 AND T502 NEED TO BE VERIFIED.

DESIGN NOTES
SEE DRAWING INPUT LIST

NO.	DATE	BY	CHKD.	DESCRIPTION

ALL DIMENSIONS ARE GIVEN TO MILLIMETERS UNLESS OTHERWISE NOTED

ALL DIMENSIONS SHOWN ARE NOMINAL UNLESS OTHERWISE NOTED

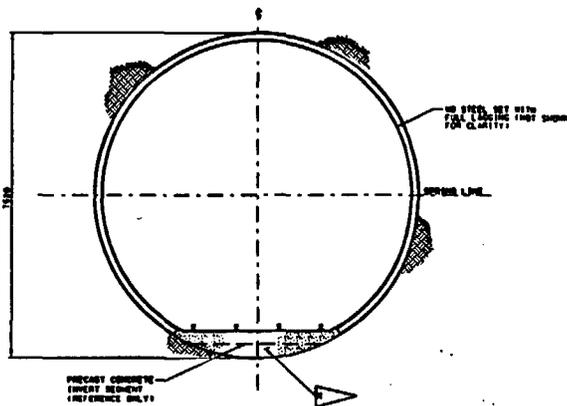


NO.	DATE	BY	CHKD.	DESCRIPTION

U.S. DEPARTMENT OF ENERGY
 Yucca Mountain Site Characterization Project
 M&O Management & Construction Division
 EXPLORATORY STUDIES FACILITY
 7.62 m TUNNEL
 GROUND SUPPORT MASTER SECTIONS
 SHEET NO. 11111-0000-01117-000-00191-00
 REVISION: SEE NOTE 0105 & 0106
 DATE: 01/19/01

PRELIMINARY

100-94109-0012-21110-000013878



**CLASS V GROUND SUPPORT
TYPICAL TUNNEL CROSS SECTION**

SCALE: 1/8" = 1'-0"



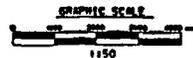
CLASS V NOTES

- GROUND SUPPORT COMPONENTS ARE CLASSIFIED AS GC-1, GC-2, OR GC-3. GROUND SUPPORT ITEMS IN THIS SECTION ARE GC-1; GC-2 UNLESS OTHERWISE NOTED.
- SEE SPECIFICATION SECTION DESIGN FOR FABRICATION AND INSTALLATION OF STEEL SETS AND LACING.
- INSTALL 10 STEEL SETS AT MINIMUM 6" ON OC.
- PERMIT OR PARTIALLY REMOVE STEEL LACING AS POSSIBLE TO FACILITATE SITE CONSTRUCTION LACING.
- LACING SHALL BE REPLACED IF CORROSION NECESSARY BY THE CONTRACTOR, OR AS DIRECTED BY THE GC FOR DAMAGE DURING OR AFTER CONSTRUCTION. LACING MAY BE REPLACED AT ANY TIME IF CONDITIONS PERMIT.

100-195-037 SEISMIC DESIGN VALUES NEED TO BE VERIFIED.
 100-146-037, 100-147-037 THERMAL STRESS VALUES HAVE YET TO BE DETERMINED.
 100-093-00 ROCK MASS STRENGTH ESTIMATES FOR T501 AND T502 NEED TO BE VERIFIED.

DESIGN INTENT
SEE DRAWING IMPACT LIST

NO.	DESCRIPTION	DATE	BY



DESIGNER ACCEPTANCE FOR CONSTRUCTION

Date

ALL DIMENSIONS SHOWN ARE MINIMAL UNLESS OTHERWISE NOTED

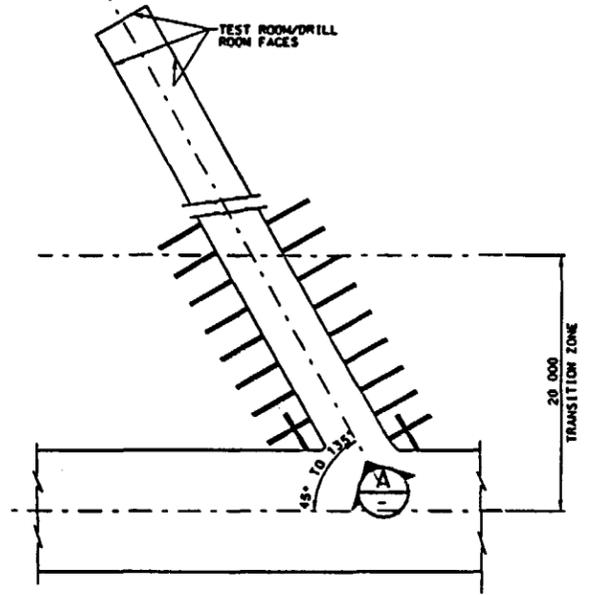
ALL DIMENSIONS ARE SHOWN IN FULL UNLESS OTHERWISE NOTED

NO.	DESCRIPTION	DATE	BY

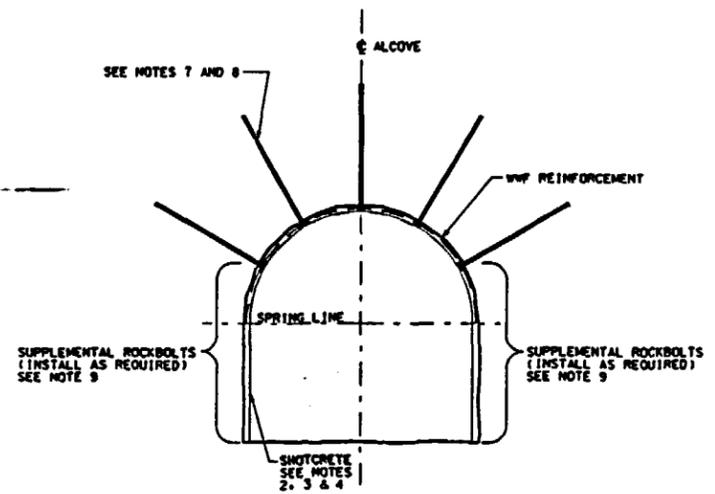
U.S. DEPARTMENT OF ENERGY
 Yucca Mountain Site Characterization Project
 MDC CONTRACTOR'S GENERAL CONTRACTOR
 EXPLORATORY STUDIES FACILITY
 7.62 m TUNNEL
GROUND SUPPORT CLASS V SECTION

100-94109-0012-21110-000013878
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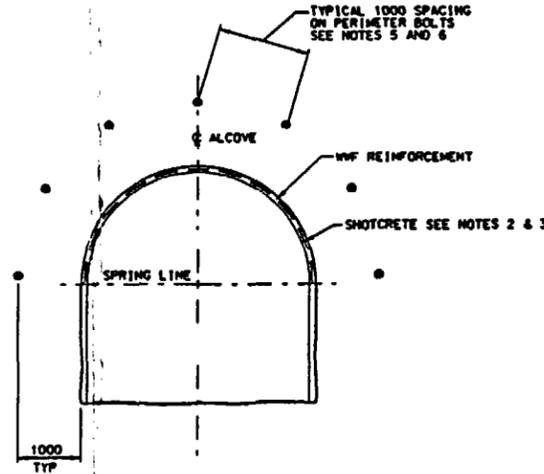
PRELIMINARY



GENERAL ARRANGEMENT PLAN-ALCOVE
 SCALE: NONE



CROSS SECTION
 SCALE: NONE
 NOTE: FOR EXCAVATION CONFIGURATION/DIMENSION DETAILS SEE APPLICABLE ALCOVE LAYOUT DRAWINGS



ELEVATION
 SCALE: NONE

- NOTES:**
1. THE PERMANENT FUNCTION GROUND SUPPORT IN THE MAIN ACCESS AT THE ALCOVE/MAIN ACCESS INTERSECTION IS TO BE GROUND SUPPORT CLASS III OR HIGHER (REFER TO DRAWING 40151). APPLICATION OF PERMANENT FUNCTION SHOTCRETE MAY BE DEFERRED UNLESS OTHERWISE DIRECTED BY THE A/E.
 2. SHOTCRETE IS THE ONLY PERMANENT FUNCTION GROUND SUPPORT WITHIN THE TRANSITION ZONE INSIDE THE ALCOVE. SHOTCRETE SHALL BE APPLIED TO A NOMINAL 150 mm (100 mm MINIMUM) THICKNESS. SHOTCRETE IN THE TRANSITION ZONE IS CLASSIFIED QA-1 AND QA-5. SHOTCRETE APPLICATION MAY BE DEFERRED UNLESS OTHERWISE DIRECTED BY THE A/E.
 3. SHOTCRETE SHALL NOT BE APPLIED IN THE ALCOVE PRIOR TO THE A/E OBTAINING TCO APPROVAL. SHOTCRETE AND ROCKBOLTS MAY BE INSTALLED OVER PREVIOUSLY APPLIED SHOTCRETE.
 4. PERMANENT GROUND SUPPORT, INCLUDING SHOTCRETE, WITHIN THE ALCOVE BEYOND THE TRANSITION ZONE IS CLASSIFIED MC. SHOTCRETE, IF USED, SHALL BE INSTALLED IN ACCORDANCE WITH NOTE 2, BUT WILL NOT BE CONSIDERED QA-1 OR QA-5.
 5. INSTALL 3000 mm NOMINAL LENGTH PERIMETER ROCKBOLTS OUTSIDE THE ALCOVE "C" LINE PRIOR TO THE EXCAVATION OF THE ALCOVE.
 6. PERIMETER ROCKBOLTS SHALL BE EITHER GROUTABLE OR SUPER SWELLEX ROCKBOLTS. GROUTABLE ROCKBOLTS SHALL BE GROUTED AT LEAST 72 HOURS PRIOR TO ALCOVE EXCAVATION.
 7. ROCKBOLTS INSTALLED IN THE ALCOVE SHALL BE A MINIMUM 1800 mm LENGTH. WHERE THE ALCOVE WIDTH AND/OR HEIGHT IS 4500 mm OR GREATER, 3000 mm MINIMUM ROCKBOLTS SHALL BE USED. ROCKBOLTS SHALL BE FRICTION TYPE ROCKBOLTS (STANDARD SWELLEX, SUPER SWELLEX, OR SPLIT SETS).
 8. ROCKBOLTS INSTALLED IN THE ALCOVE ARE TO BE INSTALLED ON A NOMINAL 1000 mm BY 1000 mm SQUARE PATTERN. CONSTRUCTOR MAY ADJUST LOCATION, ORIENTATION AND SPACING TO ADDRESS GEOLOGIC STRUCTURES.
 9. THE CONSTRUCTOR SHALL COORDINATE WITH THE A/E THE INSTALLATION OF GROUND SUPPORT BELOW SPRING LINE AT THE TEST ROOM AND DRILL ROOM FACES. TCO ACCEPTANCE OF GROUND SUPPORT LAYOUT IN THESE AREAS IS REQUIRED PRIOR TO INSTALLATION.
 10. GROUTED ROCKBOLTS SHALL NOT BE INSTALLED INSIDE THE ALCOVE.
 11. GROUND SUPPORT SHALL BE INSTALLED PER SPECIFICATION SECTIONS 02165, 03362, AND 03363.

ANSTEC APERTURE CARD

Also Available on Aperture Card

TBY-193-ESF SEISMIC DESIGN VALUES NEED TO BE VERIFIED.
 TBD-146-ESF & TBD-147-ESF THERMALLY INDUCED STRESSES HAVE YET TO BE DETERMINED.
 TBY-069-DD ROCK MASS STRENGTH ESTIMATES FOR TS#1 AND TS#2 NEED TO BE VERIFIED.

DESIGN INPUTS
 SEE DRAWING INPUTS LIST

NOTICE OF OPER CHANGE DOCUMENTS			
THIS PROJECT IS CONTROLLED BY THE USER'S ORIGINAL DRAWINGS AND SHALL BE USED WITHOUT THEM.			
NO.	DESCRIPTION	DATE	BY

ALL DIMENSIONS ARE SHOWN IN MILLIMETERS UNLESS OTHERWISE NOTED

ALL DIMENSIONS SHOWN ARE NOMINAL UNLESS OTHERWISE NOTED

DOE/EMP ACCEPTANCE FOR CONSTRUCTION
 By _____ Date _____

NO.	DESCRIPTION	DATE	BY	CHK	APP	REV	DATE	DESCRIPTION

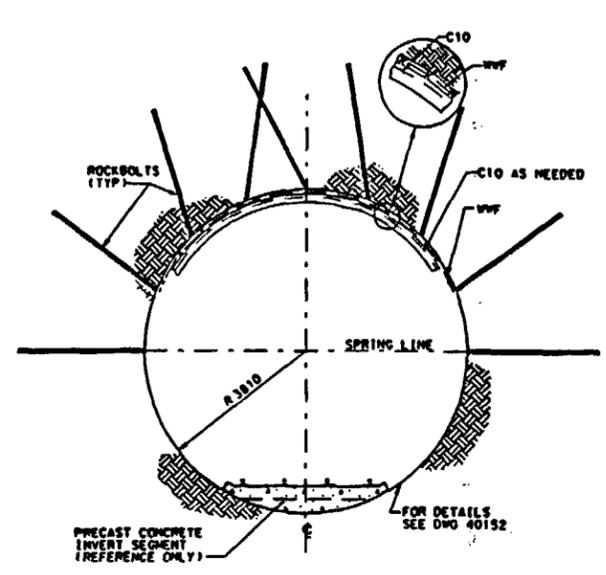
U.S. DEPARTMENT OF ENERGY
 Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System
 MANAGEMENT & OPERATIONS CONTRACTOR
EXPLORATORY STUDIES FACILITY
ALCOVES
ROCKBOLTS & SHOTCRETE
PLAN, SECTION & ELEVATION

NO. DOCUMENT 01 IDENTIFIER BABE0000-0117-2100-40161-000
 DATE NONE SEE NOTES 1, 2, 6
 CAP FILE MINE:40161.DGN

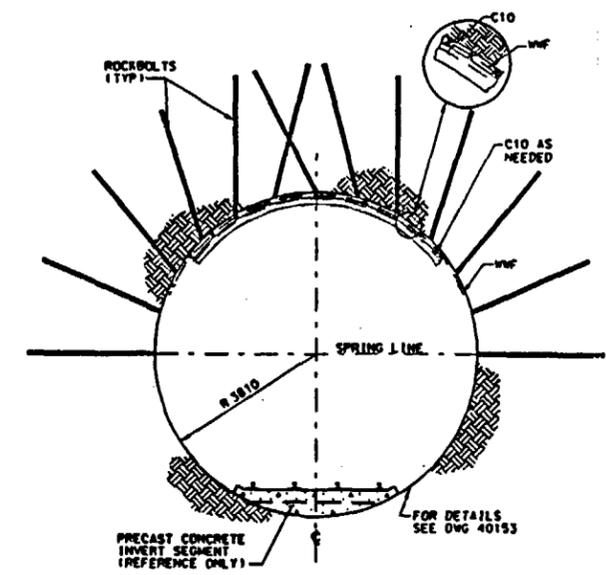
9512060135-01

ENCLOSURE 2

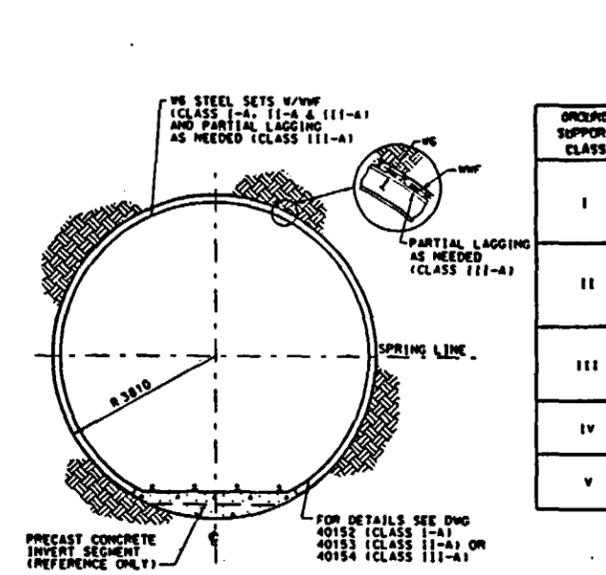
PRELIMINARY



CLASS I
SCALE: 1:175 (REFERENCE ONLY)



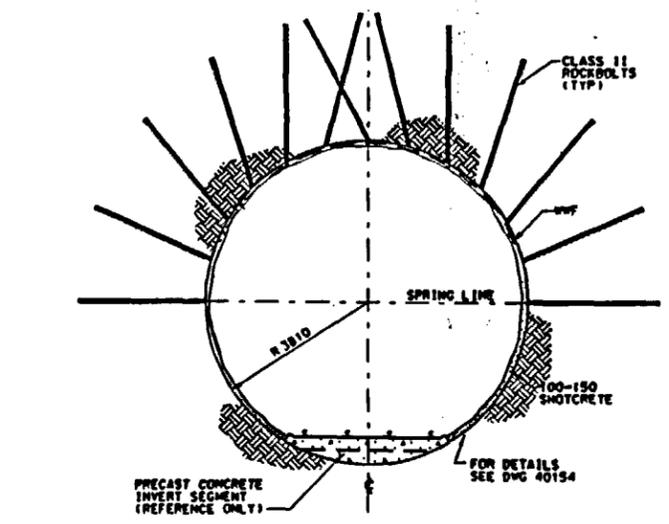
CLASS II
SCALE: 1:175 (REFERENCE ONLY)



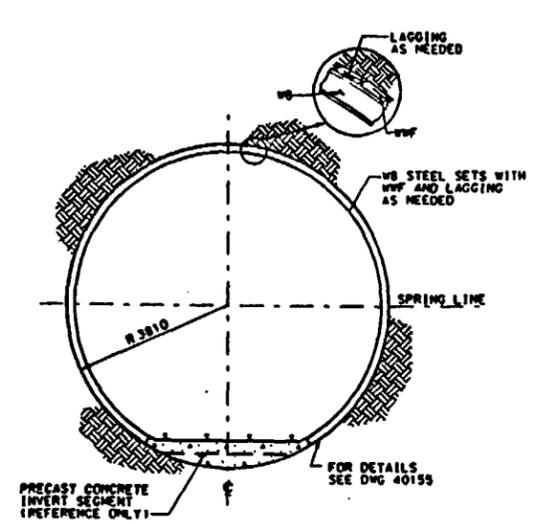
CLASS I-A, II-A & III-A
SCALE: 1:175 (REFERENCE ONLY)

GROUND SUPPORT CLASS	RANGE OF RQD VALUE	EXPLORATORY STUDIES FACILITY GROUND SUPPORT RECOMMENDATIONS
I	>10	CLASS II: ROCKBOLTS NOMINAL 1500 x 1500 mm SPACING WITH WVF. SPOT BOLT AS NECESSARY. PINS AND CHANNEL MAY BE USED TO SECURE MESH AS NEEDED. CLASS I-A: ALTERNATIVE: WVF STEEL SETS SPACED 1220 mm TO 1800 mm WITH WVF.
II	4.0 TO 10.0	CLASS III: ROCKBOLTS NOMINAL 1000 x 1000 mm SPACING WITH WVF. SPOT BOLT AS NECESSARY. PINS AND CHANNEL MAY BE USED TO SECURE MESH AS NEEDED. CLASS II-A: ALTERNATIVE: WVF STEEL SETS SPACED 1220 mm WITH WVF.
III	0.4 TO 4.0	CLASS III-A: ROCKBOLTS NOMINAL 1000 x 1000 mm SPACING WITH WVF. SPOT BOLT AS NECESSARY. PLUS 100-150 mm SHOTCRETE. CLASS III-A: ALTERNATIVE: WVF STEEL SETS SPACED 1220 mm WITH WVF AND PARTIAL LAGGING AS NEEDED.
IV	0.1 TO 3.4	CLASS IV: WVF STEEL SETS SPACED 610-1220 mm WITH WVF AND LAGGING AS NECESSARY.
V	0.01 TO 0.1	CLASS V: WVF STEEL SETS SPACED 610 mm WITH FULL LAGGING.

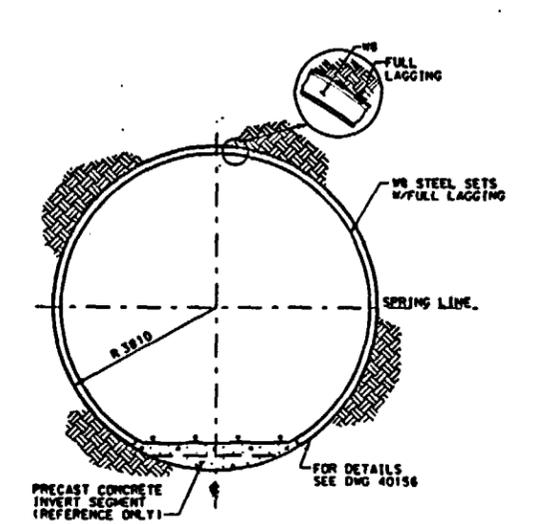
WVF - WELDED WIRE FABRIC OR INTERLOCKING STEEL MESH AS MANUFACTURED BY THE RAYHEI CO. OR APPROVED EQUAL. SEE SPECIFICATION SECTION 02165.
 ** - THE ALTERNATIVE GROUND SUPPORT FOR P7a UNIT IS WVF STEEL SETS FOR ALL GROUND SUPPORT CLASSES.



CLASS III
SCALE: 1:175 (REFERENCE ONLY)



CLASS IV
SCALE: 1:175 (REFERENCE ONLY)



CLASS V
SCALE: 1:175 (REFERENCE ONLY)

- NOTES**
- PERMANENT FUNCTION GROUND SUPPORT IS CLASSIFIED QA-1, QA-2. CROSS-SECTIONS ARE FOR REFERENCE ONLY. FOR INSTALLATION AND QA CONTROLS SEE RESPECTIVE GROUND SUPPORT CLASS DRAWINGS.
 - GROUND SUPPORT RECOMMENDATIONS ARE ESTIMATES BASED UPON PROJECTED INFORMATION AND APPLY TO THE EXPECTED "NORMAL" CONDITIONS. THE SELECTION OF A PARTICULAR SUPPORT CLASS SHALL BE BASED UPON OBSERVATION OF ACTUAL CONDITIONS INCLUDING LOCAL "DIP NORMAL" OR ANOMALOUS CONDITIONS, AND MAY VARY FROM THE SUPPORT RECOMMENDATIONS. SEE SPECIFICATION SECTION 01501.
 - GROUND SUPPORT CLASSES WERE PREVIOUSLY CALLED GROUND SUPPORT CATEGORIES.
 - DETAILS OF ROCKBOLTS AND ACCESSORIES ARE FOUND ON DRAWING 40157.
 - SEE SPECIFICATION SECTION 02341 FOR FABRICATION AND INSTALLATION OF STEEL SETS.

TBY-193-ESP SEISMIC DESIGN VALUES NEED TO BE VERIFIED.
 TBD-146-ESP, TBD-147-ESP THERMAL STRESS VALUES HAVE YET TO BE DETERMINED.
 TBY-089-DD ROCK MASS STRENGTH ESTIMATES FOR T5w1 AND T5w2 NEED TO BE VERIFIED.

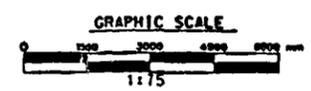
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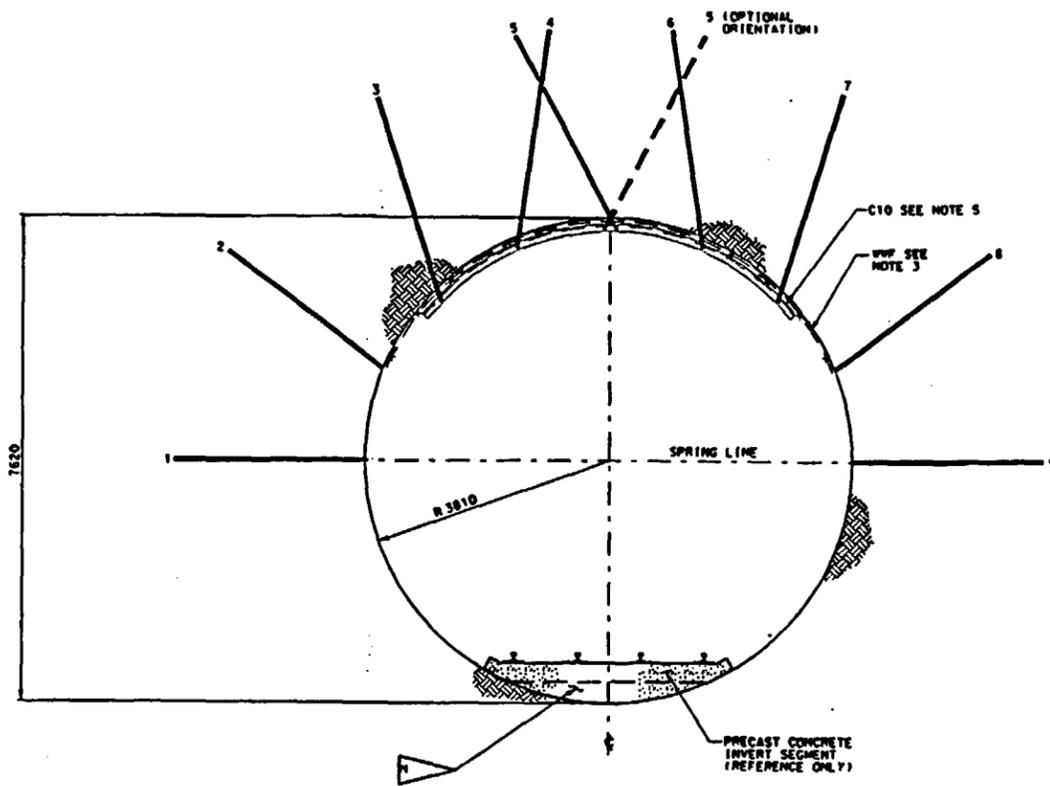
U.S. DEPARTMENT OF ENERGY
 Yucca Mountain Site Characterization Project
M&O Civilian Radioactive Waste Management System
 MANAGEMENT & OPERATING CONTRACTOR
EXPLORATORY STUDIES FACILITY
7.62 m TUNNEL
GROUND SUPPORT MASTER SECTIONS

DATE: 11/26/01
 DRAWN BY: J. NAAP
 CHECKED BY: M. KENNEDY
 APPROVED BY: J. NAAP

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9512040135-02

ENCLOSURE 3



**CLASS I GROUND SUPPORT
TYPICAL TUNNEL CROSS SECTION**
SCALE: 1:150

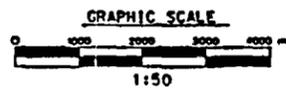


CLASS I NOTES:

- GROUND SUPPORT COMPONENTS ARE CLASSIFIED OA-1, OA-5. SEE DRAWING 40157. ALL GROUND SUPPORT ITEMS IN THIS SECTION ARE OA-1, OA-5 UNLESS NOTED OTHERWISE.
- INSTALL 3000 mm LENGTH ROCKBOLTS IN AN APPROXIMATELY SQUARE 1500 mm BY 1500 mm PATTERN.
- WHEN WVF IS INSTALLED FOR PERSONNEL SAFETY FORWARD OF THE SUPPLEMENTAL PLATFORM, USE THE LARGER 6"x6" WVF TO FACILITATE SITE CHARACTERIZATION. 3"x3" WVF OR WVF MESH PANELS MAY BE USED FORWARD OF THE SUPPLEMENTAL PLATFORM WITH APPROVAL FROM THE SHIFT A/E REPRESENTATIVE. BEYOND THE SUPPLEMENTAL PLATFORM, THE SELECTION OF THE APPROPRIATE WVF SHALL BE MADE BY THE CONSTRUCTOR.
- INSTALL SUPPLEMENTAL ROCKBOLTS WHERE GEOLOGIC FEATURES ARE IDENTIFIED AS REQUIRING ADDITIONAL SUPPORT.
- C10 MAY BE INSTALLED TO HOLD WVF TO THE TUNNEL CROWN. LENGTH OF C10 TO BE FIELD DETERMINED. C10 MAY BE SECURED WITH ROCKBOLTS THAT ARE NOT DEDICATED OA-1, OA-5. PERMANENT FUNCTION/ROCKBOLTS DO NOT HAVE TO PASS THROUGH CHANNEL.
- THE ROCKBOLT PATTERN MAY BE ADJUSTED BY THE CONSTRUCTOR OR A/E WHERE NECESSARY TO ADDRESS GEOLOGIC FEATURES. MINIMUM ROCKBOLT DENSITY SHALL BE 9 ROCKBOLTS PER 1500 mm OF TUNNEL LENGTH. ORIENTATION OF BOLTS MAY VARY.

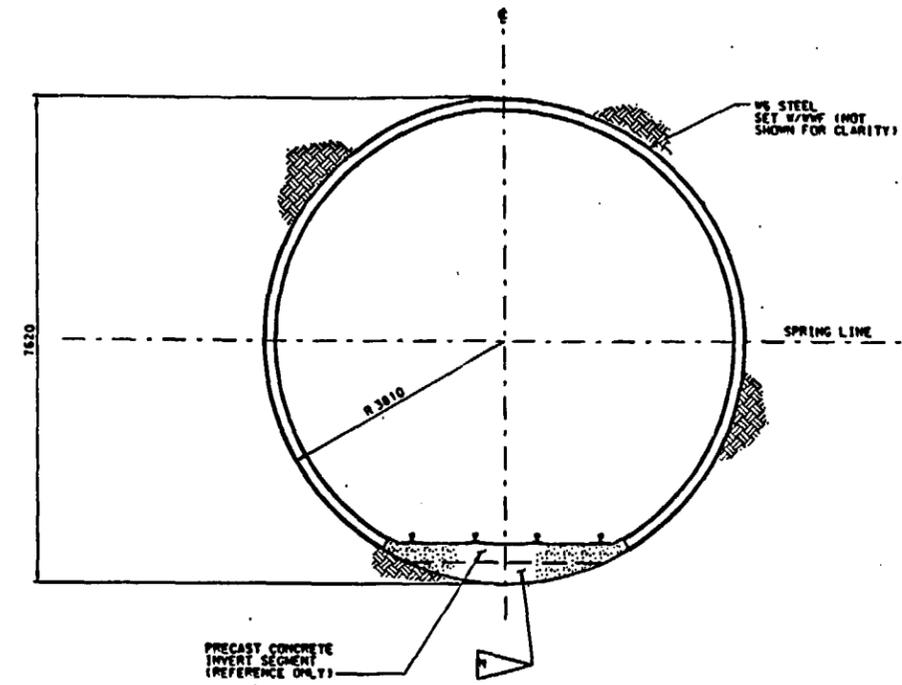
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**ALTERNATIVE CLASS I-A GROUND SUPPORT
TYPICAL TUNNEL CROSS SECTION**
SCALE: 1:150



CLASS I-A NOTES:

- GROUND SUPPORT COMPONENTS ARE CLASSIFIED OA-1, OA-5. ALL GROUND SUPPORT ITEMS IN THIS SECTION ARE CLASSIFIED OA-1, OA-5 UNLESS OTHERWISE NOTED.
- SEE SPECIFICATION SECTION 02341 FOR FABRICATION AND INSTALLATION OF STEEL SETS.
- SEE SPECIFICATION SECTION 02165 FOR WVF INFORMATION.
- INSTALL W6 STEEL SETS AT NOMINAL 1220-1800 OC.
- WHEN WVF IS INSTALLED FOR PERSONNEL SAFETY FORWARD OF THE SUPPLEMENTAL PLATFORM, USE THE LARGER 6"x6" WVF TO FACILITATE SITE CHARACTERIZATION. 3"x3" WVF OR WVF MESH PANELS MAY BE USED FORWARD OF THE SUPPLEMENTAL PLATFORM WITH APPROVAL FROM THE SHIFT A/E REPRESENTATIVE. BEYOND THE SUPPLEMENTAL PLATFORM, THE SELECTION OF THE APPROPRIATE WVF SHALL BE MADE BY THE CONSTRUCTOR.

TBY-193-ESP SEISMIC DESIGN VALUES NEED TO BE VERIFIED.
TBD-148-ESP, TBD-147-ESP THERMAL STRESS VALUES HAVE YET TO BE DETERMINED.
TBY-069-DD ROCK MASS STRENGTH ESTIMATES FOR TS_{w1} AND TS_{w2} NEED TO BE VERIFIED.

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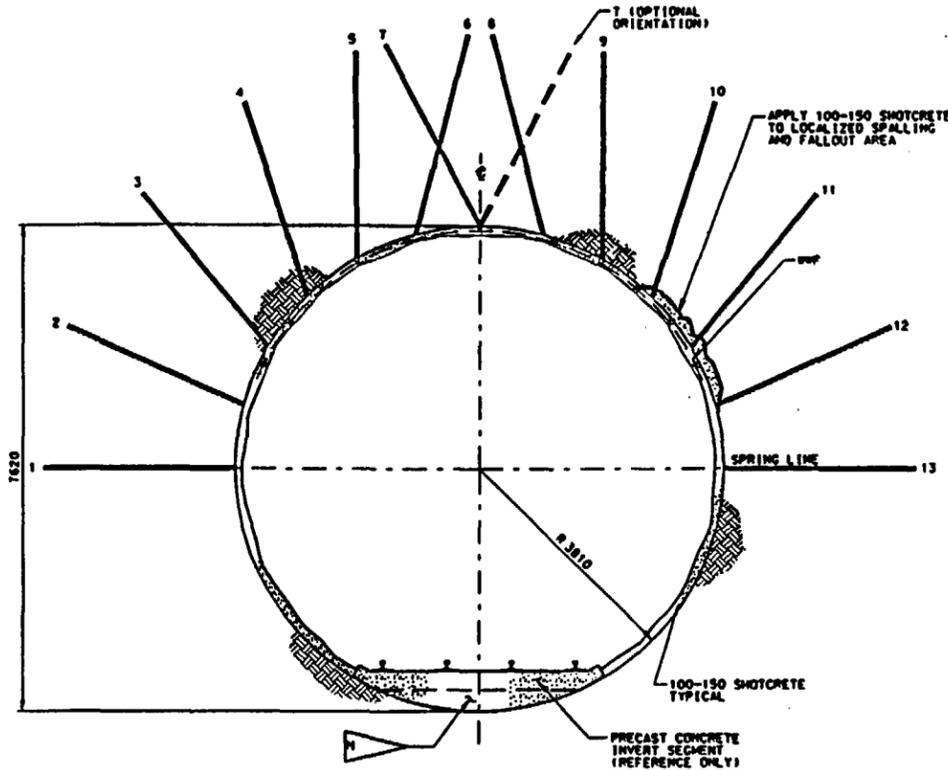
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Yucca Mountain Site Characterization Project
M&C Civilian Radioactive Waste Management System
MANAGEMENT & OPERATIONS CONTRACTOR
EXPLORATORY STUDIES FACILITY
7.62 m TUNNEL
GROUND SUPPORT CLASS I & I-A
SECTIONS

DATE: 01/11/00
DRAWN BY: J. HERRERA
CHECKED BY: J. BEESLEY
DESIGNED BY: M. GOMEZ
REVISIONS:
BY: W. KENNEDY
DATE: 01/11/00
BY: J. HERRERA

DOC ID: BAE0000-01717-2100-40152-000
NOTED: SEE NOTE 11.2.6
MINE: 40152.DGN

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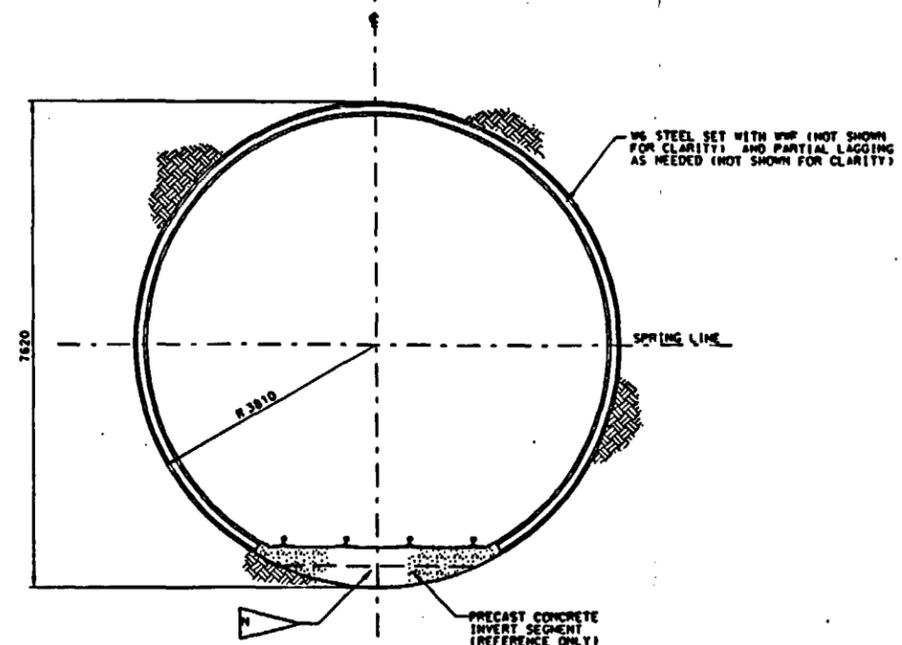
CLASS III GROUND SUPPORT TYPICAL TUNNEL CROSS SECTION

SCALE: 1:150



CLASS III NOTES:

- GROUND SUPPORT COMPONENTS ARE CLASSIFIED QA-1, QA-3. SEE DRAWING 40154. ALL GROUND SUPPORT ITEMS IN THIS SECTION ARE QA-1, QA-3 UNLESS OTHERWISE NOTED.
- INSTALL CLASS II GROUND SUPPORT IN ACCORDANCE WITH DRAWING 40153.
- SHOTCRETE MAY COVER ROCKBOLTS, WVF, MINE ROOF MATS OR CHANNEL.
- REMOVE WVF AS NECESSARY TO EXTRACT SPALLED ROCK AND ENHANCE SHOTCRETE APPLICATION WHERE WEIGHT OF ROCK IS NOTICEABLY DEFORMING WVF.
- APPLY SHOTCRETE TO ENTIRE PROFILE OF TUNNEL AND IN FIRM CONTACT WITH CURB ON INVERT SEGMENT.



ALTERNATIVE CLASS III-A GROUND SUPPORT TYPICAL TUNNEL CROSS SECTION

SCALE: 1:150



CLASS III-A NOTES:

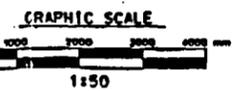
- GROUND SUPPORT COMPONENTS ARE CLASSIFIED QA-1, QA-3. ALL GROUND SUPPORT ITEMS IN THIS SECTION ARE QA-1, QA-3 UNLESS OTHERWISE NOTED.
- SEE SPECIFICATION SECTION 02341 FOR FABRICATION AND INSTALLATION OF STEEL SETS AND LAGGING.
- SEE SPECIFICATION SECTION 02165 FOR WVF INFORMATION.
- INSTALL WV STEEL SETS AT NOMINAL 1220 OC.
- INSTALL PARTIAL LAGGING AS REQUIRED FOR PERSONNEL SAFETY.
- WHEN WVF IS INSTALLED FOR PERSONNEL SAFETY FORWARD OF THE SUPPLEMENTAL PLATFORM, USE THE LARGER 6 X 6 WVF TO FACILITATE SITE CHARACTERIZATION. 3 X 3 WVF OR WIRE MESH PANELS MAY BE USED FORWARD OF THE SUPPLEMENTAL PLATFORM WITH APPROVAL FROM THE SHIFT A/E REPRESENTATIVE. BEYOND THE SUPPLEMENTAL PLATFORM, THE SELECTION OF THE APPROPRIATE WVF SHALL BE MADE BY THE CONSTRUCTOR.
- ADJUST OR PARTIALLY REMOVE STEEL LAGGING AS POSSIBLE TO FACILITATE SITE CHARACTERIZATION TESTING.
- LAGGING SHALL BE REPLACED IF CONSIDERED NECESSARY BY THE CONSTRUCTOR, OR AS DIRECTED BY THE A/E FOR GROUND SUPPORT OR PERSONNEL SAFETY. ADDITIONAL LAGGING MAY BE INSTALLED AT ANY TIME IF CONDITIONS REQUIRE.

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TBY-193-ESF SEISMIC DESIGN VALUES NEED TO BE VERIFIED.
TDD-146-ESF, TDD-147-ESF THERMAL STRESS VALUES HAVE YET TO BE DETERMINED.
TBY-069-DD ROCK MASS STRENGTH ESTIMATES FOR TS#1 AND TS#2 NEED TO BE VERIFIED.

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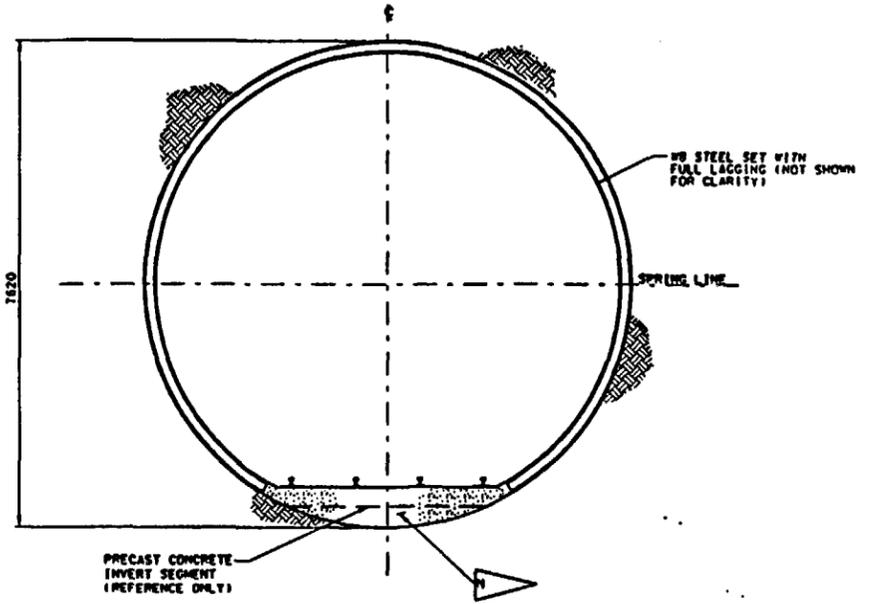
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Yucca Mountain Site Characterization Project
M&O Management & Operating Contractor
EXPLORATORY STUDIES FACILITY
7.62 m TUNNEL GROUND SUPPORT CLASS III & III-A SECTIONS

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**CLASS V GROUND SUPPORT
TYPICAL TUNNEL CROSS SECTION**
SCALE: 1:50

- CLASS V NOTES:**
- GROUND SUPPORT COMPONENTS ARE CLASSIFIED GA-1, GA-2, GA-3. ALL GROUND SUPPORT ITEMS IN THIS SECTION ARE GA-1, GA-2 UNLESS OTHERWISE NOTED.
 - SEE SPECIFICATION SECTION 02341 FOR FABRICATION AND INSTALLATION OF STEEL SETS AND LAGGING.
 - INSTALL WB STEEL SETS AT NOMINAL 610 OC.
 - ADJUST OR PARTIALLY REMOVE STEEL LAGGING AS POSSIBLE TO FACILITATE SITE CHARACTERIZATION TESTING.
 - LAGGING SHALL BE REPLACED IF CONSIDERED NECESSARY BY THE CONSTRUCTOR, OR AS DIRECTED BY THE A/E FOR GROUND SUPPORT OR PERSONNEL SAFETY. LAGGING MAY BE REPLACED AT ANY TIME IF CONDITIONS REQUIRE.

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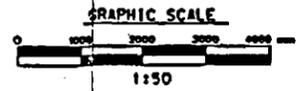
TRY-193-ESF SEISMIC DESIGN VALUES NEED TO BE VERIFIED.
TBD-146-ESF, TBD-147-ESF THERMAL STRESS VALUES HAVE YET TO BE DETERMINED.
TBY-069-DD ROCK MASS STRENGTH ESTIMATES FOR TSe1 AND TSe2 NEED TO BE VERIFIED.

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EXPLORATORY STUDIES FACILITY
7.62 m TUNNEL
GROUND SUPPORT CLASS V
SECTION

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APPROVED: J. HERRERA
DESIGNED: J. BEESLEY
CHECKED: M. GOMEZ
DRAWN BY: W. KENNEDY
DATE: J. NAAP

DOC ID: BAREE000-01717-2-100-40156-00
SCALE: 1:50
NOTED: 08-1, 08-3, 1.2.6
DATE: 08-15-00

9512040135-07

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