"QA N/A"
WBS 1.2.6.1.1

ESF TEST COORDINATION OFFICE WORK PLAN

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

Work Plan ID: WP 92-20D, Rev. 08/10/94
(Administrative Only)

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

This work plan (WP) implements and operates within the constraints and requirements established in Test Planning Package (TPP) T-93-2 and Job Package (JP) 92-20D and guides field interactions. Sample Plan (SP) 92-20D is consistent with this WP and provides further instructions for core sample handling and packaging. This WP will be revised as necessary by the Test Coordination Office (TCO) and changes will be communicated to all participants identified herein. Final illustrations will be provided as field work proceeds and will be included as revisions to this WP.

This WP has been prepared to facilitate work to be conducted in the field. This plan has been reviewed (1) to ensure that it is fully consistent with the controlled requirements basis represented in the TPP T-93-2 and JP 92-20D, and (2) to ensure that it contains no quality affecting requirements. The WP does provide a planned method to meet requirements in the TPP and JP listed above. Any anticipated deviations from this plan should be brought to the immediate attention of the TCO. The TCO will ensure that proposed changes are evaluated to determine if they are consistent with the requirements basis. Approved changes will be documented by the TCO prior to proceeding with the work. If changes are determined to be inconsistent with the requirements basis, work will not proceed until inconsistencies are resolved.

This Construction Monitoring WP covers SCP activities directed by the Excavation Investigations and In Situ Design Verification Study Plans. The relationship between these study plans and the Exploratory Studies Facility (ESF) tests that are covered by this WP is shown below.

Excavation Investigations (8.3.1.15.1.5)

Access Convergence (8.3.1.15.1.5.1)

Rock mass response measurements (includes both convergence and rock mass displacement measurements)
In situ stress measurement
Induced stress/stress change measurement
Liner contact and rock bolt load measurement

In Situ Design Verification (8.3.1.15.1.8)

Evaluation of Mining Methods (8.3.1.15.1.8.1)

Blast monitoring
Blast damage assessment
Documenting methods and equipment

Monitoring of Ground Support Systems (8.3.1.15.1.8.2)

Rock mass classification
Rock bolt load monitoring
Steel set load monitoring

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

Monitoring Drift Stability (8.3.1.15.1.8.3)

- Convergence measurement
- Rock mass displacement
- Seismic monitoring

Air Quality and Ventilation Experiment (8.3.1.15.1.8.4)

- Radon monitoring in boreholes
- Air quality surveys
- Sample collection for radon measurements

The following activities will be performed in support of the listed tests:

1. PROJECT SCHEDULING AND COORDINATION

1.1 The U.S. Department of Energy (DOE) Field Test Coordinator (FTC), the ESF TCO Field Test Representative (FTR), the Reynolds Electrical and Engineering Co., Inc. (REECo) Construction Department Manager (CDM); Test Survey Coordinator (TSC), the Photo Support Section Leader (PS), the Civilian Radioactive Waste Management System Management & Operating (CRWMS M&O) Contractor Construction Manager (CM), and the Principal Investigator (PI) or their representative, will mutually review and accept the WP and any subsequent TCO revision and will mutually agree upon a tentative schedule, implementation methods, and representative or approval authority for the work described below.

Organizational Participant Representative Signatures

FTC W. A. Hinkley Date 8/10/94

TCO FTR Richard G. Kasch Date 8/5/94

CM Richard C McDonald Date 8/8/94

CDM M Howard Date 8/5/94

TSC Lee E. Watson Date 8/5/94

PS Donald E Engebretson Date 8-9-94

PI Joseph E Gauthier Date 8/5/94

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

The TCO FTR and the Project Engineer (PE) for this activity have been delegated by signature of the DOE FTC above to authorize the initiation of procurement or the initiation of tasks required by the planning package as necessary to support the contractors' procedural requirements for the Yucca Mountain Site Characterization Office (YMSCO) FTC. Attachment 1 of this WP presents the recommended format to accomplish this communication.

2. GENERAL INSTRUCTIONS

2.1 TEST INSTALLATION INITIATION AND INSTALLATION CLOSE-OUT

Attachment 3 of this WP presents the recommended format to accomplish and administratively document "Construction Monitoring Activity Requests", "Authorizations" and "Releases to Construction" communications. These forms will be used to initiate and close each of the test installation activities described in Sections 3. through 17.

2.2 ESTABLISH CONSTRUCTION EXCLUSION AREA

The CM will provide effective means acceptable to the TCO FTR and PI or designee to ensure the safety, accessibility, and continued functioning of each completed test installation until notice of test completion. A construction exclusion area may be established around the instrument location. Requests for construction exclusion areas may be made using Attachment 3 of this WP. The areas will be identified by means of wall tags placed by the FTR. A copy of this tag is included in Attachment 3.

2.3 CONNECTION TO THE INTEGRATED DATA AND CONTROL SYSTEM (IDCS)

Several of the tests in Sections 3-17 will be connected to the IDCS when it becomes available. Initial date acquisition may be accomplished manually or with a data logger if the IDCS is unavailable.

3. CONVERGENCE MEASUREMENT INSTALLATIONS

3.1 IDENTIFY TEST INSTALLATION LOCATIONS

The number of measurements will be determined. The location of the measurement or instrumentation will be behind the tail shield of the Tunnel Boring Machine (TBM), from the trailing decks of the TBM, behind the TBM in the ramp, and in the alcoves.

The PI or designee, TCO FTR, and the CM will agree when to initiate the convergence pin installation test activity, and the time and approximate location for the test. The PI or designee will provide verification to the TCO FTR that the test and installation equipment is ready.

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

3.1.1 When, in the opinion of the CM and the TCO FTR, the selected test location may be safely accessed, the CM will provide to the TCO FTR access authorization permitting the activity to commence.

3.1.2 At the approximate location for the convergence test the PI or designee will select and mark the locations for the anchor holes. The location(s) will be based on accessibility of ramp circumference as indicated on the attached illustrations (Attachment 2). The location(s) will be noted in the PI or designee notebook, TCO FTR log book, and weekly report.

3.2 INSTRUMENTATION DRILLING AND CORING

3.2.1 Holes will be drilled in concrete floor segments to permit installation of convergence floor anchors. Recovered concrete core or drift rubble will be provided to the Sample Management Facility through the TCO FTR.

3.2.2 Following completion of drilling at a single location and prior to demobilization of the drilling equipment, the PI or designee will inspect and accept the holes or direct additional drilling in the event that any completed holes are found to be unsuitable for the test purposes.

3.2.3 The convergence pins anchors will be approximately 230 mm (9 in) long and 29 mm (1 in) in diameter and will be supplied by the PI or designee. The PI or designee will also supply all grouts and epoxy's used to anchor the pins. The holes to be drilled will have to accommodate pins of the size noted above. The actual size of the holes may vary due to type of grout used to anchor the pins and the rock conditions.

3.3 INSTALL CONVERGENCE PIN INSTRUMENTATION SYSTEM

Upon acceptance of the test drill holes the TCO FTR will direct the Constructor to support the installation of the convergence pins which will be installed under the direction of the PI or designee. The installation may be monitored and witnessed by the PI or designee. Attachment 4 of this WP presents the format to administratively document the instrument installation configuration.

3.3.1 The convergence pins will be installed taking into consideration potential interference from utility lines, cable trays, conveyor belts, transformer stations, and vent lines to allow for long term (years) monitoring.

3.3.2 The TCO FTR will ensure that the system is functioning to the satisfaction of the PI or designee.

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

3.4 REPORTING RESPONSIBILITIES

3.4.1 Some convergence measurements are part of the information defined by the CRWMS M&O for input to Title II design. Convergence information will be reported to the CRWMS M&O field engineer in accordance with the Test Planning and Job Packages. The format and frequency of submittals will be determined by the PI or designee, CRWMS M&O A/E, and the TCO FTR.

3.4.2 Other reporting instructions are contained in Section 19 of this WP.

4. ROCK MASS RESPONSE (MULTIPOINT BOREHOLE EXTENSOMETER - MPBX) INSTALLATION

4.1 IDENTIFY TEST INSTALLATION LOCATIONS

The number of measurements will be determined. The location of the measurement or instrumentation will be behind the tail shield of the Tunnel Boring Machine (TBM), from the trailing decks of the TBM, behind the TBM in the ramp, and in the alcoves.

The PI or designee, TCO FTR, and the CM will agree when to initiate the MPBX experiment, and the time and approximate location of the MPBX anchor installation.

4.1.1 When, in the opinion of the CM and the TCO FTR, the selected test location may be safely accessed, the CM will provide to the TCO FTR an access authorization permitting the test activity to commence at the proposed test location.

4.1.2 A limited number of MPBX gauges will be installed at the tail shield of the TBM; the majority of the gauges will be installed from the trailing gear and from behind the TBM. The mining schedule may allow for drilling in areas not normally accessible during normal TBM operations; these opportunities will be coordinated by the FTR on an as available basis. Additional MPBX installation will occur in test alcoves and unique geological formations as determined by the PI or designee.

4.2 INSTRUMENTATION DRILLING AND CORING

The MPBX drill hole locations selected by the PI or designee will be drilled by the Constructor. Attachment 5 provides an estimate of the length and diameter of boreholes required for MPBX installation.

4.2.1 The location of the MPBX experiment will in many cases dictate the size of the hole, depth and equipment available for drilling the hole. Access to the main drift will be coordinated with the CM representative to assure personnel safety. Holes may be drilled "wet" but the use of water will be minimized and the use of a water

recirculation system such as that used in drilling the MPBX holes in the ESF Starter Tunnel, may be needed.

4.2.2 Core handling and packaging instructions can be found in SP 92-20D (Construction Monitoring Sample Plan for the in the Ramps, MTL Drifts, and Alcoves).

4.2.3 The PI or designee will observe the drilling of the MPBX holes and make final acceptance.

4.3 BOREHOLE VIDEO LOGGING AND INSPECTION

The PI or designee may inspect the holes with a video camera (see "Blast Damage Assessment," Section 10.)

4.4 INSTALL MPBX INSTRUMENTATION SYSTEM

The PI or designee will advise the TCO FTR when the MPBX gauges are to be installed. The PI or designee will provide installation tools for the MPBX. The Constructor will assist the PI or designee during installation of the MPBX equipment and will provide all necessary support equipment. Attachment 4 of this WP presents the format to be used by the PI or designee to administratively document the instrument installation configuration.

4.4.1 The PI or designee will wire the MPBX instrument. Depending on the situation, the PI or designee may elect to leave the wires coiled up out of the construction area or may tie the wires temporarily to rock bolts and hang them on the right rib. The Contractor will provide permanent wiring, which shall include running the instrument cables in flexible conduit from the gauge to a panel located on the right rib approximately 1.5 meters (5 ft) above the invert. The PI or designee will provide the panel and will terminate the cables in the panel. The Constructor will install the panel using unistrut and rockbolts with anchors on the end (e.g., same as used in the ESF Starter Tunnel).

4.4.2 The TCO FTR will ensure that the system is functioning to the satisfaction of the PI or designee.

4.5 REPORTING RESPONSIBILITIES

4.5.1 Some MPBX measurements are part of the information defined by the CRWMS M&O as being necessary for Title II design. MPBX information will be reported to the CRWMS M&O field engineer in accordance with the Test Planning and Job Packages. The format and frequency of submittals will be determined by the PI or designee, CRWMS M&O A/E, and the TCO FTR.

4.5.2 Other reporting instructions are contained in Section 19 of this WP.

5. IN SITU STRESS MEASUREMENT INSTALLATION

5.1 IDENTIFY TEST INSTALLATION LOCATIONS

The number of measurements will be determined by the PI or designee. The location of the measurement or instrumentation will be behind the TBM in the ramp and in the alcoves.

The PI or designee, TCO FTR, and the CM will agree when to initiate installation of the in situ stress measurement instrumentation and the timing and approximate location for constructing boreholes within which the test will be deployed. Optional test equipment is described in the TPP and references.

5.1.1 When, in the opinion of the CM and the TCO FTR, the selected test location may be safely accessed, the test activity will commence at the proposed test location.

5.2 DRILLING AND CORING

5.2.1 The required hole location, depth and angle will be selected by the PI or designee. The holes will be cored from a location within one of the north ramp test alcoves or from a platform located behind the TBM. Attachment 5 provides an estimate of the length and diameter of boreholes required for in situ stress measurements

5.2.2 If the overcoring method is selected, the PI or designee will observe the sequential operations of borehole drilling, gage installation, and overcoring.

5.2.3 If borehole slotting is selected as the test method, the PI or designee will observe the drilling of the boreholes and will verify final acceptance of the borehole for testing purposes. If the hole is cored, core handling and packaging instructions can be found in SP 92-20D (Construction Monitoring Sample Plan in the Ramps, MTL Drifts, and Alcoves).

5.2.4 If required by the PI or designee, the Constructor will provide a plug/cover for completed holes.

5.3 BOREHOLE VIDEO LOGGING AND INSPECTION

The PI or designee may inspect the holes with a video camera (See "Blast Damage Assessment,").

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

5.4 INSTALL INSTRUMENTATION SYSTEM

Upon PI or designee acceptance of the test drill holes, the TCO FTR will direct the Constructor to support the PIs or designees to install the test equipment in accordance with the PIs or designees instructions. The installation will be monitored and witnessed by the PI or designee. The PI or designee will document the test configuration using the form in Attachment 4.

5.4.1 The PI or designee will provide installation tools and will record the approximate instrument location within the hole. The Constructor will provide all support equipment required for installation as defined by the PI or designee.

5.5 REPORTING RESPONSIBILITIES

5.5.1 Some in situ stress measurements are part of the information defined by the CRWMS M&O as being necessary for Title II design. In situ stress information will be reported to the CRWMS M&O field engineer in accordance with the Test Planning and Job Packages. The format and frequency of submittals will be determined by the PI or designee, CRWMS M&O A/E and the TCO FTR.

5.5.2 Other reporting instructions are contained in Section 19 of this WP.

6. INDUCED STRESS /STRESS CHANGE MEASUREMENT INSTALLATION

6.1 IDENTIFY TEST INSTALLATION LOCATIONS

The number of measurements will be determined. The location of the measurement or instrumentation will be behind the TBM in the ramp and in the alcoves.

The PI or designee, TCO FTR, and the CM will agree when to initiate installation of the induced stress and stress change instrumentation and the timing and approximate location for constructing boreholes within which the test will be deployed. Optional test equipment is described in the Test Planning Package and TPP references.

6.1.1 When, in the opinion of the CM and the TCO FTR, the selected test location may be safely accessed, the test activity will commence at the proposed test location.

6.1.2 The location of each test will vary from directly behind the TBM tail shield to behind the TBM trailing gear.

6.2 DRILLING AND CORING

6.2.1 The required hole location, depth and angle will be selected by the PI or designee. The holes will be drilled or cored from a location behind the TBM.

Attachment 5 provides an estimate of the length and diameter of boreholes required for induced stress and stress change measurement.

6.2.2 If required by the PI or designee, the Constructor will provide a plug/cover for the completed holes. The instrument will not be installed until after mining is completed (or at the direction of the PI or designee).

6.2.3 The PI or designee will observe the drilling of the boreholes and will verify final acceptance of the borehole for testing purposes. If the hole is cored, core handling and packaging will be carried out as described in SP 92-20D (Construction Monitoring Sample Plan in the Ramps, MTL Drifts, and Alcoves).

6.3 BOREHOLE VIDEO LOGGING AND INSPECTION

The PI or designee may inspect the holes with a video camera (See "Blast Damage Assessment,").

6.4 INSTALL INSTRUMENTATION SYSTEM

Upon acceptance of the test drill holes the TCO FTR will direct the Constructor to support the PI or designee to install the test equipment in accordance with the PI or designee procedures. The installation will be monitored and witnessed by the PI or designee. The PI or designee will document the test configuration using the form in Attachment 4.

6.4.1 The PI or designee will provide installation tools and will record the approximate instrument location within the hole. The Constructor will provide all support equipment required for installation as defined by the PI or designee.

6.4.2 The instrumentation wiring will consist of "pigtails" that will be tied to the rib of the tunnel by the PI or desginee. No Constructor support is necessary.

6.4.3 The TCO FTR will ensure that the system is functioning to the satisfaction of the PI or designee.

6.5 Reporting requirements are provided in Section 19 of this WP.

7. LINER CONTACT STRESS MEASUREMENT INSTALLATION

7.1 IDENTIFY TEST INSTALLATION LOCATIONS

The number of measurements will be determined based on placement of the liner.

The PI or designee, TCO FTR, and the CM will agree when to initiate the liner contact stress measurement activity, and the time and approximate location for installing the instrumentation.

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

7.1.1 The FTR, CM representative, and the PI or designee will agree when to initiate the liner contact stress measurement. No tests for this section of the WP are identified or planned at this time.

7.2 INSTALL INSTRUMENTATION SYSTEM

The TCO FTR will ensure that the pressure cell(s) and all other directly related materials required for the functioning of the test are present and ready at the test location when required.

7.2.1 The PI or designee will select and mark the location where each liner contact pressure cell will be installed.

7.2.2 The Constructor will furnish at the test location all the required equipment, lighting, power, and experienced personnel to efficiently install the pressure cells.

7.2.3 The PI or designee will direct and witness the installation of the liner contact pressure cells and will observe subsequent installation of the liner. The PI or designee will document the test configuration using the form in Attachment 4 of this WP. The installation of the pressure cells will be documented by photographs.

7.2.4 The PI or designee will wire the stress cells. Depending on the situation the PI or designee may elect to leave the wires coiled up out of the construction area or may tie the wires temporarily on the right rib. The Contractor will provide permanent wiring and shall run the instrument cables in flexible conduit from the stress cells to a panel located on the right rib approximately 1.5 meters (5 ft) above the invert. The PI or designee will provide the panel and terminate the cables in the panel. The Constructor will install the panel using unistrut as a mounting bracket. The PI or designee will verify that the gauge is functioning properly.

7.3 ESTABLISH CONSTRUCTION EXCLUSION AREA

The pressure cells and cables will be protected by the Constructor prior to shotcreting. After shotcreting the permanent installation to the data logger will be completed by the Constructor.

7.3.1 The Constructor will provide effective means to ensure that the completed test fixtures are protected from damage and tampering. The CM will also ensure that the test fixtures are accessible for as long as required.

7.4 Reporting requirements are contained in Section 19 of this WP.

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

8. ROCKBOLT LOAD CELL AND INSTRUMENTED ROCKBOLT INSTALLATION

8.1 IDENTIFY TEST INSTALLATION LOCATIONS

The number of measurements will be determined. The location of the measurement or instrumentation will be behind the tail shield of the Tunnel Boring Machine (TBM), from the trailing decks of the TBM, and in the alcoves.

The PI or designee, TCO FTR, and the CM will agree when to initiate the rockbolt load cell activity, and the time and approximate location for installing the rockbolt load cells.

8.1.1 When the CM and the TCO FTR determine that the selected test location may be safely accessed, the test activity will commence at the proposed test location.

8.2 INSTALL INSTRUMENTATION SYSTEM

The TCO FTR will ensure that the rockbolt load cell and all other directly related materials required for the functioning of the test are present and ready at the test location when required.

8.2.1 The PI or designee will mark the rock bolt to be monitored or the location for the Instrumental rock bolt (IRB) to be installed. Bolts selected will be approved by the CM. Rock bolt load cells (RBLCs) or IRBs will be installed by the PI or designee with assistance from the CM. No special requirements exist for RBLC installations. IRBs will be installed supplemental to the Constructors rock bolts. Borehole requirements are shown in Attachment 5.

8.2.2 The Constructor will furnish at the test location all the required equipment, lighting, power, and experienced personnel to efficiently install the rockbolt load cells.

8.2.3 The PI or designee will direct and witness the installation of the rockbolt load cells, and cans to cover the load cells. The PI or designee will document the test configuration using the form in Attachment 4 of this WP.

8.2.4 The PI or designee will wire the load cells/instrumented rockbolts; depending on the situation the PI or designee may elect to leave the wires coiled up out of the construction area or may tie the wires temporarily to rockbolts so the wires can hang on the right rib. The Contractor will provide permanent wiring (at approximately 20% of the locations) which shall include running the instrument cables in flexible conduit from the load cells to a panel located on the right rib approximately 1.5 meters (5 ft) above the invert. The PI or designee will provide the panel and terminate the Cables in the panel. The Constructor will install the panel (at all locations) using unistrut and rockbolts with anchors on the end (e.g., as used in the ESF Starter Tunnel).

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

8.3 ESTABLISH CONSTRUCTION EXCLUSION AREA

The load cells and cables will be protected by the Constructor prior to shotcreting. After shotcreting the permanent installation to the junction box will be completed by the Constructor.

8.3.1 The Constructor will provide effective means to ensure that the completed test fixtures are protected from damage and tampering. The CM will also ensure that the rockbolt test fixtures are accessible for as long as required.

8.4 REPORT RESPONSIBILITIES

8.4.1 Some rock bolt load measurements are part of the information defined by the CRWMS M&O as being necessary for Title II design. Rock bolt load information will be reported to the CRWMS M&O field engineer in accordance with the Test Planning and Job Packages. The format and frequency of submittals will be determined by the PI or designee, CRWMS M&O A/E, and the TCO FTR.

8.4.2 Other reporting instructions are contained in Section 19 of this WP.

9. BLAST MONITORING ACTIVITY

9.1 IDENTIFY TEST ACTIVITY LOCATIONS

The PI or designee, TCO FTR, and the CM will agree on the timing of blast monitoring activities and on the locations for installation of the blast recording equipment.

9.1.1 The PI or designee, TCO FTR, and CM will agree to a schedule of monitoring blast activity. The PI or designee will install seismographs, to monitor the blast activity, and the monitoring equipment at the agreed-to locations.

9.1.2 In addition to conventional blast monitoring, near field blast monitoring will be conducted for several alcove blasts. Accelerometers will be installed within or very near the blast. Four instrument holes approximately 5 m deep will be required at each alcove. Accelerometers may require grouting in the holes. These instruments are considered non-recoverable. The PI or designee will supply all monitoring equipment and will install the accelerometers. The Constructor will provide assistance with drilling, power, and grouting.

9.1.3 The CM/Constructor will give to the TCO FTR/PI or designee, copies of the following information: (1) The design of each blast round requested (2) an assessment of the blast performance; overbreak, underbreak, fragmentation, condition of the remaining surface, and commentary as appropriate.

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

9.2 BLAST MONITORING

The PI or designee will obtain acceleration, peak particle velocity (ppv), and wave form data associated with blasts. In addition, the PI or designee will obtain the blast location data to permit analysis of the ppv data. Preliminary field information will be provided to the CM from the PI or designee on request.

9.2.1 The designated PI or designee will furnish and operate the seismograph and all other equipment required to measure ppv.

9.3 REPORTING RESPONSIBILITIES

9.3.1 Upon request to the PI or designee or the TCO FTR, the PI or designee will, in a timely manner, furnish ppv information to the FTR and the CM to assist in blast design refinement.

9.3.2 Some blast monitoring data are part of the information defined by the CRWMS M&O as being necessary for Title II design. Blast Monitoring information will be reported to the CRWMS M&O field engineer in accordance with the Test Planning and Job Packages. The format and frequency of submittals will be determined by the PI or designee, CRWMS M&O A/E, and the TCO FTR.

9.3.3 Other reporting instructions are contained in Section 19 of this WP.

10. BLAST DAMAGE ASSESSMENT ACTIVITY

10.1 IDENTIFY TEST ACTIVITY LOCATIONS

The number of measurements will be determined. The location of the measurement or instrumentation will be in the alcoves.

The PI or designee, TCO FTR, and the CM will agree when to perform blast damage assessments.

10.1.1 The TCO FTR, after receiving a request from the PI or designee, will give reasonable notice to the CM of the time and approximate locations for instrumenting and monitoring the blasts and blast effects. At the same time the PI or designee will furnish a description of the equipment and procedures which will be followed during the conduct of this test (see 9.1.2).

10.1.2 When, in the opinion of the CM and the TCO FTR, a selected test location may be safely accessed, the CM will allow the test activity to commence.

10.1.3 At the designated time and location for the test, the PI or designee will identify existing drill holes in support of this test. If new drillholes are required, they will be drilled by the Constructor.

10.2 DRILLING AND CORING

10.2.1 If new drillholes are required, the hole location, depth and angle will be selected by the PI or designee. The holes will be drilled full face or cored. Attachment 5 provides an estimate of the length and diameter of boreholes required for blast damage assessment.

10.2.2 If required by the PI or designee, the Constructor will provide a plug/cover for the completed holes.

10.2.3 The PI or designee will observe the drilling of the boreholes and will verify final acceptance of the borehole for testing purposes. If the hole is cored, core handling and packaging described in SP 92-20D (Construction Monitoring Sample Plan in the Ramps, MTL Drifts, and Alcoves) will be carried out.

10.3 BOREHOLE VIDEO LOGGING AND INSPECTION

The Constructor will provide a platform and operator suitable for the TCO FTR/PI or designee to access the drill holes and the PI or designee will operate a borehole video camera and ancillary equipment. The Constructor will provide lighting and power as required.

10.3.1 The PI or designee will provide the video camera, bore scope, and ancillary equipment for the operation of the test. The PI or designee will direct the operation of the test and verify its satisfactory completion. The TCO FTR will notify the FTC and CM/Constructor when the test is completed and that the support equipment may be removed.

10.4 REPORTING RESPONSIBILITIES

10.4.1 The PI or designee will analyze the borehole video data and will furnish to the TCO FTR in a timely fashion, an assessment of the blast effects on the excavation perimeter for possible future blast design modification.

Additional reporting requirements are contained in Section 19 of this WP.

11. DOCUMENTING TUNNEL CONSTRUCTION METHODS AND EQUIPMENT

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

11.1 ACCESS TO THE TBM

Controlled access will be provided by the Constructor to the TBM so that the PI or designee can collect the requisite information.

11.1.1 Where possible, data will be obtained from the Constructor so that access to the TBM will not be required for this activity. Under this option, the Constructor will supply the required data through the CM according to the pre-arranged schedule.

11.2 REPORTING RESPONSIBILITIES

Reporting requirements are contained in Section 19 of this WP.

12. ROCK MASS CLASSIFICATION ACTIVITY

12.1 TEST ACTIVITY LOCATIONS

12.1.1 The Sandia National Laboratories (SNL) PI or designee or a representative will perform rock mass quality assessments from behind the tail shield of the TBM. Information will be collected by SNL field engineers on all production shifts.

12.1.2 Rock mass quality data may also be collected from other locations on the TBM including, but not limited to, the mapping gantry and drill platforms. Authorization and controlled access to these locations will be provided by the CM through the TCO FTR.

12.2 ROCK MASS CLASSIFICATION

Upon completion of the Rock Mass Classification analysis, the PI or designee will transfer the preliminary Rock Mass Classification field information to the Constructor and CRWMS M&O Field Engineer for further distribution to affected and interested parties.

12.3 REPORTING RESPONSIBILITIES

12.3.1 Some rock mass quality data are part of the data set defined by the CRWMS M&O as being required to confirm rock support selection and for input to Title II design. Data will be reported to the CRWMS M&O field engineer in accordance with the requirements contained in the Test Planning and Job Packages. The format and frequency of submittals will be determined by the PI or designee, CRWMS M&O A/E and the TCO FTR.

12.3.2 Preliminary assessments of rock mass quality indices will be recorded on mapping forms and provided to the CRWMS M&O MK field engineer.

12.3.3 Other reporting instructions are contained in Section 19 of this WP.

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

13. STEEL SET LOAD MONITORING

13.1 IDENTIFY TEST INSTALLATION LOCATIONS

The location of the measurement or instrumentation will be at the tail shield of the TBM.

The PI or designee, TCO FTR, and the CM will agree when to initiate the steel set load monitoring activity, and the time and approximate location for installing the monitoring instrumentation.

13.1.1 When, in the opinion of the CM and the TCO FTR the selected test location may be safely accessed, the test activity will commence at the proposed test location.

13.2 INSTALL INSTRUMENTATION SYSTEM

The TCO FTR will ensure that the load cell(s), strain gages, pressure cell(s) and all other directly related materials required for the functioning of the test are present and ready at the test location when required.

13.2.1 The PI or designee will select and mark the location where each instrument will be installed.

13.2.2 The Constructor will furnish at the test location all the necessary equipment, lighting, power. The PI or designee will install the monitoring instrumentation, supported by the Constructor. The installation of the instrumentation will be documented by photographs.

13.2.3 The PI or designee will direct the installation of the instrumentation and will observe subsequent installation of the liner components in the vicinity of the test equipment. The PI or designee will document the test configuration using the form in Attachment 4 of this WP.

13.2.4 The PI or designee will wire the monitoring instrumentation; depending on the situation the PI or designee may elect to leave the wires coiled up out of the construction area or may tie the wires temporarily so the wires can hang on the right rib. The Contractor will provide permanent wiring which shall include running the instrument cables in flexible conduit form the load cells to a panel located on the right rib approximately 1.5 meters (5 ft) above the invert. The PI or designee will provide the panel and terminate the cables in the panel. The Constructor will install the panel using unistrut and rockbolts with anchors on the end (e.g., same as used in the ESF Starter Tunnel).

13.3 ESTABLISH CONSTRUCTION EXCLUSION AREA

Instrumentation and cables will be protected by the Constructor prior to completing any additional construction activities that may detrimentally affect the monitoring instrumentation.

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

13.3.1 The Constructor will provide effective means to ensure that the completed test fixtures are protected from damage and tampering. The CM will also ensure that the test fixtures are accessible for as long as required.

13.4 REPORTING RESPONSIBILITIES

13.4.1 Some steel set load monitoring data are part of the information defined by the CRWMS M&O as being necessary to confirm rock support adequacy and for input to Title II design. Load monitoring information will be reported to the CRWMS M&O field engineer in accordance with the Test Planning and Job Packages. The format and frequency of submittals will be determined by the PI or designee, CRWMS M&O A/E and the TCO FTR.

13.4.2 Other reporting instructions are contained in Section 19 of this WP.

14. SEISMIC MONITORING

14.1 IDENTIFY TEST INSTALLATION LOCATIONS

Seven to ten (7 - 10) monitoring stations are planned for the North Ramp. The location of the monitoring stations will be behind the TBM in the ramp and in the alcoves.

The PI or designee, TCO FTR, and the CM will agree when to initiate the seismic monitoring experiment, and the time and approximate location for the installation of both surface mounted and borehole accelerometers.

14.1.1 When, in the opinion of the CM and the TCO FTR the selected test location may be safely accessed, the CM will issue to the TCO FTR an access authorization permitting the test activity to commence at the proposed test location.

14.2 DRILLING AND CORING

Boreholes needed for installing accelerometers will be drilled by the Constructor. Attachment 5 provides an estimate of the length and diameter of boreholes required for installation of borehole accelerometers. When drilling holes of this length, the holes may be drilled wet but minimal water will be used. Recirculation of drilling water, as done for the MPBX holes in the ESF Starter Tunnel, may be necessary.

14.2.1 The PI or designee will observe the drilling of the boreholes and make final acceptance.

14.3 BOREHOLE VIDEO LOGGING AND INSPECTION

The PI or designee may inspect the holes with a video camera (see "Blast Damage Assessment," Section 10)

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

14.4 INSTALL INSTRUMENTATION SYSTEM

The PI or designee will advise the TCO FTR when Constructor support is needed to assist the PI or designee in the installation of the accelerometers. The PI or designee will provide tools for installing both the surface mounted and borehole accelerometers. The Constructor will assist the PI or designee during installation of the instrumentation and provide all necessary support equipment. The PI or designee will document the test configuration using the form in Attachment 4 of this WP.

14.4.1 The PI or designee will wire the seismic gauges. The Constructor will mount a small junction box provided by the PI or designee and will provide 110 volt power to the location if necessary.

14.5 The TCO FTR will ensure that the system is functioning to the satisfaction of the PI or designee.

14.6 REPORTING RESPONSIBILITIES

14.6.1 Seismic monitoring data are part of the information defined by the CRWMS M&O as being necessary to confirm rock support adequacy under seismic loading and for input to Title II design. Data will be reported to the CRWMS M&O field engineer in accordance with the Test Planning and Job Packages. The format and frequency of submittals will be determined by the PI or designee, CRWMS M&O A/E and the TCO FTR.

14.6.2 Seismic monitoring data are also needed by the USGS and other investigators for the site seismic monitoring network. Data will be reported to the USGS field representative in accordance with the requirements contained in the Test Planning and Job Packages.

14.6.3 Other reporting instructions are contained in Section 19 of this WP.

15. RADON MONITORING IN BOREHOLES

15.1 IDENTIFY TEST LOCATIONS

The number of measurements will be determined. The location of the measurement or instrumentation will be behind the TBM in the ramp and in the alcoves.

The PI or designee, TCO FTR, and the CM will agree when to initiate the radon monitoring in borehole(s) experiment, and the timing and approximate location for constructing boreholes within which the test will be deployed.

15.1.1 When, in the opinion of the CM and the TCO FTR the selected test location may

be safely accessed, the CM will issue to the TCO FTR an access authorization permitting the test activity to commence at the proposed test location. The testing for radon will not interfere with other tests being conducted in the alcoves.

15.2 DRILLING AND CORING

Required boreholes will be drilled by the Constructor. Attachment 5 provides an estimate of the length and diameter of boreholes required for radon monitoring.

15.2.1 The PI or designee will observe the drilling of the boreholes and make final acceptance.

15.2.2 No core is anticipated from these boreholes.

15.3 BOREHOLE VIDEO LOGGING AND INSPECTION

The PI or designee will inspect the holes with a video camera (see "Blast Damage Assessment," Section 10).

15.4 INSTALL INSTRUMENTATION SYSTEM

The PI or designee will advise the TCO FTR when Constructor support is needed to assist the PI or designee with the installation of the radon measuring gauges. The PI or designee will provide tools for installing the test equipment. The Constructor will assist the PI or designee during installation of the instrumentation and provide all necessary support equipment. The PI or designee will document the test configuration using the form in Attachment 4 of this WP.

15.4.1 The PI or designee will wire the radon gauges; depending on the situation the PI or designee may elect to leave the wires coiled up out of the construction area or may tie the wires temporarily so the wires can hang on the rib. The Contractor will provide permanent wiring which shall include running the instrument cables in flexible conduit from the gauges to a panel located on the rib approximately 1.5 meters (5 ft) above the invert. The PI or designee will provide the panel and terminate the cables in the panel. The Constructor will install the panel testing using unistrut and rockbolts with anchors on the end (e.g., same as used in the ESF Starter Tunnel).

15.5 The TCO FTR will ensure that the system is functioning to the satisfaction of the PI or designee.

15.6 Reporting requirements are contained in Section 19 of this WP.

16. AIR QUALITY SURVEYS

16.1 IDENTIFY LOCATION FOR INSTRUMENTATION INSTALLATION

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

The SNL PI or designee currently anticipates that data required for this test will be supplied by the Constructor. If required information is not being collected by the Constructor, the PI or designee will initiate tests to collect the required data.

16.1.1 The TCO FTR will modify this section of the workplan based on requirements identified by the PI or designee.

16.2 TEST AREA PREPARATION

To be identified in future revisions of the WP.

16.3 INSTALL AIR QUALITY MONITORING INSTRUMENTATION

To be identified in future revisions of the WP.

16.4 ESTABLISH CONSTRUCTION EXCLUSION AREA

To be identified in future revisions of the WP.

17. BULK SAMPLE COLLECTION FOR RADON MEASUREMENT

Bulk sample collection and preservation is covered by the Consolidated Sampling Work Plan (WP 92-20C) and Consolidated Sampling Sample Plan (SP 92-20C).

18. SAFETY

18.1 The DOE YMSCO Assistant Manager for Environment, Safety and Health, (AMESH) has assigned underground construction and mining safety to the Constructor (Reynolds Electrical and Engineering Company, Inc.). The TCO recognizes and endorsed this action. The TCO will, as required, coordinate planned scientific activities to comply with the Constructors concerns for safety and perform/direct these scientific activities to proceed after full consolation with the Constructor as to safety status.

18.2 Safety responsibilities are identified in the "Work Plan Safety Analysis," Attachment 7.

19. REPORTING RESPONSIBILITIES

19.1. The TCO FTR will submit a weekly activity report to the FTC. The report will include the identification of conditions that affect data gathering and agreed to specific requirements such as drill hole length location and size.

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

19.2 The TCO FTR will submit a monthly status report to the FTC and will submit a copy to the Document Records Center (DRC) DRC-098. Copies of construction exclusion area forms will be attached to the monthly report.

19.3. The Constructor will provide to the appropriate DRC file (tracking number DRC-098) and to the TCO FTR the following information:

A. Report of underground spills of fuels, lubricants and coolants.

B. Record of underground fuel use by class of equipment.

C. Record of underground volume of water, tracers, fluids, and materials as specified in Job Package 92-20, Job Package 94-16 or current Job Package implementing ESF construction.

D. Design of each blast round and assessment of blast performance (see Blast Monitoring Activity Section).

E. Other records identified in subsections of this WP.

REECo will notify the FTC and TCO FTR of any noncompliance and known problems during any phase of construction monitoring.

19.4. The PI or designee or designee will notify the LANL ESF FTR in writing that the field portion of the activity is complete and data collection has entered a monitoring phase, and will provide status of associated milestones and commitments.

20. VERIFICATION

20.1 PLAN DEVELOPMENT

Raytheon Services Nevada (RSN) will develop a verification plan to confirm instrument location and number. This plan will be approved by the TCO FTR.

20.2 CONFIRM INSTRUMENTATION INSTALLATIONS

RSN will verify location and number of test boreholes and installed instrumentation using the approved verification plan and shall utilize Attachment 4 forms developed during instrument installation.

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

21. WORK PLAN CLOSE OUT

21.1. At the conclusion of the field activity, the TCO FTR will submit a close out report under JP 92-20D.

21.2 Concurrence from the job package records coordinator (JPRC) that record package turnover requirements have been met.

Signature: _____(JPRC)/ Date: _____

22. CONCURRENCE OF THE COMPLETION OF THE CONSTRUCTION MONITORING WORKPLAN

22.1 PI or designee or Representative

Signature: _____/ Date: _____

22.2 ESF Test Coordination Office (TCO FTR) Representative

Signature: _____/ Date: _____

22.3 YMP- Assistant Manager for Site Programs (AMSP) FTC

Signature: _____/ Date: _____

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

ATTACHMENT 1

REQUEST FOR WORK ORDER MODIFICATION
2 Pages

Reynolds Electrical & Engineering Co., Inc.

YUCCA MOUNTAIN PROJECT

REQUEST FOR WORK ORDER MODIFICATION

Date: _____ Station No.: _____

Work Order No.: _____ Work Order Modification No.: _____

To: REECo YMP Project Control Department From: _____
REQUESTOR ORG.

Detail Scope of Work:

Attachment/Reference Documents:

Estimated By: _____ Date: _____

LABOR	MATERIAL	EQUIPMENT	OTHER	TOTAL

DOE Representative Date

CLD Representative Date

Check for Distribution:
[ ] REECo YMP
[ ] REECo YMP Construction Department
[ ] REECo YMP Drilling Department
[ ] REECo YMP P.P. & B.
[ ] DOE/YMSCO
[ ] DOE/YMP _____
[ ] ESF/TCO-SITE _____
[ ] ESF/TCO-LV _____
[ ] PI _____

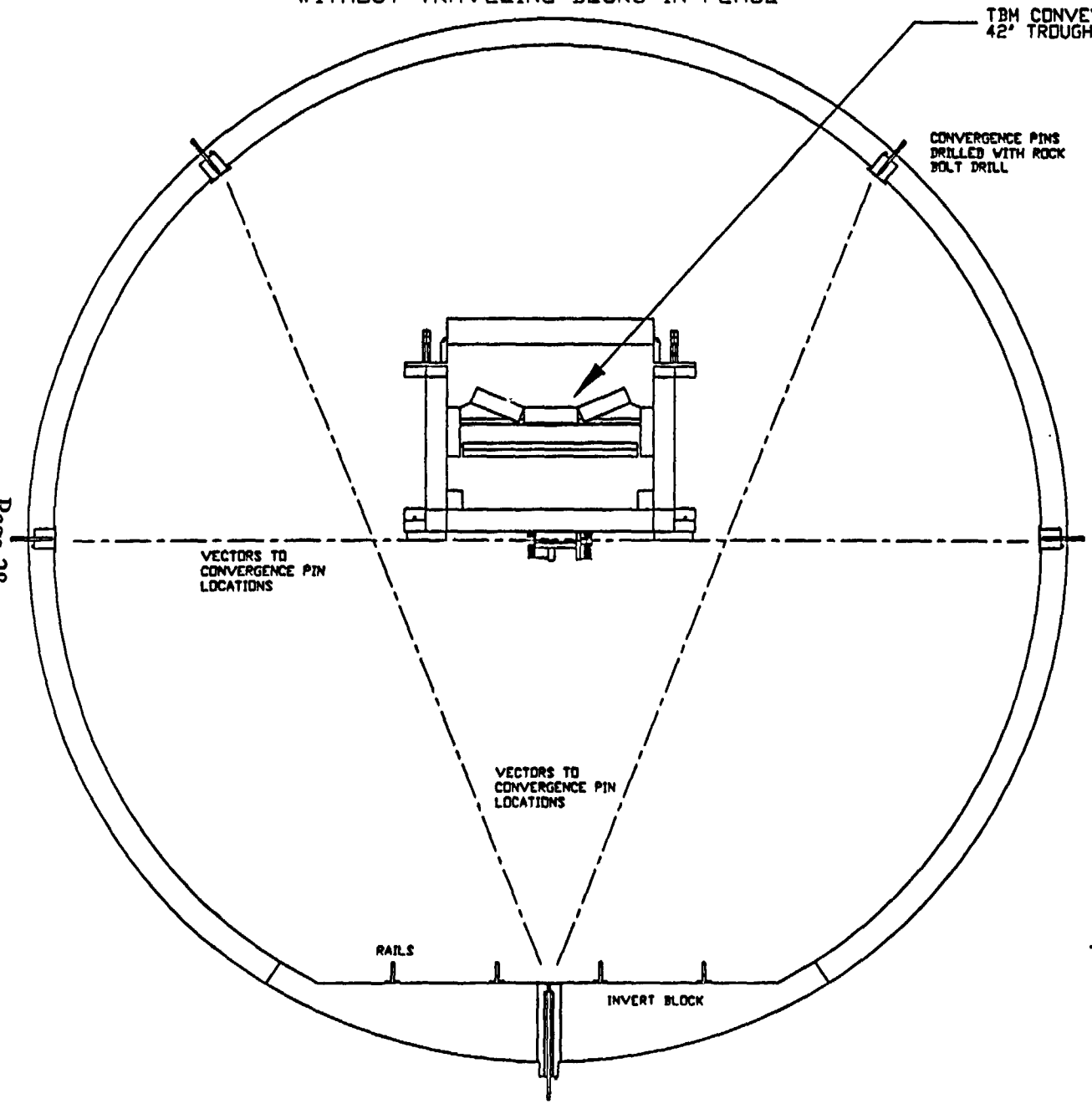
CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

ATTACHMENT 2

ILLUSTRATIONS
3 Pages

SECTION OF TBM BEHIND TAIL SHIELD LOOKING TOWARD PORTAL

POSSIBLE CONVERGENCE PIN ARRANGEMENT WITHOUT TRAVELING DECKS IN PLACE



GENERAL COMMENTS

BASIS OF ILLUSTRATION: CTF DRAWING #DE200, "TBM YUCCA MOUNTAIN," DATED NOV. 2, 1993

APPROXIMATE TRAVEL OF RING ERECTOR AND ROOF BOLTER TRAVELING DECKS IS 2.4 m (8 FEET).

NOTE:
ILLUSTRATION NOT TO SCALE
ARRANGEMENT IS APPROXIMATE

NOTE:
COORDINATES AND DIMENSIONS ARE PRELIMINARY

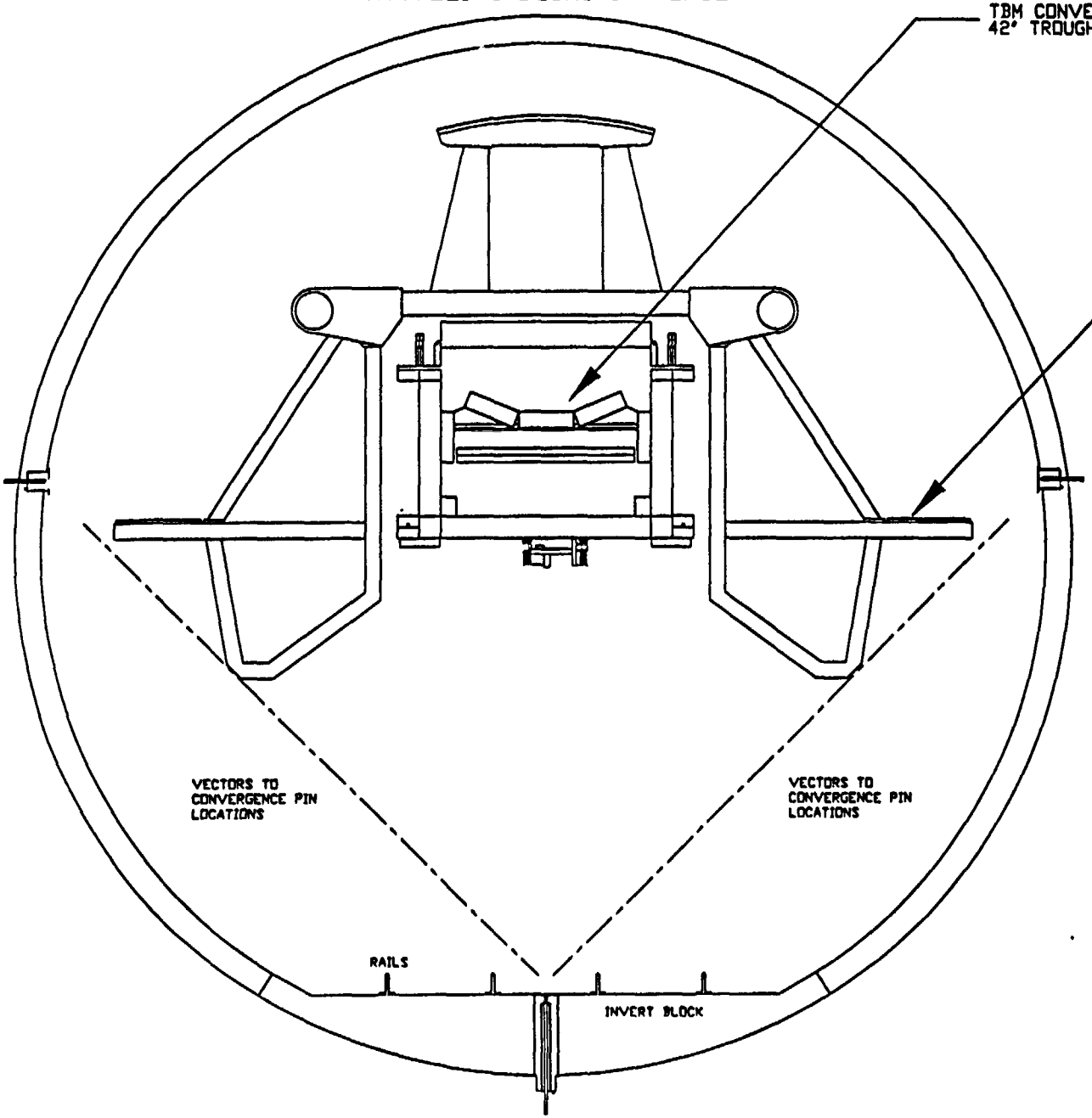
LOS ALAMOS NATIONAL LABORATORY
TEST COORDINATION OFFICE - YUCCA MOUNTAIN PROJECT

PROJECT: CONSTRUCTION MONITORING - CONVERGENCE PIN ARRANGEMENT WITHOUT OBSTRUCTION

CAD FILE: CONPINSE.DWG	AUTOCAD R12	PLOT SCALE: A	NOTES	REVISION: A1
DRN. BY: D.J. WEAVER	APPROVED BY: ON FILE N.Z. ELKINS/R.D. OLIVER		DATE DRN: 7/3/94	
NOTES: ADMINISTRATIVE/ILLUSTRATIVE USE ONLY			PLOT DATE: 7/12/94	

SECTION OF TBM BEHIND TAIL SHIELD LOOKING TOWARD PORTAL

- POSSIBLE CONVERGENCE PIN ARRANGEMENT WITH TRAVELING DECKS IN PLACE



GENERAL COMMENTS

BASIS OF ILLUSTRATION: CTS DRAWING #92200, "TBM YUCCA MOUNTAIN," DATED NOV. 2, 1993

APPROXIMATE TRAVEL OF RING ERECTOR AND ROOF BOLTER TRAVELING DECKS IS 2.4 m (8 FEET).

NOTE:
ILLUSTRATION NOT TO SCALE
ARRANGEMENT IS APPROXIMATE

NOTE:
COORDINATES AND DIMENSIONS ARE PRELIMINARY

LOS ALAMOS NATIONAL LABORATORY
TEST COORDINATION OFFICE - YUCCA MOUNTAIN PROJECT

PROJECT: CONSTRUCTION MONITORING - CONVERGENCE PIN ARRANGEMENT WITH OBSTRUCTION

CAD FILE: CONPINS1.DWG	AUTOCAD R12	SIZE: A	SCALE: NOTED	REVISION: A1
DRN. BY: D.J. WEAVER	APPROVED BY: ON FILE N.Z. ELKINS/R.B. OLIVER	DATE DRN: 7/9/94		
NOTES: ADMINISTRATIVE/ILLUSTRATIVE USE ONLY		PLOT DATE: 7/13/94		

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

ATTACHMENT 3

CONSTRUCTION MONITORING ACTIVITY REQUEST/AUTHORIZATION
3 Pages

(1) Request for Construction Exclusion Area

(2) Copy of Instrument Location Wall Tag

REQUEST FOR CONSTRUCTION EXCLUSION AREA

A. REQUEST FOR CONSTRUCTION EXCLUSION AREA (date: ___ /___ /___)

The following areas are required for testing or sampling and should be protected from potential construction damage during the defined testing duration:

Ramp: Right Rib_____ Left Rib_____ Back _____
(or) Alcove #_____: Right Rib_____ Left Rib_____ Back _____ Face_____

From: Construction Station (CS) _____ to CS _____

Anticipated duration of testing from: date: _____ /_____ /_____ to date: _____ /_____ /_____

Test Equipment or sample location to be Protected:_____
_____
_____
_____
_____
_____
_____
_____

The Constructor is requested to provide effective means, approved by the TCO, to ensure that the completed sample location is physically labeled and identified and that test equipment is protected from damage and tampering. In addition:_____
_____
_____
_____
_____
_____
_____
_____

Concurrence:
PI _____ Date _____

ESF TCO FTR _____ Date _____

CM _____ Date _____

Distribution: TCO Project Engineer, EES-13/LV, MS 527
TCO Field Test Representative, EES-13/FOC, MS 527
TCO Records Coordinator, EES-13/LV, MS 527
Field Test Coordinator, YMSCO, MS 523

Affected Organization Test Representative:

Organization_____ Test Rep._____

Construction Monitoring Location

PI Name: _____ **Date:** _____

PI Organization: _____

CS: _____

Location Description: _____

Place Equipment Bar Code Label or Equipment Identifier here or in box at the right.

_____

_____

_____

Measurement Type: _____

_____

Comments: _____

_____

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

ATTACHMENT 4

INSTRUMENT INSTALLATION CONFIGURATION FORM
2 Pages

Instrument Installation Configuration Form

Test Name	Test Planning Package	Job Package	WBS

Principal Investigator	PI Organization	Prepared By/Organization	Date

Instrumentation Description

_____
_____
_____
(Serial # or Tag Bar Code)

Data Description

Measured Parameter (Units): _____
Data Collection Start Date: ____/____/____
Data Collection Rate: _____
Data Collection Termination Date: ___/___/___

Signal Type: ___Volts ___Amps ___Hz
Data Logger: [ ]
PC System: [ ]
DAS: [ ]
Other System: _____
(Provide system description or ID)

Layout/Location Sketch/Picture

Provide Sufficient Detail for Drawing As-Built Configuration
(use backside if necessary)

Location Survey Description

CS + Offsets: _____
Location Description: _____
Field Note ID/
Organization: _____/_____

Supplemental Data

Photo: [ ] YMSCO [ ]TCO [ ]PI
Other: _____
Video: [ ]

Request for Supplemental Support Photo: [ ] Survey: [ ] Other: [ ]

Comments

_____
_____
_____
_____
_____
_____

Distribution

ESF/TCO PE, EES-13/LV, MS 527
ESF/TCO FTR, EES-13/FOC. MS 735
ESF/TCO Records Coordinator, EES-13/LV, MS 527
PI - _____, _____, _____
Name Organization MS

This form constitutes an administrative record of the installation of an instrument or piece of test equipment (including geophysical logging activities). This form is to be completed by the responsible PI or designee and provided to the TCO FTR as a part of the activity or installation process.

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

ATTACHMENT 5

PLANNED DRILLING QUANTITIES
2 Pages

Attachment 5 -- Planned Drilling Quantities

Activity	Instrumentation	Instrument Location	Borehole Requirements			
			Length (ft)	Diameter (in)	No.	Location
In Situ Design Verification						
- Rock Quality Classification	N/A					
- Blast Monitoring	N/A Inspection		15	2	16	Alcove
	Accelerometer	End of Borehole	10	2	24	Drill from NR parallel to Alcove centerline using D&B drill jumbo
- Induced Stress	Borehole Slotter		50	6	7	Alcove
	USBM Borehole Deformation Gage	End of BH	5	1.5	20	Install behind TBM tailshield
- Seismic Monitoring	Accelerometer	End of BH	75	4	7	Ramp Wall
- Monitor Ground Support						
Rock Bolts	Instrumented Bolts	Occupies length of borehole	15	2	100	Drilled from TBM
	Load Cells	Attached to Exdsting Rock Bolts			100	No drilling required
Steel Sets	Strain Gages					
	Convergence Pins					
	Load Cells					
- Drift Stability						
Drift Convergence	Convergence Pins		1	6	330	Drill from TBM
			0.25	1	330	Drill from TBM
Rock Mass Displacements	MPBX		25	2	23	Horizontal
	MPBX		25	2	22	Vertical
	MPBX		75	4	10	Horizontal
	MPBX		75	4	10	Vertical
- In Situ Stress	Overcoring		75	6	12	Alcove
- Induced Stress						
- Stress Change	BDG		15	2	10	Drilled from TBM
- Air Quality Experiment						
Excavation Investigations						
- Access Convergence						
Rock Mass Modulus	Wire Extensometer	Between back of gripper pads on TBM.				

Total eight (8) inch		330	ft
Total six (6) inch	Core	1250	ft
Total four (4) inch	Core	2025	ft
Total two (2) inch	Air Rotary	3255	ft
Total one and a half (1.5) inch	Air Rotary	100	ft
Total one (1) inch	Air Rotary	82.5	ft

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

ATTACHMENT 6

POINTS OF CONTACT

1 Page

FOC Visitor Control	L. Camp	5-5915
PE/JPC	R. Oliver	4-7095
JPRC	A. Mitchell	4-7156
ESF TCO FTR	R. Kovach	5-6180
ESF TCO Manager	N. Elkins	4-7097
ESF TCO Safety Coordinator	J. Berry	5-3547
Construction Manager	M. Renegar	5-3699
ESF Designer (Title II)	J. Pye	4-5330
ESF Designer (Title III)	A. Watkins	5-4068
REECo Construction Dept. Manager	T. Leonard	5-5983
RSN Survey Engineer	L. Watson	5-5804
SNL Technical Project Officer	L. Shephard	(505)848-0795
SNL Principal Investigator	J. Grant	5-6867
SNL Task Leader	J. Pott	(505) 844-1580
SNL (JFTA) Field Technical Coordinator	C. Brechtel	(303) 242-4220
SNL (JFTA) Field Design and Implementation	A. Richardson S. Carlisle	(303) 242-4220 (303) 242-4220
SNL Field Support	R. Taylor	5-6578
T&MSS/SAIC Photo Coordinator	D. Unglesbee	5-5921
YMSCO-AMSP FTC	W. Girdley	5-7927
Kiewit/PB	C. Johnson	5-5120

CONSTRUCTION MONITORING IN THE RAMPS, MTL DRIFTS, AND ALCOVES

ATTACHMENT 7

CONSTRUCTION MONITORING WORK PLAN SAFETY ANALYSIS
2 Pages

CONSTRUCTION MONITORING
WORK PLAN SAFETY ANALYSIS

The U.S. Department of Energy (DOE) Yucca Mountain Site Characterization Office Assistant Manager for Environment, Safety, and Health (AMESH) has assigned underground construction and mining safety to the constructor (Reynolds Electrical and Engineering Co., Inc.). The Los Alamos Natonal Laboratory Test Coordination Office (TCO) recognizes and endorses this action. The TCO will, as required, coordinate planned scientific activities to comply with the constructors concerns for safety and perform/direct these scientific activities to proceed after full consultation with the constructor as to safety status.

A. References

A.1 DOE Order 5481.1B, Para 4,C
A.2 Preliminary Safety Analysis Report (PSAR) YMP/92-37
A.3 Project Training - General Employee Training, General Employee Radiological Training, General Underground Training, and First Aid (Red Cross)
A.4 O.S.H.A. Hazard Communication 10 CFR 1910, Latest Rev.
A.5 YAP (TBD), "Exploratory Studies Facility (ESF) Access Control"

B. All Field Personnel will be trained as cited in reference A.3, and will remain current by attending appropriate refresher courses.

C. Most work described in the work plan can and will be accomplished using normal underground construction practices for which no safety analysis is required as cited in reference A.1 (exclusion).

D. All field personnel will be equipped with personal safety gear. This includes but is not limited to; hard hat, safety glasses, hard toed shoes, hearing protection, safety belts and lanyards, and a self-rescuer. Training in their use will be per reference A.3 and the safety standards of the appropriate participants.

E. The Principal Investigators (PIs) do not anticipate the use of hazardous materials that are covered by reference A.4.

F. Access to the tunnel boring machine for scientific personnel will be controlled by the TCO as cited in reference A.5.

G. The field activities covered by this Safety Analysis are identified and described in the Construction Monitoring Work Plan WP 92-20D.

G.1 The PI may, as part of testing activities, utilize specialized mechanical equipment to conduct special small scale testing operations such as over-core drilling or borehole slotting. If this occurs, the PI should submit to the TCO safety coordinator a task specific safety analysis and operations plan for the activity five working days before such operations will begin.

G.2 The TCO safety coordinator will distribute copies of the plan to appropriate safety professionals for informal review and concurrence for use.

Yucca Mountain Project
Exploratory Studies Facility

Technical Procedure
NWM-USGS-GP-32, R0

Underground Geologic Mapping

SCP No. 8.3.1.4.2.2.4
WBS 1232212

Prepared by

The Bureau of Reclamation and U.S. Geological Survey

for work funded by the

U.S. Department of Energy

~~9501110182~~ 22 pp.

TABLE OF CONTENTS

USGS TECHNICAL PROCEDURE GP-32, Rev 0

UNDERGROUND GEOLOGIC MAPPING

Prepared by S.C. Beason, J.C. Bowen, D.W. Ryter

1.0 INTRODUCTION. This procedure provides guidance for geologic mapping of underground excavations of the Exploratory Studies Facility (ESF). The procedure outlines the techniques and requirements that govern the collection of site characterization data in the ESF. This procedure applies to YMP-USGS personnel and their contractors who use this procedure to collect data for site characterization.

2.0 RESPONSIBILITIES. The Principal Investigator (PI) is responsible for ensuring compliance with this procedure and shall ensure that users of this procedure have an adequate background in geology, and training for underground mapping. Responsibilities of others are as described in YMP-USGS-QMP-5.01, Preparation of Technical Procedures.

3.0 TECHNICAL REQUIREMENTS. This technical procedure assists in meeting the technical requirements that are established in SCP Study Plan 8.3.1.4.2.2, Characterization of Structural Features in the Site Area, specifically SCP Activity 8.3.1.4.2.2.4, Geologic mapping of the exploratory studies facility.

4.0 IMPACT ON OTHER WORK. There is no anticipated impact on other work. HP-260, Hydrologic Testing, Monitoring, and Sampling Perched-Water Zones in the Exploratory Studies Facility, may interface with this procedure. Specifics of the interface shall be documented if appropriate to the conditions encountered. Job package 92-20C will provide guidelines and interfaces with other procedures for consolidated sampling. Study Plans for those samples shall be identified on the Sample Management Facility sample collection report.

5.0 PREREQUISITES, PRECAUTIONS, AND ENVIRONMENTAL CONDITIONS. Prior to the use of this procedure all personnel are required to undergo General Underground Training. Personnel shall be required to wear the personal safety equipment as identified in Para. 8.1. There are no other special prerequisites, precautions, or environmental conditions associated with the implementation of this procedure.

6.0 SOFTWARE. There is no Scientific or Engineering Software used in conjunction with this procedure.

7.0 SAMPLES. Samples shall be collected in accordance with this or other YMP approved technical procedures or scientific notebooks and identified in accordance with appropriate YAPs. Samples shall generally reside in the custody of the Sample Management Facility. Disposition of samples shall be determined by the investigator for whom the samples are collected and shall be tracked and documented by that investigator.

7.1 SAMPLING PROCEDURES

Sampling should be performed to satisfy specific requirements of the various WBS site characterization tasks described in Job Package 92-20C (Consolidated Sampling in the Starter Tunnel), and to provide adequate representation of the lithology. Geologists should take representative samples of the wall rock wherever the lithology or characteristics of the rock change. Geologists may also take samples of fracture infillings, lithophysal fillings, or any other materials he/she deems necessary. These representative samples will be taken according to the judgement of the geologists on each mapping shift.

Upon arriving at the tunnel section to be mapped, the geologist should determine which samples will be collected. Samples must be uniquely identified in accordance with YAP-SII.4Q, Collection, Submission, and Documentation of Non-Core and Non-Cuttings Samples to the Sample Management Facility for Site Characterization, and controlled in accordance with YMP-USGS-QMP-8.01, R4, Identification and Control of Samples. Consequently, each of the sample sites should be marked with a Sample Management Facility (SMF) sample number. To mark the sample location, the large SMF number from the SMF sample

identification bar code sticker sheet (Attachment 1) should be placed on a sample location marker. The location marker with the number should be glued to the wall at the position where the sample was removed. The locations of the markers should be surveyed. Geologists should provide the survey crew representative a list of samples marked to avoid omission of the sample locations from the survey record. The sample location and sample number should be photographed by the photographic contractor. The contractor will keep the photographs as part of the permanent record, and will handle all QA records and archiving requirements.

Samples should generally be placed into moisture resistant bags (heavy plastic bags) or other suitable containers, with at least one SMF sample identification bar code on the inside of the container. The bag or container should be sealed soon after collection and a sample collection tag affixed to the outside of the container (Attachment 2). A matching SMF bar code sticker should also be affixed to this tag. Only the relevant spaces on the sample collection tag need be filled out. Because the SMF sample collection report duplicates the information for the record, this tag is solely for the convenience of the mapper and is not intended to be part of the required QA record. An SMF bar code must be affixed to either this sample tag or the outside of the container. As soon as possible after collection of the sample, an SMF sample collection report (SCR, Attachment 3) must be filled out according to YAP-SII.4Q. When entering the name of the collector, the mapper should put his/her own name. The name of the scientist for whom the sample is being collected should be entered as "Recipient". Samples collected for general purposes should show the name of the collector and should state "for SOC" in the recipient section. This will allow the Sample Overview Committee (SOC) to determine the disposition of the sample at a later date. "Sample collected in accordance with GP-32, R0" (or the appropriate procedure used, if applicable) should be written in the "Remarks" section of the SCR.

The location of the sample (generally in stationing and position on the wall, i.e. right wall, sta. 1+55, 1.2 m below springline), a brief geologic description of the sample, and the reason for taking the sample should appear in the geologist's field notebook or equivalent. An SMF bar code sticker should be placed in the notebook to identify these entries.

7.2 SAMPLE CUSTODY TRANSFER

All samples should be transferred to the SMF as soon as practicable. As the project progresses, this transfer may take place at the ESF surface portal facility, or the samples may be locked in a designated storage facility for later transfer to the SMF. Until such arrangements are made, the samples should be hand-carried to the SMF as soon after collection as practicable. The samples should be transferred to the SMF as outlined in YAP-SII.4Q. A Transfer of Custody and Receipt Form must be completed for each group of samples given to the USGS (Attachment 4). A copy of each sample collection form should be filed in the Bureau of Reclamation mapping field office for independent record. A copy of the sample collection report should also be given to the Los Alamos National Laboratory (LANL) field test coordinator (TCO). The TCO will oversee the combining of the sample collection data with the surveyed location and photograph number.

Guidelines for sampling for other principal investigators listed in JP 92-20C will be coordinated by Los Alamos National Laboratories Test Coordinator's Office. Specific requirements for sampling for each principal investigator (PI) will be described in detail in these guidelines. The purpose of the consolidated sampling program is to provide a service to the other PI's to minimize sampling costs and allow geologists who are most familiar with the tunnel geology to take the samples. The program is not intended to preclude any PI from taking his/her own samples if they desire. Samples taken for other PIs will be marked and handled in accordance with YAP-SII.4Q.

8.0 MATERIALS/EQUIPMENT

No special handling, storage and/or shipping is required. All materials and equipment shall be as per listed manufacturer or equivalent. The accuracy of off-the-shelf commercial-grade measuring devices (measuring tapes, wheels, Brunton compasses, etc.) are considered acceptable for measurements made within this procedure. Brunton compasses shall be checked periodically to ensure they

are functioning correctly. The following is a suggested list of equipment required for mapping in the ESF. (Except for sampling equipment, the recommended number of items listed is per person.)

8.1 MAPPING EQUIPMENT

Equipment Description	Recommended Number
GENERAL MAPPING EQUIPMENT	
Brunton compass	1
Mapping vest	1
Water resistant field notebooks	3
measuring tape, 25-100m	1
measuring tape, 3-10m	1
measuring wheel, metric	1
Protractor scale for measuring rake	1
Full-periphery field map sheets	2
Black ink pen	2
Dilute HCL acid, small bottle with dropper	1
Geologists rock hammer	1
Indelible black marker	2
Metric pocket scale, 1:125	1
Clipboard or drawing board	1
Hand Lens	1
SAMPLING EQUIPMENT	
Sample location markers	30
Adhesive (GE Silglaze N or equivalent)	1
Caulking gun	1
Sample collection bags (heavy plastic)	15
Sample collection vials	10
Sample identification tags	30
SMF sample identification bar codes	20 sets
Cold chisel	1
GAD-pry bar	1
Wire ties for sealing sample bags	20
Twister for wire ties	1
2-lb sledge hammer	1
DETAILED LINE SURVEYS	
Carpenter's shape copier (shape gage)	1
Wire (12- 18 gauge recommended)	1 roll
Concrete Nails	.5 kg
Metric aperture measuring device (feeler gage, calipers and/or mm rule or tape)	1
PERSONAL SAFETY EQUIPMENT	
Safety Boots	1pr
Safety Glasses, Clear	1pr
Hard hat with Lamp Bracket	1
Hearing Protection	1pr
Gloves	1pr

9.0 METHODS.

9.1 DETAILED LINE SURVEYS (DLS)

Detail line surveys provide complete sampling of all significant features (primarily fractures) encountered within a survey area which is a predetermined distance (30 cm. for the ESF) above and below a stretched tape. The method entails measuring and recording information such as location, orientation, trace length, aperture, infilling, roughness, continuity, and other features deemed important by the site geologists for each fracture greater than a given length (30 cm for the ESF) or other significant feature(s) occurring in this zone. The rigid methodology helps to minimize bias from individual mappers.

Detail line surveys will be performed, if possible, along or near the springline of the right walls (as the tunnel is viewed looking toward the heading) for all tunnel excavations of the Exploratory Studies Facility. These surveys will consist of fixing traverses along the tunnel walls using measuring tapes stretched along the rock surface. The location of each geologic feature or discontinuity which intersects the tape is recorded in a field notebook along with the feature's characteristics. For accurate location of each feature, the ends of the tape will be surveyed by contractor personnel.

9.1.1 LOCATIONS

Detailed line surveys (DLS) will be performed along traverses on the tunnel walls at various locations. Traverses will be identified by location (i.e., RW for right wall) and will match tunnel stationing. Normally, these locations will be the right and/or left springlines. However, conditions may occur which preclude performing surveys at these locations. These conditions include, but are not limited to, tunnel walls being obscured by tunnel support (steel rings, lagging, etc.), unavailability of the mapping gantry, lack of access, and location of testing equipment. The accurate location of each detailed line traverse will be surveyed by the surveying contractor. The ends of the traverse should be clearly marked and labelled with a unique number. Numbering for the traverse should be determined by the mapping team prior to the start of the mapping session. Numbering should include the stationing and an indicator of where on the tunnel periphery the DLS is being done (i.e., right wall springline, crown centerline, etc.)

9.1.1.1 FEATURES TO BE MAPPED

All fractures greater than 30 cm. in length which occur within 30 cm above or below the tape shall be recorded. Fractures less than 30 cm. in length may also be recorded if deemed significant by the geologist. Strike, dip, aperture, infilling and thickness, roughness, continuity, offset, and termination characteristics of each fracture should be recorded in table form in the field notebook. In addition to fractures, foliation or partings, size and aspect ratio (L:H) of lithophysae, rake of slickensides, and any other feature related to the structure or porosity of the rock mass should be recorded. Trend and plunge of tubular fracture decorations should be measured and recorded.

9.1.2 STATIONING

For simplicity, the distances of the tape should be matched to the tunnel stationing. For example, if the survey is being started at station 1+45, the 45 meter mark on the tape should be attached to the wall at that point. Matching the tape to the stationing simplifies interpretation of the survey and coordinates the locations of particular fractures with those of the full-periphery map.

The location of each feature should be recorded in the field notebook as the point where the projection of the feature intersects the traverse tape. The locations of features occurring above or below the tape can be approximated by projecting the feature to the point where it would intersect the tape. Aligning a flat surface such as a notebook with the feature may aid this process. The location on the tape should coincide with tunnel stationing as discussed above.

An identification number incorporating the location should be assigned to each fracture that is surveyed. This number needs to be unique only from other fracture ID numbers within the same detail line survey (other detail lines can utilize the same numbering scheme). A simple scheme is recommended, such as numbering all faults, fractures or joints as "F" followed by the location.

After measuring and recording all data for a fracture, it is recommended that the fracture be marked with bright chalk to aid the mapping process.

9.1.3 MEASUREMENT OF LITHOPHYSAE

The aspect ratios (length:height), dimensions and orientation of lithophysae can be determined and recorded in the field book. Dimensions should be measured in metric units with a tape or ruler. Other general information such as average size and frequency of lithophysae and description of infillings should be noted as comments in the field notebook. Additionally, the strike and dip of fractures cutting lithophysae may be recorded.

9.1.4 RIGHT-HAND RULE FOR MEASURING STRIKE AND DIP

The azimuth and dip of each planar feature shall be determined with Brunton compass using the right-hand rule. Occasionally, because of the presence of tunnel support or proximity of mechanical equipment the compass will give erroneous azimuth readings. In this case, the geologist should try siting along the feature from a distance. Individual Brunton compass declination should be verified to be set at 14 degrees.

According to the right-hand rule, the strike azimuth is determined in the direction such that the direction of dip is always to the right of the strike direction. An easy way to determine this is to remember that when the thumb of the right hand is pointed in the direction of strike, the fingers should point in the direction of dip so that the dip is 90 degrees or less (Attachment 5). For the case of a vertical feature, the strike can be measured in either direction.

9.1.5 MEASURING AND RECORDING TRACE LENGTHS

Trace lengths of fractures should be measured (in metric) in four parts so that the fracture can be accurately reproduced in three dimensions on drawings or for analyses. The four measurements required are: 1) total circumferential trace length above the tape, 2) total circumferential trace length below the tape, 3) maximum observed trace height along dip direction, and 4) maximum observed trace width along strike. A diagram of the required trace length measurements is provided in Attachment 6. Smaller fractures which are readily accessible to the mapper should be measured with a tape or ruler, however the circumferential lengths of the larger fractures can be estimated if wire mesh is used for tunnel support, by multiplying the number of wire reinforcement grids crossed by the fracture by the size of the grid. Traces that intersect the grid at an angle should be adjusted using the appropriate trigonometric function. The trace height along dip and width along strike should be measured with a tape or ruler. Alternatively, long widths can be determined using tunnel stationing and the pythagorean equation or appropriate trigonometric function to calculate length of hypotenuse. Where possible, a rolling wheel measure can be used to measure long circumferential trace lengths.

9.1.6 FRACTURE TERMINATIONS

The number of fracture terminations on each fracture visible to the mapper, and a description of each termination should be noted in the field notebook. The number of visible terminations will range from 0 to 2. Description of the termination should include whether the fracture terminates in rock, or against another fracture or feature such as lithophysae. Terminations should be identified as upper or lower, or by general compass direction (i.e. N termination). The mapper should be as specific as possible on these descriptions and note the identification number of truncating fractures if such fractures

are within the detail line survey area. Terminations which are covered or not visible should be noted as such.

9.1.7 MEASUREMENT AND DESCRIPTION OF INFILLINGS

Infillings should be measured and described in the field notebook. The average thickness in millimeters should be determined using a tape or gage. Maximum and minimum thicknesses or dimensions of infillings should also be noted. The names of infilling minerals should be recorded if known, or the fillings described if not known. Percentages of minerals may be visually estimated using the charts in Attachment 7.

9.1.8 MEASURING APERTURES

Aperture is the open, unfilled distance between the sides of a fracture measured perpendicular to the sides. It should be measured using caliper, feeler gage or rule, and recorded in millimeters in the field notebook. A range of measurements such as 0-5mm or 5-10 mm may be used to describe the aperture. Alternatively, the minimum, maximum and average aperture can be noted for each fracture. Apertures less than 1 mm should be noted as "tight" or "hairline", while those which cannot be seen, such as a single open face, should be noted.

9.1.9 MEASURING ROUGHNESS

Roughness of each fracture should be recorded in the field notebook. Where there are exposed surfaces of a fracture, small-scale roughness can be recorded using a shape copier (shape gage). To accomplish this, the carpenter's shape copier is held normal to the fracture surface and gently pressed onto the surface until the impression of the surface is visible in the copier. The shape of the copier is then traced into the field book, and the fracture number written next to the profile. The profiles will later be compared with a sheet of known roughness curves and values (Barton, 1971). The roughness of the fracture should also be estimated using the R1 through R6 scale (See Table 1) . Where the roughness varies, or does not fit a single roughness curve, a range may be entered, such as R4-R5.

Alpha-Numeric Descriptor	*Descriptor*	*Criteria*
R1	Stepped	Near-normal steps and ridges occur on the fracture surface
R2	Rough	Large, angular asperities can be seen
R3	Moderately rough	Asperities are clearly visible and fracture surface feels abrasive
R4	Slightly rough	Small asperities on the fracture surface are visible and can be felt
R5	Smooth	No asperities, smooth to the touch
R6	Polished	Extremely smooth and shiny

Table 1 - Joint roughness descriptors (from Bureau of Reclamation, 1989)

If a fracture exhibits just a trace line with no exposed fracture faces, the roughness should be approximated by comparison of this trace line with the fractures that have been previously measured for roughness.

9.1.10 ADDITIONAL NOTES

Items or characteristics of fractures that are not adequately covered by the previous sections are to be described as "comments" or additional notes in the field book. Examples of this type of information are amplitude (height from peak to trough) and wavelength (length from peak to peak) of wavy fractures, indications of movement along fractures (i.e. feather joints) and truncations of lithophysae or fractures. Lithologic changes, contacts and other geologic observations should also be noted. Characteristics of contacts between geological units shall be recorded, such as strike and dip, infillings, aperture and roughness. Liberal use of drawings to illustrate feature attributes and relationships is encouraged.

9.2 FULL-PERIPHERY MAPPING

9.2.1 INFORMATION ABOUT THE TECHNIQUE

A significant portion of the on-site data collection in the ESF will be full-periphery mapping of the larger features in the excavation. Generally only geologic discontinuities greater than 1m in length will be noted on the maps. Full-periphery mapping involves sketching the geologic features exposed on the walls onto a base map which represents the full periphery of the excavation (except the invert). The method consists of plotting the points at which various features intersect the crown centerline, each springline, and reference points such as tunnel support elements (Corps of Engineers, 1970; Hatheway, 1982; Proctor, 1971). The geologic features are then sketched between the known points onto a field base sheet for later transfer onto an office base map. If available, a reference grid may be placed next to the tunnel wall to aid in locating features on the map. As much geologic information as possible should be placed on the base map, and overlays of other non-geologic information such as the location of photogrammetry targets and rock bolts may be placed on overlays.

9.2.2 WHAT FEATURES ARE MAPPED

The full-periphery map data should include all pertinent geologic information as well as the locations of rock bolts, targets and any other objects which would aid in location of the geologic features. The locations of rock bolts targets and other subsidiary information should ultimately be placed on separate overlays. This will allow room on the base drawing for maximizing the plotting of geology and geologic notes. However, to simplify the field mapping procedure and reduce the number of field sheets, this subsidiary information should be drawn along with the geologic features onto a single field sheet, then later transferred to an overlay. The locations of the additional data will help the mappers determine and plot the locations of geologic features.

The locations of faults, shears, fractures, breccias, partings, stratigraphic contacts, intensely fractured zones, or other distinctive features should be shown on the full-periphery geology field map. Some features shorter than 1m may be shown if deemed significant by the geologist. Where space allows, the geologist should include as much information as possible regarding the geologic feature on the map. This information may include strike and dip (adhering to the right-hand rule, section 9.1.4), relative offset, thickness, mineral or material infilling, aperture (if open), and rake of slickensides. Where fractures with tubular decorations are exposed, the rake of the tubes should also be noted.

Where space on the field map does not allow the inclusion of all information, data should be recorded in an auxiliary field notebook. The field book may be used to record any observations about the geology of the section being mapped. The geologist should take care to write complete descriptions of the features, so that they may be understood by other scientists at a later date. The geologist may also use the field book to record observations about ground conditions, support requirements, difficulties encountered either with techniques used or interpreting the geology. Because the mappers occasionally may be mapping relatively short reaches of tunnel, these observations, while not providing discriminating interpretations, may record information which yield important pieces of the geologic puzzle.

9.2.3 MEASURING FEATURES

In general, full-periphery features should be measured as described for detailed line surveys in Section 9.1, however with slightly less detail. At a minimum, strike, dip, attitude of slickensides and offsets should be collected for each fracture. If accessible, apertures and infilling thicknesses should be measured with a metric tape or rule, and recorded on the map if possible or in a field notebook. If recorded in a notebook, care should be taken to accurately identify the feature by using the location or identification number, so that description in the field notebook can be matched to the proper feature on the map.

9.2.4 SKETCHING FEATURES ONTO THE MAP

Generally, faults, shears, and other fractures with trace lengths greater than 1m should be recorded on the map. Fractures that are not continuous for more than one or two meters may be represented by a joint symbol only. Standard geologic symbols should be used (Compton, 1962, Bureau of Reclamation, 1989) should be used to represent features on the map. A section of completed full-periphery map of the starter tunnel is provided in Attachment 8 showing some of the symbols and cross-hatch patterns used to represent shear zones, breakouts, intensely fractured zones and other geologic features. Visible fracture terminations should be indicated by a small cap as shown in Attachment 8.

The traces of features should be sketched onto the field map (Attachment 9) by plotting the points at which the various features cross the crown centerline, each springline, or the base of each wall. The intersections of the features are scaled and plotted as dots on the map. When the intersections have been plotted on the base map, the feature is sketched between the points with curves as appropriate. The mapper should make use of the locations of photo targets, rockbolts, and other non-geologic items to aid in accurately locating geologic features onto the map. If available a mapping grid should be used. Strike and dip symbols should be plotted on the map in the location that they were measured on a given feature. Offsets along faults or shears should be indicated on the map by arrows (see Attachment 8) and displacements in centimeters or meters where determinable.

The trend and plunge of linear features such as tubular decorations, and the rake of linear features imposed on a plane such as slickensides, should be plotted as described in Compton (1962).

9.2.5 LOCATION AGREEMENT WITH DETAILED LINE SURVEYS

It is recommended that mappers use detailed line survey feature locations (if available at the time of full-periphery mapping) to help them accurately locate these features on the full-periphery maps. This will ensure that the full-periphery maps are in agreement with the detailed line surveys. If this is not possible, the full-periphery maps should be compared with the detailed line surveys as soon as possible to check for any discrepancies in locations or descriptions. Any discrepancies should be resolved by revisiting the map\survey area if possible, or by review of the data by the responsible mappers.

10.0 CALIBRATION. No calibrations are required on any equipment in this procedure.

11.0 LIMITATIONS/ASSUMPTIONS. None

12.0 VERIFICATION AND HOLD POINTS. None

13.0 ACCEPTANCE CRITERIA. There are no quantitative acceptance criteria for the data associated with this procedure. Data receive a supervisory review using qualitative criteria based on an experienced geologist's professional judgement. For this procedure, data sheets from the detailed line surveys and full-periphery maps shall receive an initial review by the mapper's supervisor (the project geologist, the PI, or the Rock Characteristics Section Chief (or delegate)) prior to submittal for formal data review under QMP-3.04, Technical Review and Approval of YMP-USGS Data and Publications. This initial supervisory review shall determine internal acceptance of the data.

14.0 QUALITY ASSURANCE RECORDS. Quality assurance records produced under this procedure shall be prepared and submitted per YMP-USGS-QMP-17.01, YMP-USGS Records Management for Records Sources, by the PI or delegate.

14.1 Data Records: The final data sets obtained will consist of completed sheets of fracture data in tabular form as produced by the detailed line surveys. Full periphery maps record and provide a graphical representation of the fracture and geologic feature traces. Worksheets and drafts of preliminary maps are not considered part of the final data set. The final data shall be submitted as part of a records package in compliance with YMP-USGS data management procedures.

14.2 Supporting Information: Supporting information consists of pertinent entries from field notebooks that support the final data sheets and full-periphery maps. As appropriate, the supporting information shall be submitted as part of the data records package identified in Para. 14.1.

15.0 MODIFICATIONS. Modifications to this procedure shall be processed in accordance with YMP-USGS-QMP-5.01.

16.0 REFERENCES CITED.

Barton, N.R., 1971, A relationship between joint roughness and joint shear strength, Proceedings of the International Symposium on Rock Fracture, Nancy, France, (ISRM), paper 1-8.

Bureau of Reclamation, 1989, Engineering Geology Field Manual, 598p.

Compton, R.R., 1962, Manual of Field Geology, John Wiley & Sons, New York, New York, 378p.

Corps of Engineers, 1970, Geologic Mapping of Tunnels and Shafts by the Full Periphery Method, Engineering Technical Letter No. 1110-1-37, Department of the Army, United States, 32p.

Hatheway, A.W., 1982, Trench, Shaft, and Tunnel Mapping, Bulletin of the Association of Engineering Geologists, Vol. XIX.

Job Package 92-20C, Consolidated Sampling in the Starter Tunnel.

NWM-USGS-HP-260, Hydrologic Testing, Monitoring, and Sampling Perched-Water Zones in the Exploratory Studies Facility.

Proctor, R.J., 1971, Mapping Geological Conditions in Tunnels, Bulletin of the Association of Engineering Geologists, Vol. VIII, No. 1, 43p.

SCP Study Plan 8.3.1.4.2.2., Characterization of Structural Features in the Site Area.

YAP -SII.4Q, R0, The Collection, Submission, and Documentation of Non-Core and Non-Cuttings Samples to the Sample Management Facility for Site Characterization

YMP-USGS-QMP-3.04, Technical Review and Approval of YMP-USGS Data and Publications

YMP-USGS-QMP-5.01, Preparation of Technical Procedures

YMP-USGS-QMP-8.01, Identification and Control of Samples.

YMP-USGS-QMP-17.01, YMP-USGS Records Management for Records Sources.

17.0 ATTACHMENTS.

Attachment 1 Sheet of SMF Bar Codes
Attachment 2 Sample Collection Tag
Attachment 3 Sample Collection Report
Attachment 4 Transfer of Custody and Receipt Form
Attachment 5 The Right-Hand Rule
Attachment 6 Measurement of Trace Lengths
Attachment 7 Chart for Visually Estimating Percentages
Attachment 8 Full-Periphery Map of the Starter Tunnel
Attachment 9 Base Map

18.0 APPROVALS AND EFFECTIVE DATE.

EFFECTIVE DATE: 8/1/94

Steven C. Beason 6/30/94
PI: Steven C. Beason Date

for 6/30/94
YMP-USGS QA Manager Date

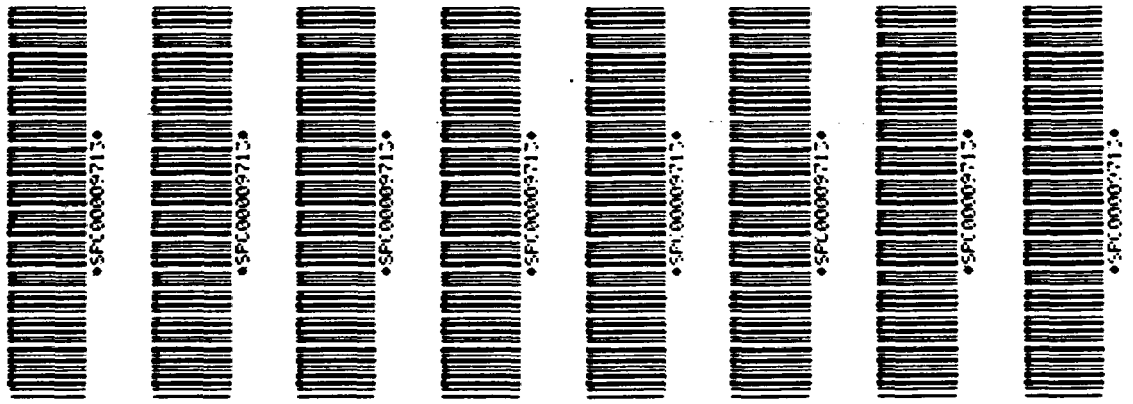
Z. P. Peterman 6/30/94
Tech. Rev.: Z. Peterman Date

FOR 6/30/94
Chief, YMPB Date

for 6/30/94
Chief, GSP: J.S. Stuckless Date

19.0 HISTORY OF CHANGES.

Revision No.	Effective Date	Description of Change/Revision
0	08/01/94	NA
0	08/18/94	Editorial change to Para. 9.1.5 on Page 8.



SPC00009713

YUCCA MOUNTAIN PROJECT

GEOLOGIC MAPPING OF THE ESF

SCP No.8.3.1.4.2.2.4

FEATURE_____

Location_____

STATION_____

OFFSET_____

DESCRIPTION _____

_____

Stratigraphic Unit_____

Date Collected_____

Collected by_____

Sack _____ of _____

SMF Bar Code

Sample Collection Tag

YMP-101-R3
06/06/94

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
SAMPLE COLLECTION REPORT

Page ____ of ____

Date Collected: _____

Collector Name: _____

Organization: _____ Phone: _____

Address: _____

_____

Recipient Name: _____

Organization: _____ Phone: _____

Address: _____ Study Plan No.: _____

_____ Title: _____

Type of Sample: *(circle one)* rock soil alluvium caliche muck liquid gas other _____

Number of Samples Collected:

Site Type: *(circle one)* Trench Outcrop Surface Spring Tunnel Borehole
Other _____

Describe Sample: ☐ Q ☐ Non-Q

Describe Site:

Other Documentation *(Field photos, maps, reports, etc.)*:

Remarks:

For SMF Use Only

Record Verified By: _____ Date: _____
SMF TS

Exhibit YAP-SII.4Q.1

YMP-189-R0
06/06/94

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
TRANSFER OF CUSTODY AND RECEIPT FORM

1. Number of Samples/Containers Transferred: _____ / _____

2. Sample/Container Listing

3. Storage Requirements:

4. Ship To:

Study Plan Number: _____ Title: _____

Released By: _____ _____
(Print Name) (Signature)

Organization: _____ Date: _____

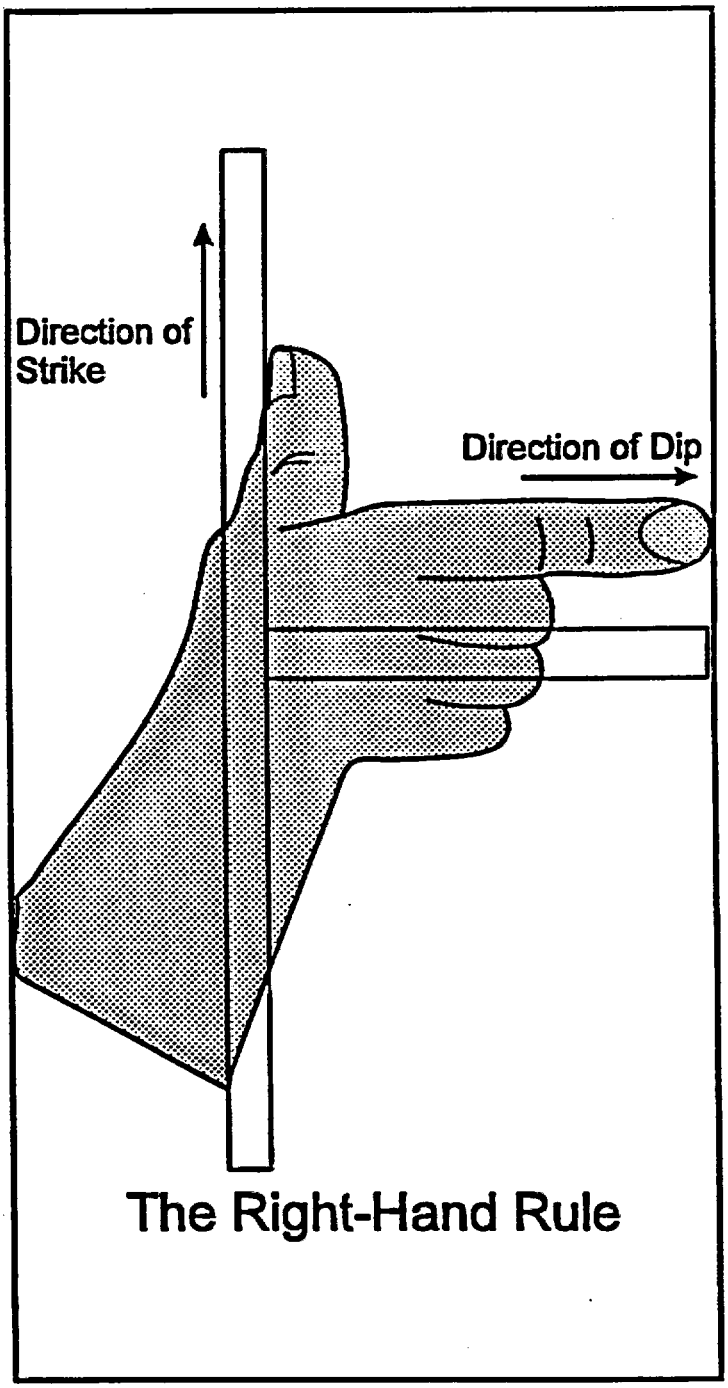
Address: _____ Phone: _____

Accepted By: _____ _____
(Print Name) (Signature)

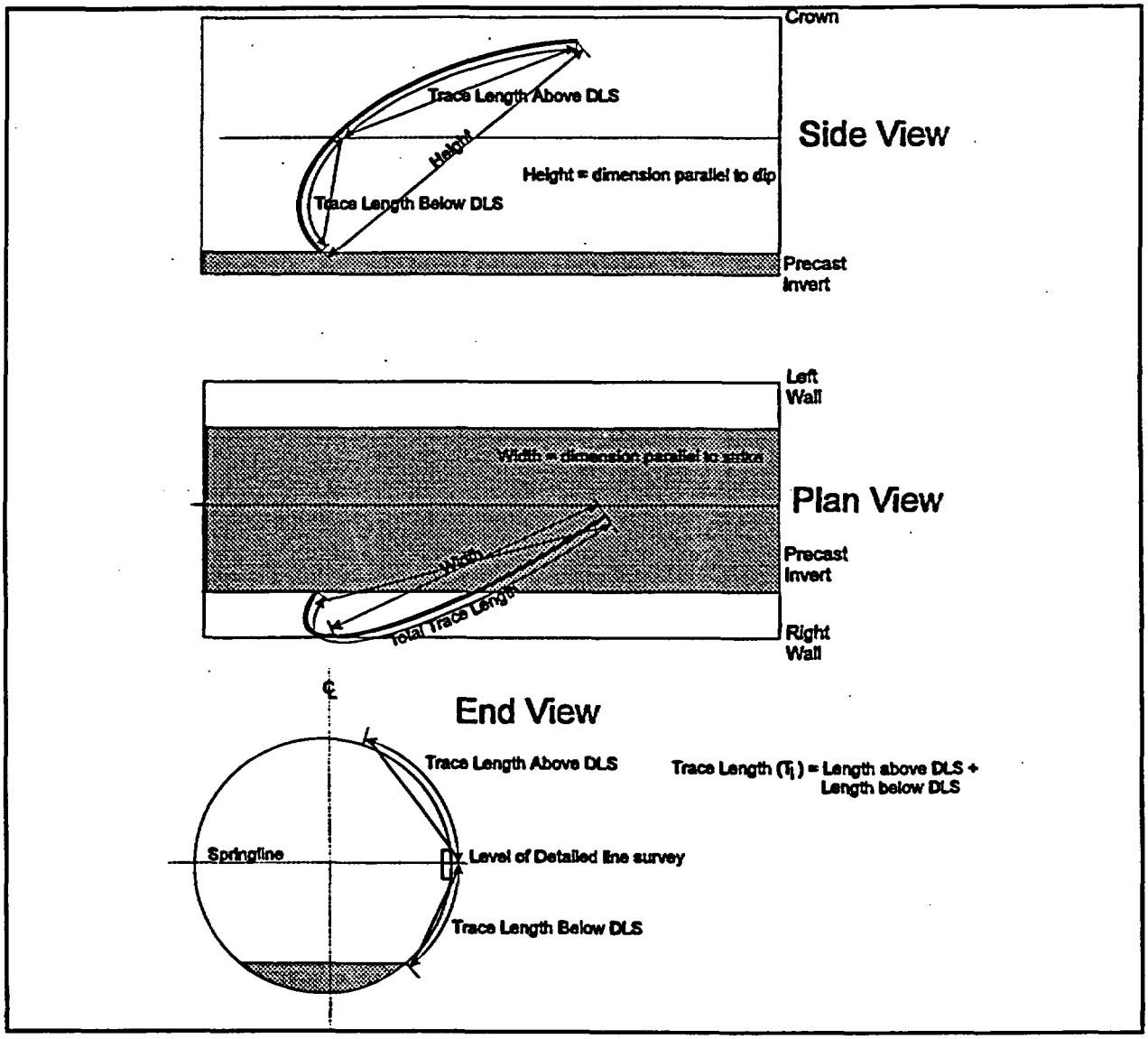
Organization: _____ Date: _____

Address: _____ Phone: _____

Exhibit YAP-SII.4Q.2



The Right-Hand Rule



Measurement of Trace Lengths

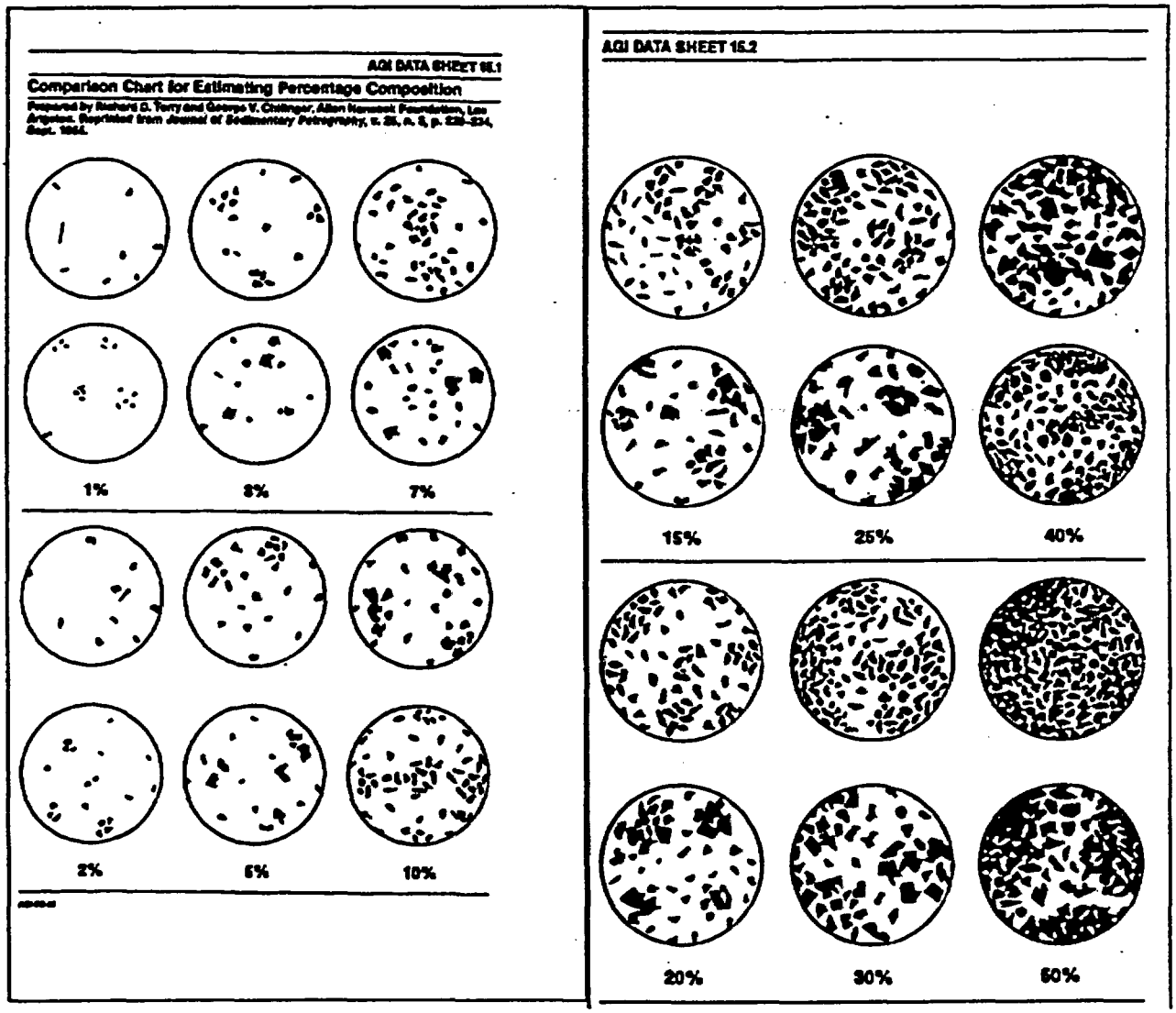
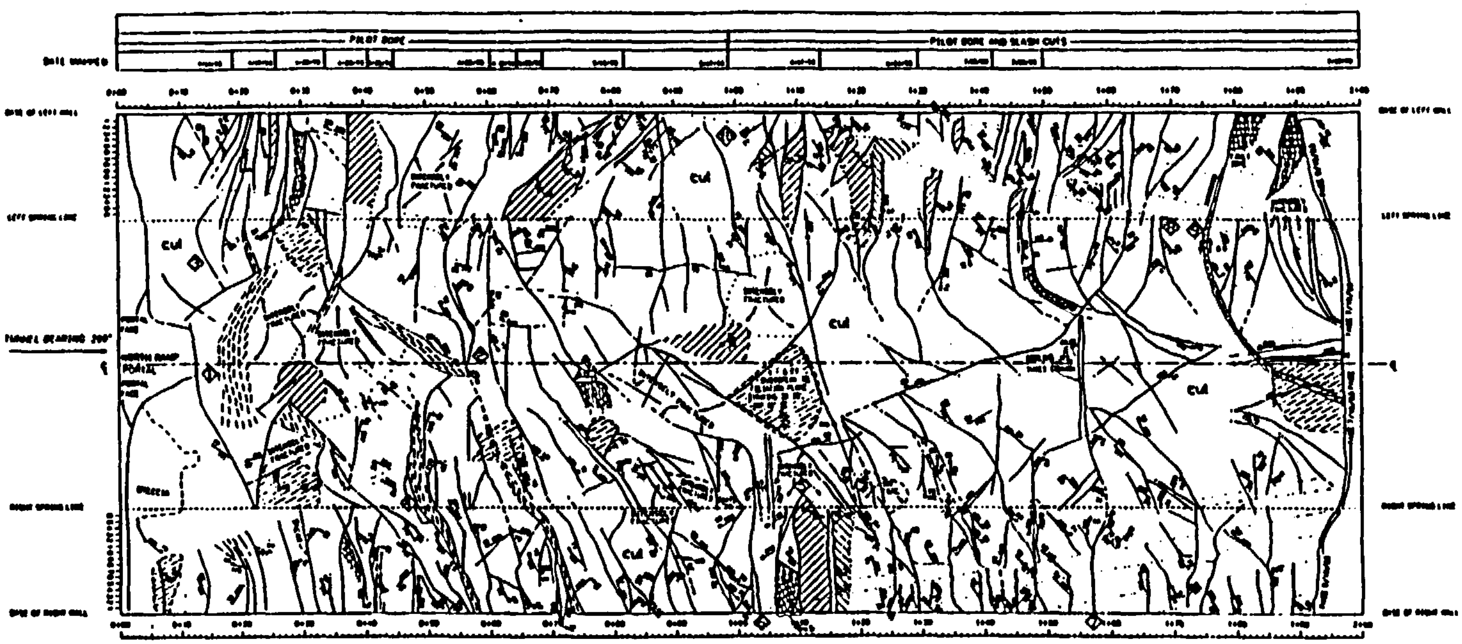


Chart for Visually Estimating Percentages

NOTES

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. Shear zone with crushed rock and breccia
6. [illegible]
7. [illegible]
8. [illegible]
9. [illegible]
10. [illegible]



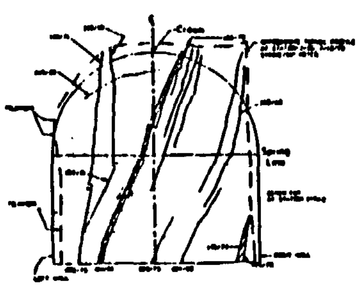
EXPLANATION

[illegible]

DEFINITIONS

[illegible]

SKETCH OF TUNNEL FACE STATION 1+96



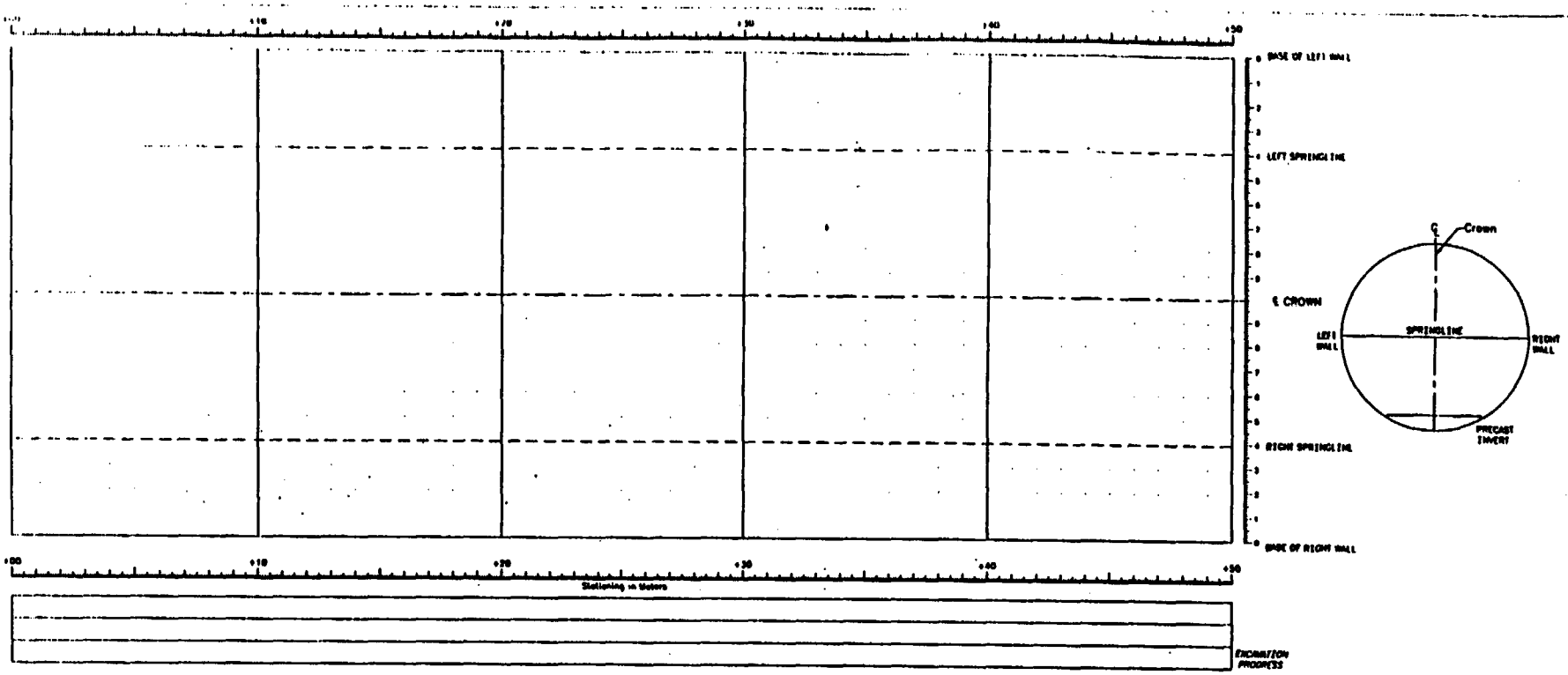
SAFETY

YUCCA MOUNTAIN PROJECT

STARTER TUNNEL - EXPLORATORY STUDIES FACILITY

FULL - PERIPHERY GEOLOGY MAP

0A-46-171



Notes:

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION / U.S. GEOLOGICAL SURVEY
YUCCA MOUNTAIN PROJECT

EXPLORATORY STUDIES FACILITY
AS-BUILT GEOLOGY – NORTH RAMP

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DENVER, COLORADO	JUNE 29, 1994	

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WITHIN THIS PACKAGE...OR,

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