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BECHTEL SAIC COMPANY, LLC

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CONTRACT NO. DE-AC08-01RW12101 - TRANSMITTAL OF METHODOLOGY FOR THREE-DIMENSIONAL DEPICTION OF FRACTURES BETWEEN ALCOVE 8 & NICHE 3

Reference: Unsaturated Zone Appendix 7 Meeting on October 11, 2001

At the referenced meeting, Philip S. Justus of the U. S. Nuclear Regulatory Commission requested additional information relative to the development of a three-dimensional (3D) depiction of Alcove 8 & Niche 3 fractures. The enclosure describes the steps that were used in developing the 3D depiction of fractures between Alcove 8 & Niche 3. The Full Periphery Geologic Maps of Alcove 8 & Niche 3 referenced in the enclosure will be available by February 2002.

We are ready to assist you in any way that will be beneficial to the project. Please contact Mark Wisenburg at (702) 295-5316 or Krishna Iyengar at (702) 295-7570 for any additional information you may require.

for Nancy H. Williams
Manager of Projects

11/16/01
Date Signed

KI:cdg - 1113010426

Enclosure:
Process and Methodology for Developing The 3D Depiction Of Fractures Between Alcove 8 and Niche 3

NMSS07
WM-11

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RPC = 15 Pages

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Process and Methodology For Developing The 3D Depiction Of Fractures Between Alcove 8 And Niche 3

November 2001

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11/09/01
Date

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11-9-01
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Process and methodology for developing the *3D Depiction of Fractures between Alcove 8 & Niche 3.*

The first step in creating this depiction was to develop a 3-D representation of both Alcove 8 and Niche 3. This task was accomplished using as-built survey data taken from the TDMS. The as-built survey data for Alcove 8 can be found under DTN: M00006GSC00241.000 (alcove profile) and M00008GSC00269.000 (borehole collars and bottoms). The as-built survey data for Niche 3 can be found under DTN: M00003GSC00103.000 (niche profile) and M00002GSC00064.000 (borehole collars and bottoms). This data is compiled in Easting, Northing, and Elevation, based on the Nevada State Plane Coordinate System in feet. This data was entered, in real world space, in AutoCAD 14. The profile surveys provided centerline and springline locations, and once these were entered, the remainder of the excavation was created by projecting lines to where the roof and wall meet and the floor and wall meet. These projections were made based on the same dimensions used to create the Full Periphery Geologic Maps (FPGMs) of Alcove 8 & Niche 3 (Figure 1). These maps are TBV subject to technical review and submission to the TDMS. After the excavations were created, a 5-meter in diameter by 10 meter long cylinder was placed on the axis (299^0) of the ECRB and a 7-meter in diameter by 10 meter long cylinder was placed on the axis (183^0) of the ESF Main. This process completed the creation of the two excavations. Based on the survey data, six boreholes were added to Alcove 8 and four were added to Niche 3.

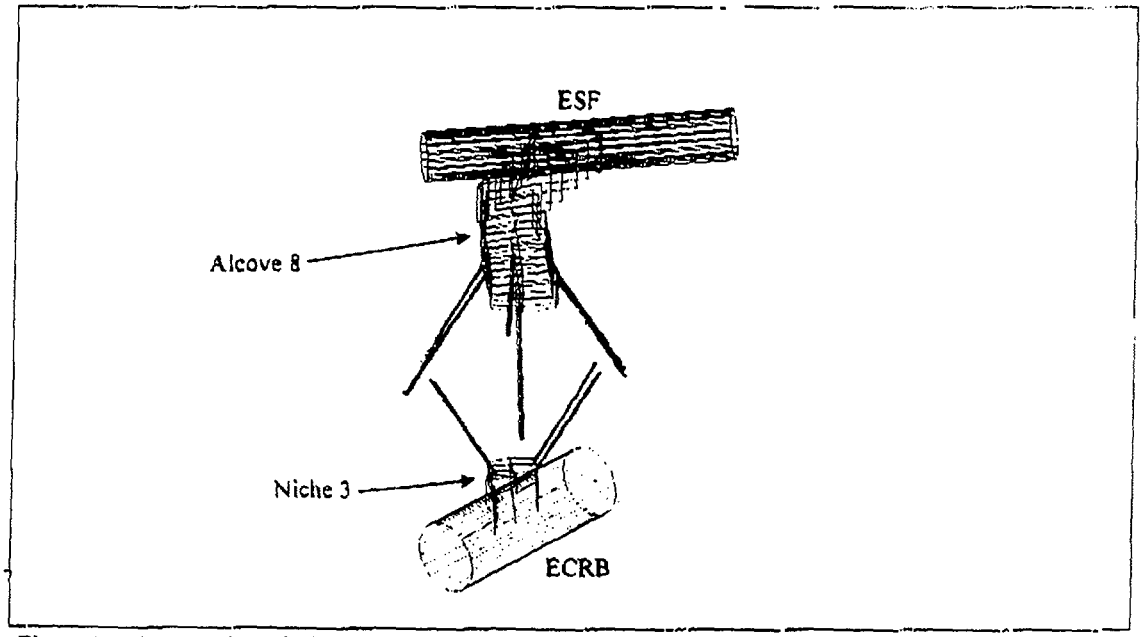

Figure 1. Line drawing of Alcove 8 and Niche 3 with survey data in red, projected lines in cyan, the boreholes in green, and the ESF and ECRB tunnels in magenta.

The second step in creating this depiction was to begin to add the fractures and the Tptpul/Tptpmn contact. Fractures were added based on how they were mapped on the FPGM. The initial assumption in creating this depiction is that the trace length of a given fracture will be used as the length and height to create a 3-D plane in space. For example, if a fracture is mapped with a trace length of 2 meters on strike, then 2 meters is used to project that fracture on dip. This projection is accomplished by simply calculating the adjacent side, of a right triangle, by knowing the dip angle and the trace length from the map. For example in a right triangle $A = C \sin \alpha$, where C is the trace length and α is 90° minus the dip angle. If the trace length is 2 m and the dip is 75° then A is 0.5. In AutoCAD 14 the original trace length is copied up or down 2 m in elevation and moved over 0.5 m at a right angle to strike in the dip direction. This creates two parallel lines each 2 m long oriented along the strike of the fracture. At this point the lines are connected to create a 3D plane along the strike and dip of a given fracture. This process was then repeated for all the fractures that were mapped in the floor of Alcove 8 and the roof of Niche 3. The Tptpul/Tptpmn contact is taken directly from the *Seismic Tomography Technology for the Water Infiltration Experiment TDR-EBS-MD-000017 REV 00* report. The contact was added by simply inputting Easting, Northing and Elevations for each corner of the contact plane (See Figure 2).

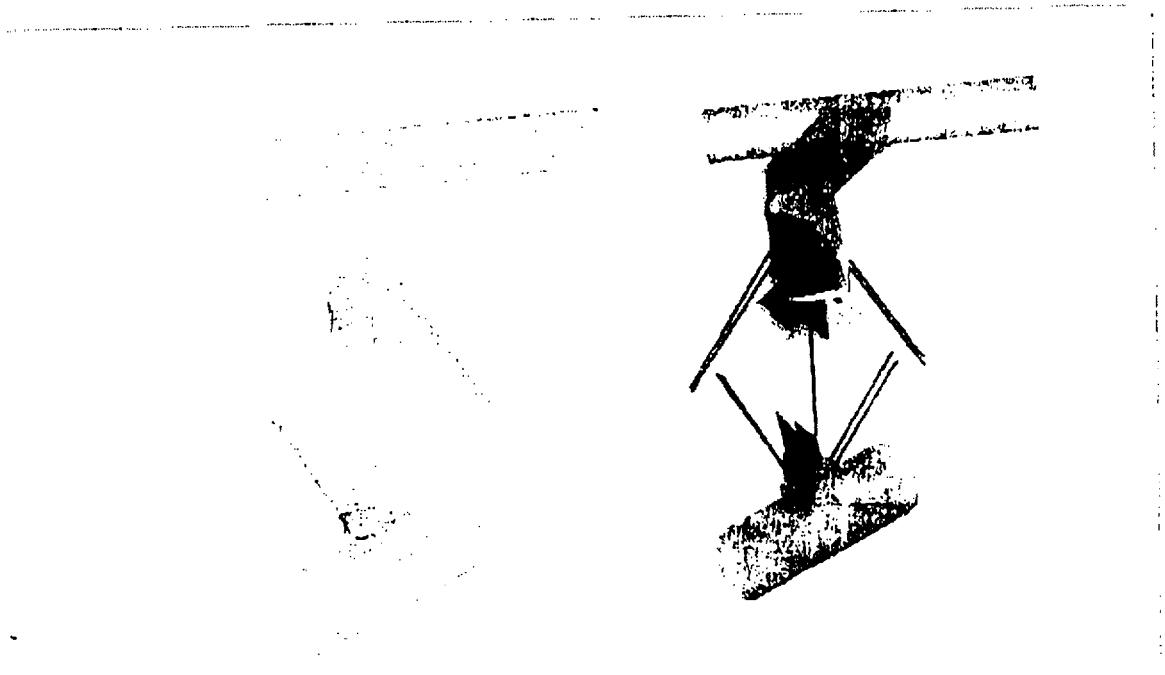

Figure 2. Drawing on left showing excavations and mapped fracture planes and contact. Drawing on right is depiction once drawing has been rendered.

Upon completion of the creation of the surveyed excavations and the mapped fractures the depiction can be populated with predicted fractures. This process involved simply increasing or decreasing the elevation of the fracture plane by its trace length. Copying and moving the fracture by its trace length avoids increasing the fracture density in the depiction. Once the fracture plane is offset in elevation by its trace length, it is distributed, on northing and easting, within the depiction to allow for spatial variability. For example, a fracture with a trace length of 2 m is represented with a plane which is 2 by 2 m along strike and dip. The plane is then repeated up or down to the contact on 2 m centers. At this point the planes are distributed throughout the depiction based on professional expertise without changing the elevation of each plane (see Figure 3).

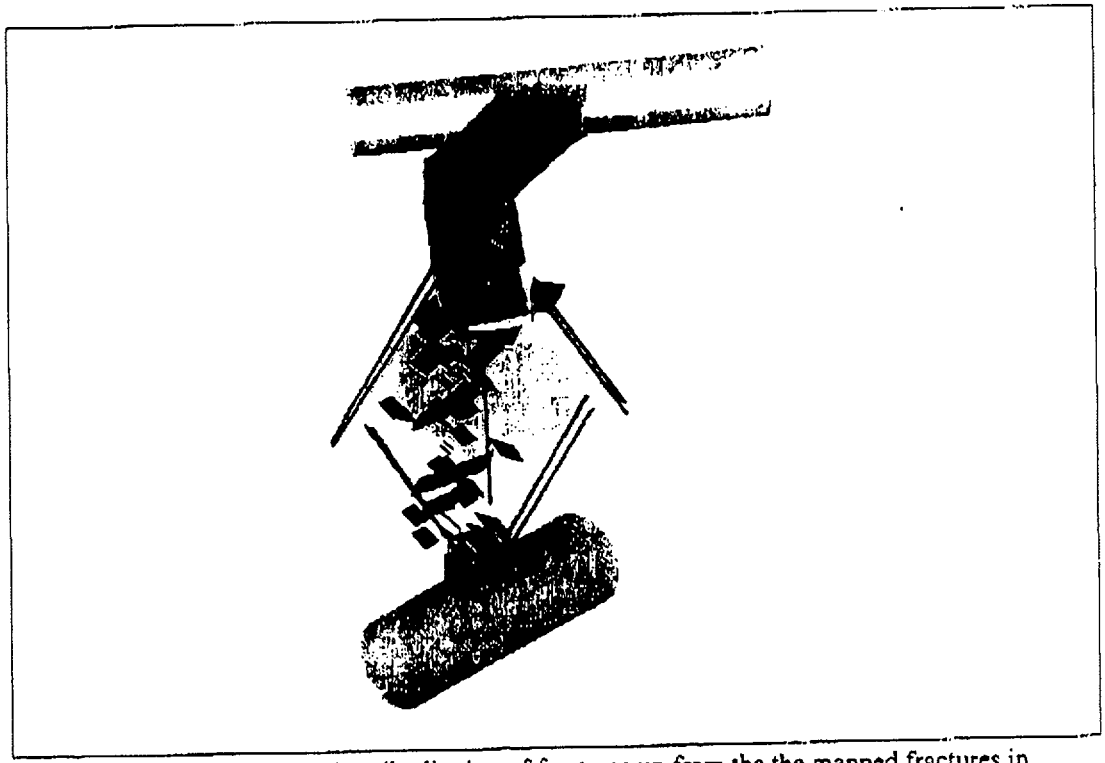

Figure 3. 3D depiction showing distribution of fractures up from the the mapped fractures in Niche 3 and down to the contact in Alcove 8.

The following is a copy of the assumptions and guidelines used to generate the depiction. This also explains the color coding of the fractures. All line drawing work for this depiction was done in AutoCAD 14 while the text was added in CorelDraw 10.

Assumptions and Guidelines used to generate this depiction

1. Trace lengths of mapped fractures were used to project fracture planes into 3 dimensions. Trace lengths of individual fractures were also used as the distance to populate projected fractures in the vertical dimension. Fractures are depicted as square planes, the size of which are based on the mapped trace length.

2. The Tptpul/Tptpmn contact is taken directly from the Seismic Tomography Technology for the Water Infiltration Experiment report. Prepared by the CRWMS M&O, document number TDR-EBS-MD-000017 REV 00. Although the contact is shown as a flat, sharp plane, in actuality the contact is gradational and based on lithophysae percentage.

3. The fault drawn from the heading of Alcove 8 to the turn-in of the crown of Niche 3 is connected based on similar strike and dip, and similar throw.

4. Although this depiction shows a high degree of connectivity between the two excavations it does not imply a high degree of porosity or permeability. Fracture aperture is not a factor considered in this depiction.

5. The characteristics of the fracture network of the Tptpul are similar to that of the Tptpmn near the contact. The contact is based on a decreasing amount of lithophysae not the fracture network. Experience shows that the differences in the fracture network between these subunits occurs above Alcove 8.

6. All projected fracture locations have been based on the mapped fractures characteristics.

7. Fractures are color coded according to orientation. Sets are taken from the Geology of the Main Drift - Station 28+00 to 55+00, Exploratory Studies Facility, Yucca Mountain Project, Yucca Mountain, Nevada. DTN GS970208314224.005. Green fractures (set 1) azimuth range from 069 to 185 degrees and dip ranges from 65 to 90 degrees. Orange fractures (set 2) azimuth range from 191 to 250 degrees and dip ranges from 65 to 90 degrees. Blue fractures are low- angle (dip) and represent a combination of set 3 (325/13) and set 4 (293/49) fractures.