UNITED STATES
NUCLEAR REGULATORY COMMISSION
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MEMORANDUM TO: N. King Stablein, Acting Branch Chief
ENGB/DWM/NMSS

Budhi Sagar
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H. Larry McKague, Element Manager, CNWRA
Danny Skelton, Computer Technician, CNWRA

SUBJECT: TRIP REPORT: (I) APPENDIX 7 MEETING IN LAS VEGAS, NEVADA, JULY 16-17, 1997, ON THE U.S. DEPARTMENT OF ENERGY'S 3D-INTEGRATED SITE GEOLOGIC FRAMEWORK MODEL-2.0; (II) SITE VISIT TO YUCCA MOUNTAIN, NEVADA, JULY 18, 1997; (III) APPENDIX 7 FOLLOW-UP MEETING IN SAN ANTONIO, TEXAS, SEPTEMBER 23, 1997

I. APPENDIX 7 MEETING ON ISM 2.0 IN LAS VEGAS

ATTENDEES

See list of attendees at Appendix 7 meeting (July 16) in Attachment 1. On July 17, staff and CNWRA attendees included: L. Hamdan, C. Glenn, W. Belke, L. McKague, and D. Skelton (P. Justus, not present.)

PURPOSE

Participate in Appendix 7 NRC/DOE interaction for DOE briefing in Las Vegas on its 3D-Integrated Site Geologic Framework Model and CNWRA briefing on the NRC's 3D-Site Geologic Framework Model.

OBJECTIVES

(1) Establish a path forward to reach agreement on the use of data, interpretations, and applications of the 3D-Geologic Framework Model and obtain NRC feedback on the sufficiency of models and approaches for their intended use and purpose;

2) Understand bases and uses of the Integrated Site Geologic Model (ISM) 2.0 sufficient to evaluate adequacy as integrated database and basis for other models;

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(3) Provide informal feedback to DOE on selected parts of ISM 2.0.

SUMMARY

List of discussion topics was distributed at the Appendix 7 meeting, by mutual agreement of DOE/NRC (Attachment 2).

Attributes of ISM 2.0: areal coverage is a 166 km2 rectangle that includes the conceptual controlled area boundary; stratigraphic units - 37; faults - about 44; rock properties include bulk porosity, Ksat, thermal conductivity, matrix porosity, matrix Ksat; minerals mapped separately: zeolites, quartz, crystobalite, smectite; other information: potentiometric surface, perched water occurrences, geochemical sample locations, Exploratory Studies Facility (ESF) tunnel, repository outline.

DOE's M. Tynan indicated that ISM 2.0 will continue to be accessed via the DGI's EarthVision system which runs best on Silicon Graphics, Inc. hardware. DOE committed to the use of DGI's software in 1992; in 1994, it enlarged the model area and depth to encompass the Conceptual Controlled Area Boundary and the top of the Paleozoic. He stated that the U.S. Geological Survey (USGS) 3D-Geologic Framework model of Yucca Mountain (YM) will continue to be built on the Lynx system; that LBL and M&O Design group uses Lynx; that USGS will not be required to transfer its model to EarthVision. Lynx can feed files to EarthVision, but communication cannot go the other way (as of FY97). DOE is working with DGI and Lynx manufacturers to effect two-way compatibility. Tynan stated that LANL uses Stratamodel to display its stratigraphic framework. DOE plans to develop another version of the model (ISM 3.0) to support its license application; and it will upgrade its modeling capabilities by updating to EarthVision version 4.0. DOE was reminded that NRC is continuing to develop its EarthVision capability but has not considered obtaining Lynx or Stratamodel in the near future.

M. Tynan confirmed that the ISM 2.0 model is a "Q" item. A retrospective analysis of qualified and unqualified data input to the model indicated that a number of key inputs, such as certain stratigraphic contact depths originating from logs published prior to the approved QA logging program in 1992, would have to undergo a qualification process. This is underway. At the time of the Appendix 7 meeting, 70-90 percent of the data in the model was non-Q, DOE's goal was to have 70 percent Q by the time of license application. The staff acknowledged that DOE has approved procedures for qualifying pre-QA program data and will follow this process to assure it meets the intent of the NRC comments on qualification of existing data expressed in the August 19, 1996, letter from J. Austin, NRC to S. Brocoum, DOE.

ISM 2.0 will be used to support DOE's Viability Assessment. Principal users are the unsaturated and saturated zone modelers. DOE noted that the Paintbrush Canyon fault

is the only fault in the model that is not cut by another fault. Some consequences of development of ISM 2.0 were mentioned that staff may review in FY98. Some faults were "invented" to satisfy space requirements of the model. For example, at least one fault was modeled under alluvium in Fortymile Wash; and faults not mapped, but which may explain geophysical anomalies, were modeled in Midway Valley. The major structures of the model are fixed in place to honor surface mapping data and are projected downward. One or more viable tectonic models, for example, C. Fridrich's half-graben conceptual model is not portrayed in ISM 2.0 (this is not unexpected and is not a criticism of ISM 2.0). The consequences of the assumption that if a fault cuts another fault at the surface, it also cuts the fault at depth, needs to be evaluated. The assumption appears to be based on the general concept that YM faults are anastomosing laterally and vertically. DOE suggested that north-south normal faults appear to be characterized by oblique slip to the southwest. Also, DOE suggested that because faults at depth in the ESF generally mirror faults found on the surface, there should be no significant blind faults found at depth.

A problem that DOE identified is the location of the Paleozoic rock surface. This is due to uncertainties in interpretation of geophysical data; and the dearth of borehole data on the depth to the Paleozoic rocks. The ISM 2.0 shows one interpretation, apparently unsaturated zone flow modelers are showing another. ISM 2.0 does not show all faults of the same general extent and offset. For example, the Ghost Dance Fault is shown, but others like it in size are not shown. Such inconsistencies, whether or not there are others, can lead to misperceptions about the extent and nature of faulting. Staff must be cognizant of these inconsistencies in order to provide credible comments.

M. Tynan gave a heads-up on future publications: a color version of the W. Day et al. Central Block Geologic Map; a geologic map covering the area between Skull Mountain and Bare Mountain; a potentiometric head contour map; the saturated zone hydrological model, which will cover a more extensive area than ISM 2.0; and the repository design model, which will be produced by the M&O using the Lynx system.

DOE identified several issues related to the geographic coordinate system used in its model. These issues addressed inconsistencies within the DOE technical groups on the use of Nevada State Plane Coordinate System (NSPCS, also called State Plane Units; feet), and two North American Datums: NAD-1927 and NAD-1983 (this system is also known as WGS84). ISM 2.0 uses the NSPCS. DOE indicated to the On-Site Representatives on July 21, 1997, that it was continuing the discussion on use of different coordinate systems among the parties involved. The effects of DOE's use of NSPCS are negligible on NRC's program because the State Plane Units are easily converted into the Universal Transverse Mercator System (UTM) used by the NRC's 3D- model. However, it is more difficult to convert from UTM to NSPCS. If DOE wanted to convert the NRC's model from UTM to NSPCS, it could do so using either ARC/Info or PROJ.4 (USGS public domain software).

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The NRC staff pointed out that the potentiometric head data in some of the boreholes at and near YM are indicative of a low hydraulic conductivity zone at about 1000 m depth, which may be impacting flow in the saturated zone. The staff inquired if the model identified any stratigraphic or structural features in support of the potentiometric head data. DOE and contractor staff indicated that there is a significant increase in the isochores for low-permeability stratigraphic units in the saturated zone beneath YM and referred to specific illustrations in their ISM 2.0 report (U.S. DOE, 1997) that they believed support the presence of a low hydraulic conductivity zone. DOE contractors further indicated that there are isotopic groundwater quality data, and possibly gravity data, that could also lend support to a low hydraulic conductivity zone at YM. The staff indicated that it will examine the available data to determine the cause of the potentiometric head anomaly at YM.

On July 17, NRC participants had a sit-down session with R. Clayton to discuss and clarify the model construction and applications. Discussions included rationale for blind faults, hidden stratigraphic units, representation of the water table and hydraulic gradients.

DOE requested that NRC provide the location of NRC geophysical surveys and data available from those surveys. DOE made the request with the idea of incorporating, if possible, new site information into its model. Staff responded that it would comply [data packages are being compiled by Center subcontractors; magnetics and gravity will be made available in the second quarter of FY98]. Staff inquired about the documentation of the basis of decisions to project faults to depth, to depict fault intersections at depth, and to depict stratigraphic relationships between datapoints (i.e., boreholes). Such information is recorded in Scientific Notebooks, which may be reviewed by staff.

II. SITE VISIT TO YUCCA MOUNTAIN

ATTENDEES

Staff/CNWRA attendees were same as July 16 (W. Belke, P. Justus not present).

PURPOSE

Participate in visit to YM site for familiarization with developments in ESF and surface-based testing.

OBJECTIVE

Observe selected lithologic units and fracture sets in ESF, south ramp geology, thermal alcove testing, Ghost Dance fault in alcoves, Fran Ridge thermal test, and geology from Yucca Crest.

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SUMMARY

Participants observed the ESF including stratabound fractures from stations 28+00 to 52+00 (distinguishable terminations at the middle non-lithophysal unit boundary), sites of CL-36 anomalies (indistinguishable from adjacent similarly fractured sites), Ghost Dance, Sundance, and Drill Hole Wash faults (not prominent features).

III. APPENDIX 7 MEETING ON ISM 2.0 IN SAN ANTONIO

ATTENDEES

On September 23 principle attendees included: L. McKague and D. Skelton (CNWRA), R. Clayton (M&O).

PURPOSE

DOE to provide technical assistance and clarification on the construction of the ISM 2.0 model to CNWRA staff in San Antonio.

OBJECTIVES

(1) Demonstrate and discuss the DOE procedure used to calculate the original model and methods used to manipulate the ISM 2.0 model with current EarthVision software;

(2) Discuss alternative ways of building the model, including use of data files, rock unit horizons, and isochores.

SUMMARY

Discussions held at CNWRA office in San Antonio by R. Clayton were helpful in that they clarified several problems the CNWRA staff were having in constructing and interpreting the model. The Appendix 7 meeting enabled CNWRA staff to prepare for review of ISM 2.0.

IV. INTEGRATED COMMENTS ON THE MEETINGS AND SITE VISIT

AGREEMENTS

DOE/NRC procedures do not enable agreements to be reached at an Appendix 7 meeting.

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PROBLEMS

CNWRA and Headquarters (HQ) had problems in getting ISM 2.0 up and running and fully operational. These were overcome at the CNWRA by the follow-up Appendix 7 visit of M&O's technical representative (R. Clayton) to CNWRA on September 23, 1997. HQ is in process of procuring sufficient hardware to get the code operational and is expected to be operational in early FY98.

CONCLUSION

The objectives of the Appendix 7 meetings and site visit were met.

OBSERVATIONS OF ISM 2.0:

1) DOE had provided NRC with a report that describes the model (U.S. DOE, 1997) and an electronic copy of the model on 8 mm tape. This enabled CNWRA staff to conduct a preliminary review of ISM 2.0 and brief NRC and DOE on its observations. ISM 2.0 is a significant improvement of ISM 1.0, submitted about a year earlier. Comments made on ISM 1.0 were mooted by ISM 2.0. A number of minor errors in ISM 2.0 were noted, such as wrong sense of movement on several faults, and faults with both normal and reverse displacement vertically along the fault plane;

2) DOE's ISM 2.0 modeling process has enabled DOE's geologists and hydrologists to reasonably project rock and hydrologic units and faults into unexcavated or undrilled crustal spaces (i.e., predicts aspects of the hydrology and geology);

3) DOE has, by using virtually all available geologic and hydrologic data, produced a comprehensive, sophisticated 3D-geologic site model that is a powerful and useful tool for testing and evaluating existing and future aspects of hydrology and geology; provides a common basis for building process-level flow models; and enhances the ability of all interested parties to comprehend the gross structure of the natural system at the site scale (i.e., focusses attention on prominent existing hydrologic and geologic features, such as certain Type I faults and the apparent hydrologic gradient anomaly).

RECOMMENDATIONS

1. TO DOE, concerning different geographic coordinate systems used by DOE: When more than one coordinate system is used within the DOE program, staff reviewers will need to know the location/datum system used in any particular

model. DOE should identify the coordinate system used in each of its models, as appropriate.

2. TO NRC, concerning maintenance of staff capability to review DOE's 3D-model: (A) Selected NRC HQ staff and CNWRA staff should continue to develop the capability (obtain necessary hardware, software, training, and access to the model) to fully understand the input and output files and utilize ISM 2.0, to maintain the evolving DOE data files and to independently evaluate the results of DOE's modeling activities; (B) it would be useful to periodically demonstrate to HQ and CNWRA staff, at their respective locations, the capabilities and limitations of ISM 2.0. Implementation of these recommendations is a function of funding and work priority.

3. TO NRC, concerning feedback to DOE: As requested by DOE, provide feedback to DOE on the use of data, interpretations, and applications of the ISM 2.0 and on the sufficiency of models and approaches for their intended use and purpose. Such feedback will require application of resources at HQ and CNWRA and time to evaluate ISM 2.0. Given limited CNWRA resources and HQ need to upgrade its advanced computer system to get ISM 2.0 up and running, this recommendation could not be implemented in FY97. This recommendation has been proposed for tasking in FY98. As a minimum, consider providing written preliminary feedback based on the observations made at the Appendix 7 meeting and summarized above.

4. TO NRC, concerning continued independent development of its 3D-Geologic Framework Model: Consider adopting DOE's ISM 2.0 and adapting it for its own uses. This may be prudent given that ISM 2.0: (a) is on a platform compatible with what is in use at CNWRA, or soon to be available to HQ staff; (b) has a substantially greater investment in more useful details (e.g., strata, faults, mineralogy, hydraulic parameters) than NRC's current equivalent model; (c) staff resources remain limited for 'catch-up paced' development of its 3D-model; and (d) DOE intends to continue to update the model, at least to version 3.0.

REFERENCES

U.S. Department of Energy, "ISM 2.0: A 3D-Geologic Framework and Integrated Site Model of Yucca Mountain Rev 00 February, 1997" WBS: 1.2.3.9.5 QA:L

U.S. Department of Energy, "Study Plan 8.3.1.4.2.3, Rev 0, 3-D Geologic Framework and Integrated Site Model", S.J. Brocoum to M.J. Bell dated September 27, 1996.

Stirewalt, G.L., S.R. Young, and D.B. Henderson, "A Preliminary Three-Dimensional

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Geological Framework Model for Yucca Mountain, Nevada: Report to Accompany Model Transfer to the Nuclear Regulatory Commission", CNWRA 94-023, September 1994.

Attachments: As stated

DOE/NRC Appendix i July 16, 1997

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Attachment 1

DRAFT DISCUSSION TOPICS
APPENDIX 7 INTERACTION: DOE'S 3D INTEGRATED SITE GEOLOGIC MODEL-
DATA, INTERPRETATIONS, USES AND NRC FEEDBACK

PURPOSE OF MEETING
* DOE briefs NRC/CNWRA on its 3D Integrated Site Model (ISM)
* NRC briefs DOE on its 3D Site Geologic Framework Model

OBJECTIVES
* Establish a path forward to reach agreement on the use of data, interpretations, and applications of the 3-D Geologic Framework Model and obtain NRC feedback on the sufficiency of models and approaches for their intended use and purpose
* Understand bases and uses of ISM 2.0 sufficient to evaluate adequacy as integrated database, basis for other models
* Provide informal feedback to DOE on selected parts of ISM 2.0

WEDNESDAY, 16 JULY 97

8:00 - 8:15	Purpose and objectives of this meeting (M. Tynan, P. Justus)
8:15 - 8:50	Overview and purpose/uses of ISM (M. Tynan)
8:50 - 9:50	Overview of NRC/CNWRA Site Geologic Framework Model (L. McKague, D. Skelton)
9:50 - 10:10	Break
10:10 - 10:45	ISM 1, ISM 2.0, plans for ISM 3 (R. Clayton)
10:45 - 12:00	ISM 2.0 (R. Clayton, Wm. Zelinski, C. Rautman)
12:00 - 1:00	Lunch
1:00 - 2:45	ISM 2.0, continued
2:45 - 3:00	Break
3:00 - 3:30	NRC informal feedback on ISM 2.0 (All NRC/CNWRA)
3:30 - 4:00	DOE/NRC summary and selection of breakout-session topics (Scope: stratigraphic units, faults-Paintbrush Canyon dominant, potentiometric surface, matrix porosity, bulk lithophysal porosity, saturated hydraulic conductivity, density, thermal conductivity, zeolite/silica distributions, perched water, ties between faults and offset of Paleozoic surface; ref: ISM 2.0, Rev 00, February 1997, WBS 1.2.3.9.5 QA:L)
4:00	Adjourn

THURSDAY, 17 JULY 97

8:00 - 8:15	Objectives & organization of poster/breakout sessions (M. Tynan, P. Justus)
8:15 - 8:45	Poster sessions and discussions (DOE, NRC/CNWRA)
8:45 - 10:00	Breakout sessions and discussions (DOE)
10:00 - 10:20	Break
10:20 - 12:00	Breakout sessions and discussions (DOE)
12:00 - 1:00	Lunch
1:00 - tbd	Breakout sessions and discussions (DOE)
tbd	Additional feedback, if warranted (All NRC/CNWRA)
by 4:00	Adjourn (7/7/97)

Attachment 2