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June 13, 2003
Contract No. NRC–02–02–012
Account No. 06002.01.061

U.S. Nuclear Regulatory Commission
ATTN: Mrs. Deborah A. DeMarco
Office of Nuclear Material Safety and Safeguards
Mail Stop 8 A23
Washington, DC 20555-0001

Subject: Submittal of Abstracts: (1) A physical analog model of extensional deformation in the Yucca Mountain region, Nevada; and (2) Methodology for analysis of fracture reactivation in response to thermally induced stresses at Yucca Mountain

Dear Mrs. DeMarco:

The purpose of this letter is to transmit to NRC the subject abstracts for programmatic review. The papers will be presented at the Geological Society of America Annual Meeting and Exposition to be held November 5–8, 2003, in Seattle, Washington. Included with each abstract is a copy of NRC Form 390A.

These abstracts document technical work that supports current issue resolution with the U.S. Department of Energy. In addition, this technical work has lead to a better understanding of the tectonic setting of Yucca Mountain and provide fundamental components in the evaluation of the performance of the proposed repository at Yucca Mountain, Nevada.

Should you have any questions regarding this please contact Dr. John Stamatakos at (210) 522-5247 or Dr. H. Lawrence McKague at (210) 522-5183.

Sincerely,

[signature] for B. Sagar

Budhi Sagar
Technical Director

rae
Attachment

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J. Schlueter	A. Campbell	P. Justus	N. Franklin	CNWRA Dirs./EMs (letter only)
E. Whitt	K. Stablein	J. Trapp	J. Stamatakos	Record Copy B (SwRI IQS)
M. Young (OGC)			D. Sims	A. Morris (UTSA)

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A physical analog model of extensional deformation in the Yucca Mountain region, Nevada

SIMS, Darrell W., Center for Nuclear Waste Regulatory Analyses (CNWRA), SwRI®, 6220 Culebra Rd., San Antonio, TX 78238, MORRIS, Alan P., Department of Earth and Environmental Science, University of Texas at San Antonio, 6900 N Loop 1604 W, San Antonio, TX 78249, FERRILL, David A., STAMATAKOS, John A., WAITING, Deborah, J., Center for Nuclear Waste Regulatory Analyses (CNWRA), SwRI®, 6220 Culebra Rd., San Antonio, TX 78238

The structural geology of the Crater Flat (CF) basin, including Yucca Mountain, consists of west-dipping extensional faults that trend between 000° and 030°, with subsidiary strike-slip and reverse faults. Faulting developed in response to E-W or NW-SE extension coeval with deposition of Miocene tuffs. We consider CF as the deformed hanging wall of the east-dipping and listric-shaped Bare Mountain Fault (BMF). To simulate extensional deformation of CF, we developed a 1:100,000 scale model of the CF basin. The analog model consisted of a layered sandpack above a rigid wood and clay footwall. The BMF décollement was simulated by a plastic sheet that separated the sandpack from the footwall. Balanced cross sections drawn across northern and southern CF were used to define the shape of the BMF. In the northern section, the thickness of the hanging wall above the modeled BMF was 6 cm [2.4 in]. In the southern section, the hanging wall thickened to 12 cm [4.7 in]. An E-W lateral ramp connects the deeper southern and shallower northern hanging walls. This lateral ramp is interpreted to lie beneath a zone of NW trending strike-slip and oblique slip faults within Yucca Mountain and coincident with major displacement transfer from the Solitario Canyon fault in the east to the Fatigue Wash and Northern Windy Wash faults in the west. The analog model was deformed by E-W extension. Results show that the deformed model closely reproduces the pattern of faults observed within CF. At the southern end of the model, deformation of the hanging wall is characterized by large NS trending antithetic normal faults. At the northern end of the model, these faults transfer displacement to a set of smaller antithetic normal faults that lie much closer to the BMF. Above the lateral ramp an array of NW trending oblique to strike slip faults formed. Sequential sections cut through the model after completion resemble the balanced cross sections drawn through CF. These observations support tectonic interpretations in which faults in CF were produced by E-W or NW-SE extension of the CF hanging wall above an irregular-shaped BMF.

[The views expressed in this abstract are those of the authors and do not necessarily reflect the views or regulatory position of the U.S. Nuclear Regulatory Commission.]

Methodology for analysis of fracture reactivation in response to thermally induced stresses at Yucca Mountain

FRANKLIN, Nathan M., FERRILL, David A., OFOEGBU, Goodluck, I., Center for Nuclear Waste Regulatory Analyses (CNWRA), SwRI®, 6220 Culebra Rd., San Antonio, TX, 78238, MORRIS, Alan P., Department of Earth and Environmental Science, University of Texas at San Antonio, San Antonio, TX 78249, USA

Fractures at Yucca Mountain in southwestern Nevada are important to the performance of the proposed high level nuclear waste repository because they would affect drift degradation and impact saturated and unsaturated flow. In particular, fracture propagation influences drift degradation by connecting fractures to form rock blocks surrounding the emplacement drifts. These rock blocks could fall on the drip shields and waste packages, potentially damaging the engineered barrier system and eventually filling the drift with rock debris. Over the lifetime of the repository, fractures will be subjected to complex and evolving local stress fields caused by a combination of (i) regional tectonic stress, (ii) lithostatic load, (iii) excavation-related stresses , (iv) perturbations from nearby fault slip, and (v) thermally induced stresses. Significant thermal loading is expected to result from the radioactive decay of the emplaced nuclear waste. Knowledge of the fracture network and thermal and stress conditions under which fractures propagate to produce rock blocks is therefore important to performance assessment of the proposed repository.

Here, we discuss a new approach for evaluating the effect of thermally-induced stresses on fractures at Yucca Mountain. This methodology evaluates detailed three-dimensional, synthetic fracture models using numerical models of the evolving three-dimensional stress fields. The synthetic fracture models are constructed using detailed fracture data from the site. Modeled stresses include the effects of heating of the repository and advance of this thermal pulse through the rock volume surrounding the drifts. The calculation and display of resolved stresses (normal and shear) as well as slip tendency on fractures are then used to evaluate the stability of the drift walls. This methodology identifies fracture orientations and fracture locations that are likely to reactivate (slip), thereby forming rock blocks. The methodology of combining detailed stress information and detailed fracture information can also be used to investigate flow behavior in the fractured rocks by calculating dilation tendency.

[The views expressed in this abstract are those of the authors and do not necessarily reflect the views or regulatory position of the U.S. Nuclear Regulatory Commission.]

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Darrell W. Sims, Alan P. Morris, David A. Ferrill, John A. Stamatakos, and Deborah J. Waiting

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