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Mr. Harold R. Roberts
International Uranium (USA) Corporation
1050 Seventeenth Street, Suite 950
Denver, CO 80265

Subject: White Mesa Uranium Facility
Cell 4 Seismic Study
Blanding, Utah

Dear Mr. Roberts:

This document has been prepared to examine the seismicity of the White Mesa site and to recommend a design peak ground acceleration (PGA) to be incorporated in the Cell 4A design. This letter addresses concerns brought forth in comments by Utah Department of Environmental Quality (UDEQ) as documented in Interrogatory IUC R313-24-4-05/05: Dike Integrity.

Comments in Interrogatory IUC R313-24-4-05/05

Comments from UDEQ state that the seismic loading used (0.10 g) for stability analysis of the Cell 4A slopes is based on an outdated seismic analysis presented in the 1988 Cell 4 Design Report (UMETCO), and that updated seismic hazard analysis should be performed. As stated in the Interrogatory 05, it is not thought that there is any new information on active faults that would impact the hazard at White Mesa. However, UDEQ requested ground motion attenuation relationships be updated to reflect current evaluation methods.

Original Design Basis for Cell 4

This original design report for Cell 4 (UMETCO, 1988), characterized the geologic conditions at the site. Section 1.3.4 identified potential earthquake hazards to the project. The specified hazards include minor random earthquakes not associated with a known seismic structure, and an unnamed fault located 57 km north of the project site (north of Monticello), with a fault length well defined for 3 km, and possibly as long as 11 km. The fault is considered a suspected Quaternary fault, but does not have strong evidence for Quaternary movement. Estimates of the maximum credible earthquake (MCE) associated with this fault were estimated to have a magnitude of 6.4 based on relationships developed by Slemmons in 1977. Ground motions at the project site were estimated using attenuation curves established in 1982 by Seed and Idriss. Peak horizontal accelerations at the site from the fault were estimated to be 0.07 g.

Updated attenuation relationships

A search of the Quaternary Fault and Fold Database (USGS 2006) lists Shay graben faults as a Class B (suspected) Quaternary fault. No other faults within 50 km of the site are included in the database. Shay graben faults were included in the Lawrence Livermore National Laboratory (LLNL) report. Other faults considered as possible seismic sources include the unnamed fault north of Monticello that was the design basis of the design accelerations in the 1988 report.

Many attenuation relationships have been developed within the last ten years and are currently being used to estimate ground motions. Three relationships are used in this report to estimate the peak ground motion at the White Mesa site. Abrahamson and Silva (1997) is a well accepted relationship used for shallow crustal earthquakes in Western North America. In addition, Spudich et al. (1999) is used because it has been specifically developed for extensional tectonic regimes, such as those encountered in the area of the site. Campbell and Bozorgnia (2003), is also examined as a current, applicable model, which accounts for normal faulting. In all cases, mean values plus one standard deviation are reported. A comparison of the three methods can be found in Table 1.

Design Peak Ground Acceleration for Cell 4

The above discussion is based on the PGA associated with MCE predicted for a known tectonic feature, and as such, cannot be correlated to a specific return period. 10 CFR 100 Appendix A and 10 CFR 40 Appendix A of Nuclear Regulatory Commission (NRC) regulations are interpreted to apply to long-term, reclaimed impoundments. A distinction should be made between seismic conditions that apply to operational conditions versus long-term conditions. Disposal areas are required to demonstrate closure performance that provides control of radiological hazards to be effective for one thousand years, to the extent reasonably achievable, and, in any case, for at least 200 years. However, this standard should not apply to the operational time-period of the disposal cell. In 2002, the USGS updated the National Seismic Hazard Maps (NSHM), which show peak ground and spectral accelerations at 2 percent and 10 percent probability of exceedance in 50 years. From these maps, the PGA for the White Mesa site is shown to be 0.090 g with a 2 percent probability of exceedance in 50 years. The probability of exceedance can be represented by the following equation:

$$PE = 1 - e^{-(n/T)}$$

Where PE = probability of exceedance, n = time period, in years, and T = return period, in years.

It can be shown that the return period associated with a PGA of 0.090 g is equivalent to 2,475 years, and if the life of the project is conservatively taken to be 100 years, the probability of exceedance of 0.090 g is approximately 4 percent. Therefore, the PGA taken from the USGS maps is an appropriate design acceleration to use for operational conditions of the disposal cell.

Conclusions

The seismic loading of 0.1 g used in analysis of the Cell 4A dikes exceeds the PGA associated with a 2 percent probability of exceedance within 50 years, and is appropriate for the operational life of the disposal cell. At the time when design of closure is implemented, design PGA based on the MCE associated with known or suspected Quaternary features and the background seismicity of the area should be incorporated into the design long-term seismic loading.

References

Abrahamson, N.A., and W.J. Silva (1997). Empirical Response Spectral Attenuation Relations for Shallow crustal Earthquakes, Seismologcal Research Letters, Vol. 68, No. 1, pp. 94-127, January/February.

Campbell, K.W., and Y. Bozorgnia (2003). Updated Near-Source Ground-Motion (Attenuation) Relations for the Horizontal and Vertical Components of Peak Ground Acceleration and Acceleration Response Spectra, Bulletin of the Seismological Society of America, Vol. 93, No. 1, pp. 314-331, February.

Spudich, P., W.B. Joyner, A.G. Lindh, D.M. Boore, B.M. Margaris, and J.B. Fletcher (1999). SEA99: A Revised Ground Motion Prediction Relation for Use in Extensional Tectonic Regimes, Bulletin of the Seismological Society of America, Vol. 89, No. 5, pp. 1156-1170, October.

UMETCO, 1988. Cell 4 Design, Appendix A, White Mesa Project.

U.S. Geological Survey (USGS) 2002. Quaternary Fault and Fold Database: http://Qfaults.cr.usgs.gov/.

If we can be of further assistance, please do not hesitate to contact the undersigned.

Sincerely,

TETRA TECH COMPANY
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cc: Tetra Tech EM
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Attachment(s)

Table 1: Peak Ground Accelerations – White Mesa

Name	Fault Length (km)	Fault Type[1]	Site Class[2]	Distance from site (km)	MCE (Wells and Coppersmith, 1994)	PGA Mean plus 1 SD (Spudich et al., 1999)	PGA Mean plus 1 SD (Abrahamson and Silva, 1997)	PGA Mean plus 1 SD, Campbell-Bozorgnia 2003	PGA Mean plus 1 SD average
unnamed fault north of Monticello, defined length	3.0	N	R	57.4	5.49	0.034	0.027	0.037	0.032
unnamed fault north of Monticello, possible total length	11.0	N	R	57.4	6.23	0.050	0.059	0.055	0.055
unnamed fault north of Monticello, 1/2 total rupture	5.5	N	R	57.4	5.84	0.041	0.039	0.044	0.041
Shay graben faults (Class B)	40.0	N	R	44.6	6.97	0.096	0.116	0.113	0.108

[1]Fault Type: N = Normal

[2]Site Class: R =Rock or shallow soils