Enclosure

Regulatory Guide Periodic Review

Regulatory Guide Number: **1.198**

Title: **Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites**

Office/Division/Branch: **RES/DE/SGSEB**
Technical Lead: **Thomas Weaver**

Recommended Staff Action: **Reviewed with issues identified for future consideration**

1. What are the known technical or regulatory issues with the current version of the RG?

Since issuance of RG 1.198 in 2003 recent liquefaction research by Bray and Sancio (2006) and Boulanger and Idriss (2006) calls into question screening techniques for evaluating liquefaction potential of fine grained soils presented in the RG's Discussion Section. These techniques are:

> *"Cohesive soils with fines content greater than 30 percent and fines that either (i) are classified as clays based on the Unified Soil Classification (UCS) system or (ii) have a Plasticity Index (PI) greater than 30 percent should generally not be considered susceptible to liquefaction.*
>
> *"Other designations involving the "C" description, if the clay content is greater than 15 percent by weight and the liquid limit is greater than 35 percent and occurs at natural water contents lower than 90 percent can be considered nonliquefiable."*

In addition, updated procedures for evaluating liquefaction potential have been proposed (Cetin et al. 2004, Moss et al. 2006, Boulanger and Idriss 2012). There are considerable differences in the newly proposed empirical methods, in part due to differing interpretations of the liquefaction case history database. The differences in interpretation need to be assessed. A National Research Council (NRC) study has been initiated to address the differences in the empirical models. This work needs to be completed prior to updating RG 1.198.

The first draft of the NRC report is scheduled for September 2014 with a final report September 2015. While waiting for the National Research Council to address the case history database, the information in the RG continues to be the most up to date guidance available with the exception of the two sentences from the Discussion Section mentioned above.

References:

Bray, J. D. and Sancio, R. B. (2006) "Assessment of the liquefaction susceptibility of fine-grained soils," Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 132, No. 9, pp. 1165-1177.

Boulanger, R. W. and Idriss, I. M. (2006) “Liquefaction susceptibility criteria for silts and clays,” Journal of Geotechnical and Geoenviromental Engineering, ASCE, Vol. 132 No. 11, pp. 1413-1426.

Cetin, K. O., Seed, R. B., Der Kiureghian A., Tokimatsu K., Harder L. F., Kayen, R. E., and Moss, R. E. S. (2004). “Standard penetration test-based probabilistis and deterministic assessment of seismic soil liquefaction,” Journal of Geotechnical and Geoenvironmental Engineering ASCE, Vol. 130, No. 12, pp. 1314-1340.

Moss, R. E. S., Seed, R. B., Kayen, R. E., Stewart, J. P., Der Kiureghian A., and Cetin K. O. (2006). “CPT-based probabilistic and deterministic assessment of in situ seismic soil liquefaction potential,” Journal of Geotechnical and Geoenvironmental Engineering ASCE, Vol. 132, No. 8, pp. 1032-1051.

Boulanger, R. W., and Idriss, I. M. (2012). “Probabilistic standard penetration test-based liquefaction-triggering procedure,” Journal of Geotechnical and Geoenvironmental Engineering ASCE, Vol. 138, No. 10, pp. 1185-1195.

2. What is the impact on internal and external stakeholders of <u>not</u> updating the RG for the known issues, in terms of numbers of licensing and inspection activities?

There are no large power reactor license applications anticipated in the near future (next 3 to 5 years). Thus, there is no immediate need for revising the guide at this time to address their licensing. For small modular reactors one application is anticipated in the next two years.

3. What is an estimate of the level of effort needed to address identified issues in terms of full-time equivalent (FTE) and contractor resources?

Revision of the RG will take 0.5 FTE of NRC staff time to participate in National Research Council meetings, and to perform in-house research on application of risk based methods for liquefaction assessment.

4. Based on the answers to the questions above, what is the recommended staff action for this guide (Reviewed with no issues identified, Reviewed with issues identified for future consideration, Revise, or Withdraw)?

Recommend action is to consider RG 1.198 reviewed with issues identified for future consideration, pending release of National Research Council final report in September 2015**.**

5. If a RG should be revised, provide a conceptual plan and timeframe to accomplish this.

Not applicable.

NOTE: This review was conducted in September 2014 and reflects the staff’s plans as of that date. These plans are tentative and subject to change.