Regulatory Guide Number:	1.198, Revision 0
Title:	Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Site
Office/division/branch: Technical Lead:	RES/DE/SGSEB Thomas Weaver
Staff Action Decided:	Revise

#### 1. What are the known technical or regulatory issues with the current version of the Regulatory Guide (RG)?

Since publication of RG 1.198 in 2003, new performance-based models developed using expanded case history data sets have been published (such as Cetin et al., 2004, Moss et al., 2006, Boulanger and Idriss, 2012, and Boulanger and Idriss, 2016, Cetin et al., 2018, and Saye et al., 2021). Due to some differences between older and newer models, the National Academies of Sciences, Engineering, and Medicine (NASEM) formed a committee to evaluate the state of the art and practice in assessing liquefaction. The NASEM report titled, "State of the Art and Practice in the Assessment of Earthquake-Induced Soil Liquefaction and Its Consequences," was published in 2016 (revised in 2021) and included the following recommendations:

- Establish a curated, publicly accessible database of relevant liquefaction triggering and consequence case history data;
- Explicitly incorporate uncertainties from field investigations, laboratory testing, numerical modeling, and local site conditions on earthquake ground motions in developing new liquefaction triggering and consequence models; and
- Implement performance-based approaches to evaluating liquefaction.

In response to the NASEM 2016 report, the US NRC in a collaborative effort with the US Bureau of Reclamation supported liquefaction research to develop a publicly accessible case history database and the development of performance-based liquefaction triggering models. Use of these new models along with other newer triggering models will improve capturing epistemic uncertainty in liquefaction triggering models and should result in less bias in liquefaction hazard evaluations.

In addition to providing the recommendations listed above, the revised NASEM 2021 report summarizes newer approaches to evaluating liquefaction susceptibility that differ from guidance in RG 1.198. The NASEM report notes that susceptibility criteria for fine-grained soils should be used cautiously.

Because of the insights from the significant amount of research performed over the 21 years since RG 1.198 was published in 2003 not updating this RG could result in the application of outdated methods for evaluating liquefaction susceptibility and triggering.

For example, use of existing screening criteria provided in RG 1.198 could result in precluding some fine-grained soils from a liquefaction triggering evaluation where application of newer susceptibility criteria would indicate there is potential for liquefaction triggering.

Therefore RG 1.198, Rev. 0, published in 2003 should be updated to:

- Incorporate new screening techniques for evaluating soil liquefaction potential (susceptibility); and
- provide guidance on the use of performance-based methods for evaluating liquefaction triggering.

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

Staff expects 5 to 15 applications for new and advanced reactors in the next several years that should make use of updated guidance.

## 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?

It is anticipated that NRC staff will need approximately 0.5 FTE to synthesize the available research on assessing liquefaction susceptibility and triggering and incorporating that information into a revision of RG 1.198. Contractor support is expected to provide external peer review of the staff developed revisions to RG 1.198.

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

Revise.

### 5. Provide a conceptual plan and timeframe to address the issues identified during the review.

The NRC Office of Research has supported research to support developing the technical basis for updating RG 1.198. Research Information Letters 2024-13, "Next Generation Liquefaction Models for Susceptibility, Triggering, and Manifestation," (Ulmer et al. 2024) and 2024-14, "Addendum: SPT-Based Probabilistic Liquefaction Models," (Ulmer et al. 2024) document development of performance-based models for evaluating liquefaction susceptibility, triggering, and manifestation.

NRC staff will incorporate findings from these reports along with other pertinent literature into updated guidance for performing liquefaction hazard evaluations using performance-based approaches. The staff plans to develop a draft guide by the first quarter of CY 2026.

#### REFERENCES

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- NOTE: This review was conducted in 1/2025 and reflects the staff's plans as of that date. These plans are tentative and subject to change.