

**Report on the Implementation of
Periodic Natural Phenomena Hazards Assessment Reviews
at Department of Energy Sites**



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**Office of Nuclear Safety
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1.0 INTRODUCTION

This report provides the results of a review conducted by the Office of Nuclear Safety (AU-30) of the implementation of periodic Natural Phenomena Hazards (NPH) assessment reviews by sites reporting to the National Nuclear Security Administration (NNSA), and the Offices of Environmental Management, Nuclear Energy, and Science.

The purpose of this review effort was to determine and evaluate the current field practices, their effectiveness, and identify any challenges in executing the Department of Energy (DOE) requirement for periodic reviews of NPH assessments. From this information, recommendations have been developed that will be useful to DOE, including NNSA, Program and Site Offices in conducting future periodic reviews of NPH assessments in a consistent, graded and acceptable manner.

2.0 BACKGROUND

Periodic reviews of NPH assessments, at a frequency not to exceed ten years, are required by DOE Order (O) 420.1C, *Facility Safety* (and by previous versions of the Order). Until the issuance of DOE Standard (STD) 1020-2012, *Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities*, there had been minimal guidance for conducting periodic reviews of the NPH assessments.

Appendix A provides extracts of the DOE O 420.1C and DOE-STD-1020-2012 requirements and guidance for NPH assessment reviews.

3.0 REVIEW APPROACH

The review was carried out in three phases. In the first phase, the Site Offices completed an NPH assessment review questionnaire to provide information on their current NPH review practices and results. The following DOE laboratories/sites completed the questionnaire: Brookhaven National Laboratory (BNL), Hanford, Idaho National Laboratory (INL), Lawrence Berkeley National Laboratory (LBNL), Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), Nevada National Security Site (NNSS), Pantex, Sandia National Laboratories (SNL) New Mexico, Savannah River Site (SRS), SLAC National Accelerator Laboratory (SLAC), and the Y-12 National Security Complex. Attachment B lists the questions in the questionnaire.

Following an evaluation of the responses to the NPH assessment review questionnaire, the second phase of the review was initiated, which involved in-person visits to selected sites to meet with Federal and contractor staff. These sites were: Hanford, INL, LANL, and LBNL. In addition, staff at SRS provided information through a telephone interview with the review team. The focus of the meetings was to gather information primarily along the topics of discussion listed in Appendix C.

The third phase of the review consisted of analyzing the information gathered from the questionnaires and the onsite/telephone meetings, determining which best practices/lessons learned would be most beneficial to the complex, and completing this report to document recommendations for future NPH assessment reviews.

4.0 REVIEW RESULTS¹

4.1 Summary of Ten-Year Review Status, Practices and Results

The following are highlights of Site Offices implementation of the ten-year NPH requirement; methods and practices that the Site Offices are using to perform the NPH assessments; and results of the assessments:

- Most sites reported that they had either just completed the ten-year review process or were currently undergoing the review process;
- Some sites reported conducting the ten-year review of NPH assessments for the entire site, while other sites reported focusing the review specifically on nuclear facilities or buildings;
- Sites reported that Expert/Subject Matter Expert (SME) peer review was the most common approach to performing the ten-year review of site NPH assessments;
- Procedures for conducting the ten-year review of NPH assessments varied vastly among sites;
- Most sites used a single comprehensive document to summarize their NPH analyses, with a few sites reporting specific NPH hazards separately, notably the seismic hazard;
- Most sites reported that their last ten-year review of NPH assessments indicated the need to either update existing assessments, or to conduct new assessments based on increasing hazard information. The most common NPH assessments requiring action were seismic hazard assessments. The next most frequent NPH assessments requiring update were wind and flood hazards, followed by volcanic ashfall, rain, snow, and tornados;
- Most sites updated their Probabilistic Seismic Hazard Analysis (PSHA) as part of their ten-year review of NPH assessments; and
- When hazard levels were found to have increased as a result of the assessment, actions taken by sites included evaluation of the changes followed by physical facility modifications and adding additional administrative and engineering controls, and lastly revision or updates were made to facility safety documents to reflect the changes.

4.2 Site Issues and Concerns

The following are highlights of issues and concerns identified by Site Offices:

- There is a lack of clarity in the applicability of the periodic NPH assessment review assessment requirement in regards to which sites, facilities, and hazards would be subject to such a review.
- Better guidance is needed on the following activities:
 - conducting non-seismic NPH assessments;
 - conducting ten-year review NPH assessments on non-nuclear sites;

¹ AU-30 is maintaining documentation of the responses to the questionnaire and information from the site visits.

- how to address the differences between Orders 420.1B and 420.1C in regards to the NPH assessment review requirement;
 - what the appropriate scope is for the NPH assessment review and appropriate level of rigor to apply when performing the periodic NPH assessment reviews;
 - understanding what constitutes a “significant” change in data, criteria, or assessment methods that warranted updating a hazard analysis; and,
 - determining how to use site-specific or regional data for extreme wind and precipitation probabilistic hazard analyses.
- There are no clear expectations on how to perform the ten-year reviews and there is a need for good examples of documented ten-year reviews to assist in doing them.
 - Multiple sites identified that continuous NPH data collection programs are quite valuable, because they result in making significant amount of data available if a new hazard analysis is needed. However, they also noted the challenge of maintaining funding from Site Offices for ongoing data collection programs.
 - Some Site Office staff stated that sensitivity analyses were a helpful component of the ten-year review, aiding in the determination of what might lead to a significant change in the hazard level. Sites would like to see better communication of NPH information among the Site Offices, perhaps through an interactive forum or database.
 - Adequately characterizing some hazards in a manner compliant with DOE-STD-1020-2012 can be very difficult and expensive.
 - Up-front planning is needed to ensure analytical models have appropriate software quality assurance, including verification and validation documentation.
 - Assessing the structural condition of older, inherited buildings that lack design documents can be very challenging.
 - The seismic detection requirement in DOE O 420.1C needs more specificity regarding the expectations for type and number of monitoring stations.
 - There is limited funding and in-house expertise (both Site Office and contractor staff personnel) with conducting the ten-year review process. In general, the ten-year review process requires a level of specialized expertise that does not exist at most sites. The assessments often need to be contracted out, which may impact site resources.

4.3 Lessons Learned/Good Practices for Sites

The following lessons learned/good practices were identified by Site Office personnel during this review:

- Maintaining a single document containing summaries of all NPH analyses, design load documentation, periodic review dates performed/scheduled, and results of any past reviews is valuable, especially for sites with multiple nuclear facilities. This document can be incorporated by reference in multiple Documented Safety Analyses (DSA), thereby simplifying DSA maintenance at large sites. Similarly, a plan to outline future or ongoing NPH data collection programs is helpful.

- When reviewing existing NPH analyses, or embarking on new analyses, early peer review of results and early discussions with stakeholders can avoid future re-work and schedule setbacks. Similarly, a single meeting among technical experts, DOE decision makers, and other stakeholders to review the status of an existing hazard analysis can lead to quick consensus on whether the existing analysis remains viable or must be replaced.

5.0 RECOMMENDATIONS

Recommendations for the Office of Nuclear Safety

The following recommendations are suggested to AU-30 to better support periodic reviews of NPH assessments complex-wide: :

- Develop guidance for the use of an appropriate Senior Seismic Hazard Analysis Committee (SSHAC) level for the PSHA updates to ensure that an adequate level of rigor is utilized in performing the analysis and in a cost-effective manner.
- Provide guidance to the Site Offices in determining what changes in NPH assessments (data, models, analytical methodologies, etc.) would be significant enough to warrant updates.
- Develop sample procedures for conducting periodic NPH reviews.
- Facilitate the exchange of information among Site Offices through various means, such as forming a technical working group, developing an interactive forum, providing access to completed periodic reviews, etc.
- Provide sites with needed guidance on the seismic monitoring program for implementing the requirement in DOE O 420.1C. Guidance should include information such as number and types of free-field instruments to be placed on and around DOE sites, and guidance provided for monitors within key facilities.
- Provide guidance on references to use to determine design load basis for structures, systems and components.
- Consider increased participation from experts with DOE site-level experience in the standard development process.
- Provide better guidance in DOE-STD-1020 on conducting assessments for Hazard Category 1 and 2 non-radiological facilities.

Recommendations for Program/Site Offices

The following recommendations are suggested to Program/Site Offices to enhance the effectiveness and efficiency of their NPH assessment reviews:

- Develop written procedures to guide the conduct of NPH assessment reviews in a consistent, efficient, and effective manner.
- Maintain a single document containing summaries of all NPH analyses and a log of scheduled periodic review dates. This document will be particularly valuable for sites with

multiple nuclear facilities, as it can be incorporated by reference in different facility specific DSAs, simplifying the DSA maintenance at large sites.

- Consider undertaking early peer reviews and discussions with the technical experts, DOE management, and other stakeholders on the respective site's evaluation and recommendations regarding existing NPH analyses before embarking on new ones. This can be done as part of the periodic assessment review process, and ideally lead to an upfront consensus and avoid future rework.
- Establish continuous NPH data collection programs (e.g. subsurface, regional flooding, meteorological, seismic monitoring data) as part of an over-arching site-wide NPH program plan to ensure that up-to-date data will be available when performing a periodic review of the NPH assessment or initiating a new hazard analysis. Program Offices and Sites Offices should coordinate access to expertise across DOE on NPH related matters to overcome a shortage of such expertise.
- For sites with facilities under the control of multiple Program Offices, the Program/Site Offices should collaborate on their NPH review assessment effort.

6.0 CONCLUSIONS AND NEXT STEPS

The Office of Nuclear Safety's evaluation of the implementation of periodic NPH assessment reviews found that DOE sites are performing these reviews in a variety of manners, and that there are opportunities for improving the efficiency and effectiveness of these assessments. This report documents the results of this evaluation, including the status of the implementation of the NPH assessment review requirement; lessons learned and best practices; as well as recommendations for improvements.

AU-30 is taking action to incorporate some guidance on performing these periodic ten-year NPH assessments reviews into the DOE NPH Handbook, Natural Phenomena Hazards Analysis and Design Handbook for DOE Facilities, which is under development. Furthermore, AU-30 will be working with the Program and Site Offices to support implementation of the NPH assessment review requirements, including providing technical assistance and training.

APPENDIX A. TEN-YEAR REVIEW REQUIREMENTS

DOE O 420.1C, *Facility Safety* - Chapter IV. Natural Phenomena Hazards Mitigation, Section d. Review and Upgrade Requirements for Existing DOE Facilities:

- (1) Existing facility or site NPH assessments must be reviewed at least every ten years for any significant changes in data, criteria, and assessment methods that would warrant updating the assessments. Section 9.2 of DOE-STD-1020-2012 contains criteria and guidance for performing these reviews. The review results, along with any recommended update actions, must be submitted to the head of the field element. If no update is necessary, this result must be documented following the review.
- (2) If a new assessment of NPH demands indicates deficiencies in existing structures, systems and components (SSC) design, a plan for upgrades must be developed and implemented on a prioritized schedule, based on the safety significance of the upgrades, time or funding constraints, and mission requirements. Section 9.3 of DOE-STD-1020-2012 contains guidance on performing upgrade evaluations.

DOE-STD-1020-2012, *Natural Phenomena Hazards Analysis and Design Criteria for Department of Energy Facilities*, Section 9.2 Periodic Review and Update of NPH Assessments:

9.2.1: At a frequency not to exceed ten years, the following aspects of NPH assessments shall be reviewed for changes that would warrant updating the assessments:

- NPH data and data collection methods;
- NPH modeling techniques, either generic or specific to the region of interest; and
- NPH assessment methods.

9.2.2: Consistent with DOE O 420.1C, a preliminary estimate of whether changes to data, models, or methods are “significant” and warrant updating the assessments should be performed and consider the following criteria:

- Are the changes to data, models, or methods likely to cause a change in the estimates of the major inputs to hazard calculations?
- Given potential changes to the hazard inputs, by what magnitude might the calculated hazard results change, and how might the results impact current site design standards?

9.2.3: The preliminary estimate of how hazard results might change from new inputs will likely be imprecise. An expected significant increase in the hazard results would clearly favor completion of a new assessment to ensure the NPH assessment continues to have a viable technical basis.

9.2.4: In the case of seismic hazard assessments, a determination of whether an existing assessment remains adequate for future use should consider the criteria in Section 4.1 of American National Standards Institute/American Nuclear Society (ANSI/ANS)-2.29-2008 for the suitability of existing studies. Additional guidance on the bases for updating existing seismic assessments can be obtained from U.S. Nuclear Regulatory Commission (NRC)

Regulation (NUREG)-2117, *Practical Implementation Guidelines for SSHAC (Senior Seismic Hazard Analysis Committee) Level 3 and 4 Hazard Studies*.

9.2.5: A decision on updating an NPH assessment should consider the intended application of the assessment results. Such considerations include:

- The number of facilities affected by the NPH assessment, and the hazards posed by the facilities;
- The life-cycle stages of the facilities affected by the NPH assessment;
- Whether the assessment results will be used as design input for any future facilities;
- NUREG-2117, Chapter 6; and
- NUREG-CR 6372, *Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and use of Experts*, Appendices Vol.2, Appendix G.

9.2.6: If the review and evaluation of the changes warrants an update, the updated assessment shall be performed following the criteria in this Standard for new facilities.

9.2.7: If the review and evaluation of the changes does not warrant an update, the review and evaluation results shall be justified and documented.

**APPENDIX B.
NPH QUESTIONNAIRE**

#	Question and Site Response
1	When was the last ten-year NPH review done for your site?
2	Is any ten-year NPH review being planned or currently underway? (Please provide start and estimated completion date)
3	What was the reason for conducting the review (i.e. routine, new NPH information, new site related information etc?)
4	Is there any written procedure for conducting the review?
5	Was the review conducted for the entire site or just one or more select facilities?
6	Did the last review indicate the need to update any existing assessments, or conduct any new assessments? If so, which NPH assessments required action?
7	Which facility on your site was involved in the assessment?
8	What approach (e.g. expert review) did you use to perform the review, and what criteria did you use to judge the adequacy of the current assessment(s)?
9	Have any recommended new assessments/updates been performed, and if not, why?
10	Did you update PSHA as part of the assessment, and how was the decision to update PSHA made?
11	If new assessments/updates were performed, did hazard levels increase or decrease?
12	If hazard levels increased, what additional actions, if any, were taken?
13	What concerns do you have about the ten-year NPH review process?
14	What are the lessons learned?

APPENDIX C.
TOPICS FOR SITE INFORMATION GATHERING ON THE
PERIODIC REVIEW OF NPH ASSESSMENTS

1. Review of Hazard Assessments

- a. Indicate which of the following natural hazards are applicable to the site:
 - Seismic;
 - Extreme Straight line wind;
 - Flooding;
 - Precipitation;
 - Tornadoes;
 - Hurricanes;
 - Lightning;
 - Volcanoes;
 - Snow/ice; and
 - Extreme Temperatures.
- b. Indicate which natural hazards have site-specific assessments versus a reliance on building code, ASCE 7 standard hazard values or other sources.
- c. Describe how each of the following were addressed for each hazard assessment subject to a periodic review:
 - Sources used to search for new data that might impact the hazard assessment;
 - Examination of how new data, models, or methods might change the hazard results;
 - Decisions made as to whether something is a significant change that warrants a new assessment;
 - Other considerations that went into a decision on whether a new assessment was necessary; and
 - Discussion about updating an existing assessment versus completing a new assessment.

2. Personnel

- a. Indicate reviewer experience and qualification.

3. Procedures

- a. Indicate which of the following addresses procedure usage for the periodic site-specific NPH assessments:
 - Use written and approved procedures;

- Written procedures are not available (indicate guidance used to perform the periodic site reviews); and

b. Indicate if exceptions to the procedures are used including their basis and approval.

4. Hazard Related Information

a. Documentation of hazard related information used during the review for determining any change in hazards.

5. Site Reports

a. Reporting of the periodic review by the contractor.

b. DOE review.

6. Site Remarks

a. Indicate challenges and suggested changes to improve the periodic review process.

b. Lessons learned.