

## Implementation of Periodic Natural Phenomena Hazards (NPH) Assessment Reviews at U.S. Department of Energy (DOE) Sites

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### ABSTRACT

The United States (U.S.) Department of Energy (DOE) national laboratories and technology centers are a system of facilities and laboratories overseen by the U.S DOE for the purpose of advancing science and technology to fulfil the DOE mission. DOE Order 420.1C, *Facility Safety*, contains requirements to help ensure the public, workers, and environment are protected from hazards posed by facility operations. As part of the mitigation of hazards posed by natural phenomena, it requires facility or site natural phenomena hazards (NPH) be reviewed at least every ten years for any significant changes in data, criteria, and methods that would warrant updating the assessments. During 2013-2014, DOE Office of Nuclear Safety conducted a study of how these periodic NPH assessment reviews were being performed.

To support this study, a questionnaire was provided to DOE Site Offices and interviews were conducted at selected DOE Sites to collect information on their current NPH assessment review practices and results. Site Office staff identified issues and concerns, lessons learned and good practices related to the ten-year review requirement. The study team distilled a number of recommended actions and guidance that has been documented in a study report, which will support DOE staff in conducting future periodic NPH assessments reviews. Some study insights revealed variation in procedures for conducting the ten-year review of NPH assessments among sites; subject matter expert peer review was reported by sites as the most common approach to performing the ten-year review of site NPH assessments and 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. The most common NPH assessments requiring action were seismic hazard assessments.

The Office of Nuclear Safety is incorporating guidance on performing periodic assessments reviews into a DOE NPH Handbook. Furthermore, the Office of Nuclear Safety will provide assistance and training to facilitate effective implementation of DOE's ten-year NPH assessment review requirement.

### INTRODUCTION

DOE requires that facilities be designed to withstand natural phenomena hazards (NPH) such as earthquakes, floods, and high winds. Our understanding of natural processes, hazard assessment techniques, and the availability of data continue to evolve and expand, so a periodic review of natural

hazard assessment is prudent. 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. DOE O 420.1C contains high-level requirements for NPH mitigation and mandates use of DOE-STD-1020-2012, which contains requirements for analysing NPH and criteria for designing facilities commensurate with the hazards. The Standard has sections devoted to the analysis and mitigative design for seismic, wind, flood, lightning, precipitation, and volcanic hazards. Particularly relevant to this discussion is Section 9 of the Standard, “Evaluation and Modification of SSCs in Existing Facilities.” This section provides requirements for periodic review and update of NPH assessments and evaluating potential facility upgrades due to changes in NPH assessments.

The DOE Office of Nuclear Safety establishes and maintains nuclear safety policy, requirements, and guidance including policy and requirements relating to hazard and accident analysis, facility design and operation, and quality assurance. It conducted this review effort to determine and evaluate the current field practices, their effectiveness, and challenges in executing the DOE requirement for periodic reviews of NPH assessments. In accordance with DOE O 420.1C, existing facility or site NPH assessments must be reviewed at least every 10 years for any significant changes in data, criteria, and assessment methods that would warrant updating the assessments. Based on information from the review effort, recommendations have been developed and good practices identified that will be useful to DOE, Program and Site Offices in conducting future periodic reviews of NPH assessments in a consistent, graded and acceptable manner.

## **REVIEW APPROACH**

The review was carried out in three phases. In the first phase, DOE laboratories and operating Site Offices completed an NPH assessment review questionnaire to provide information on their current NPH review practices and results. 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 and telephone interviews at selected sites to meet with Federal and contractor staff to gather detailed insights.

The third phase of the review comprised of analysing 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.

## **REVIEW RESULTS**

Results of the review were evaluated in terms of Site Offices’ ten-year review status, practices and results; issues and concerns; and lessons learned.

### ***Status, Practices and Results***

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. 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. Additionally, 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.

Some sites reported that they conducted ten-year review of NPH assessments for the entire site, while other sites reported focusing the review specifically on nuclear facilities or buildings. Procedures for conducting the ten-year review of NPH assessments varied vastly among sites as well. For example, 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.

### ***Issues and Concerns***

Site Offices identified a number of issues and concerns related to the periodic NPH assessment review requirement. The most common concern was a lack of clarity in the applicability of the periodic NPH assessment review requirement in regards to which sites, facilities, and hazards would be subject to such a review. It was stated that there are no clear expectations on how to perform the ten-year reviews and that there is a need for good examples of documented ten-year reviews to assist in doing them. Site Offices seek better guidance in the following areas: conducting non-seismic NPH assessments; how to address the differences between current DOE Facility Safety Order (O 420.1C) and its previous version (O 420.1B), in regards to the NPH assessment review requirement; what the appropriate scope is for the NPH assessment review and the 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. Notable challenges identified by Site Offices was the high cost to adequately characterize some hazards in a manner compliant with DOE-STD-1020-2012; conducting up-front planning 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; and limited site office and contractor staff personnel expertise with conducting the ten-year review process.

### ***Lessons Learned***

Lessons learned identified by Site Office personnel during this review included: maintaining a single document containing summaries of all NPH analyses, periodic review dates performed/scheduled, and results of any past reviews, especially for sites with multiple nuclear facilities; and performing early peer review of results and early discussions with stakeholders to avoid future re-work and schedule setbacks when reviewing existing NPH analyses, or embarking on new analyses. Furthermore, a single meeting among technical experts, DOE decision makers, and other stakeholders to review the status of an existing hazard analysis was found to be beneficial to lead to quick consensus on whether the existing analysis remains viable or must be replaced, and qualified contractor and site office staff are necessary to perform and review NPH analyses, periodic reviews, and updates.

## **RECOMMENDATIONS AND GOOD PRACTICES TO IMPROVE DOE PERFORMANCE**

From a review of all of the practices, issues, and lessons learned, the study team identified high level recommendations and good practices to enhance the effectiveness and efficiency of NPH assessment reviews. Some recommendations for the Office of Nuclear Safety, as the DOE Office responsible for developing the NPH requirements and providing assistance in implementing them, include:

- developing guidance to the Site Offices in determining what changes in NPH assessments (data, models, analytical methodologies, etc.) would be significant enough to warrant updates;
- developing sample procedures for conducting periodic NPH reviews;
- facilitating exchange of information among Site Offices through various means, such as forming a technical working group, developing interactive forum, providing access to completed periodic reviews, and

- providing sites with needed guidance on the seismic monitoring program for implementing the requirement in DOE O 420.1C.

Some Site Office best practices identified include:

- developing written procedures to guide the conduct of NPH assessment reviews in a consistent, efficient, and effective manner;
- maintaining a single document containing summaries of all NPH analyses and a log of scheduled periodic review dates;
- undertaking early peer reviews and discussions with the technical experts, DOE management, and other stakeholders on the respective site staff's evaluation and recommendations regarding existing NPH analyses before embarking on new ones, as part of the periodic assessment review process; and
- establishing 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 the availability of up-to-date data when performing a periodic review of the NPH assessment or initiating a new hazard analysis.

Furthermore the study found that DOE could benefit by coordinating access to expertise across DOE on NPH related matters to overcome a shortage of such expertise; and having sites with facilities under the control of multiple Program Offices collaborate on their NPH review assessment effort.

## 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 there are opportunities for improving the efficiency and effectiveness of these assessments. This paper discusses 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.

The Office of Nuclear Safety 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, the Office of Nuclear Safety will be working with the Program and Site Offices to support implementation of the NPH assessment review requirements, including providing technical assistance and training.

## REFERENCES

- U.S. Department of Energy. (2012a). DOE Order 420.1C, *Facility Order*. Washington, DC, USA
- U.S. Department of Energy (2012b). DOE-STD-1020-2012, *Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities*. Washington, DC, USA.