

## Why GAO Did This Study

On March 11, 2011, an earthquake triggered a tsunami wave that exceeded the seawall at Japan's Fukushima Daiichi nuclear power plant, leading to the release of radioactive material into the environment. The disaster raised questions about the threats that natural hazards, such as earthquakes and floods, may pose to U.S. commercial nuclear power reactors. NRC licenses and regulates U.S. nuclear power reactors. NRC criteria for licensees to assess natural hazards were developed using an approach that required reactors to be designed according to a set of potential accidents using deterministic analysis. Since the 1990s, NRC has been encouraging the use of PRA as part of a risk-informed, performance-based approach.

GAO was asked to (1) determine the extent to which PRA is applied to natural hazards at operating U.S. reactors and (2) describe expert views on and suggested changes, if any, to NRC processes for assessing natural hazards at such reactors. GAO reviewed documents; analyzed responses from 15 experts in assessing nuclear reactor risks and/or natural hazards; visited five selected nuclear power plants; and interviewed NRC officials and industry and public interest group representatives.

## What GAO Recommends

GAO recommends that NRC analyze whether licensees of operating reactors should be required to develop PRAs that address natural hazards. NRC agreed with the recommendation and stated it will conduct the analysis in the context of ongoing initiatives.

View [GAO-12-465](#). For more information, contact Frank Rusco at (202) 512-3841 or [ruscof@gao.gov](mailto:ruscof@gao.gov).

# NUCLEAR REGULATORY COMMISSION

## Natural Hazard Assessments Could Be More Risk-Informed

## What GAO Found

The Nuclear Regulatory Commission (NRC) and companies licensed to operate nuclear power reactors (or licensees) apply probabilistic risk assessment (PRA) to natural hazards at operating U.S. nuclear reactors to a limited extent. When the 104 operating reactors were originally licensed before 1997, NRC required licensees to assess natural hazards using deterministic analysis, which— informed by historical experience, test results, and expert judgment—considers a specific set of potential accidents and how the consequences of those accidents can be prevented and mitigated. Subsequent to most of these initial licenses being issued, NRC, through policy statements and other documents, has endorsed PRA—a systematic method for assessing what can go wrong, its likelihood, and its consequences, resulting in quantitative estimates of risk—as a means to enhance and extend traditional deterministic analysis. In 1991, NRC requested that licensees voluntarily examine their reactors' vulnerability to natural hazards and suggested PRA as one of several possible methods for licensees to use in their examinations. However, most licensees opted to use other methods. According to NRC officials and nuclear power industry representatives—and reflected in data GAO obtained from five licensees that together operate 25 reactors—few licensees are likely to have developed or updated since the 1990s PRAs that address natural hazards. NRC would have to conduct an analysis to determine whether or not to require licensees to develop PRAs that address natural hazards. According to agency officials, NRC has not conducted such an analysis.

The experts in assessing natural hazards and/or nuclear reactor risks that GAO interviewed offered a range of views on (1) the overall adequacy of NRC processes for assessing the threats that natural hazards pose to operating U.S. nuclear power reactors and (2) what, if any, changes to those processes are warranted. Several experts said they believe NRC processes are generally adequate for assessing the threats that natural hazards pose to operating reactors. However, more than half of the experts GAO interviewed suggested expanding the use of PRA for assessing natural hazards as a complement to traditional deterministic analyses to provide a more robust approach. Those experts cited a number of advantages to doing so, including that PRA can help identify vulnerabilities that might otherwise be overlooked by relying on traditional deterministic analyses alone. Several experts also identified challenges to expanding the use of PRA for assessing natural hazards, including the limited number of experts qualified to develop PRAs and the costs of doing so.