SAFETY APPROACH TO NUCLEAR OPERATIONS

The Department of Energy's Nuclear Facilities

Background and Perspective

The Department of Energy's (DOE's) nuclear safety infrastructure has, as its primary objective, the protection of the workers, the public, and the environment. The requirements, standards, and performance expectations at all DOE facilities are proportionate to the risks involved. DOE nuclear facilities have been designed to withstand severe natural disasters, including earthquakes, extreme winds (e.g. tornados, hurricanes), volcanic eruptions, and floods.

More specifically, each DOE nuclear facility has been analyzed to select the seismic events that are probable for that site, considering such factors as the magnitude and distance to earthquake sources and the seismicity and the geology of the area. The set of the events expected at each site is referred to as the design basis events. Contributions from these events are calculated to determine the design basis earthquake (DBE) ground motion. Dynamic response (in layman's terms this loosely translates to the amount of "shaking" that would occur at the facility) of the safety-related structures, systems, and components (SSCs) in nuclear facilities, when subjected to the ground motion resulting from the DBE, are then evaluated to ensure that the SSCs in the facility will not be damaged in a manner that would endanger the public. It is important to recognize that some DOE nuclear facilities were designed and built many years ago and were not always originally built to withstand a DBE that would result from the application of current DOE seismic design and evaluation requirements. DOE, however, has extensively remodeled many nuclear facilities to strengthen safety components to enhance their ability to withstand a seismic event.

Although DOE has ensured that nuclear facilities define a very conservative set of design bases events, the recent earthquake and tsunami in Japan demonstrate that, while unlikely, an event beyond the design basis is not impossible. As a result, DOE has determined that it is prudent to further evaluate its facilities to consider "beyond design basis events," which are events that are more severe than what facilities were originally designed for in the safety reviews.

This evaluation is now in progress. Several actions, including reviews of safety controls and emergency capabilities, are being planned. The reviews of the higher hazard facilities are being performed first and are scheduled to be completed this spring. Additionally, DOE is taking action to inform the public about how safety is applied in its DOE nuclear facilities, which are quite different from the commercial power reactors that were impacted in Japan.

DOE has determined that its facilities are safe, but also recognizes that it should always be alert to new information and lessons learned. In fact, continuous improvement is a guiding principle in DOE's safety policy. Therefore, DOE will analyze information regarding the reactor accidents in Japan carefully to identify opportunities for improving the safety of all DOE nuclear facilities. DOE is also partnering with the Nuclear Regulatory Commission and the Institute for Nuclear Power Operations to study lessons learned from the Japan events.

Types of Nuclear Operations

DOE conducts three basic types of nuclear operations: Nuclear Weapons Stockpile Maintenance, Research, and Environmental Cleanup. The operations are performed in a variety of facilities including several research reactors; weapons disassembly, maintenance, and testing facilities; and at waste processing and disposal facilities.

Facility Hazard Classifications

DOE uses three categories to classify its nuclear facilities according to the level of hazard they could present to the public and workers.

- Hazard Category 1 indicates that there is a potential for significant off-site consequences. DOE has two such facilities (research reactors).
- Hazard Category 2 indicates that there is a potential for significant on-site consequences. DOE has 147 such facilities.
- Hazard Category 3 indicates that there is a potential for significant consequences within the facility itself. DOE has 38 such facilities.

The nuclear facilities (including those that are DOE Hazard Category 1) contain smaller amounts of radioactive material than commercial nuclear power plants. Also, unlike commercial power reactors, DOE nuclear facilities do not require extensive emergency cooling after they are shutdown; the failure of these cooling systems and the associated electric power supplies was a critical factor in the accident at the Japanese commercial power reactors.

DOE's Nuclear Safety Approach

Nuclear safety is a foundation of facility construction and operation, which is supported through design, personnel and procedures, a quality assurance program, emergency response, integrated safety management, independent oversight, and through DOE's Nuclear Safety Policy and Safety Goal.

- ***Design:*** This means designing nuclear facilities to rigorous safety standards that require multiple layers of protection against the release of hazardous materials. Not all facilities are designed to the same criteria. For example, with respect to earthquakes, DOE designs its facilities according to the type of earthquake zone they are located in to assure that facilities are robust enough to withstand the necessary level of ground motion. DOE also works closely with various expert organizations (e.g. American Nuclear Society and the American Society of Civil Engineers) and working groups (e.g. Nuclear Regulatory Commission, the Defense Nuclear Facilities Safety Board and industry) on national standards.

- ***Personnel & Procedures***: Operating and maintaining its facilities with highly qualified and trained personnel using well-defined procedures.

- ***Quality Assurance***: Requiring a strong quality assurance program to ensure that all aspects of facility safety from design calculations, equipment procurement and facility construction, to operations and maintenance are properly implemented.

- ***Emergency Response***: Establishing emergency plans and procedures and routinely exercising these procedures to train and prepare to handle emergency situations.

- ***Integrated Safety Management:*** Integrating safety into work planning and execution at all levels and establishing a strong safety culture.

- ***Oversight:*** Implementing comprehensive oversight to confirm that design, construction, operations, and decommissioning are conducted in a manner to protect the public, workers and environment.

Nuclear Safety Policy & Goal

To design, construct, operate and decommission its nuclear facilities and conduct DOE operations so workers, members of the public and the environment are provided a level of protection from the consequences of DOE operations and such that individuals bear no significant additional risk to life and health than that to which members of the general population are normally exposed.

Out of this policy, the following key actions resulted:

- Nuclear safety requirements were established that use national consensus standards.

- DOE's Safety Management System, including establishing a strong safety culture and performing independent oversight, was implemented.

- The use of hazardous materials was minimized and a defense-in-depth approach to hazard control was applied.

DOE Safety Requirements

Safety requirements include regulations and directives. They cover quality assurance, safety analysis, facility designs, conduct of operations, maintenance and training, emergency management, and line management and independent oversight.

DOE Nuclear Safety Standards and Guides

There are a variety of standards and guides which DOE uses. These include:

- ***Safety Analysis Standards:*** Provide standard and appropriate approaches for performing analysis of potential nuclear accidents and establishing controls to prevent their occurrence.

- ***Natural Phenomena Hazards Standards:*** Focus on hazard and design analysis to protect nuclear facilities from the effects of earthquakes, tornadoes, etc.

- ***Facility Safety Standard and Guide:*** Address defense-in-depth and reliable design to ensure that multiple layers of safety are part of all DOE nuclear facilities.