

**Staff Response to Recommendations in the Report from the Advisory Committee on
Reactor Safeguards on the Combined License Application
for Levy Nuclear Plant, Units 1 and 2**

In a letter dated December 7, 2011, the Advisory Committee on Reactor Safeguards (ACRS) issued its report to the U.S. Nuclear Regulatory Commission (NRC) on the safety aspects of the combined license application (COLA) for Levy Nuclear Plant (LNP), Units 1 and 2. The ACRS report included two specific recommendations. This enclosure provides the staff's response to those recommendations for which the ACRS sought specific staff action.

ACRS Recommendation: A license condition should be established to require inclusion of a probabilistic evaluation of the tsunami hazard in the site-specific, full-scope probabilistic risk assessment required before fuel load.

Using state-of-the-art models, the applicant calculated the inundation level from the bounding tsunami for the LNP site. The applicant concluded that storm surge and probable maximum precipitation flooding were of greater concern. The staff's independent analysis confirmed the applicant's results. The risk from flooding by a conservatively calculated maximum tsunami is not significant for the Levy site.

NRC regulations (Title 10 of the *Code of Federal Regulations* (10 CFR) Section 52.79(a)(46)) require combined license applicants to provide a description of the plant-specific probabilistic risk assessment (PRA) and its results. Chapter 19 of the LNP final safety analysis report addressed external flooding risk in accordance with Regulatory Guide (RG) 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities." RG 1.200 addresses natural phenomena, such as river or lake flooding, ocean flooding from high tides or storm surges, unusually high precipitation, tsunamis, and seiches. In addition, the RG considers events from human activities and infrastructure, including the failure of dams, levees, and dikes. Some of these phenomena were not applicable to the LNP site; for example, dam failures need not be considered because there are no dams within the watershed where the plant will be built. The site is less than 10 miles from the sea, so peak ocean water levels were calculated conservatively, using deterministic methods. The peak water level from storm surge is nearly as high as the level from probable maximum precipitation, which is the design-basis flood for LNP. Both are significantly higher than a conservatively calculated tsunami level. None of these floods would have any adverse impact on the safety-related or risk-significant structures, systems, and components on the Levy site. Because the consequence of external flooding events is negligible, they were screened from further analysis in accordance with RG 1.200. NRC regulations (10 CFR 52.79(a)(46)) have been satisfied, and for these reasons, the staff does not think it appropriate to impose a license condition requiring an analysis of tsunami hazard probabilities.

Currently, probabilistic tsunami hazard assessment (PTHA) is in development. In response to the 2004 Indian Ocean tsunami, the NRC initiated a research program to address tsunami hazards and their potential impact on U.S. nuclear power plants. This research program focuses on developing modern hazard assessment techniques and additional guidance through cooperation with the National Oceanic and Atmospheric Administration and the United States Geological Survey (USGS). This effort has already led to several technical reports, conference papers, and an update to NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," (Section 2.4.6). The potential for PTHA will be explored in the final phase of the research program. The goal is to provide new

Enclosure

regulatory guidance on tsunami hazard assessment in parallel with ongoing efforts of the International Atomic Energy Agency Working Group on Tsunami Hazards. The United States and Japan are tasked with the lead for submarine landslide and seismic tsunami sources, respectively.

Currently, the NRC evaluates tsunami hazards for new license applications in terms of determining the probable maximum tsunami (PMT). At LNP, the source for the PMT is a submarine landslide in the Mississippi Canyon. For the last several years, USGS has conducted research to first identify and date significant submarine landslides along the western Atlantic margin and the Gulf of Mexico (Agencywide Documents Access and Management System (ADAMS) Accession No. ML082960196). Recent efforts have focused on how submarine landslide probability might be determined using available geological and geophysical information and on identifying the challenges of incorporating this information into PTHA. An NRC-sponsored workshop on submarine landslide probabilities was held on August 18—19, 2011, at the USGS Woods Hole Science Center in Massachusetts. Academic, industry, and government participants provided an overview of topics that included geological characterization of submarine landslides, geotechnical techniques and measurements of slope stability, hydrodynamic modeling of landslide-generated tsunamis, and probabilistic methods for hazard assessment. The workshop concluded that there is currently insufficient information with which to incorporate submarine landslides into PTHA at the very low probabilities of interest to the NRC. The agency's research will continue to address this issue.

ACRS Recommendation: Prior to approval of the COLA, the staff should verify that inclusion of the adjacent shipping canal and watercourse would not significantly affect the conclusions of its deterministic tsunami hazard evaluation described in the Advanced Safety Evaluation.

Nationally and internationally recognized tsunami experts for the staff (from USGS, Massachusetts Institute of Technology/Woods Hole, and Texas A&M University) and the applicant (University of Delaware) performed independent, state of the art, numerical modeling of tsunamis relevant to LNP. They modeled three tsunamigenic source types:

- distant earthquake sources
- a regional earthquake source in the Gulf of Mexico
- regional submarine landslide sources in the Gulf of Mexico

In their analyses, the applicant and NRC staff used different tsunami models, and for all conditions, the most conservative source parameters were employed to provide an absolute upper limit. Most of the modeling focused on three Gulf of Mexico landslide sources: the Mississippi Canyon, East Breaks, and Florida Escarpment. The applicant determined that the PMT near the LNP site would be caused by a landslide in the Mississippi Canyon. The PMT is less than 4 meters (m) (13 feet (ft)) North American Vertical Datum of 1988 (NAVD 88), which is far below the LNP grade of 15.5 m (51 ft).

The staff's independent analysis, as documented in "Technical Letter Report with No Open Items for the Levy County, Florida, COL Review" (ML12017A152), considered a range of simulation conditions. The staff's most conservative and least plausible condition used a one-dimensional simulation with no friction. The staff also considered a conservative, but realistic, condition that used a two-dimensional simulation with realistic conservative friction coefficients. For bathymetry and topography, the staff used a subdomain sized about

200 kilometers (km) (125 miles) by 150 km (94 miles), and centered 75 km (47 miles) offshore. The staff's analysis applied a constant grid size of 100 m, and conservatively assumed both the sea floor and the land were smooth, with no bottom friction dissipation. Use of these most conservative assumptions provided an upper physical limit for the inundation distance. The staff's independent confirmatory analysis resulted in a maximum water level of 6.1 m (20 ft) NAVD 88, which is well below the LNP grade elevation of 15.5 m (51 ft) NAVD 88. The Cross-Florida Barge Canal was included in the staff's analysis, in that the location of the canal fell within the staff's model grid. The Cross-Florida Barge Canal is 13.4 km (8.3 miles) long and located 4.8 km (3 miles) south of the LNP site. The design depth of the canal is 3.7 m (12 ft) and the width is 45.7 m (150 ft), which also falls within the staff's model grid. Using state-of-the-art analyses, the staff evaluated the applicant's methodology and is satisfied that the Cross-Florida Barge Canal has been adequately considered. The impact of the canal and watercourse on the overall water level at the site resulting from a tsunami is negligible given the size and location of the canal and watercourse relative to the site. The staff does not believe that any additional deterministic analyses are needed to support the conclusions of its deterministic tsunami hazard evaluation described in the Advanced Safety Evaluation.