

## Proposed Resolution Plan for Tier 3 Additional Recommendations

### Basis of Emergency Planning Zone Size and Pre-Staging Potassium Iodide Beyond 10 Miles

#### Background

As directed by staff requirements memorandum to SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated August 19, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML112310021), the staff sought to identify additional recommendations related to lessons learned from the Fukushima Dai-ichi event, beyond those identified in the Near-Term Task Force (NTTF) report. Many additional recommendations were received from U.S. Nuclear Regulatory Commission (NRC) staff and external stakeholders, including the Office of Science and Technology Policy, Congress, international counterparts, other Federal and State agencies, nongovernmental organizations, the public, and the nuclear industry. These issues were raised in a variety of fora, including the staff's August 31, 2011, public meeting and a September 9, 2011, Commission meeting.

As part of its evaluation of additional recommendations, the staff identified a Tier 3 recommendation to reconsider the basis of the emergency planning zone (EPZ) size and practices associated with the prestaging of potassium iodide (KI) beyond 10 miles. This was determined to be a Tier 3 issue because further assessment and information from the Fukushima accident were needed before the evaluation could be completed.

Related to this issue, a petition for rulemaking (PRM) (PRM-50-104) was filed on February 15, 2012 (ADAMS Accession No. ML120488004). The petitioner requested that the Commission amend its regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," to expand existing EPZs around nuclear power plants, create a new EPZ, and require the incorporation of concurrent natural disasters in the required periodic emergency plan drills. The NRC published a notice of acceptance, docketing, and request for public comments in the *Federal Register* (FR) on April 30, 2012 (77 FR 25375). The comment period for this PRM closed on July 16, 2012. The NRC received 5,993 comment submissions, 5,953 of which supported the petition and 40 of which opposed the petition. Of the 5,993 comment submissions, 5,702 were form letters and 291 were unique submissions. The NRC prepared a comment response document to demonstrate how all comments were considered and to respond to the issues identified in the comments. The comment response document is available in ADAMS under Accession No. ML14042A227.

The NRC staff provided its recommendation on this PRM to the Commission in SECY-13-0135, "Denial of Petition for Rulemaking Requesting Amendments Regarding Emergency Planning Zone Size (PRM-50-104)," dated February 27, 2014 (ADAMS Accession No. ML13109A503). The NRC staff concluded that the current size of EPZs is appropriate for existing reactors and that emergency plans provide an adequate level of protection for public health and safety in the event of an accident at a nuclear power plant. The current EPZs provide for a comprehensive emergency planning framework that would allow expansion of the response efforts beyond the

designated distances should events warrant such an expansion. On February 27, 2014, the Commission approved the staff's recommendation to deny this PRM.

### **Current Status**

The staff continues to conclude, after extensive reviews, that the current size of EPZs is appropriate for existing reactors and that emergency plans provide an adequate level of protection of the public health and safety in the event of an accident at a nuclear power plant. In addition, the staff concludes that the current distribution program for KI tablets within the 10 mile EPZ provides an adequate level of protection of public health and safety.

The staff maintains awareness of, and involvement with, international scientific organizations (i.e., International Atomic Energy Agency (IAEA), the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), and the World Health Organization (WHO)), which continue to monitor the health and environmental impacts of the radioactive releases from the Fukushima Dai-ichi reactors.

### **Discussion**

The NRC's regulations in 10 CFR Part 50 require two EPZs around each nuclear power plant. The 10-mile zone establishes the area in which exposure from a radiological release would likely occur and protective actions, such as sheltering in place or evacuation, would be appropriate. The 50-mile zone is the ingestion exposure pathway EPZ, where human exposure to radionuclides would likely result from ingestion of contaminated food, milk, or surface water. Nuclear power plant licensees, Federal, State, and local governments, and offsite response organizations perform comprehensive planning for these zones and routinely test and evaluate these plans through full participation exercises. The licensee develops the onsite emergency plan for NRC review. The State and local governments develop and maintain the offsite emergency plans, which are evaluated by the Federal Emergency Management Agency (FEMA). Through coordination of their emergency plans, the licensee and State and local governments establish the EPZ for the respective site.

Following the event at Fukushima Dai-ichi, the NRC, in conjunction with other U.S. Government entities, issued a conservative travel advisory for American citizens within a 50-mile range of the Fukushima site. The 50-mile travel advisory was made in the interest of protecting the health and safety of U.S. citizens in Japan based on the information available at that time and the rapidly evolving situation. Because of this action, the staff determined that it was appropriate to consider whether the basis of current EPZ requirements for U.S. nuclear power plants provides reasonable assurance of adequate protection of public health and safety. NUREG-0396, "Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants," issued November 1978, provides the technical basis for the plume exposure pathway EPZ and an ingestion exposure pathway EPZ. NUREG-0396 analyzes a spectrum of potential nuclear plant accidents and determines the size of EPZs, in which detailed planning would be appropriate for the protection of public health and safety.

The task force that developed NUREG-0396 considered several possible rationales for establishing the size of the EPZs, including risk, cost effectiveness, and the accident

consequence spectrum. After reviewing these alternatives, the task force concluded that the objective of emergency response plans should be to provide dose savings for a spectrum of accidents that could produce offsite doses in excess of the U.S. Environmental Protection Agency's (EPA's) protective action guides (PAGs) (EPA-400-R-92-001, "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents," issued May 1992). This rationale established bounds for the area in which detailed planning would be required as a defense-in-depth measure.

The EPZ requirements also provide consistency in nuclear plant preparedness across the nuclear fleet and the supporting State and local governments. All U.S. nuclear power plants currently have approved emergency plans that include EPZs in compliance with the regulations. FEMA provides oversight of offsite response plans that support nuclear power plants. Any changes to EPZs will be reviewed in coordination with FEMA.

Since the issuance of NUREG-0396, the staff has conducted several studies useful in evaluating the adequacy of the plume exposure pathway EPZ. NUREG/CR-6953, "Review of NUREG-0654, Supplement 3, 'Criteria for Protective Action Recommendations for Severe Accidents'" (ADAMS Accession Nos. ML080360602 (Vol. 1), ML083110406 (Vol. 2), and ML102380087 (Vol. 3)), evaluates the efficacy of various protective action strategies within the EPZ. NUREG/CR-6864, "Identification and Analysis of Factors Affecting Emergency Evacuations" (ADAMS Accession Nos. ML050250245 (Vol. 1) and ML050250219 (Vol. 2)), examines large evacuations in the U.S. between 1990 and 2003 to gain a fuller understanding of the dynamics involved. NUREG/CR-6981, "Assessment of Emergency Response Planning and Implementation for Large Scale Evacuations," issued March 2008 (ADAMS Accession No. ML082960499), assessed Hurricanes Katrina, Rita, and Wilma, as well as other large-scale evacuations, for lessons learned to further enhance the emergency preparedness program for radiological emergencies at nuclear power plants. Evacuations related to these incidents have revealed issues that have not been previously encountered during large-scale evacuations. The knowledge gained from studying 11 large scale evacuations (in excess of 10 million people) was used to determine if the emergency planning activities were effective in managing the response effort. The 11 incidents covered wide geographical areas and affected 14 nuclear power plant EPZs, although none of the evacuations were related to issues associated with those nuclear power plants. Research of evacuations such as these provided an opportunity to understand contributing factors that support the effectiveness of emergency response activities. A key finding of NUREG/CR-6981 is that emergency planning for nuclear power plants has substantially anticipated and addressed the issues identified in the large-scale evacuations.

Draft NUREG-1935, "State-of-the-Art Reactor Consequence Analysis (SOARCA) Report" (ADAMS Accession No. ML120250406), evaluates hypothetical evacuations within EPZs and beyond, in response to a series of accident scenarios. These analyses informed the staff's conclusion that the current requirements for EPZs remain protective of public health and safety. In response to a frequently asked question regarding protective action recommendations, the staff informed all licensees that it is a regulatory requirement for a licensee to develop and communicate a protective action recommendation when EPA PAG doses may be exceeded beyond the 10-mile plume exposure pathway EPZ.

In addition, the staff has reviewed information obtained from health studies on the affected populations. These studies have been undertaken by the Japanese Government (Fukushima Health Management Survey), as well as the WHO and the UNSCEAR. The Fukushima Health

Survey is a long-term study that will follow affected populations for years to assess radiological health impacts from low-dose radiation. These health studies based their conclusions, to date, on modeling, dose reconstruction, and real world information, such as field data and thyroid bioassays.

The Japanese government had arrangements for protective measures in place prior to the accident. These arrangements included criteria for sheltering, evacuation, and the use of potassium iodide for thyroid blocking. During the Fukushima Dai-ichi accident, the government evacuated and sheltered populations in the areas around the plant site. The use of potassium iodide was not implemented uniformly, primarily due to the lack of detailed arrangements. In addition, in some areas, the population was already evacuated when decisions regarding the use of potassium iodide were made.

The IAEA 2015 technical report on the accident at Fukushima attributes the low thyroid doses of children partly to restrictions placed on drinking water and food, including leafy vegetables and fresh milk. While dairy products were not the main pathway for the ingestion of radioiodine in Japan, it is clear that the most important method of limiting thyroid doses, especially to children, is to restrict the consumption of fresh milk from grazing cows.

UNSCEAR issued its scientific report in April 2014, which assessed radiation doses and associated effects on health and the environment from the Fukushima Dai-ichi accident. The UNSCEAR found that the radiation exposure of the Japanese population was low, leading to correspondingly low risks of health effects due to radiation later in life. The average effective doses for adults in evacuated and nonevacuated areas of the Fukushima Prefecture caused by the releases from the Fukushima reactors ranged from a few up to about 1,000 millirem (mrem). (10 millisieverts (mSv)). The effective doses for 10-year-old children and 1-year-old infants were estimated to be about twice as high. For neighboring prefectures and for the rest of Japan, doses were lower. To provide context, the average effective dose received annually in Japan from natural background radiation is about 210 mrem (2.1 mSv.).

Average absorbed doses to the thyroid among those most exposed individuals ranged from up to about 3.5 rads (35 milligray (mGy)) for adults and up to about 8 rads (80 mGy) for a 1-year old. This is significantly higher than absorbed doses to the thyroid from natural background radiation; the average annual absorbed dose to the thyroid from naturally occurring sources of radiation is typically of the order of 1 rad (1 mGy). The WHO, in its 1999 publication, "Guidelines for Iodine Prophylaxis Following Nuclear Accidents, Update 1999," recommends a generic intervention level of 10 rad (100 mGy) avertable dose for all age groups, although it recommends that a lower intervention level be considered for small children. This recommendation for a much lower intervention level was based largely on the increased number of thyroid cancers seen in young children as a result of the Chernobyl accident. The U.S. Food and Drug Administration of the U.S. Department of Health and Human Services issued its guidance on KI use in a 2001 publication, "Guidance Potassium Iodide as a Thyroid Blocking Agent in Radiation Emergencies." The recommended intervention level for children was 5 rem child thyroid dose, also based on those early reports of increased pediatric thyroid cancer.

Ongoing follow-up health studies undertaken by WHO and UNSCEAR have largely attributed the increased rates of childhood thyroid cancers from the Chernobyl accident to the high levels of radioactive iodine released during the accident and to the failure to interdict the milk supply, as well as an iodine insufficiency in the local diet. In its 2006 publication of health effects of the

Chernobyl accident<sup>1</sup>, the WHO concluded that “since radioactive iodine is short lived, if people had stopped giving locally supplied contaminated milk to children for a few months following the accident, it is likely that most of the increase in radiation-induced thyroid cancer would not have resulted.”

As a result of the Fukushima nuclear power plant accident, the Fukushima Prefecture launched the Fukushima Health Management Survey to investigate long-term, low-dose radiation exposure caused by the accident. The survey estimated radiation exposure from the accident and more detailed dose assessments by recreating the whereabouts of every Fukushima Prefecture resident for the 4-month period beginning on March 11, 2011, the date of the nuclear accident. The primary purposes of this survey are to monitor the long-term health of residents, promote their future well-being, and confirm whether long-term, low-dose radiation exposure has health effects. The June 2015 report of the Fukushima Health Management Survey<sup>2</sup> stated that doses have been estimated for approximately 449,000 survey respondents. Over 99.8 percent of the respondents received doses less than 500 mrem (5 mSv), while the highest dose was estimated to be 2,500 mrem (25 mSv).

To date, the results of these ongoing studies do not challenge the EPZ planning basis nor the KI distribution program. As such, the staff’s assessment is that no further regulatory action is necessary in response to this recommendation and that it can be closed. The staff plans to continue to monitor the studies being conducted by WHO, UNSCEAR, and the Fukushima Health Management Survey, and engage stakeholders through the appropriate fora. Such fora include: the annual Regional State Liaison Officers meeting, the quarterly meeting of the Federal Radiological Preparedness Coordinating Committee, and the annual meeting of the Conference of Radiation Control Program Directors.

### **Stakeholder Interactions**

The staff has had extensive stakeholder interactions on these recommendations as part of routine activities, post-Fukushima correspondence, and the resolution of PRM-50-104.

In addition, the NRC staff provided the Fukushima subcommittee of the Advisory Committee on Reactor Safeguards (ACRS) an overview of the staff’s plans to resolving the open Tier 2 and 3 recommendations during a meeting held on October 6, 2015. A similar meeting is planned with the ACRS full committee on November 5, 2015. The staff also provided an overview of its proposed resolution plans for all the open Tier 2 and 3 recommendations during a Category 2 public meeting held on October 20, 2015.

### **Conclusion and Recommendation**

Based on the staff’s assessment provided above, the staff proposes to close this recommendation.

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<sup>1</sup> An overview can be found at [http://www.who.int/ionizing\\_radiation/chernobyl/background/en/](http://www.who.int/ionizing_radiation/chernobyl/background/en/) (accessed September 4, 2015)

<sup>2</sup> Available at <http://fmu-global.jp/fukushima-health-management-survey/#report> (accessed September 4, 2015)

**Resources**

The staff estimates that approximately 0.25 full-time equivalent staff are needed for the Office of Nuclear Security and Incident Response to support the monitoring of these ongoing studies in fiscal year (FY) 2016. The resources are currently budgeted in FY 2016 in the Operating Reactors Business Line, Licensing Product Line, Fukushima NTTF Product.