Radiological Environmental Protection

ISSUE STATEMENT

Nuclear power plants must manage effluents in a manner that protects the health and safety of the public and maintains releases within regulatory limits. Since the levels of radioactivity released by nuclear power plants are maintained at levels far below regulatory limits, stakeholder confidence and environmental stewardship are becoming larger components of these programs. For example, recent events have led several plants to undertake extensive remediation processes to address stakeholder concerns related to tritium leaks and spills resulting in soil and groundwater contamination. Also, as nuclear power plants continue to reduce the total radioactivity in monitored effluents, they will need to report radionuclides such as carbon-14 that were previously not reported because they did not represent significant fractions of the overall effluent radionuclide mixture. Current guidance for the estimation of dose from such obscure radionuclides in effluents is generic and may not apply to all nuclear power plant environments, leading some plants to report values that are not precise to their site-specific conditions. Due to the low impact on public health and safety, research and technology development on the minimization of low-level releases of radionuclides has been limited.

DRIVERS

Public Perception: Although the small quantities of radionuclides released to the environment from recent industry events do not pose a human health and safety concern, public awareness has increased, prompting utility action. Public sensitivity to this issue could further increase as new plant licensing proceeds and as plants pursue life extension. Utilities will need to continue to reduce radioactive emissions from nuclear power plants by applying the as low as reasonably achievable (ALARA) principal and by being transparent and precise about informing the public about the sound environmental stewardship provided by the operation of the nuclear power plants.

Industry Initiatives: In response to increased stakeholder concern, the U.S. nuclear power industry has committed to implementing the “Groundwater Protection Initiative” to mitigate leaks and spills and to prevent off-site migration of groundwater contamination (per NEI 07-07 and NEI 08-08). The industry has also committed to the “Underground Piping and Tanks Initiative” to mitigate leaks from buried pipe systems and tanks (per NEI 09-14) at each nuclear power plant site. These initiatives highlight the need for more advanced monitoring, detection, and remediation technologies. EPRI provides the technical guidance and technologies needed to cost effectively implement these Initiatives.

Regulatory: Current regulations are not a significant driver for groundwater protection. However, in response to stakeholder concerns, the U.S. NRC is currently evaluating its policies, regulations, and industry commitments related to groundwater contamination (e.g., U.S. NRC Groundwater Task Force Final Report, June 2010). This evaluation may lead to new policies and regulations based on control of licensed materials and stakeholder confidence.

Nuclear power plants are required to report concentrations and associated doses of radionuclides that make up significant fractions of the total amount of radionuclides in effluent streams. As certain radionuclides are eliminated and as the total radioactivity of effluents is reduced, other radionuclides (e.g., Carbon-14, Strontium-90, Cesium-137, and Chlorine-36) will likely need to be reported. Power plants need guidance to determine and understand the site-specific impacts of such radionuclides on humans and non-human biota.

RESULTS IMPLEMENTATION

Each nuclear power plant needs to implement the program described in the EPRI Groundwater Protection Guidelines and in the Soil and Remediation Guidelines to meet the requirements of NEI 07-07 and NEI 08-08. These guidelines address the risk ranking of systems, structures, components and work practices; groundwater sampling programs; and procedures for responding to leaks and spills. Implementation of the guidelines requires the coordination of a multi-disciplinary group that includes experts on hydrogeology and plant engineering. In some cases implementation may require the installation of new
plant equipment, primarily in the form of monitoring wells. The groundwater protection technologies developed by EPRI can be implemented to facilitate cost-effective groundwater characterization and remediation. Some will require vendor support for implementation. The EPRI Groundwater Protection Assessment programs provide support for utility implementation of EPRI research results.

The implementation of the EPRI method for estimating carbon-14 and other radionuclide generation and release will require reactor core design information (e.g., neutron flux and mass of coolant) and information on the operation of various plant systems and components (e.g., gaseous effluent release practices). The precise estimation of plant dose to the public may require an updated land-use census and environmental sampling around the nuclear power plant. EPRI will provide the guidance and technologies to accurately understand and communicate impact of site-specific radiological effluents on human and non-human biota.

**PROJECT PLAN**

**Groundwater Protection**
- Update the EPRI Groundwater Protection and Remediation Guidelines to address industry program gaps identified through the Groundwater Protection Initiative (GPI) Peer Assessments and to identify opportunities for cost-effectively meeting the technical requirements of NEI 07-07.
- Coordinate the risk assessment methodologies and guidance for buried piping and groundwater protection, resulting in a streamlined approach for risk ranking to meet the requirements of NEI 07-07 and NEI 09-14.
- Provide technical guidance for using groundwater sample analysis methods to support faster identification of the source of a leak or spill.
- Develop and demonstrate automatic groundwater monitoring and tritium separation technologies to optimize monitoring and remediation required to address stakeholder and regulatory concerns.

**Effluents Management**
- Develop and validate precise calculation models for the generation, release, and dose to public of carbon-14 based on unit-specific reactor physics, design, and operation information
- Provide guidance for the precise calculation of carbon-14 dose to the public based on site specific land use, geographic, and climate information.
- Investigate other radionuclides in plant effluents from a risk basis to evaluate any potential impacts to humans and non-human biota as necessary.

**RISKS**

Research risks related to the characterization and mitigation of low level radioactive releases to the environment include:
- Cost-effective detection technology may not be available to measure the extremely low concentrations of radioactivity concerning the nuclear power industry.
- New regulations may introduce new or unexpected requirements that have not yet been addressed.
- Unpredictable public perception and concern may continue to drive actions that are not based on health and safety or risk based environmental protection.