

The Industry Ground Water Protection Initiative:

A Watershed Moment

By Kathleen C. Yhip, George J. Oliver, and Ralph L. Andersen

Nuclear power plant licensees are required to control releases of radioactive liquids and airborne materials from their facilities to ensure that they are below regulatory limits (*Code of Federal Regulations* (CFR) Title 10, Parts 20 and 50) and to provide adequate protection for public health, safety, and the environment. Regulatory requirements for the control of radioactive effluents include provisions for sampling, analysis, monitoring during releases, assessing the potential impacts, and reporting them to the NRC. In addition, licensees are also required to develop and implement a radiological environmental monitoring program to assess the long-term impacts from plant operation.

Decommissioning experience during the 1990s at facilities such as Connecticut Yankee, Yankee Rowe, and Maine Yankee highlighted the potential for small leaks or spills or equipment failures that occur from time to time during plant operation to result in unanticipated subsurface contamination that must be addressed at decommissioning. In addition, inadvertent releases at operating plants (e.g., Braidwood 2005–2006, Byron 2006, Callaway

2006, Indian Point 2005, Dresden 2004, and Salem 2002) brought heightened public and regulatory interest in the issue, although none of these instances resulted in any risk to public health, safety, or the environment.

Inadvertent releases of radioactive material to the environment clearly undermined stakeholders' trust in the openness of communication by the local utility and in the industry's commitment to operate nuclear power plants in an environmentally responsible manner. In November 2005, the Nuclear Energy Institute (NEI) formed a task force to develop a coordinated approach and guidance for ground water protection.

The U.S. Nuclear Regulatory Commission formed the Liquid Radioactive Release Lessons Learned Task Force in

March 2006 to review industry events and any associated public health impacts, industry actions, applicable NRC inspection requirements, and communications with external stakeholders. The NRC task force issued its final report¹ on September 1, 2006. Among the report's 26 recommendations were to augment the existing regulatory framework, review design and maintenance requirements for components that contain radioactive fluids but are not considered safety-related, and perform additional reviews of guidance and regulations for decommissioning and license

The Ground Water Protection Initiative is an industry-developed voluntary program designed to improve utilities' management of inadvertent releases of radioactive substances to soil and/or water and to enhance communications with stakeholders about those instances of unanticipated environmental contamination.

renewal. Regarding public health impacts, the report concluded as follows:

The most significant conclusion of the task force regarded public health impacts. Although there have been a number of industry events where radioactive liquid was released to the environment in an unplanned and unmonitored fashion, based on the data available, the task force did not identify any instances where the health of the public was impacted. (page i)

To ensure that industry's efforts were responsive to the NRC's and other stakeholders' concerns, the NEI staff and key industry representatives participated in several public meetings with the NRC to discuss industry actions and progress on the development of the Industry Ground Water Protection Initiative (GPI) and associated industry guidance. In May 2006, the Nuclear Strategic Issues Advisory Committee for NEI unanimously voted to adopt the GPI,² which established voluntary measures to minimize the potential for inadvertent releases of radioactive liquids to the environment and to improve communication with external stakeholders and provide reassurance that the nuclear power industry is committed to a high standard of public radiation safety and protection of the environment. Interim guidance documents for developing the action plan and for developing the voluntary communication protocol were issued in June 2006.^{3,4}

Each nuclear power plant committed to implementing the Industry GPI by July 31, 2006. During the same time frame, each facility voluntarily provided a summary of previous leaks and contamination events to the NRC that is available on the NRC's electronic system, ADAMS. The major elements of the Initiative included the following:

1. Development and implementation of an action plan to assure timely detection and effective response to instances of inadvertent radiological liquid releases to ground water to prevent offsite migration of licensed material and to quantify the potential impacts on de-commissioning.
2. Expansion of the reporting requirements to include voluntary communication of leaks and spills or sample results for onsite ground water that exceed environmental reporting thresholds and inclusion of those data in 30-day and annual reports to the NRC.

Peer reviews to verify that each facility had an action plan and communication protocols were performed in the fourth quarter of 2006 and first quarter of 2007, respectively. By August 1, 2006, each utility had an action plan in place and had begun to assess its facilities' systems, structures, and components and work practices to identify those items that presented the highest potential for equipment failure or a leak of radioactive material. The initial phase for implementing the GPI also involved updating studies of the site's hydrology and geology as necessary to ensure that monitoring wells were appropriately located to provide for early detection of any ground water contamination. To meet the goal for improving transparency about plant operations, each member company reached out to its external stakeholders to discuss the GPI and their approach for implementing the voluntary initiative.

To ensure that industry efforts were responsive to the NRC's and other stakeholders' concerns, the NEI staff and key industry representatives participated in several public meetings with the NRC to discuss industry actions and progress on the development of the Industry GPI and associated industry guidance.

The very short time frame to develop and adopt the Industry GPI did not allow for industry technical standards to be developed for ground water protection programs prior to the implementation of the GPI. In September 2006 an Electric Power Research Institute (EPRI) committee began work to develop technical guidelines for an effective ground water protection program, resulting in implementation of the GPI occurring concurrently with the development of the guidance. EPRI published technical guidance for a comprehensive ground water protection program in November 2007.⁵

To facilitate the transfer of knowledge, the NEI held a workshop on ground water protection in February 2007. Since then, the NEI and EPRI have held joint annual workshops on ground water protection to provide a forum for industry, vendors, research organizations, and the NRC to interact and share lessons learned to improve ground water protection programs.

NEI Guidance for the Initiative

In August 2007, the NEI issued NEI 07-07, "Industry Ground Water Protection Initiative—Final Guidance Document." This revision incorporated the lessons learned from the industry reviews, requests for clarification and observations during implementation from member companies, and input from stakeholders.

The GPI has become an ongoing program that will apply throughout each stage of a nuclear power plant's life cycle. Following are the elements of an effective ground water protection program to meet NEI 07-07:

- i. To understand the flow of ground water through the site based on the hydrology and geology and to be able to predict how inadvertent contamination would likely move.
- ii. To evaluate systems, structures, and components and work practices that could lead to inadvertent contamination through equipment failure and/or human error.

- iii. To develop an effective ground water monitoring program to provide for early detection of inadvertent contamination and to use that information to improve decommissioning recordkeeping and planning.
- iv. To enhance communications with external stakeholders about events that could result in inadvertent contamination of soil and/or subsurface water, even if there is no risk to public health or protection of the environment.
- v. To ensure independent review and oversight of the ground water protection program.

To accomplish the elements described previously, NEI 07-07 provides specific actions and objectives. For elements i–iii, those objectives are as follows:

- 1.1 Ensure that the site characterization of geology and hydrology provide an understanding of predominant ground water gradients based upon current site conditions.
- 1.2 Identify the site’s potential for inadvertent leaks or equipment failure based on plant design and work practices.
- 1.3 Establish an onsite ground water monitoring program to ensure timely detection of inadvertent radiological releases to ground water.
- 1.4 Establish a remediation protocol to prevent migration

of licensed material offsite and to minimize decommissioning impacts.

- 1.5 Ensure that records of leaks, spills, and remediation efforts are retained and retrievable to meet the requirements of 10 CFR 50.75(g).

For the communication element (iv), the objectives include the following:

- 2.1 Conduct initial and periodic briefings on the site-specific GPI program for designated state and local officials.
- 2.2 Perform “informal” communication as soon as practicable to appropriate state and local officials with followup notification to the NRC, as appropriate, regarding a leak/spill as defined in NEI 07-07 into ground water and onsite or offsite water sample results exceeding the reporting criteria for environmental samples.
- 2.3 Submit a 30-day report to the NRC for any result for an onsite ground water sample that exceeds the reporting criteria for environmental samples of ground water to be used or that may be used as a source of drinking water. Copies of the 30-day report shall also be provided to appropriate state and local officials.
- 2.4 Document all onsite ground water sample results and a description of a leak/spill as defined in NEI 07-07 in the Annual Radioactive Effluent Release Report or the

Annual Radiological Environmental Operating Report.

The final guidance also added objectives for independent review and oversight of the program (element v), as follows:

- 3.1 Perform an independent self-assessment of the GPI program.
- 3.2 Conduct a review of the GPI program under the auspices of NEI.

NRC Activities

The NRC has undertaken a variety of activities to close out the recommendations in the final report of the Liquid Radioactive Release Lessons Learned Task Force. In September 2007, the staff revised the significance determination process for Public Radiation Safety to address unplanned, unmonitored releases or spills as a failure to implement the radioactive effluent release program. The NRC issued Temporary Instruction 2515/173 in May 2008 to assist NRC inspectors in assessing licensees' implementation of the GPI; those inspections began around September 2008. Ground water monitoring and/or site characterization has also been included in several changes or development of new regulations and regulatory guidance. For example, the NRC included aspects of onsite ground water monitoring in new or revised regulatory guidance for minimization of contamination, control of

radioactive liquid and gaseous effluents, and environmental monitoring.^{6,7,8} At this time, they are also considering including requirements for ground water monitoring and/or site characterization in rulemaking and changes to regulatory guidance for decommissioning planning and license renewal.^{9,10}

The GPI Continues

The GPI is and will be part of the ongoing programs for nuclear power plants. At this stage, many nuclear power plants are refining their initial implementation of the GPI by collecting additional data to improve their site conceptual model of the flow of ground water through the site, augmenting existing programs or developing new techniques to monitor the condition of plant components, and improving the administrative controls of their radiological work practices to minimize the potential for leaks or spills or licensed material. NEI-sponsored independent peer reviews are under way to verify that member companies are addressing each objective in NEI 07-07.

Because of increased attention to ground water protection and onsite ground water monitoring, leaks of radioactive liquids from buried piping have been detected. In 2007, the Institute for Nuclear Power Operations (INPO) expanded their plant evaluations to include the condition of buried pipes. The following year, EPRI formed the Buried Pipe Integrity Group and by December 2008 had issued guidance for a buried piping program.¹¹ As a result of the leaks from buried pipes, in September

2009 NRC Chairman Gregory Jaczko requested that the staff review the NRC's existing regulations and activities for oversight of buried pipes and provide the Commission with a paper explaining ongoing and planned generic activities to address leaks from buried piping.¹² Collectively, the industry is working to develop a proactive assessment and management program for buried pipes and is pursuing research in inspection and analysis techniques to better determine the condition of the buried components.

Significant Improvements

All nuclear power plants are committed to implementing an effective ground water protection program, improved management of unplanned or unmonitored releases, and improved communications with external stakeholders. In addition to meeting the objectives of NEI 07-07, new plant applicants may use the NEI 08-08, "Generic FSAR Template Guidance for Life-Cycle Minimization of Contamination," to demonstrate compliance with 10 CFR 20.1406. The early detection of leakage described in NEI 08-08 relies on Sec. 1, Ground Water Protection Program, in NEI 07-07 as the technical basis.

The nuclear power industry has a vested interest in ensuring consistent implementation of the Industry GPI. Regulatory and public confidence in a plant's commitment to responsible environmental stewardship is essential to supporting the ongoing operation of the current fleet and future construction and operation of new nuclear plants.

In the two and a half years since the GPI was adopted, the industry has made significant improvements to the management of inadvertent releases and to ground water protection programs. Many plants have established or augmented periodic meetings with external stakeholders to discuss plant operations, including the routine planned releases of low levels of radioactive effluents from the plant. The response from external stakeholders to recent voluntary communications appears to have benefited from the improved communication and education about the environmental protection aspects of nuclear power plant operations.

References

1. "Liquid Radioactive Release Lessons Learned," Task Force Final Report, U.S. Nuclear Regulatory Commission (Sept. 1, 2006).
2. "Initiative on Ground Water Protection," Nuclear Energy Institute (May 2006).
3. "Industry Ground Water Protection Action Plan Development Interim Guidance Document," Nuclear Energy Institute (June 2006).
4. "Industry Ground Water Protection Voluntary Communication Protocol Interim Guidance Document," Nuclear Energy Institute (June 2006).
5. "Ground Water Protection Guidelines for Nuclear Power Plants," EPRI 1015118, Electric Power Research Institute (Nov. 2007).
6. "Minimization of Contamination and Radioactive Waste Generation: Life Cycle Planning," *Reg. Guide* 4.21, U.S. Nuclear Regulatory Commission (June 2008).
7. "Measuring, Evaluating, and Reporting Radioactive

The NRC included aspects of onsite ground water monitoring in new or revised regulatory guidance for minimization of contamination, control of radioactive liquid and gaseous effluents, and environmental monitoring. At this time, they are also considering including requirements for ground water monitoring and/or site characterization in rulemaking and changes to regulatory guidance for decommissioning planning and license renewal.

Material in Liquid and Gaseous Effluents and Solid Waste," *Reg. Guide* 1.21, Rev. 2, U.S. Nuclear Regulatory Commission (June 2009).

8. "Radiological Environmental Monitoring for Nuclear Power Plants," *Reg. Guide* 4.1, Rev. 2, U.S. Nuclear Regulatory Commission (June 2009).

9. "Guidance to Implement Survey and Monitoring Requirements Pursuant to Proposed Rule Text in 10 CFR 20.1405(c) and 10 CFR 20.1501(a)," draft, U.S. Nuclear Regulatory Commission (Jan. 2008).

10. "Preparation of Environmental Report for Nuclear Power Plant License Renewal Applications," draft, *Reg. Guide* DG-4015, Rev. 1, U.S. Nuclear Regulatory Commission (July 2009).

11. "Recommendations for an Effective Program to Control the Degradation of Buried Pipe," EPRI-1016456, Electric Power Research Institute (Dec. 8, 2008).

12. NRC Chairman G. Jaczko, Memo to R. W. Borchardt, NRC Executive Director of Operations, "Evaluation of Buried Piping at Nuclear Reactor Facilities" (Sept. 3, 2009). ■

Kathleen Yhip is the NEI's senior project manager for Ground Water Protection. George Oliver has retired but was the NEI's senior project manager for Environmental Issues. Ralph Andersen is the NEI's director of Radiation Safety and Low-Level Radioactive Waste. For additional information on this topic, contact Kathleen Yhip at kcy@nei.org.