Underground Piping and Tank Integrity

ISSUE STATEMENT

Many of the world’s nuclear power plants have been operating for about 40 years. As such, aging mechanisms have had sufficient time to potentially challenge the structural and leakage integrity of some components such as buried piping and tanks.

Leakage from plant components has the potential to contaminate groundwater. For example, a number of U.S. plants have leaked some amount of liquids into the soils surrounding piping, tanks, and pipe vaults. Although these leaks and spills seen have not posed a hazard to human health, they have impacted public confidence. The lack of effective tools to monitor and control degradation mechanisms could degrade public and regulatory confidence.

DRIVERS

**Equipment Reliability and Public Confidence**: Contaminated effluent leakage events can impact public confidence and raise questions about equipment reliability.

**Regulatory**: The U.S. Nuclear Regulatory Commission (NRC) issued a “Groundwater Task Force Final Report” in June 2010 which indicates that it is considering regulatory actions for leakage of licensed materials at U.S. nuclear facilities. Non-U.S. regulatory bodies are monitoring U.S. industry and regulatory activities on buried pipe and groundwater protection. The NRC has stated that non-U.S. regulators are recommending that their licensees establish actions to monitor integrity of their buried piping and other structures, systems and components.

**Maintenance Costs**: Significant portions of a nuclear plant’s buried infrastructure (piping systems) were designed and installed without taking into account the possibility of future inspection and repair needs. As a result, inspection and repair of buried components are complex tasks that can complicate outage planning and execution.

**Limitations of Inspection Technology**: The nondestructive evaluation (NDE) technologies that can be applied to inspecting buried piping are limited. Technologies available to the oil and gas industries are typically not immediately transferrable to a nuclear plant’s inspection needs.

**Limitations on the Availability of Codes and Standards**: Codes and standards applicable to the design of buried pipe and the “fitness for service” of buried pipe do not exist. Work is needed to support ASME development of appropriate Code Cases.

**Industry Commitments**: In the United States, the nuclear industry’s chief nuclear officers have committed to two initiatives to address groundwater protection and buried piping. The 2007 initiative on groundwater protection is aimed at preventing radioactive materials from migrating off-site. The 2009 initiative on buried piping integrity is aimed at preventing radiological and non-radiological leakage from buried piping. In August 2010, the scope was expanded to include all underground, normally inaccessible piping and underground tanks.

RESULTS IMPLEMENTATION

EPRI buried pipe research will result in the availability of technologies for inspection, analysis, repair and mitigation of ongoing corrosion in buried infrastructure. This includes:

- Development and delivery of appropriate reference documents and training to support broad knowledge awareness around buried piping.
- Development and transfer of new buried pipe inspection technologies, such as remote field NDE inspection robotics.
- Identification and evaluation of existing technologies that may be directly applied or easily adapted for nuclear plant buried piping inspection.
• Improved understanding regarding the usefulness of guided wave acoustic NDE technologies for buried piping screening
• Availability of repair and replacement alternatives for buried pipe applications, including high-density polyethylene (HDPE).
• Enhanced buried pipe risk-ranking technologies through updates to existing software.

PROJECT PLAN

Research activities are coordinated across EPRI’s Plant Engineering and NDE Programs.

The Plant Engineering Program will provide buried pipe program owner guidance documents, reference materials, and upgraded risk ranking software (BPWorks™), and also will support the development of various ASME Code Cases for repair/replacement activities. Training courses will be offered for newly assigned Buried Pipe Program owners to help ensure buried pipe management guidance is appropriately deployed in the field. Reference materials on cathodic protection will be developed to address buried pipe coatings needs. Through the Buried Pipe Integrity Group, EPRI will provide a forum for information exchange among nuclear plant personnel, vendors and other stakeholders to identify and transfer best practices for buried pipe inspection and assessment.

The NDE Program will focus on the identification and assessment of existing robotic and inspection technologies, as well as the development of new robotic inspection technologies using remote field detection technology. Efforts will continue to identify, demonstrate, evaluate, and qualify inspection technologies suitable for buried pipe applications, with special emphasis on guided wave ultrasonic technologies. Further development of guided wave will focus on modeling of defects using actual buried pipe mockup and plant removed specimens.

RISKS

Significant resources have been expended in the design, fabrication and testing of remote field eddy current robotic technologies. A device capable of testing large diameter pipe (36 inches to 10 feet) has been built and successfully proof-tested. A second robot for piping between 12 and 36 inches has been built and will be proof tested in the spring of 2011. To date, neither of these robotic technologies has been commercialized. As such, it may be an extended period of time before either is available to the nuclear power industry.

Training, qualification, and certification efforts related to guided wave acoustic technology have not attained the same level of written standardization as other NDE technologies. As a result, regulators may not allow its use as an inspection technology. EPRI is working with ASME to conduct materials research on HDPE. A lack of industry involvement may cause this effort to lag.