In Development

A Corrosion-Free Alternative to Steel Pipes

EPRI Looks at High-Density Polyethylene for Pipes in Nuclear Plants

By Sarah Stankorb

Metallic pipes form the backbone of cooling systems in nuclear power plants. Steel is an affordable, strong, readily available, and well-understood material that has been used in pipes in various settings for 150 years. However, it can degrade when exposed to water, presenting potential plant safety and reliability problems.

Since 2005, EPRI has examined high-density polyethylene (HDPE) as an alternative. Made from petroleum, HDPE is a hard, tough, corrosion-resistant plastic, commonly used for natural gas distribution pipes, municipal water transport, and fire protection systems.

“We have a great opportunity to use this advanced material, HDPE, which undergoes none of the corrosion processes that we see in carbon steel piping,” said EPRI Principal Technical Leader Ryan Wolfe. “Before utilities could deploy HDPE pipes in nuclear plants, several technical questions had to be answered. Our research has been aimed at determining whether they are an acceptable alternative to steel pipes.”

When utilities initiate projects to use HDPE pipes in nuclear plants, they do so using an American Society of Mechanical Engineers (ASME) Code Case. This Code Case uses extensive EPRI research performed over the past 12 years as a technical basis.

Scratches, Windows, and Joints

When plastic pipes are moved during construction or installation, their surfaces can get scratched by rocks, soil, and debris. One EPRI test is examining the extent and degree of scratching that HDPE pipes can sustain safely.

“The HDPE piping performed well,” said Wolfe. For two years, pipes with scratches deeper than what is permitted under the ASME Code were subjected to high pressures and temperatures. No failures were observed. These results are being used to propose updates to ASME Code.

If the manufacturer did not thoroughly mix HDPE pipe ingredients, pipes may contain small transparent regions called “windows.” When such pipes are heated and joined, the windows may make the joints more susceptible to cracking. There is neither an established maximum acceptable window size nor a nondestructive technique to detect windows, challenging the use of HDPE in nuclear power plants. EPRI is collaborating with the Plastic Pipes Institute to help address these issues.

Also, the ASME Code Case does not address cold fusion in HDPE joints. Fused joints may appear complete on the surface but may be incomplete and weak within the joint, potentially leading to breakage. EPRI found that three nondestructive evaluation methods—phased array ultrasonics, microwaves, and standing torsional stress waves—are effective in detecting cold fusion in HDPE joints.

EPRI also has examined fatigue, creep, and response to fire and earthquakes.

"So far, every time we answer one of these questions, it's one less concern about using HDPE pipe in a nuclear plant," said EPRI Technical Leader Craig Stover.

In 2018, EPRI plans to publish a comprehensive guide for utilities interested in installing HDPE pipes, pending the results of the ASME Code Case.

Key EPRI Technical Experts

Ryan Wolfe, Craig Stover