



TIP AWARDS

## Entergy wins top prize for vessel head inspection device

EMPLOYEES AT ENTERGY Nuclear's Palisades nuclear power plant in Michigan have received the Nuclear Energy Institute's B. Ralph Sylvania Best of the Best Award for the development of an innovative device used to inspect reactor vessel heads.

The device, called a gimbaled head, uses ultrasonic transducers to identify irregularities within the welded steel reactor vessel head nozzles used for control rod drive mechanisms and nuclear instrumentation. Previously, four different kinds of testing devices were needed to perform the inspection. The gimbaled head device can perform the entire inspection, conducting a more thorough, accurate, and effective examination in less time. Additional improvements have enabled the ultrasonic transducers to produce higher quality and more consistent inspection information.

The Best of the Best Award and 15 other Top Industry Practice (TIP) awards—including four vendor awards, 10 process awards, and a vision and leadership award—were presented during the 2010 Nuclear Energy Assembly, NEI's annual meeting, held May 17–19 in San Francisco.

The Best of the Best Award honors the late B. Ralph Sylvania, an industry leader who was instrumental in starting the TIP awards in 1993. This year, 142 award entries were submitted.

### Vendor awards

Employees at Dominion Power's Surry nuclear plant in Virginia collaborated with Areva to win the Areva Vendor Award for developing a deposit minimization treatment process to decrease sludge buildup on the plant's steam generator tubes, which had reduced steam pressure and could have affected power generation. The previous method for cleaning such material from the tubes required harsh chemicals.

Dominion's engineering and chemistry personnel developed a cost-effective and environmentally sound solution that eliminated the buildup and restored consistent power generation. The new treatment is a safer, simplified system that reduced deposits by 700 to 800 pounds and saved the company about \$32 million. It does not require harsh chemicals, and waste from the

*NEI's Top Industry Practice awards recognize nuclear power industry employees for innovations that improve safety, efficiency, and performance.*



The development of an innovative device used to inspect reactor vessel heads won TIP's Best of the Best Award for employees at Entergy Nuclear's Palisades nuclear power plant. The gimbaled head device, seen here on a delivery platform, uses ultrasonic transducers to identify irregularities within the welded steel vessel head nozzles used for control rod drive mechanisms and nuclear instrumentation. (Photos: NEI)

process can be treated with filtration to decompose the active ingredient.

While the old system required that cumbersome equipment be connected to the steam generator in several places, the new system has smaller and fewer pieces and requires only a single connection. The equipment can be placed in a remote location, eliminating the need for work within the reactor building and enhancing radiation safety and security. The process has application potential for other pressurized water reactors.

■ Employees at Exelon's Dresden nuclear plant in Illinois collaborated with GE Hitachi Nuclear Energy to earn the GE Hitachi Nuclear Energy Vendor Award for the creation of the control rod drive tube-flushing Vortex Tool, designed to remove iron oxide buildup in control rod drive guide tubes.

Iron oxide in the water flowing through the reactor can adhere to fuel assemblies and later detach during refueling, affecting control rod drive mechanisms. The previous method for removing loose iron oxide was to vacuum the guide tubes when the control rod blades were replaced. Blade replacement, however, rarely coincided with the need to remove iron oxide buildup, and the cleaning process was time-consuming and cumbersome.

The Vortex Tool can be used with the control blades in place. It deploys from the bottom of the vessel, flushes iron oxide from the control rod drive mechanism, and then visually inspects the guide tubes with a camera. The tool increases equipment reliability while reducing refueling outage time and radiation exposure. The tool can be adapted for use at all boiling water reactors, NEI said.

■ Employees at American Electric Power's Cook nuclear plant in Michigan received the Westinghouse Design Vendor Award for their root cause analysis of a turbine failure in 2008.

The surface of each failed turbine blade was analyzed for data about the blade loss. State-of-the-art analytical techniques revealed that three blades on two of the three turbines had been subjected to stresses that were exacerbated by a design fault. By determining the root causes of the turbine blade failure, the team facilitated the necessary repairs and Cook-1's return to service. Key lessons learned have been shared with the nuclear industry and will help improve turbine reliability and safety, according to NEI.

■ Employees at Dominion Nuclear Connecticut's Millstone nuclear plant received the Westinghouse Combustion Engineering Design Vendor Award for accomplishing two major plant modifications while increasing safety, reducing worker radiation exposure, and decreasing work time.

First, reactor components known as thim-

ble tubes needed to be replaced, a job performed by underwater divers. This task had been done in the industry only five times before, according to NEI. Using a Westinghouse process-mapping technique, the team overlaid work-flow diagrams from each previous effort and analyzed every step and component down to the minute. This analysis, along with several weeks of diver training exercises, ensured that the safest and most efficient process was used to replace the thimble tubes.

The second modification involved a weld overlay for nine nozzles in the reactor coolant system. The team combined process improvement tools with timed challenges in a mock-up environment to identify the most efficient repair method, enabling the team to refine the process and reduce the time needed to complete it.

The techniques used in both modifications are applicable throughout the nuclear energy industry, NEI said.

### Process awards

Employees at Entergy Nuclear's Palisades plant were honored with the Maintenance Process Award and the nuclear energy industry's B. Ralph Sylvia Best of the Best Award for the development of an innovative vessel head inspection device (described above).

■ Employees of Exelon Nuclear and Areva NP received one of two Community Relations Process Awards for developing and implementing a comprehensive communications plan for the transport of two massive steam generators to the Three Mile Island nuclear plant in Pennsylvania. Two 153-foot-long transporters weighing 825 tons each made a month-long, 75-mile journey across parts of Pennsylvania and Maryland, including 23 municipalities (*NN*, Jan. 2010, p. 48).

Implementing a joint communications plan developed over 18 months, Exelon and Areva employees used new and existing tools to ensure that information about the transport was available to the public, the media, public officials, and other key stakeholders, with the goal of making the process as transparent, safe, and smooth as possible.

The plan included open-house meetings and educational programs, advertising and notifications, and safety briefings and updates. Information was disseminated via the Internet and a Twitter account, and a dedicated phone line ensured that members of the public could call to learn how the transport could affect them. Team members were stationed along the transport route, walking alongside the generators and answering questions from onlookers.

The two steam generators—a shipment more than twice as large as any load ever transported by road through Maryland or Pennsylvania, according to NEI—arrived

safely and on time at the TMI site. The transport garnered more than 110 news stories, and more than 12 000 spectators turned out to witness the event.

■ Employees at PSEG Nuclear's Salem and Hope Creek generating stations in New Jersey received a Community Relations Process Award for an outreach program that built public support for the license renewal of the plants and an early site permit for a potential fourth reactor at the Salem/Hope Creek complex.

The company hosted meetings with elected officials and business groups and formed an active partnership with the local media. Community groups were offered plant tours that included a visit to a control room simulator and enabled visitors to learn about everything from plant design and licensing requirements to safety and security. Members of the public met with security personnel, plant management, training personnel, and subject matter experts.

In all, more than 430 people toured the plants, and more than 730 met with members of the PSEG Nuclear leadership team. The program was bolstered by partnerships with the local community college and technical schools to establish nuclear technology degree programs to develop the future workforce.

When the license renewal application for the Salem and Hope Creek plants was submitted to the Nuclear Regulatory Commission, no contentions were filed, and significant community support was shown at the public meeting on the license renewal.

■ Southern Nuclear Operating Company employees collaborated with Westinghouse to earn the Equipment Reliability Process Award for the development of first-of-its-kind engineered leak rate seals, which have improved the reliability of Westinghouse reactor coolant pumps. Poor seal performance can result in the shutdown of a reactor coolant pump and, consequently, the shutdown of a reactor.

Low levels of seal leak-off resulted in four forced or extended outages at Southern Nuclear power plants between 2004 and 2008. To address the issue, Southern Nuclear employees formed a subcommittee that developed and copyrighted the engineered leak rate seal. The subcommittee determined that the angle of the seal surface is critical to seal performance and leak-off flow. The group collaborated with Westinghouse to improve the manufacturing process in order to produce a seal with a more tightly controlled seal angle, measured to millionths of a degree. The new seal ensures that leak-off remains within normal levels and cannot drop low enough to affect the pump's performance.

Westinghouse now offers the engineered leak rate seal for use with Westinghouse 93A and 93A-1 reactor coolant pumps throughout the industry. The new seals have



“Before” and “After” shots of a check valve that underwent electrochemical cleaning at the Tennessee Valley Authority’s Browns Ferry-1. The cleaning is part of a program at the plant that helped win its employees TIP’s Management Processes and Support Services Process Award. The program—which incorporates a variety of technologies, including the application of a protective coating to key materials to maintain equipment and prevent the buildup of cobalt—has resulted in Browns Ferry-1’s having the lowest occupational dose to workers at any BWR in the world.

been installed in two of Southern Nuclear’s reactors and are performing well, according to NEI.

■ Exelon Generation Company employees received the Nuclear Fuel Process Award for the development of the Fuel Vendor Collaborative Management Review Process, an integrated process implemented across Exelon’s fleet of reactors to ensure that relevant issues are regularly discussed with its three fuel vendors.

The process is centered on regularly reviewed performance indicators in 11 areas ranging from engineering productivity to fuel integrity and reliability. Initiatives and improvements are developed, and the fuel vendors have the opportunity to provide feedback to Exelon. This open dialogue facilitates continuous improvement and has resulted in cost savings and improved safety and efficiency.

An example involves the metal control blades that move in channels inside the reactor fuel assemblies. Durability issues were brought to management’s attention through the review process. Now, by improving the capability to predict and address interference between control blades and the channels they move in, the blades will be fully utilized through an extended, carefully monitored operating lifetime.

Easily transferable across the nuclear industry, the review process also resulted in steps to protect fuel, implemented a core design strategy to use fuel more efficiently, reduced worker radiation exposure, and increased safety.

■ Employees at FirstEnergy Nuclear Operating Company’s Beta Laboratory received the Materials and Services Process Award for their success in upgrading integrated control system circuit cards. By developing an in-house solution based on manufacturing processes, the team enhanced the design and

produced a more reliable circuit card while saving time and money.

Because integrated control system circuit card malfunctions can cause power reductions and other plant challenges, improved equipment reliability was also among the team’s top goals. The new circuit cards feature improved relay design and higher performance specifications, which enhance plant reliability and reduce the preventive maintenance needs of the plant, according to NEI.

Every step of the process was completed in-house, including design enhancement, prototyping, manufacturing, and assembly. The final step was a rigorous testing process conducted by a comprehensive automated program that was also developed in-house. The in-house solution upgraded the circuit cards for 8 percent of the cost of off-site manufacturing. This innovation saved more than \$1 million and contributed to greater supply chain efficiency.

■ Exelon Nuclear team members at the Peach Bottom plant in Pennsylvania earned the Operate Plant Process Award for the development of the Exelon Jet Pump Ultrasonic Cleaning Hummingbird, which is used to clean the jet pumps that control the reactor power level.

Jet pumps regulate the power level by ensuring that enough water flows into the reactor vessel, where it is changed into steam. Millions of gallons of water flow through the jet pumps, and the large amount of flow can result in a buildup of microscopic corrosion products. Over time, this buildup can increase vibration and reduce flow, requiring more fuel to compensate for lost generation.

The standard technique for removing corrosion from jet pumps is ultrahigh pressure cleaning, which requires that portions of the jet pumps be disassembled and re-

moved from the reactor vessel. The team developed methods utilizing an ultrasonic cleaning bath, which has also been used to clean pressurized water reactor fuel assemblies. The method allows the jet pumps to be cleaned more often and more effectively to combat buildup before it interferes with power generation. Most important, the new cleaning method requires no jet pump disassembly. As a result, it improves safety and has a positive impact on outage scheduling.

■ American Electric Power received the Plant Support Process Award for its innovative solutions during turbine restoration at the Cook nuclear plant.

The loss of several turbine blades led to turbine failure and subsequent damage to the lower exhaust hoods that are the outermost casing of the turbines. Vibration created friction between the base of the exhaust hoods and the surface below, necessitating detailed inspections, leveling, and repairs that included straightening bent turbine rotors.

The team used an innovative lifting technique to raise the 175-ton hood for inspections and repairs. Instead of disassembling the hood into several pieces and repairing each one separately, which could have resulted in inconsistent adjustments, the team raised the entire hood as a single unit. This innovative method eliminated the disassembly process, thereby reducing the likelihood of a safety incident and saving time.

The team also pioneered a method to straighten three bent and damaged rotors that didn’t require complete disassembly. Using heat, vibration, and high-speed spinning, each of the 400 000-pound rotors was successfully repaired, eliminating the need for costly replacements. This project involved 3 million work hours and the lifting of heavy loads totaling 43 million pounds,

and it was completed without a single lost-time or restricted time incident.

■ Employees at the Tennessee Valley Authority's Browns Ferry-1 in Alabama received the Management Processes and Support Services Process Award for a program that resulted in the lowest occupational dose to workers at any boiling water reactor in the world.

The integrated source term reduction program has reduced the amount of radioactive cobalt available to be activated and thus distributed in the plant. The multifaceted program incorporates a variety of technologies, including the application of a protective coating to key materials, to maintain equipment and prevent the buildup of cobalt. X-ray fluorescent technology also was used to identify cobalt that needed to be removed.

The benefits of the program are numerous, according to NEI. With a lower occupational dose comes a reduced need for engineering controls, respiratory protection, and administrative controls in high-radiation areas. The program has also shortened outage time and improved worker efficiency. For radiation protection technicians in particular, the program allows a greater focus on improvement rather than constant monitoring. This program is expected to lower radiation exposure and yield millions of dollars in cost savings, NEI said.

■ Employees at Southern Nuclear Operating Company's Vogtle nuclear station in Georgia were recognized with a Nuclear Training Process Award for their training dosimetry simulator that creates a virtual radiation environment where workers can develop their skills to keep radiation exposure as low as possible—well below federal limits.

Previously, instructors followed trainees so that they could alert the worker of higher-than-expected doses. The new method combines two technologies. The first, Virtual Radiation Environment, is a software program that allows a trainer to define a virtual radiation zone and assign radiation sources and areas of varying radiation levels. The second, Near-Field Electromagnetic Ranging, uses low-frequency radio to track worker location in real time. Together, these technologies display the exposure levels based on the worker's location within the virtual radiation zone. It is a realistic approach that ensures that workers remain protected from radiation as they gain actual work experience, NEI said.

In addition, the system maps the steps the worker will take in performing an upcoming task. By reviewing the task map, planners can eliminate unnecessary actions, minimize idle time, and reduce radiation exposure, thereby making the work process safer and more efficient.

### **Vision and leadership award**

Employees at Progress Energy's Harris nuclear plant are recipients of the Vision and Leadership Award for their pioneering developments in fire protection.

In 2004, the NRC approved the use of the National Fire Protection Association's performance-based standard. The Harris fire protection team has led the industry in implementing the standard, focusing on two actions in particular to improve fire protection.

First, because extreme heat can damage conventional cable, the team replaced vital and vulnerable cables with a fire-rated version that can withstand three hours of exposure up to 2000 °F. The use of fire-rated cable in critical areas helps ensure that the plant can be shut down safely in the event of fire.

Second, the team developed an early-warning system that can detect fire-prone conditions before a fire can start. The system monitors critical equipment for signs of degradation and notifies operators so that preventive maintenance can be performed before problems arise.

The Progress Energy team led the nuclear energy industry through this important strategic fire protection process. Their innovations will improve nuclear plant safety and produce significant savings across the industry, according to NEI. **IN**