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An Inside Look at Ft. Calhoun's Big Outage

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Fort Calhoun's "Big Outage"

BY MICHAEL R. JONES

While other nuclear plants have replaced some components during refueling outages, Fort Calhoun is the nation's first to do it all at once.

ON DECEMBER 3, 2006, the Fort Calhoun Nuclear Station successfully completed one of the most ambitious and complex outages ever attempted in the nuclear industry. In addition to routine maintenance and the replacement of one-third of the fuel assemblies in the reactor core, the outage included the replacement of the plant's two steam generators, the reactor vessel head, the pressurizer, the low-pressure turbines, and the main output transformer.

Fort Calhoun, a 478-MWe Combustion Engineering pressurized water reactor located in eastern Nebraska, is owned and operated by the Omaha Public Power District (OPPD). The unit started commercial operation in June 1974.

Ross T. Ridenoure, vice president and chief nuclear officer of OPPD, is responsible for the safe and reliable operation of Fort Calhoun. Ridenoure admits that initially there were some in the industry who thought that the plant had taken on too much for one outage. "Looking back at what we were able to accomplish, that was clearly not the case," he said.

Ridenoure

The $417-million project was completed five days ahead of schedule and approximately $40 million under budget.

Ridenoure said the decision to undertake such an extensive refurbishment project followed a great deal of study and consideration. Fort Calhoun had been operating for 27 years when, in late 2000, OPPD began looking at extending the life of the plant as an option for meeting future generation needs. Life extension would require the renewal of the plant's operating license, which was scheduled to expire in 2013.

A detailed study performed by OPPD determined that a 20-year license extension was the best and least-cost option to help meet future electricity demand. The study also determined, however, that such an extension would require the replacement of some of the plant's original nuclear components, such as the steam generators.

The study resulted in the preparation of a detailed aging report, along with the submission of a license extension request to the Nuclear Regulatory Commission. After nearly two years of review, the NRC approved the extension request in November 2003.

Ridenoure said that even before the NRC granted the license renewal, OPPD began planning for the replacement of the plant's steam generators. The scope of the refurbishment was subsequently expanded to include other major components, such as the low-pressure turbines, the main output transformer, the reactor vessel head, and the pressurizer. In addition, plans were made to replace some components, such as the main condenser and moisture separators, in 2005 in preparation for the 2006 outage.

"We spent literally hundreds of thousands of man-hours on our planning—everything from detailed outage planning, identifying and quantifying risks, developing contingency plans and mitigation strategies, and creating the kind of teamwork among our people, our vendors, and supplemental personnel necessary to make refurbishment a success," he said.

Ridenoure adds that while other nuclear plants in the United States have replaced some of their components during refueling outages, "we are the first nuclear power plant to do it all at once."

One major step in replacing the main components was creating an opening in the containment building large enough to accommodate the massive equipment that would be moved in and out of the building. Because the walls of the containment building consist of four-foot-thick reinforced concrete, this was no small task. The process of cutting through the containment wall took about a week. Workers accomplished the task using industrial-sized jackhammers, cutting torches, and smaller jackhammers.

Meanwhile, to accommodate moving the components in and out of containment, a steel rail runway was built to support special cranes that were used for the heavy lifting inside containment. Once the big nuclear components were replaced, the reinforcement bars were replaced, the concrete was repoured, and the containment opening was resealed.

Ridenoure admits that the challenges posed by a project with such a large scope were staggering. "We recognized this going into the outage and overcame these challenges through solid teamwork by everyone involved—in-house and supplemental personnel alike—and, of course, all of the detailed planning that we did during

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the months preceding and during the outage," he said.

Ridenoure notes that a lot of eyes were watching with interest the results of the outage, including OPPD, Wall Street, and the nuclear industry. "Because so much was at stake, we knew that we simply could not afford to fail," he said. "Even before we actually began the outage, many people from other utilities came to Fort Calhoun to review what we had done up to that point and gave us excellent feedback on what we could do better to improve our preparations."

Representatives from at least six utilities that plan to replace their own steam generators in the next five years were on site during the outage. Ridenoure said that their purpose in being there was to learn what works and what does not.

Another critical element of the project was accommodating the personnel needed to successfully complete the refurbishment. In addition to the roughly 650 in-house OPPD employees, more than 1800 supplemental personnel were hired to support the outage. That made some seemingly simple tasks not so simple. For instance, Ridenoure notes that just getting those people on site, finding them a place to park their vehicles, getting them into the plant, and finding a place for them to sit or put their gear became a huge logistical effort. The plant ended up creating various "outage success teams" to address key logistical issues—everything from satisfying parking needs and developing a temporary trailer siting plan to providing an equipment lay down area for equipment coming out of and going into containment.

One example of how well the system worked was the plant personnel who were responsible for getting the supplemental workers their badges and ensuring that the contractors' training was completed. The average time from arrival on site to being ready to work—about 50 hours in Fort Calhoun's previous outage—was reduced to 32 hours, with no decrease in quality.

"The bottom line is that it took a huge effort to make sure the infrastructure was in place to support having all those additional people on site at one time," Ridenoure said.

Two significant lessons learned came out of Fort Calhoun's Big Outage, according to Ridenoure. The first was that it is possible to successfully manage several projects in parallel and complete them ahead of schedule and under budget. This lesson, he said, should be carried forward in preparation for the nation's next-generation nuclear fleet, in that what was accomplished during the Big Outage could serve as a microcosm of what is needed for the successful construction of a new nuclear plant.

The second lesson was that the Big Outage demonstrated to other utilities that might be considering refurbishments of a smaller scope that it is possible to expand the scope of an outage and accomplish in one outage what otherwise would take two or three outages.

In the end, the outage was a success because of the people involved, Ridenoure said, adding that these workers were "110 percent committed to the success of the project, regardless of for whom they worked." Early in outage preplanning, Fort Calhoun started a "One Team, One Goal" campaign to underscore the importance of working together. The idea took hold, and as a result, there were consistent leadership behaviors in many key areas: teamwork, communications, planning, and respectful but firm "pushback and problem resolution," he said. The "One Team" message was promoted before and during the outage to ensure that the plant was ready and able to execute the plan.

Now that the outage is complete, Ridenoure said that he is elated with the outcome and extremely proud of everyone who supported it. "This was an enormous project," he said, "and to do what this team did—and to do it safely, with no serious injuries or lost-time accidents, with very high quality, and under schedule and well under budget—is nothing short of amazing." NN

An inside look at Fort Calhoun's "Big Outage"

A transport barge carries new steam generators, a pressurizer, and the reactor vessel head (not shown) to the Fort Calhoun nuclear plant in Nebraska. The components were manufactured by Mitsubishi Heavy Industries in Kobe, Japan. (Photos: James M. Uhland/OPPD)

WITH THE THEME of "One Team, One Goal", the 25th refueling outage at Fort Calhoun included work that made it one of the most complex outages ever undertaken by a U.S nuclear plant. In addition to refueling the plant's 478-MWe Combustion Engineering pressurized water reactor, jobs included installing a new reactor vessel head and two steam generators, and new low-pressure turbines, a pressurizer, and a main output transformer.

Some of the components arrived by barge from Japan. To fit them into containment, plant workers had to create an opening large enough to accommodate them while moving them in and out of the building.

The outage was completed last December five days ahead of schedule at a cost of $417 million, about $40 million under budget.

The photographs that follow tell the outage story.

Right: The new steam generators are taken directly from the transport barge to a temporary storage tent on site.

Left: Workers loosen tendons on the top of Fort Calhoun's containment building before their removal so that an opening can be created in the side of the containment building. The tendons are used as just one measure to keep the containment building tight and secure, similar to twine tied around a package.

Above & Inset: In order to cut the opening in the containment building, workers use jackhammers to remove the final few inches of concrete surrounding the rebar that is part of the containment's liner.

Left: With the containment opening created, workers clean out a channel that once contained a tendon.

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Above: This view is from inside the containment building looking out. Workers prepare for the moving of large components through the opening.

Right: One of the two old steam generators is removed from containment to make way for the new components. The old steam generators were moved to the ground from the holding platform, about 80 feet in the air, at a rate of 1 inch per minute.

Below: As it makes its way out of the containment opening, an old steam generator is surveyed by the plant's Radiation Protection group.

Below right: A worker welds one of the new steam generators into place.