THE *NUCLEAR NEWS* INTERVIEW

Ed Avella: Turkey Point's award-winning vessel head replacement

Faced with hurricanes and a lack of work space, Turkey Point was still able to complete a pair of reactor vessel head installations in 46.5 days each.

Ed Avella is director of projects for Florida Power & Light Company (FPL). A project recently completed by FPL was a big one—the replacement of the reactor vessel heads at Units 3 and 4 of the Turkey Point nuclear power plant. FPL's decision to replace the heads was a proactive one because the existing heads were in good condition and not yet physically degraded. But the company wanted to avoid the extensive examinations and repairs of the heads that were likely to come down the road, based on industry experience with primary water stress corrosion cracking (PWSCC) in Alloy 600 reactor head penetrations.

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The replacement project involved three main parts. First, because the existing equipment hatches in the containment buildings were not large enough to accept the new reactor heads, temporary openings had to be cut through the steel tendons and concrete that make up the buildings. Second, because of the lack of qualified suppliers of nuclear-grade concrete in the area, FPL had to set up a temporary facility to produce replacement concrete of specification standards. Third, with a lack of work space around Unit 3, a tower crane had to be used instead of a more traditional crawler crane, and the tower crane had to be anchored to foundation pilings that reached down 65 feet into the earth.

The project was completed last June, when the installation job at Unit 4 was finished, 34 months after the initial formation of a project team to handle the job for the two units. One of the project's main requirements was safety compliance, and during Unit 3's head replacement (completed in December 2004—*NN*, April 2005, p. 42), there were only two OSHA recordable injuries and 18 minor injuries. By the end of Unit 4's head replacement, through the use of job hazard analysis and lessons learned, no OSHA recordable injuries were experienced and only 10 minor injuries were recorded.

By the project's end, records had been set in the industry for lowest radiation dose to workers for both vessel head replacements. So impressive was the performance that *Power Engineering* magazine, in its January 2006 edition, named the Turkey Point-4 work the "Best Nuclear Project" of 2005.

Avella said the outstanding performance of the whole effort was due to the teamwork of company and contracted workers. No single person carried the project, but all were responsible for completing it safely and under budget.

The Turkey Point site, in Florida City, Fla., has four generating units. Units 1 and 2 are fossil powered generators, while Units 3 and 4 are Westinghouse pressurized water reactors. The nuclear units are each rated at 720 MWe. Unit 3 started commercial operation in December 1972, and Unit 4 in September 1973.

During his talk with *Nuclear News*, Avella was joined by FPL's Mike Moran, engineering manager; Alan Katz, construction manager; and Dick Sipos, project manager. For purposes of this interview, Avella is the only one quoted. The interview was conducted by Rick Michal, *NN* senior editor.

What was the project's timeline, from initial planning to final completion?

We started in August 2002, when the project team was formed, and ended in June 2005. We scheduled 67 days for completion of each installation job, but we were able to complete each in 46 and a half days, saving considerably on costs. Our initial activity was to order replacement reactor head forgings for the two units. That was followed immediately by extensive engineering and construction planning.

What were the conditions of the vessel heads when they were replaced?

They were the original Westinghouse heads from when the units first came on line in the early 1970s, and they had no history of repairable indications. The project was developed based on what was happening in the industry in 2002, with data indicating that there was a trend toward PWSCC in Alloy 600 reactor head penetrations. For FPL, it boiled down to what the cost would be to inspect the heads every outage and then do necessary repairs. The fact is, we didn't want that hanging over us. What we wanted was the reliability of having the units come on line when planned and being able to make electricity for our customers. The new heads gave us the confidence that we could do that.

The process of doing head inspections and repairs and then being able to come back on line is subjective in that there is no predictability to it. Other nuclear plants, for instance, have spent months off line doing repairs or having to do emergency head replacements. It's a situation we did not want to get into, because the "risk profile" for the Turkey Point units put them in the high-risk category due to their age and the temperature at which the reactors operate. That's what prompted us to move quickly. We did not want to have the risk of unplanned activities.

A service platform was constructed next to Turkey Point-3's containment building. Faint orange markings on the concrete wall indicate the "cut line" where an opening would later be created in order to move reactor heads in and out of containment. (Photos: FPL)

Which vendor made the replacement heads?

The heads were made by Areva, in France, specifically for our Turkey Point units. We placed the first order in October 2002, the first of what were a few different submittals of purchase orders. That first order was for the raw materials that had to be forged into mono-block—or one-piece—heads. The intent was to get one forging going as the first step of a horizontal process. By that I mean that first we ordered the forgings, then the nozzles, then the drives, and finally the integrated head assemblies. The heads were then delivered to Turkey Point one at a time, based on a production schedule that got them here at least 30 days prior to the outages.

What were some challenges of the project?

One challenge was that the heads had to be assembled at Turkey Point. All the parts were delivered from France, where they were made. We like to joke that there was a label attached that translated from French to English to say, "Some assembly required."

Another challenge was that we had to make openings in the containment buildings that the heads could fit through. We decided to make the openings a little bigger than what has been the norm in the industry—approximately 20 ft by 32 ft—so that we could bring the heads in completely assembled and in the upright position. That way we didn't have to assemble the replacement heads in radiation areas. Each head was put together in a temporary building that we call the monster garage, which is 40 ft by 40 ft by 85 ft high and cost $1.6 million to build. If you can imagine, before assembly each head looked like a giant Frisbee, and we put it in the garage, welded the drives on, and then built the integrated head assemblies on top of that. Once the head was assembled, we slid it into the containment building and then repaired the opening in the building.

How were the openings created?

For each one, we had to de-tension 108 tendons, cut and remove 62 of those tendons, and remove 110 yards of concrete. These steel tendons had been tensioned to 748 000 pounds. We worked with SGT [The Steam Generator Team, LLC, a company formed by Areva and Washington Group International] on cutting the openings and, later, on the restoration process, and also for the rigging and hauling of all the reactor heads, old and new. To create the openings, we had to hydro-blast away the concrete, which required twelve 500-horsepower diesel engines that powered four nozzles that shot out 90 gallons of water per minute at 25 000 psi per nozzle. In addition, the wastewater had to be taken away, and the aggregate had to be removed and remediated. Our work on Unit 4 was the briefest duration for such a job in the industry. It took only 29 hours for the tendon removal, and 23 hours for head removal. These are industry records.

We also had to set up a temporary plant to make nuclear-grade concrete to patch up the openings because there are no nuclear-grade concrete suppliers near Turkey Point. The concrete had to match the original design specification and achieve a design strength of 7200 psi in less than 72 hours. And it did. SGT handled the concrete mix and material qualifications.

Why was a tower crane used for the Unit 3 job?

In one word, space. Because of the way the plant site is configured, we couldn't bring a large crawler crane onto such a small footprint. We just didn't have the space available because Unit 3 is right next to one of Turkey Point's fossil units. On the other hand, a crawler crane *was* used for the Unit 4 job because space was available there, but for Unit 3 there was no room for anything but a tower crane.

The tower crane was huge—more than 250 ft tall—and it had to be capable of lifting a reactor head weighing 143 tons. For that job, we had to set up a 100-ton work platform that had deep "cast-in-place" pilings for support. The pilings were necessary because of the poor soil conditions of the Florida coastline. Each of the 12 pilings was 24 inches in diameter and 65 feet deep. The crane also had to be able to withstand hurricane force winds of up to 160 mph, which came in handy because soon after installation, three hurricanes hit us. The crane had been demobilized before each hurricane, of course, but it never suffered any damage.

The unit's old reactor head was wrapped in a blue cover before leaving containment through the construction opening.

What were the radiation dose figures for each replacement job?

The Unit 3 job had an industry-low radiological dose rate of 5.8 rem, compared with the industry average of 23.67 rem for head replacement projects. Unit 4 came in even lower than Unit 3, for a new industry record, with a radiological dose rate of 5.685 rem.

How many workers were on the job, and how many person-hours were used?

Combined, there were 450 FPL and contracted labor workers on this job. Most of them were union craft. All combined, we spent 750 000 person-hours on direct construction, head fabrication at the plant, and installation of the heads. And it was well in excess of 1 million person-hours when engineering, planning, and support work were added in. For all that work, there were only two OSHA recordable injuries and no lost-time accidents. It was an incredibly successful project. While good planning counts, it is teamwork that makes the difference. SGT was our main contractor, and they used four or five different subcontractors. We also got great cooperation from Areva. And, of course, FPL Project Management and Engineering managed the project. No one team did the job. It was all three of us—FPL, SGT, and Areva—that did it. We all became one team, and there was no difference between utility and contracted personnel when we got up to speed. That's the one thing that brought us success where other places have struggled.

Why did you use union craft?

It's our commitment to the building trades. We have a strong belief in teamwork, and it has us in alignment with the international building trades—we're proud of that. They respond to us because they know we go to them when we need people. For this job, SGT and Areva knew that we had built a relationship based on mutual respect with the union craft, and that we trust the craft to do the job right. Our own FPL workers are unionized, too, but for this job we went almost exclusively with union craft brought in by our contractors.

And if I can blow our horn a little for the project's team leaders, I will. This includes myself, Mike Moran, Alan Katz, and Dick Sipos, who were all in FPL management positions on the project and who were all instrumental in its successful completion. Some credit also has to go to FPL's senior management, because they put together a team of people who know the plant. We're not just guys who have construction and engineering backgrounds, but we're people who have worked in these plants. We were able to say, for example, "This is a good feature to add to the new reactors." It worked out well getting people from the utility to manage the project.

The new reactor head is suspended from the tower crane before being placed on the service platform.

What lessons learned came out of the project?

The Unit 3 head replacement was done first and was successful. It got us to change a lot of the process before we went on to the Unit 4 job. The other thing regarding lessons learned is that the process didn't really start with the Unit 3 job. Before that, we did a significant amount of benchmarking throughout the industry. We went to every utility possible that had a similar project on the books or was planning one so that we could take their lessons learned back to Turkey Point. It's great being in the nuclear business—everyone else calls it industrial espionage, but we call it benchmarking. We did more than 10 000 person-hours of benchmarking time for the Turkey Point project.

Did your team handle the pressurizer project at FPL's St. Lucie-1 nuclear plant in late 2005?

Yes, it did. The same project team got back together at St. Lucie and successfully replaced the reactor head and pressurizer at Unit 1—and made many more benchmarks for the nuclear industry. This was performed within four months of the Turkey Point replacements, so we accomplished a total of three replacement outages within 15 months.

Turkey Point's head replacements recently won you a "Best Project" award from Power Engineering *magazine. What's up next for your project team?*

The team is now honing continuous improvement skills for the "Big One." This will be a steam generator replacement, reactor head replacement, and a pressurizer Alloy 600 mitigation project at St. Lucie-2, scheduled for fall 2007. The focus on "first-time quality of welding" will ensure schedules will be met. There is no doubt that this seasoned team will continue setting records and industry benchmarks. NN