

THE NUCLEAR NEWS INTERVIEW

Hart and McCollum: An overhead job at Oconee

An ambitious refueling outage was completed last fall at Duke Energy's Oconee-3 nuclear power plant. In addition to the refueling work, activities included the replacement of control rod drive cables and the inspection and repair of some Alloy 600 welds on reactor vessel penetrations. The largest job, however, involved abating and recoating half of the carbon steel liner plates in the dome of Unit 3's containment building. The job was necessary due to the aging of the 35-year-old coating system—consisting of a zinc primer and a top layer of enamel paint—on the liner plates. Paint chips were flaking off the liner plates and falling down inside the containment building, causing plant operability concerns.

What made the job especially challenging was that it had to be done in a radiologically contaminated environment and at 187 feet above ground level, using thousands of pounds of specialized scaffolding that was supported by clamps attached temporarily to a metal grid in the upper areas of the containment building.

The Oconee plant, in Seneca, S.C., houses three Babcock & Wilcox pressurized water reactors, each rated at 886 MWe. Unit 1 started commercial operation in July 1973, Unit 2 in September 1974, and Unit 3 in December 1974.

All three Oconee units have had containment areas where the coating systems were degraded, but the dome

Abating and recoating half of Oconee-3's carbon steel liner plates in the containment building's dome had technicians working 187 feet in the air.



Rick McCollum (left) and Allen Hart, holding some tools of the trade, headed the coatings project at the Oconee nuclear power plant. (Photo: Chad Rawlings)

portion of Unit 3 needed the most work. The two people who headed up the recoating project—Oconee's Rick McCollum, job sponsor and coatings technical support, and Allen Hart, civil engineer and scaffold technical support—offered their insights on the job to *Nuclear News*. McCollum has worked at Oconee for more than 30 years. Hart, who worked at the plant for 12 years, recently took a position at Bartlett Nuclear. He collected some of McCollum's responses to questions about the project, and later talked about the recoating job with Rick Michal, *NN* senior editor.



How long has Oconee been dealing with the issue of degraded coatings?

McCullum: We identified the failed liner plate coatings as an issue about 10 years ago, but our commitments to the Nuclear Regulatory Commission regarding repair efforts and actual work on the units started in late 2003. That's when we did some patch work to Unit 1. Oddly enough, there were unique areas of each unit that needed attention, rather than similar, across-the-board problems, which is what might be expected. For example, the coatings on Unit 1's polar crane were in particularly bad shape, whereas the vertical portions of the liner plates in Unit 2 and the upper dome of Unit 3 needed the most attention.

How did the problems develop?

McCullum: Inside the containment building, the dome is made up of trapezoidal panels—flat liner plates that approximate a dome. The plates were originally primed and coated in the late 1960s or early 1970s, depending on which of Oconee's three units we're talking about. The coating consisted of a sprayed-on layer of zinc primer, followed by a topcoat of enamel paint. The coating was applied in a field outdoors as the plant was being built, which meant that there was a certain amount of overspray because of the wind's effect. Over time the primer oxidized, as it was supposed to, to protect the substrate, but when it did so the topcoat of paint was no longer securely "attached" to anything. The problem was that when the zinc oxidized, it created a gray powdery substance, and it was that powder the paint was adhering to instead of the liner plate metal.

How did you fix the problem?

McCullum: We'd done experiments where we stripped off the outer layer of paint and tried to remove the old zinc, but we could never remove all of it. So, during our experiments, a new layer of coating that we applied wasn't lasting even one fuel cycle. We determined that we couldn't just try to strip off the old zinc primer, we had to mechanically remove it all the way down to the bare metal. We identified the two worst quadrants of the dome and totally abated the liner plates down to bare metal, using a vacuum-head tool to suck up all the powder we were grinding off. The tool has a flapper wheel that grinds all the way down to the substrate metal. It leaves a somewhat rough surface that helped the adherence of the new coating, which is an epoxy paint called Carboline 890. Not only did the new coating chemically bond to the liner plate, but the substrate had enough

surface profile that it had a mechanical bond, too.

Were paint chips falling down inside containment?

Hart: Yes. Before we completed our re-coating project, you could look up and see that one plate would be unblemished, while the one beside it had potato chip-size flakes coming off it. The big concern that drove the coating repair was not aesthetics, but that those flakes could negatively affect the performance of the plant. For example, if we were trying to take suction on the emergency sump to keep the reactor core cooled, the emergency sump could be inoperable if the debris falling from the dome clogged the intake filters.

Did you recoat the entire dome?

Hart: No, we did half of it during the outage. If you stood in the center of containment and looked up at the dome, it was as though a line were drawn from north to south, and the entire western hemisphere was recoated. We used paint brushes and rollers to do the job. The outage planners wanted us to spot and patch in order to save time, but we realized that the stripping and painting was the easy part. The hard part was getting the scaffolding up there, which was 187 feet above ground level. We talked the outage management into letting us do the entire hemisphere instead of just a patch job.

Do you plan to go back and recoat the eastern hemisphere?

Hart: Management hasn't decided, although everybody would like to do it from an aesthetic standpoint. It's much brighter now inside the reactor building because the new paint is an off-white color. No one realized how much the old paint had faded. When we put on the new paint and turned on the lights, it seemed like daylight in there.

What was the duration of the project?

Hart: Unit 3 was shut down for the refueling outage on November 1 of last year, and the actual dome coating work started on November 8. We were given a 25-day window within the outage for the dome work, but we did the job in 23 days and change, saving about three or four work shifts. We worked the project around the

clock. One crew did not descend from the dome area until the next crew was up there to relieve them.

What were the considerations that went into your recoating plan?

Hart: Identifying and prioritizing the degraded areas was the easy part. After that was done, we had to work with the outage planners to look ahead several years and determine which outages would have large enough work windows to support a large job like ours. Of course, budgets, personnel availability, and training figured in. Also, when all of this first came into play, we didn't have any idea how we were going to access some of these areas. The liner plates were painted during the plant's initial construction, of course, and that was at a time when no one gave much thought to ever having to go back for coatings maintenance.

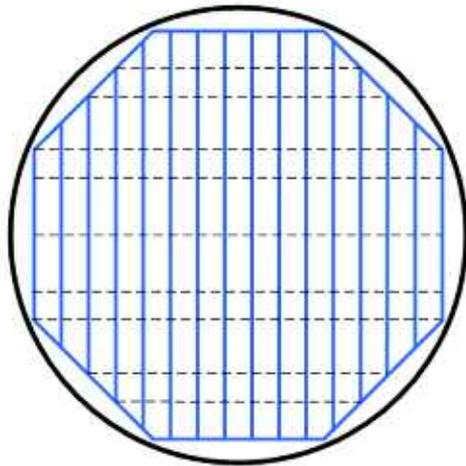
How did you access the work areas of the dome?

“The big concern that drove the coating repair was not aesthetics, but that those flakes could negatively affect the performance of the plant.”

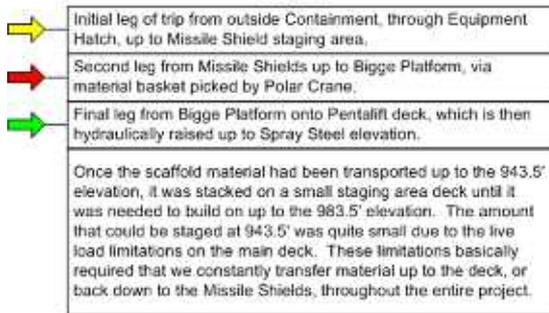
Hart: We built a scaffold up there. The key, I think, was taking advantage of the spray header steel up in the dome area and working off of that. The spray header steel is a gridwork of 8-inch steel I-beams located at the area where the dome caps off the top of the wall of the containment building. Seven-eighths-inch-diameter steel sag rods that go all the way up to the ceiling of the dome support this entire grid. The reason the grid is there is to support the 6-inch-diameter stainless steel piping right below it. That piping is the building's spray system, and every so often there are spray heads on the piping. If we had an emergency situation in containment and the building pressure was going toward 60 psi, we could pump cool, borated water up to the piping and the water would spray down through the containment building, which would condense the steam cloud and drastically lower the pressure in the building. The spray system is a key component of the emergency core cooling system.

Continued

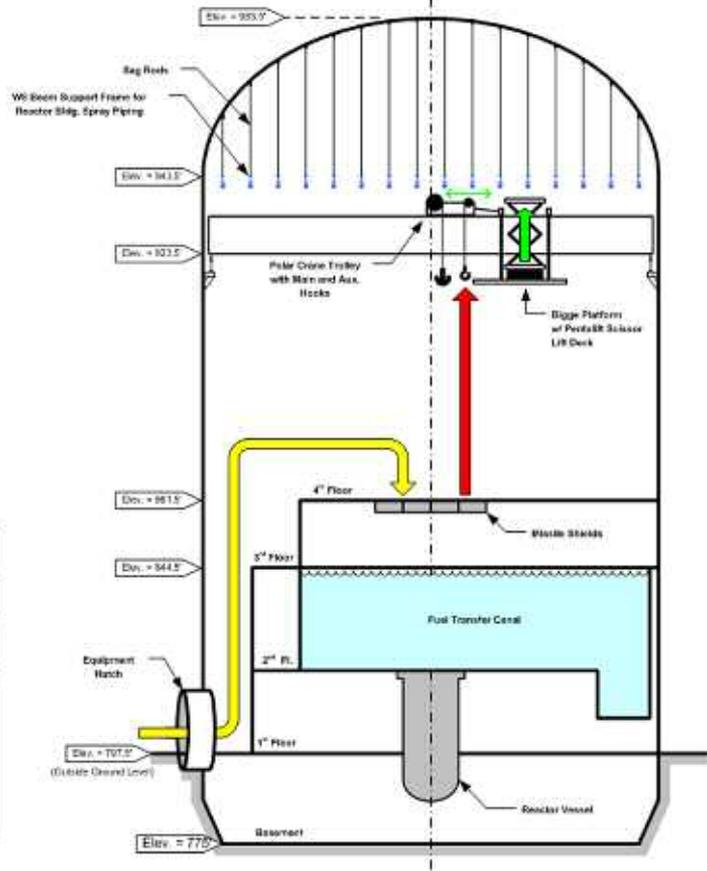
ONS Unit 3 Containment Bldg. Plan View
(Showing Spray Steel Framework Only)



Scaffold Material
Flowpath



ONS Unit 3 Containment Bldg. Cross-Sectional Elevation View



Illustrations showing the spray header steel grid (left) and a cross-sectional elevation view inside containment at Oconee

So, you used the gridwork as the base of the scaffold instead of using the ground floor of the containment building?

Hart: That's right. We had no floor up there to build a scaffold on, so all of the design that we did was centered on the spray header steel. That was the only thing like a floor that we had to build on. Basically, when we started to design the scaffold, we took into account that we had an I-beam every 7 feet running the width of containment, supported by X number of sag rods, each of which can carry Y amount of weight. We divided it out and calculated that in no place in this design could the scaffold weigh more than Z pounds per square foot. One of the big constraints in designing the scaffold was not only developing a design that could be affixed up there, but it had to be light enough not to exceed the allowable loading. We could have built a gargantuan structure, but we couldn't guarantee that the sag rods would hold it up.

Did you have to build the scaffolding to standards?

Hart: Yes. Federal safety laws require any structure like that to have a four-to-one factor of safety. If I say that I'm going to put 100 pounds per square foot up there, the actual structure, per square foot, has to be able to carry 400 pounds.

What were the dimensions of the scaffold?

Hart: The scaffold consisted of 5178 pieces, weighed almost 81 000 pounds, and when installed, its area covered 50 percent of the containment dome. It was 114 feet wide and almost 37 feet tall.

How was the scaffolding secured?

Hart: We designed a special foot that was key to all of this. The foot clamped to the top flange of the spray header steel, and the scaffold started up from there. There were no scaffolding legs that came down to what you would call a solid structure. When you came into containment and looked up, it looked like the scaffold was just hovering there. Excel Modular Scaffolding, of Walker, La., custom designed and fabricated the scaffolding system for us.

What other major pieces of equipment were needed?

Hart: For the most part we had to come up with very specialized systems that were customized for the specific area that we were attempting to access. Before we started abatement work in any of the containments, we saw that we needed a large and dependable work platform that rode on the polar crane bridge girders and had a means of lifting material up to the area where the spray header steel is located, which is about 20 feet above the crane girders. For that lift platform, we partnered with Bigge Crane and Rigging, from San Leandro, Calif. We

have been using that platform for all three abatement jobs. We used it first for scraping loose coatings off the spray header steel on Unit 1 in 2003, and we used it again to abate and recoat the entire polar crane on Unit 1. It's the same platform that was used for access and material movement when we recoated Unit 3's dome.

We also made extensive use of Sky Climber swing stages to abate and recoat the vertical wall portions of the liner plate in Unit 2's containment building over the course of several outages, the last one being in 2005. A swing stage is like the platforms that window washers use when they're working on tall buildings.

What were your primary concerns and considerations in planning the Unit 3 project?

McCullum: With a project of this size and complexity, there were plenty of make-or-break issues to think about. Of course, the primary consideration in any of our projects is safety. If we could not have developed a totally safe and dependable access system like the one we used, the dome job would not have happened. We were asking a lot from our coatings technicians to do this job, because they had to dress out in protective clothing, wear full-face respirators, and deal with other requirements. They didn't need to be worrying about whether or not the scaffold they were working on was safe.

What specific safety measures did you take during the job?

Hart: When we first looked at potential means of access for this job, we knew that dropped objects represented a huge risk. That led us to pursue a debris netting system, because parallel outage work would have to continue at elevations below us. Once we had the scaffold feet clamped on the spray header steel, the rest of the scaffold went up quickly. Also, since Excel's scaffold is a modular system, there were a lot fewer individual components, such as clamps, that could be dropped. We felt that anything that reduced our risk of a dropped object was a good thing.

Excel's production engineer, Ken Hensley, was also very diligent in working with us to come up with ways to save weight on the system, but still provide an acceptably rigid structure. Staying within our predetermined dead load and live load limitations was crucial and nonnegotiable. Dead load typically refers to any structure that you're putting in place, while live load means the workers, tools, and equipment that you're going to put on that structure. Those limitations allowed us to be sure that the scaffold and the spray header steel that was supporting it would provide the required safety factors. Not only was this critical for personal safety, but since we were building above the reactor and other critical components, it figured heavily into nuclear safety.

Did you practice doing the job beforehand?

McCullum: Yes, we did. That, along with providing practice for the scaffold builders, was one of the main reasons we did a full-scale mockup exercise using the actual scaffold components out in the parking lot, prior to the actual work in containment. Also, in addition to the scaffold mockup, we used a small mockup of the liner plates so that the coating technicians could practice using the abatement tools.

What about radiation protection activities?

Hart: The scaffold and coatings work was monitored and controlled by the Oconee radiation protection technicians to ensure that proper control was being maintained to keep the workers safe. Afterward, the scaffold components, which were contaminated, were stored and will be handled and controlled in the future as contaminated material.

Who did the abatement and coating work—was it Oconee personnel or contract workers?

McCullum: We used vendors for the job. Personnel availability and help with project management and oversight drove us to request bids for a turnkey labor contract. We ended up awarding the job to a partnership of Environmental Enterprise Group and Cannon Sline. That worked out well because it allowed Allen and me to step back

from the project and provide an additional, higher level of oversight.

What were the key contributors to the project's success?

Hart: I appreciate the contributions that all of the groups on site made to the project, including outage management, engineering, and safety, among others. We had several in-depth tabletop reviews that exposed some areas in our plan that needed more work. In one of those reviews, we invited peers and subject-matter experts from the other two Duke nuclear sites and the general office. They looked at our plan from a fresh perspective and provided insights that we would never have come up with. Just the fact that we had to defend our plan in front of other groups meant that we had to put it all on paper. We had to explain in detail every procedure, such as how we were going to get workers from containment's fourth floor up to the work platform, and from there up to the spray header steel, and from there up to the scaffolding.

Our safety people really got involved in what kind of harnesses and tie-off methods we were going to use. We ended up going with what is called 100 percent tie-off. Instead of having one lanyard with a safety clip on a worker's harness, he would wear two lanyards with clips. If he had to walk from one point to another, he'd first unhook one of the two lanyards, walk a few yards and hook it up, then go back and unhook the first one, and so on until he got to his destination. At no point was he unattached from the structure. Once you get up above 8 or 10 feet in the air, you don't want to fall, and we were 187 feet in the air.

I have no doubt that some of their suggestions relating to safety actually prevented injuries. We're very pleased that we performed a project of this size with only one minor injury. In that incident, a worker lost his grip on a tool that was tied off and it swung back and hit him. He took a few hours off to get checked out, but he was back at work the next day. Also, out of more than 80 000 pounds of scaffold material and tools that were brought up and then back down, we had only two small dropped items, and our debris net caught them.

Were you satisfied by the results of the project?

Hart: Yes, definitely, and it's left me with a tremendous sense of accomplishment. It's one thing to get the work done, but the fact that everybody got to go home has left me feeling very satisfied. All of these contractors work off the road, and the fact that they got to go home to their wives and kids is what it's about. If we could not have figured out a way to do it that we felt good about, it would not have been done. **NW**

See photo feature on pages 40–41 →



Oconee-3's containment painting project

LATE LAST YEAR, Duke Energy's Oconee nuclear plant completed a project to recoat a portion of the carbon steel plates that line the dome of Unit 3's containment building.

An Oconee team planned the project to fit within a 25-day window during a refueling outage. The recoating job, done in a radiologically contaminated environment and at 187 feet above ground level, involved grinding off layers of old paint and applying new layers of primer and epoxy paint.

To access the containment dome, a temporary scaffold was built in an area above the polar crane. The scaffold was supported by a gridwork of 8-inch steel I-beams called the spray header steel. To ensure that the job would be done safely, workers first practiced on scaffolding built outside the containment building using a mockup of liner plates to test the paint abatement and recoating tasks.

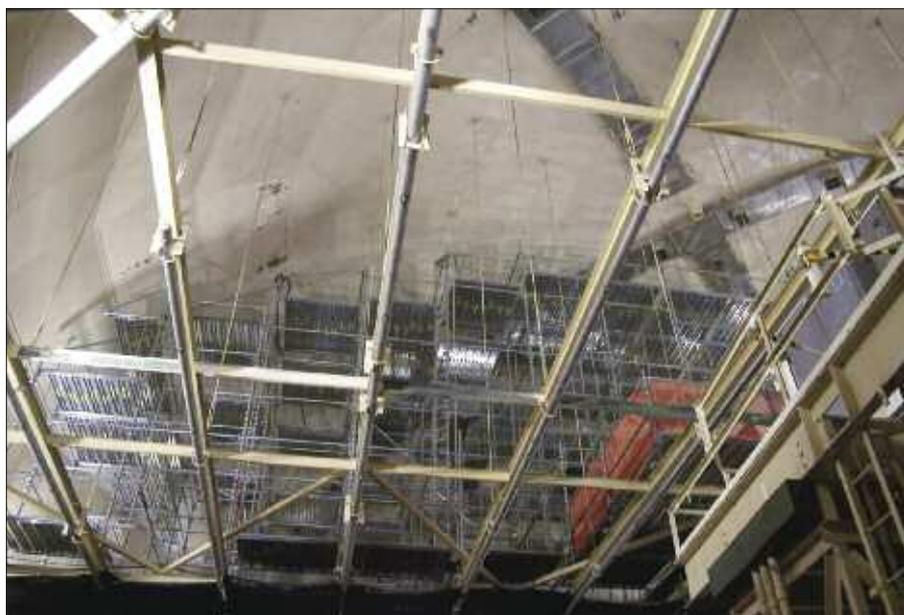
The recoating project was necessary because the existing coating system—made up of 35-year-old primer and paint—was failing. Paint chips were flaking off the liner plates, causing some plant operability concerns.

By project's end, workers had recoated half of Unit 3's dome, which was the goal, in less than the allotted time and with only one minor injury. The photographs on these pages help tell the story of this challenging project.

Top: This view, inside Unit 3's containment building, is looking up through the grid formed by the spray header steel. The dome shows some areas of failed coatings. (Photos: Bill Meldrum/Oconee)

Right, top: Workers construct a scaffold mockup on the grounds of the Oconee plant. Although difficult to see, an exact layout of the spray header steel grid and the liner plate perimeter was painted on the concrete slab supporting the scaffold. The mockup represented about half of what was actually built in containment.

Right, bottom: Scaffolding was erected on top of the spray header steel.





Top, left: Workers building the scaffold.

Top, right: The scaffolding was attached to the spray header steel by using a customized foot fabricated by Excel Scaffolding.

Bottom, left: A view looking down into containment from the ring girder that supports the polar crane bridge.

Bottom, right: A worker in protective clothing applies a new coat of epoxy paint to the containment dome.

