

THE NUCLEAR NEWS ROUNDTABLE

## Plant maintenance: Lessons learned and the benefits of collaboration

To obtain a perspective on what utilities and vendors must consider when performing major maintenance work at nuclear power plants, *Nuclear News* convened a conference-call roundtable discussion with a fleet-level utility manager and three executives in the vendor/contractor realm. Much of the discussion centered on the kind of work that is done during refueling outages, but the participants were also asked to address topics such as aging management, workforce mobility, and the use of electronics to simplify work processes, as well as to raise points for discussion and to follow up on points raised by others. A main topic of discussion was the collaboration among vendors and with plant personnel, and how utilities and vendors benefit when they have a vested interest in one another's success.

*Four industry executives joined Nuclear News in a roundtable discussion of nuclear power plant maintenance issues.*

The participants were Ken Sturtecky, executive director of fleet outages for FirstEnergy Nuclear Operating Company; Roger Maggi, vice president of key accounts for Areva; Gary McKinney, president of Day & Zimmermann NPS; and Kyle Harsche, vice president of Westinghouse Americas. Steve Wanczyk, of Braithwaite Communications, was instrumental in gathering this knowledgeable group of industry executives for the purposes of the roundtable. *NN* Senior Editor E. Michael Blake prepared the questions that were presented to the group and served as the moderator of the roundtable discussion.

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Sturtecky



Maggi



McKinney



Harsche

*What are your planning processes for refueling and maintenance outages? How have they developed, based on your past experience?*

**Sturtecky:** I can lead off the discussion from a utility perspective. FirstEnergy has outage-readiness procedures that back up to two years in advance of an outage. Milestones are set up for the specific areas of preparing for an outage—scope, schedule, budget, and selecting vendors are just a few key areas. The procedures have been built with fleet and industry experience. The industry does a good job of sharing procedures and best practices. We also incorporate feedback and input from our key partners in order to make the procedures work efficiently.

If we have a procedure and it's creating difficulty for the vendors, we'll go back and modify the procedure as long as it does not conflict with our core business. We try to facilitate and work together for the common benefit.

As I said, the procedures are set up with milestones that are required to be met across the board. It doesn't matter if you're a large vendor, a small vendor, or just an individual department. If you're responsible for a milestone, you are required to meet it. Each milestone is reviewed by the outage management team at each of the sites to ensure that it has met the closure criteria specified. With that, as part of that readiness process, we perform a fleet readiness as-

essment. We also have readiness meetings with the executive leadership team.

We'll have a T-6 meeting, with the primary focus of covering scope. At T-3, we hold an in-depth peer team review, when we bring in industry experience and expertise. We look at the unique aspects to ensure that the site is ready to execute the outage and has developed contingency plans as needed. The T-2 meeting, in which all of our vendors are included, is to demonstrate readiness to the leadership team. Finally, to tie in what we have learned during the outage, we conduct a T+1 meeting, which includes lessons learned that will be carried forward not only for the site but for the fleet as well. We do not want to experience the same challenges or issues in future outages.

**McKinney:** I would just add to what Ken had to say that as the maintenance contractor on-site and an alliance partner to FirstEnergy, it's obviously important to us and to everyone that we plan the work and work the plan. To accomplish that, we become engaged early on in the customer's planning efforts. Certainly that allows us to work toward a successful outage. In addition to the T-minus meetings that Ken referenced, we have a proprietary outage readiness assessment tool. It's a Web-based tool that is designed based on the industry milestones with regard to readiness and is specific to our scope of work. We bring in a team of

subject matter experts from other locations to do an independent review of the Day & Zimmermann outage scope, just to confirm that we are, in fact, prepared. That review allows us to bring all of our industry lessons learned and to leverage them into readiness for the upcoming outage.

**Harsche:** To set some context, perhaps it's worth saying something about the economic situation in which we're currently operating in the nuclear industry. Electricity prices are low, demand is flat or down in many regions of the country, there's pressure from natural gas and subsidized renewables, etc. Especially for merchant nuclear operators, this translates to a significant pressure to deliver on planned outage schedules. It was commonplace in the past to see a 60- to 90-day outage schedule. Today, target durations are in the 30-day range, or even lower. That imposes unique requirements to get ready to execute.

First of all, we work very closely with Ken's organization in particular to coordinate deep-dive review meetings. They are different from the run-of-the-mill readiness checks. They actually go to a very detailed level to be sure that everybody is aligned and coordinated with what needs to be done to execute that outage safely and on schedule. A second area is pre-outage work—the work that needs to be done before the outage begins to set the stage for success during

the outage. A third is ensuring very close integration with the site's planning team to be sure that schedules are aligned and agreed upon and that work prerequisites are aligned and in the schedule, so that we don't have any surprises when we execute. And finally, communication and alignment are key. Many of us have seen the video-gone-viral of the team that built a house in less than four hours, but it takes a lot of coordination to get that done. While not to that extreme, an outage is still a very well-orchestrated event these days, and it requires a lot of up-front planning and in-depth reviews. From my perspective, those four areas have now become standard procedure, which is a significant improvement over years past.

**Maggi:** We talked about internal challenges, procedures, milestones, and the importance of following those, and the points that Kyle brought up were very relevant as well. I do know that as alliance partners to FirstEnergy, we all bring that commitment to the table. One of the things that I believe has become standard for all three of these companies is the site services manager and the role that person plays in the day-to-day activities and coordination at the site. We all are doing these outages every spring, every fall. We're at dozens of plants every year. But having that one dedicated resource who is strictly focused on their plant is key. So

there's a Westinghouse person, an Areva person, or a D&Z person who is focused on a specific plant, doing all those alignment activities to which Kyle referred, looking at the schedules, and participating on high-impact teams, helping to deal with new, first-of-a-kind technologies or items that have challenged the team in the past. That person has usually been at the site for many, many outages and has that knowledge and history. When you approach these outages with a utility to which you are closely partnered, as we all are with FirstEnergy, and you have these additional resources there to help the team and provide all that coordination, it really makes a big difference.

*To expand on what Kyle mentioned about the importance of staying on the outage schedule, have any of you found that with the plants getting older, the work related to aging management influences how long an outage will be? The outage schedule is set by the licensee, but are there things you've had to do that are newer and more recent in order to work aging management into the service you provide?*

**Harsche:** It's actually working in both directions. There are plants in operation with original components that do require some additional inspection, or in some cases, repair. But also, many of those plants have undergone component replacements

and upgrades, as in the case of Beaver Valley Unit 1. New steam generators have inspection and maintenance requirements that are actually fewer and farther between due to the next-generation materials that are utilized in those components versus the original. Another example is simplified head assemblies, which allow disassembly and reassembly to be done safely in a more coordinated and efficient manner.

**McKinney:** I would add that with Day & Zimmermann, it's certainly important for all the partner contractors to effectively mitigate the impact of any emergent work, or additional scope, or scope growth that you may experience during an outage. That requires some collaboration, not only with our customer but also with each other, in performing risk analyses and evaluations on the work packages as they're prepared prior to the outage. That carries over into developing contingency plans, so that if we encounter a worst-case scenario as we begin work, we're still prepared to execute the work and pick up the slack.

**Maggi:** That's a good point. I'd just like to finish this off as far as the vendor side on developing those contingency plans and being ready for the emergent discovery issues. They do happen, but not quite as frequently as they did in the past, believe it or not, even though the plants are getting older. The plants are being managed better. We know

what the issues are. We know that Alloy 600 is an issue. We know where to look for the potential problems, and we have the solutions ready to go. In the past, problems would surprise us, and we sometimes had to develop solutions on the fly. I think we have the ability to actually do more work in shorter outages because of that experience, which is what the big vendors bring. But I also want to point out, especially with the three vendors here in this discussion, that there were several times—very recently at Palo Verde and also specifically at Davis-Besse—where Westinghouse and Areva have had to pull together to address some very significant Alloy 600 issues. And they had to rely on each other's capabilities and be willing to work side by side, which I think we've all done very well. This is an industry that we need to protect and save. We can't do that if we're not willing to work together.

**Sturtecky:** There is a very significant strategic planning process that we go through that covers how we schedule all of our units within the fleet. This starts from a financial basis of looking at the market and reviewing the demand needs of the grid. If we experience a forced outage at a nuclear plant, we theoretically can move an outage back by the duration of the forced outage without having an impact on the life cycle of the plant. On the other hand, we can't just be moving outages all over, be-

cause we rely on those key critical resources that each one of our vendors provides to us. They're not supporting just FirstEnergy; they have other utilities, other customers, other outages. We're always working together to maximize and optimize where our outages are well in advance so that not only do we have the resources to support our outages, but they have the resources to support the other companies with which they work.

Now, to describe how we scope our outages. Our first priority is to address both nuclear and personnel safety. We strive to scope the outages from the standpoint of doing the right work in the right outage. That starts with the development of the long-range business plan, which primarily covers the large components and significant work planned. The long-range plan is a 10-year plan that is developed to help ensure that work is bundled in the appropriate outage. We set backbone outage durations and build from there to support our business goals. We combine a financial analysis with a technical analysis of what work needs to be performed. We drive those durations down to meet the outage duration and criteria, based on how long it takes to shut the unit down, take the reactor apart, refuel, and then put it back together. That's what we call the backbone. If we have a long outage driven by a unique

scope of work, we try to optimize by including other large scopes in that outage. To ensure that we have the right work and that it is achievable in the outage, we perform vertical and horizontal schedule reviews to make sure we're not driving too much in one duration or too much in one location or in a system.

Westinghouse, Areva, and D&Z not only bring their world experience, but also their contingency planning based on their experience. They help us develop our decision trees and unique outage plans, which allow us to assess risk for the outage. We balance our outages between corrective maintenance, preventive maintenance, surveillances, and plant improvements. Being in a merchant fleet, we have to make the hard evaluations and look at whether it's the right work for the plant, in order to not challenge nuclear or personnel safety. We rely on support from our key vendors that are involved in this roundtable. They are an integral part of that process with us on the components and the equipment we use and work on.

*A few years ago, FirstEnergy went to a tighter fleet organization. Does that allow you to coordinate outages among all the plants in such a way that you can have specialists working on outage planning for all of the plants in the fleet?*

**Sturtecky:** We have a corporate organization that has responsibility for both nuclear and fossil outages. We have teams on both sides of the house that help coordinate and, to some extent, plan. Their focus is on strategically planning and coordinating fleet outages, not on physical “go-and-do-work” aspects. We share resources across all of our power plants, and nuclear to fossil. We also line it up on the nuclear side with our vendor resources so that we don’t overlap outages. This provides personnel a small break between outages when we’re going to go back-to-back. The ability to schedule our outages sequentially typically saves in-processing time for the workers and allows us to be more efficient, as they understand the expectations and have the standards and behaviors that we’re looking for at our power plants. We try to optimize and use our personnel and those people who support us in the most efficient and effective way so that we don’t burn them out.

*How vertically deep do you go as far as sub-contractors or sub-subcontractors that you bring in for outage work? Do these tend to be organizations with which you’ve worked often?*

**Maggi:** It’s very important, even critical, that we have high returnee rates to our sites and our utilities. That familiarization really cuts down on the learning curve, not just from the difference in working, say, fossil versus nuclear, but working from plant to plant. Having that tribal knowledge with high returnee rates really increases your odds of being able to stay on that critical path schedule. I think we all try as much as we can, even with the change in demographics in the industry, to bring as many of our subcontractors back to a plant as possible to really minimize the use of people who are new to the industry, unless they’ve gone through an extensive training program and mentorship.

**Harsche:** I would echo most of what Roger said. We have a couple thousand Westinghouse employees dedicated to outage work, and that’s our first pool. We then use one or two of our partner subcontracting entities to augment crews where appropriate. Again, that allows us to maintain the high returnee rates, and also to get standard training and qualifications in place so that we have the right people for the right role at the right time.

**McKinney:** We rarely use subcontractors, with the exception of specialty or subject matter expertise. On the manual labor side, the area of welding comes to mind. We may need to do some automated welding for which we might use a subcontractor. We basically self-perform our work. I would add, though, that we set up—as we have done at FirstEnergy and other major utilities around the country—a tripartite arrangement with the union building trades. We meet with

those folks on a periodic basis. The tripartite relationship includes FirstEnergy, the contractor, and the union labor organizations. We keep them up to speed as to where we are, what work is upcoming, and what skills are required. If we have a particular type of project that union workers have done previously at another plant, we may work with the unions to bring staff over from that plant to the new plant. We also spend significant time with their training organizations to confirm that the right training is taking place. Meanwhile, as it relates to our temporary supervision, we utilize a system called “Temp Help” that maintains all the personal information, industry experience,

and past performance evaluation history in one central location. We can quickly identify, based on the scope of work that is on our plate, who the qualified management team should be. We can confirm that they’re available for 12 to 18 months ahead.

*Are there new techniques that you can adapt to an outage to do tasks more quickly or to confirm more quickly that they’ve been done correctly?*

**Harsche:** I’ll offer something that we’re beginning to deploy: remote expertise. For many years we’ve had a centralized command center with the ability to review specific inspection data. If you are inspecting a

large component such as a steam generator, there can be remote review of the data, and if there is an action that needs to be taken, it can be reviewed by the subject matter experts at the command center. There are both quality and cost benefits to this approach. Today, we're expanding this approach to include standard refueling and outage services, whereby we have video capability to actually see what is going on at an outage from our command center location. When a situation arises, we can have the right people looking in real time at the situation to determine the best course of action. It's a pretty exciting new development utilizing today's technology that affords us a next-generation look at and approach to both quality and maintaining the schedule during outages.

**Maggi:** In terms of new technologies that can improve outage performance on the aging nuclear fleet, one of our main focus areas at Areva is the remote nondestructive examination [NDE] capabilities for both the BWR and the PWR fleet. The aging management programs will require a high level of inspection analysis, which is what Kyle is referring to, and the ability to get through the data and to have that communication quickly resolved as it's being seen is important. It's also important that we all work to develop better technologies for gathering the data. The materials reliability program will have us all inspecting the vessel internals over the next eight to ten years in great, great detail. Developing remote NDE capabilities will help us get through these outages efficiently, minimize the risk of missed areas or errors in inspections, and really allow the utilities to properly plan an outage with inspection schedule certainty.

*At ANS's Utility Working Conference, held in mid-August, Neil Wilmschurst, vice president of nuclear for the Electric Power Research Institute, gave a presentation on EPRI's efforts to improve that. He noted that if you can do more remote manipulation of ultrasonic testing, the people who actually do the assessments and the evaluations of the tests can stay out of the high-radiation zone so they don't pick up the dose. As a result, they aren't limited on the number of tests they can perform in a year.*

**Maggi:** That's right. You can do the entire reactor vessel exam in a 10-year in-service inspection in about two to three days. There is nobody in the reactor building during that exam. The manipulators are performing exams throughout the reactor vessel and are driven remotely by inspection personnel outside of containment through the use of fiber-optic networks. Data can be viewed in real time thousands of miles away by data analysts. You're right, the dose becomes much less of an issue.

**McKinney:** We utilize some 3-D modeling or mapping, which allows us to see areas

that are not typically accessible while the plant is on line. It helps us identify rigging requirements or interference concerns so that we can do the appropriate planning ahead of time. In addition, we have a radiation protection group that does some area modeling. But one thing that I think has made a big difference in our business is pre-planning tools, which we talked about earlier, and the fact that those tools are now Web-based. All the leadership of the organization can easily look at a dashboard every morning to see where we are in regard to our readiness state at one of the First-Energy outages and how our behavior-based safety program is performing. It's said that a safe outage is a successful outage. It's important that we have access to safety information as close to real time as possible. That way, we can look at lagging indicators and identify leading issues that we can get in front of quickly. There have been some real advances that have put things right on our smartphones. No matter where we are, we can see if we have an issue we need to get in front of.

**Sturtecky:** When we go into an outage, our power plants use remote technology, such as cameras, where applicable. We have monitors set up in strategic areas so that personnel who need to see what's going on don't have to go out there and expose themselves to the dose field. Those are set up through our radiation protection organization. Some of our vendors bring their own equipment that they set up in their working locations as well.

The second thing we do to improve efficiency is to ensure that the personnel are trained for the evolution or activity. Our site personnel train with our vendors at their facilities, wherever they might be. They utilize full-scale mock-ups in a teaming atmosphere. Then, when the workers come together at the site, they've already worked together. They know what to anticipate from each other, and they have a pretty good idea about how to communicate. This also enhances our efficiency.

The third point is that we predesignate issue response teams. Each includes site personnel as well as our vendors. They are part of the team, and they facilitate some of the meetings and the recovery plans that we have.

The last point is part of what FirstEnergy is working on to streamline our work process. This is to use electronic devices to work from versus traditional paper documents. For example, a work order could be generated in the field, with pictures, if required. The end user could then use an electronic device to perform the walkdown and the work.

*Are you using electronic work packages yet?*

**Sturtecky:** Not yet. We do some tasks electronically—some of our preventive maintenance tasks and our surveillances

that are duplicates. All the planner has to do is autoprint, and the worker can add whatever notes, comments, or changes are needed. That is a level of automation we have right now, along with any of the pictures or drawings that would be added to a work order. They're all electronically captured, and then we save them electronically as well.

*Clearly there is growth in the use of electronic technology in this kind of work. Obviously we can't discuss cybersecurity in any kind of detail. As you think about taking more of these initiatives, however, do you find that you have to get regulatory guidance in advance?*

**Sturtecky:** Regulatory guidance has already been provided to utilities. As technology changes and evolves, we need to ensure that we do not violate any of the rules that are in place. Cybersecurity is directed toward the power plant, but whoever has mobile devices is also required to conform to the same requirements.

*On the vendor side, do you have to find out in advance whether or not an electronic innovation will be acceptable for cybersecurity?*

**McKinney:** To Ken's point, any technology we utilize on-site requires the client's approval. Anything we're doing is vetted through the client and approved for use on-site.

**Maggi:** I believe that because we are companies that have cybersecurity solution capabilities, we are well aware of what the requirements are and we're able to comply, knowing what is acceptable and what is not. As far as the equipment that we bring to a site, it's easier to isolate those networks from the utility or plant computers. Where you really get challenged is in doing plant modifications, where you are actually bringing in new systems, perhaps going from an analog to a digital system somewhere in the plant, and having to make sure that you design the cybersecurity and necessary requirements into that system.

**Harsche:** Gary's and Roger's comments are on point. I would just note that the types of remote communication technology advancements that Westinghouse is making—we discussed those in the previous topic—are separate from plant systems. They're akin to using a telephone to relay information back to headquarters and would follow more standard information technology and computer prudence rules rather than regulatory-driven cybersecurity requirements.

*How do you track situations that have occurred at plants and make sure that they lead to learning and improvement?*

**Maggi:** We took a page from the utility playbook and developed our own outage control center [OCC] four years ago. It's staffed 24 hours a day during the outage

season, and all of our sites call into that center together at a specified time every day. Each outage is discussed for safety, quality, and human performance issues. All of that information is shared not just with the OCC, but also with each plant, as appropriate plant staff are online listening to the other plants' issues so that lessons learned and trending can be picked up immediately. Actions can be taken to mitigate the possibility of repeating the issue in another outage, and if an outage needs additional support, the staff in the OCC is able to gather appropriate resources and respond quickly.

**McKinney:** On the Day & Zimmermann side, obviously we want to get as close to real time as possible. Safety infor-

review external operating experience as well, such as that issued by INPO.

*Now we'll give each of you a chance for closing remarks.*

**McKinney:** Ken mentioned the need to work together, particularly with regard to training and confirming that we have the right subject matter expertise. I'd like to share a couple of opportunities that we're currently working on because they include all three vendors that are on the phone. I know that with Transnuclear, which is part of Areva, you have pool-to-pad services, and we recently sent a crew of multidisciplined individuals down to Aiken, S.C., for some specialized training. And then we're supporting some of

Westinghouse's services at Perry with radiation protection technicians, and we recently put a number of those folks through some Westinghouse-specific training. The point I want to make is that in addition to being partners with the utility, we're also working with each other to make sure

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mation goes into a database, and we push it out for future opportunities to prevent the same issue from recurring. But I commented earlier that a number of our systems are Web-based, and we receive the information on our smartphones. If we have a near-miss or any safety issue at any of the projects across the country that we're working on, the entire executive team and I immediately receive a notification on our phones so that we can quickly engage. We have what we call “flashes” that go to all of our project managers so they can immediately see the issue with a general description of what occurred. We can quickly rally the troops and get in front of that specific situation, in addition to putting measures in place to try to prevent that type of incident from occurring again.

**Harsche:** At Westinghouse, we utilize at least three systems. First is our corrective action system, compliant with Nuclear Regulatory Commission, Institute of Nuclear Power Operations, and ISO standards. Second are customer- and outage-specific post-project reviews, out of which come lessons learned and operating experience. Third is our daily human performance brief. Similar to what Roger outlined, we host daily communications from every one of our ongoing major projects. The outcome of that can range from something similar to the “flash” that Gary just described, all the way up to a stand-down of all crews nationwide, and in some cases worldwide, depending on the significance of the issue. Of course, we

that we're all pulling in the same direction.

**Maggi:** I think FirstEnergy has done a great job of fostering a culture and environment in which three competitive vendors are encouraged to come together to work through issues and produce a team result in outage execution, and we've demonstrated our ability to do that many times. That is something in which FirstEnergy has really excelled.

**Sturtecky:** I'd like to echo those comments. We're all in this together. We have a long-range vision that has all of us working together in a collaborative effort with all of our vendors. Our key vendors are equally vested in the long-term success of our power plants as we are in the long-term success of their companies. We need each other to survive, and we coexist together. Even though there is competition, it's a healthy relationship that we have with everyone.

**Harsche:** I think the guys have summed it up quite well. We have this symbiotic relationship. I'll go back to my comments at the outset of this call. The environment today is unlike any that we've seen in the nuclear industry, and it brings with it new challenges. Major projects and outages in particular have taken center stage, because delivering on schedule and on budget can mean the difference between a profitable year for our utility customers and one that's not. As an alliance partner, we are stepping up to the same challenges FirstEnergy is faced with and recognize that the only way to be successful in this environment is to work together. **■**