THE *NUCLEAR NEWS* INTERVIEW

Sarver and Jordan: Maintenance at Millstone

The plant's maintenance staff has become more effective at keeping emergent work from having an impact on the scheduled work.

In combined service, Steve Sarver and Skip Jordan have worked for Dominion (and its predecessor company, Virginia Power) for more than 45 years. Sarver is director of operations and maintenance at the Millstone nuclear power plant, and Jordan is the plant's nuclear engineering director.

Sarver has been with the company for 26 years and has served at Millstone since January 2003. He worked most recently at Dominion's Surry nuclear plant. Jordan, with the company for 20 years, has been in his current position since last November. He has been around the circuit with extensive experience in power generation, having worked variously at the company's fossil, hydro, and nuclear plants.

Steve Sarver (left) and Skip Jordan: On the turbine deck at the Millstone-2 nuclear power plant. Behind them is a new turbine that will replace an existing component during an outage in October.

Millstone, in Waterford, Conn., has two operating units. Millstone-2 is an 869-MWe (net) Combustion Engineering pressurized water reactor, and Millstone-3 is a 1136-MWe (net) Westinghouse PWR. A third unit on the site, Millstone-1, was a 660-MWe (net) General Electric boiling water reactor that was retired in August 1998.

Sarver and Jordan discussed how maintenance has changed at Millstone since Dominion purchased the plant from Northeast Utilities in March 2001. The conversation also delved into the TIP (Top Industry Practice)/Framatome ANP Vendor Award that Millstone received in May from the Nuclear Energy Institute. The award honored Millstone for its testing process that searches for possible leaks in control rod drive mechanisms. The process that the Millstone staff developed is an ultrasonic inspection technique that assesses the relevant surface area of the reactor vessel head and penetration nozzles. Using this method, plant technicians can detect leaks, verify the integrity of the carbon steel vessel head, and perform a full volumetric testing of the nozzle base material.

The interview was conducted by Rick Michal, *NN* senior associate editor.

How have vessel-head examinations differed for Millstone-2 and -3, considering that Unit 2 was manufactured by Combustion Engineering and Unit 3 by Westinghouse?

Jordan: The inspections are not primarily different because the units were manufactured by different companies. Any difference has more to do with susceptibility determination and the significance associated with the primary water stress corrosion cracking (PWSCC) issue. The Nuclear Regulatory Commission's guidelines place various plants in different categories for vessel head cracking susceptibility. At Millstone-2, we've done a full volumetric ultrasonic examination of each nozzle from under the head, as well as a portion of a bare metal visual examination on top of the vessel head. At Millstone-3, we've done only the bare metal visual inspection at the top of the head. That is the only difference between the two units at this point.

What susceptibility category is each unit in?

Jordan: Unit 2, which started commercial operation in December 1975, is in the high-susceptibility category for PWSCC. Unit 3, which started commercial operation in April 1986, is in the lower susceptibility category. Operating age and the operating temperatures and pressures are the primary considerations for putting the plants in the two separate categories. Both units had vessel head inspections during their most previous refueling outages. Unit 2's was completed in February 2001, and Unit 3 in April 2002.

Has Dominion made a determination about replacing the vessel heads at Units 2 and 3?

Jordan: The vessel head replacement for Unit 2 is scheduled to take place in 2005. For Unit 3, we have no current plans to replace the reactor vessel head.

Could you talk about Millstone's award-winning technique for searching for control rod drive mechanism (CRDM) leaks?

Jordan: The process is known as the Leak Path Detection Technique. It assesses the contact surface area of the interference fit region between the penetration nozzle outer diameter surface and the carbon steel vessel head penetration internal surface area. As we were preparing for Unit 2's outage, we looked at techniques that were being used at other utilities. All the other tests relied on bare-metal visual inspections on top of the head, or surface exams on the J-groove weld. Since neither were attractive options, we evaluated alternative non-destructive examination methods. We were able to demonstrate from the data that had been collected at the CRDMs that if the contact surface of interference fit was disturbed by erosion, corrosion, pitting, or the deposit of foreign material, it would be detected by changes in the acoustic energy. In other words, the geometry of the acoustic energy would be significantly affected by that disturbance. We would pick it up with the UT beam and be able to tell what kind of problem was in that area.

Was this technique developed in-house?

Jordan: Yes. We took a lot of data from other utilities that were doing UT techniques, looked at that data, and decided what would work for us. We put that into play and demonstrated with a vendor using the technique that the Leak Path Detection Technique was a viable option. The actual UT was not developed in-house, but the use of the technique to prove viability for this particular application was done in-house.

Has the technique spread to other PWRs in the industry?

Jordan: Yes. Other utilities are using it, hence our receipt of the TIP Award. People recognized that it's a good thing and they're starting to use it.

Who at your plant was primarily responsible for the technique's development?

Jordan: It was developed primarily in the engineering ranks. The people I credit are the ones who actually received the TIP Award.

Our nondestructive examination specialist Mike Stark was involved in that, as were his supervisor Harvey Beeman and the project manager for the reactor vessel head, Tim Petit. They were all looking at a way to get the inspection done for the least amount of dose, the least amount of time, and the least amount of physical interference work to be done on the head. The Leak Path Detection Technique is the process they came up with.

Has maintenance improved in any way since Millstone was acquired by Dominion? For example, do you share personnel with the company's North Anna and Surry plants, or purchase better equipment because of economies of scale?

Sarver: We are not yet to the point of sharing significant numbers of people with North Anna and Surry, although those two stations do a lot of sharing between themselves. Geographic proximity is the biggest hurdle there, in that we're in Connecticut and those units are in Virginia. So, the outages of all of Dominion's nuclear units are not necessarily coordinated due to the different geographic regions in which we operate.

I think our primary improvement in maintenance since the acquisition by Dominion has been the combining of the maintenance staffs at Millstone. Before the acquisition, it was recognized that we needed to bring the Unit 2 and Unit 3 maintenance staffs together so that we'd get economies of scale across the site, but it was never done. So, prior to the acquisition, there had been separate maintenance staffs assigned to each unit. It was only after Dominion purchased the site that the staffs were merged.

In addition, we've adopted a team concept rather than having the classic maintenance organizational structure of electrical, mechanical, and I&C. We also have specialty teams at Millstone that focus on specific areas of the station or specific systems. We have a secondary team, an auxiliary team, and an NSSS (Nuclear Steam Supply System) team that focuses on specific groups of equipment and thereby develop expertise in the tooling, equipment, and equipment performance in those areas, such as our intake structures, intake, and circulation water equipment. It's been a particular challenge for us. We have a specific team assigned that picks up nearly all of that maintenance. That amount of continuity, familiarity with the equipment, and how it's worked and how it's performing is a significant improvement for the site. We're continuing to build on that.

So, that is the difference between ourselves and North Anna and Surry, in terms of how maintenance is organized. We're looking to share lessons learned across our three sites for that.

Are you saying that North Anna and Surry, which are two-unit sites, have maintenance teams devoted to each unit at the sites?

Sarver: No. Each station has one maintenance department that services both units at the site. They never did have unitization at Surry and North Anna. What they don't do that we do at Millstone is they don't generally have a team concept assigned to specific equipment areas within the plant. Of course, they do it in limited fashion, but not nearly to the degree that we have organized at Millstone.

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At Surry and North Anna, they have a single maintenance organization focused for each two-unit site. They essentially have dual-unit sites—a common control room, and many of the facilities are common to both of the units at North Anna and Surry. Millstone also is a two-unit site, but with two separate units and two separate control rooms. Nearly all of the supporting facilities are separate for our units. That is a significant difference there.

Was it difficult to merge the two maintenance staffs at Millstone so they could work on both units?

Sarver: I'm certain it wasn't easy. The merger took place before I started working here. I think the area where we still have a good bit of specialization associated with the units is in the I&C area. Dealing with the specific Combustion Engineering versus Westinghouse processes and protection systems still requires a lot of specialization. It's the most difficult area for bringing a common group up to par in knowledge and skills to span those different process and control designs. With the electrical and mechanical work, it's been far easier to bring that maintenance crew together and have people qualified to work on Unit 2 breakers or Unit 3 breakers, or Unit 2 charging pumps versus Unit 3 charging pumps. It's been a far easier thing. So, we still do have some specialization in our I&C ranks.

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Do you employ "FIN" teams—"Fix it now" teams—at Millstone?

Sarver: Yes, we do. They've been in existence for about five years now. We have their work scope very well defined in terms of what the FIN teams can and should work on. They are a very effective group at doing minor maintenance and high-priority work items that are more difficult to fit into a normal crew's schedule. We have both a day shift FIN team and one for overnight work. Actually, our night shift maintenance team acts as a FIN team. We don't schedule a large amount of routine work for our night shift when we're not in an outage, so our night shift works as a FIN team to pick up emergent work from both units. They perform that maintenance if it's within their scope to do so.

How many personnel are on the day shift FIN team?

Sarver: I estimate the day-shift FIN team consists of about six to seven people—a supervisor, two or three mechanics, two electricians, an I&C tech, and an operator. We always have an operations individual assigned to the FIN team to facilitate its getting to work in a quick fashion.

Has a maintenance backlog ever been an issue at Millstone?

Jordan: I think there are two areas where the FIN team has really helped. The first is working off the backlog. The other is on protecting the schedule and allowing the work that we have scheduled to proceed. In other words, the emergent work that would normally come in is being protected from having an impact on the regular work crews. In the past, it was a challenge for us to handle both of those. We found we were losing some of the scheduled work and were having to shift resources to emergent work. Now we're much more effective in not letting the emergent work affect the scheduled work.

What currently is your biggest challenge in maintenance at Millstone?

Sarver: I think our biggest challenge is the effective coordination of maintenance resources in staffing and the scheduling of

work. After Dominion acquired Millstone, and after the site went through a number of other organizational changes, the maintenance staff had a lot of new supervisors and a good bit of movement in maintenance staff resources. The biggest challenge was effective coordination of resources to focus on the work. We obviously have challenges in equipment obsolescence, in our ability to maintain adequate supplies of spare materials, and in performing work on equipment that grows more obsolete by the day. And our work management system could stand some improvement, too. But right now our biggest challenge is the coordination of maintenance resources to handle the work load.

How has the role of the maintenance manager at your plant changed in the past few years?

Sarver: Going back to bringing the two units together and establishing a team concept is the greatest change for the maintenance manager. Part of that change is keeping up with adequate maintenance on site while also addressing specific equipment areas.

Jordan: I don't think that challenge is specific just to the maintenance manager. Moving from the regulated to the deregulated environment, the business-acumen focus has shifted, too. An individual in charge of a department now realizes the impact that his budget has on the overall station. That individual has a keener awareness in terms of cost and overtime expenditures than was present in the regulated environment.

Has maintenance changed in any way in the post-9/11 world?

Sarver: We see a direct effect in the way plant access has changed in regard to the delivery of materials to the site. It has become a more cumbersome process simply because our site access has been modified to provide for additional security measures. While it has had an impact on the timeliness of materials to the site, I would not call it a significant impact. We have figured out how to get materials to the site in an effective manner so it has not degraded our ability to perform maintenance. Beyond that, we have not identified anything significant in terms of additional maintenance activities directly related to 9/11.

Are there any regulatory requirements from the past few years that have caused extra burden on maintenance?

Sarver: We could point to a number of indirect regulatory initiatives that are going to create additional maintenance work. The Alloy 600 inspection program is the largest one that is going to greatly expand our need to evaluate Alloy 600 components and component locations. There will be more detail in the way we evaluate the observance of boric acid on components in terms of its source and its impact on components. Beyond that, even if I point back to the NRC's Maintenance Rule, EQ requirements, and a number of those other regulatory initiatives, I wouldn't characterize them as creating any additional burden on maintenance. In fact, I believe they've provided us with a framework to better prioritize our maintenance.

In terms of maintenance burden, no, I don't think any recent regulatory requirements have specifically implied an additional burden on maintenance. Clearly, it's going to change some of the priorities in how we evaluate deficient component conditions, especially when it comes to boric acid and Alloy 600. Beyond that, I don't believe we can point to any significant additional burden from a regulatory standpoint.

What are some of the Alloy 600 components that you have to inspect?

Jordan: Pressurizers, heater penetrations, primary hot leg and cold leg, and RTD thermal weld locations. We also have a number of safety injection system RTD and instrumentation small-bore penetrations to the primary piping that have to be inspected. It is a significant expenditure in terms of dose, dollars, and time. If the inspection reveals some degradation and we make the decision to change out whatever

part it is, that new part would be of Alloy 690 material, which is more corrosion-resistant than Alloy 600.

Has either Unit 2 or Unit 3 had to replace some component for degradation reasons?

Jordan: To date, we have not. We have what we call a "mensa" clamp, which is an approved ASME Code temporary repair, on a couple of our pressurizer heater penetrations. We have not had to replace specific components. For an upcoming refueling outage for Unit 2, we have set up contingency plans for mensa clamps and some small-bore RTD penetrations that we may need, just in case.

Are you trying to reduce your maintenance budget? If so, how?

Sarver: Yes, we certainly are. Two things I would point out. First, we have more effective planning than we used to have. Increasing the productivity of our maintenance staff is the largest single impact we can have on budget reduction and budget effectiveness. Anytime we have a job that doesn't go exactly as planned where we haven't prestaged the appropriate parts, or have tagging issues—anything that gives us less than a perfect execution plan on a work order or job—the efficiency of a maintenance organization is affected. That is where we are placing the largest amount of emphasis. The bottom line is better planning for maintenance work.

The second area where we need significant effort—and where we'll apply resources in the future—is in PM (preventive maintenance) optimization. PM optimization is something that can save us significant resources. Our PM program, while it's very thorough, has some inefficiencies and has not been optimized to ensure that we are doing preventive maintenance when it needs to be done, at the frequency it needs to be done, and to the extent it needs to be performed on particular pieces of equipment. We can have a large impact on the maintenance budget by simply optimizing that preventive maintenance and reducing the amount that we're doing on equipment that doesn't need to be taken out of service.

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Have there been any significant changes in the way your maintenance staff interfaces with other organizations on site, such as operations or engineering?

Sarver: Yes, and I'll point to two significant areas. First, operations now has a single work control group assigned to it. That group covers both of Millstone's units, and it provides the maintenance interface with operations for the entire site. Prior to the group's being established several years ago, maintenance was communicating with and interfacing with different managers at the shift manager level.

Establishment of the group has helped focus the maintenance staff on the most important priorities across both units. If we have 10 jobs to do today, half on each unit, it may not be appropriate that we work the first job on each unit. So, the group has been effective at helping focus the maintenance resources on day-to-day activities that affect each unit.

In addition, the engineering organization has sought to collectively bring a single focus to maintenance priorities on site. This is helping maintenance when it comes to establishing the correct priorities for what needs to be worked. We've recently formed a Station Equipment Reliability Team, called SERT. It was formed at the initiative of the engineering group.

SERT is establishing single priorities for the site when it comes to the consolidation of Maintenance Rule Alpha One issues. When a component or a system is placed into the Alpha One category, it requires a specific action plan to restore it to Alpha Two status. Those issues need to be assigned priorities.

A second change in how we interface with other organizations on site deals with operator work-arounds. Those work-arounds identify specific equipment deficiencies that give the operations group some additional work or complication. The deficiencies need to be properly prioritized. In that regard, we needed to have a group that provided a single focus and a single set of priorities for the maintenance staff or we'd be working for too many masters. The SERT, which is participated in by engineering, operations, maintenance, planning, and several other key line functions on site, is now providing that for us. We think SERT is not only unique, but also a very useful team force at Millstone.

Could you talk about any specialized training of Millstone's maintenance personnel?

Sarver: We do have some unique equipment here and we have unique training for that equipment. What I would point to is our significant focus on leadership training for the maintenance supervisory staff. This has been an area where we knew that our maintenance leadership needed to have a broader set of skills when it came to employee relations, as well as the management of our own particular areas within the maintenance group—business acumen, employee relations, etc. We're putting a larger focus on not just getting to the maintenance manager and his immediate direct report staff, but down to the first-line supervisor, and down even farther to lead craft personnel within groups that are being provided leadership training. The goal is to broaden their perspective on how to better coordinate work activities and the importance of their work as it relates to the overall plant.

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Could you give an example or two of some of your unique pieces of equipment for which workers need specialized training?

Jordan: We do some specialized training for the main steam isolation valves. That's a unique setup in an area where we had problems with solenoids that failed. We put a design change in place to rectify that condition.

Also, we have some flow-scan equipment on which we provide specialized training and certification.

Another area for us is acoustical monitoring. We have within the engineering organization a condition-based maintenance group. We have some acoustical monitoring equipment we use, and we need specialized training to be able to use it. The acoustical monitoring is used for welded-in check valves. The monitoring gives us back an indication that is different from the norm, and then we know something is wrong. For example, we have a baseline signature that we've taken on some of the equipment, similar to what we do with vibration monitoring. That baseline signature is the norm. The acoustical monitoring pro-

vides a difference from our baseline condition to another condition, so it advises us that something has changed in that component. We then can make a decision whether to open up that piece of equipment and look inside. In some cases, we'll have to replace that equipment.

The vibration monitoring also helps us determine how rapidly we need to do work. It can give us a rate of degradation or the significance of the degradation. With information gained from vibration monitoring, we're able to schedule a piece of equipment for work or put it in an emergent work condition.

Do you have any provision for soliciting suggestions from plant and contractor personnel for practical improvements in maintenance methods?

Sarver: We have a few things. One is our site-side reporting system, which accommodates all kinds of condition reporting for the site. To make that system work, we have trained our people to identify deficiencies and improvements for the site. And we do get significant feedback for improvements in maintenance methods. It could be related to a specific task where a mechanic felt the job might go better if something were changed for the next time. Or it might be a contractor who has seen something we do that could be improved with an idea he's brought from another site he's worked at. Our site-wide reporting system is a single repository that has the capability to allow us to sort, segregate, track, and trend feedback, whether it is improvement items or factual information about how a job played out.

Also, during outages where there are significant numbers of contractor personnel on site, we have lessons-learned tools that are available. We especially focus on our contractor staff to give us feedback on evolutions or activities performed during outages so we can make improvements prior to the next outage. All those suggestions are evaluated by our outage integration teams to make certain that we're taking the benefit of those lessons learned.

A final example is something we recently started called our work week critique, although a number of other plants have been doing something similar. The work week critique takes a snapshot of all of the work that was planned and executed during the previous week. We review that work with the maintenance, operations, engineering, and outage and planning staffs to see where we were successful or not successful, and we evaluate where improvements can be made for later work. This is a weekly process that tries to capture fresh and detailed information about the successes or failures of the previous week's maintenance work. We factor it in so that we don't make the same mistakes twice. NN