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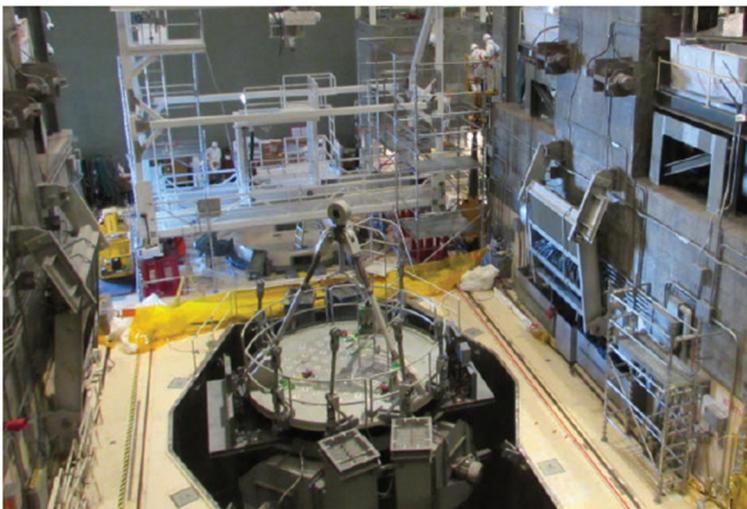
Statement:

Unlike typical cleanup projects, or facility decommissioning and demolition work, the projects and maintenance programs performed at nuclear power generation stations are performed during a regularly scheduled outage. These outages are when the reactor is taken offline for a short period of time to accommodate refueling and work activities. Outages can have a cost impact ranging into the millions of dollars per day either as an expense to the company or as a profit. Because of this, work performed during an outage is tightly scheduled, closely managed, and tracked, typically to the minute.

The Southern Nuclear Operating Company Vogtle project was recently published in *Nuclear Power International* for their outstanding performance during a recent outage at the Vogtle reactor Unit 2, in the spring of 2016. The team had taken a new approach to planning and execution which led to refueling the reactor and installation of a new refueling machine in record time. The improvements allowed Unit 2 to be completed in half the time it took for Unit 1, just 6 months earlier. Management did not point to a single activity as the pivotal element but to all the improvements implemented in preparation and execution of the work during the outage.

Discussion:

Southern Nuclear Operating Company (SNOG) operates the Alvin W. Vogtle Unit 2 reactor located in Waynesboro, Georgia. This is a pressurized water reactor licensed for 3.6 Gigawatts thermal production and undergoes regular outages for refueling activities. In the fall of 2015 an outage was performed at Vogtle Unit 1 to refuel the reactor and to replace the refueling machine. The result was described only as that the outage was longer than planned. The expectation of reactor outages is that they are “*accurately planned and precisely executed*” (Ruff, 2017, p. 5). This is due to the potential million dollar per day impact to the company.



Installing the new refueling machine—a critical path task. Photo courtesy: Elizabeth Adams, Southern Nuclear.

In the spring of 2016, just 6 months after the completion of Vogtle Unit 1, the Vogtle Unit 2 reactor was scheduled for an outage to perform the same refueling and refueling machine replacement activities as Vogtle Unit 1. Based on the performance of Vogtle Unit 1, the outage team took actions to improve their process. After developing and implementing new practices and improving old practices, Vogtle Unit 2 outage was completed in half the time of Vogtle Unit 1. The team beat the outage schedule by 32.5 hours and refueled the reactor 11.5 hours quicker than scheduled.

“There was no single improvement that made the Vogtle Unit 2 spring 2016 outage the best in the company’s history. There were changes in strategy, increased and all-inclusive participation in schedule review meetings, lessons learned examined and applied, an exemplary collaboration between teams and plan and contractor personnel, senior management support, employee empowerment and teams brought on-site earlier than in the past, among others” (Ruff, 2017, p. 10). A number of specific activities were identified in the article which have been summarized below with applicability to EM work activities.

Develop a Realistic and Achievable Schedule

The Vogtle site planning team maintains a multi-year out-year schedule for outages. Once an outage is complete, the schedule and milestones for the succeeding outage are released. Following a rigorous procedure, contractors build-out the schedule for their scope of work. Contractor teams are assembled early to discuss pre-planning, details, and sequence of the work to validate and improve the approach. The two months prior to the outage, table top reviews begin with senior management and contractor executives to discuss the details and challenge the teams to develop the most accurate and realistic schedule. Contingency plans are developed and tested. The final weeks before the outage, project teams work through “all-inclusive” schedule reviews. Every person on the team goes through a dry rehearsal of their duties explaining what they are doing and what is expected from them.

Vogtle Outage manager Mike Griffin stated *“For this outage, we laid out the most accurate and realistic schedule we’ve ever developed”*, *“Schedule fidelity and table top readiness reviews were fundamental in delivering the best outage we have ever executed”* (Ruff, 2017).

Utilize Lessons Learned for process improvement

Following the completion of the Vogtle Unit 1, Vogtle site personnel and Westinghouse (the contractor for both Unit 1 and Unit 2 refueling machine replacements) worked together and identified over 100 lessons learned from the experience. Based on this process improvement activity, they challenged and improved four of their procedures: Installation, Demolition, Site Initialization, and Site Acceptance Testing. Two project management leads were sent to Westinghouse’s manufacturing facility for the refueling machine and one was sent to the installation team’s home office. They were able to address lessons learned with these sites to create better products and services which included installing electrical snap connectors and use of clamps to reduce drilling inside the containment zone.

Westinghouse captured video footage from the Vogtle Unit 1 refueling machine installation and reviewed it with SNOC. Based on installation issues, the Westinghouse project leads and engineers assembled a mockup rail for the refueling machine to be tested on to verify actual movement of the machine and evaluate proximity issues within the reactor containment zone before installation. To reduce time within the containment area, the team installed a tent with utilities so that work such as performing inspections, applying stencils, performing some acceptance testing, along with other activities which did not require execution within the containment area. This more reduces complications of the installation process once inside the containment area.

“All of this resulted in the Unit 2 refueling machine installation being completed in half the time of the Unit 1 installation and a day ahead of the planned schedule. Since this installation was driving the critical path schedule, this savings was helpful to the overall outage schedule.” (Ruff, 2017, p. 8)

Early and Consistent Management Involvement

SNOC management was integrally involved in the planning and execution phases of the work. They reviewed and challenged schedules and contingency plans to ensure that the schedules were realistic and achievable. They created the position of containment manager to support the crews and communicate with the outage control center. These positions were filled with highly experienced professionals in outages and were used to clear

roadblocks and ensure the crews had what they needed when they needed it. Westinghouse's management re-evaluated their crew makeup and instituted changes allowing for easier flow of work with less downtime due to work authority. SNOC management maintained their interest in worker involvement and encouraged worker level decision making. Reporting twice-a-day to senior management allowed workers to discuss barriers to work to get the support they needed, improving efficiency and accountability.

Westinghouse Outage Manager Larry Burrows stated *"New Senior Management really got the teams to take ownership of their work – there was a very positive can-do teamwork approach"* (Ruff, 2017, p. 7).

Early Team Involvement

Two to three weeks before the outage began, project teams were brought to the site. The teams were able to participate in schedule reviews discussing their perspectives and concerns. They were able to demonstrate their knowledge of the work scope before entering the containment area so that when work was performed, there was no confusion. The teams began pre-installation, inspection, and acceptance activities which did not require work to be performed inside the containment area.

Westinghouse Outage Manager Larry Burrows stated *"Normally in an outage, the team doesn't feel like a team until five or six days into the outage. In this case, everyone knew who the teams were and who they would be working with two to three weeks prior to the start of the outage"* (Ruff, 2017, p. 7).

Through developing realistic and achievable schedules; using lessons learned to help plan and execute work; getting early and consistent involvement from management; and having work crews get involved in the planning earlier, the SNOC Vogtle team demonstrated the level of project control that is achievable when an entire team is dedicated to a work effort.

The mission of the Office of Environmental Management (EM) includes construction, testing, startup, and commissioning of new nuclear facilities. EM also operates nuclear facilities, and is involved in outages where some of these actions may apply. EM could benefit from the lessons learned in terms of advance planning and taking proactive actions to ensure schedule success.

Recommended Actions:

The following recommendations are an abbreviated high level summary of the practices identified in the article about Southern Nuclear Operating Company's Vogtle outage lessons learned.

EM FPDs and Site Managers should consider these recommendations for applicability and implementation during planning phases of work in their projects and operations activities.

Develop a realistic and achievable schedule:

- 1. Perform table-top reviews to ensure schedule fidelity**
- 2. Test contingency plans to ensure they capture the risks and mitigate issues**

Utilize lessons learned for process improvement:

- 3. Begin developing lessons learned after work is complete**
- 4. Use monitoring equipment to support the collection of lessons learned information**

Early and consistent management involvement:

5. Management should utilize their expertise to ensure the fidelity of project documents
6. Encourage involvement at all support levels from management to the field

Early team involvement:

7. Onboard teams early to support the planning process
8. Have crews demonstrate their knowledge and understanding of the work scope and activities

Critical Decision(s): CD-1 to CD-4

Facility Type(s): All

Work Functions(s): Project Management

Technical Discipline(s): Planning, Execution, Startup-Commissioning

References:

1. Ruff, D. (2017, Jan/Feb). Southern Nuclear Sets New Outage Record at Vogtle Unit 2. *Nuclear Power International*.