Outage Management Continues to Improve

By Nancy Spring, Senior Editor

Cut costs, optimize performance, improve safety programs: outage management teams at fossil and nuclear stations are being asked to do more with less, while still ensuring reliable power production.

We asked industry experts to identify the most important trends impacting the business today and the best practices they recommend to power generating asset operators for successful outage planning and management. From new contracting strategies to workforce programs that increase “wrench time,” the focus is on running outages cost-effectively and efficiently, without sacrificing operational excellence.

Current Trends

With many existing coal-fired power plants reaching 30, 40 and even 50 years of age, one would think the learning process to improve outages would have run its course, said Bob Seay, director, asset services, WorleyParsons, but even today, power plant owners are finding they can reduce the duration and execute more work by up to 20 to 30 percent or more.

A recent study by the Construction Industry Institute identified nine critical areas of significance to a successful outage. Seay said more than 40 companies and 100 outage professionals participated in the study. Understanding the business objectives of the outage and factoring in the impact of plant expectations two to three years in advance for capital work were identified as the highest priorities.

Regulatory issues, plant life extension and changing workforce are today’s top industry trend categories according to Ron McCall, president, maintenance division, the power group, The Shaw Group Inc. Shaw teams work with nuclear power clients to develop and support best outage management practices based on industry trends.

The regulatory category includes issues related to long-term storage of spent fuel, security modifications, collective radiation exposure and fatigue management. Plant life extension includes work related to extended major capital improvements such as power uprates, steam generator replacements, repairs to underground piping and degradation of components reaching their life expectancy. To cope with the changing workforce, gaps related to retiring workforce and an increased demand for skilled construction craft employees must be addressed.

With money tight, operation and maintenance budgets are being cut and capital expenditures reduced. When that happens, even more pressure is put on the plant team to keep plants in operation most cost-effectively. Some would argue that process discipline has to move aside to let short-term decisions take priority, but Seay said it becomes even more important, especially from a fleet perspective, that disciplined approaches to planning and executing work are used and participation in industry forums and venues is ongoing.

Shrinking maintenance dollars and third-party outsourcing have been growing trends in the power industry for a number of years, said Jim Miller, vice president of operations and maintenance, PIC Group Inc. Because of the current economic environment, those trends are accelerating and the challenge of maintaining profitability while keeping equipment reliable and efficient is growing.

“The days of bloated maintenance budgets are over; customers want first rate results at lower prices,” said Miller.

Miller said original equipment manufacturers (OEMs) were relied upon in the past for most service needs under either short- or long-term service contracts, but today third-party service providers like PIC offer an alternative.

“The advantage of alternate providers to the end user is choice,” said Miller. “Competition is almost always the end user’s best friend.”

Current Best Practices

“The real question of best practices is not should we continue to discover better ways—we do—but is the delivery vehicle and discipline from the top of the organization to the plant floor in place to take full advantage of them?” said Seay.

Advanced planning, a continuum of support, alliance contracting, improved workforce practices and safety emerged as the top best practices according to the companies interviewed for this article.

Integrated Planning. There are many important aspects to every outage but advanced planning is the first and most important step, said Miller. “Those who have experienced an outage gone badly will likely tell you that poor planning led to the result.”

Planning should start as soon as possible. For most outages, internal support and site teams should begin planning a minimum of 12 months in advance. Some outage types may require starting up to two years in advance. The forecast should include all aspects of the outage in addition to the resources required to execute it. PIC recommends developing a 10-year outage forecast for each asset.

Producing a project schedule to assign and track tasks as well as to identify areas of concern is the next step. This “road map” lays out the coordination strategy and directs the overall execution for both the interrelated and independent tasks.

Failing to follow the plan will likely lead to losing control of the outage and losing revenue, but the plan shouldn’t be static. “Enforcing unnecessary tasks purely for the sake of enforcement is not the way to gain the most value from your plan,” Miller said. Instead, maintain flexibility and be able to change as needed throughout the outage.

“Planning and scheduling continue to grow in sophistication, serving as the foundation for owners to optimize costs,” said Greg Kern, vice president, fossil operations, Day & Zimmermann NPS.

Improvements continue on many levels. For instance, scheduling outages so materials and contingency workforces are optimized has grown from a focused plant activity to fleet-wide assessment. Seen as impossible just a few years ago, a limited number of customers take into account local and regional planning for outage scheduling when drawing on the same material and contingency workforce resources.

“Outage management techniques like this have maximized cost containment and enhanced the number of trained personnel at one fleet’s fossil outages,” said Kern, and substantial sums have been saved in duplicative in-processing and training requirements at nuclear facilities.

Emerging tools also include pre-outage peer reviews by contractors—an independent one- to two-day challenge review of every outage management activity including scheduling, cost control, specialized tooling assessments, craft needs and field administration.

Shaw’s McCall has found that plant owners who involve contract leaders to review outage plans and assess readiness to execute work scopes will generally see a stronger performance in the contracted workforce.

Continuum of Support. One best practice endorsed by Shaw is providing a continuum of support and planning between refueling outages, rather than acting as a labor broker to provide only outage staffing.

“Managing an experienced, mobile core team of professionals who can join site teams during refueling outages provides consistent project execution,” said McCall. Consistent contractor presence improves safety and work performance because employees become more knowledgeable about site expectations and work requirements.

Alliance Contracting. Another best practice Shaw endorses is forming alliances. When utility operators and contractors form integrated service alliances, refueling outage performance dramatically improves, said McCall.

Alliances develop stronger execution plans by using one team of engineers, construction workers and maintenance craft to achieve planning milestones on time and within budget. “This single point of accountability results in shorter outages, reduced rework and increased savings,” he said.

Greater overall value can be achieved if alliance contractors also perform online and capital improvement work during non-outage periods. Utilities can enhance confidence in work scopes through supervisory meetings and continuous improvement plans with contractors.

Paul Williams, vice president, fossil operations, Day & Zimmermann NPS, said he is also seeing an increasing number of electric utilities opting for alliance contracting for their fleet-wide outage management instead of adopting a time-and-materials or fixed-price contracting strategy.

“The goal is to align the owner’s performance and cost needs with the commercial interest of the contractors,” said Williams.

Owner and contractor accept a collective responsibility for results, risk and reliable performance. Client and contractor work collaboratively, “avoiding the conventional they-and-us ‘silos’” as they determine the best possible solutions for on-time, within-budget outage performance. Management allows and the contractor accepts intimate involvement in outage planning, scheduling and budgeting along with the risk of a pay-for-performance contract.

In one alliance arrangement, Williams said the customer structured an outage performance plan over a 5-year period with the contractor, defining reliability goals for baseline units, making specialized teams available for unique maintenance needs at smaller peaker units and incentivizing the contractor to achieve budget targets for planned outages through the contract duration. Two other customers were able to keep work out of the shutdown’s scope by planning and executing in-service work and managing the maintenance backlog with in-house and contractor staff.

“Alliance strategies hold solid promise for repeatable performance by defining key performance indicators developed with the customer,” said Williams. Setting baseline budgets and reliability needs allows for improved outage activity at reduced costs.

Workforce. Competently recruiting and retaining skilled craft and supervisory personnel is another critical best practice.

“Thousands of utility and construction workers new to the nuclear industry will have to learn and follow codes and regulations different from what they previously experienced in non-nuclear construction fields,” said Shaw’s McCall.

Nuclear industry training is based on recommendations from the Institute of Nuclear Power Operations (INPO) and the Nuclear Energy Institute (NEI) and includes standardized, industry-specific guidelines and mentoring.

Use of worker utilization studies is growing to maximize workforce “wrench time” during outages, said Williams. Based on the premise that trained craftsman are coming to work, coupled with studies showing 70 percent of non-wrench time is organizationally created, these efforts attempt to remove impediments and maximize work time.

“A key best practice has been the engagement of third-party entities that have expanded on the industrial engineering

paradigm to increase 'wrench time' by identifying all processes, procedures and other requirements required for effective performance and cost-efficiency," Williams said.

The studies can be as technical as work assessments, technical tooling requirements and procedural review and improvement or as mundane as the location of lunch rooms, elevators and parking lots to create less obvious choke points decreasing worker productivity during outages.

Safety. Industrial safety, human performance and quality work continue to emerge as the most important acitivities in the management of outages at nuclear power plants, said Chuck Lepisto, vice president, nuclear operations, Day & Zimmermann. "Emphasizing procedures, policies, programs and training eliminates accidents and human error and will ensure budget and scheduling success."

Contractors are developing standardized and systematic electronic tools using Web-based technology to optimize outage performance. Day & Zimmermann, for example, has developed a project execution tool and an environmental, safety and health (ESH) tool that tracks, manages, trends and improves outage preparation and execution as well as providing real-time management engagement in injury case administration.

Day & Zimmermann NPS President Gary McKinney said the company has implemented a Web-based, Blackberry-compatible ESH tool that allows immediate incident notification and up-to-date reporting of injuries and their causes. With this tool, D&Z is tracking and trending incidents based on more than 17 million hours of data per year, gathered from nuclear and fossil plants throughout the U.S.

Some of the most important best practices demonstrate a commitment to all safety procedures and policies, particularly those related to radiation protection in nuclear plants. Precise planning that reduces radiation exposure to as low as reasonably achievable (ALARA) must happen every day, said Shaw's McCall. Pre-job briefs incorporating tools such as work hazard cards help employees understand potential safety issues and work together to address issues.

"Creating a safety culture that empowers every employee to stop unsafe work without retaliation helps drive down human performance errors, keeping everyone safe every day," he said.

As WorleyParson's Seay said, when reviewing the lessons learned and the best practices over the last 10 years, there are no "silver bullets." Instead, a combination of best practices and techniques is key to outage budgeting and scheduling success. Clearly, outage management techniques will continue to evolve and improve.

Fighting Chemical Attack: Critical pump systems were repaired during an outage at the Navajo Generating Station.

By Vic Lundberg, Process Engineer, Quadna Inc.

During a nine-week outage at the Navajo Generating Station power facility, several critical pump systems and components were serviced and repaired. The outage began on Jan. 30, 2010, and wrapped up in early April. The two-month-plus outage was the only one planned for 2010.

The Navajo Generating Station (NGS) is located on the Navajo Indian reservation near Page, Ariz. The 2,400 MW station has three 800 MW coal-fired units that serve electric customers in Arizona, Nevada and California and supplies energy to pump water through the Central Arizona Project.

The facility's Allis Chalmers WSDD 66 x 78-inch split case cooling tower recirculation pump and Pratt butterfly valves provide cooling water to the Unit 2 cooling tower. The pump pulls water from the cooling basins to the top of the cooling tower to provide an ongoing evaporative cooling effect. The butterfly valve isolates the cooling tower basins from the pump and is located immediately in front of the pump's suction.

A double suction impeller for one of the cooling tower pumps. Photo, Quadna.

Achieving good water chemistry in cooling towers is challenging. A host of chemicals are required to maintain pH and to keep algae growth to a minimum but the required chemicals are not always compatible with pump and valve materials. The outage team was concerned that chemical attack was damaging the butterfly valves and pump shaft. The team wanted to ensure the system not only received repairs and replacements but that the components could be better protected against aggressive chemical attack.

Quadna was asked to repair the two 66-inch diameter Pratt butterfly valves. Each valve weighed close to 12,000 pounds and had been in-service for more than 30 years with only the seals being replaced during that time. The valves were connected to the split case recirculation pump, which had suffered from shaft issues during the past several years. This particular pump used two shaft sleeves on each side of the impeller and had experienced extensive chemical attack at the sleeve interface. An intense and localized corrosion was present under the sleeves and at the interface, caused by a corrosive effect know as "crevice corrosion," which occurs when the crevice is large enough to allow liquid to enter and narrow enough to maintain a stagnant zone.

The team determined that the corrosion was substantial and had to be mitigated. If left unchecked, it most certainly would

have led to failure. According to Dana Smith, planner/scheduler for NGS-operator Salt River Project (SRP), the facility had a catastrophic failure due to crevice corrosion in 1999 that resulted in shaft breakage in its Unit 1A circulation pump.

“Last year when we were able to inspect one of the new shafts installed a number of years ago, we saw the same effect in the shaft sleeve to bell/sleeve “O”-ring area,” said Smith. SRP determined that this could be happening on all six in-service shafts.

In 2009, shaft replacement was determined to be the best option and a new shaft was ordered. “Unfortunately, we were not able to install the shaft, because the manufacturer had threaded the end to a specific rotation—not what NGS had specified for the new shaft.”

To eliminate the crevice corrosion condition, Quadna modified the sleeve-to-sleeve sealing area, prolonging the life of the shaft and reducing or eliminating the need for shaft replacement.

Smith said that in 2009, SRP was also concerned with the condition of the pump impellers, the amount of wear and damage to vanes and material loss. The impellers have been in service for 30-plus years.

“We ordered a new impeller, but unfortunately the manufacturer could not meet our need date so we had to put a bad impeller back in-service,” said Smith. In early 2011, SRP will begin the replacement of impellers on Unit 1, followed by others during future outages.

Recommended solutions included coating all of the surfaces where the chemical attack was prevalent to reduce future wear. The shafts were machined, sleeved and seal welded. The pump’s cast iron casing rings were coated with 3M Scotchkoat 134. The chemical attack had affected the cast iron housings and base metal, causing the base to lose its competency. The 3M Scotchkoat fuse coat now helps prevent hydrochloric acid from destroying the rings and the valves.

The Allis Chalmers split case recirculation pump received a new impeller, wear ring housings and related components. A combination of coatings was used on the pump and valve and the team changed the impeller from a nickel aluminum bronze to stainless steel 316 to further ensure a long service life and efficient operating dynamics.

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