New outage preparation process set out at British Energy's Hinkley Point B

BY DICK KOVAN

British Energy is implementing a new process for outage planning and organization as it prepares to extend the lives of its fleet of advanced gas-cooled reactors.

BRITISH ENERGY'S DECISION last December to extend the operation of the Hinkley Point B and Hunterston B nuclear power stations, both twin-unit advanced gas-cooled reactor (AGR) plants, will take the units' operational lifetimes through the period covered by the latest 10-year Periodic Safety Review to reach 40 years in 2016. Although not unexpected after the board gave the go-ahead to extend the operation of its oldest AGR station, Dungeness B, in 2004, it was still welcome news to the plants' management and staff.

Nick Wall, strategic outage manager at Hinkley Point B, noted that this is an excellent achievement. Without wanting to pre-empt future board decisions, Wall said that he is confident of obtaining further extensions. "I do not see a cliff edge," he said.

Wall

Wall's confidence is also based on the progress he can see in his own area. Over the past 18 months, he said, British Energy has been implementing a new 24-month outage planning process, which owes much to the procedures used by Exelon in the United States and by other utilities around the world, and he expects significant improvements in conducting outages. Later this year, the first outage to go through the entire two-year planning process will be carried out.

Wall took on the job of outage manager at Hinkley Point B just two years ago, at a time when the need for a new approach was clear. Financial problems in the late 1990s, due particularly to measures taken by the market regulator to keep electricity prices down, made it necessary for the company to reduce the cost of operations as much as possible, which had an impact on many areas, including outage management. The company's focus on outage management, which is critical to plant performance and ultimately to the company's bottom line, certainly suffered, Wall said. "We have been building it up in the past couple of years," he said, adding that the company has also created a central outage team to help all plants with their outage issues. These measures have been helped greatly by improved market conditions, which have allowed British Energy to invest more resources in enhancing performance and preparing for future growth, and even for new nuclear plants.

British Energy's Hinkley Point B (Photos: British Energy)

The new 24-month planning process fits well with the outage cycle of Hinkley Point B, which is now also on a two-year interval. (It previously followed a three-year outage cycle.)

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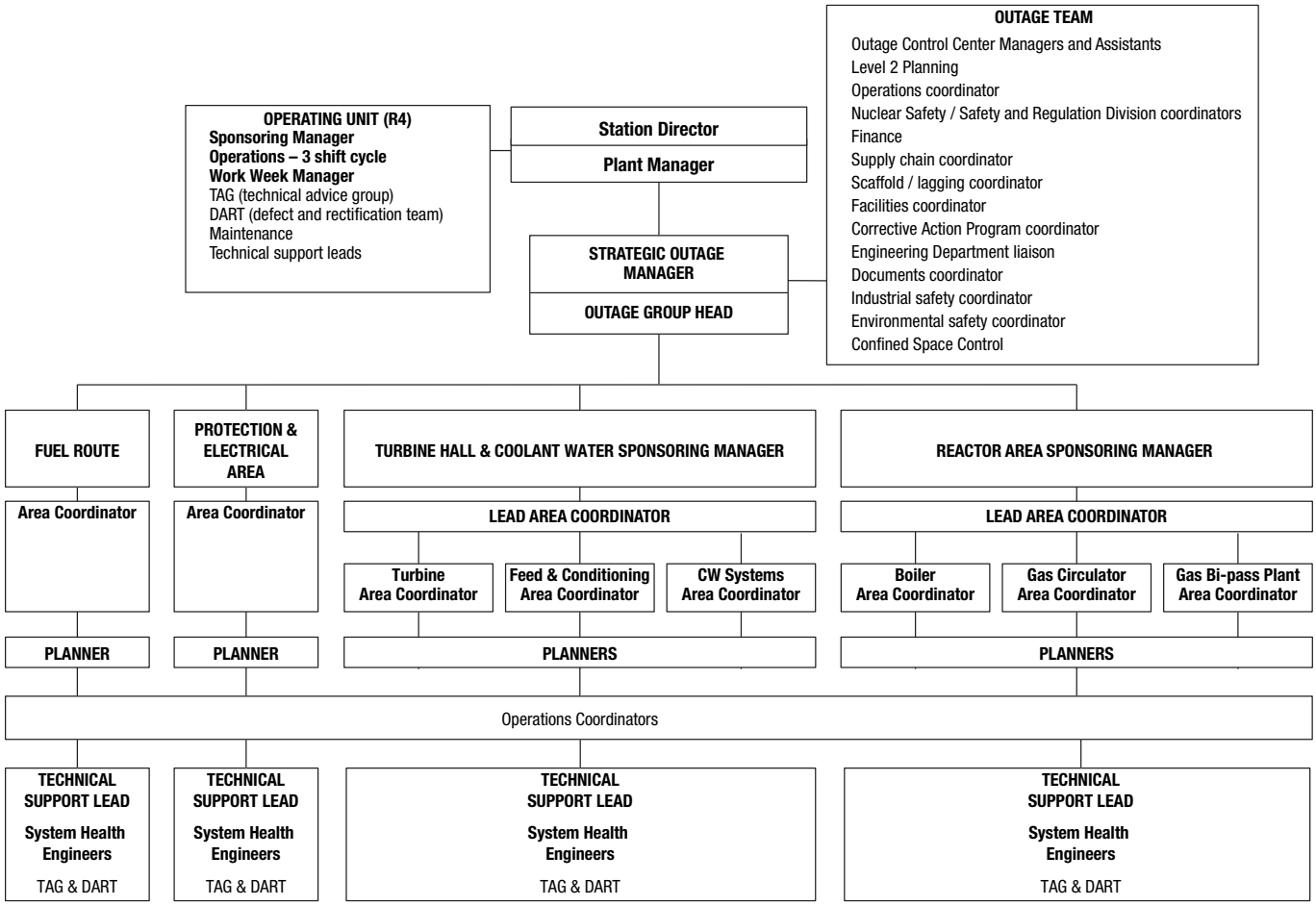

Outage delivery structure for Hinkley Point B R3 2008 refueling outage

Unlike British Energy's only pressurized water reactor at Sizewell B, its AGRs are designed for on-line fueling, although not all plants are able to undertake it. For those reactors that do fuel on line, the timing of planned outages is determined by the statutory inspections of safety-critical plant and systems requirements, as well as other maintenance requirements, as agreed on by the U.K. safety regulator, the Nuclear Installations Inspectorate.

When the AGRs first started operating, the statutory inspections were required every two years. This was extended to a three-year cycle, when a case could be made for longer periods between inspections. Hinkley Point B, for example, had operated on a three-year outage cycle for some 15 years. Now, however, Hinkley Point B and Hunterston B have had to move back to a two-year schedule to accommodate more frequent inspections of their reactor boiler tubes and graphite. All of the other AGRs remain on a three-year statutory outage cycle.

The boiler defects are caused by creep damage as a consequence of operation over a lengthy period of time at higher temperatures. Already aware of this phenomenon, workers have monitored the tubes over the past several years. It was during the 2006 outage at Hunterston B that the level of cracking was found to be much greater than expected, leading to a shutdown of the reactors at both Hunterston B and Hinkley Point B to undertake inspections and make repairs.

The stations have also experienced graphite-brick cracking due to irradiation and temperature-induced effects, which cause internal stresses to build up in the bricks. Because the graphite cores of other AGR plants are younger, they have suffered less damage from these effects and do not yet have to move to the shorter outage cycle. In the meantime, Wall said, the plant has developed a safety case for operating with cracked bricks and now needs to gather empirical data on a more frequent basis to support it.

The susceptibility of AGRs to these problems has already meant that reactors have to be operated at reduced core temperatures, and, therefore, power, to minimize the potential for further degradation. The Hinkley Point B units are currently operating at about a 70 percent power level. The plant is looking at ways to increase power, such as adding more insulation on certain boiler tubes to reduce the temperatures at the critical areas, which will increase the safety margin.

To move back to the two-year cycle, Wall said, the plant has had to review its maintenance routines to see which ones to pull back to two-year intervals and which to move out to four years. Using this approach, some of the extra costs incurred as a result of more frequent outages will be made up for by shorter outage durations.

Benefits of the new process

Whether outages are performed on a two- or three-year cycle, carrying them out efficiently depends on how well prepared the plant is before the outage begins. The new 24-month process has many benefits, Wall said, and requires that much more careful thought and rigor go into planning the outage than before. The new process provides a procedure to freeze the scope of work much earlier, and it generally covers all the elements needed for a good outage. The process will also help streamline outage execution and provide increased confidence that the outage schedule will be met.

Establishing a robust scope-freezing process and applying it rigorously was seen by Wall as a big challenge when he took on this job, having seen the consequences of allowing engineers to make changes in a project's scope late in the preparation phase. Changes in scope disrupt the downstream activities, he said, and it becomes virtually impossible to let proper contracts

if the target keeps moving. "You can't plan the work, you can't walk it down"—all the things that are needed for a successful outage, he noted.

Improved planning should also reduce the level of work that has to be aborted because of a lack of resources, spares, and permits, for example, and lead to a reduction in working capital and inventory holdings. Less time will be wasted "reinventing the wheel," Wall said. The process should also ensure that all stations share best practices and lessons learned, such as risk management strategies, engineering change and material solutions, pooling of resources, optimized execution plans, and many others.

Wall's job as strategic outage manager was a new position in the company, created to put some strategy and long-term thinking back into outage planning. Wall also has overall responsibility for outages, which means ensuring that resources and organization are in place, while also looking ahead to future outages.

The new outage approach requires a much larger team, putting more station staff into a new outage organizational structure to perform outage tasks, and giving them more responsibility for planning and preparation. The actual outages are managed through an Outage Control Center (OCC), which is set up before the outage begins and operates 24 hours a day, seven days a week. The OCC is staffed by senior employees who ensure that the day-to-day schedule is delivered and who troubleshoot problems, particularly those that might hold up the schedule or cause safety issues.

The OCC uses the "30-minute rule" for critical and near-critical path activities during the outage. The rule states: "If you encounter a problem, try to sort it out yourself in the first 10 minutes, get your supervisor within 20 minutes, contact the OCC helpline within 30 minutes—this will put you through to the OCC manager, who will then decide on the person best equipped to deal with your problem."

As the person who appoints others to manage the various outage tasks, Wall from time to time does find himself involved directly in outage events, for example, when there is a forced outage, which has its own management procedure to follow. In fact, the new approach involves a number of

Milestone planning at Hinkley Point B

To deliver its 24-month outage preparation process, British Energy has adopted a generic Pre-Outage Milestone Plan (POMP) that sets out the main outage activity milestones. From the start of the planning process (S-24) to the beginning of the outage (S-0), there are 64 milestones.

Each milestone activity has a set of acceptance criteria, a responsible person/department, and a completion date. The activities are defined either for compliance with site license conditions, which include the inspections of safety-relevant components and systems and other statutory requirements, or to undertake other outage objectives, such as the completion of major capital improvement projects and repairs.

Reviews of the plan are conducted regularly throughout the preparation process to ensure that adequate nuclear safety margins are maintained throughout the statutory outage work and are not unnecessarily eroded. All activities to be carried out during the outage are discussed with the regulator, the Nuclear Installations Inspectorate (NII).

The outage process is led by the Outage Coordinator, who reports to the Outage Group Head, who represents the plant manager for outage-related matters. The main activities are usually broken down into discrete subprojects, each of which has an outage subproject coordinator who is responsible for the coordination and timely completion of all related activities.

The milestone time line

The first milestone, which effectively starts the countdown, is the issuance of the Level 1 POMP, which identifies when specific milestones are to be met. The milestones for the first five months of the outage planning process, referred to as the Project Definition Phase, focus on key investment work to be delivered during the outage, including, for example, the following:

- Initial ("Gate A") approval of planned investment work, which includes significant major capital and repair items (such as those that have a high cost, a long lead-time, or potentially a large impact on the outage critical path).
- Issuance of the Department Outage Preparation Plan, which details what each station department, the Central Technical Organization, and main contractors have to do to meet the Level 1 POMP milestones.
- Issuance of the Concept Definition Paper, which includes the outage goals and covers issues of safety, quality, time, cost, and other operational requirements.
- Issuance of the Level 1 Outage Execution Plan, showing all the major items of work likely to be undertaken. This enables subsequent outage programs to be suitably scoped and developed as subprojects. Input for the execution plan comes from various sources, including compliance requirements, significant capital items, major engineering modifications, and significant corrective work.
- Issuance of the Outage Project Definition Document, which defines the purposes of the outage, including the business benefits, the critical success criteria, and the intended scope of the outage, and sets out the management, organizational, and oversight arrangements to be put in place for the outage.

The milestones over the next several months focus on reviews of the work to be carried out, such as routine maintenance, modifications, and corrective work, including, for example, the following:

- Issuance of the Intended Scope Report, which provides additional detail to the Concept Definition Paper, giving a brief and concise narrative of the work involved for each major activity.
- Issuance of the Level 2 Execution Plan, which includes the Engineering Changes. This is the underlying foundation of the outage program.
- Engineering Change Scope Freeze applied.
- Final ("Gate C") approval of planned investment work.

Significant milestones over the last nine months include the following:

- S-9—Outage organization published and a dominant activity freeze applied. (One of the objectives of this freeze is to provide enough certainty to allow contractors to quote accurately against the work.)
- S-8—Contractor request for quotations issued.
- S-7—All engineering changes approved and Outage Intentions Document issued to the NII.
- S-6—Work scope freeze, covering all outage tasks.
- S-5—Presentation of work scope to the NII.
- S-4—All contracts and the site mobilization plan issued.
- S-3—Final Readiness Review.
- S-2—Risk review execution plan and contingencies prepared.
- S-1—All personnel security cleared.
- S-0—All contractors confirmed ready and start of outage.—*D.K.*

other processes for managing risk, for lessons learned, for outage peer review preparation, and for station readiness review.

His work also involves building relationships with the company's suppliers. The preparation process requires that the main contractor partners—which for Hinkley Point B include Doosan Babcock (which provides the main reactor services), Alstom (turbines), Weir (pumps), and Alstec (plant services)—become involved earlier in planning their work. Contractors are also being urged to become more financially involved by investing in outage improvement methods. In return, the plant is able to contractually share some of the benefits with them.

Creating a fleet standard

One of the drivers for introducing a corporate outage planning process was to bring the entire fleet together under a standard system. Previously, individual British Energy plants developed procedures that were much less detailed than those in the new process. This system worked, Wall said, because plants had long-serving staff members who had been involved with the plants from the beginning. Not only are experienced people now retiring, but there is also a higher staff turnover than in the past. The new outage process provides a much better basis for bringing new people on board.

The company is very much committed to implementing the process across the fleet, recognizing that the outage area is crucial to driving up standards and improving plant performance. Using this standard preparation process also makes it possible to measure performance at each station using the same benchmarks, and, therefore, to identify best practices across the company. Previously, with each station doing things differently, Wall said, he could not easily identify best practices within British Energy's own fleet. Now, however, it is very easy to identify best practices by looking at how a station measures up in achieving outage milestones.

As British Energy rolls out the process across its entire fleet, each plant will be at a different place along the road to implementation, depending on factors such as when their outages are scheduled or when events, such as forced outages, occur. In Wall's opinion, Hinkley Point B has had one of the better runs at embedding the process—that is, making it the "new normal."

Wall said that the outage processes provide a clear structure that helps ensure that all required actions are delivered and milestones are successfully reached. It provides clear accountability as to what has to be done, when it must be delivered, and who is to do it. "It is an 'a-b-c' [guide] for project management," he said. NN