

Best Practices Awards

**For Management
For Safety
For Operation and Maintenance**

Gas-turbine-based powerplants compete against nuclear, coal-fired, and hydro generating facilities for a share of the electric power market. Product price is of primary importance and competition is keen.

Large GT-based plants—most installed within the last five years—are challenged today by the high cost of natural gas and the need to pay down construction debt. By contrast, nuclear, coal, and hydro facilities generally are 25 or more years old and virtually debt-free. Their fuel resources also are much less expensive compared to natural gas. Hydro plants, for example, do not even pay for “fuel.”

What attributes of GT-based plants allow them to compete successfully in such a difficult market? Essentially, it is their advanced combustion and materials technologies and control systems—and thermodynamic cycle—that enable operation at much higher efficiencies and with less environmental impact than is possible at most other generating stations. In addition, GT-based facilities are able to start quickly, thereby satisfying a market need for “premium” power during periods of peak consumption. Recall that electricity cannot be stored in large quantities and must be produced “on demand.”

The challenge for owners and operators of GT-based plants is to continually improve the performance of their facilities to grow market share and revenues. One component of this goal of “continual improvement” is Best Practices. These are the methods and procedures plants rely on to assure top performance on a predictable and repeatable basis—an absolute necessity to mitigate risk in the relentlessly competitive merchant power market.

The Best Practices Awards program launched late last year by the **COMBINED CYCLE** Journal has as its primary objective the recognition of the valuable contributions made by plant staffs—and headquarters engineering and asset management personnel as well—to ensure reliable, efficient, and safe operation of GT-based generating facilities. Entries for the 2005 awards in Management, O&M, and Safety are presented below, all edited for style, some for length.

As the CCJ goes to press, these entries are being evaluated by a panel of judges with plant management experience. Awards recognizing the achieve-

ments at individual plants will be presented during a special luncheon on April 4 sponsored by the Combustion Turbine Operations Task Force at its Spring Meeting in Annapolis. Incidentally, the CTOTF, the senior-most user group supporting gas-turbine operations, is celebrating its 30th anniversary in 2005. To register and for more information on the group's activities, visit www.ctotf.com, or contact Wickey Elmo, group and conference coordinator, at info@ctotf.com or 704-753-9988.

Announcement of the 2006 awards program is presented on the next to last page of this issue (inside the back cover in magazine parlance). Entries should not take more than about an hour to prepare and can be submitted to Bob Schwieger, editor and publisher, at any time before December 31, 2005. Every entry will be profiled in the first issue of 2006. This is one sure way to get the recognition your plant, your staff, and you have earned by your collective resourcefulness. Please plan to participate. CCJ

Entries for the Best Practices Awards for Management

1. Optimizing backfeed power contracts reduces cost

Challenge: Offline and startup power costs are a major expense for plants that cycle frequently and have low capacity factors.

Solution: We reviewed the terms and conditions of our backfeed power agreement to see if we could reduce the cost of this service. Our baseline demand usage was less than 2 MVA when offline; however, we were paying for 10 MVA of firm demand. We noticed that we could dramatically reduce expenses by lowering the firm demand limit in our contract. We met with our backfeed power provider and reduced that limit to 2 MVA.

Renegotiation of the backfeed power contract

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improved the project's bottom line and competitiveness. This was accomplished by ensuring that the terms and conditions of the backfeed power agreement—such as the firm and non-firm demand limits—were optimized to reduce the monthly power bill. In addition, control room operators were coached on contractual requirements to help them identify unnecessary auxiliary loads that increased backfeed. Their contributions proved invaluable.

Results: The project's firm demand limits were reviewed and the project's backfeed power agreement was revised. Along with operator initiatives, this resulted in a saving for 2004 of over \$300,000—or more than 30% of the annual backfeed bill.

2. O&M management philosophy

Challenge: Facility staffs are lean, margins are low, and management philosophy is the key to achieving profit through efficient teamwork in today's competitive power market.

Solution: Trust, communication, and feedback processes are critical to our management philosophy. A priority for our team is making sure that the key business goals are understood by every employee. We do not have any secrets, and understanding what is important to the company's success enables superior performance. Having employees who are knowledgeable and excited about our goals has led to numerous innovations.

Some examples of activities that illustrate this philosophy include the following:

- Presentation of shift-by-shift financial performance at the end of the month, including heat rate, excess energy, backfeed power, generation stability, ramping, and other measures.
- Safety committees.
- Operations round-table brainstorming and procedure optimization.
- A compelling training initiative.
- Open door policy.
- Informational sessions.

Results: Getting employees involved has resulted in the optimization of startup fuel usage, reduction in backfeed power on startups and shutdowns, increased reliability, superior environmental and

Central Alabama Generating Station

885-MW, gas-fired combined cycle Billingsley, Ala

Owner: Tenaska Alabama II Partners LP

Key project participants:

Robert Threlkeld, Plant Manager
Cecil Boatwright, Operations Manager
Chuck Eliason, Asset Management Technical Analysis Director
Brian Pillittere, Plant Engineer

safety performance, and efficiency. These efforts have increased revenue through cost reductions and made the plant more economically appealing to our customer. Our maintenance team has been very proactive in repairing and anticipating any problems that might affect plant performance. This all translates into lower cost and greater reliability for our customer.

3. We're All in This Together (WATT)—a powerplant workforce united in practice and purpose

Challenge. Cultivate and stimulate positive professional relationships with all project partners—for example, employees, owners, lenders, energy purchaser, regulators, etc—through an unyielding commitment to high ethical standards, while producing exceptional results.

Solution: The plant's foremost guiding principle is to be absolutely honest, ethical, and professional in the areas of employee relations, contracts administration, safety and environmental conduct, O&M

obligations, and to have confidence that such unwavering ethical behavior will pay dividends in the form of positive financial, environmental, and safety results. In other words, the plant's employees are committed to "always do the right thing—and let the chips fall where they may."

Additionally, employees embrace a WATT way of doing business. Project successes are recognized and

celebrated as a team; setbacks are analyzed and accepted as a team.

Employees are encouraged to enjoy their job—to laugh—and to generally have fun. The employees are very good at what they do and consistently produce exceptional results; nevertheless, they also are encouraged to enjoy themselves while at work.

Results: The plant's relationship with the project partners is exceptional. The forthcoming and honest manner in which the employees communicate with the partners, coupled with the obvious desire

to conduct business in a fair and professional manner, has resulted in a great deal of mutual trust and respect.

There are many benefits associated with a positive relationship between the energy seller and purchaser. The plant enjoys the benefits that result from an outstanding ability to meet daily dispatch schedules, as well as a sincere desire to serve their sole customer to the best of their ability. During 2004, the seven-month average peak-month availability to meet dispatch was 99.81%. The five-month average non-peak-month availability to meet dispatch was 98.04%. There were 596 dispatched unit starts during the year.

Plant employees have worked more than 1500 days and 250,000 personnel-hours without a lost-time accident. There has been only one minor "Doctor's Treatment Accident" experienced since initial staffing took place in August 2000. The plant has never experienced an air-quality or NPDES Notice of Violation; it has undergone several ODEQ Air Quality and Water Quality Audits during the past four years without a noteworthy issue brought forth.

4. Calpine Operational Review for Excellence (CORE) program

Challenge: Company owning and/or operating a large number of powerplants needed to discover, develop, and leverage the best practices that existed at these facilities. It was also desired that facilities be reviewed for compliance with company standards.

Solution: A plant review program was developed and implemented (CORE). The purpose of the CORE program is to conduct periodic operational reviews of company's power production facilities. CORE teams assembled from company's O&M experts and internal audit department conduct the reviews and document the results based on checklists of issues and requirements. The objective is to establish and maintain the industry's highest standards of performance for the company's powerplant operations. This results in the creation and continuous improvement of best practices.

An operational review is performed at a different facility every six weeks. Review teams typically consist of three plant managers from other inter-company powerplants, two internal audit analysts, technical specialists, and the senior vice president who manages the program. The intent

Green Country Energy LLC

800-MW, gas-fired combined cycle
Jenks, Okla

Managing partner: Cogentrix Energy Inc

Project leader:

Rick Shackelford, Plant Manager

of these reviews is to document best practices at the facility, which are then made available to other facilities, and to compare actual operations at each facility with the best practices of the company.

For each review, three detailed reports are written and

posted on a CORE program intranet website available to all company personnel. One report reviews and analyzes the plant's thermal performance since COD. A second report reviews the reliability of the plant. Both of these reports benchmark the subject plant against its peers. The third report documents the actual review, which focuses on these 15 areas:

- Safety, health, and environmental.
- General plant operations.
- Thermal performance.
- Purchasing and inventory.
- Communications.
- Budgeting and financial results.
- Staffing and organization.
- Reliability review.
- Training and qualification.
- Community relations.
- Documentation and change management.
- Plant material condition.
- Forced-outage recovery.
- Maintenance practices.
- Plant security.

In the detailed report, best practices, positive findings, and any suggestions for improvement for the reviewed powerplant are described.

Results: Goal of CORE is to realize a minimum of \$20 million in value during the five-year period from 2005 through 2009. To date, the program has identified 650 practices that can be classified as best practices or otherwise very good ideas for implementation at the company's powerplants.

5. Fleet-wide computerized maintenance management system

Challenge: Improve maintenance practices corporate-wide.

Solution: Company implemented a fleetwide Reliability Performance Model. The RPM defines standard processes, practices, procedures, roles, and responsibilities for the performance of maintenance functions and assuring asset reliability. The model provides specific direction in five (5) key areas:

- Work identification and control.
- Job planning.
- Scheduling.
- Outage coordination.
- Materials management.

Calpine Corp

San Jose, Calif

Project leader:

Fred L Manuel, Senior
VP—Operations, SH&E

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Results: Implementation of the RPM has already resulted in the elimination of work-order backlogs that numbered into the hundreds prior to the project. The project team consisted of a wide range of personnel from senior staff to supervisors and coordinators from every division within the company. There had been several attempts in the past to replace the outdated inventory control and work order system. The project succeeded this time because it received early approval from upper management, every division/department was represented throughout the project, and senior management provided full support throughout the implementation process.

Associated Electric Cooperative Inc
Springfield, Mo
Project participant:
Gabriel Fleck, Electrical Engineer

Entries for the Best Practices Awards for Safety

1. Teams Operating Plants Safely (TOPS)

Challenge: Operational excellence can be elusive unless a formal program is in place for continually monitoring and improving performance.

Solution: TOPS is a behavioral-based program designed to create and reinforce a culture of operational excellence that can be universally applied to any organization. The program highlights eight key performance categories required to safely and effectively operate and maintain production facilities. The major observation categories of the program are: leadership, planning and preparation, execution, communication, barriers, tools and equipment, and housekeeping. Ladder safety is included as a supplemental category because of the high injury rate associated with ladder use and also because of their routine use.

In each of the major performance categories there is a subset of expected behaviors. Trained observers use a scorecard to determine if the sub-categories observed are classified as “safe” (functional) or a “concern” (questionable or dysfunctional). The sub-set of behaviors for each category shown on the scorecard points back to causal factors identified in accident and event investigations (RCA) completed over many years. The findings of RCA are considered “lessons to be learned.” Note that a “lesson to be learned” cannot be classified as a “lesson learned” until it is confirmed through observations that the organization has changed its behavior to prevent recurrence.

Wolf Hills Energy LLC
250-MW, gas-fired peaking plant
Bristol, Va
Owner: Constellation Generation Group LLC
Project participant:
Richard W Evans, Plant Facility Manager

It is probably fair to say that all of the most common observation programs in use today have produced positive results in one form or another. In general, they are all good in that they bring focus to ensuring a safe work place. Nothing is more important. However, most programs are limited to managing risk associated with personnel accidents and/or injuries. TOPS leverages from the success of proven safety observation programs by expanding the risk-management concepts to plant safety, equipment safety, operational safety, and reliability. The belief is that the same risk-management thinking required to maintain a safe work place can be applied to protect plant equipment, improve reliability, and increase asset value to stakeholders.

A second item that differentiates TOPS from other programs is how information is viewed and over what period of time. Most observation programs record snapshots of safety either instantaneously or over a fairly short period of time. The snapshot record is then plugged into a database to trend for common organizational deficiencies. Likewise, TOPS also records and trends information. However, TOPS takes a closer look at the complete job cycle from beginning to end. The net result is that a common organizational mental model is created as a standard that every worker should be able to easily recognize.

Safety (or risk management) is the cornerstone of the TOPS program. Operational excellence is the

Category	Frequency
Safety	NEW
Exec	Unusual
Ops	Routine
Plans	
Other	

Risk	Increased Ops
High	Leadership
Medium	Planning & Prep.
	Execution
	Communication
	Barriers

expected outcome. Excellence is achieved through focusing on personnel safety, plant safety, equipment safety, and reliability as one. The belief is that the same dysfunctional behaviors that lead to accidents and injuries also lead to plant, system, and equipment failures.

The TOPS program reinforces the functional behaviors that work toward event-free plant operations by discouraging any dysfunctional behavior that increases risk to personnel, equipment, and loss of revenue. The TOPS program captures STAR (Stop, Think, Act, and Review) verification techniques as an observable behavior and also transposes the findings of Root Cause Analysis (RCA) into a set of functional behaviors necessary to prevent recurrence.

Results:

- Uses proven safety principles and observation techniques to build a culture of operational excellence.
- Promotes safety and reduces risk of human error. Program is non-punitive and owned by technicians.
- Provides a formal method for reporting problems.
- Data trends provide insight for more effective corrective action plans.
- Captures STAR techniques as an observable set of behaviors.
- Builds a standardized mental model of operational excellence for employees to emulate.
- Develops a contingency and systems thinking culture.

Reduces risk of accidents, injuries, equipment damage, and loss of plant revenue. Results have varied from plant to plant, depending on the starting point with respect to accident rate, etc. In one instance, for example, the OSHA recordable rate was reduced from 3.5 to 0.067 in one year. It would be difficult to over-emphasize the results of the program.

2. Pay close attention to the lock-out/tag-out process to improve safety

Challenge: Protect inexperienced employees working on multiple units during plant commissioning.

Solution: In many combined-cycle plants, multiple units can cause confusion when trying to implement lock-out/tag-out (LOTO) procedures. Add to this a workforce that may not have extensive experience in the application of LOTO and you have an increased potential for mistakes and injuries. Years of experience reflect that vigilance with respect to LOTO never ends if you want to prevent locks and tags from ending up on the wrong device.

Here are a few simple best practices that greatly reduce the number of mistakes with the application of LOTO:

1. Add second checks to the process. One of the six basic steps outlined in 29 CFR 1910.147 cautions, "Verify isolation of machine prior to work." The verification of isolation is usually accomplished by trying to start the machine or equipment. That may work for electrical equipment, but what about manually operated valves and switches? The simple addition of a second check of the LOTO by a person that is not involved origin of the LOTO but is knowledgeable of the equipment or machine can help to avoid mistakes. Our experience indicates there is a mistake with a LOTO approximately 30% of the time.

Here's how it works: After locks and tags have been applied by the authorized employee, the shift supervisor selects a qualified person to perform a

Magnolia Energy

840-MW, gas-fired combined cycle
Ashland, Miss

Owner: InterGen

Project participant:

Gary Couture, Plant Chemist/HS&E

second check and discusses the LOTO with that person. The person doing the second check takes a copy of the original LOTO form to walk down the LOTO and verify the proper locks and tags are in the right place. Then he or she initials each tag and initials

the space on the form that the second check was performed. Only then can the shift supervisor authorize the equipment to be worked on.

2. Monthly audits. Although an annual inspection of the process is all OSHA requires, monthly audits help to keep the whole lock-out / tag-out program on track. Regular audits can identify small problems before they become big ones. An authorized employee who is not using the energy control procedure being audited must perform these audits. In a facility where there is light lock-out/tag-out activity, a monthly inspection should be adequate to keep the system on track. In those facilities where there is heavy lock-out/tag-out activity, weekly inspections may be necessary.

Results: Close control of work processes can eliminate LOTO failures.

Entries for the Best Practices Awards for Operation and Maintenance

1. HRSG reliability improvement

Challenge: HRSG tube leaks and socket-weld leaks caused reduced availability, increased maintenance costs, and reduced efficiency during our first year of commercial operation. Repair of leaks can cost several days of operation, not to mention availability penalties and lost reputation with the power purchaser. Repairing tubes involves cutting the jumper between bundles, separating bundles to allow access, cutting tubes to allow access to the damaged tube, repairing the damaged tube, welding your way out, stress relieving, and welding together the jumper and stress relieving it. Several causes of these failures were identified: gas-turbine (GT) tuning during startup, quenching from attemperator valve leak-by, quenching from over attemperation, and quenching from water left in the bottom of tube headers during a unit start. Socket welds failed because of insufficient QA—for example, minimal x-rays—single-pass versus double-pass welds, and not taking into account thermal growth and movement of bundles.

Solution: We increased the size of drain lines for

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the superheater and reheater from 1 to 1½ in.; changed permit logic to saturation temperature plus 50 deg F for attemperator usage; manually drain low points of reheater and superheater bundles prior to purge, during purge, and during GT initial firing; modified the procedure for keeping the HRSG drains open until 50 psig; imposed strict temperature limits on tuning 30-80 MW; and added automatic drains to the reheat desuperheater for added protection. Above all, operators were extensively trained on all of these issues and all operating procedures were updated to reflect these new practices.

Results: Zero tube failures during second and third peak seasons. Minimal socket-weld failures were thought to be caused by commissioning fatigue. We transferred lessons learned to sister plants, one of which experienced zero tube failures for the first and second peak seasons, and zero HRSG internal socket-weld failures.

2. Optimizing plant startups

Challenge: During daily plant startups and shutdowns, revenue from the power being sold is less than the cost of the gas it takes to get the plant up and running and/or taken offline. This is a major expense for our power offtaker.

Solution: To minimize the fuel costs the power offtaker incurs during plant startups and shutdowns, we have optimized the timeline of starts and shutdowns with a condensed schedule. The daily startup schedule has been fine-tuned to increments of one minute. Through the use of PI data to track previous starts, a very tight schedule has been developed for energizing or de-energizing equipment. Whether it is a cold, warm, or hot start, everything from the time the operators initiate a start to the time they ramp the plant to meet requested energy is charted on a table for various energy dispatches and timeframes. This allows the operators to concentrate more on the operation of the plant with little worry about the timeline or making the energy delivery tolerance. Assuming plant conditions are normal, all the operators have to do is initiate equipment starts or stops when the chart indicates the timeframe and the dispatch numbers will fall into place.

Lindsay Hill Generating Station

845-MW, gas-fired combined cycle
Billingsley, Ala

Owner: Tenaska Alabama Partners LP

Key project participants:

Robert Threlkeld, Plant Manager
Don McBride, Operations Manager
Kevin Simpson, Maintenance Manager
Dave Merkley, O&M Support Manager
Mark McKenzie, Lead Control Room Operator

Results: The plant maintains a great working relationship with its power offtaker because of a tight energy delivery tolerance during startups and shutdowns. In the competitive market, a plant must get on line quickly without using too much gas or making too many megawatts for sale at low prices. This is a vital part of the offtaker's decisions. It is the difference between getting the call to operate the next day or that

opportunity falling to someone else. Because the start times have been shortened and optimized, the plant runs less time without the injection of ammonia, thus shortening the time that NO_x levels are high during startup. The environment benefits and the cost of ammonia is reduced.

On a three-unit hot start, the plant is able to get from zero to more than 700 MW in less than two hours, while staying in the guidelines set forth by various equipment vendors and using minimal gas. During warm starts, the plant is able to start in 2 hr 15 min. The plant maintained 99.4% availability on peak and 99.7% availability off peak for the calendar year.

However, the real impact cannot be seen through availability numbers. The plant's efforts to opti-

mize startups resulted in megawatt numbers that the power offtaker wanted during startup and shutdown being achieved 92.8% of the time. The offtaker was able to sell startup and shutdown megawatts knowing that it could count on the reliability of those dispatches. The offtaker also saved a considerable amount of money because of the reduced amount of gas burned during the shortened starts. Calculations suggest a

saving of more than \$270,000 in gas alone for 2004.

Central Alabama Generating Station

885-MW, gas-fired combined cycle
Billingsley, Ala

Owner: Tenaska Alabama II Partners LP

Key project participants:

Robert Threlkeld, Plant Manager
Cecil Boatwright, Operations Manager
Brian Pillittere, Plant Engineer
James D Brown, Lead Control Room Operator

3. Use demin water to reduce electrical load during shutdown

Challenge: How to reduce auxiliary load during shutdown periods, which was excessive because plant design required use of the full closed cooling system to cool bearing oil while turbines were on turning gear.

Solution: Plant implemented an effective and

inexpensive modification to the closed cooling system that has reduced auxiliary energy consumption by nearly 50% during shutdown periods. The modifications were made with 1-in.-diam PVC piping utilizing existing pumps and equipment. Installation was performed by site personnel that further improved project economics. Payback was realized within a matter of weeks rather than typical improvement projects that require years to recover the initial capital outlay. The project has had the added benefit of increasing the useful life of key components through reduced operation and, consequently, has saved money by reducing maintenance costs. The success of the project also empowered the site personnel and has been a catalyst for new cost-saving innovations during long plant shutdown periods.

Both the gas turbine and steam turbine must be continually slow-rolled in order to meet OEM requirements and readiness for emergency dispatch. Therefore, lube-oil pumps and coolers for both machines must remain in operation during shutdown periods. Under existing design, the turbine lube oil is cooled in water-to-oil heat exchangers that use water from the closed cooling water system, which in turn, is cooled by the auxiliary cooling system through another heat exchanger. These cooling loops consume a significant amount of energy. The closed cooling water pump has a 150-hp motor and the auxiliary cooling water pump a 100-hp motor. By comparison, the demineralized-water transfer pump is driven by a 15-hp motor.

When the plant is shut down, the required heat removal from the turbine lube oil is minimal. Therefore, very little cooling water is necessary. Rather than continuously running the pumps of the closed cooling and auxiliary cooling systems, plant personnel decided to recirculate demin water through the same heat exchanger to cool the lube oil. The 300,000-gal demineralized water storage tank acts as a heat sump.

It takes approximately 10 days for the demin water to reach 95F. When this temperature is reached, the lube oil is cooled according to original design using the closed cooling and auxiliary cooling systems. The water in the demineralized water storage tank cools to ambient temperature in approximately two days.

After demin water in storage is cooled, the lube-oil cooling process is transferred back to the demineralized water loop after thoroughly flushing the water side of the lube-oil heat exchangers with demin water. Rinse-water samples are taken before lining up the demin cooling loop to ensure no possibility of system contamination. Sampling includes analysis for conductivity, silica, pH, and trace oil. The flushing process is concluded (typically 15 minutes) when all these parameters are found equal to, or better than, the purity of the demineralized water.

Results: The improvement was implemented early last year. In 2004, plant saved over \$36,000 as a direct result of this modification.

4. Maximizing HRSG availability and life

Central TermoEmcali

235-MW, gas-fired combined cycle
Cali, Colombia

Managing partner: InterGen
Operator: North American Energy Services

Project leader:
Jim McConville, Division Director,
NAES

Challenge: How to commission, operate, and maintain a new combined cycle in order to avoid costs related to HRSG tube failures over the unit's design lifetime.

Solution:

1. Invested in critical infrastructure and training, including:

- Consulted with the Electric Power Research Institute (EPRI), Palo Alto, Calif, prior to construction regarding water chemistry and instrumentation.

- Conducted pre-commissioning HRSG chemical cleaning with EDTA in accordance with EPRI recommendations.

- Installed additional access doors in critical areas of the HRSG.

- Installed double-isolation blocking valves in key attemperator lines to prevent tube quenching.

- Partnered with EPRI on an HRSG thermal study involving installation of over 80 thermocouples in one unit. Study includes chemical practices as well.

- Trained key plant personnel in EPRI's boiler-tube failure reduction program.

- Developed procedures for optimum operation to include ramp rates.

2. Monitored assets both online and with physical inspections.

- Real-time monitoring includes water chemistry, ramp rates for temperature and pressure, and thermocouple data for evaluation.

- Physical inspections are conducted of the HRSG and attemperators during outages. HRSG inspection includes visual check of drums, insulation, tube condition, impingement baffles, etc. Tube thickness and materials verification are also part of this work.

3. Established a program that enables quick identification of problems and repairs/corrections where necessary to prevent a recurrence. This program is enabled by the following:

- Maintaining tube material onsite.

- Having tube repair contracts in place ("R" Stamp).

- Maintaining certifications for onsite welders.

- Training staff appropriately and maintaining reference material.

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- Conducting monthly meetings of the boiler-tube failure reduction team and updating procedures as necessary.

Results:

EPRI audited the plant and rated it “World Class” with respect to both boiler-tube failure reduction efforts and water chemistry specifically:

- Reduced commissioning steam-blow times significantly after chemical cleaning.

- No O&M-related tube failures to date. However, two leaks did occur because of poor welds during manufacture.

- No lab analyst coverage required on weekends, saving overtime.

Jasper Generating Station

875-MW, gas-fired combined cycle
Hardeeville, SC

Owner: South Carolina Electric & Gas Co

Project participants:

Galen Bullock, Maintenance Superintendent

Kurt Koenig, Plant Engineer

Don Belle, Mechanical Maintenance Supervisor

Pete Pye, Senior Lab Analyst

Brad Lagrow, Lab Analyst

John Pearrow, Manager, System Chemistry and Environmental Compliance

Barry Dooley, EPRI Technical Executive

available 24/7 wherever key personnel are.

Our plant installed and configured the OSI PI ACE™ (for Advanced Computing Engine) module to maximize the benefits of PI. This client application sits outside of the PI server and is a full programming environment using Visual Basic. Complex calculations, communications applications, and data transfer programs can be executed whenever an input changes (for example, a unit breaker opens) or when a time-based model has run (such as hourly production totals). Unlike PI,

ACE can trigger calculations on multiple input tags and then instantly create and send an e-mail to a distribution list. A typical message e-mailed to the BlackBerry might relate to an emissions excursion, duct burner on/off, or even a high vibration level on a turbine.

Results: In effect, PI ACE and text messaging devices have enabled plant personnel who are off-site to receive information critical to operations at the same time the control room operator does. This permits our key decision-makers to instantly monitor the status of the facility while freeing the plant operator to focus on his/her task of locally controlling the event. Emissions excursion notifications are issued directly to the compliance engineer as soon as the event occurs. Plant trips, critical equipment conditions, and other alarms are configured to alert the O&M manager for his immediate attention while plant output totals and load changes are transmitted to all personnel responsible for production monitoring.

5. Remote plant condition monitoring facilitates problem-solving

Challenge: Make critical plant operating data available to management and/or key decision-making personnel when they are offsite. Examples: hourly production status, environmental compliance, critical equipment monitoring, and instantaneous changes in plant configuration.

When an abnormal event occurs in a combined-cycle plant, decision-making involves more than just the plant operator. During the event, or soon after it has occurred, the operator may notify a hierarchy of plant personnel including the operations manager, plant engineer, and plant manager. If the event involves air or water permit compliance, an environmental manager might also require immediate notification. The task of controlling an event while notifying all the proper personnel can be daunting in the midst of trying to restore the facility to a safe condition.

Solution: Implementing OSI™ Process Interface (PI) and analysis tools to capture real-time production data and equipment status, and instantly communicate any significant deviations in plant conditions to key personnel via a text messaging device—such as a BlackBerry. The configurable message is sent at the same time that the plant operator sees the event on the DCS. Critical conditions are

Mesquite Generating Station

1250-MW, gas-fired combined cycle
Arlington, Ariz

Owner: Sempra Generation

Key project participants:

Merritt Brown, Plant Manager

Joe Davis, O&M Manager

Steve Perrizo, Plant Engineer

Kevin Rose, Compliance Engineer

Don Maultin, DBMSoft Inc

6. Side-stream filtration reduces operating cost of closed cooling systems

Challenge: Our combined-cycle plant has three individual closed cooling water (CCW) systems—one for each of the two gas turbine/generators (GTs), one for the steam turbine/generator (ST). A solution of 70% demineralized water and 30% propylene glycol is circulated by the CCW pumps through auxiliary heat exchangers to equipment requiring cooling. Changes in volume are

accommodated by maintaining the level in the CCW system head tanks. Plant maintains very tight CCW systems, requiring minimal makeup. The advantage of this is that only a small amount of chemical must be replenished to maintain each system and helps control cost.

These cooling systems are treated with a molybdate inhibitor for corrosion protection at high concentrations which makes treatment costs significant even though the systems each contain only 1000 to 3000 gal of cooling water.

Each system loses approximately 15% of its volume annually. Sometimes water must be dumped because of a build up in degraded glycol components and the accumulation of iron and other metals. Since these materials can create corrosion issues or deposits on heat-transfer surfaces, it is normally recommended that the systems be dumped when the turbidity or solids increase to a given level. To dump and replenish the glycol and inhibitor costs from about \$2400 to \$5000 per system. The cost of disposal is extra.

Solution: Following a comparison between chemical use and installation of a side-stream filtration system, plant opted purchase a portable, side-stream filter that uses a sock-type filter medium. Cost of the 8-in.-diam filter with stainless steel housing, fittings, thick-walled rubber hoses, and two pressure gauges was approximately \$2000. It is rotated among the three units.

Installation required penetrations on the recirculation pump suction and discharge piping. All fittings utilize quick disconnect fittings and two thick-wall rubber hoses. Initially a 10 micron filter was used followed by the use of a 5 micron filter but very little contaminants were being removed as evident by low differential pressure and visual examination of the filter element. Currently, a 1 micron filter element is used.

Results: Significant changes in the water color have been observed with increased differential pressure. One GT's CCW system was operated with the filter in service for a period of one month and required only one filter element replacement.

The side-stream filter has been in continuous service for 18 months with relevant success. To date, the CCW systems for both GTs and ST have not been dumped in nearly three years. There may come a time that the

CCW systems require dumping, flushing, and replenishment, but it does appear that side stream filtration has allowed us to at least prolong the frequency that this would normally occur. Permanently installed filtration systems are planned for each CCW system.

7. O&M cost saving through optimization of backfeed power usage

Mustang Station

486-MW, gas-fired combined cycle
Denver City, Tex

Owners: Denver City Energy Associates LP and GS Electric Generating Co-op Inc

Operator: North American Energy Services

Project participant:
Thomas Phare, NAES

Problem: Offline and start-up power costs are a major expense for plants that cycle frequently and have low capacity factors.

Solution: The optimization of the use of backfeed power when offline and during start-ups improves the project's bottom line and competitiveness. This is accomplished by minimizing the use of backfeed power when offline and

reviewing startup procedures and control logic to minimize the use of backfeed power and limit reactive demand spikes during plant startups and shutdowns.

Results: Modifications to the DCS logic that removed the requirement for a start of a boiler-feed pump and circulating-water pump until a generator is online resulted in a 50% reduction in backfeed demand spikes. This logic evaluates steaming potential of the high-pressure economizer, and initiates an auto start on the boiler-feed pump as needed. The circulating-water pump, which draws 2 MW, is started after the first unit is synchronized.

We also installed a low-capacity standby auxiliary cooling-water pump to reduce power demand for turning gear and shutdown operations, and

use startup vents to reduce heat load to the condenser. The small pump allows us to shut down the larger circulating-water pump earlier than previously possible. In addition, the auxiliary cooling-water pumps were modified and connected to the circulating-water header to allow us to use the smaller pumps at moderate heat loads to the condenser. We also take the last generator offline by opening the breaker, instead of waiting on the reverse power relay, further reducing backfeed load.

Lindsay Hill Generating Station

845-MW, gas-fired combined cycle
Billingsley, Ala

Owner: Tenaska Alabama Partners LP

Key project participants:

Robert Threlkeld, Plant Manager
Don McBride, Operations Manager
Kevin Simpson, Maintenance Manager
David Martorana, Plant Engineer
Dave Merkley, O&M Support Manager
Eric Powell, Control Room Operator
Claude Couvillion, Control Room Operator