New software tools promise higher reliability, lower maintenance costs

If you've heard it once in the last few years, you've heard it a dozen times: The electric power industry is ageing rapidly and "go-to" people are retiring at an alarming rate. Industry headhunters have created a scare scene reminiscent of the fairy tale, Henny-Penny. Fact is this industry has always been "home" to large numbers of employees who entered young and stayed to retirement because the jobs were good, remuneration fair, and benefits generally excellent.

However, what has happened in the last decade or so to raise concerns about retirements is a shift from an industry dominated by regulated electric utilities to one with a significant percentage unregulated assets owned by non-utility generators (NUGs). In the regulated world of yore, utilities played a major role in community affairs and were big employers—simply put, the companies believed they had a social obligation. NUGs, by contrast, often are transparent to the communities in which they own generation assets.

Twenty years ago, a typical regulated coal-fired station would have had about one employee for every two megawatts of nameplate capacity, a number that has been pared back recently—power cost often becoming more important than the social contract with the community. Merchant generators have been particularly influential in establishing a new standard for staffing. Most of them are committed to highly automated gas-turbine-based generation—facilities that are not encumbered by manpower-intensive coal-handling operations and emissions-control processes. A typical combined cycle has one employee for every 20 MW of capacity and many owners are pressing for still smaller staffs.

It stands to reason that when you have a large staff, there's almost always someone in-house who is qualified to fill an open position. That's not necessarily true at a combined-cycle plant; most senior vacancies are filled from the outside. Likewise, when commissioning a new combined cycle, an owner is lucky if half the staff has any industry experience at all. And this situation is not likely to change, certainly not in the near future.

What to do? It seems simple enough. A good first step might be to accept the fact that, as a plant manager, your primary responsibility after making sure the plant is delivering the power required by the grid operator is identifying, hiring, and training the people needed to maintain the facility's "best in class" status. That's a tall order, and one difficult to fulfill unless your staff has access to the new tools available to "remember" everything that happens in the plant on a daily basis.

Many plant managers, asset managers, and front-office executives should consider rethinking internal processes that rely on employees' memories and migrate to ones that extract the collective knowledge of the staff, organize it, and present it in a manner that facilitates business decision-making conducive to higher profitability.

Think of it this way: You're paying top dollar for top talent to maximize revenue and profit. Why put that position at risk when a key person decides to leave the organization? You can minimize the risk of a "knowledge gap" by extracting from every employee all the information he or she gains on the job that's critical to business success.

For example, what now happens to all the knowledge your employees acquire at user group meetings? Are comprehensive trip reports prepared and entered into a searchable database? Where are the lessons learned by all employees and contractors during an outage recorded for posterity? If you're not doing this, ask yourself why your facility is organized to relearn lessons over and over again? Why should you pay for the same education multiple times? It makes no sense. Knowledge can be captured and retained relatively simply today.

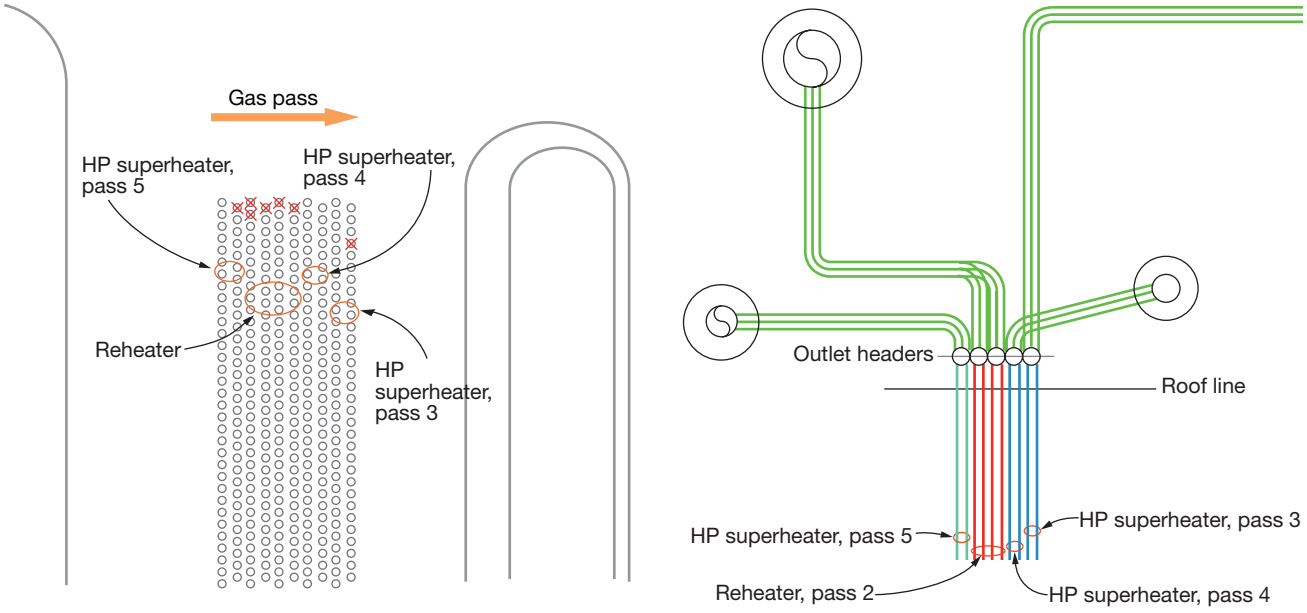
This article describes one of the new tools you should be Aware™ of. According to several users interviewed by the editors, the Automation Technology Inc (ATI, San Jose, Calif) product is at the leading edge of software designed to capture the details of equipment condition—heat-recovery steam generators (HRSGs) and high-energy piping systems for the purposes of this discussion.

But Aware is only a small—albeit important—part of the coming revolution in information management and training. Elsewhere in the issue, a user describes the value of simulators in training and requalifying operators on plant startups and shutdowns, as well as the tough internal sales job ahead for almost everyone who thinks their generating station needs a simulator (all do). Dave Ulozas, the new chairman of the 7EA Users Group and a plant manager for Nebraska Public Power District shares his experiences beginning on p 31.

As noted earlier, many new employees have no industry experience. They were hired for their mechanical/electrical aptitude, but must learn the details of powerplant safety practices as well as of individual systems and equipment to reach full potential. Given the vitality of today's Web-based tools, distance learning is both convenient and economical for this purpose. General Physics Corp's GPiLearn portfolio is a leader in the field as the following article attests.

Just because a given software package has a compelling promise doesn't necessarily mean that it's a good fit for your facility. Read Consultant Jason Makansi's short article on plant software (p 82) you'll learn that many offerings have been oversold and are considered a burden and of marginal value by users. This is particularly true of computerized maintenance management systems (CMMS). Thus you have to do a rigorous cost/benefit analysis before making a purchasing decision—as you would for any capital equipment.

"Optimizing the flow and analysis of plant operating data for effective asset management," co-authored by



1-3. Aware allows you to capture any type of data that documents assessment activities. This includes text, data, graphics, physical location, digital images, audio, video, etc. The software suite maintains a history of all inspections performed on the various components and builds the knowledge base required to maintain the HRSG to a high level of quality. Aware also allows you to associate reference information from other data sources with any system or inspection type. Enhanced screen shots left and right pinpoint location of tube leaks ("X"), provide tube specifications, and color-code materials (teal is HP superheater, pass 5; red is reheater; first two rows of royal blue tubes in the direction of gas flow is pass 4 of the HP superheater; second two rows is pass 3). Actual photo of tube fracture is incorporated into the database as well

Direct Energy LP's Anthony Ligato, illustrates how the ORAP® platform monitors and evaluates key plant-performance metrics automatically (p 94). Plus, it enables maintenance decision-making down to the serialized-parts level for a fleet of generating assets. Most plants have millions of maintenance dollars at risk; minimize that risk with the right tools.

What Aware does

Aware was developed to organize all the details regarding equipment condition from the various organizations that help ensure the plant operates at peak performance—including plant personnel, manufacturer, third-party service providers, etc. Using the software suite's HRSG module as an example, each piece of information is linked to a component—such as the first row of superheater tubes—so it's easy to review the inspections, assessments, studies that have been conducted over the years and to find the recommendations and work done based on those findings.

Many in the industry believe that the equipment details impacting outage work reside on the CMMS. But that's not true. The CMMS creates the work order, but the "if" and "when" behind the decision to issue the order, and the optimum time to conduct the work, is based on the engineering measurements, analysis, results, etc, resident in Aware and similar software suites.

In the merchant power business, high availability is particularly important. The inability to operate—even for a relatively short period—when a unit is under contract to deliver power can have a severe financial impact on earnings. Thus being able to avoid tube failures, one of the primary causes of forced outages, and to recover quickly from those outages, is a competitive advantage. Aware promises to help you achieve both objectives.

Preventing tube failures. Clues as to where and when tube leaks are going to occur can be found in historical unit and fleet data. Visual Aware provides the tools necessary to record, view, and report tube failures and display them on plant-specific interactive AutoCAD® drawings. It's easy for analysts to see tube failures for a specified time period displayed on a drawing with color-coded criteria settings for failure cause, description, repair type, repair status, unit, etc. Also, to help analysts better assess boiler condition and how rapidly it is ageing.

Ultrasonic test readings and wastage rates can help predict where future tube failures will occur, so the Aware HRSG module manages these data as well. Users can take readings, upload them into the system and calculate a wastage rate over a specified period.

Outage planning, recovery. The module helps engineers and planners determine where to focus their attention during planned outages. It also provides quick access to the data required to repair/replace failed or damaged components and return the unit to service promptly. A messaging feature notifies the user to issue work orders for any follow-up activities associated with a failure that must be inspected, permanently repaired, etc, during the next scheduled outage.

Companion modules to the HRSG include high-energy piping (main steam, cold reheat, and hot reheat), boiler-tube failures, and boiler inspection.

What users are saying

The editors spoke with engineers responsible for implementation of Aware—specifically the HRSG module—at three utilities to learn from

their experiences with the software suite, which is customized for each plant. Ron Riselli, PE, senior reliability engineer in TransAlta Corp's Generation Technology Group; Richard Anderson, senior engineer at Salt River Project; and Frank Timmons, boiler engineer for Dominion Resources Inc contributed to the dialog that follows.

Among the three companies, only one is now running Aware HRSG and only at one of its combined cycles; the other two utilities are still in the implementation phase although close to "going live." The company with the most experience began running Aware, customized for each of several coal-fired units, a few years ago to track tube failures and repairs.

Pleased with the results, the power generator partnered with Automation Technology to develop a module for HRSGs. The first software package, configured for a 2 × 1 combined cycle with NEM bv boilers, has been in place for about a year. Aware hasn't yet had the opportunity to prove its value at this installation because the boilers have operated without incident. Aware configurations for other combined cycles with different boilers will be developed in the future.

Aware got "gold stars" from this user for several reasons:

- Access to historical data is virtually instantaneous: Records are stored on a company server and retrieved via the Internet. Note that some users prefer to have their records maintained by ATI; user access is via the Web.
- Data are of high quality, well organized, and all in one place; plus, nomenclature is consistent across the enterprise.
- Corporate reporting is vastly simplified. Before Aware, phone calls to each plant were required to gather data for monthly reports. This typically took hours over a period of days, given personnel availability, to collect the information and homogenize it. Now one query is run, a spreadsheet is generated, and it is exported to Excel. Add a little formatting and the data portion of the monthly report is ready in a matter of minutes.
- The Aware database is a valuable asset for updating the company's "boiler strategy" annually. It's easy to review tube failures and other problems across the fleet to better plan maintenance activities and budget more precisely.

A case in point: One fossil-fired boiler averaged a secondary-superheater tube failure every three or four months—each requiring a forced outage for repairs. Digging into historical data—including failure locations, ultrasonic scans of wall thickness, etc—engineers justified replacement of a portion of the superheater during a planned outage. That happened two years ago and there hasn't been a tube leak since.

Such a positive testimonial is a "slam dunk" for Aware from a corporate asset- management perspective. But don't underestimate the challenge of "selling" the idea at the plant level. The "carrot and stick" approach won't work because there's no "carrot" for the plant. Despite the simplicity of data entry, training is involved and there's still more work for someone in this staff-constrained industry.

Furthermore, each plant always has tracked its failures and repair work and that information is retrievable by the onsite O&M personnel who need it. So getting "buy-in" from plant staff for any promising software package takes a leap of faith on their part that the new approach will benefit them in the long run.

Another user is spearheading his company's effort to deploy Aware across an asset base of more than two-dozen HRSGs and coal-fired boilers—an implementation program he thinks will take about two years from start to finish. Work is well underway. The engineer said that it takes more time than you might think to customize Aware modules for each plant; there's really not much replication. Another reason for the slow-going is that drawings are not available in digital form—at least theirs are not.

Each plant in this fleet has appointed one of its staff as the Aware onsite administrator. At present, the company is developing procedures on what boiler information will be collected and how. The thinking is that direct input from plant instrumentation is best; also, directly from inspectors using handheld computers. The company's plan is to complete its roll-out of Aware in a matter of weeks and then begin implementation of the high-energy piping module.

Business case for the project was developed at the corporate level. One of the motivating factors was that the prevailing method for accessing historical boiler information was akin to conducting a cold-case police investigation. The information sought often was never found.

To make sure the Aware implementation would move ahead smoothly, representatives from all stakeholders—such as engineering, IT, etc—were invited to participate in the process of identifying software capabilities/features/functionality required and vendor selection. The timeline was six months from developing the business case through contract.

Software products from seven companies were entertained by the evaluation committee. Two were eliminated rather quickly and the remaining five investigated. Three suppliers were invited to submit RFPs. ATI was the clear winner.

The third engineer interviewed said he attended ATI's 2005 user-group meeting after management decided to explore the idea of having a corporate-wide database to track inspection and repair histories of critical plant components. First step for this company was to appoint a team to identify needs and develop selection criteria. This enabled objective review of various software offerings. Products from seven companies were reviewed; demonstrations and interviews were conducted. Conclusions reached by the various team members were normalized by establishing a decision matrix with a numerical weight associated with each criterion. The top scorers were asked to submit bids. Again, ATI was successful.

A deliberate approach was taken to gain experience in software implementation and to understand better how Aware would be used across the enterprise. One of the company's 2 x 1 F-class combined cycles was selected to confirm the value proposition. If expectations were met, the software suite would be implemented at other plants as well.

The HRSG and high-energy piping modules were purchased in February 2007. The next three and a half months were spent gathering unit/system information and reviewing ATI's drawings. Planned outages, vacations, and other projects put off software training until December.

The utility's implementation team noted early on that there were only a handful of HRSGs running Aware and those units had modeled only the tube harps in the gas path. It decided to "raise the bar" by also modeling the links and headers in the upper and lower boxes, as well as including the main-steam (MS) and hot-reheat (HRH) outlet headers and cold-reheat (CRH) inlet header. This required more than 80 drawings per unit. Integration of MS, HRH, and CRH piping with all weld numbers, pipe hangers, and dimensions proved challenging.

Plans call for implementing Aware on other HRSGs in the fleet during first quarter 2008 and extending the build-out to the company's coal-fired plants in the second quarter. The central engineering group is inputting historical data. **CCJ**