CUSTOMER CASE STUDY

AVEVA Improves GenOn Power Station Operational Efficiency & Enhances Workforce Enablement

GenOn Energy - www.robindale.energy/seward-generation/
Industry - Power

Goals

- Develop a training program to enable the easy transfer of technical knowledge and real-world experience from veteran power plant operators to new trainees in the shortest possible time period
- Deliver a training solution with a high-fidelity model of the Circulating Fluidized Bed (CFB) waste coal-fired combustion process

Challenges

- Seward Generating Station management had to overcome initial skepticism from veteran operators that a computer simulator solution could replicate the intricacies and nuances of running an advanced technology waste coal-fired power station
- New equipment and upgrades required the testing of alternative procedures and processes, which needed to be conducted without impacting live plant operations

AVEVA Solution

- DYNSIM® Dynamic Simulation
- OPC Server
- DYNSIM Dynamic Simulation OPC Client Link to ABB Harmony Training Simulator (HTS)

Results

- DYNSIM Dynamic Simulation is successfully being used to qualify new trainees and simulation training has standardized responses to specific problem or error conditions
- All control changes are first made and tested on the simulator before implementing on the plant, improving operational efficiencies and adding higher levels of confidence to control room management

GenOn Energy's Seward Generating Station is in this new class of environment friendly power generation because it is specifically designed to economically use low quality waste fuel while assisting in reclaiming fallow land. The plant, located in the lush valleys and rolling hills of western Pennsylvania about 70 miles east of Pittsburgh, turns waste coal not suitable for traditional coal-fired generating stations into safe, reliable power with significantly reduced environmental impact.

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Alan Metzler,
Operations Manager
GenOn Energy's Seward Generating Station

AVEVA offers track record with power station training solution

The Circulating Fluidized Bed (CFB) power station was commissioned in 2004, replacing a traditional coal-fired plant constructed on the same site in 1919. The new plant now produces 525 megawatts, nearly three times the power output of the prior plant. Plus the Seward station hit the record books as the largest waste coal power station in the world. The power station was named the 2004 "Plant of the Year" by Platt's Power magazine and the facility was additionally honored with the Pennsylvania Governor's Award for Environmental Excellence. When GenOn Energy looked for unique solutions for bolstering the efficiency of the power station through enhanced operator training and procedural improvements, the company turned to AVEVA after a search of companies specifically with extensive experience in power station systems. AVEVA already had a demonstrated track record with power station boiler simulators, with the added advantage of on-staff engineers who had previously worked for CFB boiler manufacturers.

"What made AVEVA stand out over others was the technology and expertise of the proposed team members that were going to be part of the simulator," said Brian Rematt, controls engineer at the Seward Generating Station. "It made my decision pretty easy as to which company to go with. When it all came down to it we felt AVEVA could deliver the best simulator for the final outcome we were looking for."

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The CFB combustion process for coal-fired power installations was developed in Europe more than 30 years ago, and has more recently found favor with U.S. power generators. The CFB process turns blighted piles of waste coal into reclaimed green space for community use. Since the other CFB power plants are much smaller than the Seward station, the plant has a unique set of operational and training needs.

"The quality, professionalism and knowledge of the AVEVA team exceeded our expectations," said Paul Demi, shift supervisor and simulator trainer. "The AVEVA engineers wanted to make a simulator that they could sit back and be proud of as much as we wanted the same. That helped drive all of us to do the best we could and work closely together."

Challenges of a sophisticated, new power generation process

Transitioning from a standard pulverized coal-fired process to CFB did not come without overcoming a few hurdles. In addition to increasing regulatory compliance and implications of an aging workforce, managers were concerned about worker performance issues; specifically day-to-day plant operations and the analysis of processes and procedures.

The startup and shutdown sequences as well as equipment maintenance procedures for a CFB plant are distinct from traditional coal-fired power station operations. The control technology and power generation systems are highly specialized and require heightened levels of vigilance by well-trained operators. As a result, plant management focused on ways to leverage the knowledge of its experienced operators so that it could be easily transferred to staff involved in the operator training program. The power generating station needed a solution that could train prospective operators in an extremely dynamic environment so that the nuances and operational sensitivities of the CFB combustion process could be experienced in the assured safety of a simulated control room environment.

"We felt we had to do something with a simulator and it seemed to be a potential," said Alan Metzler, operations manager for the Seward Generating Station. "We did a lot of upfront investigation regarding understanding simulators and how they might model a CFB. AVEVA made us feel even more comfortable by telling us it was going to be a tough project and that they weren't sure they could do it with the accuracy that we were asking for. We knew that would be an issue because of the nature of the CFB."

The alternative to plant simulation was to drill down on conventional management and operator training approaches, with a focus on classroom instruction with carefully supervised on-the-job training. Instead, plant management decided to step outside of the traditional training envelope with operator training simulator (OTS) technology already proven in other types of fossil fuel power stations. However, the simulator training approach wasn't received without some skepticism from the veteran operators.

"When we first told the people about the simulator they initially laughed at it and thought it was going to be a waste," said Larry Borsa, control room operator at the Seward station. "Now the people that have gone through the training come into the control room totally amazed about how the simulator closely mirrors the control room. Their confidence level is very, very good.

They are not afraid to make changes; they are not afraid to do different things. Also, with the observations of the equipment running they've become very aware of what's going on around them. I trained a lot of operators at the old station and it took a long time just to get people to touch something. We no longer have that issue with the people going through this new training procedure."

The DYNSIM Dynamic Simulation solution selected for the project is a comprehensive, dynamic process simulation program designed to enable Seward power plant operators to tackle the challenges of operating one of the world's largest CFB plant safely and with a bottom-line eye on performance and operating cost efficiency. The simulation technology offers a basis for a comprehensive approach to operator training, which in turn improves plant performance and reduces capital investment costs by improving the consistency of operations and lowering the probability of equipment damage due to incorrect operation.

The Seward plant operates two CFB boilers that produce steam to power an Alstom steam turbine. CFB technology increases the residence time of the fuel in the furnace significantly, allowing low BTU waste coal fuel to burn completely. Also, CFB furnaces operate at a lower furnace temperature than traditional coal firing technology, which, when combined with the selective non-catalytic reduction system installed in the flue gas path, results in low NOx (nitric oxide and nitrogen dioxide) emissions. Sulfur dioxide emissions are controlled by injecting limestone into the furnace and via an ash hydration and re-injection system installed at the plant. Particulate emissions are controlled with a baghouse.

The simulator was created using the DYNSIM Dynamic Simulation. It was designed to create first-principle models of process operations, including typical power plant equipment. The flexibility of DYNSIM Dynamic Simulation made it possible to extend the existing furnace model to achieve a realistic representation of the Seward CFB boilers. The system used a virtual stimulation of the plant's ABB Harmony distributed control system (DCS). In addition, the AVEVA solution also emulated the Alstom steam turbine controls, and the PLC-based controls for the ash-handling and air-heater leak detection systems. Communication between the DYNSIM Dynamic Simulation model and the ABB HTS virtual controllers was accomplished through the DYNSIM Dynamic Simulation OPC client communicating with a server embedded in the ABB HTS system.

The link between the DYNSIM Dynamic Simulation emulation of PLC controls in the plant and the Harmony DCS was conducted through the DYNSIM Dynamic Simulation OPC server.

AVEVA Simulator Technology sways the skeptics

Despite operator reservations that the complex CFB coal-burning process could not be easily modeled in a computer simulation, AVEVA was able to deliver a solution with an extremely high level of process fidelity. AVEVA extended the capabilities of its existing high-fidelity furnace model, adding calculations related to the inventory and circulation of ash in the furnace, which allowed the addition of heat transfer, combustion and pressure gradient calculations specific to the CFB. These equations could be tuned to match the startup behavior observed at the plant. Another simulator accomplishment was the modeling of the coal ignition process.

“The hardest part is to get an operator to understand the process and the interactions,” said Metzler. “They are able to see all that in the simulator. That’s not something you get in a classroom or a textbook or in a procedure. You have to live it. Fortunately our operators are now able to ‘live it’ via simulation, and they are able to deal with many more scenarios and situations in a much smaller amount of time than someone could possibly experience under any other training program.”

Indeed, the simulator has been so true-to-life that plant operators have been able to use the technology to identify control issues and create what-if scenarios off-line, then incorporate new processes and control solutions into plant operations. The simulator training is considered so realistic that it can both qualify new plant trainees and maintain and enhance the skills of even the most senior power plant operators.

Mirroring live operations is the key to success

The control room layout is a horseshoe design. The center HMI screen controls the steam turbine, and to the left and right are four DCS screens, complemented by a set of PLC HMI screens for a total of 13 HMI monitors. The simulator training room is virtually a mirror image of the control room setup and, to help trainees stay close to the pulse of the plant, is located within 30 feet of live operations.

“When we are doing the training we can compare what we are doing in here to what’s going on in the real plant - it makes a good connection for the trainees,” Metzler said. “It was important for us to have the simulator in an area that would be representative of real-life control conditions. The research we had done stressed the importance of making it as realistic as possible so that it’s not just a bunch of computer screens in an unrealistic setup on a worktable in the back of a conference room. We spent a good amount of money to have a special area available and the team spent a significant amount of effort in the design application and then in the construction of the system to have it be an almost exact replica of the real control room. Space is at premium in the plant but we made a commitment to have it located near the actual control room as opposed to putting it in a trailer in a parking lot somewhere.”

A number of considerations weighed into the decision to implement an operator training simulator solution. Factors included new plant equipment, new operating procedures and insufficient or inappropriate training. The Seward plant confronted the additional challenge of training additional personnel as the new CFB equipment came online. Staffing needed to be doubled to increase the number of trained control room operators at the 24/7 plant, and on-the-job training was no longer a practical approach for knowledge transfer of the sophisticated CFB combustion process.

“When we first started there were people who didn’t think it could be done,” said Demi. “There was always a question as to whether we were ever going to reach our goal. Now we bring a person that has never worked in the control room and give them four weeks of intense training, 10 hour days, five days a week. When they go into the control room they not only know how to operate the equipment but they feel comfortable working with the controls.

To be able to train someone to operate the DCS for a plant our size speaks volumes to what the simulator can do. I'd say hands down we reached our goal."

For watchers of the bottom line, simulation pays mighty dividends

The AVEVA solution has provided additional dividends that have exceeded the success in operator training. DYNSIM Dynamic Simulation technology is now used to develop and test new control logic options that can be incorporated into the DCS.

"All in all, the simulator has saved our bacon," Metzler said. "We originally got it to train control room operators and to improve our existing operations. We can say it scored an A+ for all of that. Our human performance errors and resulting loss in generation has been reduced significantly. This came at a time when capital dollars for the installation were scrutinized as much as I have ever seen in my career at power plants. But we were committed that if we were going to do it, we were going to do it right and we kept to our guns and achieved a successful outcome. We didn't want something close enough; we needed something right on."

"After a recent turbine control system upgrade the plant struggled to put the unit online. There was a considerable amount of computer handshaking happening invisible to the operators. It wasn't happening like it should have so we decided to try it on the simulator, and when we did that, sure enough, we witnessed what we should have been seeing in real life," said Rematt. "And then we actually applied it to our own device and we were able to get the turbine online the very first time. Prior to that we had two to three failed attempts but after we saw it on the simulator, how it should really go, we took that onto the floor and applied that and it worked the first time."

Control development on the simulator delivers real-world solutions

The simulator was additionally used to develop controls to mitigate relief valve operation due to pump overpressure issues. After running through several tests and developing process approach options, management implemented the new logic in the plant, bringing additional safety to power generation operations and shortstopping potential undesired cascading shutdown events involving pressure relief valves, feedwater pumps, the boiler furnaces and the power-producing steam turbine.

"You can't understate that, that is very significant, the single occurrence of bringing the turbine online saved a lot of time and money but this issue with the relief valves, it was significant dollars and significant time and many other benefits," said Metzler.

The simulator has enabled operators to define alternative procedures for handling certain process conditions. For example, the procedure to handle a feedwater pump trip now calls for the trip of one of the two boilers, which enables the plant to continue safe operation at half load. Also the simulator has been used to increase the efficiency of the plant startup and shutdown procedures. Plus simulator training has improved operational reliability and established the standardization of operator responses to problem conditions.

AVEVA's dedication continues from project through support

The AVEVA SimSci simulator team retains its "customer first" philosophy of remaining dedicated through the life of the simulator investment.

"We started with AVEVA at a point when we tried to fine tune the simulator to the best areas that we could in comparison to the plant and overall it took a long period of time and dedication from AVEVA," said Borsa. "They went above and beyond all expectations in terms of trying to work with us to try to make this simulator that would be well worth the investment. It took a lot of hours and dedication on everyone's part."

GenOn clearly saw the need to enable its workforce so that employees would be in a position to make confident, informed decisions. A combination of skills, tools and system design were brought together in a manner that accelerated process improvements from capturing, transferring and institutionalizing best practices.

“From a support perspective we haven’t had many issues with the simulator; it’s been relatively problem-free for more than two years,” said Rematt.

AVEVA solution prepares operators and enhances working environment

Since the AVEVA solution was installed, by all accounts it has exceeded the performance expectations of GenOn Energy. The AVEVA simulator is now the gold standard for preparing operators to work in the plant, and training time has been cut in half compared to the prior classroom and on-the-job learning approaches.

“The AVEVA solution has helped us significantly, that’s the pure dollars and cents of the project,” Metzler said. “But there’s also been quality of life improvements regarding overtime for the control room operators. Our control room operators don’t have to work 40 percent overtime to cover when people are unavailable because of vacation time or sick leave. We now have highly trained operators available for the central control room, fully confident in being able to step in when needed.”

Experienced operators also now routinely sharpen their skills in dealing with plant problems and alerts, as well as test scenarios to develop more efficient operational procedures. Testing procedures in the simulator reduce the risk and anxiety associated with changing or modifying control room procedures in the power plant. While GenOn spearheads reclamation of green space in Pennsylvania using its CFB boilers, AVEVA has served as a key partner in helping the company achieve excellence in preparing the workforce while maximizing the operational and cost efficiencies of the power station.