Client: SSE Peterhead Power Station

Peterhead Power Station is a multi-generator station situated just south of Peterhead in Aberdeenshire. It is owned and operated by SSE plc - one of the "Big 6" companies dominating the UK energy market and involved in:

- Generation and supply of electricity and gas;
- Operation of gas and telecoms networks;
- Other energy related services such as gas storage, contracting, connections and metering.

Construction of Peterhead Power Station began in 1973. Originally planned as a 1,320 MW oil-fired power station, its boilers were subsequently converted to burn gas as well as oil.

In 1999, the station was converted to a hybrid configuration in which a gas turbine was added. Running the combined cycle made possible by the hybrid of gas turbine, boiler and steam turbine increased the maximum potential power output to 1,524 MW and greatly increased the efficiency of the station. It also added flexibility, as it:

- Enabled the plant to be run either in steam turbine mode or in combined mode;
- Introduced a backup option, in the sense that power could still be delivered even if the gas turbine were to fail.

Peterhead's installed capacity now sits at 2,177 MW, following a compressor and combustion control upgrade in 2007 and the decommissioning of two turbines in 2009. Peterhead is now the largest power station in Scotland.

ORIGINS OF THE TRAINING SIMULATOR REQUIREMENT

Thanks to a premium contract from National Grid, the skills of Peterhead's control room operators have never been so critical to the station's continued operation. Peterhead is one of the power generating resources commissioned by National Grid under its Strategic Balancing Reserve, designed to assure that at least 5% excess grid capacity is maintained constantly UK-wide.

The significance of skills and training is that the National Grid contract calls for control sequences that even long-serving operators had never encountered previously. Such as switching individual generators in and out, on remote command, as National Grid seeks to balance demand with supply.

It was this imperative of having a well drilled squad of control room operators that drove Peterhead to adopt a simulator based approach to mission-critical operational training.

ENTER PISYS

With this background Pisys were contacted in 2011 on behalf of Peterhead's Operations Manager. Ray Allen, Pisys's Director responsible for the Peterhead relationship, comments: "Because of the scale of the project, SSE had to go out to tender. There were two other companies in contention – one of them a household name. The brief was to take the existing plant and model it in just enough detail for training purposes".

SSE Project Engineer Alex Wallace picks up the thread: "Providing a meaningful training experience hinged on being able to run realistic scenarios. And because of that, the plant had to be modelled to a high degree of integrity. It was evident that close working between the Peterhead team and the simulator developer would be critical to the success of the project. Pisys fitted the bill perfectly in this respect, and also submitted a proposal featuring an attractive combination of price and build time".

Ray adds: "I suspect that how we develop our simulator systems also played a part. Our basic architecture, which was already proven across many installations, separates the plant-specific aspect – the model of the asset – from the underlying simulation engine. We build our models top-down. So they embody all the plant and process detail that's required for control room training, but without all the nuts and bolts and the molecular level physics.

"The turbine and control system manufacturers take a very different, bottom-up approach for their so-called 'fully blown' simulators - emulating the detailed physics of the turbines and other key elements of the plant. That's largely why we're able to deliver a high fidelity user experience with a much slimmer price tag.

BUILDING THE SIMULATION MODEL AND OPERATIONAL SCENARIOS

The need to replicate the Peterhead plant meant that the simulator project had a significant development element.

"The systems and processes that had to be modeled were elaborate", observes Alex Wallace. "Starting up and shutting down a generator, for example, involves a 10 hour sequence in 56 steps. Devising the best way to transfer and convert data from our PI plant data historian system into Pisys's software was also pretty taxing. As was designing all the scenarios we could foresee needing for our course programmes (like switching down from three turbines to two). And so, anticipating challenges such as these, we assigned one of our best engineers to support Pisys's development activity".

THE WORKING RELATIONSHIP – "AS CLOSE AS IT GETS"

Having selected Pisys partly on the conviction that close co-operation would be vital to the success of the project, the Peterhead team found its expectations exceeded when detailed design and implementation commenced.

"They more or less moved in with us", observes Malcolm Clark, Peterhead's Simulator Training Lead. "Two of the Pisys team sat in the room next door to me, building the simulation model, while a third worked literally alongside me, developing the live logic plans. As working relationships go, that was as close as it gets!".

"I'd say it was a masterclass in inter-company teamwork", Ray Allen interjects. Every technical discipline has its own vocabulary and language, and we were fortunate in having Alex and Malcolm on hand. Verifying our translation of the plant documentation was something they had to do. But they went far beyond that. Most of all, they went out of their way to make sure that our model represented accurately the systems and interfaces that trainees would have to become expert in".

THE "DAY JOB" OF THE SIMULATOR: STAFF TRAINING

Simulation training at Peterhead largely falls under two headings:

- Basic training for new starts – such as introductory courses for new engineers;
- More advanced training for control room operators.

Simulator training is fundamentally rooted on a framework of scenarios. In other words, the simulator presents the trainee with an "animated" sequence of events mimicking an operational sequence of the plant. Based upon this, the trainee plays out the role of control room operator as events unfold, responding to and managing the situation according to SSE's time-honed operational procedures.

The key to the success of simulator training is very simple: the trainee essentially learns the job by practicing in a "safe" environment. (No danger of blowing up the power station or bringing down the National Grid!).

Malcolm Clark comments: "In a typical course we use a blend of real situations – where we re-run data extracted from our PI Plant Data Historian system – and potential scenarios that haven't yet happened. So it's a mixture of re-enacting past events and rehearsing possible futures".

He adds: "We don't train droves of staff – it's at the level of one or two people a month. But the numbers that matter here are not trainee numbers. It's the potential cost of control room staff not being able to deal with unforeseen events – and deal with them quickly – that makes the Pisys simulator crucial to the Peterhead operation".

AN UNEXPECTED APPLICATION

Even before the Peterhead simulator had been fully developed, it was attracting interest from an unexpected quarter – plant engineering. Ray Allen explains: "Engineers started coming to us with queries about operational anomalies they had observed – along the lines of: 'Step 42 in startup scenario B is taking much longer than we would expect'. To resolve these queries, we started running 'What if?' scenarios on the simulator – akin to using it like an optimisation tool".

Malcolm Clark quickly emphasizes: "That's true, but of course it's not actually a plant optimisation system. Better to call it an alternative option for troubleshooting. If a plant engineer or a unit operator can sit down at the simulator and run through the relevant scenario, it gives them a quite different viewpoint. The simulation model represents the plant control processes with a high degree of fidelity. And because of that it can help the engineers to understand whether or not there is a flaw in the design of a particular process – and if so, then what the nature of the flaw is".

VALUE FOR MONEY

Talking of re-running scenarios: if they revisited the process of procuring their simulation training capability, would Alex and Malcolm do it exactly as in 2011? Or would they seek a different outcome?

Malcolm replies first: "The Pisys simulator has paid for itself ten-fold already, and so we've had our value from it. Now a cold start takes seven hours (repeatably) – virtually a 50% reduction on the 13 hours it took before. So for each cold start, that's a gain of six hours generating at hundreds of Megawatts".

Alex adds: "Overall we got what we wanted, and it was a win-win in the end. Pisys's capabilities are excellent, and their team were all very accommodating. There was also a lot of additional work required, and that was all done by Pisys within the original budget".

FUTURE DEVELOPMENTS

The simulator as its stands embodies 19 different scenarios, such as "cold start" and "block shutdown". In recent months only modifications to existing scenarios have been required, to meet occasional special needs when called for by specific training sessions.

Now, however, a fresh wave of activity is expected in 2015. To keep the competencies of its control room staff in step with the plant configuration, all modifications must be mimicked in the training simulator. An imminent programme to resize Peterhead's steam turbine will therefore spawn major simulator development work.

A less certain but potentially prestigious development for Peterhead is a pioneering Carbon Capture & Storage project. Due to be commissioned in 2016/2017 by the UK government - and with Peterhead strongly positioned to win the project - the necessary plant extensions would also dictate an extension to the Pisys simulator.

A GOLD STAR SYSTEM SUPPLIER

Supposing Alex Wallace and Malcolm Clark were approached by another power station considering a Pisys simulator. What would be their advice? "I would say that it is really important to know what you want to build before you build it", replies Alex. I would explain the difference between a mathematical process simulation and a realistic, scenario based learning tool like ours, that uses historic plant data. And naturally I would give Pisys a gold star!".

About Pisys

Pisys specialise in the creation and delivery of specialist software products and services for energy sector customers.

Our experience of technology development for the most hostile of environments on the planet has also placed us in a unique position to assist companies who require effective high-tech solutions to complex problems in any industry.

Founded in 1988 and based in Scotland, our industry standard products are used by companies of all sizes.

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