CUSTOMER CASE STUDY

AVEVA Everything3D allowed one of Sweden's nuclear plants to stay up and running more profitably while keeping their reactors safe.

OKG
Industry - Nuclear

Goals

- To achieve greater efficiency.
- To reduce costly down-time.
- To streamline operations.

Challenges

- A day-long outage of a reactor cost the company around 1 million EUR.
- Safety was of the utmost importance.

AVEVA Solution

- Everything 3D (AVEVA E3D)
- PDMS
- Laser Model Interface

Results

- OKG has a new process in place.
- Reactor outage time has been reduced to below 80 days from the original 150 days.

Creative Engineering Dramatically Reduces Reactor Outage Time at OKG.

Oskarshamn, Sweden – OKG was founded in 1965 and has approximately 850 employees and an annual turnover of around SEK 3 billion. OKG is owned by E.ON, one of the world's most geographically diversified power producers, with major asset positions in Germany, the United Kingdom, Sweden, Russia, the US, Italy, Spain, France and the Benelux countries.

Oskarshamn's Nuclear Power Plant, OKG, owns and operates three boiling water reactors, Oskarshamn 1, 2 and 3, often referred to as O1, O2 and O3. The nuclear power plant is located on the Swedish east coast, 30km north of Oskarshamn. The three reactors, with a net capacity of 2,511 MW, produce 10% of Sweden's electricity and went into commercial operation between 1972 and 1985. OKG needs to invest constantly in safety and modernisation in order to ensure that the plants can continue to operate for their planned 60-year lifetime.

Safety first

OKG's aim is that the reactors should operate at the highest possible safety level for at least 60 years.

When AVEVA visited OKG, the O2 plant had been shut down for a huge, complex modernisation project to upgrade the turbine plant, installing many heavy items of equipment and involving demanding installation activities for vital safety systems.

The O3 modernisation project

One of the key aspects of this modernisation was the replacement of the electrical cabling that passed through the concrete containment walls and connected to equipment inside the containment area. The modernisation included, not only the cables themselves, but also the penetration assemblies that fit into the wall.

These penetration assemblies are important to the overall safety of the reactor as they prevent radiation and radioactive materials from passing through the penetrations in the wall in any emergency situation.

Conventional design and installation of cables and electrical components would take between 120 and 150 days, causing a long outage and significant loss in production.

When similar modernisation programmes were performed for the O1 and O2 plants, OKG succeeded in reducing the outage to 80 days by partially prefabricating the electric cables and connectors.

Based on their experiences from the O1 and O2 projects, E.ON IT and OKG found areas which could enable the installation to be achieved even more efficiently, since OKG's goal for the O3 project was to further reduce the outage to 58 days.

The extent of prefabrication was even greater than for the equivalent O1 and O2 projects. All electrical cables and connectors were prefabricated externally, similar to the way in which they are made in modern automobile manufacturing processes. This offered an opportunity to cut on-site work, which considerably reduced outage time. The cables were prefabricated at both ends, with their connectors, and pretested in a radiation-free area, so that it was possible to install the whole cabling system in a single step.

The quality and accuracy required was very high, with the tolerance in cable lengths within a few centimetres. In total, there were 36 penetrations for the electrical cables and 1,800 cables with a total length of 30,000 metres.

These cables connect to almost 2,000 items including electrical cabinets, contact and magnetic breakers, limit switches, temperature and pressure switches. OKG decided to model the new cables, penetration assemblies and electric components in a 3D system, and to laser scan the inside of the reactor containment.

The laser data was then integrated with the 3D model to enable highly accurate design work and to allow views to be prepared showing exactly how the fitting task should be performed. After a thorough evaluation, AVEVA PDMS, combined with AVEVA Laser Model Interface, was chosen as the system that best met OKG's requirements.

A highly-photorealistic resolution 3D laser scan of the inside of the reactor containment was carried out from about 150 measurement locations, during a normal outage. When AVEVA E3D was launched, OKG realised that they could use it to further improve the efficiency of the design work.

After implementing AVEVA E3D, and completing a short training course, they were able to continue with the modelling tasks. The 3D model in AVEVA PDMS was easily reusable with AVEVA E3D, as the two applications are fully interoperable. A significant feature of AVEVA E3D is the seamless integration of design and 'real-world' conditions, through the fusion of laser scan data into the design environment.

This is enabled by allowing engineers to work within the laser data BubbleView. BubbleView technology is unique to LFM Software Ltd, an AVEVA Group company. It produces a high-resolution, photorealistic 3D image in a lightweight usable format whilst connecting back to the massively rich dataset.

When the BubbleView data was integrated in the AVEVA E3D model the results proved to be excellent, with high-quality photorealistic installation printouts. In total, OKG generated at least 4,000 installation printouts.

The use of laser scanning technology to automatically build an accurate laser model of the reactor building, combined with AVEVA E3D, enabled 3D design work to take place within the laser model. This resulted in a high degree of accuracy for the design of the cables and connectors.

A new process that works

Generating the fabrication drawings directly from the 3D model created using AVEVA E3D ensures that the accuracy of the design is conveyed to the fabricators. This innovative approach also extends to the installation process.

OKG estimates that a traditional, paper-based workflow would require the handling of about 20,000 design documents within the containment building. Replacing the paper documents with tablet computers transformed the efficiency of the installation.

25 tablet computers, connected to a wireless network inside the containment areas, gave the fitters access to the photorealistic installation images and assembly information prepared using AVEVA E3D, showing both the new design and the photorealistic laser scan data.

OKG's creative engineering process produces photorealistic installation images for viewing on tablets and as printouts. This means a more efficient installation, with the outage time reduced to only about half that of similar projects at other nuclear plants.

Innovative solutions, including the further development of prefabrication methods, and the introduction of 3D modelling combined with laser scanning, lead OKG to view this creative engineering as the model for future modernisation projects.