Apros® in NPP greenfield projects

Apros® process simulation software is a powerful and versatile tool that has been successfully used to support nuclear power plant greenfield projects.

Fennovoima is constructing an AES-2006 nuclear power plant (NPP) in a greenfield project to Pyhäjoki, Finland. Ensuring compliance to current safety requirements in licensing set by the Radiation and Nuclear Safety Authority of Finland (STUK) is an essential part of the newbuild project.

APROS USED AT FENNOVOIMA SINCE 2014

Creation of an Apros® model for the purposes of conducting comparison accident analyses was started based on available design data in early stage of the project.

As the design has proceeded, the level of model detailness has increased and also the model scope has extended to include automation and electrical systems as well as containment building. By combining information from different plant systems into the Apros® model, Fennovoima can analyse the potential effect of design choices on plant level with simulated responses.

VERSATILE TOOL

With simulations, the proper functionality of the designed safety systems in different accident situations can be verified. Fennovoima has chosen Fortum's modelling and simulations services utilising Apros® as an independent tool to conduct verification on the plant suppliers analysis.

In the design phase, the plant supplier conducts safety analyses for licensing purposes. Throughout the project, Fennovoima has recognised the benefits of extensive utilisation of simulation. In the design phase, Fennovoima has performed comparison safety analyses to verify the original analyses and to increase the knowledge of their own personnel of the new plant type.

This way Fennovoima assures that high quality safety analyses can be conducted also by their own personnel, thus reducing the dependence on external suppliers.

However, the use of the model is not limited to safety analysis applications. Apros® process simulation can also be utilised in

- engineering analysis
- design validation
- automation testing
- operation instructions validation
- personnel training and
- as basis for creating a testing and training simulator.

The use cases where Apros® simulation model can benefit Fennovoima during the coming decades of plant operation are countless.

Having a comprehensive Apros®-model of the power plant already in the licensing phase is a good starting point for the future commissioning and operation phases support.

"It is a crucial task to verify the plant supplier's safety analyses with own analyses and support the licensee's safety assessment. At the same time, we learn about the plant behaviour during different events and during modelling, the design of systems, e.g. I&C architecture, is reviewed.

Apros® simulation tool was easy selection because of well-known history of modelling VVER power plants and available consultant and support services."

Calle Korhonen
Safety Analysis Manager

fortum

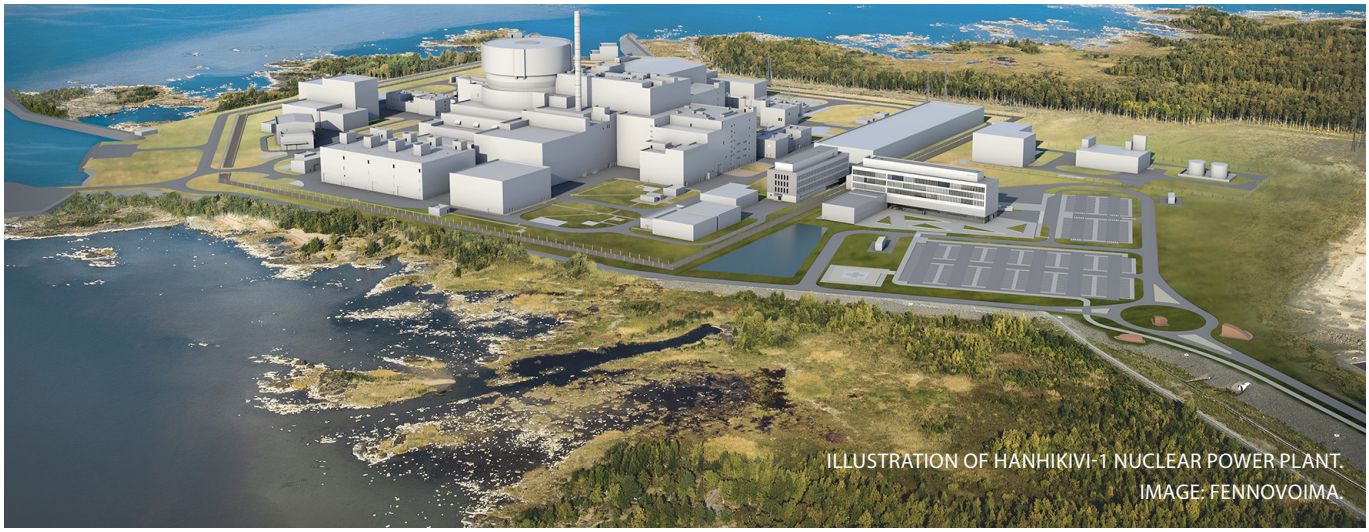


ILLUSTRATION OF HANHIKIVI-1 NUCLEAR POWER PLANT. IMAGE: FENNOVOIMA.

DYNAMIC, FLEXIBLE AND ACCURATE TOOL

Apros® has been developed since the 1980's with a focus on being a multipurpose dynamic simulation tool and it has been used extensively to support Loviisa NPP operation throughout its lifetime.

Apros® is constantly developed and it has been successfully used to model different kinds of plant types, such as EPR and many VVER plant types, including AES-2006.

The extensive Apros® component library can be used to model different nuclear power plant designs flexibly and accurately, thus making the model and its responses more realistic. As an example, passive safety systems can be modelled realistically.

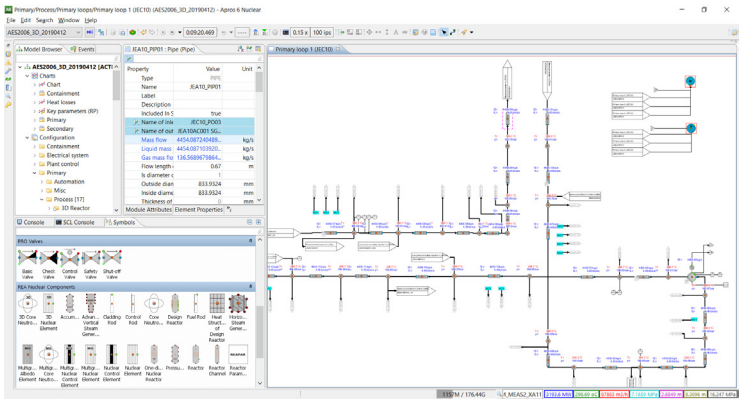
SIMULATIONS ADD VALUE TO PERSONNEL AND TRAINING

Fennovoima also uses Apros® plugin OPERUI (Operation User Interface) to develop their own HMI (Human Machine Interface) applications. The customized HMI applications provide a way for Fennovoima personnel to familiarize themselves with the power plant behaviour, where Apros® is used to provide the realistic power plant dynamic response.

This extends the potential benefit of using Apros® beyond the typical end users of a simulation tool.

Hanhikivi-1 NPP

- Government decision in principle: 2010
- Design: AES-2006
- Design company: JSC Atomproekt and OKB Gidropress
- Supplier: RAOS Project
- Turbine Generator supplier: General Electric
- Designed plant lifetime: 60 years
- Capacity: 1200 MW
- Amount of primary loops: 4



PART OF THE HANHIKIVI-1 APROS® MODEL. IMAGE: FENNOVOIMA.

In partnership with VTT

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