APROS

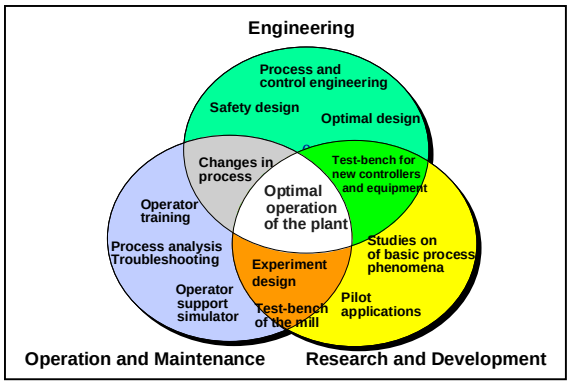
The Advanced Process Simulation Environment (APROS) provides tools, solution algorithms and model libraries for full-scale modelling and simulation of dynamic processes, such as pulp and paper mills, nuclear power plants and combustion power plants. Besides the process also automation and electrical systems can be modelled. The model libraries have been comprehensively validated against real physical process experiments.

The simulation environment meets all the requirements for the testing, design, analysis and training simulator application. The re-use of model specification is extensively supported. The modular and hierarchical approach of APROS allows unique flexibility of process analysis at various conceptual levels. The extent of the applications can vary from small computational experiments to models for full-scope training simulators.

A user can concentrate on entering process-related input data through a fully graphical user interface. The generation of model equations and choice of solution methods are done automatically. The unique on-line features of APROS allow the user to make any changes in parameter values - or even the model structure - and immediately continue the simulation. The openness of APROS allows the inclusion of the user's own models in the calculation as well as easy connection to external models, automation systems or control room equipment.

Wide range of applicability

Apros enables the use of dynamic simulation during the whole life span of the process, from the conceptual design to the operation and maintenance of the process.



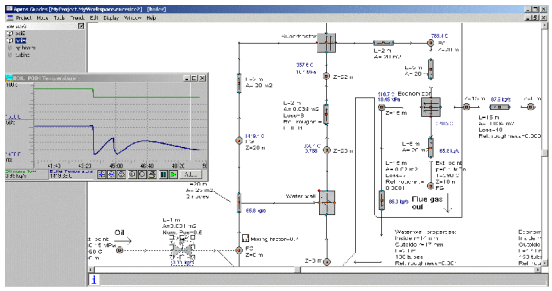
Various uses of simulation.

The same simulation model can be used for versatile tasks, thus avoiding unnecessary data transfer and reconfiguration of the simulation model. E.g. an engineering simulator can be used as a basis for a training simulator. Once the simulation model has been completed in the design phase it can be re-used with DCS (Distributed Control System) as a checkout and operator training tool in a cost-effective way.

The validity of APROS models ranges from start-up procedures to normal operation modes, normal and emergency shutdowns and failures of any combination of process, automation or electrical components.

Easy Model definition

Simulation models are created graphically through the CAD-like user interface Grades presented in the figure below. The user drags and drops components from model library palettes, draws connections between them, and enters input data using component specific dialog windows. As a result, the user gets a P&I diagram with simulation specific additions, e.g. the values of the calculated variables can be monitored.



Grades - Graphical user interface of Apros.

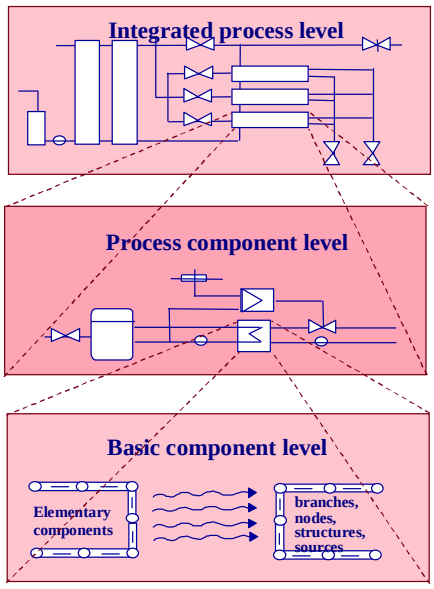
All model configuration changes made using Grades are passed to the simulation engine on-line. Thus, the simulation run can continue promptly after the configuration change.

Apros also provides a low-level command line tool for a direct access to the simulation model. Commands are given using the Apros specification language. Several commands can be collected in a script file, whose contents can be read into the Apros with a single command.

Comprehensive model libraries

The user has access to a set of predefined process component models that are conceptually one-to-one analogous with concrete devices, and hide all solution algorithms. The model libraries of the Apros cover a comprehensive set of process plant components: pipes, valves, pumps, heat exchangers, reactors, tanks, measurements, PID controllers, electric generators etc.

The Apros database structure supports hierarchical model presentation. An example on the levels of detail is shown in the figure below. Most of the time, the user operates on the process component level using predefined components, like a heat exchanger, provided in model libraries. The process component automatically creates all necessary calculation level objects (nodes and branches). Components can be composed together to form a sub process, which in turn can be used as a part of an integrated process model.



APROS model structure

Model organization and re-use

A large process model can be divided into several flowsheet diagrams. This can be done both in a hierarchical and a horizontal way.

At any time, the complete model information can be saved into a model snapshot file containing the full model configuration and its momentary state data at the time instant. Similarly, at any time, the user can backtrack to a snapshot once saved in the past.

Any part of the simulation model can be exported to a file, which can be merged to another model. This way the user can build up model libraries to re-use the work in other projects across the organisation.

APROS selected references

APROS is used widely around the globe. Here is a short extract from the reference list, describing the different uses and application areas of APROS.

Metso Automation built a training simulator for the Suomenoja power plant. The process model was made with APROS and the automation system and operator displays were copied from the plant to the virtual metsoDNA environment, which was connected to APROS using OPC communication (OLE for Process Control).

Metso Paper has used APROS to evaluate the process and control designs of new papermaking process concepts.

Fortum tested the automation system for the Estonian power plant at Narva using APROS. The process model was made with APROS and the automation to be tested with metsoDNA. The commissioning of the automation system was easier because of the tests.

APROS was used to perform the safety analyses of the Loviisa nuclear power plant modernisation project. E.g. following cases were simulated: Loss of coolant accidents (different sizes of breaks), the uncontrolled withdrawal of a control rod and the loss of feedwater accident.

A board machine of Stora Enso was modelled using APROS. The automatic grade change program was tuned using the simulator. Better understanding about the process was achieved and productivity was increased through the shorter grade change time.