EcosimPro
Modelling and Simulation Software

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EDITORIAL

In the following pages of this second EcosimPro newsletter, you can read about the advances we have made over the last few months and the main new developments introduced to help users and professionals to widen their knowledge of this powerful simulation tool.

At EcosimPro, we have continued our innovative effort to adapt to the requirements of an increasingly competitive market that continually demands new applications. Our goal is to offer full, customised service tailored to the needs of each individual project.

Along these lines, the EcosimPro team have focussed our efforts on the new version 4.6, which is now available. This new release features significant improvements that place it among the most solid and versatile tools on the market for optimising simulation processes. As part of this ongoing improvement, a new version of PROOSIS has also been released.

In recent months, much effort has been put into demonstrating how EcosimPro can be applied to the energy sector. The first seminar directed at this field was extremely well received and attended, and opened up a channel of communication that has become a resounding success.

Additionally, EcosimPro was on hand at the Space Propulsion 2010 Conference, which brought together representatives from throughout the aerospace industry. Among the events featured at the conference was a demonstration of Ecosim's ESPSS simulation library.

The following pages contain more news and information, including analyses of EcosimPro by users and experts, like Eusebio Huélamo, Head of the Thermohydraulic Simulation Department at Empresarios Agrupados, and explanations of the applications of this tool in large projects like the LHC experiment of the CERN.

As far as divulgation is concerned, the new printed image of the tool and the interest shown on the part of energy-sector technical press in knowing the uses and advantages of simulation with EcosimPro are also worth highlighting.

Finally, and for the rest of 2010, we will be intensifying our commercial and promotional activities with the goal of consolidating existing markets and opening up new domestic and international ones.

Pedro Cobas Herrero
Head of the EcosimPro Development Team

INTERVIEW

Eusebio Huélamo

Head of the Thermal-Hydraulic Simulation Section at Empresarios Agrupados

"There are a lot of aspects that make EcosimPro different from other tools."

Eusebio Huélamo is an aeronautical engineer since graduating from the Escuela Técnica Superior de Ingenieros Aeronáuticos de Madrid. He has been working at Empresarios Agrupados since 1973, is an Associate Lecturer at a private university, and is the Head of the Thermo-Hydraulic Section at Empresarios Agrupados. With a career spanning more than thirty years in the field of simulation he has become one of the most distinguished specialists in modelling complex systems in the energy world.

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Interviewer: What cases are best suited to using simulation and modelling?

Eusebio Huélamo: Using simulation is fundamental to several tasks:

-To finding design parameters or confirming the suitability of estimated ones

-To predicting little-known behaviours in highly unlikely events, which we therefore have no experience of. A case in point would be the analysis of accidents

-To studying different operating modes

Interviewer: Within the EcosimPro environment there are specific libraries for the energy sector (such as Thermal_Balance, Control, Pipeliqtran, Fluida, etc). Could you give us some more details on how they can be used in this area and in the different types of energy (nuclear power plants, combined cycle plants, etc)?

EH: The Thermal_Balance library contains virtually every item you need to make models of classic thermodynamic cycles (Rankine cycles, Brayton cycles, and combined cycles) and their variations. In other words, almost any system that makes up part of the thermodynamic cycle of a power plant can be studied without having to develop any new components. With minimum effort, expert users can develop specific components that enable them to model unique equipment not included in the standard library. One of the jobs our group is most proud of accomplishing is the analysis of the evolution of the wall temperature along the entire length of pipe from a backup boiler to a solar thermal power plant for heating thermal oil. It's only a matter of blending imagination and know-how to be able to solve new problems.

Another one, the Pipeliqtran library, is meant for studying transients in fluid systems in liquid phase. This library has been key to performing most of the water hammer analyses in power plant systems needing such analyses. From these studies we obtain the maximum and minimum pressures throughout the system, the wave forces, the dimensional parameters of relief elements, etc. Similarly, the Fluida library can be used to do the same in the gaseous phase or in two-phase mode.

Control is a support library. It has all the items needed to model everything related to system instrumentation and control.

A good example worth mentioning here is the analysis of the new level control on the Almaraz NPP steam generators, which was the
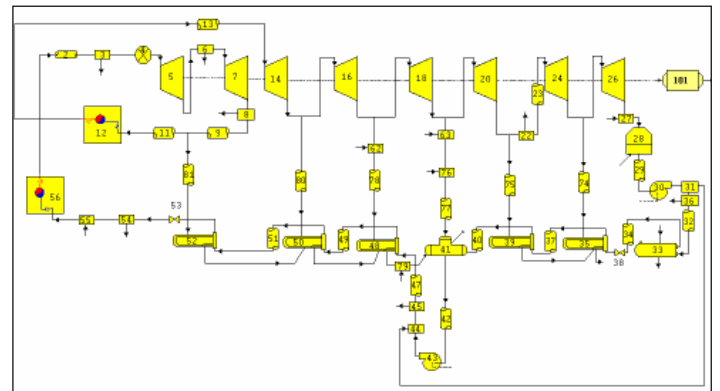
Thermal Power Plant modelled with Thermal_Balance.

subject of a paper presented at the 33rd Meeting of the Spanish Nuclear Society held in Segovia in 2007. The model used items from three different libraries (Thermal_Balance, Pipeliqtran and Control). The control library was a faithful representation of the new design that – back then was about to be implemented in the plant.

At the 35th Meeting of the Spanish Nuclear Society, held in Seville in 2009, another paper was presented describing the analysis done for controlling the discharge level and temperature at the Arrocampo Reservoir (also for Almaraz NPP).

Interviewer: What are its main applications in each case? What advantages are there in using tools like EcosimPro in the operation of different facilities?

EH: I couldn't say explicitly what the main applications are. Each case has a need, and that is its main application. Similarly, the advantages are the ones that derive from any simulation that is done well. Computers and paper can hold out against anything. Risk-free prediction of what may happen is fundamental.

Interviewer: After years of experience as an EcosimPro user, what's your opinion of this tool? Is it easy to use? What characteristics do you think make it different from other tools on the market? What has surprised you most when using it and what has your own experience been like?

EH: There is only one word to describe the tool: magnificent. It's the best simulation tool I know of. Every expert user who has seen the demo has been taken aback with its power and versatility. But you ask if it's easy to use. The answer is, absolutely not. That's like asking Fernando Alonso if his Formula 1 car is easy to drive. He'd surely answer by saying that it's easy enough to drive it on the straightaway
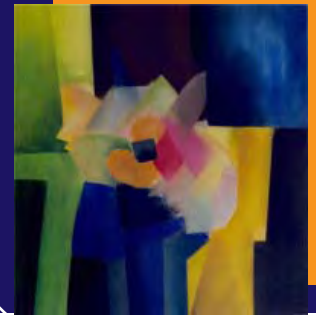
in front of the grandstand, but it's another thing entirely to drive it at Monte Carlo and get the most out of it. EcosimPro is a Formula 1.

The difficulty in using it stems only in very small part from the tool itself and a lot from needing to have a thorough understanding of what's being modelled. Those of us involved in simulation say that you need to know what the results of a model will be before you actually get them. And that's really true: although clearly you don't have to guess the numbers, you do have to know what order of magnitude and what trend the results will have. If a user is incapable of getting a ball-park figure, even if just a rough estimate of how the model is supposed to respond, maybe he had better not try using EcosimPro. He may get all sorts of results and not know if they are good, bad or so-so, or not even get any and not be able to make the model run, and not know why.

There are plenty of aspects that make it different from other tools. I'll sum them up in three ideas: re-use, by which I mean the validity of what's already done and full or partial use for new items; modelling from the physical equipment point of view instead of from the programming point of view; and open code of the libraries, meaning that you can add items which you may need on rare occasions but are not included in the libraries.

Interviewer: Many people don't know that EcosimPro is of Spanish origin and are unaware of the enormous capacities it

has. Can it be classified as a highly sophisticated tool capable of competing on the worldwide market?

EH: Not only can it be classified as such, it actually is; and in fact it is already competing on the worldwide market. The thing is, it is only known in certain very specific technological niches, and mainly abroad.

Furthermore, getting back to the idea that using it correctly is neither immediate nor easy, it should be pointed out that it's common to disqualify a tool any tool, not necessarily a computer program, it could even be a milling machine whenever the user is incapable of making it work correctly. Few users are willing to admit the fault is their own; they usually just say "it doesn't work". Perhaps that is why a lot of people are reluctant to use this kind of tool.

Interviewer: Is there any room left for new applications in the energy sector?

EH: Certainly. The sky's the limit. The thing is, with the question worded that way, it's hard to answer. But I'll go back to my example of the wall temperature: we had never even thought of solving the problem of potential degradation of the thermal oil. It wasn't until the need came up that we realized that it could be done, and that the best way to solve it was with an EcosimPro model in which the time variable replaces the distance variable.
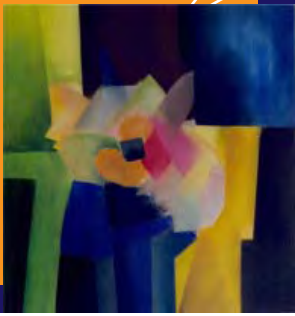
ECOSIMPRO NEWS

Experts recommend the use of modelling to optimize the design and operation of power plants

EcosimPro organized the first conference on energy simulation applications with EcosimPro, at which experts in this sector analyzed the advantages of this modelling tool in resolving of problems related to power plant design and operation.

Simulation applications in the energy sector have become an essential element for the improvement of plant operation, prevention of

errors, prediction of anomalous behaviour and cost saving in design and operation, among other useful features.

The Spanish company Empresarios Agrupados (EA) has developed the EcosimPro simulation environment that enables the user to model complete systems in the energy sector. EcosimPro is a top range product at a worldwide level and is consolidated is areas such as energy, space and aeronautics. It is the official modelling tool of the European Space Agency in areas such as propulsion, environmental control and life support systems in crewed spacecraft.

In the area of desalination plants, Luis Palacín, from the University of Valladolid, described a recently created library for desalination plants with reverse osmosis technology. The models created and applied to real plants using this library have led to optimal control of production and a detailed model of the entire chemical process.

The last example was presented by Carlos Moreno, from Ciemat, who described the use of EcosimPro in the design of tritium plants at ITER fusion energy project. He emphasised that EcosimPro adapted itself very well to the modelling of the ITER project tritium plant and he presented a system already developed in EcosimPro for modelling a Test Blanket Module (TBM) for transport and recovery of tritium.

EA presented representative works of energy simulation using EcosimPro, in collaboration with other institutions such as CENER, the University of Valladolid and Ciemat. The conference was used to analyze the advantages of this tool in modelling and the most representative results obtained at the time.

Pedro Cobas, the EcosimPro development team leader, was responsible for presenting the tool and describing both its features with regards to mathematical modelling and its libraries covering various disciplines.

Eusebio Huélamo, head of the Thermo-Hydraulic Simulation Section at EA, presented some of the most representative libraries in this area, eg Thermal_Balance used to calculate energy balances in power plants (combined cycles, thermo-solar, etc) and Pipeliqtran, used to precisely model and analyze transients in piping networks. Eusebio also described a case of water-hammer in circulating water systems.

Pierre García, an engineer in CENER's Thermo-Solar Energy Department, described the advantages of EcosimPro in the design of the parabolic mirror fields. It was possible to accurately model the complexity and dynamic behaviour of the mirror field and its connection to the power generation plant.

Alfonso Junquera, from EA's Mechanical System Development section, described the usefulness of the tool for improving the natural gas supply at combined cycle power plants, guaranteeing that after a sudden cut-off of the gas supply to one of the turbines, there will be no excessive pressure oscillation in the other turbines that remain in operation.

New EcosimPro Version 4.6 now available

EcosimPro users can now use version 4.6 which includes many improvements with respect to Version 4.4 and SPR solutions. A total of 124 bugs were corrected. Among the main novelties and improvements in Version 4.6 are: new compilers (eg.MS Visual Studio C++ 2008), a new performance analysis tool for each function during simulation, and object editors to customize any design editor.

This version also has a more solid equation solver with clearer information, new editors, an alias mechanism variables, and macro language.

EcosimPro 4.6 also has an improved post-process tool for viewing the results of the simulation, new tools for classifying the articles in the block and for exporting models outside the EcosimPro environment.

The module has also been improved so as to improve the speed and range of variable selection. This new version is 100% compatible with the previous one and will be distributed to users who have a maintenance contract. For more details on the new features, please see the following presentation:
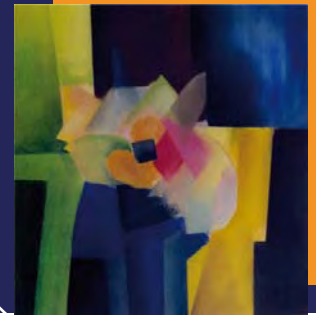
www.ecosimpro.com/download/manuals/ecosimpro_4_6_upgrade_presentation.pdf

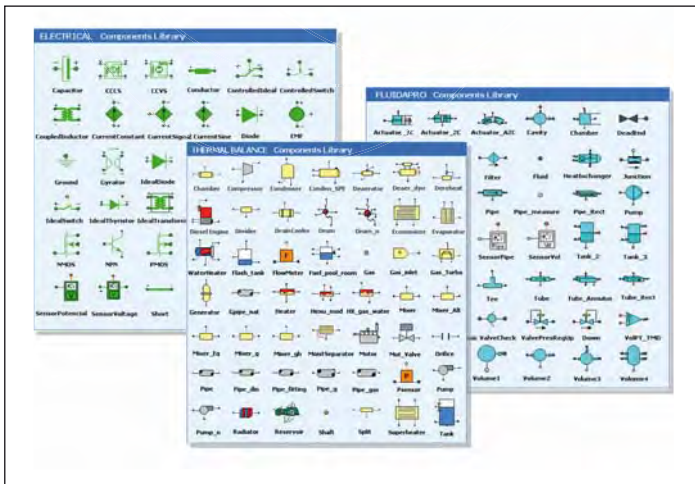## New PROOSIS version 2.2 now available

EcosimPro's propulsion section has finalized the updating of PROOSIS 2.2, which now includes improvements especially in the area of

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generation of customer decks and automatic connection of simulation models with FORTRAN. PROOSIS is a software tool based on EcosimPro that is specialized in simulating aeronautical motors.

Technical energy magazines take an interest in EcosimPro

The special issues on combined cycle power plants planned for 2009 in energy sector magazines have taken an interest in EcosimPro. Two magazines, Infopower and CV Energy, included extensive articles on the importance of simulation to the improvement of operation and safety at these plants.

New print copy for EcosimPro

Last quarter the EcosimPro team issued a new corporate brochure, including a general presentation of the EcosimPro simulation tool, its main characteristics and the industrial sectors where it is used. The purpose of this exercise was to increase awareness of Ecosim-Pro among professionals and potential users.

New EcosimPro course at Madrid Polytechnical University

Students at the faculty of Aeronautical Engineering at Madrid Polytechnical University took a general course on the use of Ecosim-Pro, given by the technical team.

The course was held in the university Calculation Centre from the 6th to 8th April and there was a good turnout and high level of interest and participation from the students. This event formed part of the EcosimPro team's plans for providing training in simulation and modelling among future engineers and professionals over different disciplines.

EcosimPro participates in the Space Propulsion 2010 Conference

The EcosimPro technical team participated in the Space Propulsion 2010 Conference from 3rd to 6th May in the Kursaal Conference Centre in San Sebastián (Spain). The team had a stand to show attendees the ESPSS (European Space Project Simulation Software) library, designed to model aerospace propulsion systems. In addition, the ESPSS developers, in collaboration with ESA, put on free demonstrations of this library at workshops organized for this purpose.

EcosimPro used in the cryogenic process in LHC at CERN

by Benjamin Bradu. Control Engineer at CERN.

The European Organization for Nuclear Research (CERN) has recently started the experiments with the most powerful particle accelerator of the world: the Large Hadron Collider (LHC). The LHC is a particle accelerator used by physicists to study the smallest known particles – the fundamental building blocks of all things. It will revolutionise our understanding, from the minuscule world deep within atoms to the vastness of the Universe.

Two beams of subatomic particles called 'hadrons' – either protons or lead ions – will travel in opposite directions inside the circular accelerator (27 km long), gaining energy with every lap. With the collide of both beams the physicists will use the LHC to recreate the conditions just after the Big Bang, by colliding the two beams head-on at very high energy.
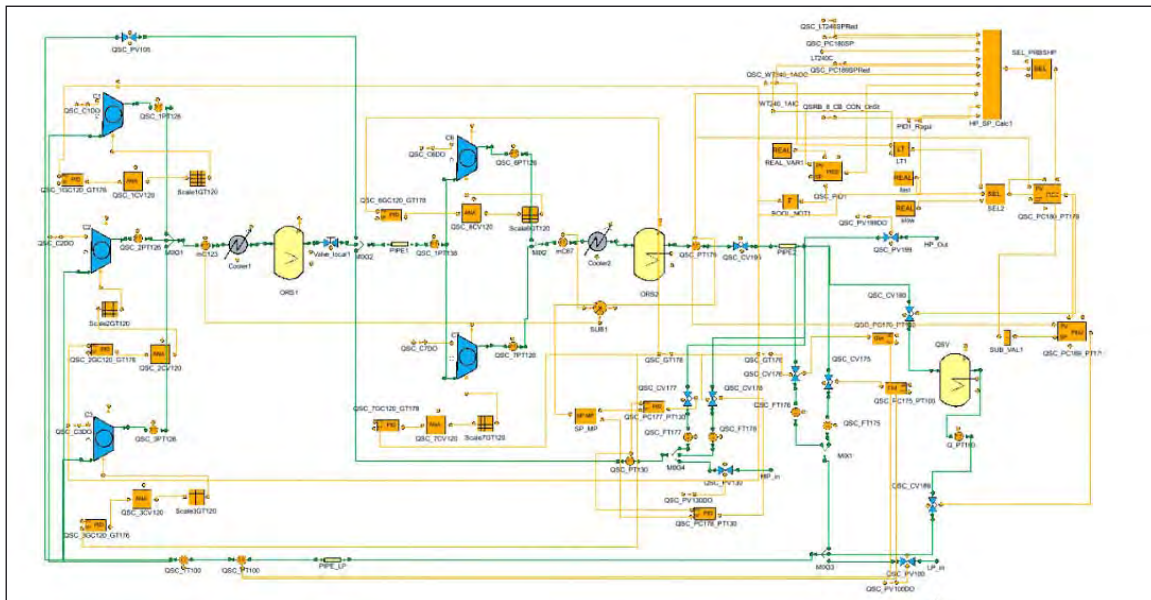
They are guided around the accelerator ring by a strong magnetic field, achieved using superconducting electromagnets. These are built from coils of special electric cable that operates in a superconducting state. This machine is composed of superconducting magnets located at about 100 meters underground in Geneva

Example of a helium compression station for the LHC in EcosimPro Schematic.

(Switzerland). The 36000 tons of superconducting magnets are cooled at 1.9 K (-271 C) with superfluid helium provided by large cryogenic installations.

Within the Cryogenics project, EcosimPro has played a very significant role in fields as simulation, training, implementation of advanced control techniques and last, the virtual commissioning of the plant-wide control system.

A dedicated EcosimPro helium cryogenic library has been developed and fully commissioned at CERN. This library allowed the modeling and simulation of the helium refrigerators present in the LHC. Due to the flexibility and the efficiency of EcosimPro, an entire LHC cryogenic plant has been simulated with a high degree
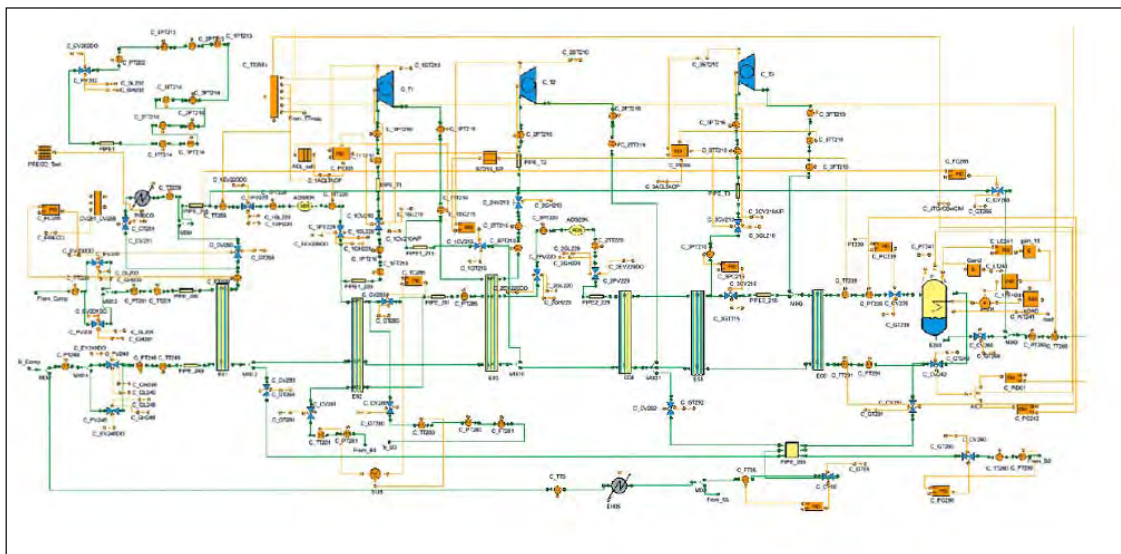
Example of a small helium refrigerator in EcosimPro Schematic.
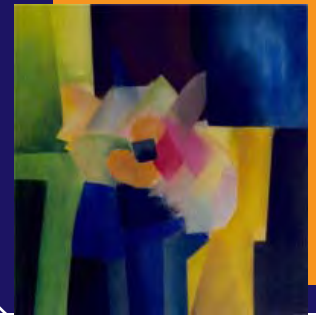
of precision, reproducing complex transients observed on the real plants and within wide operation ranges.

EcosimPro has also been used in the creation of models to be embedded in advanced controllers (non-linear predictive controllers). Precisely the tool is used to reproduce the behavior of the 1.9 K cooling loop, which is the final stage before getting the LHC superconducting magnets to its nominal temperature.

The C++ model exportation feature of EcosimPro allowed CERN engineers to develop a new complete simulation platform of a LHC cryogenic plant where the Programmable Logic Controllers (PLC) are directly connected to the model instead of the real plant keeping the same SCADA for both systems: the real one and the simulated. An operator training tool is hence now available at CERN where cryogenics operators can be safely trained on a virtual cryogenic system. Moreover the models are used in the early stages of the control system commissioning, allowing the cryogenics engineers to offline validate the control system logic (interlocks, alarms, etc.).

The success on the cryogenics project, founded in the versatility of the EcosimPro tool, eased the task of spreading the tool to other fields as cooling and ventilation processes, which are currently in progress.

A helium refrigerator for the LHC.

A helium compression station for the LHC.

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How do we create a Personalised Objects Editor?

EMPRESARIOS AGRUPADOS

Of the improvements that stand out for their use in EcosimPro's graphical modelling environment, the most prominent are the "Personalised Attributes Editors" which enable modellers to view the information on a component in a logical manner and adapted to their needs.

Introduction

Building models with complex topologies in EcosimPro has become a fast, intuitive task that can be completed in a few minutes.

Suffice it that users select the component symbols, drag them to a schematic diagram, connect them to define the new topology, and lastly – and only in necessary cases – personalise the parameters and variables of the instances the new model contains using the "Attributes Editor".

Editing attributes in instances with few variables is very easy. The attributes editors enable any types of variables to be edited; they also assist and help at all times to develop tasks typical of editing tables, text strings, arrays, etc.

However, when managing very complex components with dozens or even hundreds of variables, editing attributes is an arduous task and, even though all the data is available in the form of lists, the information displayed does not enable users to differentiate which variables are of best use to them or which are worth personalising.

The "Personalised Attributes Editors" provide the solution to this problem. They enable modellers to arrange the variables of each component according to their own logic and needs, all without losing the attributes editors' known default capabilities.
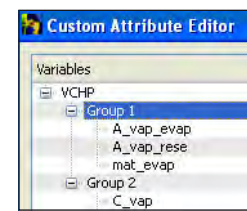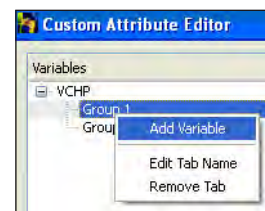
The Personalised Attributes Editors

The design of a new personalised editor is based on the structured display of a complete set of component data and variables.

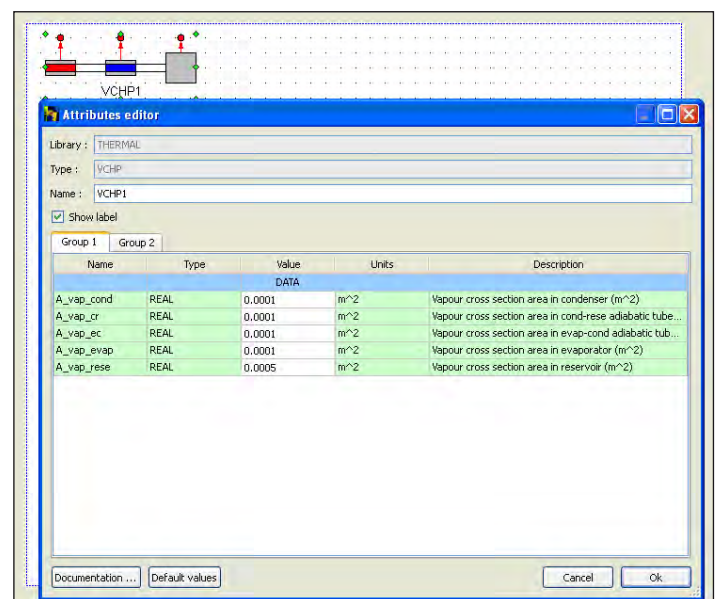The organisation possibilities are:

The division of information into tabs with their own names.
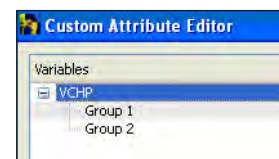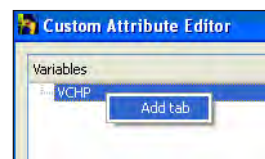
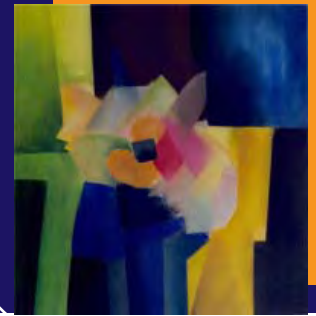The inclusion under each tab of the variables to be displayed in groups.

The final result in the schematic diagrams is an attributes editor with variables organised in a much more structured fashion and each tab containing appropriate information.
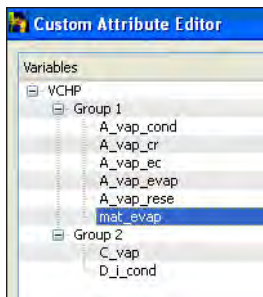
If the component has ENUM or SET_OF type variables, we can establish conditions based on them so that other variables can be displayed enabled (their values can be edited) or disabled.

This capability of the editors enables us to add one more organisation level to our variables because a direct relationship is established between one type and another.

For example, if we add "mat_evap" which is an ENUM type variable to "Group 1"

a condition can be created for the "A_vap_cond" variable so that it is enabled when the ENUM "mat_evap" has the "Aluminium" or "AL2219" values, but not for the other cases.

The following is the final result of the creation of our new condition:
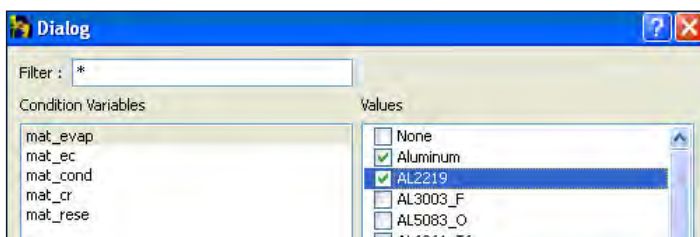

Now when an instance of our component is edited, we may or may not choose to modify the "A_vap_cond" variable based on whether the "Aluminium" or "AL2219" values are selected, or any other in "mat_evap."
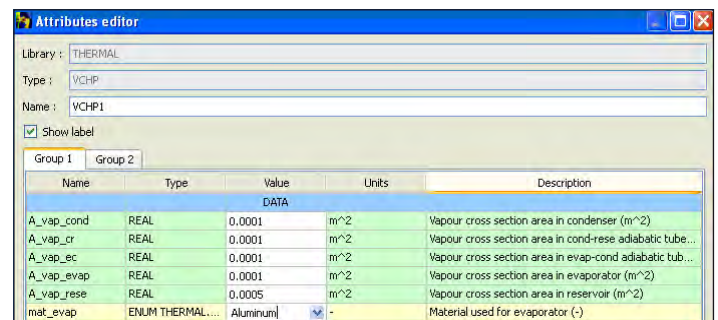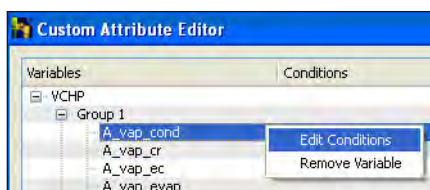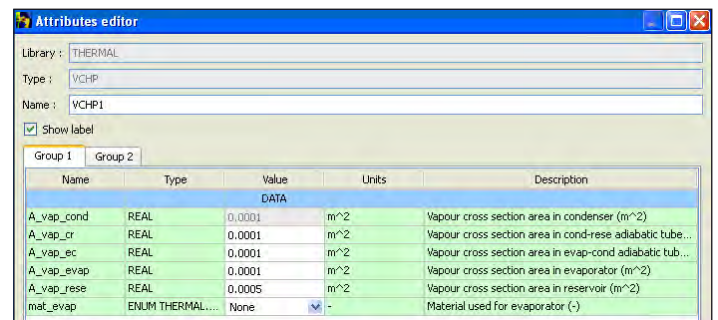
As we can see, the possibilities of the "Personalised Attributes Editors" are far ranging, enabling us to create logical modelling structures appropriate for each purpose.

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