April / May / June 2005 · 2/2005

digitalPLANT

Business + Engineering

New Type of Nuclear Reactor demands smooth Data Hand-over

Special Edition of digitalPLANT 2005 for AVEVA Group plc

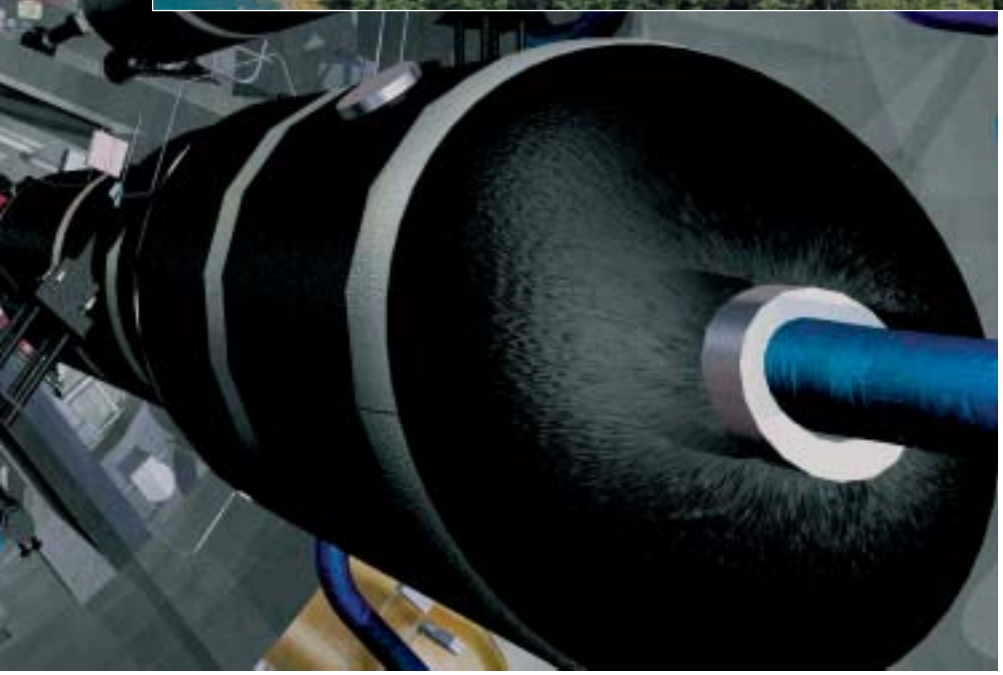
AVEVA GmbH, Otto-Volger-Straße 9b, 65843 Sulzbach (Taunus), Germany

Tel.: +49-6196-505201, Internet: www.aveva.com

New reactor type benefits from cooperation with IT market leaders

A new type of pressurized-water reactor is to be placed in operation in Olkiluoto, Finland in the year 2009. The builder, Framatome ANP, relies on the modular Vantage Suite by Aveva instead of a monolithic IT backbone of the "mother of all data" type.

Public debate sometimes gives the impression that nuclear power technology is a dying species of plant engineering and construction – at least in Germany. But the opposite is the case. The excellent German nuclear power plant building expertise is as alive as ever. New jobs are continually being created in the industry. The European Pressurized Water Reactor (EPR) has been in its development phase for more than ten years. It will be realized in Finland for the first time. Apart from the technological challenge, the project requires an IT infrastructure capable of providing support through all its phases – from engineering to execution, to final data handover to the operator. The French company Framatome and the German company Siemens have been jointly developing the EPR since 1992 as a project for and with the significant cooperation of Electricite de France (EDF) and German electricity providers. Framatome and Siemens merged their respective nuclear business sectors early in 2001 to form Framatome ANP, with Areva holding two thirds and Siemens holding one third of the shares. The EPR is a reactor of the tried and tested pressurized-water type. The pressurized primary circuit heats the secondary circuit in four large heat exchangers – the



Where things are really hot. *The large image shows the reactor core where nuclear fission takes place. Below a simulation of the three nuclear power stations.*

steam generators. These in turn drive the power generating steam turbine.

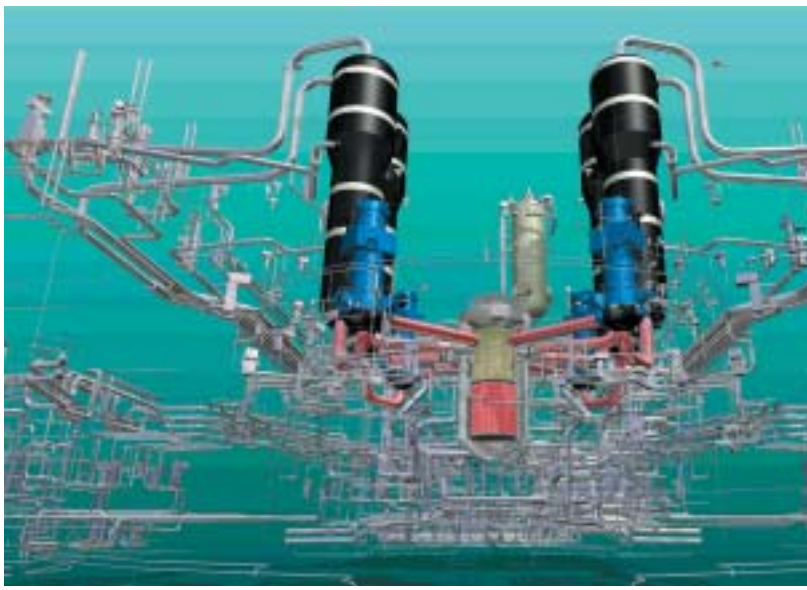
The separation of the two water circuits allows the plant to be separated into a nuclear part and a conventional part, the "nuclear island" and the "turbine island". The advanced EPR design is safer and more cost efficient than its predecessors. More-over, it generates less waste. The security systems that intervene in the event of extraordinary operating conditions are of a multiple redundant type. In combination with the other safety mechanisms, the likelihood of damage to the core - already a highly unlikely event for current pressurized-water reactors - is again reduced by the factor ten.

Excellent standing. As a matter of interest, Framatome ANP delivered a positive business result despite the planned German phasing out of nuclear power. For Germany this was achieved by modernization and service projects required for all operating installations. 130 new members of staff were hired in 2004 and the creation of highly qualified jobs will continue. This was made possible, last but not least, by the order for project "Olkiluoto 3", the turnkey construction of the fifth nuclear reactor in Finland by the Areva-Siemens consortium. Three years ago Framatome ANP entered into a fierce bid against powerful competitors from the US and Russia. The Franco-German consortium clearly asserted itself. On one hand, the EPR

The mother of all data

There are two distinct strategies for ensuring consistent data management: Either one central repository for all data, or separate linked data bases. The decisive challenge to both concepts is near real time information replication. Aveva opts for integrating the individual data generating applications of the Vantage family, such as VPD (including PDMS) or VPRM (resource management) by using high-performance workflows.

www.aveva.com



The European Pressurized Water Reactor (EPR) *is a further development of the conventional pressurized water reactor type. It is designed for the generation of 1600 MW and an operating life of 60 years. The illustration above shows 3D data generated by PDMS of Aveva.*

is the result of intensive research and development efforts based on the operating experience of almost 100 nuclear power plants built by the Areva Group world-wide.

On the other hand, EPR stands for the globally most advanced nuclear power technology with regard to cost effectiveness, safety and environmental protection[1]. Higher efficiency, greater ease of maintenance and lower personnel costs result in lower total costs of investment over an operating life of 60 years – compared to its competitors, as well as to alternative and conventional sources of energy.

At the beginning of EPR development, the subsidiary company NPI (Nuclear Power International) of Framatome and Siemens, which was founded for that purpose, started the IT project "CAPE" in order to define the IT environment for the advance development of the plant. At that point in time (1993) no software solution was available on the market that was able to meet even a fraction of the project requirements. Therefore an integrated tool infrastructure was created on the basis of proprietary programs. For 3D design PDMS from Aveva Group plc with its headquarters in Cambridge (the former CAD center) was selected. However, more than a decade was to pass before another nuclear power project was to be announced in Europe. This lead to several key elements of the CAPE suite not being developed and not being adapted to modern hardware.

"Data inconsistency is a standard phenomenon of parallel engineering processes - the task is to manage it"

Frank-Peter Ritsche, Framatome ANP

While the bid invitation of the Finnish nuclear power operator Teollidsuuden Voima Oy (TVO) was being processed, it quickly became apparent that the input required for the modernization of many of these tools would have been too high. Therefore an evaluation phase followed in 2003. As was to be expected, the software market for plant engineering and construction had developed rapidly. Moreover, TVO's requirement definitions were very ambitious for the IT sector as well: a so called Information Management System (IMS) was to control development and construction and was to be used for operation after commissioning as well.

Framatome countered this proposal with its own concept of a separate IMS for development and construction, where data would be available in open structures. The operator was to create an "Operation and Maintenance Management System" customized to its specific requirements with continuous data import from IMS during the last project phase. Instead of an instant and complete handover, continual data transfer between EPC and O/O takes place. There-fore TVO can use elements of its existing OMS for this plant, if so desired.

Framatome ANP in its market analysis considered its own requirements for an integrated IT environment for complex new construction projects, the very detailed specifications of the operator and the best practice references of partners and entities accompanying the market. Investigated models, such as "Powrtrack" by Black & Veatch employed by competitor General Electrics were not found to be worth emulating.

Due to the central management in such a "mother of all data", a closed architecture of this type forces all concerned parties, suppliers, partners and the client, to use this system - with all consequences, with regard to loss of flexibility and the input required for support and maintenance of a proprietary system. Powrtrack's roots go back to the year 1983.

After all, the investigation yielded concrete results as to what the system was to look like. Frank-Peter Ritsche, head of project logistics for Olkiluoto at Framatome ANP's Erlangen site, and his team searched for a modular system with central data management.

The system was to consist of several compact data bases on one hand, and of intelligent links and interfaces on the other hand that were to eliminate data redundancy. Finally the decision for the Aveva software suite Vantage was made. The reasons for this decision were direct transfer of existing 3D data in PDMS format and the higher productivity of the in-house system designers with the respective Aveva module.

Three pillars. The Olkiluoto project, however, demanded more functionalities. The corporate-wide implementation of the Corporate Electronic Document Manage-

[1]) There is of course a different view, assigning the predicate "Third Generation Reactor" to an existing Russian plant as well.

ment System COEDM-Documentum was accelerated (this provider for enterprise content management was acquired by the ECM corporation at the turn of 2003/2004). This system in the meantime has been deployed to manage the entire documentation generated, as well as the internal workflows.

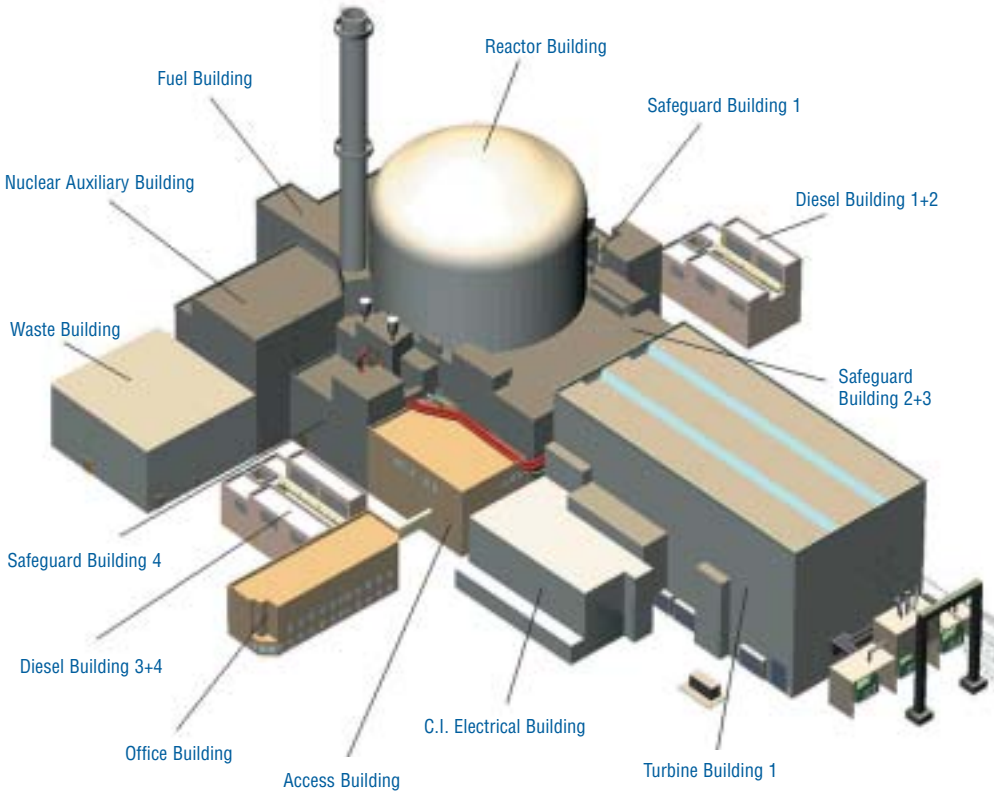
Two other systems, along with Documentum, make up the IMS sector Management Tools: Primavera Enterprise P3E, a time management software, whose predecessor has been employed in-house for a long time, and SAP R/3 for commercial management.

The second sector "Specific Design Tools" is made up of a series of specialized calculation and development tools. Among these are some further developments of the CAPE project.

The third sector "Design Coordinating Tools" is covered by three Vantage products:

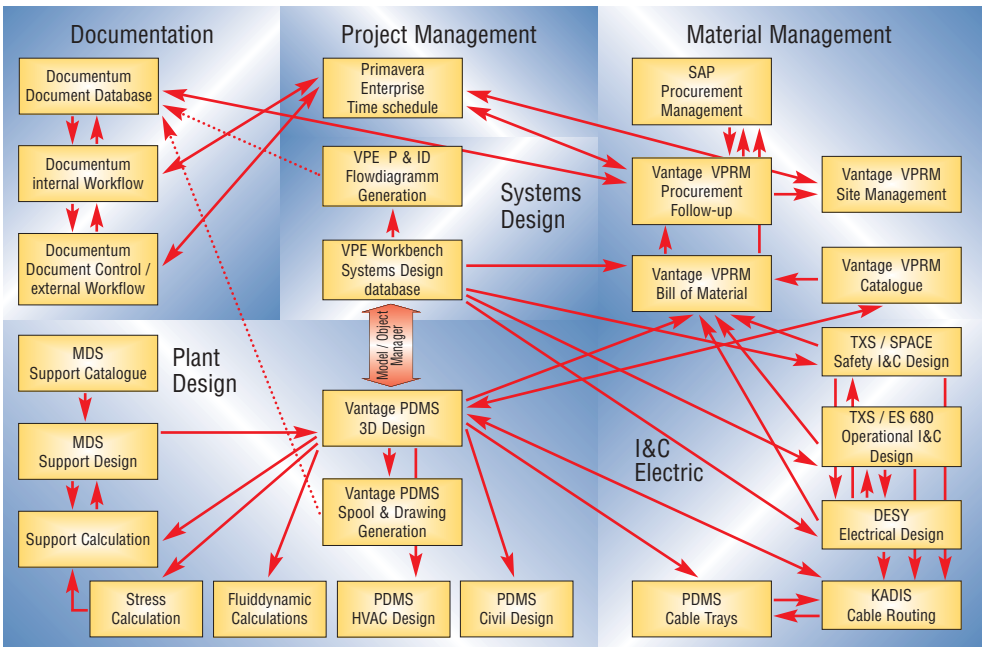
- Vantage VPRM as the material management system
- Vantage VPE for system technology design
- VPD, including PDMS, as the 3D design tool.

The actual system design, that is the definition of system functions in a system diagram, is initially created in the VPE module P&ID. Once the system diagram is released, the data are available in the VPE database, the VPE workbench, for processing by the engineers for components and assemblies, and for electrical design. An object just broadly defined as a pump in the system diagram, with a defined flow rate and certain other basic parameters, will now become a concrete device to be complemented by further devices, like the driving electric motor, the connections and other parameters.



The datasheet generated in the VPE workbench is the basis for the order process which is planned and monitored by the material management module VPRM. In parallel, the data are transferred to VPD via the Model Object Manager (MOM). There, the component is inserted into the 3D model. At the same time the pipeline setup is introduced into the 3D model. Here as well, the data are aligned with VPE workbench data via MOM and material excerpts are handed over to VPRM.

Step-by-step. This multi-step process enables working with low resolution initial data, an important prerequisite for simultaneous engineering processes. In this way subsystems can be planned using the 3D tool on the basis of the system diagram, even if component data have not been released yet. This is very important in nuclear power plant design, as Mr. Ritsche emphasizes: "Due to the special quality requirements in nuclear technology, many pipelines with large diameters have to be made of special steel. Delivery sometimes may take several years. It is therefore important to have a concept of the quantities required early on in a project in order to enable suppliers to start production of semi-finished materials parallel to detail design."

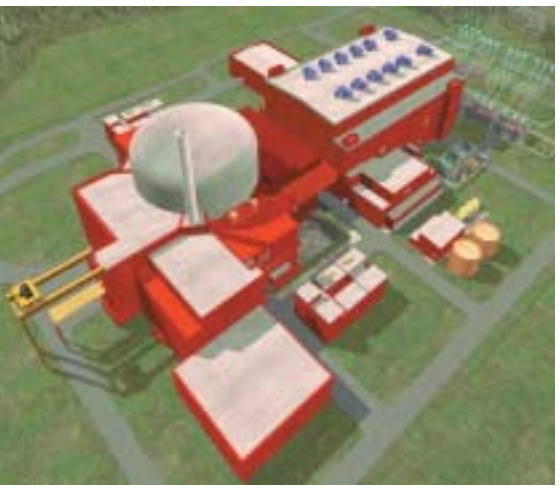


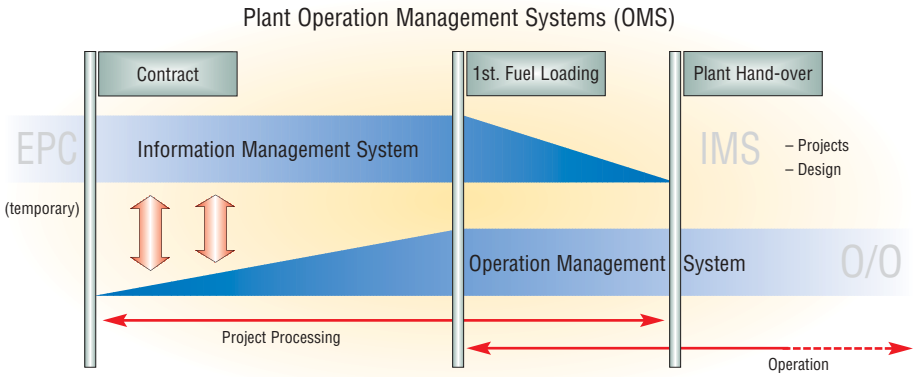
As all IMS modules are databased, the interconnection of components is simple. Aveva does not employ a singular "mother of all data" but several databases, linked by intelligent workflows. The system checks every change in one data base for its implications and it checks whether the user is permitted to actuate this change at all. "Poor change management costs money, a lot of money", Mr. Ritsche says.

Engineering changes are handed on to the executing companies by mate-

Complexity under control

Information flow between individual IMS modules is highly interconnected. Most of the interfaces could be realized with the standard software of known system providers.





***Last year** TVO started an OMS in collaboration with Framatome ANP. According to the vision of the O/O this innovative data management system will be the first system worldwide to operate a nuclear reactor of the third generation.*

rial management before the steel is welded. The fact that four locations are involved in the development, two German sites, Offenbach and Erlangen, and two French sites near Paris, La Defense and Montrouge, complicates matters.

Therefore the databases of all sites involved have to be kept up to date as well. This highly challenging task is accomplished by Aveva with its standard solutions, like the global software for PDMS - "very efficient and very much in the background", as Mr. Ritsche expresses it.

Data inconsistency and control

Mr. Ritsche points out an interesting aspect: "Data inconsistency as such is nothing objectionable. It is a standard phenomenon of parallel engineering processes - the task is to manage it as part of a controlled workflow." If the system developer inserts an additional device into the system diagram, this device cannot instantly become part of the 3D model. The 3D developer must receive information from the system that this change requires replication in the 3D model. Vice versa, the system developer must be informed if 3D planning shows that an additional drainage is required. A person in charge is defined for each individual datum. This person must decide whether change to the particular datum is to be permitted, or this person is requested to actuate change to the datum. Mapping of 2D and 3D is handled by the Aveva module MOM.

The extremely tight schedule for this project is extraordinary: the decision for Aveva was made in the summer of 2003. Half a year later, 18 December 2003, the contract for the construction of Olkiluoto 3 was signed. Then engineering started 3D design based on data of NPI advance development. The total time until power plant handover is 64 months, starting on 1 January 2004 and ending on 1 May 2009.

Early in 2004 the first requests to suppliers were made. Currently the system diagrams are almost complete and the workbench is being loaded with the actual parameters of the component data. This created the basis for further detail engineering of the electrical design, instrumentation and control in the respective design tools connected via interfaces. Peak activity in engineering will be reached in 2005, with the concurrent start of reactor building construction in spring. About 20 system technicians work with VPE and more than 60 members of staff work with the database generated from the system diagram. About 150 workstations are available for PDMS modeling.

Looking at the handover of plant and data, Mr. Ritsche notes: "Sales of engineering tools is not our core business". That is why he relies on applications by leading providers available on the market. "At the end of the project we hand over all databases to the customer in their original format." TVO then has the option to either continue working with the same tool as EPC, or to develop a proprietary solution. The widespread use of PDMS and the other applications makes the handover of data manageable. The customer is free to call for plant modification bids. As many engineering and construction companies use PDMS, they will be able to implement modifications and to provide the data required for updating OMS. With regard to project design and creation of the OMS, Framatome ANP will be in fair competition with other providers. The operator maintains its freedom to choose a different system partner.

"The timeframe for introducing such a highly complex system was very narrow", the IT manager remembers. Already, the different engineering process traditions of the French and the German sites were aligned as part of the introduction of new engineering tools. It is well known that solving tasks like these may well take several years in large corporations. "Project Olkiluoto 3 was the motor that drastically accelerated the necessary decision making. It also justified the required investment", Mr. Ritsche says.

Turning away from proprietary applications ensures that tools will remain up-to-date and that they will be developed further. "Aveva really got involved. The experience has been a thoroughly positive one. Of course, such a project generates friction, especially if old habits and ways are at stake." It was shown that Aveva, too, took a big step forward with this project. It was the first time that the complete software portfolio was employed for a project of this size and to such a degree of interconnection.

To introduce the decisive elements of such a comprehensive solution within the space of a year was a real challenge, the IT manager emphasizes. It is important in this respect that Aveva's Vantage is less complicated and more pre-configured than its competitors. More processes are already specified which therefore require no setting up.

"Vantage, on one hand, meets all our requirements. On the other hand, it enables us to provide a maximum of flexibility and a maximum of options to our customers." This infrastructure, in terms of tools as well as in terms of required skills for efficient operation, provides the basis for fulfilling the individual expectations of the customer. The IT manager emphasizes the strategic importance of this project. Not only because of the first time implementation of EPR, but also because of the fact than an IT infrastructure with such a high degree of flexibility was created which will enable direct application in further projects.

RALF STECK

INFOCORNER

Note: In issue digitalPLANT 6/2004 we have highlighted Aveva's portfolio strategy.
For further information please visit
www.aveva-gmbh.de or **www.aveva.com**