



## AREVA makes a Breakthrough in Nuclear Power Plant Simulation for Optimal Safety

### THE CHALLENGE

AREVA, world leader in the energy sector, has experimented a new computational method for the upper internals of nuclear reactors. ESI's SYSTUS solvers running on Intel's newest HPC server can simulate models of nuclear components 10 times larger than previously and 4 times faster, with greater precision.

AREVA recognizes the unmatched computing performances and reliability of SYSTUS for the design, analysis and components assessment in compliance with nuclear regulations.

### THE BENEFITS

- Ever-enhanced safety: simulate completely and accurately large nuclear components
- Optimal quality and applicability of simulation for leaders in nuclear power
- Hardware solutions with the most computational power ever on the market at affordable cost of ownership
- Precise and efficient dimensioning analyses and behavior simulations

Ranked first in the global nuclear power industry, AREVA has a unique integrated offering that covers every stage of the fuel cycle, reactor design and construction, and related services. In addition, the group is expanding its operations in renewable energies.

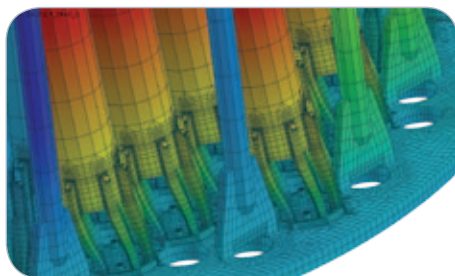
### Ensuring highest safety standards

Safety is a fundamental requirement for nuclear power. As a global leader, AREVA constantly devotes large efforts to improve the accuracy of its simulation methods, to extend their domain of applicability and to develop associated software packages enhancing the safety level of its components. AREVA's long-term partnership with ESI includes consulting studies and developing numerical simulation tools in the field of mechanics.

*"Some High-Performance Computing (HPC) workloads rely on large data sets and complex calculations that are not easily distributed across large numbers of smaller servers. Intel® Xeon® processor 7500 series-based servers and their large shared memory capabilities are ideal for these demanding applications.*

*This super HPC node delivers the necessary compute power, large memory capacity and memory bandwidth performance to solve big science faster."*

Mr. Laurent Duhem, Software Engineer,  
EMEA High Performance Computing, Intel



Large model of reactor vessel's upper internals from AREVA.  
(Simulation case using unrealistic loads)  
Courtesy: AREVA



## Leveraging powerful and innovative hardware and software technologies

Benefiting from both ESI's high value added services and Intel assistance, AREVA took advantage of the newest and fastest **Intel® Xeon® 7500 series-based server** to carry out huge computations of the upper internals, a major component in reactor pressure vessel internals.

The solution relies on ESI's SYSTUS multiphysics simulation software and a four-socket server with each processor providing up to eight cores based on the high-performance Nehalem microarchitecture.

SYSTUS versatile simulation software for advanced analysis in mechanics, electrotechnics, and heat transfer offers reliable and powerful solvers.

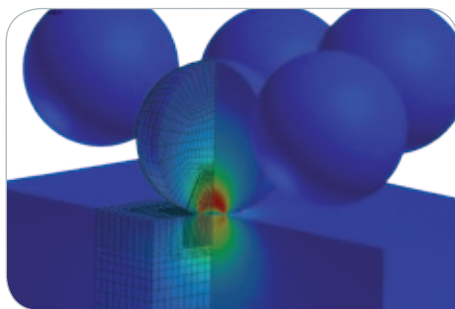
*"ESI offers scalable software solutions to help AREVA carry out detailed analyses and frequent regulatory assessment studies for higher productivity, whilst ensuring the respect of safety levels",* says Dr. Philippe Conraux, SYSTUS Product Manager, ESI Group.

Mechanical surface treatment  
(2 million nodes).

## Effective Decision Making with Realistic Simulation

ESI's expertise in the nuclear field has been developed for many years with Framatome and validated by AREVA. As a result, ESI brings a scalable simulation solution based on realistic physics, addressing the need in nuclear power for design optimization, time reduction and high quality results to meet stringent safety regulations.

The collaborative implementation of this solution, strengthened by ESI assistance turned out particularly helpful for AREVA to improve the efficiency of simulations for very large three-dimensional upper internals. In operation, the upper internals maintain axially the fuel assemblies in their correct position and provide guidance to the control rod, thus contributing to the core reactivity control and core cooling by the primary coolant in all circumstances. Like any other NPP part and component, upper internals must comply with strict criteria and operating conditions.



Enhancements to SYSTUS solvers combined with fast and powerful Intel hardware helped AREVA perform accurate computations of models **10 times bigger** than previously. In addition, this solution significantly reduced computation times up to a factor of 4 while bringing greater precision thanks to a global method. **This new approach of realistic simulation through reduced conservatism enhances productivity and safety in nuclear power.**

Intel support has been essential by providing an early high memory configuration Intel® Xeon® 7500 system, showcasing 256GB of RAM and 32 cores – along with the Intel® Math Kernel Library, the flagship for HPC Math software, required to deal with such huge computations.

AREVA is now implementing this new method for the computation of complete components such as the reactor vessel, primary circuit pumps to steam generators. In addition, other applications are currently tested by AREVA with the support of partners ESI and Intel, such as 'billage' simulation.

The combination of ESI solutions and Intel hardware has enabled AREVA to implement the industry's fastest supercomputer and at the same time attain much improved safety levels with enhanced productivity.

To find out more about ESI's solutions for Energy & Power, please visit: [www.esi-group.com/energy-power](http://www.esi-group.com/energy-power)

### ABOUT AREVA

A world leader in the energy sector, AREVA is an international group, with a commercial presence in more than 100 countries. Since 2001, when the group was founded, AREVA has continued profitable growth. Its 75,000 employees work daily to make the group a jewel of the nuclear- and renewable energies industry. For more information: [www.aveva.com](http://www.aveva.com)

### ABOUT INTEL® CORPORATION

Intel, the world leader in silicon innovation, develops technologies, products, and initiatives to continually advance how people work and live. Founded in 1968 to build semiconductor memory products, Intel introduced the world's first microprocessor in, 1971. Today Intel the world's largest chip maker is also a leading manufacturer of computer, networking, and communications products. Learn more at [www.intel.com](http://www.intel.com)

### ABOUT ESI GROUP

ESI is a pioneer and world-leading provider in virtual prototyping that takes into account the physics of materials. ESI has developed an extensive suite of coherent, industry-oriented applications to realistically simulate a product's behavior during testing, to fine-tune manufacturing processes in accordance with desired product performance, and to evaluate the environment's impact on performance. ESI's solutions fit into a single collaborative and open environment for End-to-End Virtual Prototyping, thus eliminating the need for physical prototypes during product development. The company employs over 750 high-level specialists worldwide covering more than 30 countries. ESI Group is listed in compartment C of NYSE Euronext Paris. For further information, visit [www.esi-group.com](http://www.esi-group.com).



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