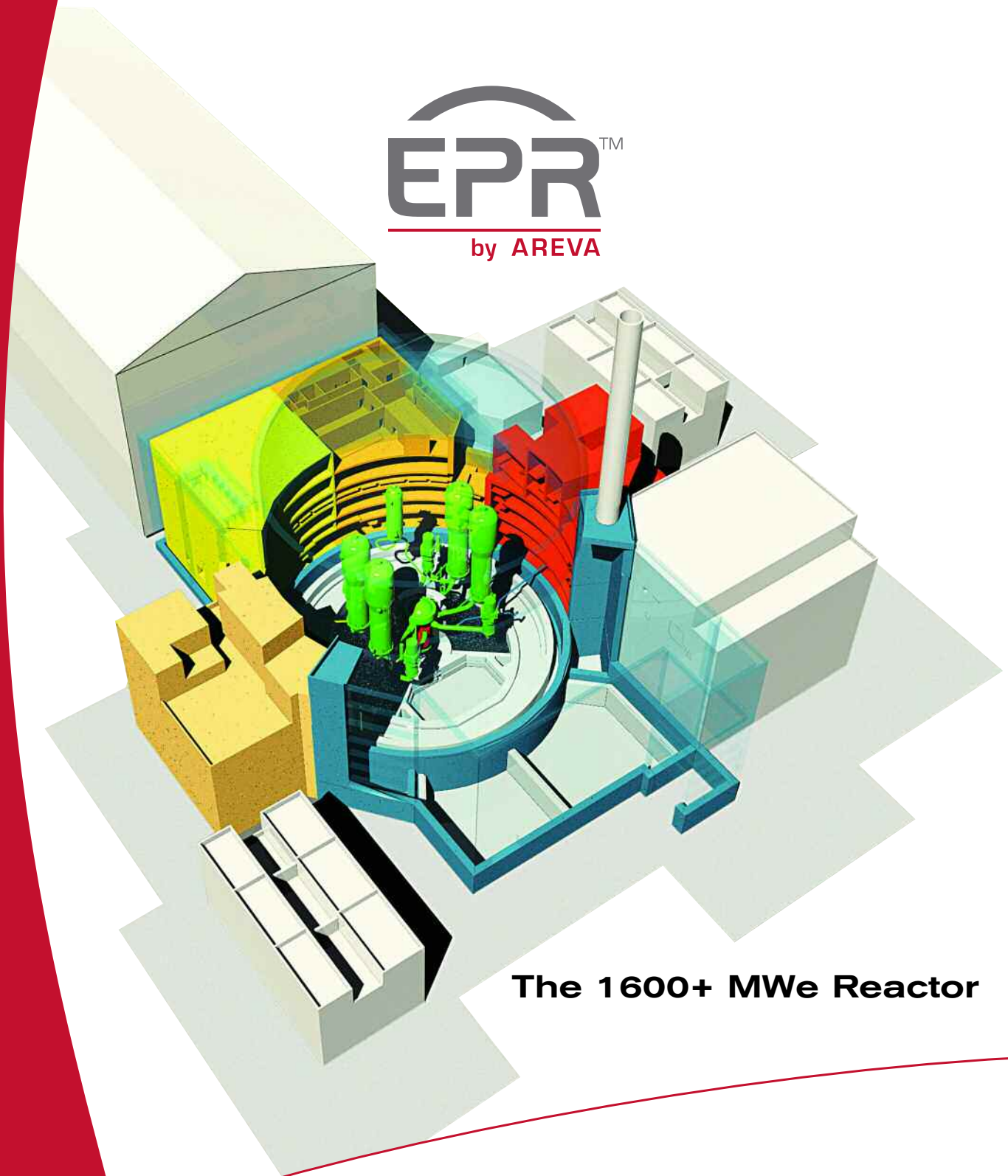
EPR™

by AREVA



The 1600+ MWe Reactor

AREVA

From paper to concrete...

we're making it happen

Olkiluoto site (Finland)

Flamanville site (France)

Taishan site (China)

Advantages of the GEN III+ EPR™ reactor

Evolutionary

Proven technology based on 87 PWRs built throughout the world, integrating numerous technological innovations.

Safe

Core meltdown prevention with 4 times 100% redundant safeguard systems, mitigation of severe accident consequences, radiological protection, functional diversity of safety systems, robustness against external hazards such as the airplane crash.

Competitive

High power output, efficiency and availability, reduced power generation costs, extended service life.

The Path of Greatest Certainty

- **Energy supply certainty** thanks to its evolutionary design, operational flexibility and shortened outages
- **Engineering certainty** for customers thanks to its evolutionary design.
- **Licensing certainty** with construction license obtained in France and in Finland, licensing launched in China, USA and United Kingdom. The EPR™ reactor is also the first to be reviewed by the MDEP, an international cooperation leading to higher efficiency and effectiveness in the licencing process.
- **Procurement certainty** for critical components directly sourced from AREVA's existing integrated facilities.
- **Project certainty** with recent building experience and established supply chain.
- **Business performance certainty** with an efficiency up to 37%, flexible fuel management, low operation and maintenance costs.

EPR™ by AREVA

Evolutionary

Performance with certitude

A reassuring pedigree

- The EPR™ reactor is a direct descendent of the well-proven N4 and KONVOI reactors, the most modern reactors in France and Germany.
- The EPR™ reactor was designed by teams from KWU/Siemens and Framatome, EDF in France and the major German utilities, working in collaboration with both French and German safety authorities.

A proven reactor

- The EPR™ design integrates the results of decades of R&D programs, in particular those performed by the CEA (French Atomic Energy Commission) and the Karlsruhe Research Center in Germany.
- The EPR™ reactor benefits from the experience of several thousand reactor-years of operation of pressurized water reactor technology, the experience behind the 87 AREVA PWRs operating throughout the world.

• N4 (Chooz B)

The best of French and German technology

Konvoi (Emsland) •

Innovative features

- An axial economizer inside the steam generator allows a higher level of steam pressure and plant efficiency.
- A heavy neutron reflector surrounding the reactor core lowers uranium consumption.
- An outer shell covering the reactor building, the spent fuel building and two of the four safeguard buildings provides protection against a large commercial or military aircraft crash.
- A core catcher allows passive collection and retention of the molten core should the reactor vessel fail in the highly unlikely event of a core melt.
- Digital technology and a fully computerized control room with an operator-friendly human-machine interface improve the reactor protection system.

Safe

Outstanding safety level

Simple and progressive

- Better separation between operating and safety functions simplifies use and layout.
- Operating and safety systems provide progressive responses proportional to the risk caused by any abnormal event.

Core meltdown prevention

The probability of a core accident at power is reduced by a factor 10 compared to previous reactors. Preventive features to protect against core meltdown include the following safety devices:

- Large water inventory of the main primary system and steam generators.
- For major safety systems, four subsystems (called trains), each of them capable of performing the entire safety function on its own.
- Functional diversity ensuring that, in case of total loss of a safety system in spite of its redundancy, the safety function can still be performed by another system.
- Dedicated valves on the pressurizer to prevent high-pressure core melt.

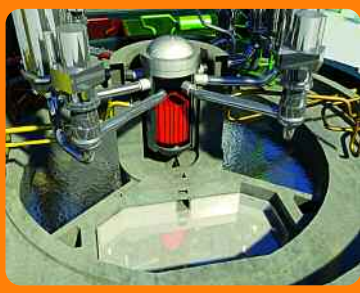
Severe accident mitigation

- The extremely robust, leaktight containment around the reactor is designed to prevent any external radioactive release.
- The arrangement of the steam generator bunker inside the containment and the use of passive hydrogen catalytic recombiners prevent the accumulation of hydrogen and the risk of deflagration.
- In the highly unlikely event of core meltdown, molten core escaping from the reactor vessel would be passively collected, retained and cooled in a specific area inside the reactor containment building.

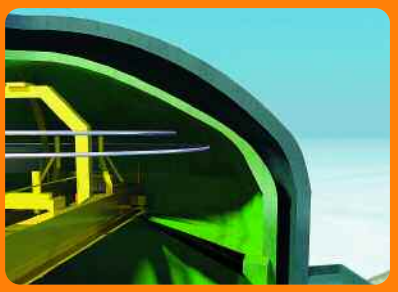
Radiological protection

Radiological protection of operating and maintenance staff is enhanced, reducing the target collective dose to less than half the one man Sv per reactor per year average currently observed in OECD countries.

The double-concrete shell covers the nuclear system, the fuel building and two of the four safeguard buildings.



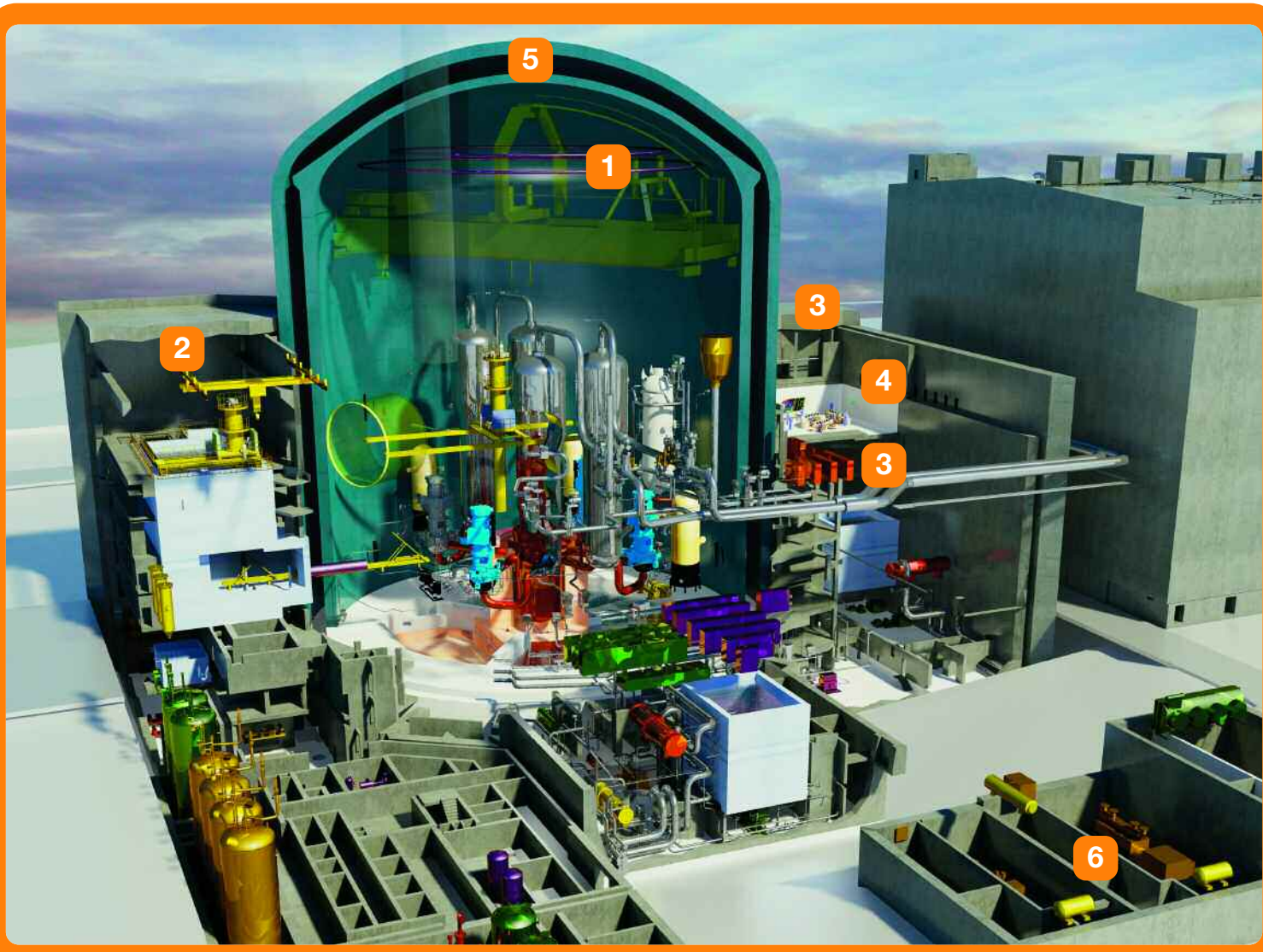
The core melt retention system provides corium confinement inside the reactor building.



The double concrete shell is designed to withstand the impact of a large airplane crash.

One train of each safeguard system in each of the four safeguard building, the core catcher and the in-containment refueling water storage tank.

The totally computerized control room is provided with the most up-to-date digital technology, adding to reliability of operator actions.



Protection against external hazards

• **Airplane crash**

The EPR™ reactor provides particularly effective physical protection against extreme external hazards. The reactor building **(1)**, spent fuel building **(2)** two of the four safeguard buildings **(3)** with the control room **(4)** are protected by an outer shell **(5)** made of reinforced concrete, thick enough to withstand the high-speed impact of a commercial or military aircraft. The other two safeguard buildings are located at opposite sides of the reactor building so that only one would be affected by an aircraft crash without any safety consequences. Similarly, the diesel generators for emergency electricity supply are located in two different buildings **(6)**, also protected by geographical separation.

• **Earthquakes**

To withstand severe earthquakes, the entire nuclear island stands on a single 6-meter thick reinforced concrete basemat. The height of the buildings has been minimized. The heaviest components, in particular the water tanks, are located at the lowest possible level.

Competitive

Best in class lifecycle costs

Economic

Economic competitiveness is achieved through an early focus during the EPR™ design stage:

- High power **(1,600+ MWe)** providing an attractive cost of the installed kWe.
- Up to 37% electrical efficiency depending on site conditions; the highest ever for light water reactors.
- Enhanced fuel utilization due to the neutron reflector, a large core and Areva's high-burnup fuel.
- High availability factor during the plant 60-year service life due to:

> flexible fuel management allowing long irradiation cycles (up to 24 months),

> shorter refueling outage time in particular due to:

- possible access to the reactor building during power operation for preparatory outage work,
- in-service maintenance thanks to the 4-train concept of the safeguard systems,
- faster cool down, depressurization and vessel head opening phases.

Thus the EPR™ design offers significantly reduced power generation costs, about 20% lower than those of large combined-cycle gas plants.

Flexible

The EPR™ design offers great flexibility:

- Operating flexibility to accommodate different types of fuel (UO_2, UO_2-Gd_2O_3, MOX), different fuel management strategies and irradiation cycle lengths, coast-down and stretch-out operation.
- EPR™ reactor can be operated at any power between 25% and 100% of nominal power in a fully automatic way. Usual load follow possible at 5%/min between 60% and 100% nominal power during 80% of irradiation cycle.

Environmentally friendly

The EPR™ reactor offers significant improvements in terms of sustainable development:

With manufacturing facilities in 43 countries and a sales network in more than 100, AREVA offers customers reliable technological solutions for CO_2-free power generation and electricity transmission and distribution. We are the world leader in nuclear power and the only company to cover all industrial activities in this field.

Our 75,000 employees are committed to continuous improvement on a daily basis, making sustainable development the focal point of the group's industrial strategy.

AREVA's businesses help meet the 21st century's greatest challenges: making energy available to all, protecting the planet, and acting responsibly towards future generations.

www.areva.com

AREVA SA - Headquarters
33, rue La Fayette
75009 Paris, France
www.areva-np.com

Energy is our future, don't waste it!