ROSATOM

STATE ATOMIC ENERGY CORPORATION "ROSATOM"

POSSIBILITIES FOR REGULATORY CO-OPERATION IN LICENSING NEW VVER TYPE PLANTS

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- Regulatory co-operation for the safety design reviews of similar nuclear power plants being licensed in several countries has been organized under the umbrella of Multinational Design Evaluation Programme (MDEP).
- This co-operation was started with a pilot project in 2006 and converted into long-term programme in 2009 by ten nations that are currently operating nuclear power plants and have plans for new construction.
- The objective of MDEP is to identify opportunities to harmonize and converge on licensing review practices, requirements, and acceptance criteria.
- The OECD Nuclear Energy Agency provides the technical secretariat support for MDEP.

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- Until now specific features of three reactor types have been reviewed in the MDEP programme:
  - EPR designed by Areva
  - AP-1000 designed by Westinghouse
  - APR-1400 designed by Korean group KEPCO/KHNP/Kopec
- The participating members in each plant specific working group are countries that have the respective plant type under construction or under licensing review.
  - The joint review does not concerns the entire plant but is focused on certain topics of common interest to all members
  - It is expected further that persons attending the meetings are experts who have conducted by themselves safety review of the topics that are discussed in the group

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- In September 2013 the Policy Group of MDEP decided to start two new groups:
  - ABWR designed by General Electric
  - VVER-TOI designed by Gidropress and Moscow AEP
- The countries that are founding members of the VVER-TOI group are Russia, India, Finland and Turkey
- Three first of these countries are permanent members of MDEP and Turkey has been invited as an associated member.
- The work is scheduled to start in a meeting in January 2014

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- In the cooperation there is no possibility to review all safety features of the plant in question.
- In the VVER group there is an additional difficulty in finding topics of common interest to all parties: each of the three countries importing a VVER plant from Russia is getting a different version.
  - India has built VVER-92 plants of 1000 MW power and it is now negotiating on two additional units
  - Finland is planning to license an AES-2006 plant (1200 MW) based on design of St Petersburg AEP
  - Turkey is going to build four 1200 MW plants that are very close to VVER-TOI type.

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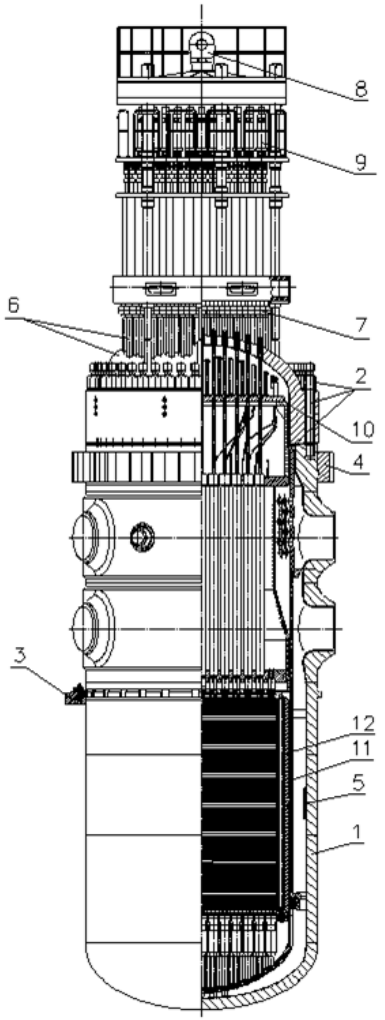
- For the co-operation work it is necessary to select design issues that are similar at all VVER types in question.
- Taking into account that the lay-out of each plant is different and also the reactor containments and the passive safety systems at the three plants are different, choice of common topics is quite limited.
- Six potential candidates for review topics that are common to all VVER plants are presented in the following slides

Measures to limit embrittlement of the reactor vessel wall and to ensure adequate ductility of the steel for 60 years of operation.

Embrittlement was a concern in the old VVER-440 reactor vessel. Now several improvements have been made

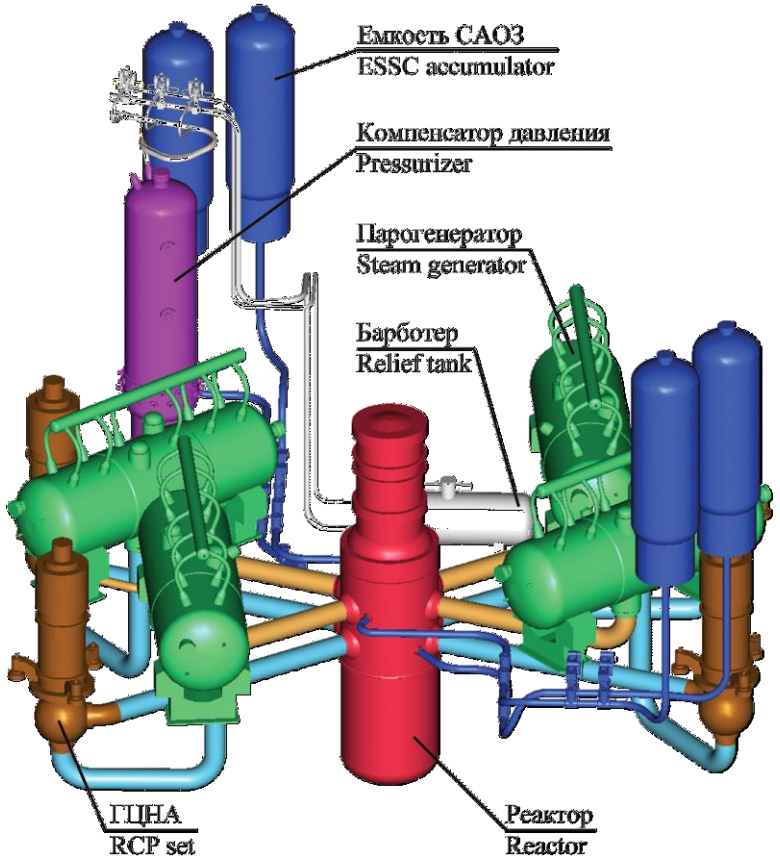
- less impurities in base metal and welds, less nickel in welds, increased vessel diameter in order to reduce neutron irradiation of the vessel;
- according to extensive research the material maintains its ductility even in lowest possible temperatures after 60 years of operation at full power;
- small material embrittlement by neutron irradiation can be confirmed by investigating material samples placed in optimum way on vessel wall.



Demonstration of break preclusion concept (including leak-before-break principle), aiming to ensure high reliability of the reactor coolant system pipelines

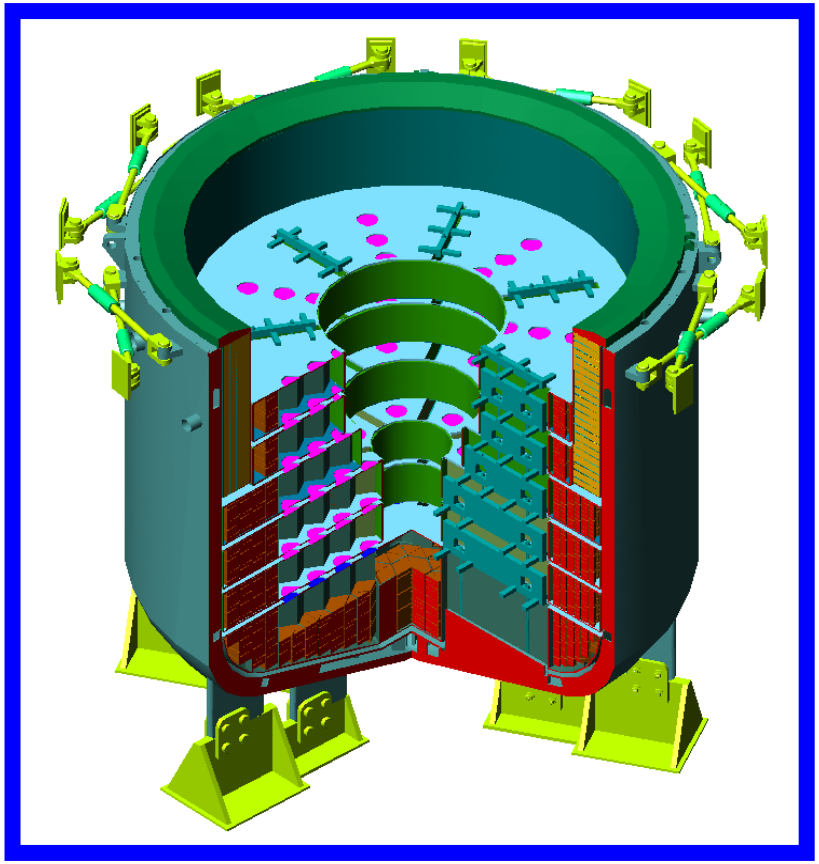
Break Preclusion (BP) principle used to eliminate the possibility of sudden large breaks of the reactor coolant circuit must involve:

- qualified construction (materials, fabrication, QA), operation (loadings, chemistry), and surveillance to prevent major cracking throughout plant life
- strength analysis to demonstrate adequate safety margins in all design-basis load conditions
- effective in-service inspections of welds and other stressed areas
- effective leak detection and verification of the leak-before-break principle

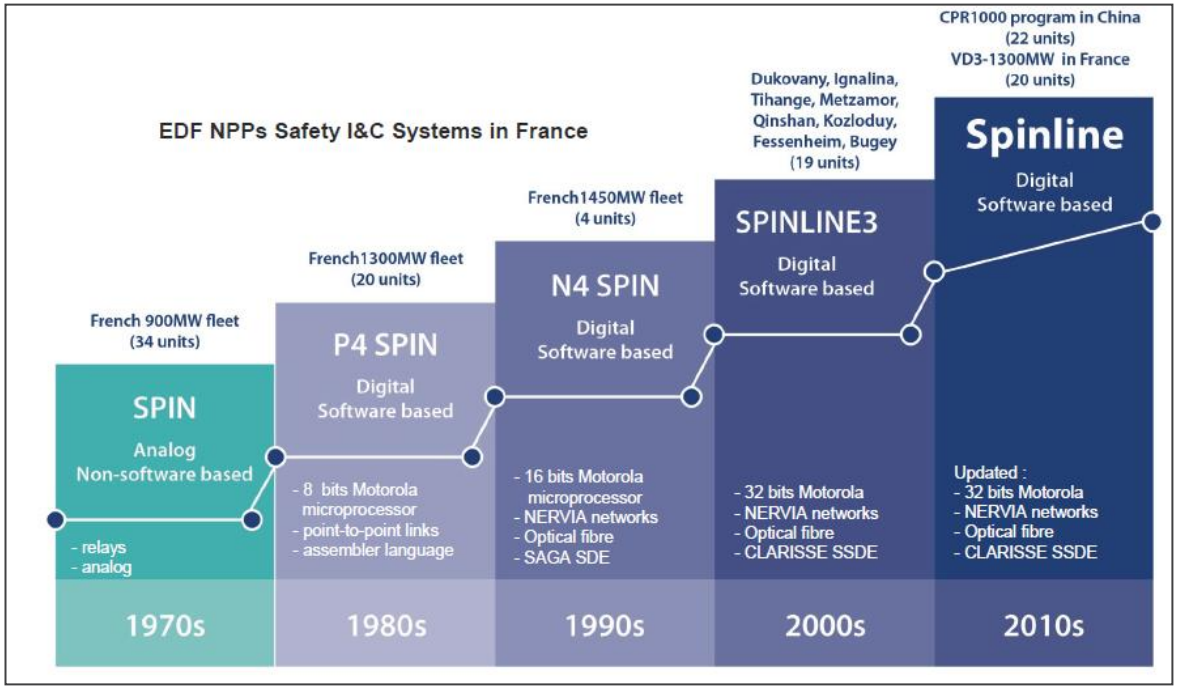


Tests and analyses conducted to demonstrate the adequate performance of systems designed to protect reactor containment after reactor core meltdown accident:

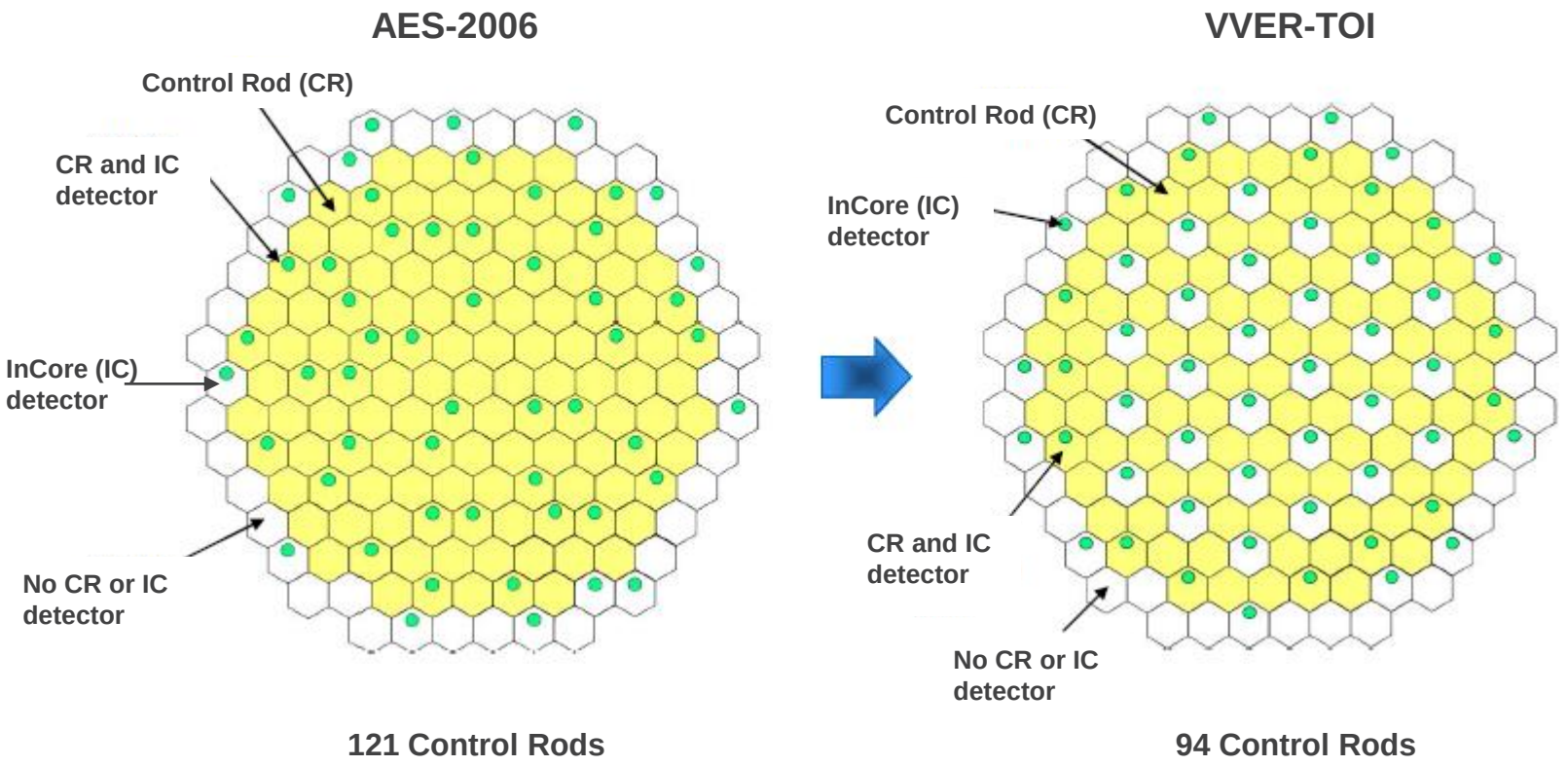
- core catcher,
- catalytic hydrogen recombiners,
- system for primary pressure relief



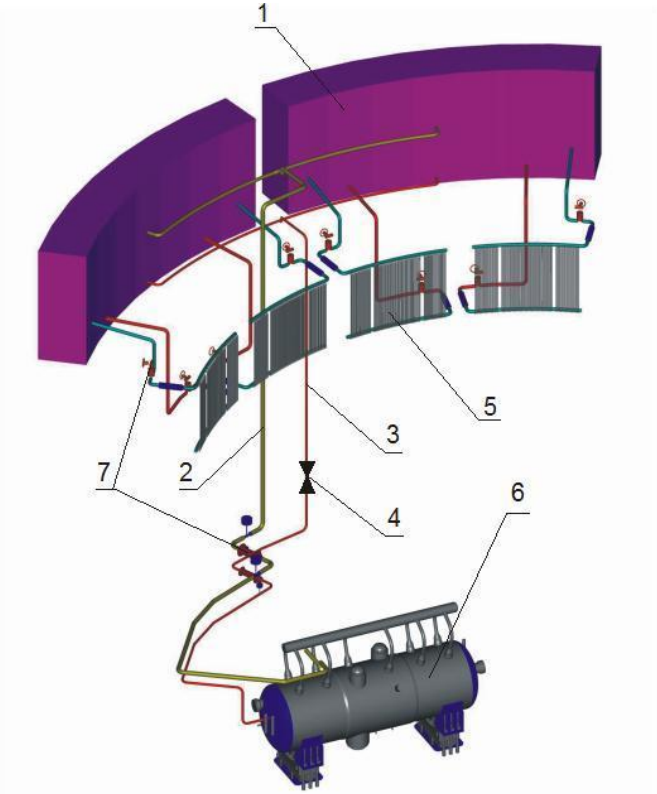
Assessment of the compliance of I&C systems with the safety principles given in the IAEA Safety Standards and the WENRA safety objectives for new NPPs



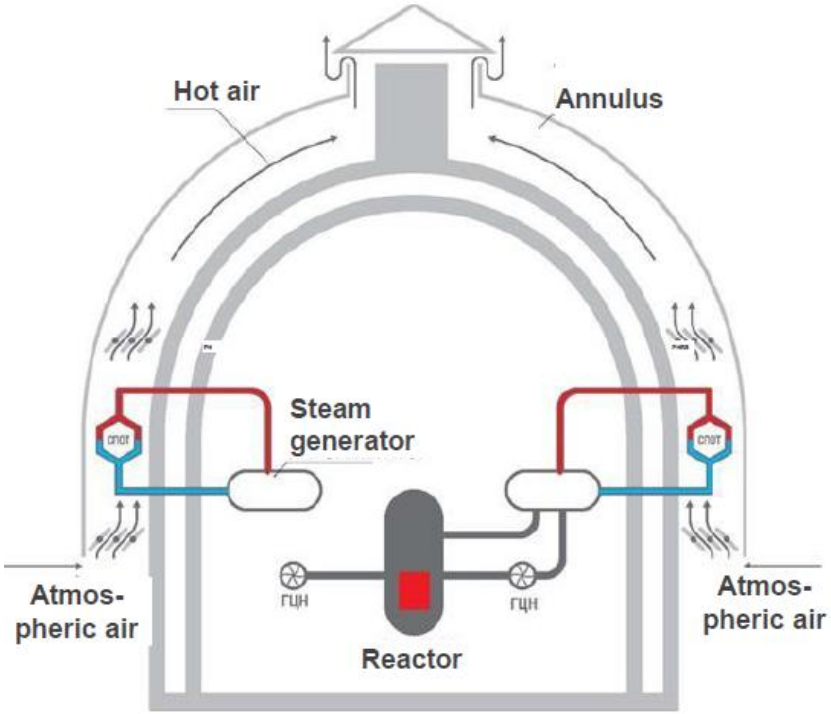
Assessment of safety characteristics and transient behavior of two most recent VVER-reactor cores:



Assessment of adequacy of testing and analysis of the two different passive systems that transfer heat from steam generators to atmosphere



SPbAEP version of AES-2006



Moscow AEP version of AES-2006

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- Participation to the plant specific Working Group would evidently be useful for all countries that have interest to build new VVER plants.
  - Among the old VVER countries these are Ukraine, Czech Republic, Slovakia, Hungary, Bulgaria, and Armenia.
  - Potential new VVER countries with earlier experience of nuclear power are South Africa, Argentina, Brazil, and the UK.
  - The potential new VVER countries that have no experience from nuclear power plants are Belarus, Vietnam, Jordan, and Bangladesh.