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EUROPEAN PRESSURIZED REACTOR (EPR)

Directorate General for Nuclear Safety and Radiation Protection (DGSNR) Point of View

J-P Clausner, Senior Executive
International Relations, DGSNR
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DGSNR's point of view on the EPR project

- **Historical milestones**
  - ✓ The set-up of French-German organisations
  - ✓ Development of the EPR project
  - ✓ The successive steps in the safety analysis
- **The EPR safety approach**
  - ✓ EPR safety objectives
  - ✓ Key subjects examined by the Safety Authorities
  - ✓ Contents of the Basic Design Report and of the EPR Technical codes
  - ✓ Contents of the "Technical guidelines"
- **State of instruction - Prospective aspects**

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Historical milestones (1) The set-up of French-German joint organisations

- **Safety organisations:**

1989 :

- ✓ Common declaration by BMU and the French Ministry of Industry.
- ✓ Agreement between GRS and IPSN.

1990 :

- ✓ Creation of the DFD (Deutsch-Französischer Direktionsausschuss)

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Historical milestones (2) The set-up of French-German joint organisations

- **Nuclear industry and customers:**

1989:

- ✓ Creation of NPI by Framatome and Siemens/KWU.
- ✓ Three different R&D programs for future PWRs developed separately :
  - NPI common product
  - EDF-Framatome REP 2000 N4+program
  - Siemens-German utilities "Planungsauftrag"

1992:

- ✓ NPI, EDF and German utilities R&D programs merged into the EPR program. Creation of the EPR Project Directorate
- ✓ First mission : developing the nuclear island of EPR.
- ✓ *Aim : ensure that the same PWR design be licensable in both countries*

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Historical milestones (3) Development of the EPR project

- **1992-1995: Conceptual Phase**
  - ✓ nuclear island only
  - ✓ *EPR "Conceptual Safety Features Review File" (Sept 1993).*
- **1995-1997: Basic Design Phase**
  - ✓ nuclear island only
  - ✓ *"Basic Design Report"* - submitted in 1997.
- **1997-1999: Basic Design Optimisation Phase**
  - ✓ examination of the possibility of increasing plant power, reduction of investment and generation cost, complying with the safety requirements.
  - ✓ Updated *"Basic Design Report"* (February 1999).

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The successive steps in the safety analysis (1) : the safety goals

- **1991: DSIN letter to EDF on the safety of future PWRs**
- **1993: DFD "joint declaration by the French and German safety authorities on a Common Safety Approach for Future PWRs"**
- **Iterative procedure between the industrial design development and the safety approach :**
  - ✓ potential inconsistencies identified early
  - ✓ extend of necessary refinement within the safety approach easier to estimate

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The successive steps in the safety analysis (2) : the joint examination process

Up to 1999:

- Examination by the technical supports IPSN - GRS

  => common reports
- Examination by the expert groups GPR - RSK

  => common positions transmitted to DFD
- Adoption of these positions by DFD (co-signed letters)

Since 1999 :

- Examination by the technical supports IPSN - GRS

  => common reports
- Examination by the expert group GPR, including invited German experts

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The successive steps in the safety analysis (3) : synopsis

- Sept 1993: Conceptual Safety Features Review File (CSFRF)
- From 1995 on:
  - ✓ Basic design studies
  - ✓ "EPR Technical codes"
- Oct. 1997: Submission of the Basic Design Report
- 1997-1999: BDR optimisation phase
- 1999: Submission of the Optimised Basic Design Report
- June 1993: Joint declaration on a common safety approach for future PWRs
- 1993-95: Investigation of 5 key subjects from the CSFRF
- Feb 1995: DFD joint recommendations on the CSFRF key subjects
- 1995-2000: Joint examination of the basic design studies
- Oct 2000: adoption by GPR of the "EPR Technical guidelines"

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The EPR safety approach : Strategy - Safety objectives

- Safety approach applicable to PWRs to be built at the beginning of the 21st century => evolutionary approach (>1000 r.y of operating experience in both countries)

- These reactors may still be in operation in 2070-2080 => ambitious safety objectives

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EPR safety objectives : an evolutionary strategy

- **An "evolutionary" strategy, grounded on:**
  - ✓ Existing reactor operating know-how, feedback and results of in-depth safety studies *(eg., PSAs)*
  - ✓ A reinforcement of the defence-in-depth.

    (eg., significant improvement of the containment function)
  - ✓ A deterministic design basis, supplemented by the use of probabilistic methods

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EPR safety objectives : severe accidents management (1)

Objectives for severe accidents:

- **Prevention of accidents:**
  - ✓ *Significant reduction of the probability of core meltdown.*
- **Mitigation of the consequences of accidents:**
  - ✓ *"Practical elimination" of accidents likely to lead to large early releases of radioactivity.*
  - ✓ *The maximum potential releases for a core meltdown accident should only require very limited protective measures in space and time.*
  - ✓ *No protective measures should be needed for accidents without core meltdown.*

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EPR safety objectives : severe accidents management (2)

- **Practical elimination of:**
  - ✓ high pressure core melt
  - ✓ early bypass of the containment
  - ✓ vapour explosion
  - ✓ global hydrogen detonation
- **Mitigation of:**
  - ✓ low pressure core melt
  - ✓ hydrogen deflagration

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EPR safety objectives : normal operation and maintenance

- **Objectives for normal operation and maintenance:**
  - ✓ simplification of operation,maintenance, inspection.
  - ✓ reduction of incidents, occupational exposure, effluents etc.

  ...to be duly studied at the design stage.

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The 5 key subjects from the CSFRF investigated by the safety Authorities

- Severe accidents: radiological consequences; approach and main orientations for the preventive and mitigating features.
- Probabilistic goals; system design
- Implementation of the break preclusion concept on the main primary coolant lines
- External hazards (earthquake, explosion, aircraft crash)
- Radiological consequences of incidents and accidents, excluding severe accidents; design basis accidents

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Scope of the EPR Basic Design Report

- Site dependant aspects and conventional part of the plant not addressed.
- Equivalent to the standard part of the French "Preliminary Safety Analysis Report" used for "Authorisation of creation."
- Relevant to establish the German "Safety Report."

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EPR design options

- 1500 MWe PWR
- Safety redundancy: 4
- Corium spreading and cooling system
- Protection against military aircraft crash
- Double wall containment with partial liner
  - ✓ designed for LOCA and hydrogen explosion
  - ✓ no direct leak
- Water pool inside containment

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Scope of the EPR Technical Codes (ETC) (1)

- **Elaboration of a set of industrial rules common to the French and German nuclear industry.**
- **Contribution to the safety demonstration in the licensing process.**
  - ✓ Supports the elaboration of the results of the Basic Design.
- **Approach following the French practice (RCC)**
  - ✓ ETC will not be binding

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Scope of the EPR Technical Codes (ETC) (2)

- **6 documents scheduled to cover:**
  - ✓ Safety and process
  - ✓ Mechanical components
  - ✓ Electrical equipment
  - ✓ Instrumentation and control
  - ✓ Civil works
  - ✓ Fire protection
  - ✓ + Common requirements for handling devices/ventilating

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Contents of the "Technical Guidelines"

- **The recommendations continuously developed by GPR and RSK have been structured into a complete set of technical guidelines, adopted by GPR and German experts**
- **Contents:**
  - ✓ Principle of the safety concept
  - ✓ Conceptual safety features
  - ✓ Accident prevention and plant safety characteristics
  - ✓ Control of reference transients, incidents and accidents
  - ✓ Control of multiple failure conditions and core melt accidents
  - ✓ Protection against hazards
  - ✓ System design requirements and effectiveness of the safety functions

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State of the project Prospective aspects

- **DGSNR is able to take position on EPR safety options**
- **EDF's goal: issuing a "Preliminary Safety Report" by end 2002.**
- **Further investigations will be necessary at the detailed design stage**

- **Considerable progress in the harmonisation of requirements between France and Germany**
  - ✓ well balanced approach rather than adding up all sets of requirements
- **Further development is needed along the path to achieve a European approach on future PWRs...**