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Nuclear Renaissance: New Challenges for Criticality Safety Concerns

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Foreword

Session II: "Current Status and Expectations on Progress of Fuel Cycles issues"

Keywords developed:

- Industry perspectives on the current fuel cycle
- Transportation
- Staff skills and Training

- **New fuel manufacturing needs**
- **Worldwide certificates for fuel shipping casks transport**
- **Higher number of criticality specialists needs**

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Summary

- **Nuclear Renaissance / New NPP construction leads to a higher criticality workload:**
  - **New fuel manufacturing needs:**
    - Growing fuel assemblies demand
    - Improvement of production capabilities/efficiency
    - New fuel development
  - **Worldwide certificates for fuel shipping casks transport**
    - Worldwide AREVA NP fuel assembly manufacturing
    - Widening of countries using nuclear energy
  - **Higher number of criticality specialists needs**
    - AREVA criticality network
    - Training/mentoring of individuals

New Fuel Manufacturing needs

- **Growing fuel assemblies demand**
  - **Increase capacity: for instance licensing up to 1800 t / year (French Fuel Manufacturing Plant)**
  - **Finland: An EPR™ first core: 241 fuel assemblies**
    - Tomorrow: Flamanville 3 – Taishan 1 & 2 (27 scheduled reloads)
- **Improvement of production capabilities/efficiency**
  - **"Tools Renewal Project" (French Fuel Manufacturing Plant)**
    - 2004-2009 (15,000 men hours for safety criticality analysis)
    - 100 M€ investments for workshops optimization
    - "One through cycle" (ex: minimum fissile material time storage)
    - Improved worker protection (ex: new pellet grinding process)
- **New fuel development**
  - **AGORA® - GAIA / ATRIUM™ - DELTA projects: "Fuel for the future"**
    - No impact for criticality concerns

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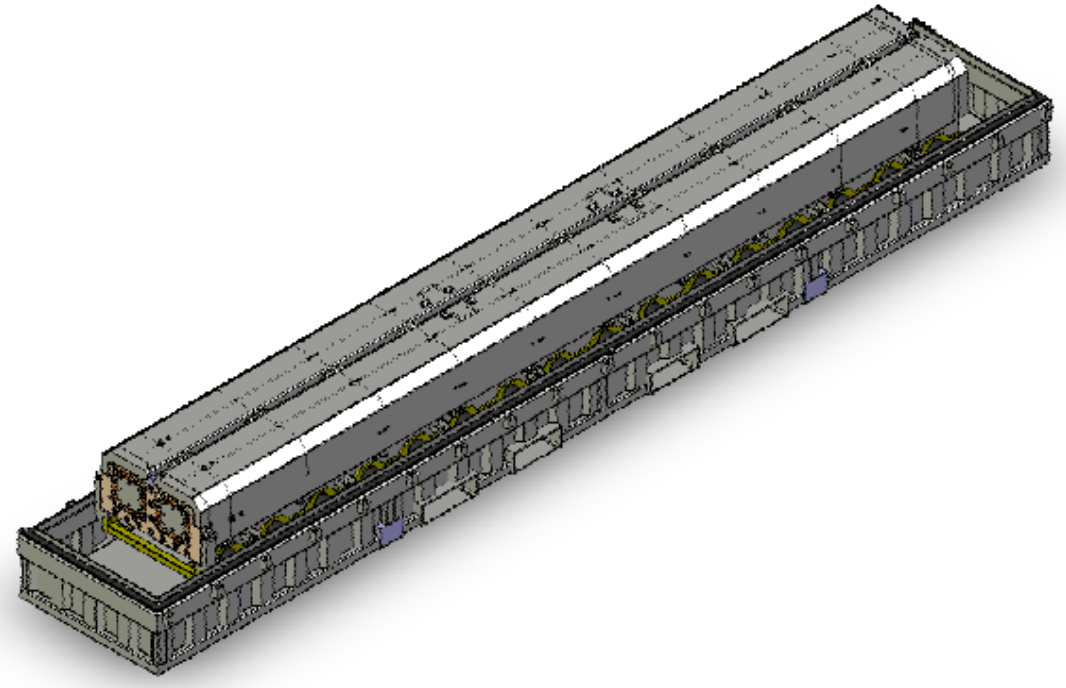
Worldwide certificates for fuel shipping casks transport

- **To get a new global container design and fleet for EPR™ deliveries usable in any country**
  - **Use in European and US fuel manufacturing plants**
  - **Use for any customers' NPP: focus on EPR™ plants**
    - Europe
    - US
    - China (TA)
- **First use:**
  - **Taishan 1st core delivery: containers ready for October 2012**
  - **A "one shot" trip to China: 125 shipping casks needed**
  - **Option (under study): Air transport for a small number of containers (<4)**
- **AREVA NP / AREVA NC (TNI) Project EPR™ container**
  - **design, development, licensing and manufacturing of a new container**

EPR™ Fuel shipping Cask - Global view

- **Main sub-assemblies**
  - Outer shell
  - Shock absorbers
  - Damping system
  - Cradle
  - T-frame + doors
- **3 materials**
  - Stainless steel
  - Balsa wood / Carbon foam
  - BORA Resin



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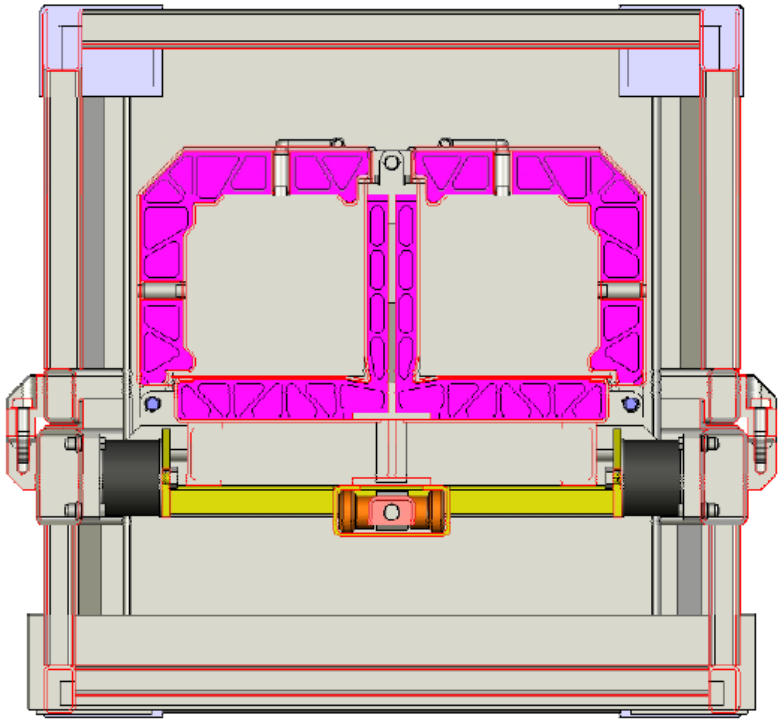
Radial view with Neutronic cavity

- Two fuel assemblies / cask
- 5% ^{235}U enrichment
- Criticality analysis
  - Differential/preferential flooding
  - Bird caging effect
  - Fuel rod sliding
  - USLSTAT uncertainties
- Allow infinite N shipping casks with comfortable safety margin
- Margins for e > 5% ^{235}U



Higher number of criticality specialists is needed

- **How to increase criticality specialists and skills ?**
  - **Formal training**
    - "Criticality Courses" like University of New Mexico training
    - "Ingénieur Criticien de Centre" like French CEA/IRSN training
    - …
  - **Criticality code training**
    - SCALE
    - MCNP
    - CRISTAL
    - …

Those courses are a first step to become a "good criticality specialist" … there is still a long way to go …

- **Since more than 10 years AREVA has mixed the above solutions adding:**
  - AREVA Criticality and Safety Network
  - AREVA NP Fuel Sector Criticality Technology Group
  - **Mentoring - Training of young individuals coupled with industrial applications**

AREVA Criticality and Safety Network

- **Objectives**
  - Mixing engineering and on-site specialists
  - Minimizing costs by sharing local feedback within the AREVA Group
  - Trying to harmonize AREVA Group practices

- **Expected benefits**
  - Solve any local or generic issue by informal or formal exchanges between France, Germany and US fuel fabrication plants and engineering offices

- **Meetings**
  - 2002 – 2004: launch meetings
  - 2008: Tokay Mura feedback on Safety Authority requirements within the French AREVA network

AREVA NP Fuel Sector Criticality Technology Group

- **Launched in 2009 within the Worldwide Neutronics Service with the following goals/targets:**
  - **Identify cross site support capabilities**
  - **Propose a worldwide competence development**
  - **Consider interaction outside the Neutronics Service when appropriate**
- **Today ongoing task**
  - **Validation of burnup credit for AREVA NP Inc sites on SFP**
    - FP validation

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Mentoring - Training of young individuals

- **Training/Mentoring is a major goal for skill transfer between specialists and young individuals**
- **Moral contract between the mentor, the learner, the hierarchy and the HR**
- **The following steps are scheduled:**
  - **Motivation of the learner … and the mentor too**
  - **Computer codes training**
    - In house
    - Outside (MCNP – CRISTAL – SCALE)
  - **Integration to the day/day industrial application**

Mentoring - Training of young individuals

- **Integration to the day/day industrial application**
  - **Weekly meeting**
  - **Description of a situation/configuration and possible issues**
  - **Learner memo**
  - **Memo meeting review**
  - **Application**
- **Milestone meetings**
  - **Every 3 months**
  - **Highlight of the blackheads**
- **Documentation**
  - **Criticality team peer review**
  - **Informatics' database storage with easy retrieval for future training**

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