The European Utility Requirements for Advanced LWR - Recent Activities and New Challenges

Guillaume JACQUART - EUR Chairman

2017, June 6th

IAEA International Conference on Topical Issues in Nuclear Installation Safety
OUTLINE

- EUR organisation
- EUR objectives
- EUR products:
  - EUR Document
  - EUR Assessments
- EUR recent achievements
- EUR 2016-2018 Roadmap and challenges
THE EUR ORGANISATION

- 14 European Utilities
- Founded in 1991
- Technical specifications for GEN III LWR Nuclear Power Plant

- Public Website: www.europeanutilityrequirements.org
The EUR Fundamentals

- Nuclear energy combined with renewable energy sources is the optimal choice to ensure that sustainable development goals are met (i.e. to reduce greenhouse gas emissions, to provide affordable prices for electricity and to ensure security of supply)

- This has to be supported by an unambiguous demonstration to the citizens of Europe that the nuclear industry is safe, competitive and presents no harm to environment and neighbouring population under any foreseeable circumstance.

- EUR specifications are developed to assure those expectations are met for new LWR to be built in Europe
The EUR Objectives

Harmonised Specifications for new LWR in Europe allowing Standard Designs to be proposed over a wide area

- **Benefits to the safety**
  - High safety objectives: shared by utilities in line with European citizens expectations

- **Reduces licensing risks**
  - Safety harmonization: within Europe (vs WENRA) and beyond (vs IAEA SSR 2/1)
  - Seek for an improved acceptance of European Regulators

- **Increases plant competitiveness**
  - Standard EU Designs: cost development can be spread over a larger number of plants
  - Promoting cost-effective design features (constructability, operation performance, ...)
  - Establishing conditions for a fair competition between the vendors
The EUR document

- **A generic GEN 3 LWR specification written by investors & operators**
  - Wide experience basis (14 operators in Europe & 7 different vendors)
  - Not a regulatory document

- **Open**
  - Design objectives and functional requirements
  - Fits all the designs of interest to the European utilities
  - Modular structure, versatile, easy to adapt

- **Neutral**
  - Does not favor any specific design
  - Seldom forbids, only if there is a bad operation experience or an unacceptable industrial risk

- **Benchmarked**
  - Other industrial specifications (EPRI-URD), regulatory documents, international design guides
  - Real Gen 3 designs assessed
The EUR document

Volume 1: Main Objectives & Policies
Volume 2: Generic & Nuclear Island Requirements
Volume 3: Applications of EUR to specific Gen3 LWRs designs
Volume 4: Specific Power Generation Plant Requirements

Revision A: Mar. 1994
Revision B: Nov. 1995
Revision C: Apr. 2001

BWR 90: 06/1999
EPR rev A: 12/1999
EP1000: 12/1999
ABWR: 12/2001
SWR 1000: 02/2002
AP1000: 06/2006
AES92: 06/2006
EPR rev B: 06/2009
EU-APWR: 12/2014

Revision A: Nov. 1996
Revision B: Mar. 2000
Revision C: Oct. 2007
## EUR Document: Structure of Volumes 1, 2 & 4

### Volume 2: Generic and NI requirements

<table>
<thead>
<tr>
<th>Chap.</th>
<th>item</th>
<th>#page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Safety</td>
<td>180</td>
</tr>
<tr>
<td>2.2</td>
<td>Performance</td>
<td>36</td>
</tr>
<tr>
<td>2.3</td>
<td>Grid</td>
<td>30</td>
</tr>
<tr>
<td>2.4</td>
<td>Design Basis</td>
<td>140</td>
</tr>
<tr>
<td>2.5</td>
<td>Codes &amp; Standards</td>
<td>16</td>
</tr>
<tr>
<td>2.6</td>
<td>Materials</td>
<td>43</td>
</tr>
<tr>
<td>2.7</td>
<td>Components</td>
<td>120</td>
</tr>
<tr>
<td>2.8</td>
<td>Systems &amp; Processes</td>
<td>180</td>
</tr>
<tr>
<td>2.9</td>
<td>Containment</td>
<td>122</td>
</tr>
<tr>
<td>2.10</td>
<td>I&amp;C &amp; HMI</td>
<td>112</td>
</tr>
<tr>
<td>2.11</td>
<td>Layout</td>
<td>132</td>
</tr>
<tr>
<td>2.12</td>
<td>Design Processes &amp; Documentation</td>
<td>46</td>
</tr>
<tr>
<td>2.13</td>
<td>Constructability &amp; Commissioning</td>
<td>41</td>
</tr>
<tr>
<td>2.14</td>
<td>Operation, Maintenance &amp; Procedures</td>
<td>59</td>
</tr>
<tr>
<td>2.15</td>
<td>Quality Assurance</td>
<td>14</td>
</tr>
<tr>
<td>2.16</td>
<td>Decommissioning</td>
<td>16</td>
</tr>
<tr>
<td>2.17</td>
<td>PSA</td>
<td>58</td>
</tr>
<tr>
<td>2.18</td>
<td>Performance Assessment</td>
<td>35</td>
</tr>
<tr>
<td>2.19</td>
<td>Cost Assessment</td>
<td>15</td>
</tr>
<tr>
<td>2.20</td>
<td>Environmental Impact</td>
<td>23</td>
</tr>
</tbody>
</table>

**About 4500 requirements**

### Volume 1: Main Policies and Objectives

<table>
<thead>
<tr>
<th>Chap.</th>
<th>item</th>
<th>#page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Introduction</td>
<td>21</td>
</tr>
<tr>
<td>1.2</td>
<td>Policies</td>
<td>13</td>
</tr>
<tr>
<td>1.3</td>
<td>Synopsis</td>
<td>08</td>
</tr>
<tr>
<td>1.4</td>
<td>EUR 53 key issues</td>
<td>35</td>
</tr>
<tr>
<td>App A</td>
<td>Acronyms</td>
<td>15</td>
</tr>
<tr>
<td>App B</td>
<td>Definitions</td>
<td>34</td>
</tr>
</tbody>
</table>

**About 1000 requirements**

### Volume 4: Specific PGP requirements

<table>
<thead>
<tr>
<th>Chap.</th>
<th>item</th>
<th>#page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Introduction to the Volume 4</td>
<td>13</td>
</tr>
<tr>
<td>4.2</td>
<td>Main turbine generator systems</td>
<td>96</td>
</tr>
<tr>
<td>4.3</td>
<td>Steam, condensate and feed-water system</td>
<td>63</td>
</tr>
<tr>
<td>4.4</td>
<td>Electric Power systems</td>
<td>43</td>
</tr>
<tr>
<td>4.5</td>
<td>Circulating water systems</td>
<td>29</td>
</tr>
<tr>
<td>4.6</td>
<td>Auxiliary systems</td>
<td>53</td>
</tr>
</tbody>
</table>

**Chapters with major updates for Revision E**

EUR assessments: Volume 3 of EUR document (1/2)

- **Assessment work: a volume 3 per standard design**
  -Analyses of compliance of the selected LWR new design projects against the EUR generic requirements

- **Analyses are done at detail level:**
  -Each of the 4500 requirements (shall, should) of the EUR volume 2 analysed by EUR utilities' engineers from information supplied by the vendors.
  -Standard scale of compliance for all the projects, rationales & references
  -Cross-checking between the different assessments
  -Several man. years for each design assessment

- **Detailed analyses are not published:**
  -Only the main deviations are highlighted in the published part as well as the main "compliance with objectives"
EUR assessments : volume 3 of EUR document (2/2)

- 5 designs assessed before 2001 against rev B
- 3 designs assessed against rev C (AP 1000, VVER AES 92, EPR rev B)
- 1 design assessed against rev D (EU APWR) – October 2014

**AP 1000**
- 1000 MWe
- 2-SG PWR with passive safety features
- Westinghouse & Ansaldo
- May 2007

**VVER AES 92**
- 1000 MWe
- 4-SG PWR with passive safety features
- AEP Moscow, GP, KI
- Dec 2007

**EPR rev B**
- 1600 MWe
- 4-SG evolutionary PWR
- Areva
- July 2009

**EU-APWR**
- 1700 MWe
- 4-SG evolutionary PWR
- MHI
- Oct 2014
Current Activities (1/2) : EUR Revision E Project

**OVERVIEW**
- 16 EUR utilities & 98 European experts involved
- 33 months of work (April 2014 - December 2016)
- 29 chapters & 1500 pages updated : ~ 5000 requirements

**MAIN DEVELOPMENTS IN REVISION E**
- **New structure of the EUR document** more suited to « licensing » & « bidding » processes
- **New EUR Policies** : Safety ; Economics ; Environmental protection ; Operational performance ; Human factors
- **Safety** : new chapter ; improved coherence with up-to-date international documents such as EURATOM Directives, WENRA Standards, IAEA guides, ..
- **Safety classification** : new approach in line with IAEA SSG-30
- **External hazards** : New approach for external hazards based on two levels of magnitude (WENRA)
- **I&C** : new chapter fully in line with IEC standards (61513, 60880, 62138, 61226)
- **PSA** : update of EUR chapter in line with IAEA SSG-3 and SSG-4
- **Grid Connection** : EUR text in line with the new ENTSO-E Grid Code (June 2015)
- **Pipe Break** : updates of EUR requirements dealing with Break Preclusion and LBB
- **Layout** : update of EUR requirements based on up-to-date international standards
Current Activities (2/2) : Design Assessments

New Design Assessments projects

- Two new design assessments are under progress
IEEE Organisation challenges for the next years
Roadmap 2016 – 2018

Main challenges for the period 2016-2018:

- Keep a strong interaction with other important stakeholders in Europe and worldwide (ENISS, CORDEL, IAEA, WENRA, OECD...)

- Promote the use of EUR Rev E widely (communication, training courses,...) (2017-2018)

- Complete the 2 current design assessments against Rev D

  (EU-APR: Nov. 2017 ; VVER TOI: mid 2018)

- Plan the next design assessments against Rev E

- Initiate position papers for the next Revision (including study of SMR inclusion)
Thank You for your attention!