EUR volume 3
main features of the the AP1000 subset

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EUR seminar
2007

Nice, May 15 2007
Key points of the presentation

- Presentation of AP1000 design

- Presentation of AP1000 assessment
  - EUR organisation and review process
  - Main results
  - Conclusion of the assessment

- Last steps up to distribution of EUR volume 3 AP1000 subset
  - Plant Description
  - Last reviews
  - Publishing
the AP1000 design which has been evaluated

As certified by US NRC [FDA, September 04 & DC December 05]
Power upgrade of the certified AP600

**Containment**

**Fuel Assemblies & Components**

<table>
<thead>
<tr>
<th></th>
<th>AP600</th>
<th>AP1000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Free Volume</strong></td>
<td>100%</td>
<td>122%</td>
</tr>
<tr>
<td><strong>Design Pressure, psig</strong></td>
<td>45</td>
<td>59</td>
</tr>
<tr>
<td><strong>Shell Thickness</strong></td>
<td>1 5/8&quot;</td>
<td>1 3/4&quot;</td>
</tr>
<tr>
<td><strong>Material</strong></td>
<td>A537 Class 2</td>
<td>SA738 Grade B</td>
</tr>
<tr>
<td><strong>PCS Water Drain Vol (72 hr)</strong></td>
<td>100%</td>
<td>162%</td>
</tr>
</tbody>
</table>

Update of all safety studies and associated ESF (PRHR, CMTs, ADS_4, SI piping ....)
Same safety principles as AP600 (cont')

Passive safety systems triggered by valves
Same safety principles as AP600 (cont')

Passive containment cooling
Presentation of EUR volume 3: AP1000 assessment

- organisation & review process
- main results
- conclusion
EUR organisation and review process

Swissnuclear
Westinghouse & ANSALDO
EDF
TRACTEBEL
IBERDROLA

EUR

Compliance analysis
Technical consultation

Assessment Performer

EPP Review
Industrial Partners

Sponsor Team
Co-ordination Group

Chapter leader
Co-ordination Group

Chapter leader
Administration Group

Technical review

Reconsideration
Co-ordination Group

Delivery to AG

OC members remain

Delivery to SC

OC members remain

Updating & Synthesis

Recall to AG

Assessment Performer
EUR review meetings at 3 levels

- **EUR AP1000 Coordination Group** (7 review meetings of 2 days):
  - CG #1 (May 04) to CG #7 (October 05) meetings

- **EUR Administration Group** (7 review meetings, not fully dedicated to AP1000):
  - AG #116 (Feb. 05), #117, #119, #120, #123, #124 and #125 (March 06) meetings

- **EUR Steering Committee** (2 review meetings):
  - SC#64 (October 05) and #66 (March 06)
Presentation of EUR volume 3: AP1000 assessment

- organisation & review process
- main results
- conclusion
Main results of AP1000 assessment of compliance

- Safety
- Performances
- Layout
- Misc.
Technical insights: safety (1/2)

- A set of passive safety systems for safety demonstration. Only valves & I&C, no AC power required for 3 days.
- For accident management use of "Defence in Depth systems" (active, non safety), then the passive safety systems.
- There is a very good compliance level with the EUR requirements.
- The autonomy vs. operator action is 72 hours for Design Basis Conditions.
Technical insights: safety (2/2)

- **Aircraft crash** protection
  - The US design can meet the probabilistic requirements of EUR revision C but no provisions in the current design for thick protection walls as requested by EUR.
  - Resistance of the shield building demonstrated vs. different missiles (US tornado missiles, EPRI studies, EP1000 design, …)
  - At the end, the AP1000 design “as of US” requires specific improvement to fit with EU today’s context.
Technical insights: performances

- A significant **Non Compliance** for the maximum **cycle length** at 24 months (“small” core, 157 FAs designed for 18 months).

- **Contrasted** picture vs. the other EUR requirements
  - the EUR overall availability targets are met, despite calculation methodology differs,
  - Return to the grid in case of forced outage longer than requested by EUR without specific improvements (two phase cooling & others) to fit with high Heat Sink T°s,
  - 50% MOX core complies with the EUR objectives, but detailed design still to be done,
  - Spent fuel storage capacity lower than requested by EUR (MOX fuel storage)
  - Steam Generators operated at rather low temperature, 60 years life time expected, beyond the EUR requirement.
Technical insights: layout

- Same footprint than AP600 design; the layout is rather compact.
- AP1000, derived from AP600 with US staffing assumptions significantly different from EU practices.
- The EUR requirements has been revised in depth (rev C is very detailed and prescriptive).
- Several significant **Non Compliances** about means of egress, escape routes and fire barriers in Main Control Room.
- **Many uncertainties** vs. EUR requirements due to EUR very detailed requirements which shall be carefully checked in detailed design phase.
In the frame of such general presentation, and except the few points already mentioned, a rather good level of compliance is achieved for the following topics:

- Design Bases
- Materials
- Components
- Systems
- Containment
- I&C and HSI
- Design process
- Constructability
- Operability/Maintainability
- Q.A.
- Probabilistic Safety
- Design process
- Cost information

Some other remarks being made on the following Chapters:

- Grid
- Codes and standards
- Decommissioning
- Performance Assessment Methodology
- Seismic Analysis of some soils defined by EUR
Main results of AP1000 assessment in 2007

From the technical standpoint, the results of the assessment are rather similar to what was presented at the ENC05 seminar in December 05 … except for a few topics coming from the Cross-Checking meeting (March 06) which compared and harmonized, all PWRs subsets of Vol. 3 assessments.

→ a last set of updates
Technical insights : the last updates ...

- **Compliances With EUR Objectives:**
  - Thermal margin
  - Severe Accident safe state: Corium not fully solidified after one week
  - Principles of Two-Phase cooling
  - Post accident sampling

- **Non Compliances:**
  - Construction time:
    *despite around 40 months of on-site construction and testing till commissioning*
  - Provisions to be considered in outage schedule for **distorted assemblies**
  - **Average RCS coolant T°** not exactly constant

- **Open points :**
  - SG replacement time
Presentation of EUR volume 3: AP1000 assessment

- organisation & review process
- main results
- conclusions
Conclusions

- The level of detail of the assessment is quite high, due to the amount of available documents. This allows to conclude on compliance for a majority of topics, with a rather good level of confidence.

- The AP1000 investment cost could be attractive, due to simplification.

- The design provides a satisfactory level compliance vs. the EUR safety requirements (except for aircraft crash, if today’s context has to be taken into account).

- Some AP1000 performance and layout issues should be improved. This may have a significant impact on the design.
Last steps up to distribution of the EUR Volume 3 AP1000 subset

- Plant Description update
- last reviews & updating
- publishing
Plant Description

- The first version of the AP1000 Plant Description was issued by the Vendors at the end of the EUR evaluation process, because DCD and PRA were providing an adequate, and even very satisfactory, level of detail for the EUR assessments.

- A final consistency checking was done for Plant Description, quite late in the production process of EUR volume 3 (second half of 2006):

- It has had **time consuming consequences**:
  - the PD text had to be reorganised, to better highlight the differences between:
    - what was included in the Certified AP1000 design
    - what dealt with relevant design alternatives that may fit the EUR requests (justified by studies and agreed by the EUR organisation),
Plant Description (con’t)

- Other consequences of the final consistency checking of the plant description:
  - Some sections had to be erased, because they were misleading when read in conjunction with the conclusions of the EUR assessment.
  - Some useful information had to be added to better explain the possible compliance of AP1000 versus certain specific EUR objectives.
  - These topics had been agreed by EUR organisation:
    - when slight differences existed between the EUR requirements and the AP1000 design,
    - when specific or even dedicated studies existed
    - when the proposed solutions did not challenge AP1000 layout and principles
Last steps up to distribution of the EUR Volume 3 AP1000 subset

• Plant Description update
• last reviews & updating
• publishing
last EUR reviews of the AP1000 subset

- **EUR SC#64 in October 2005**
  presentation of results of compliance analysis results

- **in March 2006 Cross-review** of the results obtained for the three PWR designs assessed by the EUR Organisation as of today, EPR, AP1000 and AES-92, in order to ensure uniformity in the applied assessment criteria

- **Approval by EUR SC (66\textsuperscript{th} meeting) in March 2006**
EUR Volume 3 AP1000 subset
last steps performed up to distribution

- Updating works at EDF: April 06 & mid July to October 06
- Update of the Plant Description (mid July to October 06):
  - Vendor’s last version received early July 2006
  - first update sent to WEC for comments in September 2006
  - final update issued in October 2006
- Update of the Highlights of the analysis of compliance:
  - finalize the main text,
  - take into account the comments expressed by the EUR SC
  - add a first batch of finalized Synthesis Reports
  - recently completed
Last steps up to distribution of the EUR Volume 3 AP1000 subset

- Plant Description update
- last reviews & updating
- publishing
EUR Volume 3 AP1000 subset
last steps to distribution

- Finalisation works at EDF – November 2006 to March 2007,
  - Updating the remaining Synthesis Reports & Chapters to be included in the Highlights (November 06 – February 07)
  - English review and typing finalised:
    - Plant Description: December 06
    - Highlights: March 07

- Binders of Volume 3 AP1000 subset
  - Just printed, to be dispatched to the EUR partners and the designers

- CDROM of Volume 3 AP1000 subset
  - PDF files and CDROMs to be produced

- Distribution outside the EUR Organisation subjected to Confidentiality agreement with the designers
European Utility Requirements for future LWR plants

Get fresh news at: http://www.europeanutilityrequirements.org