Current status of NPP I&C
SPAIN

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24th Meeting of the IAEA Technical Working Group on Nuclear Power Plant Instrumentation and Control (TWG-NPPIC)
Vienna May, 2013
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• Nuclear Power in Spain
• I&C Modernization projects
• Fukushima response
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Nuclear Power in Spain

Demand contribution (2012)

- Fossil: 47%
- Renewable: 31%
- Nuclear: 22%

Installed power evolution
## Nuclear Power in Spain

<table>
<thead>
<tr>
<th>Plant</th>
<th>Start Operation</th>
<th>Unit Capacity (MW)</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Santa María de Garoña</td>
<td>1971</td>
<td>466</td>
<td>BWR (General Electric)</td>
</tr>
<tr>
<td>Almaraz I</td>
<td>1981</td>
<td>1.035,30</td>
<td>PWR (Westinghouse)</td>
</tr>
<tr>
<td>Almaraz II</td>
<td>1983</td>
<td>980</td>
<td>PWR (Westinghouse)</td>
</tr>
<tr>
<td>Ascó I</td>
<td>1984</td>
<td>1.032,50</td>
<td>PWR (Westinghouse)</td>
</tr>
<tr>
<td>Ascó II</td>
<td>1986</td>
<td>1.027,20</td>
<td>PWR (Westinghouse)</td>
</tr>
<tr>
<td>Cofrentes</td>
<td>1985</td>
<td>1.092</td>
<td>BWR (General Electric)</td>
</tr>
<tr>
<td>Trillo I</td>
<td>1988</td>
<td>1.066</td>
<td>PWR (Siemens-KWU)</td>
</tr>
<tr>
<td>Vandellós II</td>
<td>1988</td>
<td>1.087,14</td>
<td>PWR (Westinghouse)</td>
</tr>
</tbody>
</table>
## Nuclear Power in Spain

<table>
<thead>
<tr>
<th>Plant</th>
<th>Current operating permit (for a 10 year period)</th>
<th>Owners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Santa María de Garoña</td>
<td>Stop Dec 2012</td>
<td>Nuclenor: Endesa 50% + Iberdrola 50%</td>
</tr>
<tr>
<td>Almaraz I</td>
<td>Jun 2010</td>
<td>Iberdrola 53% Endesa 36%, Gas Natural Fenosa 11%</td>
</tr>
<tr>
<td>Almaraz II</td>
<td>Jun 2010</td>
<td>Iberdrola 53% Endesa 36%, Gas Natural Fenosa 11%</td>
</tr>
<tr>
<td>Ascó I</td>
<td>Sep 2011</td>
<td>Endesa 100%</td>
</tr>
<tr>
<td>Ascó II</td>
<td>Sep 2011</td>
<td>Endesa 85% Iberdrola 15%</td>
</tr>
<tr>
<td>Cofrentes</td>
<td>Mar 2011</td>
<td>Iberdrola 100%</td>
</tr>
<tr>
<td>Trillo I</td>
<td>Nov 2004</td>
<td>Gas Natural Fenosa 34.5%, Iberdrola 48%, HC Energía 15.5%, Nuclenor 2%</td>
</tr>
<tr>
<td>Vandellós II</td>
<td>Jul 2010</td>
<td>Endesa 72% Iberdrola 28%</td>
</tr>
</tbody>
</table>
ATC: The Centralized Storage Facility for Spain’s spent nuclear fuel and high-level radioactive waste

- In 2006 Government stated that the construction of the Centralized Storage Facility (“ATC” in Spanish) was a priority.
- In Dec 2009 was launched a public competition for candidates municipalities to host the ATC
- In Dec 2011 the candidate in Cuenca was selected.

Enresa, the public company in charge of the safe management, storage and disposal of the radioactive waste produced in Spain, is the responsible for the ATC.
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I&C Modernization projects: General

Modernization strategy
- Migration to digital systems: Hybrid Control Rooms
- Migration plan in different phases starting by non safety related systems
- DCS provided by the reference vendor of each plant (except Cofrentes that involves additional vendors)

Use of Full Scope Simulators
- Installation in advance of DCS in simulator
- Stimulation strategy
- Early detected errors
- Engineering test at simulator
- Operation personnel familiarization and training

Future
- Computerized procedures
- Integrated Alarm system: provide advanced functions
- Operation support integrated environment: interactive tables, Tablets, etc
I&C Modernization projects: Cofrentes NPP

**BOP DCS (Honeywell)**
- Honeywell TPS 6 phases from 1998 to 2001: systems related to Heater Drain, Radwaste and Feedwater
- Drawings & operator station upgrade to Experion (Tecnatom 2005)
- Essential Services Water (Tecnatom 2009 & 2011)

**Turbine Control (Mark VI- GE)**
- HVAC & radioactive waste buildings (Tecnatom 2010)
- OFF-GAS (Tecnatom 2011)
- Other minor issues
- In simulator by Tecnatom (FAT)

**Plant Process computer**
- Turnkey project by Tecnatom (2011)
- RTP & Rolls-Royce technology

OFF-GAS (Tecnatom 2011)

Other minor issues

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I&C Modernization projects: Cofrentes NPP

Future Plans

Feedwater Control
Mark VI-e (2015)

Reactor Control
Long term
I&C Modernization projects: Ascó NPP

DCS: Ovation

- Plant Process Computer:
  - Oct 2012 Asco I
  - May 2013 Asco II

HFE

- Analysis of Design modification impact in the operation concept
- Proposals for optimization of DCS new screens: number, position, orientation, etc

BOP: Feedwater Heater & Moisture Separator Reheater:
- Oct 2012 Asco I
- Apr 2013 Asco II
Future Plans

DCS: Ovation

- Reactor Control System & Turbo-Pumps
  - Oct 2015 Asco I
  - Apr 2016 Asco II

- DEH: Turbine Control
  - Apr 2017 Asco I
  - Oct 2017 Asco II

Future Plans

Other systems

- Cooling and circulating water discharge system
  - Not programmed

MCR workplace re-design

- Installation of digital systems that improve the availability

- Room optimization of the workplaces (better communication and supervision with operators)
I&C Modernization projects: Vandellós NPP

DCS: Ovation

Essential Services Water 2009

Plant Process Computer Oct 2013

380 Kv Park Remote Control 2014

Reactor Control System & Turbo-Pumps Oct-2016

Turbine Control Not programmed
I&C Modernization projects: Trillo NPP

Migration to SPPA-T2000

- Teleperm XP (S5 migrated to S7)
  - 220 Kv. Park remote control
  - Leak Detection System
  - Azud Water Collection
  - Water Treatment

Future Plans SPPA-T2000

- Turbine Control and Protection System 2014

HFE

- Analysis of Design modification impact in the operation concept
- Large screens: number, position, size, etc

Plant Process Computer & Protection Objectives 2011

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I&C Modernization projects: Almaraz NPP

DCS: Ovation
- Reactor Control System
  - 2006 Almaraz I
  - 2007 Almaraz II
- Turbine Control
  - 2005 Almaraz I
  - 2004 Almaraz II
- Plant Process Computer
  - Jun-2011 Almaraz I
  - Jun-2012 Almaraz II
- New cooling towers
  - 2012 Almaraz I
  - 2012 Almaraz II

HFE
- Analysis of Design modification impact in the operation concept
- Large screens: number, position, size, etc

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Fukushima response

Stress Tests
- According to the European Nuclear Safety Regulators Group (ENSREG).
- Assessments show significant margins beyond the design bases.
- CSN (regulator) issues Complementary Technical instructions (ITC) to each Plant (14-04-12), planned to be implemented in three steps.

Peer Review
- Looking at people and organizations as part of the Stress Tests (nuclear safety is not just technology, it is also crucially dependent on the people that handle that technology).
- Review team (RT) appreciate that the licensees have an open and positive working relationship with CSN and have agreed on safety enhancement programs (ITCs).

Action Plan
- Considering: Stress Test and Peer Review recommendations
- Most of the Peer Review recommendations are contained in ITCs.
- CSN has demanded a new alternative emergency management center (CAGE) at each site and a new national center for emergency support (CAE) with equipment, expertise and capacity to intervene at any NPP within 24 hours (TECNATOM).
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New build I&C status

- Spanish Engineering Companies are working:
  - In I&C modernizations
  - In I&C of new Plants abroad (Tecnatom Example below)

Since 1997

- "Lungmen NPP" (Taiwan): “ABWR of General Electric”
- “ABWR & ESBWR of General Electric Hitachi”
- “AP1000 & ABWR of Westinghouse-Toshiba”
- “Pebble Bed Modular Reactor” (PBMR PTY Ltd.)
- “CPR1000 of CNPE y AREVA (Chinese)”

Now

Activities

- Analysis of human factor engineering.
- Design and implementation of man-machine interface.
- Verification and validation.
- Control Room design and full delivery.
- Development of simulators and simulation models.
- Development of operation and emergency procedures.
- Training of operation and plant personnel.
- Engineering and licensing services.
- Development and/or qualification of critical components.
- Qualification of systems and inspection techniques.
- Development of ISI equipment.
- Development of PSI and ISI programs.
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Recommendations

About evaluation of the Safety Level
• Avoid different interpretations
• To elaborate a common framework to perform audits on current safety level by an independent entity
• To define or assess the software reliability in digital systems

About COTS I&C equipment
• “Smart” devices dedication optimization (Spain is working since 2010)
• Use of SIL Level? Gap between IEC-61508 & IEC-61513
• List of dedicated COTS I&C equipment in order to reduce costs?

About regulatory position
• FPGAs
• Wireless technologies
• Cyber-security
THANK YOU!