Doosan’s Nuclear I&C system

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Korea’s NPP status & Korea Map

- **Korea’s NPP status (July 2011)**
  - 21 units operating
  - 7 units under construction
  - 8 units planned

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**Oversea**

- UAE # 1, 2, 3, 4

**Korea’s NPP status (July 2011)**

- Ulchin Nuclear Power Site
  - # 1, 2, 3, 4, 5, 6
- Shin-Ulchin
  - # 1, 2
- Shin-Ulchin
  - # 3, 4
- Wolsong Nuclear Power Site
  - # 1, 2, 3, 4, 5, 6
- Shin-Wolsong
  - # 1, 2
- Kori Nuclear Power Site
  - # 1, 2, 3, 4
- Shin-Kori
  - # 1
- Shin-Kori
  - # 2, 3, 4
- Shin-Kori
  - # 5, 6

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- Yonggwang Nuclear Power Site
  - # 1, 2, 3, 4, 5, 6

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- NPP in Operation
- NPP under Construction
- NPP Planed
DOOSAN’s Facility

**INTEGRATED MANUFACTURING COMPLEX**

DOOSAN has an integrated manufacturing facility which is capable of from raw material production to final assembly of components for Power Plants in Changwon, Korea.

- Total Area : 1,100 acres
- Floor Space : 137 acres
**Doosan Digital I&C Experience**

- **National R&D Project : KNICS (2001. 7 ~ 2008.4)**

- **KINS SER**
  - Acquisition of Safety Evaluation Report from KINS (Korea Institute of Nuclear Safety)
    - Plant Protection System, Engineered Safety Features - Component Control System, Reactor Core Protection System, Class-1E Programmable Logic Controller (09/2/18)

- **IAEA Review**
  - Objective
    - Improve the acceptance and reliability of the DOOSAN I&C system.
    - Assist in developing a firm design basis for projects in the domestic and international markets

- **Strength of Doosan I&C**
  - Pre-installation validation using integrated performance and validation test facility
  - Third party review and KINS safety evaluation during R&D phase.
  - Application of PLDs a development process that is similar to the software development process.
  - Application of TTL logic downstream of the main priority logic (diversity policy)
  - Fault tolerance structure of PPS (2 bistable processor and 3 coincidence processor per each channel) & ESF-CCS (2 out of 3 structure)
  - Design of the control rod control system eliminating single point vulnerability.
Doosan Digital I&C Experience

- Shin-Ulchin #1, 2 under manufacturing

- Control Rod System (CRCS/CEDM-CS)
  - Contracted 12 units.
  - 4 units supplied.
  - Main Features
    - Eliminate SPVs
      1) Double & DC Holder: Never drop the CEAs except RPCS or PPS
      2) Full redundant Design: Any single failure will not affect the normal operation
    - Enhance the Operability & Maintainability
      1) MTP MMI: Easily Find the Root Cause
      2) Drawer type PCM

- ASTS (Automatic seismic trip system)
  - Contracted 20 units (Kori 4 units, Yonggwang 6 units, Wolsong 4 units, Ulchin 6 units)
  - 4 units supplied.
Suggestions (based on Doosan experience)

- From 2008 to 2010, AREVA, Westinghouse & EDF suggested and commented issues in the viewpoint of supplier/vendor/system designer.

  System designer is different from each other

- Safety (best performance) could be changed according to design and operation principle.

  slow start, long stride & high propulsion, finish spurt or quick start, early propulsion & manages the race
Suggestions (based on Doosan experience)

- It is important to harmonize existing regulatory environment. However it takes long and difficult work.
- As a more effective way, it is better to develop a common regulatory position (ex. cyber security, FPGA based controller, CGID).
- There was a drastic change in some standards (ex. EPRI TR 102323), which could burden nuclear vendors.