



Doosan Heavy Industries & Construction

Doosan's Nuclear I&C system

Doosan Heavy Industries & Construction
Kook Hun Kim, Ph. D
kookhun.kim@doosan.com



**2nd MDEP Conference on New Reactor Design Activities
Panel Discussion on Digital I&C Topics
OECD Conference Centre
15-16 September 2011**

Contents

1.Korea's NPP status

2.DOOSAN's Facility

3.Doosan Digital I&C Experience

4.Suggestions

Korea's NPP status & Korea Map

□ Korea's NPP status (July 2011)

- 21 units operating
- 7 units under construction
- 8 units planned

Oversea

-UAE # 1,2,3,4

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



-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

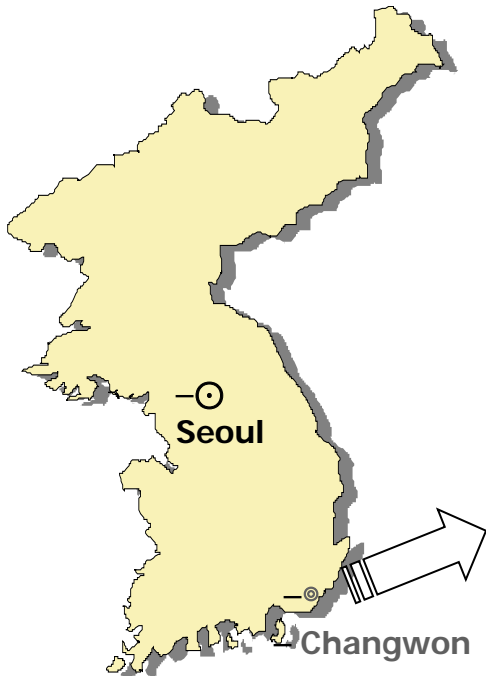
-Shin-Kori # 5,6

- 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 view point of supplier/vendor/system designer



System designer is different from each other



slow start, long stride & high propulsion, finish spurt or quick start, early propulsion & manages the race

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



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.

