



Doosan Heavy Industries & Construction

# Opening Message from host organization

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Gyeongju, Republic of Korea  
10<sup>th</sup> International FPGA Workshop



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# Doosan/Korea I&C along with ISOVIC

- Doosan/Korea I&C launched 1<sup>st</sup> ISOVIC in 2002
- ISOVIC 2017 was held last week in the city of Gyeongju.



ISOVIC 2002  
(first ISOVIC in Seoul, Korea)



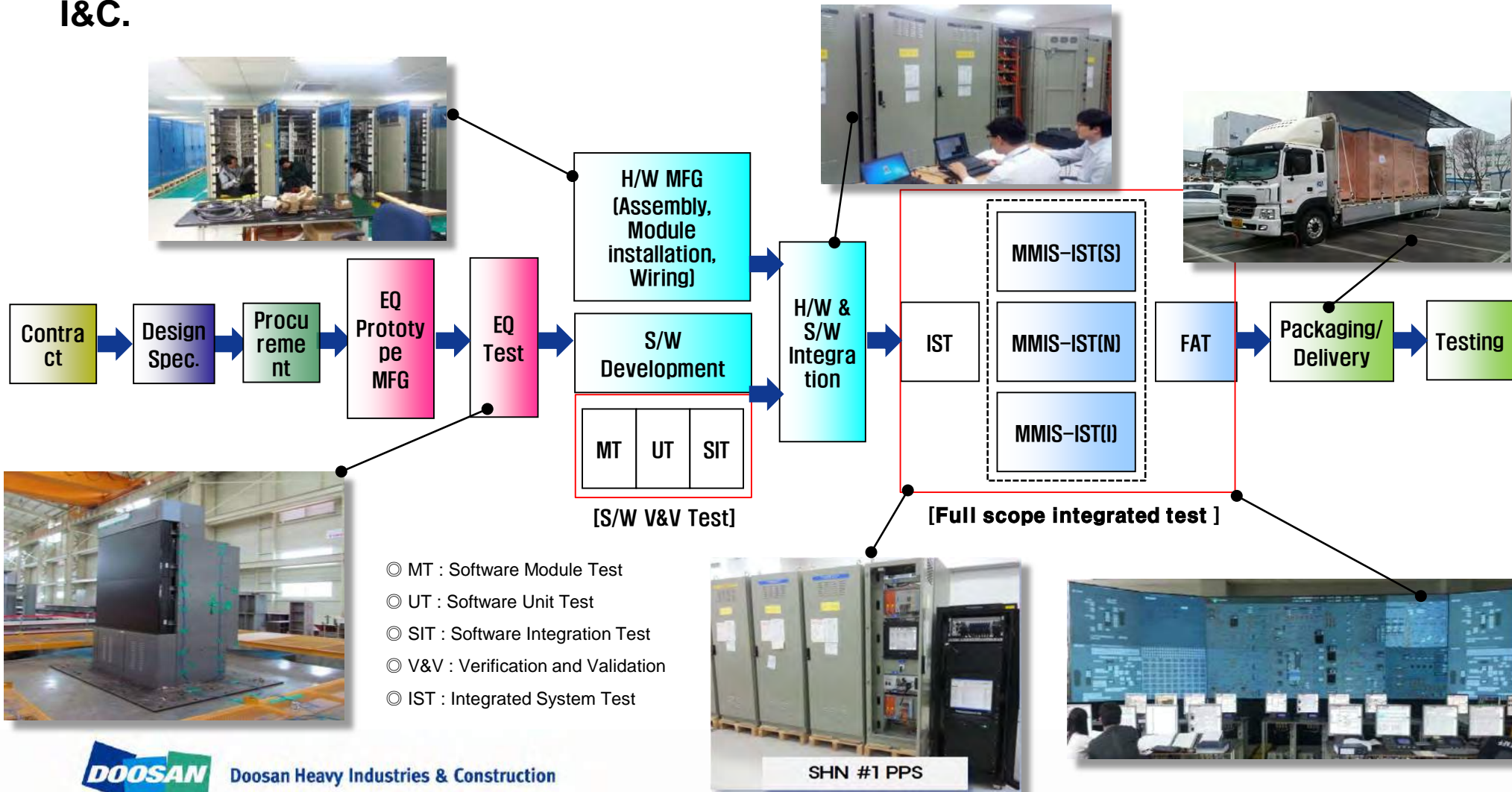
ISOVIC 2017



Doosan Heavy Industries & Construction

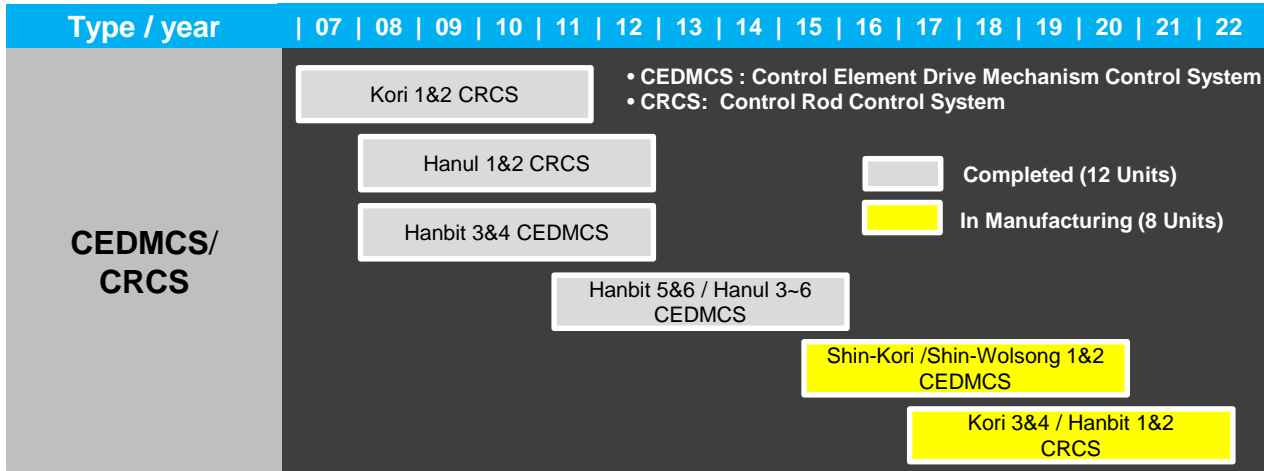
# Shin-Hanul #1,2/Shin-Kori #5,6

- Doosan successfully supplied advanced digital I&C to Shin-Hanul #1,2.
- Doosan is on the process of detailed design and manufacture for Shin-Kori #5,6 I&C.



# Doosan's I&C in operating NPP

## CRCS/CEDMCS Retrofit of all NPP



- The CRCS controls the rod motion by driving 3-coil type CRDM in response to signals from the MCR and the RCS.
- The CEDMCS controls the rod motion (withdrawal, insertion or hold) by driving 4-coil type CEDM in response to signals from the MCR and the RRS



## ASTS(Automatic Seismic Trip System)

◆ *Newly Applied to All NPP*



# Doosan I&C Progress

## ■ Doosan/Korea I&C has progressed ahead along with ISOFIC



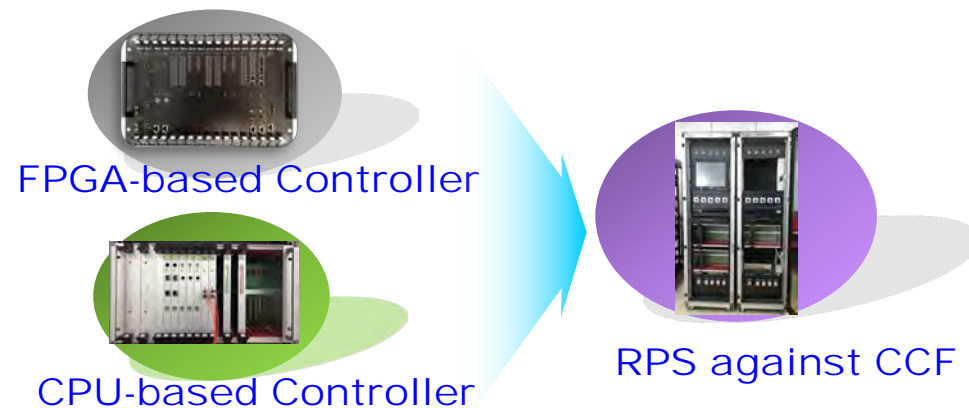
- PPS : Plant Protection System
- ESF-CCS : Engineered Safety Features-Component Control System
- PCS : Power Control System
- CRCS : Control Rod Control System

# Why FGPA?

- **FPGA Technology is inevitable in non-nuclear safety critical control/protection system as well as nuclear I&C.**
- **This would be core technology to overcome the diversity and cyber security issues.**

## Diversity

- Diversity is general approach used for addressing perceived vulnerabilities to CCF
- Diversity uses different means to accomplish the same or equivalent function, generally within one functional barrier, to compensate for a CCF that disables one or more echelons of defense
- Principle in I&C systems of sensing different parameters, using different technologies, different algorithms, or different actuation means to provide several ways of detecting and responding to a significant event



# Doosan FPGA based I&C development

- Doosan have developed.....

- FPGA based Logic controller
- New protection system using both PLC and FPGA controller

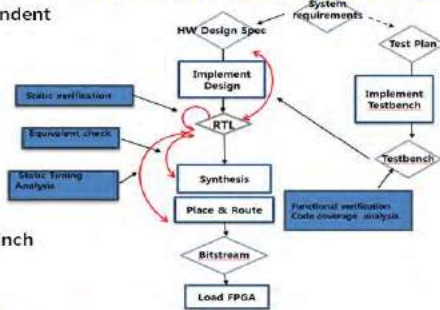
## FPGA-Based Doosan I&C Platform



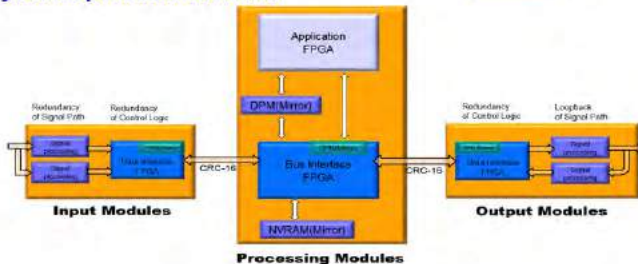
### Configuration of platform

- Data bus architecture for 4 independent multi-processing in one subrack
- 2 redundant power bus
- Processor Module
  - Safety Data Link
  - Information Network
- I/O Modules
  - Analog I/O Modules
  - Digital I/O Modules
- Size : 482.6 x 281.35 x 294mm (19 inch Standardization)

### Development/verification flow



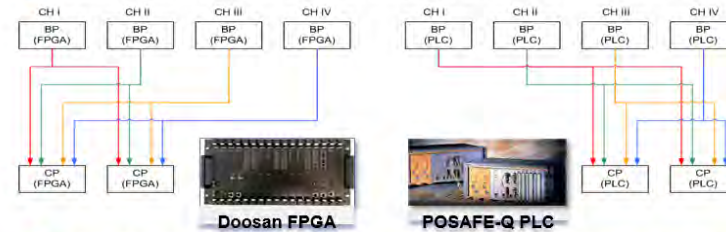
### System operation overview



## I&C Digital Upgrade – Digital Protection System against CCF

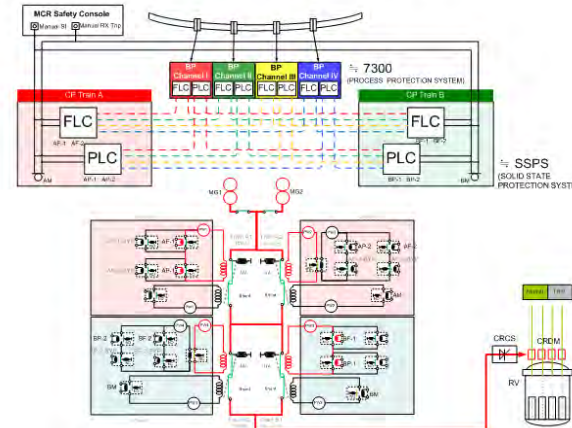
### Different Platform of PPS will resolve the CCF Issues without DPS

- As is – Class 1E Protection System and Non-Class 1E DPS
- To be – Class 1E independent Protection System using different platform
- For example) FPGA based PPS and PLC based PPS are using the same time.



### Redundancy & Combination IC eliminate the SPVs of Protection System

- As is – Single two train trip logic
- To be – Redundant & Combination Trip Initiation Circuit



## Doosan I&C

- Domestic NPP : SHN1,2 / SKN5,6
- Export APR 1400
- Collaborated supply of Doosan I&C to global NPP suppliers