# Influence of MDEP interactions on reactor designs safety

## APR1400 safety design features and the influence of MDEP interaction

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**Yun Ho Kim**

**APR1400 Deputy Project Manager**



KHNP

# Table of Contents

# History of the APR1400 Development

EPRI URD/EURD
System 80+
(CE, 1300MWe)

**APR 1400**

**1,400 MWe**

- **Operation : SKN #3 ('16)**
- **Under Construction**
  - **SKN # 4, SHN # 1,2, SKN # 5,6, BNPP #1~4**
- **Planning - SHN # 3,4**

Latest Codes &
Standards

**OPR 1000**

- **In Operation - SKN #1,2('11/'12) - SWN #1,2('12/'15)**

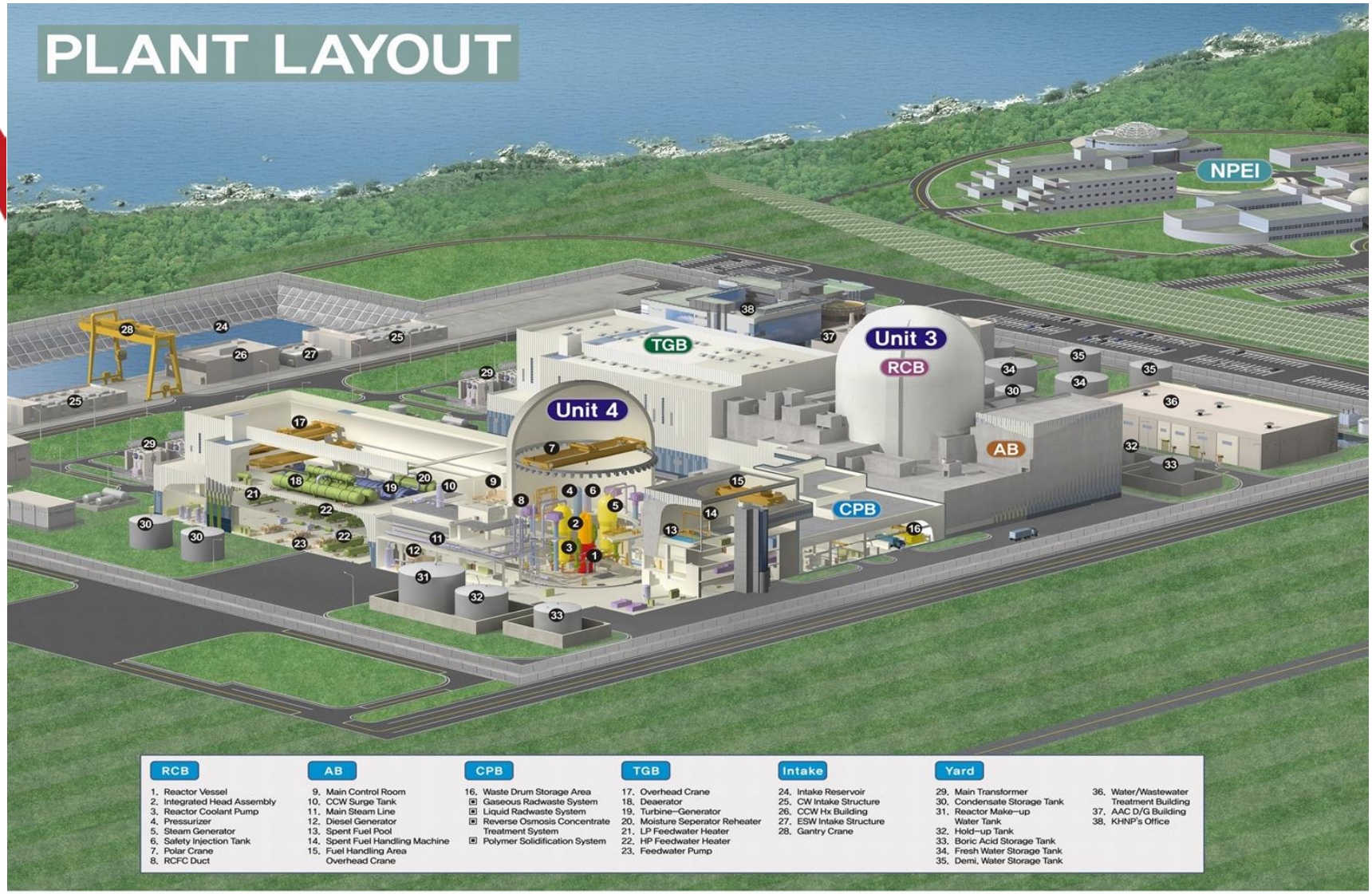
**KSNP**

- **In Operation - YGN #3,4 ('95/'96) - UCN #3,4 ('98/'99)**
  **- YGN #5,6 ('02/'02) - UCN #5,6 ('04/'05)**

# Status of the APR1400

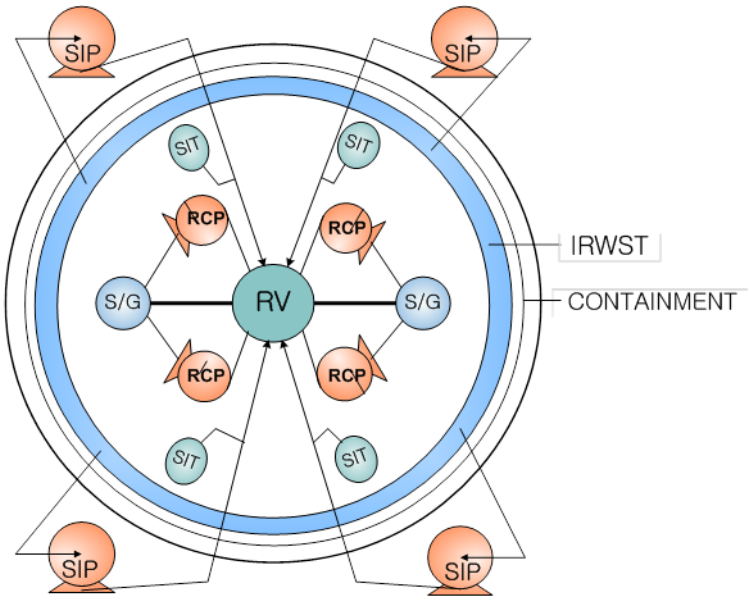
- **In Korea and worldwide**
  - Construction completed in Korea (SKN 3&4)
    - OL for Unit 3 issued on October, 2015
    - Unit 3 commercial operation began on December, 2016
    - Unit 4 under pre-operation tests
  - Under-construction in UAE (Barakah 1 ~ 4)
    - Commercial operation for Unit 1 scheduled on 2018
  - Design certification in USA
    - NRC design review in phase 4 out of 6 phases

# Design Feature of the APR1400



# Design Feature of the APR1400

- **Safety Injection System**
  - Four independent trains through Direct Vessel Injection nozzle
  - Safety Injection Tanks(SIT) with Fluidic Device
  - Safety Injection Pumps(SIP) from In-containment Refueling Water Storage Tank(IRWST)





Full scale SIT & Fluidic Device test facility

# Design Feature of the APR1400

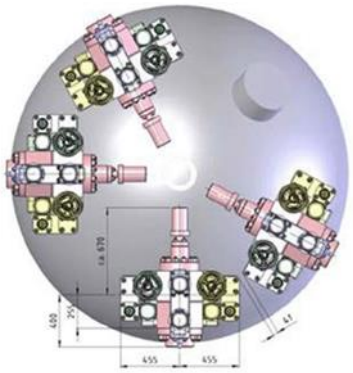
- **Containment System**
  - Containment is prestressed and has sufficient peak pressure margin
  - Containment Spray System consists of two 100% division
  - Emergency Containment Spray Backup System(ECSBS) dedicated for severe accident management
  - Controls hydrogen concentration ; PAR and Igniters

PAR

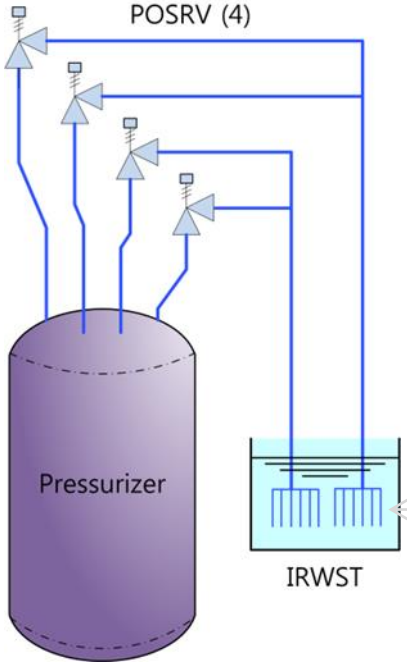
Hydrogen Igniter

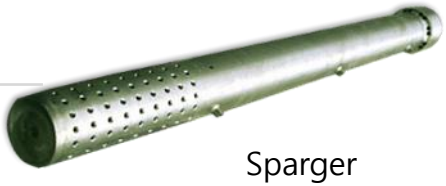
# Design Feature of the APR1400

- **Overpressure protection**
  - Maintain the RCS pressure below 110% design pressure
  - Four Pilot Operated Safety Relief Valves (POSRV) , Main Steam Safety Valve(MSSV) and Reactor Protection System(RPS)
  - The IRWST is used as the pressurizer relief tank



Bird view of Pressurizer



Sparger

# Design Feature of the APR1400

- **I&C System**
  - Fully digitalized I&C system with diverse platforms
    - Safety system : Programmable Logic Controller
    - Non-safety system : Distributed Control System
    - Diverse actuation system : FPGA-based Logic Controller
  - Data communication systems maintain independence between safety system and non-safety system
  - Remote Shutdown Room available when MCR uninhabitable

Main Control Room

# Design Feature of the APR1400

- **Other design features**
  - Aircraft impact assessment to show core cooling capability and spent fuel pool integrity
  - Loss of Power
    - Four EDGs are provided for LOOP
    - AAC GTG is provided for SBO
    - Onsite and offsite mobile DGs are provided for FLEX
  - FLEX design
    - RCS makeup and core cooling using FLEX pumps
    - SFP makeup and spray using FLEX pumps
    - Power supply using mobile DGs(onsite and offsite)
    - SFP level instrumentations

# Conclusion

- The APR1400 design is maturing through the accumulated experience from construction, pre-operation tests and operation
- Information exchange among regulators will help safe design of nuclear power plants
- KHNP is supporting MDEP to enhance safety of global nuclear industry