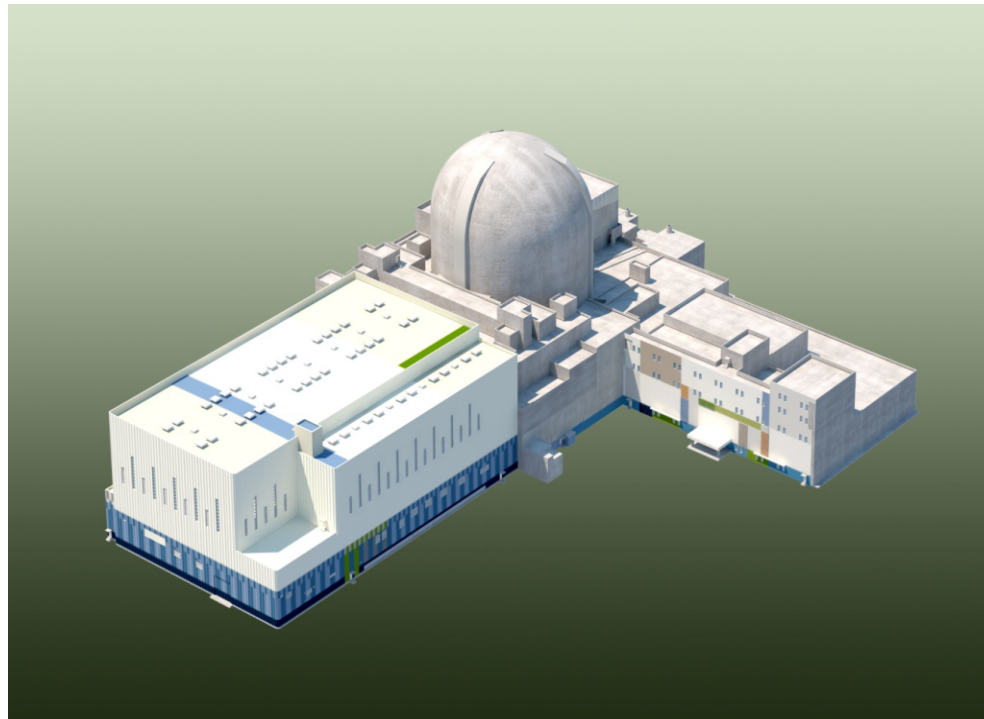


# Overview of the APR1400 DC Project



**KEPCO/KHNP**  
**Apr. 20~21, 2016**

# Contents

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- **Introduction**
  - **NPPs in Korea**
  - **Project History**
- **Design Features and General Arrangement**
- **Design Review Status**
- **Summaries**

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## ● Introduction

- NPPs in Korea
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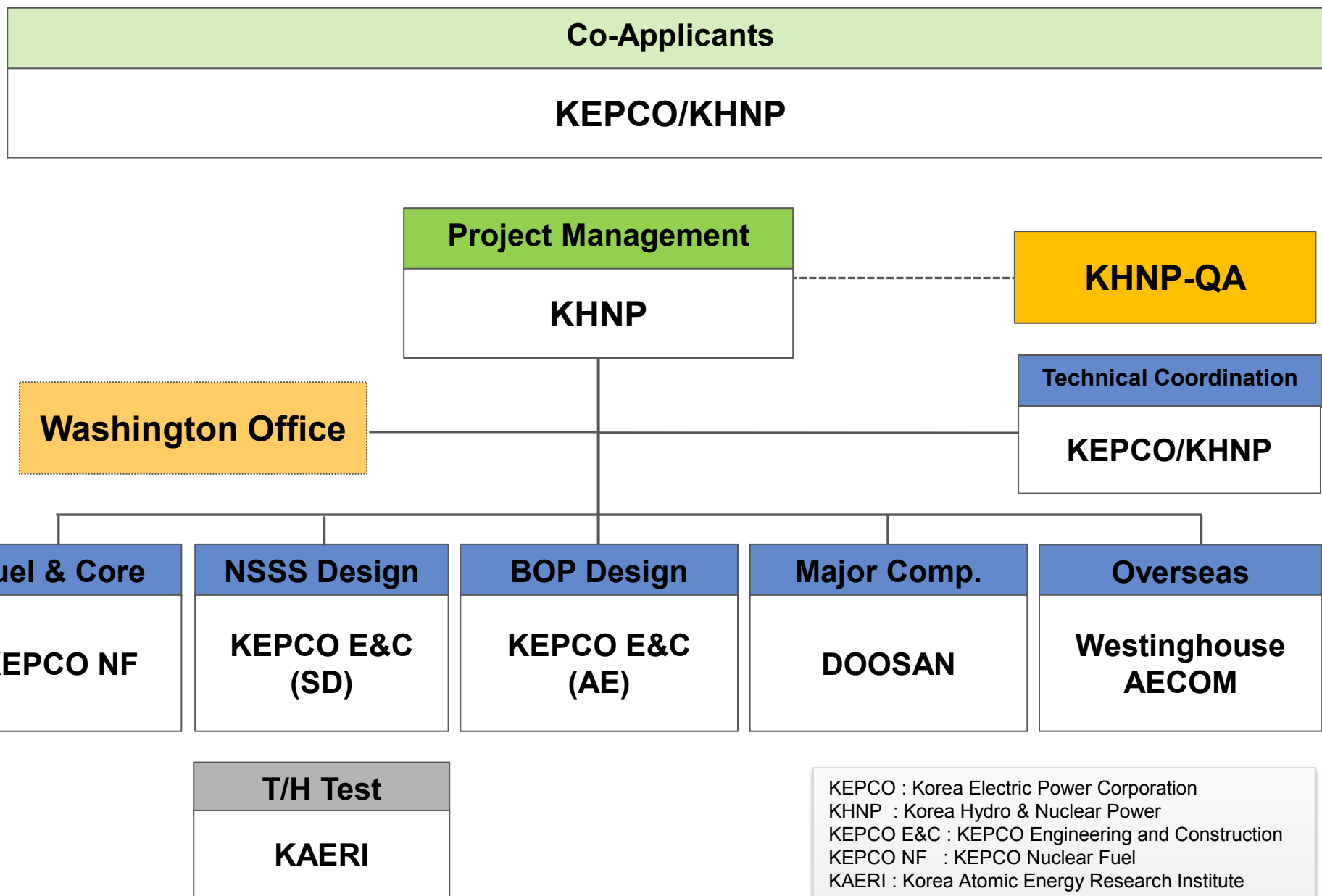
# Nuclear Power Plants in Korea

In Operation	24 Units	21,716 MW
Under Construction	4 Units	5,600 MW
Planning	6 Units	8,600 MW





# Project Organization



# Project History and Progress

- [Mar. 2009] Submittal of the Intent of APR1400 DC Application to US NRC
- [Apr. 2010~Oct. 2014] Performed total 18 PARMs
- [Dec. 2014] Submittal of the APR1400 DC application to the US NRC
- [Mar. 2015] Receive the Docketing letter of APR1400 DC application
- [Apr. 2015] Receive the First RAIs[Ch. 2 & 3]
- [Jan. 2016] Finished Phase I Review

0-21, 2016)



**NRC NEWS**  
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No: 15-012  
CONTACT: Scott Burnell, 301-415-8200

March 4, 2015

## NRC To Begin Full Certification Review of APR1400 Reactor

The Nuclear Regulatory Commission has [docketed for review](#) Korea Electric Power Corp. and Korea Hydro and Nuclear Power's application to certify the APR1400 reactor design for use in the United States.



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# Development history of APR1400

- Development of Advanced Power Reactor 1400 (1992~2002)
- Licensing agreement with ABB-CE

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



ADF/PDF  
Latest Codes &  
Standards

## Improved OPR 1000

- In Operation - SKN 1/2, SWN 1/2

## OPR 1000

- In Operation
  - Hanbit 3/4 ('95/'96)
  - Hanul 3/4 ('98/'99)
  - Hanbit 5/6 ('02/'02)
  - Hanul 5/6 ('04/'05)

## NSSS Design

Palo Verde #2 (CE, 1300MWe)

## Core Design

ANO #2 (CE, 1000MWe)



# APR1400 Design Features

- **APR1400 referenced Shin Kori Units 3&4.**
- **APR1400 is an essentially complete design**
  - Construction completed in Korea (Shin Kori Units 3 & 4)
    - OL for Shin Kori Unit 3 issued on October 2015
    - Criticality reached on December 2015
  - Under-construction in UAE (Barakah Units 1 - 4)
    - OL for Barakah Unit 1 scheduled for October 2016

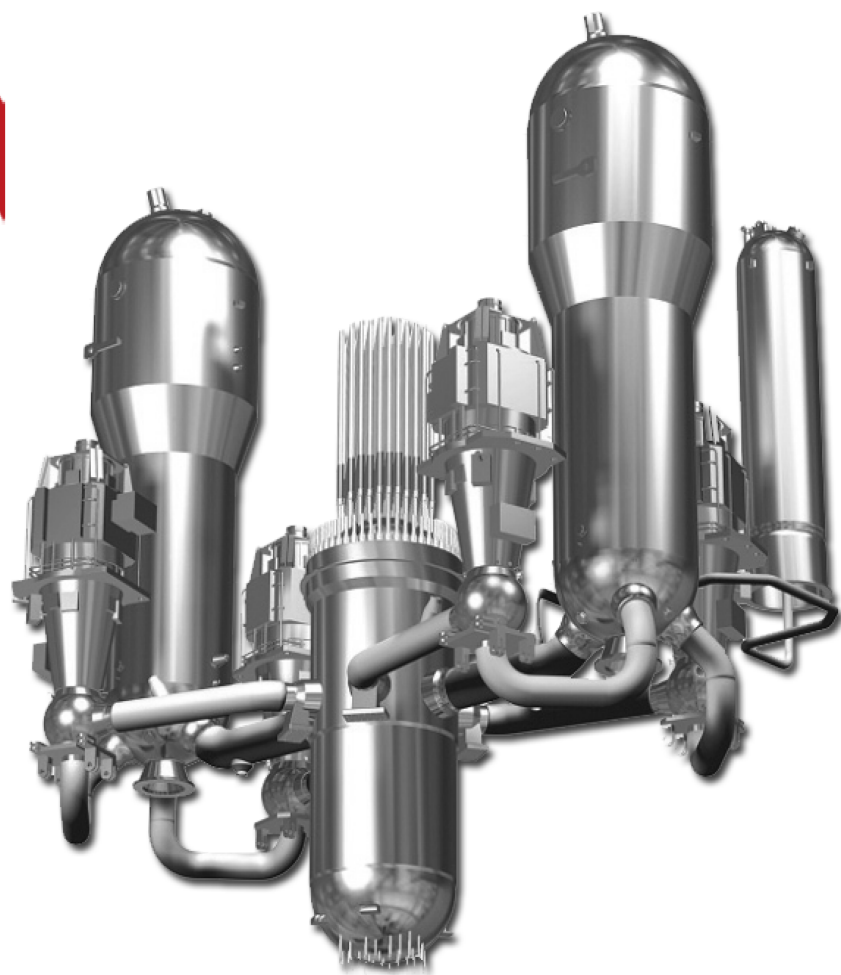
SKN 3&4, Korea



Barakah 1&2, UAE



# Design Features of the APR1400



- **Design Life Time : 60 Years for Class 1 Major Equipment**
- **Power : 4000MWth / 1400MWe**
- **Two-Loop : 2 HLs, 2 SGs, 4 RCPs, 4 CLs, 1 Pzr**
- **Primary Operating condition:**
  - **Pressure : 2250psia**
  - **HL/CL Temp. : 615/555 °F**
- **Secondary Operating condition:**
  - **Pressure : 1000psia**
  - **MF/MS Temp. : 450/545 °F**
- **Pzr Free volume : 2400 ft<sup>3</sup>**
- **SG U-tube : 13102/SG, I690**



# APR1400 for NRC DC(1/2)

## Basic approach of design change for NRC DC

- **Retain reference plant design (SKN 3&4)**
  - To take advantage of proven safety and performance
- **Meet US NRC Regulation Guidance effective on Aug. 2014**
  - Six month before the target docketing date

# APR1400 for NRC DC(2/2)

## Special Design Considerations for NRC DC

### ■ Enhance SBO coping capability

- Gas turbine generator for AAC source, 16 hr battery(Train C/D), FLEX implementation

### ■ Improve the tolerance to the beyond design basis

- Analysis of aircraft impact by 10CFR50.150
- Application of LOLA (loss of large area) design requirement
- Application of physical security requirement

### ■ Robust design for the design base accidents

- GSI-191 for LBLOCA
- Diverse reactor protection systems for common cause failures
- Application of FEM model to seismic design

# Design Differences between APR1400 and System 80+

## Containment

- **System80+** : Spherical Steel
- **APR1400** : Cylindrical PS Concrete

## Thermal Power

- **System80+** : 3,931 MWt
- **APR1400** : 4,000 MWt

## Hot-leg Temp.

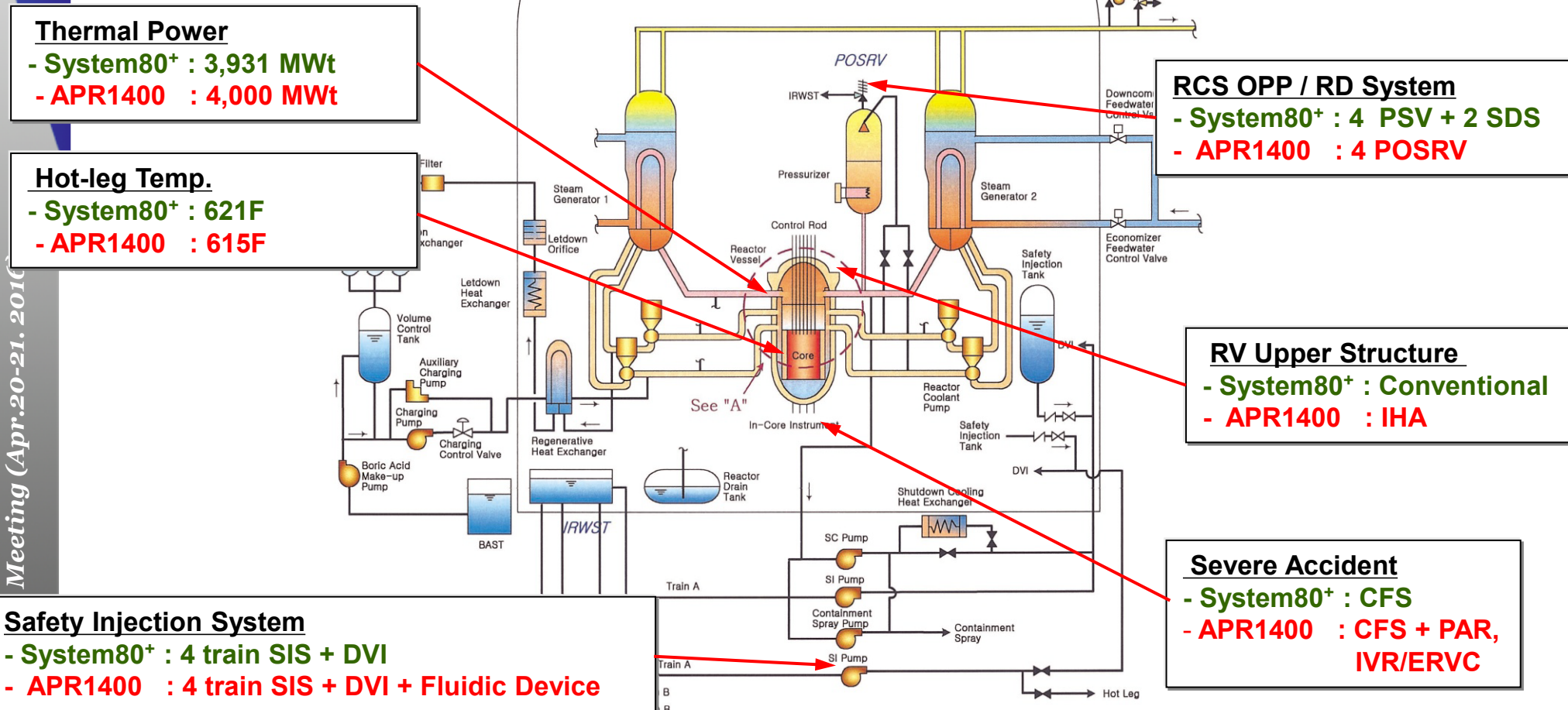
- **System80+** : 621F
- **APR1400** : 615F

Meeting (Apr.20-21, 2010)

## Safety Injection System

- **System80+** : 4 train SIS + DVI
- **APR1400** : 4 train SIS + DVI + Fluidic Device

SIS: safe injection system  
 DVI: direct vessel injection  
 POSRV: pilot operated safety relief valve  
 IHA: integrated head assembly  
 CFS: core flooding system  
 PAR: passive autocatalytic recombiner  
 IVR: in-vessel retention  
 ERVC: external reactor vessel cooling



## RCS OPP / RD System

- **System80+** : 4 PSV + 2 SDS
- **APR1400** : 4 POSRV

## RV Upper Structure

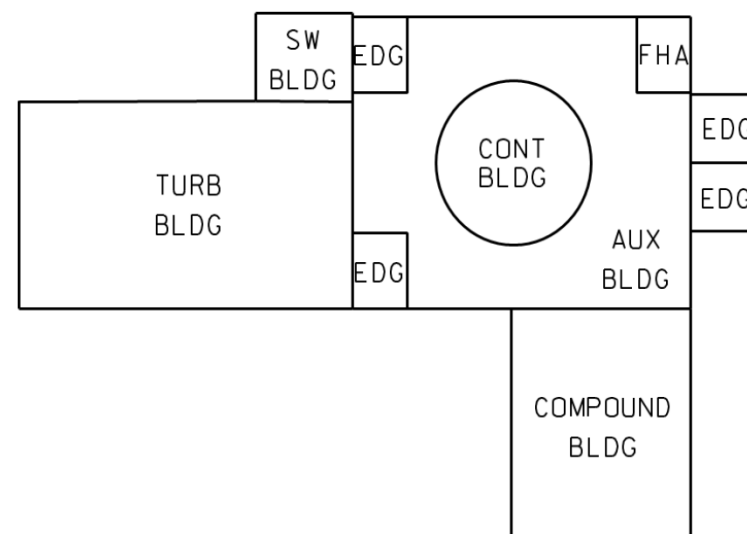
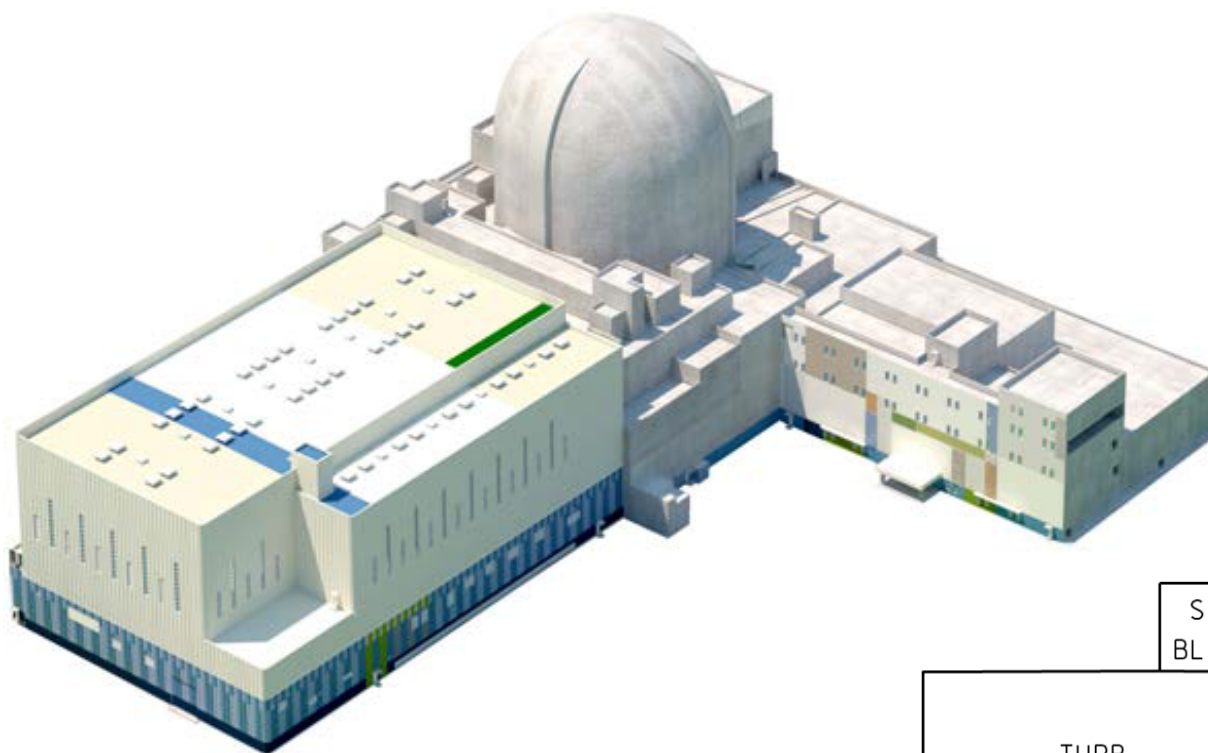
- **System80+** : Conventional
- **APR1400** : IHA

## Severe Accident

- **System80+** : CFS
- **APR1400** : CFS + PAR, IVR/ERVC

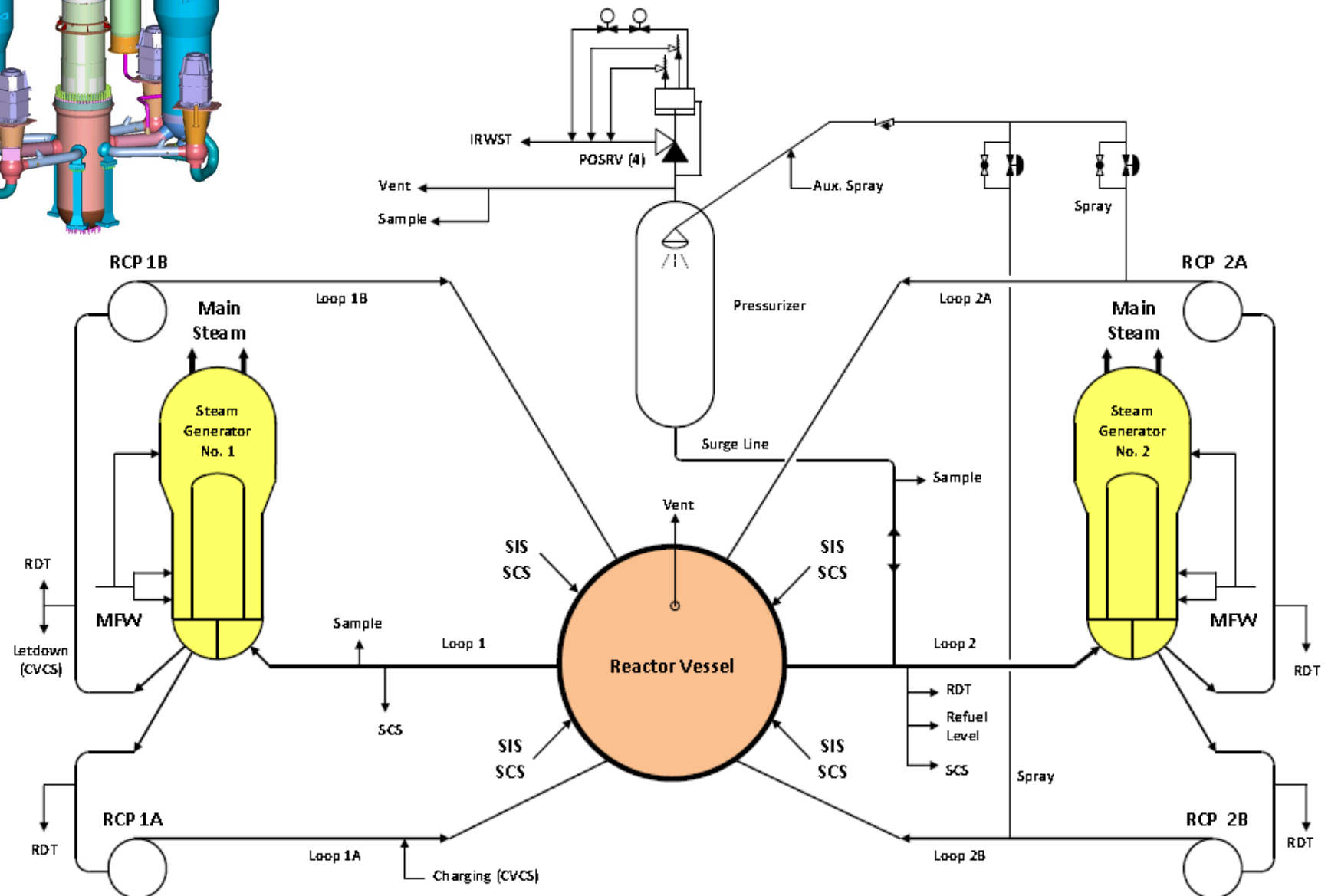
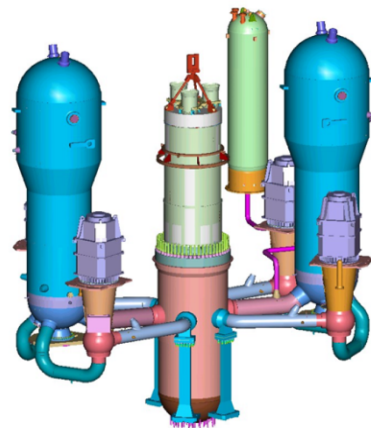
# General Arrangement (1/4)

## Plant General Arrangement



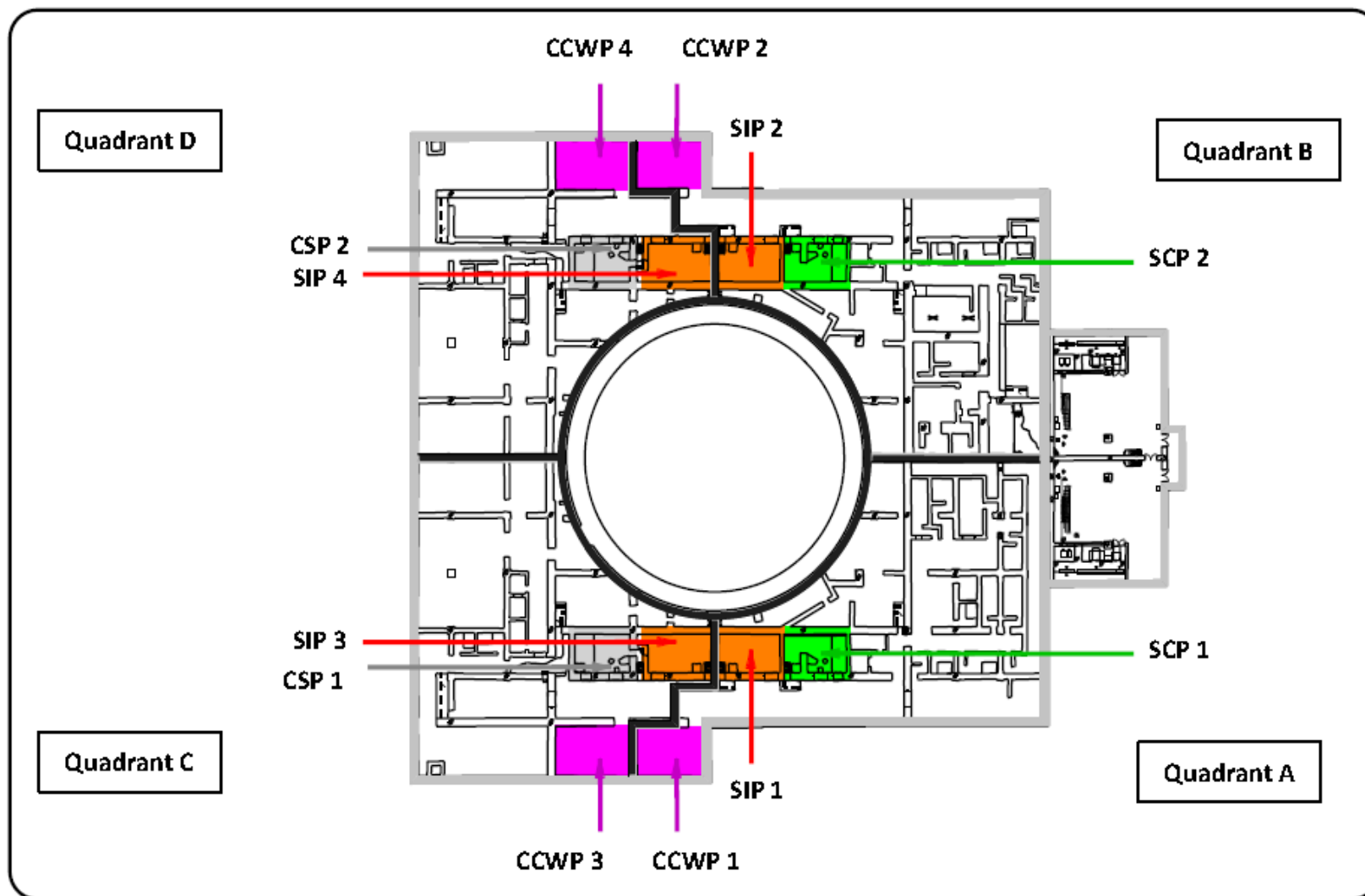
# General Arrangement (3/4)

## RCS Arrangement Plane



# General Arrangement (4/4)

## Quadrant Arrangement of Aux. Building



SIP : Safety Injection Pump  
 SCP : Shutdown Cooling Pump  
 CSP : Containment Spray Pump  
 CCWP : Component Cooling Water Pump



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# Design Review Status

Task	Description	Target Date
Phase I	PSER and RAI <b>Completed</b>	Feb. 2016 <b>Jan. 29 2016</b>
Phase II	SER with Open Items	Nov. 2016
Phase III	ACRS Review of SER with Open Items	Jun. 2017
Phase IV	Advanced SER with No Open Items	Dec. 2017
Phase V	ACRS Review of Advanced SER with No Open Items	Jun. 2018
Phase VI	Final SER with No Open Items	Sep. 2018

# Interaction with NRC

## ■ Regular meeting

- ✓ Bi-Weekly PM Conference Call
- ✓ Bi-Weekly Conference Call for PRA Issues
- ✓ Bi-Weekly Conference Call for Ch.3 Issues
- ✓ Bi-Weekly Conference Call for Ch.15
- ✓ Bi-Weekly Conference Call for Ch.9

## ■ Clarification meeting

- ✓ Phone call or face-to-face meeting frequently

## ■ Drop-in meeting

- ✓ Staff in WDCC visits NRC to coordinate issues

## ■ Audit

- ✓ Design documents, Piping, Computer code V/V. etc.

## ■ QA inspection

- ✓ GSI-191 issue : 4 findings
- ✓ Computer codes : 4 observations

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# Summaries

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- **The APR1400 adopted proven technologies from the operation of OPR1000.**
- **The APR1400 used safety analysis codes and methodologies of the certified System 80+.**
- **The APR1400 standard design approval was issued by Korean regulatory authority in 2002.**
  - The first two units of the APR1400, Shin-Kori Units 3 & 4, are being constructed and their commercial operations are under preparation.
- **The APR1400 is an essentially complete design.**



Thank you