Introduction to NPP system

















I. NPP overview









Difference Between Nuclear and Thermal Power Plant

- The difference in the source from which heat energy is obtained
 - Nuclear Power Plant: Fission energy
 - Thermal Power Plant: Chemical energy





• Fission Reaction

- The atomic nucleus of uranium-235 collides with an external neutron, splits, and emits 2-3 neutrons
- Energy is generated as much as the mass defect of atomic nuclei before and after fission
 - Mass defect : $MO + Mn = M1 + M2 + \Sigma Mn + \Delta M$
 - Lost mass is converted to energy: $E = \Delta M C^2$





Representative reactor types

- PWR : Pressurized Water Reactor
- PHWR : Pressurized Heavy Water Reactor, CANDU
- BWR : Boiling Water Reactor











- Using light water(H2O) as moderator and coolant
- Low-enriched uranium containing 2-5% uranium 235 is used as fuel
- The power plant is usually shut down every 12 to 18 months, and 1/3 of the total fuel is replaced -8-



PHWR



- Using light water(D2O) as moderator and coolant
- Natural uranium (Uranium 235 contains 0.7%) is used as fuel
- Replacing a certain amount of nuclear fuel every day using a fuel-loading machine without a reactor trip





• Main Building

• Reactor Containment Building, Auxiliary Building, Turbine Building, etc.





Site Location and Arrangement

- located away from densely populated areas
- Coastal location to secure a cooling source
- Constructed in consideration of geology, meteorology, hydrology, etc.





NPP System Classification



- Classification by coolant
- Primary system: system related to primary coolant
 - Primary coolant: a fluid that directly absorbs heat from the reactor core
 - Reactor coolant system, Chemical & Volume control system, Safety injection system, etc.
- Secondary system: system related to secondary coolant
 - Secondary coolant: The fluid that absorbs the heat of the primary coolant

by the heat exchanger and turns the turbine

- Turbine and Generator system, Main steam system, Main feedwater system, Auxiliary feedwater system, etc.

NPP System Classification



Classification by safety grade

- Safety system: Systems related to nuclear safety
 - Safety injection system, Auxiliary feedwater system, Emergency diesel generator, etc.
- Non-Safety system: Systems related only to power generation
 - Turbine system, Circulating water system, Main generator, etc.
- **※ IAEA SSR-2/1 Fundamental safety function**
 - 1) control of reactivity
 - 2) removal of heat from the reactor and from the fuel

3) confinement of radioactive material, shielding against radiation and control of planned radioactive releases, as well as limitation of accidental radioactive releases

※ Some safety systems may be included in non-safety systems

- Chemical and volume control system up to the letdown isolation valve
- The main steam system up to the MSIV front end

NPP System Classification



Seismic classification

- Seismic Category I
 - Systems that must remain functional despite the occurrence of SSE
- Seismic Category II
 - Systems that are not required to function when SSE occurs, but require structural integrity
- Seismic Category III
 - or non-seismic category

Classification of quality grades

Quality grades Q(Safety related), A(Safety influence), S(General industrial)

Electrical Classification

- C-1E
 - Electrical equipment and systems essential for safety functions
- N-1E
 - Electrical equipment not classified as Class 1E



III. Schematic diagram

Primary System



Primary System

- Primary system: system related to primary coolant
 - Primary coolant: a fluid that directly absorbs heat from the reactor core

Reactor Coolant System

Reactor, Steam Generator, PZR, RCP, Pipe such as hot/cold leg

Primary Auxiliary System

- CVCS, CCW system, ESW system, Shutdown cooling system

• Engineering safety facilities, etc.

 Reactor building, Auxiliary systems of the reactor building (including the containment spray system), Emergency core cooling system, etc.

Secondary System



Secondary System

- Secondary system: system related to secondary coolant
 - Secondary coolant: The fluid that absorbs the heat of the primary coolant

by the heat exchanger and turns the turbine

Main Steam System

- Steam generator, MSIV, MSSV, MS ADV, etc.
- Turbine/Generator and Auxiliary Systems
- Turbine/Generator, Turbine control oil system, Steam seal system, Lubricating oil system, Generator gas control system, etc.
- Condensate/Feedwater system
- Condensate water system, Main feedwater system, Aux-feedwater system

Other auxiliary systems

 Circulating water system, Secondary component cooling water system, Instrumental air system

Thank you

