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Increased Overlap of Lead Bank

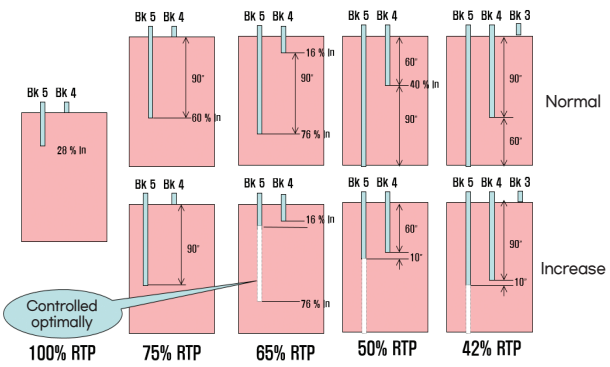
CORE ENGINEERING DEPT. JinHa Park
T. 042-868-1485 E. jhapark@knfc.co.kr

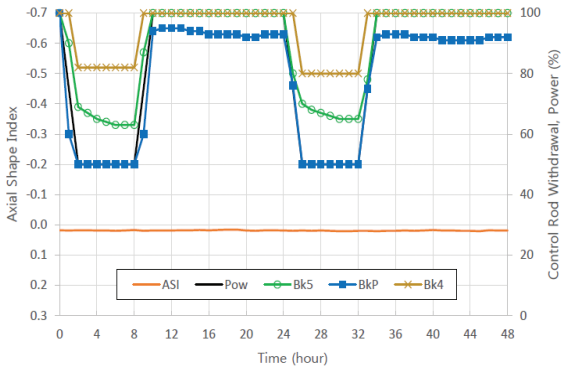
The overlap between Regulating Group 5 (Lead Bank) and Group 4 is operated flexibly using increased overlap of lead bank in order to control axial power shape optimally within the range that does not violate the PDIL. Nuclear power plants are experiencing a lot of difficulties in controlling ASI(Axial Shape Index) because it is required to control ASI within a constant range depending on the reactor power. Increased overlap makes it possible to control axial power shape optimally that is heavily skewed over the reactor core during reactor operation.

Description

● Background

- For OPR1000 and APR1400 nuclear power plants in Korea, the technical specification(T/S) requires that ASI must be controlled within the range of –0.27 ~ 0.27 during 20 % power or above where COLSS(Core Operating Limit Supervisory System) is operable. It means that ASI operation range is set to be excessively wide in high power, but it is very difficult to control axial power shape due to the narrow





ASI range in low power. Therefore, effective control of ASI is required during low power, which is severely skewed to the top of the core after the middle of a cycle.

● Purpose and Necessity

- Improve reactor operational efficiency and secure core safety by enlarging the overlap of lead bank
- Optimal control of extremely top-skewed ASI during low power operation
  - Fast power-down operation in case of reactor shutdown
  - Low power operation after RPCS (Reactor Power Cutback System)
  - Power ascension operation after reactor trip
- Elimination of operational restrictions and Improvement of economy
  - ASI control above 10 %/Hr power ascension
  - No waiting time to restart after the unexpected reactor trip

● Principle

- Increased overlap of lead bank is adopted to optimize the effective control of ASI which is severely skewed to the top of the core
- Original overlap of lead bank Regulating : Group 5 position is maintained at least 90 inches lower than Regulating Group 4 position
- Modified overlap of lead bank : Regulation Group 4 is position between 60 and 150 inches and the position of Group 5 is located at least 10 inches lower than the position of Group 4.
- Confirm the validity because the distance reduction between Regulating Groups 4 and 5 due to increased overlap affects the ejected rod worth, shutdown margin, reactivity insertion rate and core power distribution.
- The safety analysis is conducted in CEA ejection, single CEA withdrawal and CEA drop events using the above factors.

Distinctiveness

● Characteristics

- Increased overlap of lead bank without violation of T/S
- No additional alarm system is required, the existing one will be used
- Optimal ASI control for normal operation
- Application to load follow operation

● Benefits

- Improve the capacity factor through the rapid power ascension and reactor shutdown
- Eliminate operational restrictions due to the difficulty of ASI control
- Control ASI during load follow operation

Experience

- Applied to all OPR1000 power plants operating in Korea
- Applying this technology to APR1400 operating in Korea and BNPP power plants are under discussion

Deliverables

- Depending on increased overlap of lead bank
  - Safety evaluation report
  - Revised T/S and operation procedure
  - Training and lectur programs for operators