General description for SHETRAN code and Benchmark problem calculation methods

1. Code name

SHETRAN

References:

K. Sakai, et al., “Development of Ultra Fine Energy Spectrum Analysis Code for PWR Assembly,” Proc. of Autumn meeting, the Atomic Energy Society of Japan,F47,(1997),[in Japanese]

K. Sakai, et al., “Improvement of SEPCO Core Management Code System,” Proc. of Annual meeting, the Atomic Energy Society of Japan,C6,(2000), [in Japanese]

2. Organization

Shikoku Electric Power Co., Inc.(SEPCO)

3. Nuclear data library

ENDF/B-VI rev.3

4. Code used for cross section data processing

NJOY94.105

5. Spectrum calculation and energy condensation methods

The numerical solution method for the transport equation in heterogeneous geometries is based on the method of characteristics. Multi-group constants are used for the fast energy region and the thermal energy region, and ultra-fine-group constants are used for the resonance energy region. One rod cell and 3x3 rod cells are calculated in 1/8 two-dimensional heterogeneous geometry. A non-fuel cell(for example: a water hole or a burnable poison rod) is assigned at center and surrounded by fuel rods in 3x3 rod cells geometry.

70 energy group constants are generated by condensing the flux weighted multi-group constants and ultra-fine-group constants.

For assembly geometry, 70 energy group transport equations are solved by the method of characteristics in heterogeneous system.

6. Energy groups

・Group constants calculation:

Fast energy region 56 groups (10MeV – about 10keV)

Resonance energy region about 60 thousands groups (about 10keV – 2.1eV)

Thermal energy region 160 groups (2.1eV – 1.0E-5eV)

Cut-off energy is 2.1eV.

・Assembly calculation: 70 groups (10MeV – 1.0E-5eV)

7. Assumption for cross section generation

Pseudo-FPs are not assumed.

8. Nuclides self-shielding and mutual shielding considered

For resonance energy region, all nuclides are accurately treated by ultra-fine-group cross sections. For fast and thermal energy region, self-shielding is considered by NR approximation.

9. Cell calculation geometry

Mesh number for Gd fuel pin : The number of radial division is 10.

The number of azimuthal division is 4.

10.Miscellaneous

・Burn-up steps (GWd/t)

UO2 pin cell, MOX pin cell, MOX assembly:

0,0.1,0.5,1,2,4,5,6,8,10, and every 2.5 for 10-70 (total 34 steps)

Gd assembly:

0,0.1,0.25, every 0.25 for 0.25–30,and every 2.5 for 30–70 (total 138 steps)

・Burn-up chain

101 nuclides (18 actinides, 83 FP nuclides) are considered.