Specification of the OPR2D problem

The OPR2D problem represents the hot-zero-power state of a OPR1000 (Optimized Power Reactor 1000) like reactor which is characterized by the use of the Combustion Engineering type fuel assemblies having large water holes. There are five types of 16x16 fuel assemblies as defined in Fig. 1 and 177 fuel assemblies are loaded into the core as shown in Fig. 2. The water hole region and the reflector region in the core are model with water only. Each pin cell consists of a fuel pellet, cladding, and coolant. No fuel air gap or assembly water gap is modeled for simplicity. The pin cell configuration is given in Fig. 3 and the material compositions are given in Table 1. The temperature is 296°C across the core.

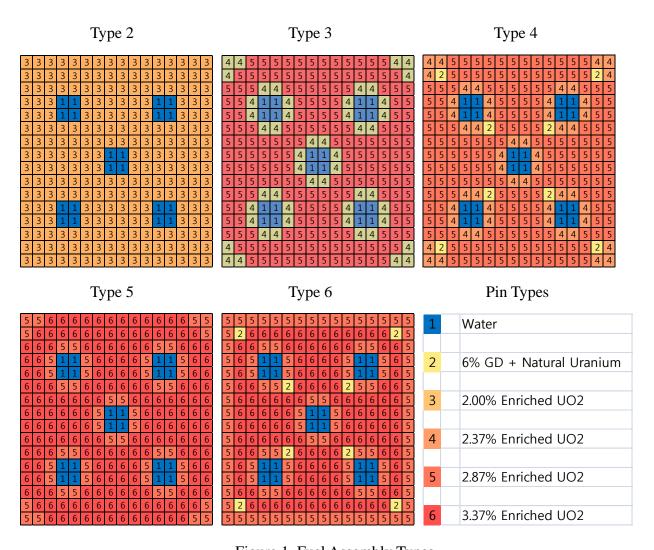


Figure 1. Fuel Assembly Types

| | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 1 | 1 | 3 | 5 | 3 | 5 | 3 | 1 | 1 | 1 | | | |
| | | 1 | 1 | 3 | 5 | 6 | 2 | 6 | 2 | 6 | 5 | 3 | 1 | 1 | | |
| | 1 | 1 | 5 | 6 | 4 | 2 | 6 | 2 | 6 | 2 | 4 | 6 | 5 | 1 | 1 | |
| | 1 | 3 | 6 | 4 | 2 | 4 | 2 | 4 | 2 | 4 | 2 | 4 | 6 | 3 | 1 | |
| 1 | 1 | 5 | 4 | 2 | 6 | 2 | 4 | 2 | 4 | 2 | 6 | 2 | 4 | 5 | 1 | 1 |
| 1 | 3 | 6 | 2 | 4 | 2 | 4 | 2 | 6 | 2 | 4 | 2 | 4 | 2 | 6 | 3 | 1 |
| 1 | 5 | 2 | 6 | 2 | 4 | 2 | 4 | 2 | 4 | 2 | 4 | 2 | 6 | 2 | 5 | 1 |
| 1 | 3 | 6 | 2 | 4 | 2 | 6 | 2 | 2 | 2 | 6 | 2 | 4 | 2 | 6 | თ | 1 |
| 1 | 5 | 2 | 6 | 2 | 4 | 2 | 4 | 2 | 4 | 2 | 4 | 2 | 6 | 2 | 5 | 1 |
| 1 | 3 | 6 | 2 | 4 | 2 | 4 | 2 | 6 | 2 | 4 | 2 | 4 | 2 | 6 | თ | 1 |
| 1 | 1 | 5 | 4 | 2 | 6 | 2 | 4 | 2 | 4 | 2 | 6 | 2 | 4 | 5 | 1 | 1 |
| | 1 | 3 | 6 | 4 | 2 | 4 | 2 | 4 | 2 | 4 | 2 | 4 | 6 | 3 | 1 | |
| | 1 | 1 | 5 | 6 | 4 | 2 | 6 | 2 | 6 | 2 | 4 | 6 | 5 | 1 | 1 | |
| | | 1 | 1 | 3 | 5 | 6 | 2 | 6 | 2 | 6 | 5 | 3 | 1 | 1 | | |
| | | | 1 | 1 | 1 | 3 | 5 | 3 | 5 | 3 | 1 | 1 | 1 | | | |
| | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | |

Figure 2. Core Configuration

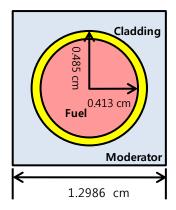


Figure 3. Fuel Pin Configuration

Table 1. Material Compositions

| Material | Density (g/cc) | Nuclide | Weight % | | |
|-----------|----------------|--|----------|--|--|
| | | 92235 | 1.76308 | | |
| UO2 2.0% | 10.24 | 92238 | 86.39082 | | |
| | | 8016 | 11.84610 | | |
| | | 92235 | 2.08924 | | |
| UO2 2.37% | 10.24 | 92238 | 86.06417 | | |
| | | 8016 | 11.84660 | | |
| | | 92235 | 2.52998 | | |
| UO2 2.87% | 10.24 | 92238 | 85.62275 | | |
| | | 92235 92238 8016 92235 92238 8016 92235 | 11.84726 | | |
| | | 92235 92238 8016 92235 92238 8016 92235 92238 8016 92235 92238 8016 92235 92238 8016 92235 92238 64152 64154 64155 64156 64157 64158 64160 8016 40000 1001 8016 5010 5011 | 2.97072 | | |
| UO2 3.37% | 10.24 | 92238 | 85.18134 | | |
| | | 8016 | 11.84793 | | |
| | | 92235 | 0.58918 | | |
| | | 92238 | 82.27710 | | |
| | | 64152 | 0.01006 | | |
| | | 64154 | 0.11109 | | |
| 6%GD+NU | 10.24 | 64155 | 0.75907 | | |
| 0%GD+NU | 10.24 | 64156 | 1.05664 | | |
| | | 24 92238 8016 92235 24 92238 8016 92235 24 92238 8016 92235 92238 64152 64154 64155 64156 64157 64158 64160 8016 35 40000 1001 8016 5010 | 0.81303 | | |
| | | 64158 | 1.29868 | | |
| | | 64160 | 1.15737 | | |
| | | 8016 | 11.92779 | | |
| Cladding | 6.55 | 40000 | 0.04244* | | |
| | | 1001 | 11.18000 | | |
| Water | 0.735 | 8016 | 88.72000 | | |
| vv ater | 0.755 | 5010 | 0.02000 | | |
| | | 5011 | 0.08000 | | |

*Number density for natural Zr given in atoms 1/(barn-cm)