

## Simplified Model of the Upper Internal Structure in PGSRF

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### 1. Introduction

The upper internal structure (UIS) is attached to the rotating plug of the reactor head and cantilevered downward into the reactor hot pool. Its bottom end is located just above the top of the core assemblies during power operation. The principal functions satisfied by the UIS are to support the control rod drivelines laterally and protect the drivelines from sodium flow induced vibration. The other function is to support the above core instrumentation drywells.

Among the above structures, the core instrumentation drywells are excluded in the finite element model. Fig. 1 shows the design configuration of the UIS in PGSRF [1]. The purpose of this study is to construct the simplified stick model for the UIS. In order to verify the simplified stick model, the modal analysis of the 3D FE model is performed and then the modal characteristics of the simplified stick model are compared with the 3D FE model.

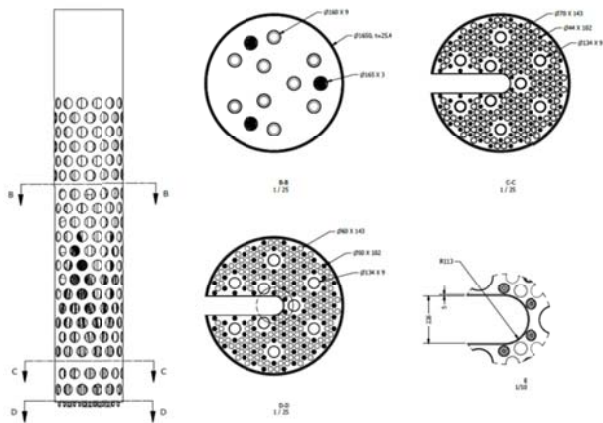


Fig. 1 Design configuration of the UIS in the PGSRF

### 2. Modeling of the UIS

#### 2.1 3D FE Model

The detailed 3D configuration including the control rod drivelines of the inside is modeled to identify the vibration characteristics of the UIS. Fig. 2 shows the 3D FE model of the UIS, which is the cantilever type structure that all nodes of the top surface of the UIS are constrained in the boundary condition. Fig. 3 represents the modal analysis result of the 3D FE model, which shows the dominant four modes extracted from the modal analysis [2]. Table 1 shows the natural

frequencies and mode shapes of the 3D FE model. The natural frequencies for the first and second modes are calculated as 11.68 Hz and 12.4 Hz, respectively.

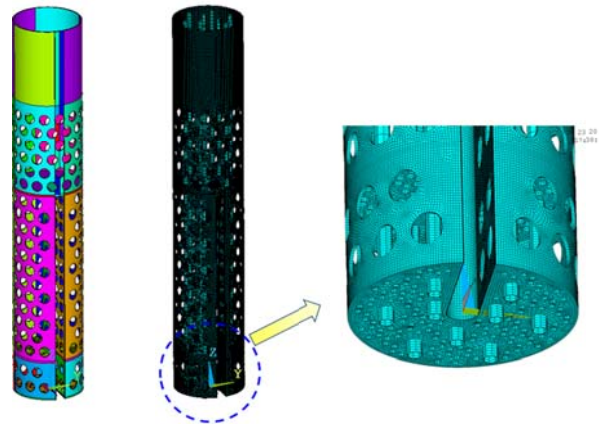


Fig. 2 3D FE model of the UIS

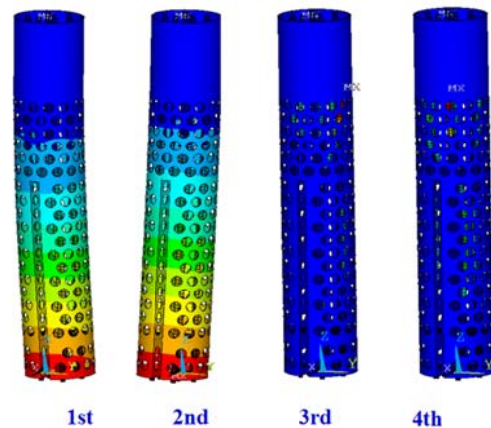


Fig. 3 Modal analysis result for the 3D FE model

Table 1 Natural frequencies and mode shapes for the 3D FE model

Mode	Natural Frequencies (Hz)	Mode Shapes
1st	11.677	Shell cylinder structure 1 <sup>st</sup> bending
2nd	12.397	Shell cylinder structure 2 <sup>st</sup> bending
3rd	20.409	Control rod 1 <sup>st</sup> bending
4th	20.417	Control rod 2 <sup>st</sup> bending

#### 2.2 Simplified Stick Model

The simplified stick model is constructed to have the similar natural frequencies with the first and second modes of the 3D FE model in the scope of maintaining

