DYNAMIC EVALUATION OF REACTOR CORE SUPPORT STRUCTURES

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A numerical integration method has been used for determining the dynamic respone of reactor internal structures subjected to blowdown forces caused by a loss-of-coolant accident.

The actual structure consists of the lower grid assembly, the plenum assembly, the core mass, and the holddown springs. The plenum assembly is made up of the upper grid assembly, the plenum cylinder, the plenum cover, and the control rod guide tube assembly. The core mass comprises a number of fuel assemblies. The stiffness of the holddown springs, which are attached between the upper end of the core mass and the upper grid assembly, is neglected during the dynamic analysis because of its small magnitude. The free length of the holddown spring is considered as a gap between the core and the plenum assembly. The core mass rests on the lower grid assembly. The lower grid assembly and plenum cover are assumed to be simply supported at the ends.

An actual structure is converted into an equivalent dynamic model by applying an appropriate transformation factor to the elements that constitute a vibratory system and simplifying an undamped, single-degree-of-freedom elastoplastic system subjected to time-varying force. The dynamic model is excited by the blowdown forces; for this analysis core force loading is used. Based on the dynamic model, three types of analysis

(i) core mass contacts with lower grid assembly,
(ii) core mass contacting neither lower grid assembly nor plenum assembly,
(iii) core mass contacting plenum assembly,

are required to determine the dynamic response of the upper and lower grid assemblies to these dynamic forces. The digital computer code PNAME was developed for the analysis; it is written in the algebraic computer language Fortran IV. Three test cases were run - two with mass rigidly connected to the spring and one with mass not rigidly connected to the spring.

The following conclusions are drawn:

1. The results of the verification studies reported in this paper indicate that this approach is good only for a single-degree-of-freedom system.
2. The analysis can consider any type of boundary conditions of the lower assembly and the plenum cover.
3. The code determines the dynamic behavior of the upper and lower grid assemblies. The motion of the upper grid assembly and the plenum cover are similar because it is assumed that the control rod guide tube assembly and the plenum cylinder are very stiff.
4. This code is applicable only when the value of the mass of the lower grid assembly and upper grid assembly are very low compared to core mass.
5. The flexibility of the fuel assembly was not considered here.

REFERENCES

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