

Non-Baseload Operation of NPPs: Reasons, Challenges and Solutions

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Abstract

For commercial, technical and regulatory reasons, most existing nuclear power plants (NPPs) are optimised to operate at steady full power, known as baseload operation, as it is generally considered to be the most efficient use of capital investment. However, there is an increasing need to operate nuclear units flexibly, specifically in frequency control and load following mode of operation. Primary reasons for this are a large nuclear generating capacity relative to total capacity, growth in renewable generation, deregulation or structural changes of the electricity supply system and the electricity market during the long operating lifetime of a NPP. This necessitates not only adaptation of technical and regulatory changes, but also operational, economic and financial rearrangements to maintain the efficiency of capital investment. The feasibility of flexible operations and the resultant decision that is acceptable by all stakeholders as to whether the NPP should be operated in a flexible or baseload mode of operation can be influenced by several factors. Technically, new-built NPPs have an advantage in that the planning and design of a NPP have usually had flexible operations in mind. However, these systems need to be validated during initial startup testing and any limitations should be determined at the beginning of operations. Additionally, the operating license application (safety case) would be developed to support flexible operations. The NPPs that have previously operated only in a baseload mode, and are now considering flexible operations, also face a complicated situation. Dependent upon the NPP design and the extent of flexibility requirements, modifications to the plant may be required to support frequency control and load following operations. Licensing changes may also be required, and existing operation and maintenance philosophies may need adjustment to support flexible operations. In the commercial aspects, the deviation from baseload operation has to be considered within the electricity market framework to minimize, eliminate or compensate for the impact of flexible operation on the efficient use of capital investment while serving the overall energy structure needs. This paper discusses all these aspects of design or operation of NPPs in flexible mode based on the existing knowledge and experience.

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