

## **Advanced Fuel Designs and Integrated Core Fuel Management, Key Factors for Minimum Power Generating Costs**

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Fuel assembly design and manufacture as well as fuel assembly management have substantial influence upon the overall nuclear plant economics. The economic improvements achieved over the last decade are considerable.

The implementation of measures to reduce the fuel cycle costs is strictly associated with maintaining or even improving the operation behavior of the fuel assemblies. This is reflected e.g. by reduction of the failure rates. Another major factor of development has been the increase of the discharge burnup. The economic effect of burnup increase essentially depends on the burnup level itself and on the approach to the disposal costs. Compared to the past, in future scenarios the specific economic effect of burnup increase will become smaller but still significant. They are supplemented by measures to improve the fuel utilization. Main areas in this respect are the reduction of neutron losses by means of advanced low leakage core loading patterns, optimization of moderation efficiency and usage of less neutron absorbing materials in the fuel assemblies. Advanced fuel assemblies of FANP combine innovative features with the objective of achieving best long term overall economy and sustainability.

As an adverse effect of the implementation of the broad spectrum of innovative features to improve the fuel cycle economy and, as well, the insertion of MOX and ERU fuel assemblies in LWRs, heterogeneity in the core increased. In addition, the increased variety in cycle lengths imposes considerable challenges to fuel management codes and methods. In response of that, integrated high capacity methods, enabling e.g. consideration of safety related physical, thermal-hydraulic as well as mechanical data on an individual fuel rod basis in the core, have been developed and put into practice. By this means, very precise analyses and predictions became possible, enabling best use of margins and answering in a optimized way to the increased needs..

In contrast to conventional energy production, nuclear power generation is characterized by a distinctively low dependence on natural resources and accordingly respective possible price increases. On the other hand, as the remainder of the power generating costs of NPP depends on technology, nuclear power holds a comparatively high potential of further successful economic improvement by further technical development.