Lessons learnt from OECD/NEA Phase II-C through Phase II-E Benchmarks

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In the OECD/NEA Phase II-C Burnup Credit (BUC) Benchmark the impact of the asymmetry of realistic axial burnup profiles of spent PWR UO_2 fuel assemblies on the axial end effect was studied. It was shown that the axial end effect increases with increasing asymmetry.

In the Phase II-D BUC Benchmark the effect of Control Rod (CR) insertion during irradiation of PWR UO_2 fuel assemblies on the spent fuel composition was studied. It was shown that CR insertion results in a change of the Spent Nuclear Fuel (SNF) isotopic inventory; and it was demonstrated that, at given initial enrichment and given burnup, SNF which was exposed to CR insertion during irradiation has a higher reactivity than SNF which has not been exposed to CR insertion.

In the Phase II-D benchmark exercises it was however assumed that the fuel assemblies were exposed to control rod insertion over their full active length; and in all cases analyzed a uniform distribution of the burnup and hence a uniform distribution of the isotopic number densities were assumed.

The Phase II-E benchmark therefore combined the asymmetry effect on the end effect with the CR insertion effect on the isotopic inventory. Thus, the objective of the Phase II-E benchmark was to study the impact of changes in the spent nuclear fuel isotopic composition due to CR insertion on the reactivity and the end effect of fuel assemblies with realistic axial burnup profiles for different CR insertion depths ranging from 0 cm (no insertion) to full insertion.

Results from the three benchmark exercises will be presented, and it will be shown that the results obtained in the Phase II-E benchmark can be understood from observations made in the Phase II-C exercises.