Submitted to the OECD Topical Meeting on LOCA, to be held at Argonne National Laboratory, USA, on May 24-26, 2004

SEGFSM Topical Meeting on LOCA Issues
Argonne National Laboratory, May 25-26, 2004.

A pragmatic methodology to assess the fuel burnup effects in licensing of LBLOCA analysis for Belgian NPPs

A. Charlier and J. Zhang
Nuclear Department
Tractebel Engineering
Avenue Ariane 7, B-1200 Brussels, Belgium
Phone: 32.2.7739843, Fax: 32.2.7738900, E-mail: jinzhao.zhang@tractebel.com

ABSTRACT

Traditional design basis large-break loss of coolant accident (LBLOCA) analysis considered the beginning of life (BOL) as the most limiting fuel conditions, which lead to the maximum fuel temperature for a given power peaking factor due to the maximum densification of the fuel. Recent experimental evidences show a degradation of the fuel thermal conductivity for fuel at higher burnups, which leads to a significantly higher fuel temperature at the end of life (EOL) than the BOL, at a constant power peaking factor. While this burnup effect is physically compensated by the natural reduction of power peaking factors as a function of the burnup, it is difficult to consider both phenomena in the LBLOCA analysis in a suitably conservative manner, without modifications of the Technical Specifications and the Reload Safety Evaluation methodologies.

Therefore, a pragmatic methodology has been proposed and accepted by the Safety Authority to assess the effects of fuel burnup in licensing of LBLOCA analysis for Belgian NPPs. In this approach, a progressive and limited reduction of the power peaking factor Fq is determined from the intermediate burnup up to high burnup limit at end of life (currently 55 GWd/t in Belgium), based on the power capability studies as function of fuel assembly (FA) burnup. It must be demonstrated that sufficient margins exist between the calculated fuel assembly maximum linear power and the proposed Fq limit, such that a systematic verification of the Fq limit for each fuel assembly at each cycle is no more necessary. Such a demonstration has to be generic for future cycles. The so-determined Fq limit will be used to assess the burnup effects in the LBLOCA analysis, in order to verify the compliance of the 10CFR50.46 final acceptance criteria.

This approach has been applied in the recent LBLOCA analyses, in support of licensing for steam generator replacement and power uprate of Tihange 2 and Doel 2 PWR plants.