Bruce B Transition Core Fuelling Study – Natural Uranium To Low Void Reactivity Fuel[1]

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ABSTRACT

Fuel management aspects of converting a Bruce B reactor from natural uranium to CANFLEX® low void reactivity fuel have been investigated using the fuelling simulation code AUTOSORO. The objective was to find a strategy that achieves the transition with sufficient margin to the channel and bundle power limits while minimizing the impact on fuel handling capability.

AUTOSORO is an integral part of the Simulation of Reactor Operation (SORO) code used at Bruce Power for compliance with channel and bundle power limits and fuel scheduling. AUTOSORO mimics fuelling engineer procedures in performing predictive simulations to create a fuelling list. High burnup (compared to target) channels are tested and scheduled if there is sufficient margin to channel and bundle power constraints following fuelling. The flux and power distributions are updated after every full power day. The spatial reactivity balance is maintained by ordering the fuelling such that the average zone power distribution is kept at the distribution specified by the user.

In addition to a reference case with natural uranium fuelling covering 800 full power days of operation at 93% full power, four transition cases were simulated for the same time period. These involve two-bundle shift as well as four and eight-bundle fuelling of low void reactivity fuel.

The current fuelling scheme consists of 380 channels designated as four-bundle shift channels and 100, eight-bundle shift channels in the outer core regions. It was found that a feasible transition strategy involves designating some channels for two-bundle shift fuelling and allowing discretionary two-bundle shift fuelling on other channels should burnup targets be exceeded by a designated amount. A decrease in channel powers in the inner core region and a corresponding increase in the outer core region will be required. There will be an impact on fuelling machine capability in terms of an increase in the on-reactor fuelling duty cycle time because of the two-bundle shift fuelling.

Fuelling power changes in the post-transition core will be larger than current changes with natural uranium fuel. Therefore a return to current fuel management practices following the transition is not anticipated. Modified fuel management practices will evolve during the transition which will likely consist of a small number of channels permanently designated as two bundle shifts, modifications to current burnup targets and reduced power in the inner flow zone with a corresponding increase in power in the outer flow zone.

[1] NSS performed this work under contract from Bruce Power.