Characterization of a Thermalhydraulics Model for the Gentilly-2 PHTS

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Abstract

The primary heat transport system (PHTS) of a CANDU 6 nuclear power plant requires monitoring throughout the plant life for efficient operation of the station. Successful monitoring of a station can identify the timing of preventative maintenance and proper assessment of safety parameters due to changes that have occurred from operation. One of the key components of successful monitoring is the development of a thermalhydraulic plant model of each component in the primary heat transport system. Thus tracking of the HTS model against HTS data is an important element in defining appropriate actions for preventive maintenance or updates to safety parameters and ROP Trip setpoints.

The first step in developing a HTS plant model is the collection of site data, in particular process measurements, and assessing their accuracy. Quite often, the process of assessing the data and developing the model will indicate potential calibration errors which help staff at the stations to verify the performance of their instrumentation. The next step is the development of the HTS model, in particular the configuration of each component: steam generator, pump, header, feeder, end fitting, channel.

In this work, the main objective is to assess the current operational status for the Gentilly-2 heat transport system. In particular, monitoring how the PHTS has changed from first commissioning.

The NUCIRC code is a one-dimensional steady state code used to predict flow rates, pressure, temperature, and quality throughout the primary heat transport system (PHTS). Some code features allow the calculation of critical channel powers (channel power at dryout), of channel flow conditions during refuelling operations, and of PHTS auxiliary system flows such as purification flows.

Although the NUCIRC code predictions agree fairly well with site data during commissioning of a new plant, use of a commissioning NUCIRC model for an operating plant shows significant disagreement with site data for increasing EFPD. Several ageing phenomena are affecting the heat transfer and hydraulic characteristics of the HTS components which is the fundamental reason why a commissioning or beginning of life

model cannot reproduce or track the observed trends in HTS operating conditions. These phenomena are: magnetite transport, pressure tube diametral creep, orifice rounding.

The assessment of the Gentilly-2 station has shown that significant magnetite transport has occurred resulting in a fouled steam generator and a significant reduction in station flow. Based upon this assessment, and other supporting studies, it was recommended that the steam generators at Gentilly-2 be cleaned to reduce the fouling level and improve station flow.

The paper will present results of the NUCIRC design model predictions of G2 first commissioning data and the adjustment parameters required to reproduce G2 operating data before and after the 1999 steam generator cleaning.