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DELOCA, A COMPUTER CODE FOR SIMULATION OF CANDU FUEL CHANNEL BEHAVIOR IN THERMAL TRANSIENTS

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Abstract. *DELOCA computer code is a software developed as an interactive program in Visual Basic*5 *to simulate the thermo-mechanical behavior of CANDU fuel channel under postulated LOCA conditions, to simulate pressure tubes ballooning phenomenon. The modeling of temperature transient conditions for both pressure (PT) and calandria (CT) tubes and moderator and also the material properties dependence versus temperature are the most important features of the code. DELOCA code is used in this paper to simulate the fuel channel response at transient conditions that are described by heating rate of pressure tube inside surface. The temperature rate values used were:* 1, 5, 10, 15, 20, 25, *respective,* 50 ^{o}C/s. *Also, DELOCA is used to perform a fuel channel analysis taking into account a postulated accident conditions for RIH* 5% *(Rupture of Inlet Header).*

Keywords: LOCA, ballooning, pressure tube, calandria tube, CATHENA computer code

1. Introduction

The CANDU-6 reactor design is based on the natural uranium fuel and heavy water as moderator and reactor coolant. The pressure tube from each fuel channel, made from Zr-2.5%Nb alloy, contains the primary cooling agent and the fuel bundles and it allows the refuelling process during reactor operation. A distinctive feature of CANDU (CANada Deuterium Uranium) design consists of the separation between coolant and moderator by an interstitial gap between pressure tube (PT) and calandria tube (CT), which is filled with an annulus inert gas [1]. There is the possibility to detect any leakage in the gap by monitoring of annulus gas moisture and, consequently, to monitor the loss of coolant.

The deformation of pressure tube is quite sensitive on the magnitude of internal pressure at high temperatures and on its overheating rate as well. In some loss of cooling accidents (LOCA), at high internal pressure and temperatures, the pressure tube can deform diametrically until its contact with surrounding calandria tube is reached. Sometimes this phenomenon is referred as pressure tube ballooning [2].

The local contact produces the heat removal to the moderator, and the heat transfer rate depends on the contact conductance and heat transfer regime established at calandria external surface. If the heat flux exceeds the critical heat flux for specified fuel channel the calandria tube will dry out. Since the post-dry out heat transfer

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