13th International Conference on CANDU Fuel
Holiday-Inn Waterfront Hotel
Kingston, Ontario, Canada, 2016 August 15-18

CANDU FUEL:
Evolution towards Optimal Performance

3D MODELLING CAPABILITY FOR CANDU FUEL PERFORMANCE

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ABSTRACT – The ELESTRES (ELEment Simulation and sTRESses) computer code models the thermal, mechanical and micro structural behaviours of CANDU®[2] fuel element under normal operating conditions. The main purpose of the code is to calculate fuel temperatures, fission gas release, internal gas pressure, fuel pellet deformation, and fuel sheath strains in fuel element design analysis and assessments. The code is also used to provide initial conditions for evaluating fuel behaviour during high temperature transients.

ELESTRES currently uses the finite-difference method to solve the classical one-dimensional equation for heat conduction and the two-dimensional axisymmetric finite element method is used for stress calculations. For fission-gas release and associated calculations, ELESTRES uses a microstructural model.

A proprietary three-dimensional modelling capability for ELESTRES code has been developed at Candu Energy, using the finite element method. The three-dimensional finite element code covers both steady-state and transient conditions.

This paper presents an overview of the proprietary three-dimensional code with descriptions of the code's finite element platform, theoretical background, and solution methodologies. The results of code testing have confirmed that the code predictions of the fuel performance parameters are reasonable, and the predictions trends with power and burnup are acceptable. Also, the code predictions have reasonable agreements with measurements. The three-dimensional code has modeling options for loading/unloading condition and transient calculation; a potential for load following applications.

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