PACKAGE ID - 000754I600000 NESTLE

KWIC TITLE - Few-Group Neutron Diffusion Equation Solver Utilizing the Nodal Expansion Method

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LIMITATION CODE -UNL **AUDIENCE CODE -** UNL

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DESCRIPTION - NESTLE is a FORTRAN77 code that solves the few-group neutron diffusion equation utilizing the Nodal Expansion Method (NEM). NESTLE can solve the eigenvalue (criticality); eigenvalue adjoint; external fixed-source steady-state; or external fixed-source or eigenvalue initiated transient problems. The eigenvalue problem allows criticality searches to be completed, and the external fixed-source steady-state problem can search to achieve a specific power level. Transient problems model delayed neutrons via precursor groups. Several core properties can be input as time dependent. Two or four energy groups can be utilized, with all energy groups being thermal groups (i.e. upscatter exits) if desired. Core geometrics modelled include Cartesian and Hexagonal. Three, two and one dimensional models can be utilized with various symmetries. The thermal conditions predicted by the thermal-hydraulic model of the core are used to correct cross-sections for temperature and dentisty effects. Cross-sections are parameterized by color, control rod state (i.e. in or out) and burnup, allowing fuel depletion to be modelled. Either a macroscopic or microscopic model may be employed.

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PACKAGE CONTENTS - Media Directory; Software Abstract; EGG-NRE-11406; Media Includes Source Code, Auxiliary Material, Compilation Instructions, Linking Instructions, Sample Problem Input and Output;

SOURCE CODE INCLUDED? - Yes

MEDIA QUANTITY - 3 3.5 Diskettes

METHOD OF SOLUTION - Few-group neutron diffusion equation is spatially discretized utilizing NEM. Quartic/quadratic polynomial expansions for the transverse integrated fluxes are employed for Cartesian/Hexagonal geometries. Transverse leakage terms are represented by a quadratic polynomial or constant for Cartesian/Hezagonal geometry. Discontinuity Factors are utilized to correct homogenization errors. Transient problems utilize a specific number of delayed neutron precursor groups. Time dependent inputs include coolant inlet temperature and flow; soluble poison concentration, and control banks positions. Time discretization is done in a fully implicit manner utilizing a first-order difference operator for the diffusion equation. Precursor equations are analytically solved assuming the fission rate behaves linearly over a time-step. An outer-inner iterative strategy is employed to solve the resulting matrix system. Outer iterations can employ Chbyshev acceleration and Fixed Source Scaling Technique to accelerate convergence. Inner iterations employ either color line or point SOR iteration schemes. Values of the energy group dependent optimum relaxation parameter and the number of inner iterations per outer iteration to achieve a specified L2 relative error reduction are determined a priori. The non-linear iterative strategy associated with the NEM method is utilized. An advantage of the non linear iterative strategy is that NESTLE can be utilized to solve the nodal or Finite Difference Method representation of the few-group neutron diffusion equation. Thermal-hydraulic feedback is modelled employing a Homogenous Equilibrium Mixture model, allowing two-phase flow to be treated. Only the continuity and energy equations for the coolant are solved. Slip is assumed to be one in the HEM model. Lump parameter model is employed to determine fuel temp. Decay heat groups are used to model decay heat. Cross-sections are expressed in terms of a Taylor series expansion.

COMPUTER - IBM RS 6000

OPERATING SYSTEMS - AIX, HPUX, ULTRIX, and SUN OS

PROGRAMMING LANGUAGES - FORTRAN77 (99%) and ANSIC (1%)

SOFTWARE LIMITATIONS - The NEM option only works for 2 and 4 energy groups.

SOURCE CODE AVAILABLE (Y/N) - Y

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UNIQUE FEATURES - Can perform both steady-state calculations with both macroscopic and microscopic depletion. Transient calculations performed with the same cross section input as steady-state calculations.

RELATED SOFTWARE - None

HARDWARE REQS - Workstation with at least 16MB or memory.

TIME REQUIREMENTS - Sample problems provided take from less than one second to forty minutes on an HP9000/735 in double precision. A state-point calculation of a typical three-dimensional problem takes one to two seconds of CPU time.

REFERENCES - P.J. Turinsky, R.M.K. Al-Chalabi, P. Engrand, H.N. Sarsour, F.X. Faure, and W. Guo, NESTLE: A Few-Group Neutron Diffusion Equation Solver Utilizing the Nodal Expansion Method for Eigenvalue, Adjoint, Fixed-Source Steady-State and Transient Problems, EGG-NRE-11406, June 1994

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SPONSOR - DOE/ER;DOE/NE

PACKAGE TYPE - SCREENED