REACTOR PHYSICS CODE WORKSHOP

Organized by:
Atomic Energy of Canada
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2004 April 19-23
Sheridan Park Conference Centre (SPCC)

PROGRAM

2004 Apr. 19 *8:30-12:00 & 14:00-17:00*	WIMS Theory – SPCC David Irish - AECL
2004 Apr. 20 *8:30-12:00*	WIMS Practice – SP1F2 David Irish - AECL
2004 Apr. 20 *14:00-17:00*	DRAGON Theory – SPCC Guy Marleau – École Polytechnique
2004 Apr. 21 *8:30-12:00*	DRAGON Practice – SP1F2 Wei Shen - AECL
2004 Apr. 21 *14:00-17:00*	RFSP Theory – SPCC David Jenkins - AECL
2004 Apr. 22 *8:30-10:00*	RFSP Theory (cont'd) – SPCC David Jenkins – AECL
2004 Apr. 22 *10:12:00*	WIMS-RFSP Interface – SPCC Wei Shen - AECL
2004 Apr. 22 *14:00-17:00*	RFSP Practice – SP1F2 Michaela Ovanes and David Jenkins - AECL
2004 Apr. 23 *8:30-12:00*	RFSP Practice (cont'd) – SP1F2 Michaela Ovanes and David Jenkins - AECL

End of Workshop

Detailed program on following pages.

WIMS Theory
David Irish - AECL

OUTLINE

1. What is a lattice calculation? - inherent approximations
2. How it all fits together. - WIMS/DRAGON/RFSP
3. Basic WIMS input of geometry ignoring neutronic (mesh spacing) constraints - example of a 7-element bundle
4. Running the code - PC and HP Unix scripts
5. Basic output
   - K and main transport routine (MTR) flux solution
   - leakage edit: keff, buckling search, (2-group parameters?)
   - reaction rates
6. Nuclear data
   - ENDF/B
   - Processing of ENDF/B files to create a data library
   - The ACR library
   - Burnup chains and data
7. WIMS theory
   - path through the code - the chains
   - spectrox calculation
   - resonance calculation
   - integral transport equation
   - collision probabilities
   - solution of integral transport equation
8. More detailed input, taking neutronics (i.e. mesh spacing) into account
9. The ACR input model
   - best model
   - practical model recommendations
   - the design model
10. Validation of WIMS-IST for standard CANDU
11. Changes to WIMS-AECL
    - WIMS-AECL 2-5d to WIMS-AECL 3.0
    - The prototype/intermediate code WIMS-AECL 2-6a
12. Validation of WIMS-AECL 2-6a

WIMS Practice

David Irish and Dimitar Altiparmakov - AECL

OUTLINE

DRAGON Theory for 3-D CANDU Problems

Guy Marleau – École Polytechnique

OUTLINE

1. Introduction to the Collision Probability Method

   1.1 The Transport Equation
   1.2 The Collision Probability Technique
   1.3 Boundary Conditions
   1.4 Cross Section Considerations

2. 3-D Collision Probability Calculations

   2.1 Collision Probabilities in 3-D
   2.2 Numerical Quadrature and Tracking
   2.3 Collision Probability Integration
   2.4 Collision Probability Normalization

3. Solving the Collision Probability Equations for the Flux

   3.1 The Power Iteration
   3.2 The Multigroup Iteration
   3.3 Leakage Models

4. Condensation and Homogenization

   4.1 Multigroup Condensation Technique
   4.2 Full Cell Homogenization
   4.3 Partial Cell Homogenization and SPH factors
   4.4 Microscopic Cross Section Homogenization

DRAGON Practice
Wei Shen - AECL

OUTLINE

Introduction
- Why DRAGON for CANDU 3D transport calculation?
- Training scope
- List of training material

Compose a DRAGON input
- Input file formats
- Data Structure
- Working with Variables
- Conditional execution and loops
- Major modules

Sample DRAGON input and output
- Test Cases
  - TCW601: 1D Mosteller benchmark problem
  - TCW606: CANDU-6 supercell model
- ACR device
  - Geometry: geo
  - Cross section: lib
  - Flux calculation: cal_ref, cal_in, cal_out
  - Homogenization: total

Managing a DRAGON Execution with Side-Step Method
- Side-Step Method
  - Model
  - Procedure
- Managing a DRAGON Execution with Side-Step Method
  - Run WIMS on PC
  - Run T16MAC on PC
  - Run DRAGON on HP

Interface with WIMS
- WIMS TAPE16 File
- Processing WIMS TAPE16 File with T16MAC

Interface with RFSP
- Incremental cross section for RFSP
- Data structure of the DRAGON CPO file
- Processing the DRAGON CPO file

RFSP Theory
David Jenkins - AECL

OUTLINE

Introduction

- Role of RFSP
- General Capabilities of RFSP
- Direct-Access File

RFSP Model

- Neutron Diffusion Equation
- Geometry – mesh spacing for ACR
- Lattice Properties Overview
- Uniform
- Local Parameters (grid based)
- History-Based Local Parameters (micro depletion)
- Reactivity Devices and Device Properties
- Smearing of the Devices

***TIME-AVER**

- Time-Average Model
- Irradiation Regions
- Average vs. Spatially-Distributed Xenon Concentration
- Perturbations
- Flux Flattening
- Time-Average Equivalence

***INSTANTAN**

- Random Age Distribution
- Patterned Age Distribution

***SIMULATE**

- Snapshots
- Average vs. Spatially-Distributed Xenon Concentration
- Bulk and Spatial Control
- WIMS-Uniform-Parameter Methodology
- Micro-Depletion Model

***CERBERUS**

- Spatial Kinetics
- IQS Method
- General Scheme of Solution
- WIMS Grid-Based Method

WIMS-RFSP Interface
Wei Shen - AECL

OUTLINE

Brief Description of the WIMS-AECL TAPE16 File

Brief Description of WIMS Post-Processing Utilities
- PROC16
- MICROBURN
- REGAV
- CONDENS
- WRFSP
- PMAT2LIB

Generation of the WIMS Tables with PROC16
- WIMS Fuel Table
- WIMS Reflector Table
- WIMS Grid-Based Table

Generation of the WIMS Tables with WIMSPAR and CELLPAR
- WIMSPAR
- CELLPAR
- Sample Input and Output

Generation of the Kinetics-Parameter Table with KINPAR
- KINPAR
- Sample KINPAR Input and Output

RFSP Practice
Michaela Ovanes / David Jenkins - AECL

OUTLINE

Introduction
- Input file format
- Defaults
- Use of Direct Access file

How to create an RFSP Model (File "acr700_sample_model.inp")
- Defining the lattice
- Defining the mesh
- Defining the fuel types and reflector
- Defining device positions and cross sections
- Print options
- Examine output (File: "acr700_sample_model.out")

Time Average Calculation (File: "acr700_sample_tav.inp")
- Define the fuelling scheme
- Define the burnup regions and exit irradiation
- Provide a starting flux guess
- Flux solution options
- Device positions
- Xenon concentration options
- *SUMMARY post processing
- Examine output (File: "acr700_sample_tav.out")

Instantaneous Calculation (File: "acr700_sample_instantan.inp")
- Defining channel ages
- Examine output (File: "acr700_sample_instantan.out")

Time Average Equivalent Calculation (File: "acr700_sample_tavequiv.inp")
- Moving data
- Creating snapshot
- Examine output (File: "acr700_sample_tavequiv.out")

Snapshot using Micro-Depletion Method (File: "acr700_sample_sim_localparm.inp")
- Reading WIMS Micro-Depletion Tables
- Defining local parameters
- WIMSHI card
- Burn step with refuelling
- Post processing (*PRTPWR)
- Examine output (File: "acr700_sample_sim_localparm.out")

Kinetics using WIMS Grid-Based Method (File: “acr700_sample_cerberus_loca.inp”)

Reading WIMS Grid-Based Tables
Defining kinetics parameters
Defining thermalhydraulic properties
Defining global parameters
Steady State Input – Case 1
Adjoint input – Case 2
Transient input – Case 3 and beyond
Time steps and SOR positions
Examine output (File: “acr700_sample_cerberus_loca.out”)

Calculating Full Core Void (File: “acr700_sample_cvr.inp”)

Redefining fuel types
Time-average “ipreserve” option
Examine output (File: “acr700_sample_cvr.out”)