WIMCIT: AN IN-HOUSE DEVELOPMENT INTEGRATED CODE FOR NEUTRON ANALYSIS IN MTR REACTORS WITH MIXED CORE

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ABSTRACT

So far, Peruvian nuclear research reactors RP-10 and RP-0 have been operating only with uranium oxide fuel elements (U_3O_8+Al). In the future RP-10 reactor will operate with mixed cores (U_3Si_2+Al, U_3O_8+Al). For this reason the calculus capacity has to be increased in order to be able to handle the new fuel management. Since preparation of nuclear libraries for diffusion calculation requires a significant amount of computational and human resources a new tool that processes libraries generation and diffusion calculations is necessary.

For this reason the WIMCIT code was developed. The main feature of this code is to integrate WIMS and CITATION codes. The user can generate nuclear libraries in different groups (from 1 to 18) in the range of 0-10MeV automatically. They are generated from the WIMS output and then interpolated to create an input to CITATION according to the user specifications. Both the flux and power profiles can be calculated in different transverse sections. The output form the diffusion calculations is processed and different physical parameters of the reactor are displayed to the user.

Others WIMCIT capabilities are, flux calculation, power profiles, burn-up average by element, control rod interaction in the core and fuel management in mixed core. The WIMCIT code has been validated on the experimental data from the RP-10 reactor fresh core to the current core (Number 24).

1. CONTENT

Development

The code was development in Delphi programming language for Windows 98 and its migration to UNIX platform has begun.

The integrated WIMCIT code use the following neutron methodology as we can see in the Fig. 1 and 2.

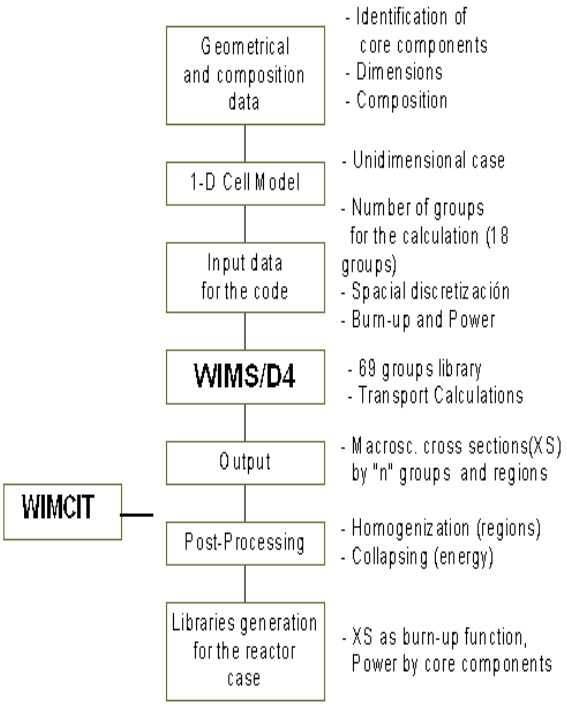

Figure 1. Cell calculation methodology.

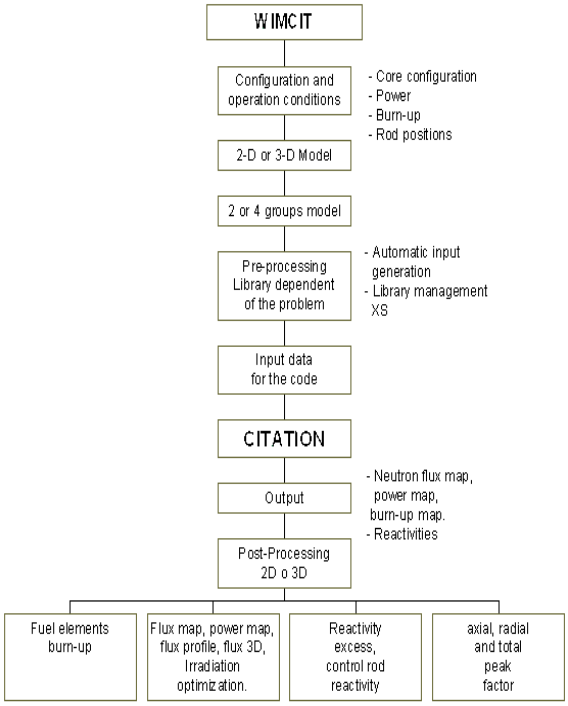

Figure 2. Diffusion calculation methodology.

Main capabilities

The integrated code WIMCIT lets us to evaluate the following parameters:

(1) Flux distribution for four and two energy groups.

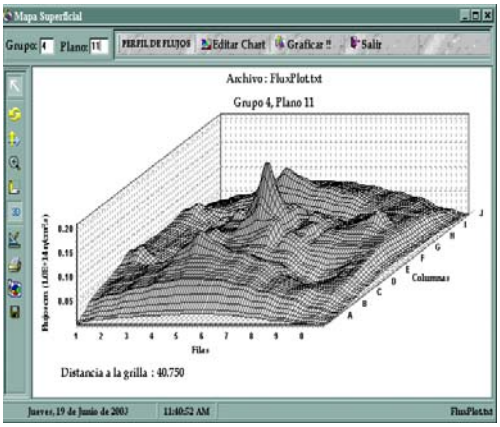

Figure 3. Flux distribution in the RP-10 core.

(2) Burn-up distribution.

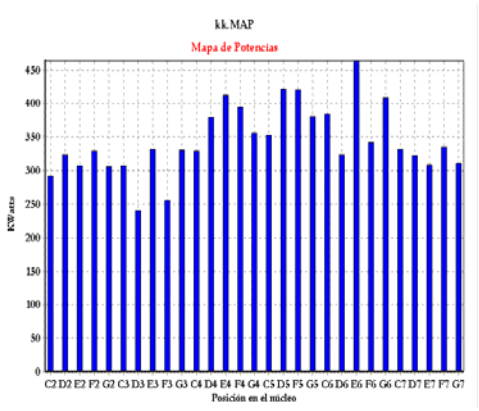

Figure 4. Burn-up for each fuel element position in the RP-10 core.

(3) Excess reactivity.

(4) Power distribution for each position in the core.

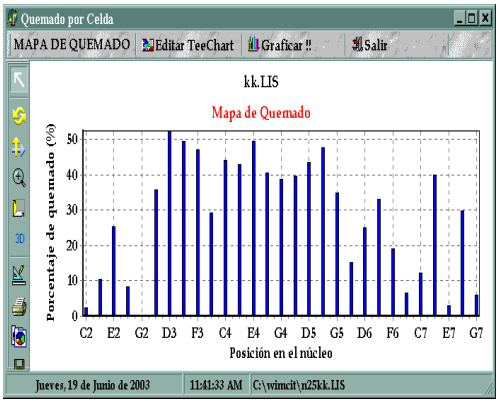

Figure 5. Power in Kilowatts for each fuel element position in the RP-10 core.

(5) Flux distribution per rod and column.

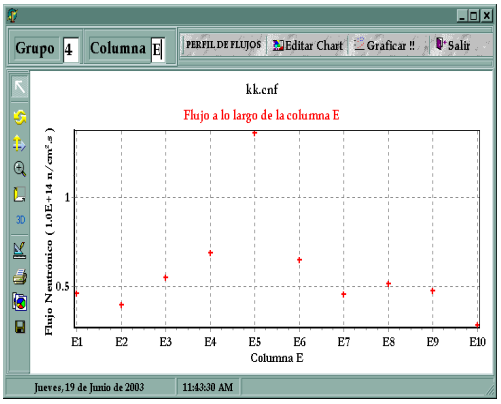

Figure 6. Flux distribution along the column E in the RP-10 core.

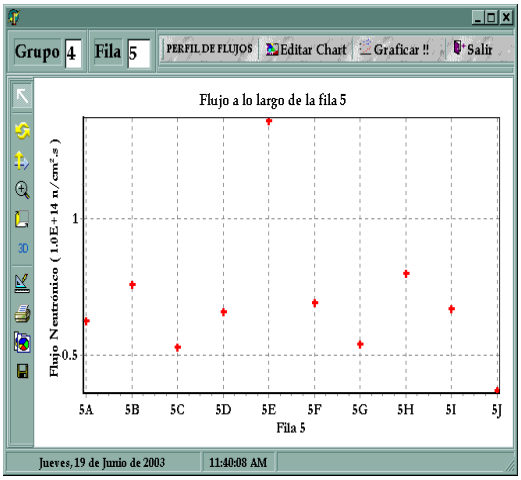

Figure 7. Flux distribution along the rod Nro. 5 in the RP-10 core.

(6) Axial power.

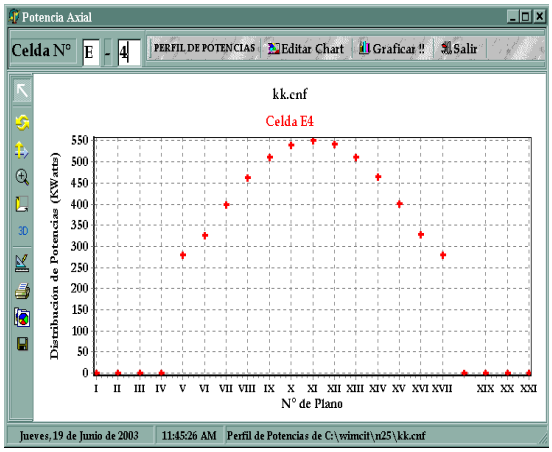

Figure 8. Axial power profile along the E5 irradiation position.

(7) Axial Flux.

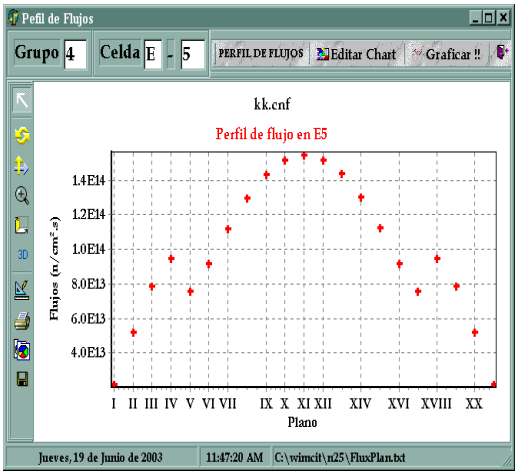

Figure 9. Axial thermal flux profile along the E5 irradiation position.

(8) Peak factors, etc.

The calculation can be made in 2D or 3 D dimensions. The fuel management can be made directly with its easy user interface as will see in the Fig. 10.

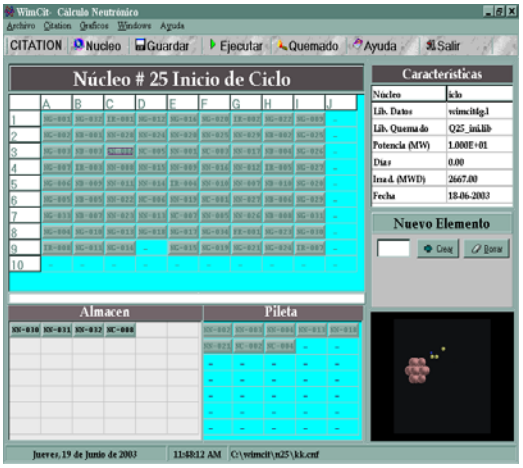

Figure 10. WIMCIT user interface.

Main limitations:

(1) The calculations are made with control rods totally extracted.

2. REFERENCIAS

1) Teobaldo Cuya G., Richard Mediana C., Desarrollo de Software para cálculo neutrónico de del RP-10 a 2 grupos de energía. RT: 004-2002-DGI/DR/CASE/NT, Huarangal-Perú, 2002.

2) Version IAEA, "WIMS code for cells calculations", 2000.

3) Teobaldo Cuya G. Comparación cálculo - experimento del exceso de reactividad y flujos térmicos en el núcleo del RP-10 usando una nueva metodología de calculo neutrónico. RT:002-2003-INST/DR/CASE/NT.

4) T.B. Fowler, D. P. Vondy, G. W. Cunninham, Nuclear reactor core analysis code: CITATION, Oak Ridge National Laboratory, 1972, USA.