WIMS® Reactor Physics Software

WIMS® is a general purpose code for reactor physics analysis.

The Software

The WIMS® package provides a wide variety of advanced easy-to-use methods, coupled with modern nuclear data libraries, that can be used for both benchmark and design type calculations.

WIMS® can be used for the assessment of a range of nuclear reactor types, and can provide modelling capabilities ranging from a simple pin cell calculation of reactivity, to whole core estimates of power, flux, temperature, depletion, pressure drop, flow rate and critical heat flux for small modular reactors. All fast and thermal reactor types, including research reactors, can be analysed.

The user can benefit from the flexibility of using predefined calculation routes or providing customised methods of solution using diffusion theory, discrete-ordinates, collision probability, method of characteristics, SPn or Monte Carlo methods. WIMS® includes subchannel methods for thermal-hydraulic analysis so that thermal feedback effects can be represented.

Whole core models can be easily constructed so that through-life core behaviour can be followed, including searches on critical boron content, critical control rod insertion and critical water height. The effects of varying xenon and samarium distributions can be considered. Online refuelling can be modelled.

Methods such as MPI parallelisation and memory decomposition are used to enhance the performance of components of whole core calculation sequences, e.g. the steps to perform cross section preparation and flux solutions.

WIMS® contains a toolkit to facilitate uncertainty quantification in reactor physics calculations. The features of this toolkit enable uncertainties due to nuclear data and manufacturing tolerances to be assessed in a straightforward manner, using a combination of sampling and sensitivity-based approaches.

Further methodologies have been implemented to allow lattice calculation uncertainties to be propagated into whole core calculations.

Strong Customer Focus

ANSWERS® has a strong global customer base, with clients in more than 30 countries around the world, including the USA, China, Japan and across Europe.

Interaction with our customers, understanding their requirements and listening to their feedback, is an important part of our mission to continuously develop and improve our software.

Customers have access to dedicated hotline support, by telephone and e-mail, and also have access to regular training courses, with bespoke/on-site training available if required.

WIMS® and Supporting Software

Due to its open modular structure, WIMS® can be used in a wide variety of modes. This range of options and the capability to build different calculation routes within one code system means that almost all types of reactor physics calculation can be specified within WIMS®. A new calculation route for wholecore modelling of small PWRs is available via the GEOM module. This route provides dynamic reshielding and homogenisation of cross-sections using the latest core state, with meshes overlaid on the core geometry to define resonance shielding, burnup, core flux and differential thermal feedback .

WIMS® has an easy to use input syntax and is backed up by a comprehensive range of introductory and reference documentation, including an easy to follow User Guide including numerous worked examples.

WIMS® also has an input package called WIMSBUILDER, which aids users in the setting up of standard models such as PWR or VVER models of lattice cells. The user is then only required to input what can be termed as engineering parameters, such as material compositions and fuel geometry for a case. A similar capability has also been prototyped for BWRs.

WIMSBUILDER also facilitates the production of data for the whole core performance code PANTHER. The TRAIL code is now incorporated as a module within WIMS® for the preparation of burnup dependent cross section libraries for use with the nuclide inventory code FISPIN.

The function of the TRAIL module is to process input from burnup dependent WIMS® interfaces containing multigroup neutron spectra and multi-group cross sections for resonance self-shieldable nuclides, averaged over one or more set of user specified materials.

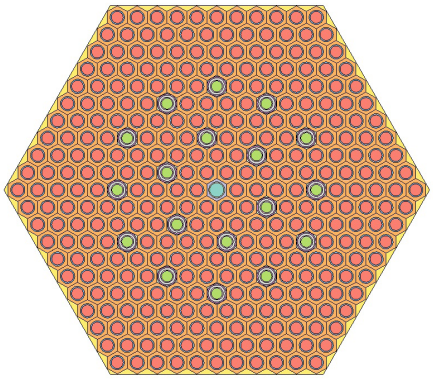
These cross sections are then augmented with multi-group cross sections from a TRAIL database of burnup independent multi-group cross section data. All of the cross sections are then condensed using the WIMS® spectra into three energy groups and output in a form suitable for use with the inventory code FISPIN.

Model verification is a key part of computer code usage and the Visual Workshop tool provides sophisticated options to assist the WIMS® user.

These include a wireframe view of the geometry components, and detailed 2D and 3D views of the geometry. The model views are fully interactive, allowing zooming, panning, rotating, material identification, and cutaway views.

In addition to displaying models for verification, Visual Workshop is a fullyfeatured integrated development environment within which users can edit model inputs, run models, display results on the geometry, and run various analysis tools. WIMS® provides the FCP interface so that userwritten Python functions can be used for aspects of a WIMS® calculation sequence.

Examples include the definition of a coolant equation of state for use in thermal-hydraulic analysis and the export of results in the HDF5 file format.



VVER - Method of Characteristics - 2D Fuel Lattice Geometry

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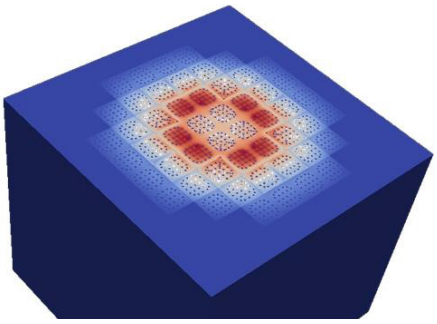
Nuclear Data

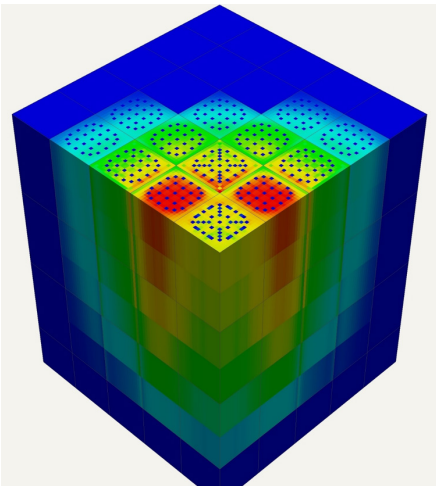
WIMS® can be used for the assessment of a wide range of nuclear reactor types including thermal spectrum systems where the nuclear data is formulated into broad group nuclear data libraries in 172 energy groups, and intermediate and fast spectrum systems where the nuclear data libraries are available in 1968 energy groups. Libraries for JEF2.2, JEFF3.1.2, JEFF3.3, ENDF/B-VII.0, ENDF/B-VIII.0, and CENDL 3.1 nuclear data libraries are available.

The WIMS® libraries contain data covering deep burn scenarios as well as the thorium fuel cycle and are regularly updated as new requirements emerge. Deterministic equivalence and subgroup resonance treatments are available as well as Monte Carlo methods to deal with a wide variety of reactor requirements.

The WIMS® code and library combination has been extensively validated against international experimental configurations.



KAIST - 3D Fuel Pin Centre Temperature (300 – 1893 °C)

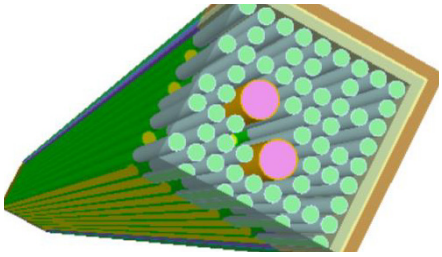


KAIST - 3D Pin Powers

WIMS® Applications

WIMS® has been successfully used in support of the design and operation of a wide range of nuclear reactors. Selected examples include:

- UOX, MOX, metal and other types of fuel assemblies
- Pin, pellet, plate and prismatic and pebble particle fuel geometry options
- Lattice cell calculations with pins on a square or triangular pitch and for cluster geometry with pins on concentric rings
- Whole core calculations for water-cooled systems including PWR and BWR, and gascooled systems such as AGR and HTR
- Fuel depletion analysis using both deterministic and Monte Carlo methods
- Design and analysis studies for novel and Advanced Generation IV reactor systems, including liquid metal and gas cooled fast reactors, high temperature reactors and molten salt reactors
- Optimisation of fuel loading and reloading
- Reactivity co-efficient and shut-down margin calculations
- Poison worth calculations
- Neutron and gamma heating studies
- Fine structure effects due to local absorbers and end-gaps
- Generation of neutron constants for use in PANTHER whole-core analysis for steadystate and transient conditions
- Experimental comparisons
- Internal benchmarking by comparing deterministic and Monte Carlo options using the same geometry and nuclear data
- Criticality searches and surveys, for example to optimise fuel pool storage
- Analyses of PWR UOX, MOX and mixed UOX/MOX core fuel loadings



BWR - Method of Characteristics - 3D Fuel Lattice Geometry

Contact

If you would like more information about Amentum's ANSWERS® Software Service, please contact:

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