

# Core Management System 5 (CMS5) for VVER plants

Studsvik's Core Management System 5 (CMS5) - VVER enables customers to be self-sufficient in their core design and analysis for VVER plants.

## Development of CMS5-VVER

Studsvik's nuclear fuel lattice code, CASMO5, and nodal simulator code, SIMULATE5, work together as CMS5 to provide the foundation for state-of-the-art core design. These have now been extended to include VVER plants.

CMS5-VVER builds upon the 40 years of operational experience gained by the use of previous generations of CASMO and SIMULATE codes in over 200 light water reactors. CMS5-VVER, comprised of CASMO5-VVER and SIMULATE5-VVER, leverages modern computing power to increase accuracy and precision without the need of supercomputers to model known industry issues learned from decades of operational experience in commercial plants. Furthermore, CMS5-VVER contains additional functions specifically built around industry operational experience.

## Flexibility for the Global Fleet

Studsvik's SIMULATE5-K-VVER nuclear fuel multigroup nodal code is an extension of SIMULATE5 and supports transient analysis for VVER reactors.

CMS5-VVER supports VVER-440, VVER-1000, and VVER-1200 plant designs. Studsvik's software is independent of nuclear reactor, fuel, and used fuel storage cask vendors. By using Studsvik's independent design and planning tools, engineering staff gain the ability to control the design of cores, fuel needs, and assessment of multiple suppliers, which provides flexibility and negotiation leverage.

## Efficiency, Accuracy, and the Future

CMS5-VVER provides highly accurate predictions at any point during the operational fuel cycle for rapid evaluation of core behaviors so that engineers are always prepared to respond to changes and issues.

CMS5-VVER combines pin-by-pin reconstruction accuracy with optimal functions for real engineering work to ensure there is an efficient calculation for both planned operations and unplanned analyses.

CMS5-VVER evolves in parallel with industry fuel designs. If it's new, the development will be included in CMS5-VVER.

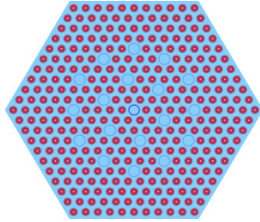
**CMS5-VVER enables nuclear power plant operators to efficiently and accurately manage the entire nuclear fuel lifecycle.**

## CASMO5-VVER

CASMO5-VVER is Studsvik's 2D lattice code for VVER reactor designs. The 2D transport solution is based on Method of Characteristics (Linear Source) and uses the latest libraries - ENDF/B-VII.I and ENDF/B-VIII.0 in a 586 energy-group structure.

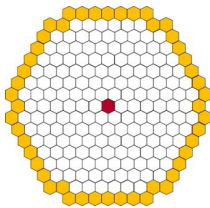
CASMO5-VVER generates few-group cross-section data for SIMULATE5-VVER and supports efforts in the following areas:

- Fuel management
- Core follow
- Plant operations
- Reload physics
- Spent nuclear fuel management



Important enhancements for VVER:

- Updated resonance self-shielding using Characteristic based Dancoff for hexagonal lattice.
- 1-D pincell spectrum calculations common to square and hex-geometry options
- Refined angular quadrature
- Detailed multi-assembly VVER reflector calculation
- Solution to Bateman system of ODEs based on new Chebyshev Rational Approximation Method (CRAM)



## SIMULATE5-VVER

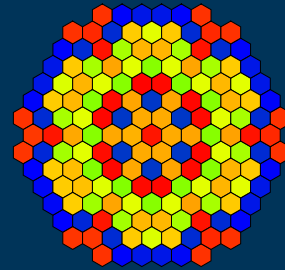
Studsvik's 3D, steady-state, multigroup nodal simulator code, SIMULATE5-VVER, applies the expertise and experience of SIMULATE5 for VVER reactor designs. SIMULATE5-VVER delivers vendor independence and unparalleled accuracy for advanced core designs with increased heterogeneity and aggressive operating strategies.

SIMULATE5-VVER efficiently and accurately analyzes core loading pattern designs even with complicated core designs. It is built to meet the needs of reactor engineers and core designers, with functionality to support startup physics testing, power maneuver guidance, thermal limit assessment, shutdown margin calculations, and much more.

The SIMULATE5-VVER model supports fuel studies and validates vendor-predicted cycle lengths, ensuring the maximum return on your fuel investment.

## S5K-VVER

Studsvik's nodal code for LWR transient analysis, SIMULATE5-K-VVER, delivers neutronic and thermal-hydraulic analysis with licensing-grade accuracy. S5K-VVER is a best-estimate nodal reactor analysis tool that employs advanced core neutronics coupled with detailed thermal-hydraulic channel models for a wide range of transients for VVER reactor designs. S5K-VVER helps operating utilities address key industry regulatory issues, including pin enthalpy. S5K-VVER uses the same high-fidelity nodal methods as SIMULATE5-VVER and solves the time-dependent multi-group neutron diffusion equations. In addition, S5K-VVER is capable of modeling transients for safety analyses such as reactivity insertion accidents and boron dilution events.



## Unparalleled Customer Support

Studsvik's technical support is built on putting the needs of its customers first.

- 24-hour response time
- Easy ticketing system
- On-line support portals
- Access to technical documentation
- Active and growing user communities of practice

## For further information please contact:

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