



CLASSROOM SOFTWARE HELPS TRAIN NEXT GENERATION

Faculty and students at MIT, in collaboration with U.S. nuclear utility, Exelon, recently used the academic versions of Studsvik Scandpower's CASMO and SIMULATE software to evaluate a system to optimize the design of reactor cores. The system uses deep reinforcement learning, an artificial intelligence technique, to identify a pattern that improves the efficiency and life of the fuel. The results of their work were published in the journal Nuclear Engineering and Design.

[*Click here to view the results of this work.*](#)

Bangor University in the U.K. recently selected Studsvik Scandpower's codes for its new nuclear engineering program. Today, classroom versions of Studsvik Scandpower's CMS and Helios are in use at more than 25 universities in nine countries. The software is used to educate the next generation of nuclear engineers and physicists. Students learn the fundamentals of reactor core physics, experiment with novel core design concepts, and graduate with real skills applicable to the nuclear fuel cycle design and analysis work that nuclear utilities do every day. Their projects often are presented at meetings of the American Nuclear Society and other professional societies.

Under an initiative sponsored by the U.S. Department of Energy, Studsvik Scandpower's S3R reactor core modeling software also will be used to run versions of the engineering simulator for the NuScale Small Modular Reactor (SMR) at three universities in the U.S. The simulators are expected to be operational in 2021.



CUSTOMERS TURN TO VIRTUAL TRAINING

Studsvik Scandpower has supported several customers by providing virtual training due to the restrictions necessitated by Covid-19. In the past six months, Studsvik Scandpower experts have provided training to the staffs at Energy Harbor, Pacific Northwest National Laboratory (PNNL), and the Nuclear Power Institute of China (NPIC). Topics included both CMS and Helios. "The biggest challenge we find with virtual training is the inability to look over each student's shoulder and offer one-on-one coaching as they build their models," says Joel Rhodes III, Manager Methods Development.

"We will continue to meet our customers' needs through virtual training as appropriate, but we will look forward to the day we can all get back together in the classroom,"

-Joel Rhodes III

WEBINAR PLANNED FOR JUNE 2021

Based on requests from customers in a survey distributed in October 2020, Studsvik Scandpower's next webinar will cover a real-world application of its GARDEL core monitoring system. The topic for the Webinar is "Using GARDEL to Plan for Restart Following a Plant Trip." Studsvik will send a notice with a registration link as soon as the event is scheduled. Presentations and videos from the previous Webinars, "CASMO5 & SIMULATE5 Upgrades and Enhancements" (June 2020), and "Transient Analysis Using S3K/S5K" (December 2020), are available on the [Studsvik Scandpower Support Site](#).

CMS5 MODEL DEVELOPED FOR LITHIUM PICKUP IN PWR CLADDING

Lithium hydroxide, which is used in western PWRs to control pH, is known to cause accelerated corrosion in zirconium alloys used as PWR fuel cladding. Fuel vendors therefore commonly place restrictions on the maximum allowed coolant lithium concentration. These limits are often very conservative which, in combination with higher demand on fuel utilization, can lead to a conflict between keeping plant dose rate low (high pH and lithium concentration) and limiting the risk of accelerated cladding corrosion.

Studsvik has developed a model for estimating lithium pickup in PWR cladding oxide. The model incorporates local thermal hydraulic data calculated by SIMULATE5, together with an oxide thickness model and a model for simultaneous pickup and leaching. It has been shown to accurately predict measured lithium pickup in Optimized ZIRLO and M5 cladding materials.

FROM THE EXPERTS – SPEEDING UP CASMO5 WITH MULTICORE COMPUTATION

CASMO5 can use multicore CPUs to significantly reduce runtimes. Three parallel options are available. First, as always, independent segments can be launched simultaneously. Second, for large multi-assembly (MxN) cases, the "OMP" option is available to accelerate the computational bottlenecks within the code. The transport solver, the part of the code with the longest runtime, achieves over 80% parallel efficiency with up to 16 threads. Third, case matrix (S3C/S5C) calculations can be run in parallel via the "cas5 -j" command-line option, which seamlessly splits the case matrix calculations in small pieces, executes the subcases in parallel, and recombines the outputs. On a 24-core server, wall clock runtimes were typically reduced by more than 10x. Using these parallel features, CASMO5 users can achieve significantly faster runtimes for a variety of workflows.



DID YOU KNOW...

...That the SIMULATE5 BWR (or PWR) control rod depletion model allows for the rod tips to accumulate fast fluence and depletion even when the rods are parked in the reflector? With SIMULATE5, you can directly calculate the impact on SDM, hot depletion, or cold criticals without relying on vendor calculations. Using this method reduces uncertainty as to when control blades or rods actually need to be replaced and prevents costly unscheduled, early replacement. Studsvik Studsvik Scandpower Senior Nuclear Engineer, Stephen Luther, made a presentation on SIMULATE5's capability to the EPRI Fuel Reliability Program Technical Advisory Committee Meeting on February 24. A copy of his presentation is available in the News & Events section of the Support Site or by clicking below.

VIEW PRESENTATION

CMS5 UPGRADES IN THE USA CONTINUE

Another US utility acquired Studsvik Scandpower's Core Management System 5 (CMS5) software in 2020, and is now licensing it for fuel and core design. The multi-unit plant provides carbon-free electricity to some 4 million people in the Southwest U.S.

SUPPORT SITE OFFERS EXTENSIVE RESOURCES

In addition to its use as a portal for technical support, the Studsvik Scandpower Support Site has extensive resources including technical papers and presentations. The CASMO section alone hosts more than 100 papers. User Manuals, Methodology Information and Changes Documents also are available. In addition, the Site hosts presentations from more than a decade of User Group Meetings. It's all at: <https://support.studsvikscandpower.com/hc/en-us>

CODE VERSION UPDATES

Studsvik Scandpower has released extensive updates to the Core Management System 5 (CMS5) suite of software and related applications, and to the HELIOS2 Code System.

Highlights of new features and capabilities, and minor software corrections available in these new versions can be found in the “Changes and Release Notes” documents in the “Software Updates” section of the [Studsvik ZenDesk Support Site](#) (login required):

CMS5 software has been qualified under the Studsvik, Inc. NQA-1 1994, 10 CFR 50 Appendix B, 10 CFR 21 Quality Assurance Program and HELIOS2 under ISO-9001.

- **CASMO5 v3.03.00**
- **CASMO5_VVER 3.03.00**
- **CMSBuilder v1.01.03**
- **CMSLINK5 v1.16.01**
- **SIMULATE5_VVER v1.21.00**
- **MARLA v3.04.00**
- **SIMULATE5 v1.21.00**

Current code versions for other Studsvik software include:

SIMULATE-3 v6.22.00, SIMULATE-3K v2.09.00, SNF v1.07.04, MARLA v3.04.00, and CMSView5 v1.0.6.

Update Highlights for CASMO5 include:

1. New Spatially-Dependent Self-Shielding (SDSS) model for radially sub-divided fuel pins.
2. Expanded spacer and detector branches in the S5C case matrix.
3. If updating CASMO5 to CASMO5 v3.03.00, then CMSLINK5 v1.16.01 must be used.

Update Highlights for SIMULATE5 include:

1. New capability to screen the core for evaluation of the Alternative Radiological Source Term (AST). The SIMULATE5 module compares the computed pin linear heat generation (LHGR) versus the limits set by either USNRC Reg. Guide 1.183 or Draft Reg. 1199.
2. New MEC.ZON card to describe the axial zones of a mechanical design type by the zone elevations. The new card is an alternative to the existing MEC.HEI card, where the axial zones are input as the zone heights.
3. Better parallel (OpenMP) scaling and performance (from updating to a new Fortran compiler: Intel™ Fortran Compiler Version 19.1 Update 3 Build Date 20200925 for Linux).

Additionally, The HELIOS2 Code System has recently been updated:

| | | |
|----------------|----------|--------------------------------|
| AURORA | v2.03.01 | (Input pre-processor module) |
| HELIOS2 | v2.03.01 | (2D Transport solver module) |
| ZENITH | v2.03.01 | (Output post-processor module) |

If you would like to receive an update to your software under your current software maintenance agreement, please contact your Studsvik representative.

ON THE CALENDAR

- **Fission Battery Workshop** (Idaho National Laboratory) (Feb. 10, 2021) P. Sharpe presented “*Connecting M&S Tools for Fission Battery and Microreactor Performance*” (Available on the [Support Site](#))
- **GARDEL Community of Practice** – 25 March 2021 (Contact Phil Sharpe – phil.sharpe@studsvik.com)
- **Webinar - “Using GARDEL to Plan for Re-start Following a Plant Trip.”** June 2021 TBD
- **Mathematics & Computational Methods Conference 2021 (ANS)** (Oct.3-7, 2021, Raleigh NC) R. Ferrer and J. Hykes will present “*Improved Rational Approximation for Spatially Dependent Resonance Shelf-Shield in CASMO5*”, and “*Parallel Computing in CASMO5*”
- **TopFuel 2021** – (Oct. 24-28, 2021, Santander, Spain) – Ulrik Svensson, Gerardo Grandi, David Schrire, Kyle Johnson, and Daniel Jädermäs will present “*Modelling Lithium Uptake in PWR Fuel Cladding Oxide*”

HELPFUL LINKS

- [Software Updates \(January 2021\)](#)
- [S3K Webinar \(December 2020\)](#)
- [CMS5 Webinar \(June 2020\)](#)
- [2020 UGM videos \(October 2020\)](#)
- [2020 UGM presentations \(October 2020\)](#)
- [Studsvik Scandpower Technical Support](#)

