SCALE Newsletter

Computational Physics and Engineering Division
Nuclear Engineering Applications Section
Oak Ridge National Laboratory
SCALE Web Site: http://www.cad.ornl.gov/scale

SCALE 4.4 is Released

SCALE 4.4 was released in September 1998. To obtain your copy of SCALE 4.4, contact the Radiation Safety Information Computational Center (RSICC) at rsic@ornl.gov. For more information on what's new in this version, refer to previous issues of the *SCALE Newsletter*.

Training Course Schedule for 1999

The SCALE staff are offering several training courses in 1999. The courses emphasize hands-on experience in solving practical problems on PCs. No prior experience in the use of SCALE is required to attend these courses. The registration fee for each course at ORNL is $1,500. A combined registration fee of $2,400 is available for the two April courses, which are offered on consecutive weeks. A copy of the SCALE software and manual on CD may be obtained at the ORNL courses for an additional fee of $250 (RSICC distribution fee). Registrations will be accepted on a first-come basis. **Registration forms submitted directly from the Web are preferred.** Registration via FAX or e-mail is also acceptable. The registration fee must be paid by check or travelers checks. We apologize that we are **NOT** able to accept credit card payment.

The training course schedule is listed below. The agenda and registration form for the April training courses are included later in the Newsletter.

Date	Title	Location
Apr. 12–16	SCALE Shielding and Source Terms Course	ORNL
Apr. 19–23	SCALE KENO VI Criticality Course	ORNL
Sept. 13–17	SCALE KENO VI Criticality Course	Versailles, France - Prior to ICNC'99 Contact Enrico Sartori (e-mail sartori@nea.fr)
Oct. 25–29	SCALE Course Topic to be determined	Tokai, Japan - following ICRS 9; contact Tadakazu Suzuki (e-mail tadakazu@HERO.tokai.jaeri.go.jp)
Nov. 1–5	SCALE KENO V.a Course	ORNL

Class size is limited, and courses are subject to cancellation if minimum enrollment is not obtained one month prior to the course. Course fees are refundable up to one month before each class.

SCALE Minor Modifications

The following minor corrections and updates have been made since the release of SCALE 4.4. These modifications will be included in the next public release of SCALE.

KENO VI: (1) Corrected a discrepancy where the code could enter an infinite loop while tracking a particle out of a unit in an array at the edge or corner of the unit. (2) Updated to allow a particle to cross from one hole directly into an adjacent hole even if the crossing is outside the allowed tolerances. This modification prevents some cases from entering an infinite loop. (MRRs 98-054 and 98-062)

QAD-CGGP: Corrected an error introduced in SCALE 4.4. The dimension on one variable in the geometry was not updated when the input format was changed to match that of MARS input. This discrepancy caused cases with more than a limited number of bodies in each zone to fail. Also updated to correct misspelled name of error output unit. (MRR 98-068)

C5TOC6/K5TOK6: The input files generated for CSAS6 and KENO VI incorrectly labeled regions generated to surround HOLEs if there were more than one region in a unit that contained HOLEs. Because of a change in KENO VI, these regions are not required. The code was modified to no longer generate these regions. (MRRs 98-066 and 98-067)

SAS4: (1) Updated to correct the dimensions on two arrays used in the user-specified surface detector option. Also changed a test comparing 2 floating-point variable names equivalent to integer variables to use function ISET. (This test has previously caused floating-point underflows on some platforms.) (2) Updated to add a PARM=CHECK option that calls PICTURE from within the SAS4 module to plot geometry but not run MORSE, similar to the same feature in CSAS. SAS4 prepares or reads MARS geometry input data, reads PICTURE plot input, writes PICTURE input file, and calls PICTURE. Several other changes were made to error messages and formats. (MRRs 98-060 and 98-057)

PICTURE: Updated to handle the PARM=CHECK option that calls PICTURE from within the SAS4 module. Also added an option that allows users to specify an X-Y, X-Z, or Y-Z plot and have the code automatically calculate the cosines used for the plot. (MRR 98-056)

MORSE: Corrected a discrepancy in scoring boundary crossings of surface detectors. A roundoff error caused by a comparison of a double precision variable to a single precision variable resulted in boundary crossings not being scored. The epsilon value for the comparison was also increased from 0.0005 to 0.001. (MRR 98-059)

SAS2: (1) Updated to correct an error introduced in SCALE 4.4 that caused the PARM=OLDSAS2 option to fail. Also corrected another problem introduced in SCALE 4.4 that caused spent fuel isotopic data written to file FT72F001 to be incorrect in certain causes where burnable poison rods or other inserts are removed from or inserted into the fuel assembly between fuel cycles. (2) Corrected a minor discrepancy that resulted in invalid characters being written to title records in ORIGEN-S binary library. Some text editors could not read SAS2 output file when invalid characters were present. (MRRs 98-058 and 98-063)

QADS: Added a test on the MIPLIB error flag that terminates execution of the problem if an error occurs in the Standard Composition input. (MRR 98-061)

NITAWL: (1) Corrected the potential cross section used for higher-order resonances ($L > 0$). The impact should be negligible in most cases. (2) Corrected the data in the transfer arrays in the sensitivity master library. This library is not used in the production version of SCALE. (MRR 98-055)

SCALE Notebook on the Web

The SCALE and RSICC staffs are working together to support a valuable new feature on the Web, the SCALE Users Electronic Notebook (http://www-rsicc.ornl.gov/ENOTE/enotscal.html). This electronic notebook provides an easy method for users to find answers to common questions or problems regarding the installation and use of SCALE. Many of the responses to users' questions via SCALE help e-mail(scalehelp@ornl.gov) are posted here. The notebook contains a table of contents, and the entries can be searched by keywords. Users can enter questions or comments that the SCALE staff and other users may address. More than 100 entries have been posted already in the notebook.

SCALE Web Updates

Users are encouraged to visit the SCALE Web site (www.cad.ornl.gov/scale) often for current information and updates on SCALE. Listed below are the latest updates.

- Update for Windows 98 Users - The original DOS BAT file that executes SCALE 4.4 in Windows 98 contained an error that prevented SCALE from returning to the user's original directory and copying the SCALE output file there. The corrected BAT file is now available from our "Download" page. For more information, see page 79 in the SCALE Users Electronic Notebook, "Corrected File for Windows 98 Users."
- SCALE Wallpaper for Your Computer Desktop - Be the first on your block to have one of these cool wallpapers on your computer! To view one of the images full size, click with the right mouse button on the image and select "View image." To download one and set as your wallpaper, click with the right mouse button on the image and select "Set as wallpaper." Thanks to Mark DeHart of our staff for creating these images.
- USLSTATS program to statistically determine Upper Subcritical Limits (USLs) was updated on December 22, 1998, to correct (1) an error in the calculation of USLs in the final printed table and (2) an error where the positive bias adjustment was not applied if the bias was positive over the full range of input. Format statements were also modified to allow printing of larger numbers.

- An ASCII version of the QADXSLIB dummy cross-section library file required by QADS was added. This file is needed to run SCALE on a Linux PC.
- The SCALE 4.4 Electronic Manual and additional fonts for viewing equations in some sections of the manual were posted.
- The "More Info" page was updated to include copies of the SCALE quality assurance (QA) documents.
- The "How to Run" page was reorganized to contain all links for information on installation and execution of SCALE. In particular, installation instructions for SCALE 4.4 on a Windows 95/98/NT PC were posted.

MORSE and QAD-CGGP May Produce Erroneous Results

Contributions to user-specified surface detectors in MORSE in SCALE 4.4 may be underestimated because of a failure to determine which surface detector to score. This failure is due to the comparison of a single precision variable to a double precision variable. Most affected cases will have a zero result for the surface detector, indicating that no particles have crossed the surface detector boundary. The recommended practice to avoid this problem is to minimize the number of significant digits that specify the surface detector location. Detector location coordinates of four digits or less are not expected to experience this problem.

We have identified and corrected a coding error in QAD-CGGP in SCALE 4.4 that usually causes the problem to fail. Because of inconsistent array dimensions, if more than a very limited number of bodies are input in one zone, the additional zone data are lost or stored incorrectly. This situation typically causes the code to fail. Though extremely unlikely, it might be possible for a case like this to run if the incorrectly stored geometry happened to be valid. QAD-CGGP users should check under the 'input zone data" header in the output to verify that the zone data agree with their input. A correction for the errors in MORSE and QAD-CGGP will be made available to SCALE 4.4 users.

SCALE Shielding and Source Terms Course

The SCALE Shielding and Source Terms Course emphasizes SAS2 and ORIGEN-ARP (depletion/source-term generation) and SAS3 and SAS4 using MORSE-SGC (3-D Monte Carlo neutron/gamma shielding). It also covers SAS1/XSDRNPM (1-D neutron/gamma shielding) and QADS/QAD-CGGP (3-D point kernel gamma shielding).

SCALE KENO VI Criticality Course

The SCALE KENO VI Criticality Course focuses on KENO VI and the associated criticality analysis sequences in CSAS6. KENO VI is the latest version of the KENO Monte Carlo criticality safety code. KENO VI contains a much larger set of geometrical bodies than KENO V.a, including cuboids, cylinders, spheres, cones, dodecahedrons, elliptical cylinders, ellipsoids, hoppers, parallelpipeds, planes, rhomboids, and wedges. The flexibility of KENO VI is increased by allowing the following features: intersecting geometry regions; hexagonal as well as cuboidal arrays; regions, holes, arrays, and units rotated to any angle and truncated to any position; and the use of an array boundary that intersects the array. It includes the 2-D color plotting capability of KENO V.a . Users should be aware that the added geometry features in KENO VI can result in significantly longer run times than KENO V.a. A KENO-VI problem that can be modeled in KENO V.a will typically run twice as long in KENO VI as in KENO V.a. Thus the new version VI is not a replacement for the existing version V.a, but an additional version for more complex geometries that could not be modeled previously.

SCALE Shielding and Source Terms Course Agenda
(April 12 – 16, 1999)

Monday
Overview of SCALE
Depletion/Decay/Source-Term Sequences
ORIGEN-ARP
SAS2
Problem Session 1

Tuesday
Review of Problem Session 1
Introduction to SCALE Shielding Sequences
SAS4 3-D Monte Carlo Sequence with Automated Biasing
Problem Session 2

Wednesday
Review of Problem Session 2
SAS3 3-D Monte Carlo Analysis Sequence
MORSE/MARS Geometry with Arrays
How to Bias in SAS3
Problem Session 3

Thursday
Review of Problem Session 3
SAS1 1-D Shielding Analysis Sequences
1-D Combined Criticality/Shielding Sequence
Problem Session 4

Friday
Review of Problem Session 4
QADS Point Kernel Shielding Analysis Sequence
Problem Session 5 and Review
Current Topics in Shielding Analysis Applications
Conclusion / Questions and Answers

SCALE KENO-VI Course Agenda
(April 19 – 23, 1999)

Monday
Overview of SCALE
Introduction to CSAS6
Resonance Self-Shielding
Standard Composition Library
Material Information Processor Library(MIPLIB) Input
Unit Cell Geometry - LATTICECELL / MULTIREGION
Problem Session 1

Tuesday
Review of Problem Session 1
KENO-VI Parameters
KENO-VI Geometry
KENO-VI Plot Data
Problem Session 2

Wednesday
Review of Problem Session 2
KENO-VI Output - How to Read it
Geometry Modification Data
(Chords/Rotate/Translate)
Media/Holes
Media/Arrays
Problem Session 3

Thursday
Review of Problem Session 3
Start Data
Bias Data
Boundary Data
Mixing Table
Problem Session 4

Friday
Review of Problem Session 4
Monte Carlo Uncertainties
Code and Data Validation Issues
Conclusion / Questions and Answers

SCALE Training Course Registration Form
Oak Ridge National Laboratory, Oak Ridge, Tennessee
April 1999
Please use the registration form on the Web if possible
(www.cad.ornl.gov/cad_nea/text/scale_course_reg.html)

I am registering for the following (check one):

☐ **Shielding and Source Terms Course**   **April 12 – 16**   Fee: $1,500
☐ **Criticality Course (KENO VI)**   **April 19 – 23**   Fee: $1,500
☐ **Both Shielding and Criticality Courses**   Fee: $2,400
Do you want to receive a copy of SCALE on CD ($250 extra)?   ☐ **Yes** ☐ **No**

Name _____

Citizenship _____

Organization _____

Mailing address _____

_____

_____

Telephone: _____ **Fax:** _____

E-mail: _____

Your level of experience (circle one for each):

	Very High	High	Medium	Low	None
Criticality					
CSAS6/KENO VI	4	3	2	1	0
CSAS/KENO V.a	4	3	2	1	0
Other_____	4	3	2	1	0
Shielding					
SAS1	4	3	2	1	0
SAS3	4	3	2	1	0
SAS4	4	3	2	1	0
MORSE	4	3	2	1	0
QADS/QAD-CGGP	4	3	2	1	0
Other_____	4	3	2	1	0
Source Term / Depletion					
SAS2H	4	3	2	1	0
ORIGEN-S/ORIGEN-ARP	4	3	2	1	0
Other_____	4	3	2	1	0

What types of problems/applications do you want to be able to analyze with SCALE after attending the course?

Please mail this form and registration fee payment to:
SCALE Training Course
c/o Kay Martin
Oak Ridge National Laboratory
P.O. Box 2008, MS 6370
Oak Ridge, Tennessee 37831-6370
FAX 423-576-3513
E-mail: x4s@ornl.gov
Classes may be canceled if minimum enrollment is not obtained.
Course fees are refundable up to one month before each class.

Short Course on the
Technical Basis and Functional Use of an
Updated Nuclear Criticality Slide Rule
May 5, 1999
DOE Training Center, Albuquerque, New Mexico
In cooperation with the annual meeting of the Nuclear Criticality Technology Safety Project
Conducted by
Nuclear Engineering Application Section
Computational Physics and Engineering Division
Oak Ridge National Laboratory

Purpose:
To develop familiarity in the use of the updated slide rule for emergency preparedness for and response to nuclear criticality accidents with high-enriched and low-enriched uranium systems.

For:
Personnel responsible for developing criticality accident preparedness and response programs and reviewing criticality accident monitor alarm placement.

Content:
The one-day course will provide:
- Introduction and background (history)
- Review and discussion about the applied theory and computational analyses
- Description and brief demonstrated use of the slide rule for estimating
    - Total and "sky-shine" neutron and gamma dose with distance/fission yield
    - Integrated total dose with distance/time/fission yield
    - Field/area fission product gamma dose rates with distance/time/fission yield
    - One-minute integrated dose with distance/time/fission yield
    - Dose reduction factors for shielding (iron, concrete, water)
    - Solution fission yields with uranium enrichment/density/container-geometry/addition-rate
- Application of example emergency response procedure
- Criticality accident alarm placement considerations
- Case studies with hands-on applications

Cost: $250
Limited class size - register early. Call Kay Martin 423-574-9213.

Technical Basis:
B. L. Broadhead, C. M. Hopper, R. L. Childs, J. S. Tang, *An Updated Nuclear Criticality Slide Rule: Technical Basis*, NUREG/CR-6504, Vol. 1(ORNL/TM-13322/V1), April 1997.
C. M. Hopper, B. L. Broadhead, *An Updated Nuclear Criticality Slide Rule: Functional Slide Rule*, NUREG/CR-6504, Vol. 2(ORNL/TM-13322/V2), April 1998.