THE RADIATION SAFETY INFORMATION COMPUTATIONAL CENTER: A RESOURCE FOR REACTOR DOSIMETRY SOFTWARE AND NUCLEAR DATA

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The Radiation Safety Information Computational Center (RSICC) was established in 1963 to collect and disseminate computational nuclear technology in the form of radiation transport, shielding and safety software and corresponding nuclear cross sections. Approximately 1700 nuclear software and data packages are in the RSICC collection, and the majority are applicable to reactor dosimetry.

History

RSICC's history as a center for the quality control of scientific software goes back to 1963, when it was established as an Information Analysis Center (IAC). It was then called Radiation Shielding Information Center (RSIC). Panel No. 6 (Information Analysis and Data Centers) of the Committee on Scientific and Technical Information of the Federal Council for Science and Technology (COSATI) adopted the following definition [1]:

"An Information Analysis Center is a formally structured organizational unit specifically (but not necessarily exclusively) established for the purpose of acquiring, selecting, storing, retrieving, evaluating, analyzing, and synthesizing a body of information in a clearly defined specialized field or pertaining to a specified mission with the intent of compiling, digesting, repackaging, or otherwise organizing and presenting pertinent information in a form most authoritative, timely, and useful to a society of peers and management."

In 1997, RSIC was renamed Radiation Safety Information Computational Center (RSICC) to better fit the stronger role in computational applications.

RSICC was founded to address the availability of and user support for the software produced by the Department of Energy's (DOE) nuclear research complex. Use and re-use of the valuable measured nuclear cross section data and the software, developed to model the transport of neutrons and gamma rays, was the primary concern of RSICC in the beginning. As it grew into a world recognized center, international agencies—including the OECD Nuclear Energy Agency (NEA) Data Bank, International Atomic Energy Agency (IAEA) and Japan's Research Institute of Science and Technology (RIST)—have contributed their software and data to the collection of over 1,700 software packages. RSICC also supports the U.S. Nuclear Regulatory Commission (NRC) by maintaining and updating a collection of about 200 NRC software packages.

RSICC as an Information Analysis Center

RSICC collects, organizes, evaluates and disseminates technical information (software and nuclear data) involving the transport of neutral and charged particle radiation, and shielding and protection from the radiation associated with: nuclear weapons and materials, fission and fusion reactors, outer space, accelerators, medical facilities, and nuclear waste management. The Center provides in-depth coverage of radiation transport topics: a) physics of the interaction of radiation with matter, b) radiation production and sources, c) criticality safety, d) radiation protection and shielding, e) radiation detectors and measurements, f) shielding materials properties, g) radiation waste management, h) shields and shipping cask design, i) radiation safety and assessment, j) atmospheric dispersion and environmental dose, k) medical applications, and l) macro- and micro-dosimetry calculations.

In the 45 years of its existence, RSICC has established itself as a repository for codes and data libraries in the area of radiation transport supporting research and development in fission and fusion reactors, outer space, accelerators, weapons, medical facilities, nuclear waste management and varied medical applications. In the words of many of its clients in research and education, RSICC is an invaluable resource, providing access to important tools for evaluating radiation dose.

RSICC currently has approximately 11,000 active users representing 92 countries.

Most RSICC software packages consist of:

- Abstract
- Source code
- Sample problem input
- Sample problem output
- Documentation
- Executable program
- RSICC packages are categorized according to:
- Computer Code Collection (CCC),
- Peripheral Shielding Routine (PSR),
- Data Library Collection (DLC)

Software that tracks particles (neutrons, photons, protons, electrons, etc.) is classified as “CCC”. Software that does not directly track particles, but is used as a tool, for example plotting, is classified as “PSR”. Nuclear cross section data form the “DLC”.

Software Quality Assurance

RSICC follows quality assurance procedures in adding software to its collection. A key element in the process is the RSICC Software Coordinator, who has the job of integrating all the components of software packaging.

Software packaging consists of the following steps:

- Ensure that the requested software package has source code and/or executables, sample problem input, sample problem output and documentation

- Produce an executable code by compilation and linkage of the source code on the computer platform for which it was developed, and adapt it to other architectures or operating systems as feasible.
- Run the executable code on the sample problem input provided by the contributor
- Verify the output by comparison with the sample problem output after resolving any discrepancies with the developer
- Document the above process for quality control
- Assign an RSICC identifier (either CCC, PSR, DLC)
- Create an abstract (see format below)
- Create the complete RSICC code package containing source code, sample problem input, sample problem output, documentation and executable program
- Announce availability of the software package in the RSICC newsletter

The RSICC software package is described using an abstract with the following elements:

1. Name and title
2. Contributor
3. Coding language and computer
4. Nature of problem solved
5. Method of solution
6. Restrictions or limitations
7. Typical running time
8. Computer hardware requirements
9. Computer software requirements
10. References
11. Contents of code package
12. Date of abstract
13. Keywords

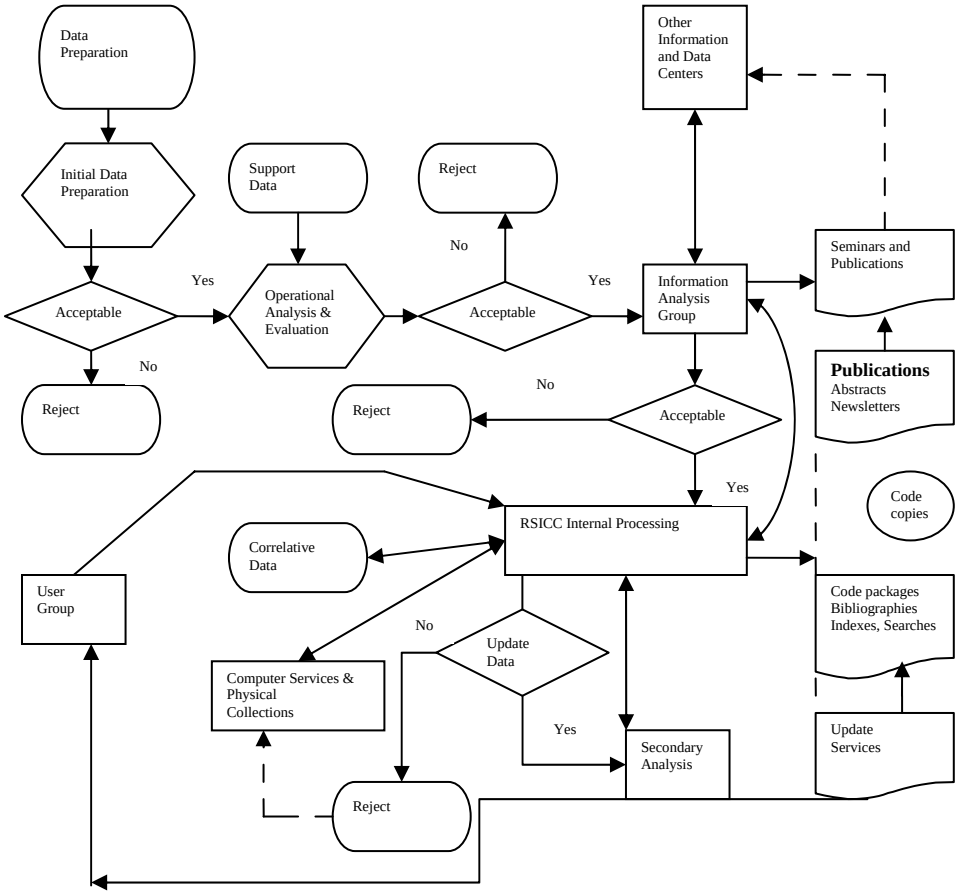

Figure 1: Diagram depicting RSICC information collection activities

Figure 1 provides a synopsis of the information collection activities at RSICC.

Software Verification and Validation

Although verification and validation are implied components in the quality assurance of software, RSICC performs the former and to some extent the latter, and relies heavily on its user community for feedback. User feedback often results in valuable corrections or enhancements to the package. Table 1 shows the extent to which software is quality assured within RSICC.

An important activity of the center is its participation in international efforts on computational and experimental benchmarks. An example is the Shielding Integral Benchmarks Archival Database (SINBAD) which includes shielding benchmarks for fission, fusion and accelerators. One of RSICC's major software validation products, SINBAD was developed through a joint effort with the Nuclear Energy Agency Data Bank [2].

http://rsicc.ornl.gov/codes/dlc/dlc1/dlc-191.html
http://rsicc.ornl.gov/rsiccnew/BENCHMARKS.htm

In this effort, major computer codes in the RSICC collection (like MCNP) are compared and tested against known experimental results for shielding designs. Shielding is a significant issue in designing reactor facilities.

Table 1: RSICC Software Quality Assurance Procedures

Software/data identification and acquisition	**Software testing and packaging**	**Knowledge management**	**User community interactions**
• serve on standards groups, international meetings and conferences • collaborate on special projects	• compile and test source code using various compilers and computers • prepare readme instructions • write code abstracts	• store and secure electronic media • manage document control and preservation • create and manage software archives	• facilitate www forums via e-notebooks • conduct personal communications • sponsor workshops and training
• seek expert advice on new code development within diverse nuclear research organization	• resolve software bugs with authors • streamline installation and verification process	• share technical information through: 1. www site 2. newsletters 3. codebooks 4. brochures 5. user interaction	• troubleshoot user issues • publish web and newsletter announcements
• interact with sponsors and technical contacts	• perform electronic scanning • prepare master document • track packaging flow in master database • process QA forms	• maintain customer database • maintain request database • ensure export control and licensing compliance	• serve as technical and administrative point of contact for students and mentors

RSICC Software Used for Reactor Dosimetry

Some of the most popular radiation transport software used in reactor studies includes SCALE 5.1, MCNP5, MCNPX, PENELOPE 2006, TRIPOLI, EASY/FISPACT, WIMSD-5B, DOORS, PARTISN, and VIM. A great majority of RSICC software is also

used in reactor analysis, especially for analysis of reactor accidents, reactor safety and reactor physics. A listing of representative software in each of these areas follows.

REACTOR ACCIDENT	
C00637 APUD 3.0	C00674 MTR_PC 2.6
D00105 BWR-LTAS	C00607 PFPL
C00485 BWR-LTAS	C00313 PLUDOS
C00238 CARNAC	C00355 PREST
P00507 COBRA-EN	C00174 RACER
C00419 CRAC2	C00088 RADOS
C00624 DOSE-SGTR	C00553 RASCAL 3.0.5
C00183 ESDORA	C00635 RETRAC
C00622 EXPRESS	C00196 RRR
C00423 FONTA	C00571 SACHET
C00231 FRCRL2	P00527 SECPOP 2000
P00401 HAARM-3	C00704 SLIDERULE 1.0
C00665 HABIT 1.1	C00602 SMART
C00568 HORN	C00507 SPEEDI
C00644 HOTSPOT 2.05	C00270 SUBDOSA-II
C00524 IRDAM	C00447 TACT-III
C00652 MACCS2 1.13.1	P00459 TORAC
P00473 MARCH2	C00427 WRAITH

REACTOR PHYSICS	
C00741 1DB-2DB-3DB	P00265 MIGROS3
M00004 ANL-BPB	P00490 MINET
C00519 AUS87	C00513 MKENO-DAR
C00578 BCG	C00674 MTR_PC 2.6
C00459 BOLD VENTURE IV	C00492 MULTI-KENO2
C00643 CITATION-LDI 2	C00641 NESTLE 5.2.1
P00507 COBRA-EN	C00433 OMEGA
P00279 DANCOFF-3	C00653 REBUS3
P00278 DASQHE	C00708 REBUS-PC 1.4
C00649 DIF3D8-VARIANT8	C00585 RHEIN
C00647 DRAGON3.05D	C00597 RMET21
P00194 FEDGROUP-C86	P00503 RODBURN-FEMAXI-V
P00536 FEMAXI 6 VER.1	C00691 SIMMER II
C00603 FPZD	P00244 SLAROM
C00615 FURNACE	P00282 SUPERDAN-PC
C00575 GENP-2	C00600 TRIGAP
P00241 GERES	P00537 TRISTAN-IJS
P00483 GT2R2	C00654 VENTURE-PC
C00593 HEXAB-3D	C00658 VIM 4.0
C00510 KENO-IV(RG)	C00481 VPI-NECM
C00436 KENO-IV/CRC	C00670 VSOP94
P00329 LTC	D00193 WIMKAL-88
P00225 MARCOPOLO	C00698 WIMS-ANL 4.0
C00562 MCRAC	C00576 WIMS-D4
P00374 MICROX-2	C00656 WIMSD-5B.12

REACTOR SAFETY	
P00431 ATHENA_2D	P00471 NORMA
P00402 BEACON MOD3	P00470 NORMA-FP
P00389 COMPBRN3	P00470 NORMA-FP
D00215 EDSFI	P00460 OCTAVIA
P00519 ENTREE 1.4.0	P00516 PARET-ANL
C00622 EXPRESS	C00574 PRISIM
P00444 FIRAC	P00422 RELAP3B/MOD110
D00125 FIREDATA	P00487 SAMCR
P00406 FRANTIC3	P00453 SEISIM1
P00517 FRAPCON2	P00380 SETS
P00436 FRAPT6/MOD1	P00493 SHC
P00446 FUELSDATA	C00691 SIMMER II
P00457 HECTR 1.5+	P00464 SOLA-LOOP
P00435 HSI-DRG	C00692 TOXRISK
P00383 KFIX 3D	P00488 TRAC-BD1
P00466 MAEROS	P00481 TRAC-PF1
P00473 MARCH2	P00477 TRAC-PF1/EN MOD3
C00689 MATADOR	P00415 USINT
P00490 MINET	P00445 VISA2
P00411 MORECA	

Summary

RSICC serves as an international center and a major source of software and nuclear data for reactor dosimetry studies. The contribution of the reactor dosimetry community is vital to the continued existence of RSICC.

References

1. Proceedings of the Forum of Federally Supported Information Analysis Centers, November 7–8, 1967, PF 177051.
2. I. Kodeli, E. Sartori and B. Kirk, “SINBAD Shielding Benchmark Experiments Status and Planned Activities”, The American Nuclear Society’s 14th Biennial Topical Meeting of the Radiation Protection and Shielding Division, Carlsbad, New Mexico, USA, April 3–6, 2006.