

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION &
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
WASHINGTON, D.C. 20555

April 2, 1991

NRC INFORMATION NOTICE NO. 91-26: POTENTIAL NONCONSERVATIVE ERRORS IN THE
WORKING FORMAT HANSEN-ROACH CROSS-SECTION
SET PROVIDED WITH THE KENO AND SCALE CODES

Addressees:

All fuel cycle licensees and other licensees, including all holders of operating licenses for nuclear power reactors, who use physics codes to support criticality safety in the use of fissile material.

Purpose:

This information notice is intended to alert addressees to potential problems resulting from errors in a common calculational method used in the support of criticality safety. These errors could result in nonconservative calculations forming the bases for criticality safety limits and practices. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice do not constitute Nuclear Regulatory Commission (NRC) requirements; therefore, no specific action or written response is required.

Description of Circumstances:

Various users of the KENO family of codes have noticed anomalous results when using some parts of the neutron cross-section data distributed with the KENO code. The KENO code, a three-dimensional Monte Carlo physics tool, has become the dominant method for nuclear criticality safety calculations in the U.S. fuel cycle industry. In the past, the various versions of KENO were commonly used in a "stand-alone" mode and used a version of the 16-group Hansen-Roach cross-section set. Users referred to this as the "stand-alone" Hansen-Roach set; code developers referred to the set as the "working-format" library. Dozens of criticality safety organizations developed a library of benchmark calculations based on this "working-format" library data set. The developers of the KENO codes also released a system of codes (SCALE) to process physics data into problem-dependent cross-section sets for KENO to use. The SCALE package also included the "working-format" library, to allow running the code-manual's sample cases and to check past calculations with the current version of the KENO code. At this time, KENO IV and KENO V.a are the most commonly used versions of the criticality code. For the code system, SCALE-4 has been recently released; SCALE-3 remains the most widely used.

Since the release of the SCALE system some years ago, the "working-format" library was not intended to be used for safety calculations. It has, however,

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remained in wide use to support criticality safety. Recently, an NRC licensee used the full SCALE-3 system to check a safety evaluation that had used the "working-format" set. The latter was shown to be 3 percent nonconservative in k_{eff} . The licensee did not pursue finding examples of larger nonconservatism. In conversation with the code developers, the licensee learned that there were known errors, for various nuclides, in the cross-section "working-format" data set, that had not been corrected because the data set was not intended for safety calculations.

In response to this conversation and others, a warning from the code developers to SCALE users and users of the PC version of the code (KENO5a-PC) was published in the December 1990, RSIC Newsletter. As a SCALE PC version is not available, PC users need to know about errors in the "working-format" library.

The January 1991, SCALE Newsletter contained the announcement reprinted below:

HANSEN-ROACH WORKING FORMAT LIBRARY

"In addition to the AMPX master format libraries utilized by SCALE, all releases have included a Hansen-Roach 16 group AMPX working format cross section library provided for use with the KENO V.a and XSDRNPM sample problems. All releases prior to SCALE-4 contain errors in this working format cross section library for the following nuclides: Mg (12100), Si (14100), S (16100), Mn (25100), Pu-242 (94200), U-238 SIGP=400 (92834), and U-238-6R SIGP=400 (92861). The impact of these errors depends on the amount of the nuclide present and the geometric conditions of the problem. One problem utilizing Mg, Si, and S in a mixture was observed to experience a 3 percent increase in k-effective when it was run using the corrected cross sections."

"It was recently recognized that some of the premixed mixtures on the working format library (all releases, including SCALE-4) were created using the incorrect nuclide cross sections mentioned above. These mixtures include Stainless Steel 304 (200), Oak Ridge Concrete (300), Ordinary Concrete (301), Magnuson Concrete (302), and Magnuson Vermiculite (701). The corrected working format library is now being distributed by RSIC. To date, no statistically significant differences due to the changes in these mixtures have been observed. However, it is recommended that those who have utilized one or more of these mixtures reverify their results using the new working format library."

"Note that only the working format library contains the above errors. This library was never intended for any use other than running KENO V.a and XSDRNPM sample problems. The working library will be removed from the next release of SCALE-4."


Discussion of Safety Significance:


There may exist a large number of criticality safety evaluations that are based on the "working-format" (also called stand-alone) Hansen-Roach data set distributed with the KENO or SCALE codes. It is possible that some of these evaluations are

significantly nonconservative. User review of those evaluations for continuing operations would ensure that adequate safety margins are retained. Note that a corrected version of the data is available. Versions of the Hansen-Roach data from other sources may not have these errors.

For safety calculations, it is important for users to adequately validate the code, physics data, and modeling methods for the intended application with appropriate experiments. Had appropriate experiments been performed, the error described above would likely have been discovered earlier.

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Charles E. Rossi, Director
Division of Operational Events Assessment
Office of Nuclear Reactor Regulation


Richard E. Cunningham, Director
Division of Industrial and
Medical Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

Technical Contact: Robert E. Wilson, NMSS
(301) 492-0126

Attachments:

1. List of Recently Issued NRC Information Notices
2. List of Recently Issued NMSS Information Notices

LIST OF RECENTLY ISSUED
NMSS INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
91-23	Accidental Radiation Over-exposures to Personnel due to Industrial Radiography Accessory Equipment Malfunctions	03/26/91	All Nuclear Regulatory Commission (NRC) licensees authorized to use sealed sources for industrial radiography.
91-16	Unmonitored Release Pathways from Slightly Contaminated Recycle and Recirculation Water Systems At A Fuel Facility	03/06/91	All fuel cycle facilities.
91-14	Recent Safety-Related Incidents at Large Irradiators	03/05/91	All Nuclear Regulatory Commission (NRC) licensees authorized to possess and use sealed sources at large irradiators.
91-03	Management of Wastes Contaminated with Radioactive Materials ("Red Bag" Waste and Ordinary Trash)	01/07/91	All medical licensees.
91-02	Brachytherapy Source Management	01/07/91	All Nuclear Regulatory Commission (NRC) medical licensees authorized to use byproduct material for medical purposes.
90-82	Requirements for Use of Nuclear Regulatory Commission-(NRC-)Approved Transport Packages for Shipment of Type A Quantities of Radioactive Materials.	12/31/90	All registered users of NRC-approved packages.
90-81	Fitness for Duty	12/24/90	All U.S. Nuclear Regulatory Commission (NRC) materials and non-power reactor licensees.

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EKraus: 3/04/91

*See previous concurrence

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