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LPDR (10,11,16)

Distribution:  
Galson

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The U. S. Nuclear Regulatory Commission (NRC) is assembling mathematical models for assessing demonstrations that the U. S. Department of Energy (DOE) is expected to make in order to show that its deep geologic repositories for high-level radioactive waste (HLW) are in compliance with NRC's HLW regulation, 10 CFR 60, and EPA's HLW Standard, 40 CFR 191. In support of this research, computer software has been developed for use in assessing the long-term risk from disposal of radioactive waste in deep geologic formations, in estimating dose commitments and potential adverse health effects from released radionuclides, and in performing sensitivity and uncertainty analyses. Because of the potential use of this software in NRC licensing and regulatory activities, it is essential that a quality assurance (QA) program exist to ensure confidence in data generated by existing codes, as well as maintenance of the codes. The QA plan [NUREG/CR-69] was developed by Sandia under the direction and approval of the NRC and published in January 1986; it is currently implemented at Sandia on the Cyber 855/NOS computer system.

The QA plan establishes a Computer Software Management System (CSMS) which is administered by the QA Coordinator. The primary function of the CSMS is to maintain a repository for current and previously-used versions of computer software as well as supporting documentation. Included in this task is the responsibility to maintain backups of all computer files.

The CSMS is made up of three major components. The first component is the physical library, a storage facility for documentation for each code, procedures for execution of the code, and hardcopy listings or microfiche of source codes, and input and output for all sample problems maintained in the library. The second component of the CSMS is a software or code library currently available on the NOS system in the user area QUALIB. This library maintains standard versions of codes along with their corresponding source code, binaries, sample problems, and any other associated files. Users have access to an interactive on-line help system that acquaints them with each code in the library. This interactive system provides general information about the code, its evolution and version, hardware dependencies, related documentation, and current Sandia contacts. All associated files are defined along with example procedures for execution. In some instances procedures for special features are provided for the user; for example, to automatically re-dimension a code for large problems. The third component is system backup. Duplicate copies of all software are maintained on magnetic tapes and or diskettes.

Due to improvements and modifications for specific applications, several versions of a computer code may exist. The standard version must be accompanied by a user's manual and sample problems, and when possible, currently used versions made compatible with the existing computer hardware and operating system. Modifications to standard versions must be accompanied by a list of the specific code changes, the input data and results. Enforcement of these requirements is provided through the manuscript review process. The QA Coordinator is required to sign off on any reports being published by the organization, and doing so ensures that the author has provided the QA Coordinator with the appropriate material. In the case of a user's manual for a new code, certain guidelines must be followed such as a description of theory, data input requirements and sample problems. In the case of a report containing numerical results, the author

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must provide the version of the code used (or modifications to an existing code) and input files and procedures needed to reproduce those results.

As outlined in the QA plan, two key elements in software QA are retrievability and traceability. To ensure future retrievability, all software maintained in the CSMS is placed into an archive file in a format that is compatible with the operational computer equipment at that time. At Sandia, standard versions are currently maintained in the user area QUALIB on the Open NOS computer. The QA plan requires that records be kept of any alteration to a program. This is currently performed through use of the Update processor at Sandia.

Pertinent information concerning each computer code is retained in a designated QA notebook. Such information includes hardware and software requirements; a brief summary of the purpose, scope and methods of the program; modifications; reported problems; and a distribution list.

The QA plan was developed to provide guidelines for establishing a software maintenance system. As the system has been implemented and the program has evolved, alternate methods for achieving quality assurance have been developed in some areas. Specifically, the use of some of the forms described in the QA plan and the options provided by the on-line help facility have evolved to meet changing requirements. Consequently, the QA plan is currently being revised to reflect present usage.

Several significant benefits have resulted from implementation of the software QA plan. Of great importance is the fact that the NRC has been provided with standard versions of computer codes developed for research efforts. Requirements that a standard version of a computer code be accompanied by sample problems assures reliability of the code (verification). In addition, availability of software with complete documentation makes reproducibility of results feasible and defensible.

A1165  
Sandy  
Seth  
Jim K

F A C S I M I L E   T R A N S M I S S I O N

DATE July 14, 1987

MESSAGE TO: Dan Galson  
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MESSAGE FROM: R. M. Cranwell 844-8368  
Name Telephone

SANDIA NATIONAL LABORATORIES  
Albuquerque, New Mexico 87185  
Organization 6416  
Building 823, Room 3451

Telecopy Number  
(505)846-0095

Verification Numbers  
(505)844-4032  
(505)844-7118