



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

FEB 4 1991

MEMORANDUM FOR: Thomas E. Murley, Director
Office of Nuclear Reactor Regulation

FROM: Eric S. Beckjord, Director
Office of Nuclear Regulatory Research

SUBJECT: RESEARCH INFORMATION LETTER NO. 169 ;
NUCLEAR COMPUTERIZED LIBRARY FOR ASSESSING REACTOR
RELIABILITY (NUCLARR)

Estimates of human error probability and hardware component failure rates are currently used in safety studies such as generic safety issue resolution, human reliability analyses (HRA), interfacing system loss-of-coolant accidents (LOCA) studies, analyses of low-power and shutdown accidents, and reviews of Individual Plant Examination (IPE) submittals from utilities. This Research Information Letter documents the results of implementing the Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR), which supports the aforementioned safety studies by making available these important data to NRC staff in reports as well as in diskettes for personal computers (PC).

1. Regulatory Issue

Probabilistic Risk Assessment (PRA) has proved to be a useful technique for safety and risk studies, and its results provide information for decisions regarding the safety of nuclear power plants (NPPs). However, the HRA portions of PRAs have large uncertainties because of modelling limitations and the lack of readily available data. A need therefore existed to develop and implement a library where data appropriate for HRAs could be processed, stored, and retrieved in a timely fashion.

In its initial research request dated November 1982, the Office of Nuclear Reactor Regulation (NRR) requested that a human reliability data bank be developed. Therefore, the initial NUCLARR objective was to develop a human reliability data bank. During the development phase, it was recognized by the NRC and the developers that a data bank handling only human errors would not be very useful and practical to the PRA analyst, and the data bank should therefore be expanded to include hardware failures. In January and March 1988, respectively, the RES Division of Reactor Accident Analysis and the NRR Division of Radiation Protection and Emergency Preparedness endorsed the concept of integrating human and hardware performance data into one management system, NUCLARR.

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2. Conclusions

NUCLARR was developed and implemented by Idaho National Engineering Laboratory (INEL) for PCs. NUCLARR was designed to be user friendly and responsive to the varied needs of the HRA/PRA analyst. After a review by PRA and HRA experts, it was revised and upgraded to ensure its accuracy, acceptability, and usefulness. It was made compatible with other risk analysis-related codes such as the Integrated Reliability and Risk Analysis System (IRRAS) and the Systems Analysis and Risk Assessment System (SARA).

NUCLARR's major components are (1) the **NUCLARR computer code** encompassing all the software for storing, processing, and retrieving human error and hardware failure data; (2) the **NUCLARR Clearinghouse** composed of INEL personnel whose function is to maintain and upgrade the software and supporting documentation and provide the primary interface and point of contact with data suppliers and data users, including a hot line function; (3) the **Human and Hardware Reliability Analysis Group (HHRAG)** composed of interdisciplinary INEL experts responsible for acquiring and screening human error probabilities (HEPs) and hardware component failure data (HCFD) for entry into the data base and supported by the Clearinghouse personnel; (4) the **HHRAG review committee** composed of PRA and HRA experts outside of INEL who serve on a rotating basis to independently review the data prepared for entry and possibly data already resident in the data base and to provide guidance for improving the data base. In order to ensure the integrity of the data base, HHRAG developed guidelines for data acquisition and data screening processes ("Procedures for Processing Data," NUREG/CR-5439, Volume III). Thus NUCLARR provides the functions of a data repository, a data management system allowing the user to perform custom-tailored data searches and data aggregations based on various kinds of statistical techniques, a process for acquiring and screening data, and a hot line to assist the user on data source, data processing, and data interpretation.

Data for input to NUCLARR are acquired from a variety of sources including (1) NRC PRAs such as the interfacing systems loss-of-coolant accident (ISLOCA), the Interim Reliability Evaluation Program, NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants;" (2) domestic utility PRAs such as the Zion, Big Rock Point, and Oconee. (3) foreign utility data such as the German Gesellschaft fuer Reaktorsicherheit (GRS) or the Swedish nuclear utility reliability data; (4) the academic literature or other technical activities involving data collection efforts such as the George Mason University research (utilizing non nuclear human performance data for nuclear applications), the "In-Plant Reliability Data Base for Nuclear Plant Components," and the report "Human Reliability in the Performance of Maintenance"; (5) computer simulation trials such as "Test Steam Line Isolation, Task 2, MAPPS Computer Run" and the Halden Reactor Project (Halden, Norway) simulator runs; and (6) applications of expert judgment techniques as the success likelihood indexing method (SLIM) for estimating human error probabilities. NUCLARR currently includes over 2300 individual data records obtained from more than 60 different sources (NUREG/CR-4639, Volume V). Each record identifies the source to allow a user to select data appropriate for specific applications.

NUCLARR data are contained on a set of floppy diskettes that are updated as new data are obtained. NUCLARR is documented in a five-volume series:


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NUREG/CR-4639, "Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR)." Volume I (Enclosure 1) is a summary description providing an overview of the NUCLARR system; Volumes II and III are the software programmer's guide and the guide to data processing and revision, respectively; Volume IV is the User's Guide; and Volume V is the Data Manual, i.e., a hard copy version of the data and supporting information.

NUCLARR is currently operating on PCs at several NRC locations, including NRR, AEOD, RES, ACRS, and the Chattanooga training center. Also, non NRC requests for access to the data base are entertained when requestors provide data appropriate for input to the data base. Thus, NUCLARR resides in several DOE laboratories such as the Brookhaven National Laboratory (BNL) and the Battelle Pacific Northwest Laboratory (PNL); utilities such as the Carolina Power & Light Co, the Power Authority of the state of New York, and the Consumers Power Co; domestic organizations such as Westinghouse (Bettis Atomic and Savannah River) and General Electric (Knolls Atomic); and foreign organizations such as the Commission of the European Communities (Italy), and the Nuclear Power Engineering Test Center (Japan).

3. Regulatory Implications

NUCLARR is currently being used for the NRC's ongoing evaluation of interfacing systems LOCAs at three U.S. plants. NUCLARR can provide a repository for the human error data to be collected by NRR from the simulator trials portion of the operator requalification examination. NUCLARR is a mature data base and can be used as a primary data source for the review of the submittals from the IPEs. In conclusion, NUCLARR provides a central repository of comprehensive data on human and hardware failure rates for risk and safety analyses in nuclear power plants.


Eric S. Beckjord, Director
Office of Nuclear Regulatory Research

Enclosure:
NUREG/CR-4639, Volume I,
Rev. 1: NUCLARR Summary Description

cc: E. L. Jordan
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A. B. Davis
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D. A. Ward
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4. Restrictions on Application

In keeping with the philosophy of NUCLARR to provide a repository for failure rate data, NUCLARR was not designed to contain an "approved" set of data. Instead, any data record that meets the qualifications established in NUREG/CR-5439, Volume III, "Procedures for Processing Data," is acceptable for entry into NUCLARR. Although this does not lessen the responsibility of the HHRAG for soliciting quality data, determining the suitability of a selected data record for a given application ultimately rests with the user. The user should view NUCLARR as a resource where screened information can be sought. He/she will determine which data should be used for a particular application. In cases where the user is not sure about the quality and interpretation of certain data, he/she should refer to Clearinghouse personnel whose function is to provide guidance in making the best use of available data.

Furthermore, NUCLARR, being a probabilistic data base designed with the PRA and HRA analyst in mind, has many capabilities allowing for custom-tailored searches and data aggregations. However, users must keep in mind that appropriate expertise in the statistical techniques as well as the principles of PRA and HRA methodologies is necessary in order to accurately use the data base. This is especially true for the human error portion of the data base which, if improperly used, may produce erroneous results.

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4. Restrictions on Application

NUCLARR is a probabilistic data base designed with the PRA and HRA analyst in mind. NUCLARR has many capabilities allowing for custom-tailored searches and data aggregations based on classical or Bayesian statistical techniques. Therefore, the user must be familiar with these statistical techniques and the principles of PRA and HRA methodologies in order to accurately use the data base.

5. Unresolved Questions/Further Work

NUCLARR, in order to fulfill its mission as a central data repository for probabilistic studies, must continue aggressive solicitation of pertinent data, especially data from actual occurrences. During the last two years, the data base has been expanded significantly, and plans for FY 1991 are to continue to obtain and solicit data at the same pace. This activity has been accelerated by instituting a policy of giving the software to organizations willing to provide qualified data for input. Thus NUCLARR contains data from many sources, including domestic and foreign utilities. In the near future actual human performance data collected for the military (and currently adapted to NPP conditions by George Mason University) will be included. However, the issue of quality data remains crucial; the user Offices can assist in this effort by making available to NUCLARR data collected through various activities or even by engaging in appropriate data collection activities to help equip NRC with a comprehensive and updated probabilistic data base that will overcome a major difficulty in obtaining meaningful results from probabilistic safety studies.

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