

ORNL/NUREG/NSIC-142
(Vol. III of TID-3362)

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NRC LIGHT-WATER REACTOR SAFETY RESEARCH
FOREIGN TECHNICAL EXCHANGE PROGRAM
VOL. III
(JANUARY-JUNE 1977)

Prepared for the U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Under Interagency Agreements ERDA 40-551-75 and 40-552-75

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109	Safety-Related Occurrences in Nuclear Facilities as Reported in 1972, R. L. Scott and R. B. Gallaher, Dec. 1973	\$15.00
110	Indexed Bibliography of Thermal Effects Literature - 3, J. G. Morgan, July 1973	\$12.50
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112	Compilation of Nuclear Standards, 3rd Edition, 1972, Part I: United States Activities, J. P. Blakely, Oct. 1973	\$12.50
113	A Selected Bibliography on Emergency Core Cooling Systems (ECCS) for Light-Water-Cooled Power Reactors (LWRs), W. B. Corbitt, Jan. 1974	\$12.50
114	Annotated Bibliography of Safety-Related Occurrences in Nuclear Power Plants as Reported in 1973, R. L. Scott and R. B. Gallaher, Nov. 1974	\$15.00
115	Protection of Nuclear Power Plants Against External Disasters, W. B. Corbitt, May 1973	\$15.00
116	A Selected Bibliography on Pressure Vessels for Light-Water-Cooled Power Reactors (LWRs), F. A. Heddleson, Jan. 1975	\$15.00

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FOREWORD

The Nuclear Safety Information Center (NSIC), which was established in March 1963 at Oak Ridge National Laboratory, is principally supported by the U.S. Nuclear Regulatory Commission's Office of Nuclear Regulatory Research. Support is also provided by the Division of Reactor Development and Demonstration of the U.S. Energy Research and Development Administration. NSIC is a focal point for the collection, storage, evaluation, and dissemination of safety information to aid those concerned with the analysis, design, and operation of nuclear facilities. A system of key words is used to index the information cataloged by the Center. The title, author, installation, abstract, and key words for each document reviewed are recorded at the central computing facility in Oak Ridge. The references are cataloged according to the following categories:

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7. Fission Product Release, Transport, and Removal
8. Sources of Energy Release under Accident Conditions
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10. Electrical Power Systems
11. Containment of Nuclear Facilities
12. Plant Safety Features - Reactor
13. Plant Safety Features - Nonreactor
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(inactive September 1973)
15. Environmental Surveys, Monitoring, and Radiation Dose Measurements
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17. Operational Safety and Experience
18. Safety Analysis and Design Reports

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19. Internal Exposure Effects on Humans Due to Radioactivity in the Environment (inactive September 1973)
20. Effects of Thermal Modifications on Ecological Systems (inactive September 1973)
21. Radiation Effects on Ecological Systems (inactive September 1973)

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ABSTRACT

Lists of documents exchanged during the first half of 1977 under agreements between the U.S. Nuclear Regulatory Commission's Office of Nuclear Regulatory Research and the governments of France, Federal Republic of Germany, and Japan are presented. During this period, the NRC received 41 reports from France, 29 from F. R. Germany, and 24 from Japan, and in return sent 107 U.S. reports to each of these three countries.

INTRODUCTION

This report lists those documents exchanged during the first half of 1977 under agreements between the U.S. Nuclear Regulatory Commission's Office of Nuclear Regulatory Research and France, Federal Republic of Germany, and Japan. This is the third report in this series, the first had a similar title, but covered the period November 1974 through December 1975, and was published in May 1976 as TID-3362. The second report covered 1976 and was published in April 1977 as ORNL/NUREG/NSIC-134. The total number of reports received by the NRC from January through June 1977 from France, F. R. Germany, and Japan, as well as the reports sent by NRC to each of these three countries during this period, are tabulated below. The numbers of proprietary documents received are listed in parentheses. Also tabulated are the documents exchanged in 1974-1975 as listed in TID-3362 and those exchanged in 1976 as reported in ORNL/NUREG/NSIC-134.

Reports received by NRC^{*}

	France	F. R. Germany	Japan
January-June 1977	41(12)	29(1)	24(1)
1976	25(6)	75(9)	38(5)
1974-1975	10	6	24

^{*}The number of proprietary documents received are listed in parentheses.

Reports sent by NRC

	France	F. R. Germany	Japan
January-June 1977	107	107	107
1976	119	154	155
1974-1975	100	181	115

For convenience in processing, each of the foreign reports received under the exchange agreements is assigned a unique number identifying it as part of the exchange. The documents from France, F. R. Germany, and Japan are listed sequentially by this assigned number. However, additional bibliographic information, including the number assigned by the issuing installation, is also presented. The numbers assigned to proprietary documents are listed, but bibliographic data on these documents and the documents themselves are privileged information. As was done in ORNL/NUREG/NSIC-134, the U.S. reports are listed alphanumerically.

All reports, both foreign and domestic, with the exception of the proprietary documents, are available from the National Technical Information Service, U.S. Department of Commerce, Springfield, Va., 22161, in either microfiche or hard copy. (In most cases, however, the hard copies of foreign reports will be reproduced from microfiche.)

NRC LIGHT-WATER REACTOR SAFETY REPORTS
TRANSMITTED TO FOREIGN EXCHANGE
AGREEMENT COUNTRIES

The following is a cumulative listing of the U.S. reports transmitted by the NRC to France, Federal Republic of Germany, and Japan during the period January-June 1977.

ANL-76-75. *A Summary of Experimental Methods for Statistical and Transient Analysis of Two-Phase Gas-Liquid Flow.* June 1976. Transmitted May 13, 1977.

ANL-76-87. *Light-Water-Reactor Safety Research Program: Quarterly Progress Report, April-June 1976.* 1976. Transmitted March 14, 1977.

ANL-76-121. *Light-Water-Reactor Safety Research Program: Quarterly Progress Report, July-September 1976.* December 1976. Transmitted April 14, 1977.

BMI-NUREG-1961. *Evaluating Strength and Ductility of Irradiated Zircaloy.* October 1976. Transmitted March 14, 1977.

BMI-NUREG-1962. *Reactor Safety Program Applications and Coordination Task 1. Steam-Water Mixing Program and System Hydrodynamics, April-June 1976.* November 1976. Transmitted March 14, 1977.

BMI-NUREG-1964. *Steam-Water Mixing and System Hydrodynamics Program.* December 1976. Transmitted April 4, 1977.

BMI-NUREG-1965. *Fission Product Transport Activities: Quarterly Progress Report, July through September 1976.* December 30, 1976. Transmitted April 4, 1977.

BMI-NUREG-1966. *Critical Experiments, Measurements, and Analyses to Establish a Crack Arrest Methodology for Nuclear Pressure Vessel Steels.* February 1977. Transmitted April 22, 1977.

BMI-NUREG-1967. *Evaluating Strength and Ductility of Irradiated Zircaloy, Task 5, Quarterly Progress Report, October through December 1976.* January 1977. Transmitted May 13, 1977.

BMI-NUREG-1968. *Steam-Water Mixing and System Hydrodynamics Program, Task 4, Quarterly Progress Report, October through December 1976.* February 1977. Transmitted May 13, 1977.

BNWL-2110. *REDIQ - A Computer Program for Estimating Health Effects from Inhalation and Ingestion of Radionuclides.* December 1976. Transmitted May 13, 1977.

BNWL-2150. Evaluation of Monticello Nuclear Power Plant, Environmental Impact Prediction, Based on Monitoring Programs. November 1976. Transmitted April 14, 1977.

BNWL-2151. Evaluation of Haddam Neck (Connecticut Yankee) Nuclear Power Plant, Environmental Impact Prediction, Based on Monitoring Programs. December 1976. Transmitted July 8, 1977.

BNWL-2152. Evaluation of Millstone Nuclear Power Plant, Environmental Impact Prediction, Based on Monitoring Programs. February 1977. Transmitted May 13, 1977.

BNWL-2152, Add. 1. Similarity Indices I: What Do They Measure? November 1976. Transmitted July 8, 1977.

BNWL-2152, Add. 2. Similarity Indices II: The Power of Goodall's Significance Test for the Simple Matching Coefficient. December 1976. Transmitted July 1977.

BNWL-2153. Evaluation of Nuclear Power Plant Environmental Impact Prediction, Based on Monitoring Programs. February 1977. Transmitted July 8, 1977.

BNWL-2159. A Test of the Performance of Personnel Dosimeters. April 1977. Transmitted July 1977.

BNWL-2189. Verification of Fuel Centerline Thermocouple Readings Through Response to Linear Power Decreases. April 1977. Transmitted July 1977.

BNWL-2212. Core Thermal Model: COBRA-IV Development and Applications. January 1977. Transmitted July 8, 1977.

BNL-NUREG-50569. Development of a Computer Code for Thermal Hydraulics of Reactors (THOR), Sixth Quarterly Progress Report January-March 1976. December 1976. Transmitted April 22, 1977.

BNL-NUREG-50596. Intergranular Stress Corrosion Cracking of Sensitized Stainless Steel, Final Report. December 1976. Transmitted April 22, 1977.

BNL-NUREG-50624. Reactor Safety Research Programs Quarterly Progress Report, Oct. 1-Dec. 31, 1976. February 1977. Transmitted July 8, 1977.

CREARE TN-255. Effect of Superheated Walls on Plenum Fillings at 1/15 Scale. March 1977. Transmitted July 8, 1977.

GEAP-10207-36. Reactor Primary Coolant System Pipe Rupture Study Progress Report No. 36, April-June 1976. September 1976. Transmitted March 14, 1977.

FRRSR-59 (SERMA/LEP/76.735). *Analysis of the Uncertainty of the Failure Probability Using the PATREC-MC Code*. CEA Centre d'Etudes Nucleaires de Saclay. 1976. Received April 11, 1977.

FRRSR-60 (SERMA/LEP/76.764). Proprietary report.

FRRSR-61 (SEN/028). Proprietary report.

FRRSR-62 (DSN 126). *Reliability of the System for the Control of the Volume and Chemistry of Reactor Water*. CEA Departement de Surete Nucleaire. August 1976. Received June 8, 1977.

FRRSR-63 (DSN 129). *Availability of a Periodically Tested System in Waiting, Approximate Calculations - Optimization*. CEA Departement de Surete Nucleaire. December 1976. Received June 1977.

FRRSR-64 (DSN 113e). *Nuclear Safety Research In France*. CEA Departement de Surete Nucleaire. December 1976. Received June 8, 1977.

FRRSR-65 (DSN 136). *Applications of Studies Using the Fault-Tree Method*. CEA Departement de Surete Nucleaire. June 1976. Received June 1977.

FRRSR-66 (DSN 137). *Application of Fault-Tree Analysis Methods to the Evaluation of the Reliability of a Safety System in a Pressurized-Water Power Station*. CEA Departement de Surete Nucleaire. June 1976. Received June 1977.

FRRSR-67 (DSN 138). *The Complex-System Reliability Computer Program PATREC-DE Based on the Recognition of Shapes*. CEA Departement de Surete Nucleaire. June 1976. Received June 1977.

FRRSR-68 (DSN 139). *Determination of Typical Accidents in Pressurized-Water Power Reactors and Their Consequences, for the Purpose of the Preparation of Appropriate Emergency Plans*. CEA Departement de Surete Nucleaire. March 1977. Received June 1977.

FRRSR-69 (DSN 140). *Human Components in the Initiating Phenomena of Nuclear Accidents*. CEA Departement de Surete Nucleaire. March 1977. Received June 1977.

FRRSR-70 (CEA-N-1933). *Some Comments about the Use of J_1 Integral Criterion*. CEA Centre d'Etudes Nucleaires de Saclay. January 1977. Received June 8, 1977.

FRRSR-71 (SETSSR 150). *Description and Use of PATREC-RCM Code*. CEA Departement de Surete Nucleaire. February 1977. Received June 8, 1977.

FRRSR-72 (SECS-SELECI 344). Proprietary report.

FRRSR-73 (EMT/76/71). Proprietary report.

FRRSR-74 (EMT/76-84). Proprietary report.

FRESR-75 (ENT-77/013). Proprietary report.

FRESR-76 (ENT-77/29). Proprietary report.

GERMAN (FRG) LIGHT-WATER REACTOR SAFETY
REPORTS RECEIVED BY NRC

The following is a cumulative listing of reports received from the Federal Republic of Germany during the first half of 1977 under the Technical Exchange Agreement. Bibliographic information is omitted from proprietary reports.

GERRSR-82 (IRS-F-32). *List of Reports on the Reactor Safety Program (Reporting Period: July 1-September 30, 1976)*. Institut für Reaktorsicherheit der Technischen Überwachungs-Vereine e.V. October 1976. Received January 6, 1977.

GERRSR-83 (MRR-163). *Research on Managing the Consequences of the Failure of the Reactor Shutdown System (ATWS) and Other Selected Safety Activities*. Technical University of Munich. September 1976. Received January 24, 1977.

GERRSR-84 (IRS-F-33). *Reports on Research Projects in the Field of Reactor Safety Supported by the Ministry for Research and Technology (Reporting Period: July 1-September 30, 1976)*. Institut für Reaktorsicherheit der Technischen Überwachungs-Vereine e.V. December 1976. Received February 4, 1977.

GERRSR-85 (MRR-164). *Theoretical Background of the Computer Codes SAFPL and CRES and Calculation of the Reliability of the Codes*. Technische Universität München. September 1976. Received April 6, 1977.

GERRSR-86 (MRR-165). *Identification of the Vibration Behavior and Estimation of System Parameters for Pressure Vessel and Internals of PWR Biblis-A*. Technische Universität München. October 1976. Received April 6, 1977.

GERRSR-87 (MRR-166). *Conclusion of the Reliability Analysis of Reactor Protection Systems*. Technische Universität München. November 1976. Received May 13, 1977.

GERRSR-88 (MRR-167). *Calculation of the Time-Dependent Local Heat-Transfer Coefficient on the Rewetting of Heated Insulated Tubes*. Technische Universität München. November 1976. Received May 13, 1977.

GERRSR-89 (MRR-155). *Parameter Identification of a BWR Nuclear Power Plant Model for Use in Optimal Control*. Technische Universität München. February 1976. Received May 13, 1977.

GERRSR-90 (RB 78/k 40). *LWR Development Program for Development of the Hydrodynamic Bearings for SWR-Rotating Pump, Final Report*. KSB Research and Construction. No date. Received May 13, 1977.

GERRSR-91 (MR-160). *Proceedings of the IAEA/WPCCI Specialists' Meeting on Use of Computers for Protection Systems and Automatic Control, Neuherberg/Munich, May 11-13, 1976. Technische Universitat Munchen. July 1976. Received May 13, 1977.*

GERRSR-92 (BF RS 50-32-C14). *Investigation of the Phenomena Occurring Within a Reactor Containment During a Loss of Coolant Accident, Experiment C14. Battelle-Institut e.V., Frankfurt am Main. February 1977. Received May 13, 1977.*

GERRSR-93 (BF-R-61.958-11). *Investigations on a Continuously Operating System for Crack Growth Surveillance in Pressure Vessels. Part IV - Further Development of Acoustic Emission Analysis with Regard to Application at the Reactor. Battelle-Institut e.V., Frankfurt am Main. April 1976. Received May 13, 1977.*

GERRSR-94 (BF-RS50-21-5). *Description of the Program Blocks RS DV for Data Processing. Battelle-Institut e.V., Frankfurt am Main. January 1977. Received May 13, 1977.*

GERRSR-95 (BF RS 50-32-C7). *Investigation of the Phenomena Occurring within a Reactor Containment during a Loss of Coolant Accident, Experiment C7. Battelle-Institut e.V., Frankfurt am Main. February 1977. Received May 13, 1977.*

GERRSR-96 (GRS-F-34). *List of Reports on Reactor Safety Research from BMFT and USNRC (Reporting Period: October 1 Through December 31, 1976). Gesellschaft fur Reaktorsicherheit mbH. February 1977. Received May 13, 1977.*

GERRSR-97 (BF RS 50-32-C16). *Investigations of the Phenomena Occurring within a Reactor Containment During a Loss-of-Coolant Accident in a Water-Cooled Reactor. Battelle-Institut e.V., Frankfurt am Main. November 1976. Received June 8, 1977.*

GERRSR-98 (Report V 1/77). *Fracture Properties of Part-Through Cracks. Institut fur Festkorpermechanik. January 1977. Received June 8, 1977.*

GERRSR-99 (Report 4/76). *On the Assessment of Cracks for Elastic-Plastic Materials Behavior. Institut fur Festkorpermechanik. November 1976. Received June 8, 1977.*

GERRSR-100 (BMFT RS 78 B). *Safety Technology Research Program, Research on Condensation and Boiling, Final Report. Keyword: Condensation IV, Part 1. Kraftwerk Union, Erlangen. November 1976. Received June 1977.*

GERRSR-101 (BMFT RS 78 C). *Research Program on Reactor Safety, Final Report. Keyword: Condensation IV, Part II. Project Part A: Pressure Fluctuations. Kraftwerk Union, Erlangen. October 1976. Received June 1977.*

GERRSR-102 (BMFT RS 78 C). *Research Program on Reactor Safety, Final Report. Keyword: Condensation IV, Part II. Project Part B: Crossbeam Loads.* Kraftwerk Union, Erlangen. October 1976. Received June 8, 1977.

GERRSR-103 (GRS-F-35). *Progress Report on Research Sponsored by the Federal Ministry of Research and Technology into the Field of Light Water Reactor Safety (Reporting Period: October 1 through December 31, 1976).* Gesellschaft für Reaktorsicherheit mbH. March 1977. Received June 8, 1977.

GERRSR-104 (Bericht SB 4). *Reactor Pressure Vessel Status Report, Vol. III. Presentation of the Significant Results of the Heavy-Section Steel Technology Program, Supplemented by the Pertinent Literature Through 1973.* Institut für Reaktorsicherheit der T.U.V. December 1976. Received June 30, 1977.

GERRSR-105 (BMFT RS 166). *Behavior of Core Melt During a Hypothetical Accident, Annual Report 1976.* Technische Universität Hannover. 1977. Received July 18, 1977.

GERRSR-106 (BF-RS 50-32-D1). *Investigation of the Phenomena Occurring within a Multi-Compartment Containment after Rupture of the Primary Cooling Circuit in Water-Cooled Reactors, Experimental Results, Experiment D1.* Battelle-Institut e.V., Frankfurt am Main. March 1977. Received June 30, 1977.

GERRSR-107 (BF RS 50-30-D1). *Investigation of the Phenomena Occurring within a Multi-Compartment Containment after Rupture of the Primary Cooling Circuit in Water-Cooled Reactors, Quick-Look Report, Experiment D1.* Battelle-Institut e.V., Frankfurt am Main. March 1977. Received June 30, 1977.

GERRSR-108 (BF-RS0016B-33-1). *Research Results on Behavior of a Two-Phase Level in a Tank (Height 11.2 m) without Internals after a Steam Pipe Rupture.* Battelle-Institut e.V., Frankfurt am Main. March 1977. Received June 30, 1977.

GERRSR-109 (OeS 8-641 440/17). Proprietary report.

GERRSR-110 (KTA 3501). *Safety Technical Regulation of the KTA - Reactor Protection System and Control of Safety Installations.* Nuclear Technical Committee. February 1976. Received June 30, 1977.

GERRSR-111. *Program of the Federal Department of Interior for Safety Technique Rules of Nuclear Technical Installations.* Federal Department of Interior. January 24, 1977. Received June 30, 1977.

JAPANESE LIGHT-WATER REACTOR SAFETY REPORTS
RECEIVED BY NRC

The following is a cumulative listing of reports received from Japan during the first half of 1977 under the Technical Exchange Agreement. Bibliographic information is omitted from proprietary reports.

JPNRSR-64 (JAERI-M-6787). *Report on Series 2A Reflood Experiment.* Japan Atomic Energy Research Institute, Tokyo. October 1976. Received January 14, 1977.

JPNRSR-65 (JAERI-M-6790). *Quarterly Progress Report on the MSRR Experiment, April 1976-June 1976.* Japan Atomic Energy Research Institute, Tokyo. October 1976. Received January 14, 1977.

JPNRSR-66 (JAERI-M-6848). *Film Boiling Heat Transfer During Reflood Process.* Japan Atomic Energy Research Institute, Tokyo. December 1976. Received January 14, 1977.

JPNRSR-67 (51-STAE-59). *Study on the Efficiency of the BWR Top Spray Emergency Cooling with an 8x8 Simulated Fuel Rod Bundle.* Hitachi Limited. September 1976. Received February 9, 1977.

JPNRSR-68 (51-STAE-58). *Study on Separation Performance for Radioactive Gaseous Waste by Permselective Membranes.* Tokyo-Shibawa Electric Co., Ltd. September 1976. Received February 9, 1977.

JPNRSR-69 (JWES-AE-7605) (Report 51-STAE-113). *Study on Structural Design Code of Fatigue and Creep Interaction of Nuclear Materials.* Japan Welding Engineering Society. October 1976. Received February 9, 1977.

JPNRSR-70 (JWES-AE-7606) (Report 51-STAE-114). *Study on Local Structural Behavior and Safety Analysis of Nuclear Piping Systems.* Japan Welding Engineering Society. October 1976. Received February 9, 1977.

JPNRSR-71 (JAERI-M-6788). *Report on Series 2B Reflood Experiment.* Japan Atomic Energy Research Institute, Tokyo. October 23, 1976. Received April 13, 1977.

JPNRSR-72 (JAERI-M-6869). *Influence of Deformation on the Subsequent Steam Oxidation of Zircaloy Cladding.* Japan Atomic Energy Research Institute, Tokyo. December 16, 1976. Received April 13, 1977.

JPNRSR-73 (JAERI-M-6879). *Zircaloy-Steam Reaction and Embrittlement of the Oxidized Zircaloy Tube Under Postulated Loss of Coolant Accident Conditions (Oxidation Kinetics and Embrittlement of Zircaloy at above 1200°C).* Japan Atomic Energy Research Institute, Tokyo. December 21, 1976. Received April 13, 1977.

- JPNRSR-74 (JAERI-M-6742). *User's Guide for FREG-3: A Computer Program to Analyze Pellet-Cladding Gap Conductance in Accordance with Fuel-Rod Irradiation History.* Japan Atomic Energy Research Institute, Tokyo. September 20, 1976. Received April 13, 1977.
- JPNRSR-75 (JAERI-M-6878). *Analysis of Pellet Center Temperatures Measured in EALDEN IFA-24 Using Program FREG-3.* Japan Atomic Energy Research Institute, Tokyo. December 21, 1976. Received April 13, 1977.
- JPNRSR-76 (JAERI-M-6626). *Displacement, Stress, and Strain in Two-Dimensional Problems of Solid and Hollow Cylinders.* Japan Atomic Energy Research Institute, Tokyo. June 23, 1976. Received April 13, 1977.
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