

AUTHORS — OCTOBER 1989

TMI-2: HEALTH PHYSICS AND ENVIRONMENTAL RELEASES

PREFACE — TMI-2: HEALTH PHYSICS AND ENVIRONMENTAL RELEASES

Carl H. Distenfeld

Carl H. Distenfeld (BS, chemical engineering; MS, nuclear engineering) is manager of fuel measurements and analysis for Bechtel National, Inc. at Three Mile Island Unit 2 (TMI-2). He is responsible for technical leadership of a group working to characterize the radiation environment of the TMI-2 reactor building and to quantify the reactor fuel remaining in the TMI-2 plant following defueling efforts.



THREE MILE ISLAND UNIT 2: THE EARLY RADIOLOGICAL CONDITIONS OF THE REACTOR BUILDING

William C. Hopkins

William C. Hopkins (MS, nuclear engineering, North Carolina State University; BSME, University of Kentucky) is a registered professional engineer serving as a nuclear engineering specialist for Bechtel Power Corporation. He has been the coordinator of Bechtel's Inter-Divisional Radiation Protection Group and was a member of Bechtel's Three Mile Island Initial Planning Study Team. His primary interests are in the areas of shielding and radiation effects as applied to reactor vessels, radiation damage, personnel protection, and severe accidents.



RADIOLOGICAL CONDITIONS AND EXPERIENCES IN THE THREE MILE ISLAND UNIT 2 AUXILIARY BUILDING

*Paul E. Ruhter
Wilbert G. Zurliene*

Paul E. Ruhter (top) (BS, 1963, and MS, 1965, radiation biophysics, University of Kansas) is the manager of the power reactor programs safety unit for EG&G Idaho, Inc. (EG&G) at the test reactor area at the Idaho National Engineering Laboratory. Prior to joining EG&G in 1984, he was employed by GPU Nuclear Corporation as the manager of the radiological technical support branch of the radiological controls department at Three Mile Island Unit 2. His current areas of responsibility include all aspects of operational safety, with particular interest in operational health physics. A photograph and a biography for **Wilbert G. Zurliene** were not available at publication time.



THREE MILE ISLAND UNIT 2 REACTOR BUILDING ENTRY PROGRAM

James W. Langenbach (BS, marine and electrical engineering, Massachusetts Maritime Academy, 1968) is presently the project engineering director for Three Mile Island Unit 2 (TMI-2) for GPU Nuclear Corporation. At the time of the TMI-2 accident, he was the project engineering supervisor for Forked River Nuclear Generation Station Nonnuclear Systems, managing modifications and projects in support of the TMI-2 recovery in March 1979 through September 1980. His interests include continued improvement in the quality of engineering with special interest in minimizing nuclear operator burden through quality engineering.

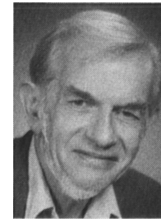
James W. Langenbach



ENVIRONMENTAL MEASUREMENTS DURING THE THREE MILE ISLAND UNIT 2 ACCIDENT

Andrew P. Hull (MS, physics, Vanderbilt University, 1961) is a certified health physicist who has been associated with nuclear operations throughout his professional career. He is currently a senior consultant for emergency planning at Brookhaven National Laboratory, Upton, New York. As a member of the U.S. Department of Energy's Region I Radiological Assistance Program, he was a member of the first off-site response to the Three Mile Island accident, where he was responsible for the technical interpretation of environmental data and dose assessment. He has performed a similar function for three exercises of the Federal Radiological Emergency Response Plan in 1984, 1985, and 1987.

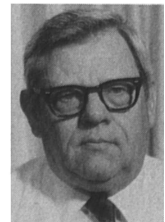
Andrew P. Hull



THREE MILE ISLAND AND THE ENVIRONMENT

Beverly A. Good (top) (MS, health physics, Purdue University) is currently manager of radiological controls in the Radiological and Environmental Controls Division of GPU Nuclear at the Three Mile Island (TMI) plant. Her responsibilities have included radiological engineering, radiological environmental monitoring, emergency preparedness, and decommissioning of a small test reactor. **Gordon M. Lodde** (center) (BS, biology and chemistry, Purdue University) is currently manager of radiological health in radiological controls, TMI-1. He is responsible for providing direct support services to TMI-1 and TMI-2 in the area of dosimetry, bioassay, radiological instrument maintenance and calibration, and respiratory fit testing. He has over 28 years of experience in the applied health physics field. **Diane M. Surgeoner** (bottom) (AA, Hagerstown Junior College) is currently administrator of radiological control records in radiological health, radiological controls, TMI-1. Previously, she was an engineer assistant in the radiological engineering department and dosimetry project coordinator in radiological controls, TMI-2, since 1979.

*Beverly A. Good
Gordon M. Lodde
Diane M. Surgeoner*



THE THREE MILE ISLAND UNIT 2 REACTOR BUILDING GROSS DECONTAMINATION EXPERIMENT: EFFECTS ON LOOSE SURFACE CONTAMINATION LEVELS

Edward N. Lazo (PhD, health physics, University of Florida, 1988; BS and ME, nuclear engineering, University of Virginia, 1979; PE, nuclear engineering, State of Pennsylvania) has been with the Safety and Environmental Protection Division at Brookhaven National Laboratory since 1987. From 1980 to 1983, he

Edward N. Lazo

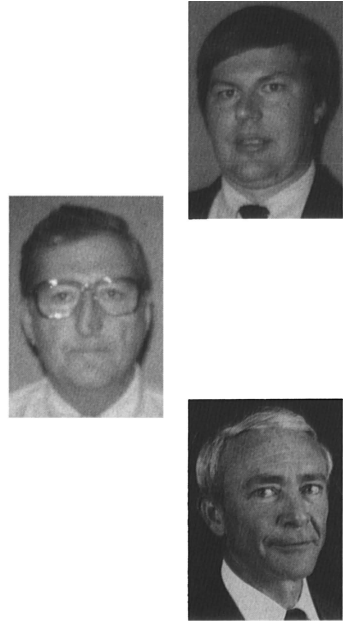


worked for Bechtel National, Inc. at Three Mile Island (TMI) nuclear station as a decontamination engineer. While at TMI, he was involved with the reactor building data acquisition and characterization programs, designed and implemented early decontamination experiments, and wrote and implemented work procedures for portions of the reactor building gross decontamination experiment. His current research interest is in the area of soil sample assay using X-ray spectroscopy.

SURFACE ACTIVITY CHARACTERIZATION WITH THERMOLUMINESCENT DETECTOR PSEUDO CORES

Robert J. Vallem (top) (BS, applied mathematics, engineering, and physics, University of Wisconsin, Madison, 1976) is a decontamination and decommissioning engineer. He worked at Three Mile Island Unit 2 (TMI-2) between 1982 and 1988 in technical planning, decontamination field operations, and defueling operations. He was involved with plant radiological characterization as part of his decontamination technical planning activities. **Carl H. Distenfeld** (center) (BS, chemical engineering; MS, nuclear engineering) is manager of fuel measurements and analysis for Bechtel National, Inc. at TMI-2. He is responsible for technical leadership of a group working to characterize the radiation environment of the TMI-2 reactor building and to quantify the reactor fuel remaining in the TMI-2 plant following defueling efforts. **Henry K. Peterson** (bottom) (BS, physics, Utah State University, 1963) is a radiological engineer for EG&G Idaho, Inc.'s Environmental, Safety, and Quality Division at the Idaho National Engineering Laboratory. He was manager of radiological analysis and effluent assessment for General Public Utilities Nuclear Corporation at the time of the thermoluminescent dosimeter characterization of the TMI-2 reactor building.

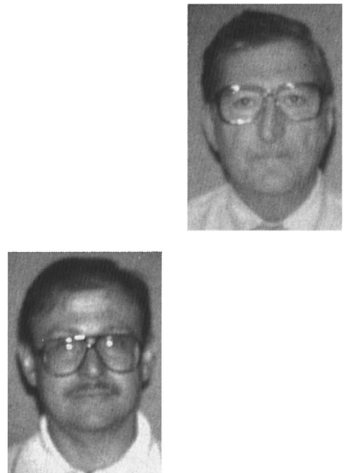
*Robert J. Vallem
Carl H. Distenfeld
Henry K. Peterson*



A FAST SORTING MEASUREMENT TECHNIQUE TO DETERMINE DECONTAMINATION PRIORITY

Carl H. Distenfeld (top) (BS, chemical engineering; MS, nuclear engineering) is the manager for fuel measurements and analysis for Bechtel National, Inc. at Three Mile Island Unit 2 (TMI-2). He is responsible for technical leadership of a group working to characterize the radiation environment of the TMI-2 reactor building and to quantify the reactor fuel remaining in the TMI-2 plant following defueling efforts. **Barry H. Brosey** (bottom) is an engineering associate with GPU Nuclear Corporation, assigned to TMI-2. He is a registered radiation protection technologist and has 16 years of experience in medical and nuclear health physics technology, with particular emphasis on instrumentation. **Hiroo Igarashi** (photo not available) (BS, atomic energy, and MS, applied physical science, Tokai University, Japan) is a professional engineer of radioisotope handling and environmental measurements. He was assigned to the reactor building characterization section at TMI-2.

*Carl H. Distenfeld
Barry H. Brosey
Hiroo Igarashi*



AIRBORNE RECONTAMINATION OF THE THREE MILE ISLAND UNIT 2 REACTOR BUILDING

James E. Tarpinian (MS, radiological sciences and protection, University of Lowell, 1980) is the manager of radiological engineering for Three Mile Island Unit 2 (TMI-2) in GPU Nuclear Corporation's radiological controls organization and is employed by Bechtel Construction, Inc. He has been responsible for various programs in health physics, radiological engineering, dose

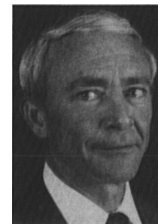
James E. Tarpinian



reduction, decontamination technical planning, and decontamination and radwaste engineering during his 9 years of involvement with the TMI-2 recovery. He is certified both in the comprehensive practice of health physics and the power reactor specialty by the American Board of Health Physics and has practiced operational health physics for over 14 years. His current interests are in automated measurement and three-dimensional imaging of radiation fields and in the application of radiological and industrial health practices to environmental remediation programs.

CHARACTERIZATION OF THE RADIOLOGICAL CONDITIONS OF THE THREE MILE ISLAND REACTOR BUILDING BASEMENT AND D-RINGS

Henry K. Peterson



Henry K. Peterson (BS, physics, Utah State University, 1963) is a radiological engineer for EG&G Idaho, Inc.'s Environmental, Safety, and Quality Division at the Idaho National Engineering Laboratory. He was manager of radiological analysis and effluent assessment for General Public Utilities Nuclear Corporation at the time of the thermoluminescent dosimeter characterization of the Three Mile Island Unit 2 reactor building.

ROBOTIC CHARACTERIZATION OF THE 86.1-m ELEVATION OF THE THREE MILE ISLAND UNIT 2 REACTOR BUILDING

Dennis E. Ferguson

Dennis E. Ferguson (no photo available) is a technologist in the Fuel Measurements and Analysis Group at Bechtel National, Inc. at Three Mile Island Unit 2 (TMI-2). His work at TMI-2 has included robotic surveys and gross gamma fuel and isotopic estimation. He is also interested in the final characterization and decommissioning of nuclear facilities.

THREE MILE ISLAND UNIT 2 REACTOR BUILDING BASEMENT CONCRETE ACTIVITY DISTRIBUTION

*Paul J. Babel
Raymond E. Lancaster
Carl H. Distenfeld*



Paul J. Babel (top) (BS, physics; MS, nuclear engineering) is a senior nuclear engineer for Burns and Roe, Inc., working at Three Mile Island Unit 2 (TMI-2). He is responsible for characterization of radiation sources in the reactor building for decontamination and dose reduction, and for location and quantification of reactor fuel throughout TMI-2. **Raymond E. Lancaster** (center) is an engineer for Bechtel National, Inc. at TMI-2. He has worked on characterization of radiation sources in the reactor building, and on location and quantification of reactor fuel throughout TMI-2. **Carl H. Distenfeld** (bottom) (BS, chemical engineering; MS, nuclear engineering) is manager of fuel measurements and analysis for Bechtel National, Inc. at TMI-2. He is responsible for technical leadership of a group working to characterize the radiation environment of the TMI-2 reactor building and to quantify the reactor fuel remaining in the TMI-2 plant following defueling efforts.



RCS CHARACTERIZATION AND SNM ACCOUNTABILITY: TRACE FUEL CIRCULATION IN THE RCS, REACTOR BUILDING, AND AUXILIARY BUILDING AT TMI-2

Jess Greenborg

Jess Greenborg (MS, nuclear engineering, University of Washington, 1961) is a scientist with Shonka Research Associates. His interest and work spans reactor and health physics. At the time this work was done, he was in the ex-vessel fuel location program



in the planning and analysis department at Three Mile Island Unit 2.

EX-VESSEL FUEL CHARACTERIZATION RESULTS IN THE THREE MILE ISLAND UNIT 2 REACTOR BUILDING

Ryusuke Kobayashi (top) (nuclear engineering, Kyushu University, Japan) is employed by the JGC Corporation of Japan. He was assigned to Three Mile Island Unit 2 (TMI-2) in 1986, working in the Fuel Measurements and Analysis Group from 1987 to 1988, where he was involved with waste management activities. **Carl H. Distenfeld** (center) (BS, chemical engineering; MS, nuclear engineering) is manager of fuel measurements and analysis for Bechtel National, Inc. at TMI-2. He is responsible for technical leadership of a group working to characterize the radiation environment of the TMI-2 reactor building and to quantify the reactor fuel remaining in the TMI-2 plant following defueling efforts. **Dennis E. Ferguson** (no photo available) is a technologist in the Fuel Measurements and Analysis Group at Bechtel National, Inc. at TMI-2. His work at TMI-2 has included robotic surveys and gross gamma fuel and isotopic estimation. He is also interested in the final characterization and decommissioning of nuclear facilities.

*Ryusuke Kobayashi
Carl H. Distenfeld
Dennis E. Ferguson*



REACTOR FUEL DETECTION AND DISTRIBUTION IN THE THREE MILE ISLAND UNIT 2 AUXILIARY BUILDING

Paul J. Babel (top) (BS, physics; MS, nuclear engineering) is a senior nuclear engineer for Burns and Roe, Inc. working at Three Mile Island Unit 2 (TMI-2). He is responsible for characterization of radiation sources in the reactor building for decontamination and dose reduction, and location and quantification of reactor fuel throughout TMI-2. **Barry H. Brosey** (center) is an engineering associate with GPU Nuclear Corporation and is assigned to TMI-2. He has 14 years of experience in medical and nuclear health physics technology, with particular emphasis on instrumentation. **Carl H. Distenfeld** (bottom) (BS, chemical engineering; MS, nuclear engineering) is manager of fuel measurements and analysis for Bechtel National, Inc. at TMI-2. He is responsible for technical leadership of a group working to characterize the radiation environment of the TMI-2 reactor building, and to quantify the reactor fuel remaining in the TMI-2 plant following defueling efforts.

*Paul J. Babel
Barry H. Brosey
Carl H. Distenfeld*



USING EX-CORE NEUTRON DETECTORS TO ESTIMATE FUEL QUANTITIES IN THE REACTOR VESSEL LOWER HEAD

Reuben Rainisch (top) (BS, marine engineering, University of Michigan, 1966; MS, nuclear engineering, University of Michigan, 1969) has been assigned by Burns and Roe to the Three Mile Island Unit 2 (TMI-2) Cleanup Program since 1983. He is a principal engineer responsible for assessment and characterization of reactor and core damage. His work experience includes reactor physics, safety analysis, and the design of light water reactors. **Victor R. Fricke** (BS, physics, Northeastern University, 1967; MS, nuclear engineering, Purdue University, 1969) has been assigned by Burns and Roe to the TMI-2 Cleanup Program since 1981. He currently serves as data management and analysis manager and is responsible for the collection, interpretation, analysis, and reporting of all data relating to the condition of the damaged reactor and the progress of defueling.

*Reuben Rainisch
Victor R. Fricke*



HEAT STRESS CONTROL IN THE THREE MILE ISLAND UNIT 2 DEFUELING AND DECONTAMINATION ACTIVITIES

John S. Schork (top) (MS, safety, University of Southern California, 1979) is manager for postdefueling survey and special nuclear materials accountability for GPU Nuclear Corporation (GPU) at Three Mile Island Unit 2 (TMI-2). He has worked in the areas of nuclear and occupational safety during his 9-year tenure at TMI. He also has experience in health physics, hazardous material safety, and chemical safety. His primary interests include nuclear materials management and safety and probabilistic risk assessment. **Bradley A. Parfitt** (BS, biology, University of Pittsburgh, 1978) is a radiological engineer at the TMI Nuclear Station operated by GPU. In his last 9 years with GPU, he has held positions in industrial hygiene, respiratory protection, and radiation protection.

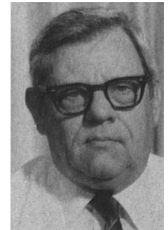
*John S. Schork
Bradley A. Parfitt*



THE SIGNIFICANCE OF RADIOLOGICAL AND ENVIRONMENTAL CONTROLS DOCUMENTATION IN LITIGATION

Gordon M. Lodde (top) (BS, biology and chemistry, Purdue University) is currently manager of radiological health in radiological controls, Three Mile Island Unit 1 (TMI-1). He is responsible for providing direct support services to TMI-1 and TMI-2 in the areas of dosimetry, bioassay, radiological instrument maintenance and calibration, and respiratory fit testing. He has over 28 years of experience in the applied health physics field. **Thomas D. Murphy** (MS, radiation biology, University of Rochester) is currently environmental and radiological support director in the Radiological and Environmental Controls Division of GPU Nuclear. His responsibilities include providing technical guidance to the environmental controls and radiological engineering groups.

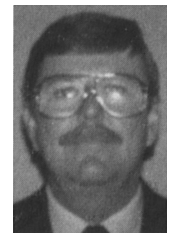
*Gordon M. Lodde
Thomas D. Murphy*



COMPUTER SYSTEM DEVELOPMENT TO SUPPORT THREE MILE ISLAND UNIT 2 RADIOLOGICAL CONTROLS OPERATIONS AND RECORDS MANAGEMENT ACTIVITIES

Richard D. Schauss is an independent consultant with 19 years of experience in the nuclear industry with focus on development of technical computer applications in support of operational programs for radiation protection and engineering. His past accomplishments include the design and implementation of on-line radiation exposure management systems as well as the design of RADMAPS, a state-of-the-art radiation mapping system, and other specialized applications that integrate with three-dimensional plant configuration models. In addition to computer-aided design and three-dimensional solids modeling, his current interests include interactive multimedia systems for the integration and communication of complex technical information.

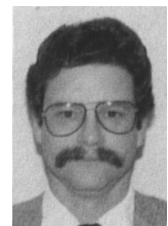
Richard D. Schauss



A GUIDE TO TECHNICAL INFORMATION REGARDING THREE MILE ISLAND UNIT 2

Kim David Auclair (right) has been associated with nuclear and related fields for more than 15 years. His expertise covers the fields of remote technology and robotics, radwaste, decontamination and decommissioning, computer programming, CAD/CAE, training, and communications electronics. Since December 1988, he has been assigned as the project engineer for Bechtel

*Kim David Auclair
Joann S. Epler*



National, Inc. at the Three Mile Island Unit 2 (TMI-2) site acting as liaison for all technical issues and operations in addition to his assignment as a recovery engineer for the data management and analysis group of the TMI-2 engineering department. Since February 1989, he has been responsible for the evaluation of reactor system internals and components condition and integrity; residual fuel/debris volumetric estimates; special remote/robotic system development, construction, and operation in support of reactor defueling, special nuclear material accountability operations, and final assessment of reactor system internals evolutions. **Joann S. Epler** (right) (MS, environmental sciences, University of Tennessee, 1979) was a technical writer at TMI through June 1986. She is currently the training coordinator for the Bechtel National, Inc., Oak Ridge office.



DEALING WITH PUBLIC PERCEPTIONS OF HEALTH RISKS IN A NUCLEAR WORLD

Robert S. Friedman (BA, political science, Johns Hopkins University, 1948; MA, 1950, and PhD, 1953, University of Illinois) is a professor of political science and senior scientist at the Institute for Policy Research and Evaluation at The Pennsylvania State University. He has served on the Safety Advisory Board on the Cleanup of Three Mile Island Unit 2 since 1981.

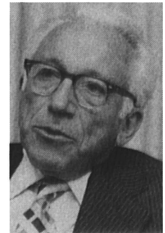
Robert S. Friedman



EXPOSURE OF THE GENERAL PUBLIC NEAR THREE MILE ISLAND

Merril Eisenbud [BSEE, New York University, 1936; ScD (Hon.), Fairleigh Dickinson University, 1960; Catholic University of Rio de Janeiro, Brazil, 1970] is professor emeritus of environmental medicine at New York University Medical Center, where he was also director of the Laboratory for Environmental Studies from 1959 to 1985. He served on the Three Mile Island Unit 2 Safety Advisory Board and is currently an adjunct professor at the University of North Carolina School of Public Health.

Merril Eisenbud



AN UPGRADED PERSONNEL DOSIMETRY SYSTEM FOR USE AT THREE MILE ISLAND UNIT 2

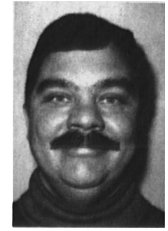
James W. Schmidt (top) (AS, general science, University of the State of New York, 1986) is a certified health physicist (comprehensive), American Board of Health Physics, with 19 years of practical nuclear experience as a plant operator and health physicist. He has been project engineer for the multielement thermoluminescent dosimetry system installation, Three Mile Island (TMI) dosimetry engineer, and radiological engineer at TMI-1 during restart. His current assignment as a corporate radiological engineer involves technical health physics support for both the GPU Nuclear TMI and Oyster Creek nuclear facilities. **Joseph M. Harworth** (BS, management, University of the State of New York, 1986) has 15 years of practical nuclear power experience in plant operation and health physics. He has been a radiological engineer at TMI-2 for GPU Nuclear and group supervisor of dosimetry, supporting dosimetry processing for the entire GPU nuclear system and directing plant support for TMI-1 and TMI-2.

*James W. Schmidt
Joseph M. Harworth*



RESPIRATORY PROTECTION LESSONS LEARNED AT THREE MILE ISLAND

Earl F. Gee is the industrial safety and health manager at the Three Mile Island (TMI) Nuclear Generating Station. He has been employed at TMI since leaving the U.S. Navy's nuclear power program in 1974, and he has held positions as the respiratory protection supervisor and deputy manager of rad con field operations.



Earl F. Gee

PERSONNEL CONTAMINATION PROTECTION TECHNIQUES APPLIED DURING THE THREE MILE ISLAND UNIT 2 CLEANUP

James E. Hildebrand (BA, biology, California State University, 1968; MPH, health physics, University of Minnesota, 1970) is the director of radiological and environmental controls for GPU Nuclear Corporation. He is responsible for radiation protection, environmental controls, and emergency preparedness programs at Three Mile Island and Oyster Creek Nuclear Generating Stations. His background includes employment with General Electric Company in the naval reactors' program. His main interest is in applied radiation protection.

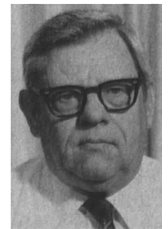


James E. Hildebrand

ASSESSMENT AND CONTROL OF THE THREE MILE ISLAND UNIT 2 REACTOR BUILDING ATMOSPHERE

Gordon M. Lodde (top) (BS, biology and chemistry, Purdue University) is currently manager of radiological health in radiological controls, Three Mile Island Unit 1 (TMI-1). He is responsible for providing direct support services to TMI-1 and TMI-2 in the area of dosimetry, bioassay, radiological instrument maintenance and calibration, and respiratory fit testing. He has over 28 years of experience in the applied health physics field. **Beverly A. Good** (center) (MS, health physics, Purdue University) is currently manager of radiological controls in the Radiological and Environmental Controls Division of GPU Nuclear at the TMI plant. Her responsibilities have included radiological engineering, radiological environmental monitoring, emergency preparedness, and decommissioning of a small test reactor. **Diane M. Surgeoner** (bottom) (AA, Hagerstown Junior College) is currently administrator of radiological control records in radiological health, radiological controls, TMI-1. Previously, she was an engineer assistant in the radiological engineering department and dosimetry project coordinator in radiological controls, TMI-2, since 1979.

*Gordon M. Lodde
Beverly A. Good
Diane M. Surgeoner*



THE ROLE OF RADIATION INSTRUMENTS IN THE RECOVERY OF THREE MILE ISLAND UNIT 2

Robert D. Holmes (top) is the analyst for respirator protection at GPU Nuclear Corporation. He joined GPU Nuclear Corporation in 1982 as a health physics instructor and was a radiological controls supervisor from 1983 to 1987. He is an ex-Navy nuclear propulsion operator, and his interests include integrated as-low-as-reasonably-achievable planning and workplace respiratory protection factors. **Gary W. Frank** has worked for 21 years in the field of portable radiological instruments, including 12 years with the Commonwealth of Pennsylvania and 9 years with

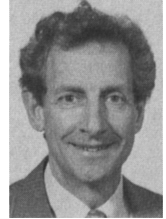
*Robert D. Holmes
Gary W. Frank*



GPU Nuclear Corporation at Three Mile Island. His field of interest lies in personal computers and their applications for machine history and the calibration control of radiological instruments.

THREE MILE ISLAND UNIT 2 REACTOR BUILDING DOSE REDUCTION TASK FORCE

Raphael S. Daniels



Raphael S. Daniels (BS, civil engineering, City College of New York, 1953; MS, sanitary engineering and nuclear engineering, Massachusetts Institute of Technology, 1959) was involved in the Three Mile Island (TMI) Unit 2 recovery project from 1980 to 1988. He was chairman of the Dose Reduction Task Force and deputy director of technical planning. Subsequently, he was project manager for the Bechtel National, Inc. contract at TMI, responsible for planning, data acquisition, and analysis of the recovery effort. Currently, he is product line manager for chemical services (decontamination, chemical cleaning, and radwaste services) for the Bechtel-KWU Alliance.

REVIEW OF RADIATION SHIELDING CONCERNS ASSOCIATED WITH THE THREE MILE ISLAND UNIT 2 DEFUELING SYSTEMS

*N. L. Osgood
D. S. Williams
R. L. Rider*

Photographs and biographies for **N. L. Osgood**, **D. S. Williams**, and **R. L. Rider** were not available at publication time.