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TMI-2 LITERATURE SEARCH AND REVIEW WITH APPLICATION TO EQUIPMENT QUALIFICATION ISSUES

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EXECUTIVE SUMMARY

A review of the open literature to date (April 1983) has been done on the Three Mile Island accident on issues regarding equipment qualification. The intent of the review was to use the information available through the open literature to assess the impact of Three Mile Island on these equipment qualification issues. More specifically, it was hoped that the accident would serve the purpose of increasing the equipment qualification information data base. Over 170 reports were initially reviewed, of those, 23 reports were reviewed in more detail. Report abstracts and summaries of those 23 reports are presented.

The review indicates that much work by the nuclear community remains to be done which will be of use to equipment qualification. Several outstanding issues have been identified and are presented in this report. For instance, planning groups formed after the accident set numerous priorities and goals that are still well short of realization. According to the literature, no Class 1E equipment has been removed from containment for laboratory inspection. Non-Class 1E equipment has been tested in the laboratory, but the applicability of the results to Class 1E equipment is as yet undetermined. Fission product releases and transport estimates are (at best) accurate within an order of magnitude. A comprehensive mapping of the fission product deposition inside containment (the top priority of one planning group) has not appeared in the open literature. The effects of the hydrogen burn are still under investigation by several organizations.

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1. INTRODUCTION

Several months have been spent reviewing the open literature for information on the Three Mile Island accident that took place on March 28, 1979. Specifically, the review was conducted in the interest of finding all the information about TMI-2 which would increase our understanding of safety-related equipment performance under accident conditions, fission product source terms and transport, and hydrogen burn phenomenon. These three issues all relate to ongoing efforts to improve the quality of Class 1E equipment and the tests done to qualify the equipment. An extensive literature search was performed from this point of view and over 170 reports were identified for further review. Appendix E lists all these reports. Keywords were assigned to reports and they were catalogued by keyword and publication date. Six keywords were assigned (EQUIP QUAL, FISS PROD, HYDROGEN, PLANNING, MISC, and INFO). The first three keywords are for the three important issues identified above, and the last three keywords identified TMI-2 planning groups (PLANNING), miscellaneous reports (MISC), and reports which were informative but not directly related to equipment qualification (INFO).

Of these more than 170 reports, 23 were given a detailed review as they were judged most relevant to equipment qualification issues. Abstracts by the authors of the 23 reports and a short synopsis of the reports' findings are presented in Appendices A through D. Since this report is based on the findings and recommendations of over 170 reports, references to individual reports are omitted (except where considered necessary for understanding).

This work will be augmented later through identification of work that has not been published in the open literature or is incomplete as of this date (April 1983).

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2. EQUIPMENT QUALIFICATION

As of this writing, the literature search on Three Mile Island has located 44 reports that relate specifically to the issue of equipment qualification. These reports were organized by date of publication and are listed in Appendix E. Careful review of these reports yielded a subset of seven reports which are applicable to equipment qualification by virtue of the results they obtained through testing of actual Three Mile Island equipment or the issues they raised based on lessons learned. Report abstracts and a short summary of these seven reports are given in Appendix A.

2.1 TESTING ON TMI-2 EQUIPMENT

Up to this point, two types of tests have been done on TMI-2 equipment:

1. In-situ tests, and
2. Laboratory tests.

In-situ tests have been done primarily by J. E. Jones of Technology for Energy Corporation (TEC) and F. T. Soberano of United Engineers and Constructors, Incorporated (UECI). Laboratory tests have, thus far, been reported by Sandia National Laboratories and EG&G, Idaho. The equipment tested was:

In-Situ Testing

Jones - All Non-Class 1E instruments

4 area radiation monitors
1 source range monitor amplifier
1 differential pressure transmitter
2 core flood tank level transmitters
2 Loose Parts Monitor (LPM) charge converters
2 core tank pressure transmitters

Soberano - 51 reactor building electrical components and discrete devices (11 of the components are related to Class 1E equipment like oil pumps, pressure, flow, and level switches, motor-operated and solenoid valves).

Laboratory Testing

Sandia - 2 area radiation monitors
2 Loose Parts Monitor (LPM) charge converters

EG&G - 2 pressure transmitters

A number of other instruments have been tested at TMI-2 (e.g., over 30 thermocouples, many self-powered neutron detectors), however, the results were not considered applicable to Class 1E equipment qualification.

2.2 TESTING RESULTS

The in-situ and laboratory tests yielded the following information about the operating status and/or failure mechanisms of TMI-2 equipment:

- Cracked GM tube (HP-R-213 area radiation monitor), possibly due to mechanical shock from the hydrogen burn that occurred about 10 hours after the accident began.
- Failed output transistor (HP-R-211), caused by a momentary short of the 600 V power line to the signal line due, perhaps, to water leakage into an improperly mated connector.
- Multivalved signal output indications by area radiation monitors due to impedance mismatches and radiation-degraded transistors.
- Instrument failure due to radiation-degraded MOS field effect transistors.
- Problems due to wet cables and corrsion.
- Common mode failures (e.g., many instruments that were wired into the same terminal block or were located around the same reactor coolant pump failed or did not yield a proper output).

2.3 RADIATION DOSE ESTIMATES

Estimates of the total gamma-ray dose to circuit components were made at Sandia National Laboratories by measuring the change in transistor gain properties for transistors in two area radiation monitors. These gamma dose estimates should not necessarily be considered generic doses for a given elevation since the instruments are in a particular area.

- HP-R-211 (347 ft. elevation) 0.07 to 0.60 Megarads
- HP-R-213 (305 ft. elevation) 0.39 to 1.86 Megarads

2.4 EQUIPMENT QUALIFICATION ISSUES

As a result of the equipment testing and lessons learned from Three Mile Island, several issues have been raised which will require investigation and further consideration of current equipment qualification requirements. Since most of the equipment tested at TMI-2 was not Class 1E, it remains to be seen how important the results will be to Class 1E LOCA-qualified equipment testing. Only 11 Class 1E device tests have been reported (in-situ tests by Soberano), and only one of those eleven appeared to have an anomalous indication (a discontinuity of the CLOSED indication circuit of the NS-V100 motor-operated valve). The best way to learn about the performance of Class 1E equipment at TMI is to test actual Class 1E equipment in the laboratory. Nonetheless, issues have been raised by the tests which may be applicable to equipment qualification.

- Careful installation and maintenance practices to prevent voiding the qualification (e.g., improperly mounted connector, pinched O-ring)
- Circuit components capable of operating in high-radiation fields
- Instrument design improvements to prevent ambiguous reading
- Instruments that will measure extended ranges
- Self-checking instruments to ensure that they are functioning as designed
- Instruments capable of withstanding the mechanical shock and thermal transient generated by a hydrogen burn.

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3. FISSION PRODUCTS

Careful review of information available on fission products at Three Mile Island resulted in the 53 reports listed in Appendix E. These reports were reviewed for their applicability to estimating accident source terms, fission product transport, fission product chemistry, and to correlate actual with expected releases. The intent here was to find information gathered at TMI-2 which would improve the fission product data base and further our understanding of fission product behavior in the event of a reactor accident, so that equipment qualification tests would be more representative of an accident environment. From these 53 reports came six reports judged most relevant. Their summaries are found in Appendix B. Important results of the review are contained in the following sections.

3.1 FISSION PRODUCT SOURCE TERMS

Much information exists on fission product releases at TMI-2. Samples of the reactor coolant, containment building atmosphere, wall and floor swipes, etc., have been taken by several organizations and analyzed for fission product content. Estimates differ due to time elapsed since the accident and the methods by which the samples were analyzed. One example is the table below which gives estimated fission product releases expressed in percent of initial fission product inventory (the initial inventory was calculated by ORIGEN). The estimates are based on reactor coolant and air samples as presented by W. N. Bishop. Other estimates of fission product releases can be found in the summaries in Appendix B.

Summary of Activity Release from Fuel on March 28, 1979

Nuclide	Percent Release
Kr-85	71
Xe-131M	70
Xe-133	68
I-131	59
Cs-134	76
Cs-136	57
Cs-137	60
Sr-89	<0.01
Sr-90	<0.07

Bishop stresses in his paper that these estimates should be considered a lower bound of fission product release since fission products not soluble in water and not gaseous would not be accurately represented in the samples. (See Appendix B for how the iodine source term was estimated by Bishop.)

3.2 IODINE SOURCE TERM

It has been estimated that as much as 60% of the iodine initially present in the TMI-2 core was released to the containment building (Bishop). Actual samples of the air and water only account for 17-28% of the iodine (Pelletier), but it is believed that the remainder will be found on reactor components and other surfaces receptive to iodine. The amount of iodine released to the outside environment was orders of magnitude less than originally predicted. It was thought that similar amounts of iodine and noble gas would be released to the environment, but 20 Ci of iodine and 10 million curies of noble gas were actually released. This evidence has lead some experts to believe that iodine was released from the core in the form of cesium iodide, a thermodynamically stable substance which is soluble in water. Therefore, much of the cesium iodide may have been removed from the containment building atmosphere by the containment spray system. Others contend that much of the iodine remained in solution in the primary system.

Since much of the iodine may have been removed by the containment spray system, suggestions have been made to re-evaluate regulatory estimates and change iodine control systems. A workshop sponsored by EPRI-NSAC concluded that, "Exaggerated estimates of potential accident releases can contribute to unfounded actions by public officals and unwarranted physical and mental stress damage to the public."

3.3 FISSION PRODUCT ISSUES

Efforts thus far have dealt largely with fission product releases to the containment building (especially iodine). Efforts are underway by NUS and Science Applications, Incorporated (SAI) to do a comprehensive mass balance of the fission products. What is really needed is a full mapping of the TMI-2 containment building to help analysts verify existing fission transport codes and improve the overall body of information on fission product release and behavior. Raw release data exist that should be analyzed and correlated to predict the time-dependent fission product releases. This would be an important contribution to equipment qualification as it would allow estimation of radiation dose levels to equipment and equipment components.

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4. HYDROGEN BURN

Nineteen reports have been published thus far on the hydrogen burn phenomenon that were considered relevant to the overall issue of equipment qualification. The list can be found in Appendix E. These reports were reviewed and seven were selected for a detailed review. A synopsis of the seven reports is located in Appendix C. Highlights and important recommendations are given in the following sections.

4.1 HYDROGEN BURN CHARACTERISTICS

The hydrogen burn event at Three Mile Island (as given by Henrie) began 10 hours after the start of the accident and only lasted 12 seconds. In this short time, 319 kg of the 459 kg of hydrogen in the containment burned causing an average temperature rise of all materials and components in the reactor building, including the containment shell, of approximately 2.2°F. Liberation of the hydrogen was caused by the interaction of the emergency cooling water and the uncovered fuel rods. It is estimated that 40-50% of the zirconium cladding oxidized during this time. The water injection and subsequent cladding rupture was the cause of fuel failure. Fuel temperatures did not exceed fuel melting points, according to calculations.

4.2 HYDROGEN BURN ISSUES

The hydrogen burn event has gained the attention of the equipment qualification community. Much controversy surrounds this event and its effects, but most agree that such an event could have serious implications for equipment not properly designed to withstand the potential mechanical shock and thermal transients. Determining the characteristics and behavior of the TMI hydrogen burn is perhaps the most important issue. Physical inspection of more TMI-2 components is required to assess the effects of the burn.

Results of the Hydrogen Burn Survival Program at Sandia indicate that "fully exposed" components may experience temperatures above current LOCA qualification guidelines, however, the local environment may provide sufficient thermal protection to assure survival. Thermal analyses appear necessary to determine the response of a given component to a hydrogen burn environment, but major redesign will probably not be necessary.

Other issues regarding the hydrogen burn that need to be studied are:

1. Hydrogen chemistry and transport within primary coolant system
2. Limits of detonation and deflagration for hydrogen-oxygen-steam mixtures at various pressures
3. Potential consequences of explosions
4. Blast levels to which critical components should be qualified
5. Methods for mitigating the consequences of hydrogen release should fuel cladding oxidation occur,
   a. Hazard analysis of facility
   b. Control in vessel
   c. Control in primary system
   d. Vent from primary system
   e. Containment building.

5. PLANNING GROUPS

Several planning groups have been established since the accident at TMI-2 which make recommendations and manage projects in the interest of gathering information for equipment qualification, and other areas of interest to the nuclear community. Six reports were found to be relevant to equipment qualification (see Appendix E), three were reviewed in detail and are presented in Appendix D. Two of the planning groups are 1) GEND Planning Group (now managed by DOE/TIO), and 2) EPRI's Mechanical Component Information and Examination Program (MCI&EP).

5.1 GEND PLANNING GROUP

The GEND Planning Group was established soon after the accident and is now managed by the Technical Integration Office of DOE. It has numerous projects set up to study the accident. The Data Acquisition Program is the one most relevant to equipment qualification and has three objectives:

1. Obtain information stemming from the TMI-2 accident for the advancement of light-water reactor plant safety, reliability, and operability.
2. Obtain information from the TMI-2 recovery for the advancement of technology in decontamination, waste disposal, and system requalification.
3. Distribute the information and technology gained from the TMI-2 programs and from GPU's recovery program to the nuclear power community.

This group sponsored the in-situ and laboratory measurements reviewed in Section 2.

5.2 EPRI's MECHANICAL COMPONENT SURVIVABILITY PROGRAM

EPRI is sponsoring a program dedicated to understand what happened to the plant and equipment as a result of the accident. The overall program plan is set up to perform inspections and examinations through 1986 on such items as pumps, valves, and vessels. Projects are currently underway to examine mechanical snubbers reflective insulation, control rod drive mechanisms, and the reactor building polar crane.

5.3 PLANNING GROUP ISSUES

The tasks and objectives of all the planning groups appear well-planned, but results to date have been far short of expectations. Studying the TMI-2 accident is indeed a long-term undertaking, however, after more than four years, many of the top priority tasks are not completed nor has any explanation or reorganization of priorities been given in the open literature. This is unfortunate since some of the information about the accident (e.g., fission products) may now be lost or untraceable.

APPENDIX A

EQUIPMENT QUALIFICATION SUMMARIES

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M. B. Murphy, G. M. Mueller, F. V. Thome, "Examination Results of the Three Mile Island Radiation Detector HP-R-211," SAND81-0725, September 1981.

REPORT ABSTRACT

An area radiation detector, HP-R-211, which was removed from the Three Mile Island containment building on August 15, 1980 has been examined. The detector had failed at some time following the accident and indicated from that point on erroneous, low-radiation levels. This report discusses the cause of failure, detector radiation measurement characteristics, our attempts to reconstruct the gamma-rate history from detector output stripchart recordings, and our estimates of the total gamma-radiation dose received by the detector electronics. We have also identified the radioactive contaminants present on the detector and explored decontamination methods.

SUMMARY

The HP-R-211 area radiation monitor is manufactured by Victoreen (Model 857-2). A transistor in the detector output circuit failed due to a momentary short of the high voltage to the signal line. Evidence indicates that spray and/or steam entered an impropely mated connector and caused the 600 V power line to short to the signal output line. The detector becomes multivalued at high-radiation levels due to detector-to-cable impedance mismatches, cable lengths, and radiation degradation of transistors and the GM tube. The total dose seen by the transistors is estimated to be 0.25 Megarads. Major fission products on the outer surface were Cs-134, Cs-137, and Sr-90. The Cs-137 concentrations were 0.973 μCi/cc on the top horizontal surface, and 0.103 μCi/cc on the side and bottom surfaces. These concentrations are a factor of 10 less than nearby containment building swipe surveys.

Two equipment qualification issues are raised by this report:

1. Need for proper installation of the instrument (e.g., mating of the connector to the detector housing), and
2. Instrument design improvements
   a. Circuit components capable of operating in high-radiation fields
   b. Connectors mounted underneath the housing and potted backshells to prevent moisture from entering
   c. Circuit design improvements to compensate for the impedance mismatch problem.

This detector is not Class 1E, but simple improvements in the design and installation would make the instrument more useful in an accident situation.

Y. Y. Hsu, A. L. M. Hon, "Some Possible Ways to Improve Nuclear Power-Plant Instrumentation," Nuclear Safety, Vol. 22, No. 6, November-December 1981.

REPORT ABSTRACT

This article examines the adequacy of nuclear power plant instrumentation on the basis of the lessons learned from the accident at Three Mile Island-2, and from some of the available advanced technology. The examination identifies two areas that could be improved--unambiguous indication and reliable data collection. It suggests that these two areas can be improved by 1) direct measurement of key parameters, 2) grouping of information, 3) disturbance analysis, 4) self-verification of sensors, and 5) ability of the sensors to survive in a hostile environment and to measure an extended range. Also reported are some of the ongoing research programs, including projects on in-vessel liquid-level measurement and on-line reactor surveillance systems at the Nuclear Regulatory Commission.

SUMMARY

Discusses existing and in-progress solutions to several instrumentation improvement issues as a result of TMI. The authors address solutions to the following issues:

1. Direct measurement of key parameters (e.g., in-core water level)
2. Extended range measurements (i.e., instruments that will measure parameters in both operational and accident conditions)
3. Instrument survivability - high radiation and extreme temperatures
4. Reliability and accuracy of key instruments through noise analysis, comparison with other instruments, and self-check of the instrument response to a known level
5. Improved display of information to the reactor operator.

These issues implicate mostly non-Class 1E equipment, however, some of the new instruments proposed (e.g., in-vessel liquid-level detectors, PORV position indicator) may need to be classified as Class 1E if they are ever used.

J. E. Jones, J. G. Smith, M. V. Mathis, "Field Measurements and Interpretation of TMI-2 Instrumentation," GEND-INF-017, Vols. 1-12, November 1981 through April 1982.

REPORT ABSTRACT

During and following the TMI-2 accident, a number of instruments failed or were suspected of providing erroneous readings. Because of this problem, industry concerns were focused upon the behavior of instrumentation under adverse conditions. To better understand failure mechanisms, the Technical Integration Office (TIO) contracted Technology for Energy Corporation (TEC) to perform field measurements on a set of selected TMI-2 instruments to determine in-situ operating characteristics. For some instruments, these measurements were to be performed prior to removal (and replacement) of new instruments to have a cross reference with post-removal observations. For other instruments, an indication of the condition of the instrument (i.e., fully operational or failed) was desired.

SUMMARY

Several non-Class 1E instruments were tested in-situ. The following is a summary of the instruments tested and their status as determined from the tests:

Instrument	Status
HP-R-211 Radiation Monitor (Victoreen Model 857-2)	Failed, output transistor
HP-R-212 Radiation Monitor (Victoreen Model 857-2)	Failed, Geiger tube
HP-R-213 Radiation Monitor (Victoreen Model 857-2)	Failed, Geiger tube or transistors
HP-R-214 Radiation Monitor (Victoreen Model 857-2)	Failed, unknown reason
NI-AMP-2 Source Range Monitor Amplifier (Westinghouse BF-3 prop, counter and Bailey 880 Amplifier)	Failed, defective cable or detector
IC-10-DPT Control Rod Drive Bypass (Bailey Type BY)	Appears operable
CF-2-LT2 Core Flood Tank 1A Level (Bailey Type BY)	Failed, no output from LVDT coil
CF-2-LT4 Core Flood Tank 1B Level (Bailey Type BY)	Appears operable
YM-AMP-7023 Charge Converter (Bailey Type BY)	Unknown
YM-AMP-7025 Charge Converter (Endevco Model 2652M4)	Unknown
CF-1-PT3 Pressure Transmitter (Foxboro)	Appears operable
CF-1-PT4 Pressure Transmitter (Foxboro Model EIIGM-HSAE1)	Appears operable

Results of these tests are not specific enough to make recommendations. Sandia has laboratory tested HP-R-211, HP-R-213, YM-AMP-7023, and YM-AMP-7025. Refer to those summaries for further results.

G. M. Mueller, "Examination Results of the Three Mile Island Radiation Detector HP-R-213," SAND82-1173, August 1982.

REPORT ABSTRACT

Area radiation detector HP-R-213 was removed from the Three Mile Island containment building on May 28, 1981. The detector apparently failed at the time of the hydrogen burn, and afterwards indicated radiation levels of less than 0.1 mR/hr. This report discusses the cause of failure, detector radiation measurement characteristics, and our estimates of the total gamma-radiation dose received by the detector electronics.

SUMMARY

The HP-R-213 radiation detector from the 347-ft. level is manufactured by Victoreen (Model 857-2). The detector failure was caused by a cracked GM tube. Total gamma dose received by the detector was estimated to be 0.99 Megarads. A multivalued behavior at high radiation levels, similiar to the HP-R-211, was observed. A pinched O-ring, but no failure, was also observed.

Equipment qualification issues raised by this report:

1. Failure due to mechanical shock from hydrogen burn (i.e., is mechanical shock important for other instruments)

2. Transistors were degraded by radiation but the circuit still worked, as evidenced by replacement of the cracked GM tube

3. Pinched O-ring indicates need for proper field practices to prevent voiding of qualification.

M. B. Murphy, R. E. Heintzleman, "Examination Results on TMI-2 Charge Converters YM-AMP-7023 and YM-AMP-7025," SAND82-0980, September 1982.

REPORT ABSTRACT

During, and for several months after, the Three Mile Island Unit 2 accident, the reactor vessel and two steam generators were closely monitored for the existence of coolant system loose parts. We have examined two Endevco charge converters removed from the loose parts monitoring system inside containment and found the devices to be severely degraded by gamma radiation. Because of this, it is likely that the loose parts readings made during the accident were lower than actual levels. This report discusses the cause of failure, our estimates of the total gamma radiation doses received by the charge converters, and our recommendations for changes in U. S. Nuclear Regulatory Guide 1.133.

SUMMARY

Two Endevco Model 2652M4 Remote Charge Converters were removed from the TMI-2 loose parts monitoring (LPM) system--one was not functioning (YM-AMP-7025), and the other (YM-AMP-7023) was marginally functional. Radiation degradation of a MEM 511 MOS field effect transistor (MOSFET) was the cause of failure in both cases. Gamma radiation dose levels received by the MOS transistors were estimated to be 0.18 and 0.54 Megarads (YM-AMP-7023 and YM-AMP-7025, respectively). A nearby radiation detector (HP-R-211) was estimated to have received 0.25 Megarads.

The most significant issue raised is the susceptibility of MOSFET's to radiation damage. Murphy estimates that charge converters with MOSFET's are useful up to about 0.1 Megarads. Charge converters are not Class 1E equipment, but it seems reasonable and prudent to recommend the use of radiation tolerant transistors instead of MOSFET's. Murphy recommends that Regulatory Guide 1.133 be modified to encourage the use of radiation-resistant LPM systems.

F. T. Soberano, "Testing and Examination of TMI-2 Electrical Components and Discrete Devices," GEND-INF-034, November 1982.

REPORT ABSTRACT

This report discusses the approach and results in the in-situ test conducted on TMI-2 reactor building electrical components and discrete devices. Also included are the necessary presumptions and assumptions to correlate observed anomalies to the accident.

SUMMARY

In-situ tests were performed on 51 electrical components and devices in an effort to determine their operating status. Of the 51 devices tested, 11 were Class 1E LOCA qualified. Cable properties were measured and signal analyses were done where possible to determine the status of a device. Fourteen devices exhibited anomalies (e.g., increased contact resistance, stuck valve); only one Class 1E device, a motor-operated valve (NS-V100), had an anomalous indication (a discontinuity on its CLOSED indication circuit). Many of the anomalous components were associated with or in the area around one reactor coolant pump (RC-P-1A). They also exhibited problems which were probably caused by the chemical spray or the steam environment, such as impedance mismatches (perhaps due to wet cables or corrosion on terminal blocks), corrosion on parts like motor commutator brushes, and high-contact resistances.

In-situ tests are useful for locating problem areas, but laboratory inspection is necessary before making any recommendations. It is interesting to note that all but one of the Class 1E equipment tested appears to be functioning.

R. C. Strahm, M. E. Yancey, "TMI-2 Pressure Transmitter Examination Program Year-End Report: Examination and Evaluation of Pressure Transmitters CF-1-PT3 and CF-2-LT3," GEND-INF-029, February 1983.

REPORT ABSTRACT

The Department of Energy has sponsored a program to examine and evaluate selected pressure transmitters located in the TMI-2 Reactor Building during the accident in March 1979, to establish operational characteristics and failure modes. This report discusses the program and the results of laboratory examinations and tests performed on two transmitters removed in July 1981. This is a continuing program and more transmitters will be removed and examined in the future.

SUMMARY

Two pressure transmitters were removed from TMI-2 and examined by Idaho National Engineering Laboratory (INEL). The first pressure transmitter was a Foxboro Model E11GM-HSAD1 (CF-1-PT3); the second was a Bailey Model BY8231X-1 (CF-2-LT3). The Foxboro transmitter had rusty bolts on the outside, but was corrosion and contamination free on the inside. Calibration experiments were done and the instrument is considered operational. The Bailey pressure transmitter also had rusty outer bolts and the inside contained water and was severely corroded making analysis difficult. It was not adequately determined how the water leaked into the instrument. Both transmitters were located in the 324-ft. elevation and are not Class 1E.

The removal of these two transmitters is part of the Data Acquisition Program sponsored by DOE and administered by EG&G. Fifty-eight pressure transmitters are in the TMI-2 Reactor Building, 43 have been given priorities according to the useful information they may provide. Twenty transmitters were rated Priority 1 (the highest priority) of which nine are Class 1E. The two transmitters examined in this report are Priority 1, but are not Class 1E.

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APPENDIX B

FISSION PRODUCT SUMMARIES

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W. N. Bishop, et al., "Fission Product Release from the Fuel Following the TMI-2 Accident," CONF-800403, Vol. 1, June 1980.

REPORT ABSTRACT

The fraction of fission products released from the fuel at TMI-2 during the temperature excursion on March 28, 1979, has been calculated using the results of radiochemical analyses on numerous samples from various plant systems. Approximately 70% of the noble gases and tritium was released from the fuel, whereas about 60% of the cesium and iodine nuclides was released. Negligible amounts (less than 0.1%) of strontium and barium nuclides were released from the fuel on March 28. Approximately 2% of the strontium and barium nuclides in the core did leach from the fuel during the first five months after the accident.

SUMMARY

Many reactor coolant and air samples were taken by various organizations after the accident. An attempt is made to estimate the number of curies released and the fraction of core inventory released based on the samples and an estimate of the fission product inventory using ORIGEN. Since the samples are taken from the coolant and air, the estimates given could be considered a lower bound as nonsoluble fission products would not be properly represented. The actual amount of the I-131 accounted for, in this report, was 42 percent. However, the author states that the iodine release was expected to be about what the cesium release was (60%), hence, a correction was made. This issue of cesium and iodine releases being about the same is still a matter of debate and probably will not be resolved until the iodine deposited on surfaces inside the TMI-2 containment is measured.

The report gives the fission product concentration versus time (based on the samples) and total releases. The table below (Table IV of Bishop's report) is reproduced and summarizes their findings on total releases.

Table IV. Summary of Activity Releases from Fuel on March 28, 1979

Nuclide	Core Inventory (Ci)	Activity Released from Fuel (Ci)	Percent Released
H-3	3.75E3	2.74E3	73
Kr-85	9.63E4	6.84E4	71
Xe-131M	4.10E5	2.87E5	70
Xe-133	1.45E8	9.86E7	68
I-131	6.54E7	3.86E7	59
Cs-134	1.68E5	1.28E5	76
Cs-136	5.44E5	3.10E5	57
Cs-137	8.45E5	5.07E5	60
Sr-89	6.23E7	<6.23E3	<0.01
Sr-90	7.77E5	<5.44E2	<0.07

A. D. Miller, "Radiation Source Terms and Shielding at TMI-2," ANS Transactions, Vol. 34, June 9-12, 1980, pp. 633-635.

REPORT ABSTRACT

The loss-of-coolant accident at Three Mile Island Unit 2 on March 28, 1979, resulted in extensive damage to the nuclear fuel, and the release of large amounts of fission products to the reactor coolant and reactor containment building. Although the magnitude of release dwarfs any previous accident in the nuclear power industry, only modest amounts of activity escaped the confines of the reactor primary containment. Several conclusions can be readily drawn:

1. The reactor containment structure performed flawlessly.
2. Sneak paths dominated the environmental release pathways.
3. Radioiodine release to the environment was very much lower than predicted by safety codes.

SUMMARY

This paper gives a summary of the TMI radiological source term expressed in percent of core inventory released into the containment. No references are given so the source of information is not known. Results were:

TMI Radiological Source Term (% of Core Inventory)

Noble Gas	60
I-131	29
Cs-137	49
Cs-134	39
Sr-89	1.5
Sr-90	1.7
Ba/La-140	1.3

The author states that licensing guides have chosen an unrealistic posture on iodine release to the environment. "The various licensing source terms imply that about one-fourth as much iodine will be released as noble gas. The accident at TMI-2 illustrated that this assumption is not simply conservative; it is wrong. At TMI-2, between 2 and 10 million curies of noble gas was released, while only about 20 Ci of iodine was released."

"Workshop on Iodine Releases in Reactor Accidents," EPRI-NSAC-14, November 1980.

SUMMARY

C. Dan Wilkinson of NSAC summarizes the principal conclusions from the workshop as follows:

1. Observed environmental releases of iodine from actual reactor accidents are several factors of 10 smaller than those predicted by licensing bases. It was reported that 36% of the I-131, 54-67% of the cesium and over 60% of the noble gas calculated to have been in the core were found outside of the core. Although 36% of the iodine was found outside of the core, only 0.003% of the calculated iodine core inventory was found in the gas phase, inside containment, with the balance of the released iodine found in various liquid reservoirs.

2. The presence of water apparently prevents large fractions of iodine released from fuel from being airborne, either inside or outside containments or other enclosures. This phenomenon probably is a major factor in the large degree of error between analysis and actual experience.

3. There is evidence that with fuel overheating in a loss-of-coolant accident iodine will be released mainly as Cesium Iodide, a thermodynamically stable substance which dissolves in water.

4. It is important in the assessment of degraded core accidents and related considerations such as siting and emergency response, that realistic analysis assessment of actual and potential iodine release behavior be included.

5. Exaggerated estimates of potential accident releases can contribute to unfounded actions by public officials and unwarranted physical and mental stress damage to the public.

6. Additional industry efforts are desirable to provide complete documentation of data, and realistic models of iodine behavior. This workshop record may serve as the basis for a formal generic document which provides a definitive and realistic approach for evaluating accident releases and transport of radioiodine.

C. A. Pelletier, "Iodine-131 Behavior During the TMI-2 Accident," EPRI-NSAC-30, September 1981.

REPORT ABSTRACT

Iodine is one of the elements that are closely watched relative to any release of radioactivity from a nuclear power plant because in an accident it might account for 25% of total health effects, and contribute 40% more toward health effects than any other single isotope. The question is whether iodine is released to the environment in proportion to its availability in the core.

Data from the accident at TMI-2 shows that contrary to expectations, licensing codes, and design basis, only very small amounts of iodine escaped to the environment from the reactor containment and auxiliary buildings. The major portion of the iodine apparently has been dissolved and retained in water in the various systems and in the water that is free in the containment. Because of I-131's short half life (8 days), it is a relatively short term health concern. The fact that iodine is retained in the containment is a most important consideration in all accident planning.

SUMMARY

The point is made very clearly that iodine is being retained inside containment much more than licensing guides have assumed. Iodine was expected to have been one quarter of the noble gas release to the environment. At TMI, 3 to 10 million curies of noble gas were released compared to 20 curies of iodine. It was also thought that cesium and iodine would be released from the core in about the same proportion, but 37% of the I-131 has been accounted for compared to 60% of the cesium. All this information points to an obvious reevaluation of regulatory source term estimates.

J. Y. Lee, "TMI-2 Containment Building Accident Water Sampling and Reactor Primary Coolant Accident Source Term", CONF-811103, November 29, 1981, pp. 837-838.

REPORT ABSTRACT

The loss-of-coolant accident on March 28, 1979, at the Three Mile Island-2 (TMI-2) nuclear generating station released approximately 270,000 gallons of reactor coolant water to the containment building basement. When containment isolation occurred, there no longer existed a mechanism for sampling the water in the basement. This paper describes the method by which the water samples were obtained, the analytical results of what that water contained, and radiochemical analyses of the TMI-2 accident reactor primary coolant samples.

SUMMARY

Samples of the water in the containment building basement were taken at three vertical locations. Table I of the paper is reproduced below:

Table I. Radiochemical Analyses of Three Solutions (μCi/ml at 0800, March 28, 1979)

Isotope	Top	Middle	Bottom
Cs-137	176	179	174
Cs-134	40	40	39.6
La-140	0.09	0.078	0.14
Sr-89+90	46.3	43.5	44.9
H-3	1.03	1.05	1.01
I-129	0.079	0.080	0.076
I-131	0.012	0.012	0.013
Sr-90	2.70	2.90	2.83

C. A. Pelletier, et. al., "Preliminary Results of the TMI-2 Radioactive Iodine Mass Balance Study," TMI-2 Special Sessions, 1982 ANS Winter Meeting, November 1982.

REPORT ABSTRACT

Analysis of samples taken from the Three Mile Island Unit 2 (TMI-2) reactor building following the 1979 accident indicates the fraction of the radioactive iodine (radioiodine) inventory in the core released to the building atmosphere is smaller than assumed in Regulatory Guide 1.4. This summary presents analytical results supporting this conclusion.

SUMMARY

The author summarizes his findings as follows:

1. Results indicate that about five months following the accident between 17 and 28% of the radioiodine fuel inventory could be accounted for in the reactor and auxiliary buildings and RCS.

2. The highest measured concentration of radioiodine in the RB atmosphere represented 0.03% of the core inventory, whereas the highest calculated concentration represented 0.2% of the core inventory. Both values are much less than the 25% of core inventory value assumed for the design basis accident in Regulatory Guide 1.4.

3. The maximum possible concentration of organic radioiodine activity represents 0.009% of the core inventory, which is much less than the 1% value specified in Regulatory Guide 1.4 or the 0.7% value used in WASH-1400.

Table I. Summary of Measured Radioiodine Inventories Five Months After Accident (August 29, 1979)

Location	Percent of Initial Core Iodine Inventory
Reactor Coolant System	2-3
Reactor Building Sump	12-19
Reactor Building Atmosphere	0.002-0.003
Reactor Building Surfaces	0.5-0.7
Auxilliary Building Liquids	2-5
TOTAL ACCOUNTED FOR	17-28

APPENDIX C

HYDROGEN BURN SUMMARIES

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R. K. Cole, Jr., "Generation of Hydrogen During The First Three Hours Of The Three Mile Island Accident," NUREG/CR-0913, July 1979.

REPORT ABSTRACT

Estimates of the amount of hydrogen generated by oxidation of fuel cladding during the first three hours of the Three Mile Island accident are presented. These results have been obtained using a combination of available data, carefully framed assumptions, and simple analytic models, and are compared with results from an existing computer code. Hydraulic behavior has been described by a boildown process, with the top of the core uncovered about two hours after scram. The liquid level then fell in an exponential manner until, an hour later with only two feet of the core still covered, a reactor coolant pump was restarted. Core thermal behavior was found to be very dependent on cooling by the water vapor generated in the boildown process. Two limiting assumptions, of adiabatic fuel heating and of perfect thermal contact between the fuel and the vapor, resulted in a factor-of-two difference in the amount of hydrogen produced. A factor-of-two difference was also noted for a five minute difference in the time the fuel was uncovered. Our best estimate is that about 35% of the total core fuel cladding was oxidized producing 350 kg of hydrogen by three hours after scram. Essentially all of it was produced after the primary system had been isolated by closing the pressurizer Electromatic Relief Block Valve. The distribution of damage is much better described as oxidation through the complete thickness of 35% of the cladding than as partial oxidation of most of the cladding. Bounding estimates suggest that not less than 20% nor more than 60% of the cladding was oxidized.

SUMMARY

Using the data they had at the time (July 1979), estimates were made of the fuel oxidation and hydrogen production. Many simplifying assumptions were used. From this the author concludes 35% of the clad was completely oxidized and 350 kg of hydrogen was liberated. Bounding estimates indicate,

$$20\% < \text{oxidation} < 60\%.$$

G.R. Otey gave a foreword to the paper and mentions the following important points that need to be resolved with regard to the hydrogen issue:

1. Hydrogen chemistry and transport within the primary coolant system
2. The limits of detonation and deflagration for hydrogen-oxygen-steam mixtures at various pressures
3. The potential consequences of explosions
4. The blast levels to which critical components should be qualified
5. Methods for mitigating the consequences of hydrogen release should fuel cladding oxidation occur.

H. S. Cullingford, F. J. Edeskuty, "Controlling Hydrogen Behavior In Light Water Reactors," LA-UR-81-681, January 1981.

REPORT ABSTRACT

In the aftermath of the incident at Three Mile Island Unit 2 (TMI-2), a new and different treatment of the Light Water Reactor (LWR) risks is needed for public safety because of the specific events involving hydrogen generation, transport, and behavior following the core damage. Hydrogen behavior in closed environments such as the TMI-2 containment building is a complex phenomenon that is not fully understood. Hence, we present an engineering approach for prevention of loss of life, equipment, and environment in case of a large hydrogen generation in an LWR. A six-level defense strategy is described that minimizes the possibility of ignition of released hydrogen gas and otherwise mitigates the consequences of hydrogen release. Guidance is given to reactor manufacturers, utility companies, regulatory agencies, and research organizations committed to reducing risk factors and insuring safety of life, equipment, and environment.

SUMMARY

The author suggests some guidelines for the industry to solve the hydrogen gas problem. Recommended steps to achieve this are:

1. Learning from TMI
2. Comparison of hazard factors in LWRs
3. Expanding the information base
4. Establishing and verifying analytical tools
5. Developing and qualifying safety equipment
6. Establishing workable procedural methods.

Also given were six levels of defense to mitigate a hydrogen hazard,

1. Hazard analysis of facility
2. Control in vessel
3. Control in primary area
4. Vent from the primary system
5. Mitigate consequences of release to the containment
6. Containment building.

J.C.M. Leung, D.A. Johnson, "Assessment of Hydrogen Release Into The Containment During The TMI-2 Accident," CONF-810606, June 7, 1981, pp. 435-436.

REPORT ABSTRACT

The net loss of coolant from the reactor coolant system (RCS), via the pressurizer electromatic relief valve (ERV), was the key factor leading to core damage during the accident at Three Mile Island-2 (TMI-2). As a result, hydrogen was produced from the zirconium-water reaction in the core, and the amount of hydrogen produced during the first critical 16 hrs would therefore yield an indication of core damage.

SUMMARY

Estimates of the hydrogen liberated and the amount of Zr oxidation that occured were:

1. Upper limit of 514 kg of hydrogen released to containment and RCS
2. 52% of the Zr cladding was oxidized.

These estimates can be compared with Cole's estimate of 20-60% oxidation and 350 kg of hydrogen released.

"Workshop on Hydrogen Burning and Containment Building Integrity," NSAC-32, July 1981.

REPORT ABSTRACT

Ten hours after the accident began at Three Mile Island, about 700 lbs of hydrogen ignited in the reactor containment building. This occurrence created a new interest in hydrogen burns and their effects on containment structures. Because of this, a two day workshop on hydrogen burning and containment building integrity was sponsored by the Nuclear Safety Analysis Center (NSAC). The workshop goal was to allow those who are expert on hydrogen flammability and its effects, and those who are expert on containments and containment strengths, to learn from each other and to find solutions to containing hydrogen burns.

The workshop participants favored controlled hydrogen ignition combined with water spray for suppressing the containment pressure buildup from a hydrogen burn. It is possible that guaranteed spark ignition requires hydrogen concentrations of more than 12%. Other methods such as flame ignition may be required for lower concentrations.

SUMMARY

Conclusions of the workshop were:

1. 318 kg of hydrogen was ignited
2. Control hydrogen by ignition in combination with water
   a. Spark ignition greater than 12% hydrogen
   b. Flame ignition for approximately less than 8% hydrogen.
3. Containment would not have failed even if 100% of the Zr had oxidized
4. Need to study hydrogen flammability and detonation
5. Need to study containment integrity futher.

W. H. McCulloch, "Hydrogen Burn Survival Program," 10th Water Reactor Safety Research, SAND82-2228C, October 12-15, 1982.

REPORT ABSTRACT

The Hydrogen Burn Survival Program was initiated at Sandia National Laboratories to investigate the survivability of safety-related equipment subjected to hydrogen burns in the course of a severe nuclear reactor accident. This report presents a summary of the activities and results of that effort through approximately August 1982. A brief discussion of the program plan, observations from two test series, and some preliminary conclusions from the analytical activities are discussed.

SUMMARY

The first goal of the program was to develop an analytical procedure to assist the NRC in evaluating equipment survivability analyses submitted by license applicants. Experiments are being performed at Sandia test facilities to verify the analytical procedures and provide insight into the models. These experiments are small scale but larger scale tests are planned.

Conclusions to date are:

1. For some credible sets of circumstances, it is reasonable to expect fully exposed components to experience temperatures above current LOCA qualification guidelines, perhaps high enough to threaten their functionability. On the other hand, the problem does not appear to be insurmountable because, in most cases, careful consideration of the local environment can provide, with little or no modification of current designs, adequate thermal protection to assure survival.

2. It will probably not be necessary to undertake major redesigns of either the safety-related components used in nuclear reactors or the associated qualification test programs. Current technology and qualification standards appear to be adequate for virtually all applications.

3. Careful thermal analyses of components in their specific applications will usually be needed to ascertain the response of the component to its hydrogen burn environment.

4. These thermal analyses are likely to constitute a significant part of reactor safety analyses and the NRC is already preparing to evaluate them effectively and expeditiously.

J. O. Henrie, A. K. Postma, "Analysis of the Three Mile Island (TMI-2) Hydrogen Burn," TMI-2 Special Sessions, 1982 ANS Winter Meeting, November 1982.

SUMMARY

Much quantitative information is presented on the hydrogen burn at TMI in the form of tables and graphs. Conclusions related to equipment qualification are as follows:

1. The hydrogen burn occurred at all three levels in the containment. The burn was initiated somewhere in the lowest level; probably on the west side. Even though the burn time was about 12 sec, nearly all of the burning occurred during a 6 sec period. Over half of the burning occurred during the last 3 sec period.

2. About 3,570 standard (zero degrees centigrade) cubic meters (126,000 standard cubic feet), 160 kg (351 lb) moles or 319 kg of hydrogen burned. Approximately 1.1% hydrogen remained after the burn and 0.6% was released from the reactor cooling system to containment during the first hour after the burn.

3. Containment gas temperatures in the flame front were about 760 centigrade (1400°F). The average containment gas temperature at the end of the burn was about 660°C (1220°F).

4. A total of 459 kg of hydrogen was accounted for.

5. The average temperature rise of all materials and components in the reactor building, including the containment shell, was calculated to be only about 1.2°C (2.2°F) as a result of the hydrogen burn. Considerably more energy came from the hot water and steam vented from the cooling system to the containment than from the hydrogen burn. This resulted in the massive shield temperatures increasing an average of about 4°C (8°F) in 2 days. In the long term, most of the heat was removed by the air coolers.

6. The burn damage observed was predominantly at the upper elevations and on the east and south quadrants. The vertical distribution resulted not only from the lower ratio of exposed surface area to gas volume at the upper elevations, but also from a more complete burning at the higher elevations.

Therefore, significant damage to hydrocarbon materials would be expected at high elevations and not at low elevations.

7. 40% of the total core zirconium or 50% of the active fuel cladding was oxidized.

H. W. Schutz, P. K. Nagata, "Estimated Temperatures of Organic Materials in the TMI-2 Reactor Building During Hydrogen Burn," GEND-INF-023, Vol. II, December 1982.

REPORT ABSTRACT

Maximum surface terperatures attained by certain materials during the hydrogen burn associated with the March 1979 accident at TMI-2 are estimated, using photographs and material samples from the reactor building. Thermal degradation, melting, and charrring noted in the photographs, and the chemical and thermal analyses of polymeric and organic materials indicated an increase in temperature with elevation in the reactor building. The maximum material surface temperatures estimated ranged from 360° to 500°F (455° to 533° K). Analyses were performed to estimate the damage to electrical cables and insulation. Based on temperatures reached and approximate duration, greater than 90% of cable insulation life remains.

SUMMARY

Four conclusions and recommendations were given:

1. Maximum material surface temperatures estimated at the three levels of the reactor building are:

Level (ft.)	Material Surface Maximum Temperature	
	°F	°K
374	450	504
347	374 to 500	463 to 533
305	360 to 400	455 to 478

   Based on the above estimates, increase of material surface temperature corresponds with height of location in the reactor building.

2. Preliminary calculations of percent of useful cable insulation life consumed during the incident indicate that where the maximum exposure temperature was 302°F (423°K), about 8% of the total life would have been consumed.

3. Most movable insulation (e.g., crane cables and telephone cords) may need to be replaced, but further investigation will be needed before this is resolved.

4. Samples of heat-affected cable insulation should be evaluated by the manufacturers or industrial experts and tested per new cable specifications.

APPENDIX D

PLANNING GROUP SUMMARIES

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S. Lefkowitz, et al., "Overview of Progress and Plans for EPRI's TMI-2 Mechanical Component Survivability Program," ANS Transactions, Vol. 43, November 14, 1982.

SUMMARY

The Electrical Power Research Institute Mechanical Component Information and Examination Program (MCI&EP) is one of several ongoing research and development efforts under way at Three Mile Island-2 (TMI-2) to understand what happened to the plant and equipment as a result of the March 28, 1979, accident. Components and materials included in the scope of the MCI&EP broadly encompass such conventional mechanical equipment as pumps, valves, and vessels, as well as vessel piping supports and protective coatings. Appropriate interfaces have been established to address electromechanical equipment and reactor vessel components.

The overall program plan describes inspections and examinations through 1986, considering projections of recovery progress and plant decontamination. Near-term examinations have been given priorities with respect to compatibility with the recovery schedule, with the aim of providing feedback of technical results to the managers of recovery work at the island while providing valuable information to the industry. Later examinations will include the larger components of the reactor coolant system, such as the reactor coolant pumps, steam generators, and pressurizer relief valves, piping, and supports. The constraining criterion on the latter examinations has been the overriding prerequisite for decontamination of the reactor coolant system and the interior of the D-rings (biological shield surrounding the reactor coolant system).

Projects are currently under way to examine mechanical snubbers reflective insulation, control rod drive mechanisms (CRDM's), and the reactor building polar crane.

"Task Plan For the U.S. Department of Energy TMI-2 Programs," GEND-INF-036, Technical Integration Office, October 1982.

REPORT ABSTRACT

The Task Plan for the U.S. Department of Energy (DOE) Three Mile Island (TMI) Unit 2 Programs identifies the tasks to be planned and administered by the DOE Technical Integration Office (TIO) in a manner which will maximize the use of available resources, obtain the maximum benefit from the opportunities associated with the TMI-2 cleanup effort, and retrieve generically useful information for addressing some of the key problems and issues facing the nuclear power industry. The Plan identifies tasks in three major program areas where DOE has assumed implementation responsibility. The DOE TMI-2 Programs are: Data Acquisition Program, Waste Immobilization Program, and Reactor Evaluation Program. The plan is intended to serve as a management overview by defining the task objective, benefits, and work scope with respect to prioritization of tasks and utilization of resources.

SUMMARY

Described in the report are the different programs set up by the Technical Integration Office (TIO) to study the TMI-2 accident. Two programs relevant to equipment qualification are 1) Instrumentation and Electrical, and 2) Radiation and Environment. They are part of the Data Acquisition Program which has three objectives:

1. Obtain information stemming from the TMI-2 accident for the advancement of light-water reactor plant safety, reliability, and operability
2. Obtain information from the TMI-2 recovery for the advancement of technology in decontamination, waste disposal, and system requalification
3. Distribute the information and technology gained from the TMI-2 programs and from GPU's recovery program to the nuclear power community.

The objective of the Instrumentation and Electrical Program is to assess the ability of specific I&E systems to perform their intended function during and after an accident and to transfer this information to the nuclear power industry.

The Radiation and Environment Program was set up to obtain, analyze, and distribute pertinent information associated with three major areas of interest: (a) fission product transport and deposition, (b) decontamination and personnel dose reduction, and (c) accident evaluation. Among the fission product tasks they plan to make a source term evaluation and study iodine transport.

S. Levine, et al., "Source Terms: An Investigation of Uncertainties, Magnitudes, and Recommendations For Research," ALO-1008/NUS-3808, March 1982.

REPORT ABSTRACT

The purpose of this document is to assess the state of knowledge and expert opinions that exist about fission product source terms from potential nuclear power plant accidents. This is so that recommendations can be made for research and analyses which have the potential to reduce the uncertainties in these estimated source terms and to derive improved methods for predicting their magnitudes. The main reasons for writing this report are to indicate the major uncertainties involved in defining realistic source terms that could arise from severe reactor accidents, to determine which factors would have the most significant impact on public risks and emergency planning, and to suggest research and analyses that could result in the reduction of these uncertainties. Source terms used in the conventional consequence calculations in the licensing process are not explicitly addressed.

SUMMARY

Eight recommendations were made for future research. They are:

1. Improved accident modeling
2. Reactor pressure vessel failure mechanisms and melt release
3. Research into containment failure
4. Fission product release rates from fuel and aerosol formation
5. The potential for formation and properties of high concentration aerosols
6. Improvement of in-containment aerosol models
7. Experimental study of fission product attenuation in large water pools
8. Overview project.

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APPENDIX E

TMI-2 LITERATURE REPORT LIST

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TMI-2 LITERATURE
ORGANIZED BY
KEYWORD AND DATE

INDEX	REPORT	TITLE	AUTHOR	ORGANIZATION	DATE	KEYWORD	COMMENTS
DOE-300	PROG NUC EN V6 #1-3	PILOT-OPERATED RELIEF VALVE DESIGN AND PERFORMANCE	FORSCHER, F.	TATF	1-Oct-79	EQUIP QUAL	GET UCSD
DIALOG	HEALTH PHY-V39-N6	INSTRUMENT PERFORMANCE AND MEASUREMENTS AT TMI - PROJECTED NEEDS FOR OTHER NUCLEAR ACCIDENTS	DISTENFELD, C.	BNL	1-Jan-80	EQUIP QUAL	PDT 1980
DOE-705	BNL-NUREG-26762	ANALYSIS OF THE TMI-2 SOURCE RANGE DETECTOR RESPONSE	CAREW, J.F.	BNL	8-Apr-80	EQUIP QUAL	80C0040237
DOE-428	CONF-800607	ANALYSIS OF SPND RESPONSE DURING THE TMI-2 ACCIDENT	SHANSTROM, R.T.	SHANSTROM	8-Jun-80	EQUIP QUAL	REVIEWED
DOE-467	CONF-800607	FUNCTION AND ROLE OF TMI-2 INSTRUMENTATION IN CORE DAMAGE ASSESSMENT	CAIN, D.G.	EPRI	8-Jun-80	EQUIP QUAL	REVIEWED
NONE	CONF-800607	PWR INSTRUMENTATION: RECOMMENDATIONS FOR IMPROVEMENT FROM TMI-2 EXPERIENCE	SHEPARD, J.L.	ORNL	8-Jun-80	EQUIP QUAL	REVIEWED
DOE-290	CONF-801103	IN-CORE THERMOCOUPLE PERFORMANCE UNDER SIMULATED ACCIDENT CONDITIONS	ANDERSON, R.L.	ORNL	5-Nov-80	EQUIP QUAL	REVIEWED
DIALOG	IEEE TRAN-V28-N1	A REVIEW OF NRC INSTRUMENTATION NEEDS	SATTERFIELD, R.M.	NRC	1-Feb-81	EQUIP QUAL	REVIEWED
NONE	NUREG-0588,REV1	INTERIM STAFF POSITION ON ENVIRONMENTAL QUALIFICATION OF SAFETY-RELATED ELEC EQUIP	SZUKIEWICZ, A.J.	NRC	1-Jul-81	EQUIP QUAL	REVIEWED
DOE-230	SAND-81-0725	EXAMINATION RESULTS OF THE TMI RADIATION DETECTOR HP-R-211	MURPHY, M.B.	SANDIA	1-Sep-81	EQUIP QUAL	REVIEWED,F-UP
DOE-163	GEND-014	EXAMINATION RESULTS OF THE TMI RADIATION DETECTOR HP-R-211	MURPHY, M.B.	SANDIA	1-Oct-81	EQUIP QUAL	REVIEWED
DOE-197	NUCL SAF V22 #6	SOME POSSIBLE WAYS TO IMPROVE NUCLEAR POWER-PLANT INSTRUMENTATION	HSU, Y.Y.	NRC	1-Nov-81	EQUIP QUAL	REVIEWED,F-UP
DOE-249	GEND-INF-017-V2	FIELD MEASUREMENTS AND INTERPRETATION OF TMI-2 INSTRUMENTATION: CF-1-PT4	JONES, J.E.	TEC	1-Nov-81	EQUIP QUAL	REVIEWED
DOE-250	GEND-INF-017-V1	FIELD MEASUREMENTS AND INTERPRETATION OF TMI-2 INSTRUMENTATION: CF-1-PT3	JONES, J.E.	TEC	1-Nov-81	EQUIP QUAL	REVIEWED
DOE-005	CONF-811103	TMI-2 INSTRUMENT ANALYSIS RESULTS	MURPHY, M.B.	SANDIA	29-Nov-81	EQUIP QUAL	REVIEWED

TMI-2 LITERATURE ORGANIZED BY KEYWORD AND DATE

INDEX	REPORT	TITLE	AUTHOR	ORGANIZATION	DATE	KEYWORD	COMMENTS
DOE-244	SAND-81-1736A	TMI-2 INSTRUMENT ANALYSIS RESULTS	MURPHY, M.D.	SANDIA	29-Nov-81	EQUIP QUAL	REVIEWED
DOE-191	GEND-017	RESPONSE OF THE SPND MEASUREMENT SYSTEM TO TEMPERATURE DURING THE TMI-2 ACCIDENT	WILDE, N.	EG&G	1-Dec-81	EQUIP QUAL	REVIEWED
DOE-107	GEND-INF-017-V9	FIELD MEASUREMENTS AND INTERPRETATION OF TMI-2 INSTRUMENTATION: HP-R-213	JONES, J.E.	TEC	1-Jan-82	EQUIP QUAL	REVIEWED
DOE-108	GEND-INF-017-V7	FIELD MEASUREMENTS AND INTERPRETATION OF TMI-2 INSTRUMENTATION: YM-AMP-7023 AND YM-AMP-7025	JONES, J.E.	TEC	1-Jan-82	EQUIP QUAL	REVIEWED
DOE-109	GEND-INF-017-V3	FIELD MEASUREMENTS AND INTERPRETATION OF TMI-2 INSTRUMENTATION: HP-R-211	JONES, J.E.	TEC	1-Jan-82	EQUIP QUAL	REVIEWED
DOE-141	GEND-INF-017-V8	FIELD MEASUREMENTS AND INTERPRETATION OF TMI-2 INSTRUMENTATION: HP-R-212	JONES, J.E.	TEC	1-Jan-82	EQUIP QUAL	REVIEWED
DOE-148	GEND-INF-017-V6	FIELD MEASUREMENTS AND INTERPRETATION OF TMI-2 INSTRUMENTATION: IC-10-DPT	JONES, J.E.	TEC	1-Jan-82	EQUIP QUAL	REVIEWED
DOE-149	GEND-INF-017-V5	FIELD MEASUREMENTS AND INTERPRETATION OF TMI-2 INSTRUMENTATION: CF-2-LT2	JONES, J.E.	TEC	1-Jan-82	EQUIP QUAL	REVIEWED
DOE-150	GEND-INF-017-V4	FIELD MEASUREMENTS AND INTERPRETATION OF TMI-2 INSTRUMENTATION: CF-2-LT4	JONES, J.E.	TEC	1-Jan-82	EQUIP QUAL	REVIEWED
NONE	DRAFT	ENVIRONMENTAL QUALIFICATION OF ELECTRIC EQUIPMENT FOR NUCLEAR POWER PLANTS (REV TO 1.89)	AGGARWAL, S.K.	NRC	1-Feb-82	EQUIP QUAL	REVIEWED
DOE-093	GEND-INF-017-V11	FIELD MEASUREMENTS AND INTERPRETATION OF TMI-2 INSTRUMENTATION: NI-AMP-2	JONES, J.E.	TEC	1-Apr-82	EQUIP QUAL	REVIEWED
DOE-094	GEND-INF-017-V10	FIELD MEASUREMENTS AND INTERPRETATION OF TMI-2 INSTRUMENTATION: HP-R-214	JONES, J.E.	TEC	1-Apr-82	EQUIP QUAL	REVIEWED
DOE-106	GEND-INF-017-V12	RECOMMENDATIONS FOR TMI-2 INSTRUMENTATION SURVEILLANCE PROGRAM	JONES, J.E.	TEC	1-Apr-82	EQUIP QUAL	REVIEWED, F-UP
DOE-098	EGG-TIO-M-00182	INSTRUMENTATION AND ELECTRICAL PROGRAM AT TMI-2, TIO	HECKER, L.A.	EG&G	17-Jun-82	EQUIP QUAL	REVIEWED

TMI-2 LITERATURE
ORGANIZED BY
KEYWORD AND DATE

INDEX	REPORT	TITLE	AUTHOR	ORGANIZATION	DATE	KEYWORD	COMMENTS
DOE-009	GEND-INF-026	STATIC IN SITU TEST OF THE AXIAL POWER SHAPING ROD AND SHIM SAFETY CONTROL ROD MECHANISMS	SOBERANO, F.T.	UECI	1-Aug-82	EQUIP QUAL	REVIEWED
DOE-042	SAND-82-1173	EXAMINATION RESULTS OF THE THREE MILE ISLAND RADIATION DETECTOR HP-R-213	MUELLER, G.M.	SANDIA	1-Aug-82	EQUIP QUAL	REVIEWED,F-UP
DOE-057	GEND-INF-022	STATUS OF TMI-2 INSTRUMENTS AND ELECTRICAL COMPONENTS	HELBERT, H.J.	EG&G	1-Aug-82	EQUIP QUAL	REVIEWED
NONE	NONE	A PRA-BASED APPROACH TO ESTABLISHING PRIORITIES FOR EQUIPMENT QUALIFICATION NEEDS	LEAVER, D.E.	WLA	29-Aug-82	EQUIP QUAL	REVIEWED
NONE	SAND82-0980	EXAMINATION RESULTS ON TMI-2 LPM CHARGE CONVERTERS YM-AMP-7023 AND YM-AMP-7025	MURPHY, M.B.	SANDIA	1-Sep-82	EQUIP QUAL	REVIEWED,F-UP
NONE	NUREG/CR-2932,1&2	EQUIPMENT QUALIFICATION RESEARCH TEST OF ELECTRIC CABLE WITH FACTORY SPLICES AND INSULATION	MINOR, E.E.	SANDIA	1-Sep-82	EQUIP QUAL	REVIEWED
NONE	ROUGH DRAFT	ISSUE SUMMARY--ENVIRONMENTAL QUALIFICATION OF ELECTRICAL EQUIPMENT	SINGH, R.N.	NUS	28-Oct-82	EQUIP QUAL	REVIEWED
NONE	GEND-INF-034	TESTING AND EXAMINATION OF TMI-2 ELECTRICAL COMPONENTS AND DISCRETE DEVICES	SOBERANO, F.T.	UECI	1-Nov-82	EQUIP QUAL	REVIEWED,F-UP
DOE	GEND-INF-024	REVIEW OF TMI-2 RESISTANCE TEMPERATURE DETECTORS ACCIDENT DATA AND IN-SITU TESTING	MOCK, J.W.	EG&G	1-Nov-82	EQUIP QUAL	ON ORD
DIALOG	TANS V43,1982	THERMAL-ANALYSIS OF THE TMI-2 PRIMARY PRESSURE BOUNDARY AND POTENTIAL IMPACT ON REQUALIFICATION PLANS	TAGART, S.W.	EPRI	14-Nov-82	EQUIP QUAL	REVIEWED
DIALOG	TANS V43,1982	IN-CONTAINMENT RADIATION MONITORING AT TMI-2	MURPHY, M.B.	SANDIA	14-Nov-82	EQUIP QUAL	REVIEWED
DIALOG	TANS V43,1982	TMI-2 SPND AND THERMOCOUPLE DATA-ANALYSIS	YANCEY, M.E.	EG&G	14-Nov-82	EQUIP QUAL	REVIEWED
DIALOG	TANS V43,1982	THE INSTRUMENTATION AND ELECTRICAL PROGRAM AT TMI-2	SCHWARZ, W.F.	EG&G	14-Nov-82	EQUIP QUAL	REVIEWED
NONE	GEND-INF-031	PRELIMINARY REPORT OF TMI-2 IN-CORE INSTRUMENT DAMAGE	YANCEY, M.E.	EG&G	1-Jan-83	EQUIP QUAL	ON ORD
NONE	GEND-INF-029	TMI-2 PRESSURE TRANSMITTER EXAMINATION PROGRAM YEAR-END REPORTS: EXAMIN. AND EVAL. OF PRESS. TRANS. CF-1-PT3 & CF-2-LT3	STRAHM, R.C.	EG&G	1-Feb-83	EQUIP QUAL	REVIEWED,F-UP

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DOE-626	CONF-791103	ASSESSMENT OF NOBLE GAS RELEASES FROM THE TMI-2 ACCIDENT	WOODARD, K.	PICKARD	12-Nov-79	FISS PROD	REVIEWED
DOE-530	CONF-791037	CRITIQUE OF SOURCE TERM AND ENVIRONMENTAL MEASUREMENT AT TMI	HULL, A.P.	BNL	1-Feb-80	FISS PROD	REVIEWED
DOE-739	IEEE,VNS27,N1	CRITIQUE OF SOURCE TERM AND ENVIRONMENTAL MEASUREMENT AT TMI	HULL, A.P.	BNL	1-Feb-80	FISS PROD	REVIEWED
DOE-675	LA-8041-MS(REV)	TMI-2 DECAY POWER: LASL FISS PROD AND ACTINIDE DECAY POWER CALC FOR PRES. COMM ON TMI	ENGLAND, T.R.	LASL	1-Mar-80	FISS PROD	REVIEWED
DOE-511	CONF-800386	UNCOVERED CORE AND FISSION PRODUCT BEHAVIOUR IN THE CONTAINMENT FOLLOWING LOCA. ANY NEW FINDINGS AFTER TMI	HOCK, R.	KRAFTWERK	25-Mar-80	FISS PROD	81Y0009849
DOE-592	CONF-800403-V2	EQUIPMENT HATCH PLATEOUT AND ACTIVITY MEASUREMENTS AT TMI	WALKER, E.	BECHTEL	8-Apr-80	FISS PROD	REVIEWED
DOE-594	CONF-800403-V2	DETER. OF TMI CONTAIN. BLDG WATER LEVEL AND SPECIFIC ACT. OF CS-137 BY GELI MEAS. THRU PENETRATION R-605	MENZEL, T.	GPU	8-Apr-80	FISS PROD	REVIEWED
DOE-603	CONF-800403-V1	FISSION PRODUCT RELEASE FROM THE FUEL FOLLOWING THE TMI-2 ACCIDENT	BISHOP, W.N.	B&W	8-Apr-80	FISS PROD	REVIEWED,F-UP
DOE-443	CONF-800607	RADIATION SOURCE TERMS AND SHIELDING AT TMI-2	MILLER, A.D.	EPRI	8-Jun-80	FISS PROD	REVIEWED,F-UP
DOE-444	CONF-800607	TMI RADIOACTIVE MATERIAL RELEASE PATHWAYS	KRIPPS, L.J.	ENERGY INC	8-Jun-80	FISS PROD	REVIEWED
DOE-469	CONF-800607	TMI-2 RADIONUCLIDE INVENTORY AND DECAY PROPERTIES	WILSON, W.B.	LASL	8-Jun-80	FISS PROD	REVIEWED
NONE	GEND-INF-001	QUICK LOOK REPORT - ENTRY 1 - TMI-2	BECHTEL/GPU	BECHTEL/GPU	23-Jul-80	FISS PROD	REVIEWED
DOE-340	CONF-801038-V2	STUDIES OF AIRBORNE IODINE AT TMI-2, SOURCES AND FILTRATION	CLINE, J.E.	SAI	20-Oct-80	FISS PROD	REVIEWED
DOE-097	EPRI-NSAC-12	PREDICTION OF TMI-2 CORE TEMPERATURES FROM THE FISSION-PRODUCT RELEASE HISTORY. FINAL REPORT	REST, J.	ANL	1-Nov-80	FISS PROD	REVIEWED
DOE-115	EPRI-NSAC-14	WORKSHOP ON IODINE RELEASES IN REACTOR ACCIDENTS	EPRI	EPRI-NSAC	1-Nov-80	FISS PROD	REVIEWED,F-UP

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DOE-194	EPRI-NSAC-14	IODINE RELEASES FROM REACTOR ACCIDENTS	MOREWITZ, H.A.	NSAC/ROCKWELL	1-Nov-80	FISS PROD	REVIEWED
DOE-391	LMF-84	CHARACTERIZATION OF AN AEROSOL SAMPLE FROM TMI REACTOR AUXILIARY BUILDING	KANAPILLY, G.A.	LOVELACE	1-Dec-80	FISS PROD	81U0064073
DOE-034	NIPPON GEN,23,#1	RADIOACTIVITY RELEASE PATHWAYS OF TMI-2 ACCIDENT	TANAKA, M.	JAPAN AERI	1-Jan-81	FISS PROD	IN JAP-UNOBT
DOE-096	EPRI-NSAC-24	TMI-2 ACCIDENT: CORE HEAT-UP ANALYSIS	ARDRON, K.H.	EPRI-NSAC	1-Jan-81	FISS PROD	REVIEWED
DOE-393	LMF-70	CHARACTERIZATION OF AN AEROSOL SAMPLE FROM TMI REACTOR AUXILIARY BUILDING	KANAPILLY, G.M.	LOVELACE	1-Jan-81	FISS PROD	REVIEWED
DIALOG	AM CHEM SOC-V181	FISSION-PRODUCT RELEASE AND TRANSPORT FOLLOWING THE TMI-2 ACCIDENT	MITTI, D.A.	B&W	1-Mar-81	FISS PROD	UNOBT
DIALOG	PROG IN NUC EN-V7-N3	CORE TEMPERATURE TRANSIENT IN THE EARLY PHASE OF CORE UNCOVERING AT TMI-2	ARDRON, K.H.	EPRI-NSAC	18-Mar-81	FISS PROD	REVIEWED
DOE-394	GEND-009	MEASUREMENTS OF $SUP 129$I AND RADIOACTIVE PARTICULATE CONC. IN THE TMI-2 CONTAIN. ATMOS. DURING AND AFTER THE VENTING	CLINE, J.E.	SAI	1-Apr-81	FISS PROD	REVIEWED
DOE-363	GEND-005	CHARACTERIZATION OF THE TMI-2 REACTOR BUILDING ATMOSPHERE PRIOR TO THE REACTOR BUILDING PURGE	HARTWELL, J.K.	EG&G	1-May-81	FISS PROD.	REVIEWED
DOE-028	CONF-810606	TMI-2 CONTAINMENT DECONTAMINATION	THIESING, J.W.	BECHTEL	7-Jun-81	FISS PROD	REVIEWED
DOE-029	CONF-810606	THREE MILE ISLAND HANDS-ON DECONTAMINATION AUXILIARY BUILDING	IRVING, B.	VIKEM IND.	7-Jun-81	FISS PROD	REVIEWED
DOE-031	CONF-810606	TMI-2 CONTAIN. ASSESS. PROGRAM : RAD MEAS. OF THE ENVIRON. ABOVE THE OPERATING FLOOR USING SPARE PENENTR.	MORRELL, M.P.	GPU	7-Jun-81	FISS PROD	REVIEWED
NONE	GEND-INF-002	QUICK LOOK REPORT ENTRY 2 TMI-2 ON AUGUST 15, 1980	BECHTEL/GPU	BECHTEL/GPU	1-Jul-81	FISS PROD	REVIEWED
DOE-133	BILD WISS,18,#8	WHERE WAS THE IODINE WHEN THE HARRISBURG ACCIDENT OCCURED	KELLER, C.	BILD WISS	1-Aug-81	FISS PROD	IN GER-UNOBT
DOE-231	EPRI-NSAC-30	IODINE-131 BEHAVIOR DURING THE TMI-2 ACCIDENT. FINAL REPORT	PELLETIER, C.A.	SAI	1-Sep-81	FISS PROD	REVIEWED,F-UP

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DOE-151	NATURE,V294,#5838	REACTOR-RELEASED RADIONUCLIDES IN SUSQUEHANNA RIVER SEDIMENTS	OLSEN, C.R.	ORNL	19-Nov-81	FISS PROD	REVIEWED
DOE-004	CONF-811103	TMI-2 CONTAINMENT BUILDING ACCIDENT WATER SAMPLING AND REACTOR PRIMARY COOLANT ACCIDENT SOURCE TERM	LEE, J.Y.	NRC	29-Nov-81	FISS PROD	REVIEWED,F-UP
DOE-126	NUCL.SAF.,23,#1	THE EVOLUTION AND CURRENT STATE OF RADIOIODINE CONTROL	KOVACH, J.L.	NUC CONS SERV	1-Jan-82	FISS PROD	REVIEWED
DOE-147	GEND-INF-019	ESTIMATED SOURCE TERMS FOR RADIO. AND SUSPENDED PARTIC. DURING TMI-2 DEFUELING OPERATIONS- REPORT ON PHASE 1	VOILLEQUE, P.G.	SAI	1-Jan-82	FISS PROD	REVIEWED
DIALOG	HEALTH PHY-V43-N1	FISSION-PRODUCT CHEMISTRY AND THE ACCIDENT AT THREE-MILE-ISLAND	STRATTON, W.R.	LASL	1-Jan-82	FISS PROD	REVIEWED
DIALOG	HEALTH PHY-V43-N1	MEAS. OF SURFACE AND VOLUME CONTAM. ON COMPONENTS AND FLOORS OF TMI-2 REAC. CONT. BLDG USING A ... GE DETECTOR	CLINE, J.E.	SAI	1-Jan-82	FISS PROD	REVIEWED
DOE-095	GEND-INF-009	PRE-DECONTAMINATION GAMMA-RAY SURFACE SCANS IN TMI-2 CONTAINMENT BLDG 305 FT ELEV	BAREFOOT, E.D.	SAI	1-Feb-82	FISS PROD	REVIEWED
NONE	NUREG/CR-2300	A GUIDE TO THE PERFORMANCE OF PROBABILISTIC RISK ASSESSMENTS FOR NUCLEAR POWER PLANTS	NONE	NRC	5-Apr-82	FISS PROD	REVIEWED
DOE-092	GEND-INF-021	ANALYSIS DATA ON SAMPLES FROM THE TMI-2 REACTOR-COOLANT SYSTEM AND REACTOR-COOLANT BLEED TANK	NITSCHKE, R.L.	EG&G	1-May-82	FISS PROD	REVIEWED
NONE	SAI-139-82-12-RV	PRELIMINARY RADIOIODINE SOURCE TERM AND INVENTORY ASSESSMENT FOR TMI-2	PELLETIER, C.A.	SAI	1-Sep-82	FISS PROD	REVIEWED
DOE	GEND-INF-011-V2	REACTOR BUILDING BASEMENT RADIONUCLIDE DISTRIBUTION STUDIES	COX, T.E.	INEL	1-Oct-82	FISS PROD	REVIEWED
NONE	NP-2722	CHARACTERIZATION OF THE CONTAMINATION IN THE TMI-2 REACTOR COOLANT SYSTEM	CUNNANE, J.C.	BATTELLE	1-Nov-82	FISS PROD	REVIEWED
DIALOG	TANS V43,1982	SURFACE DEPOSITION MEASUREMENTS OF THE TMI-2 GROSS DECONTAMINATION EXPERIMENT	MCISAAC, C.V.	EG&G	14-Nov-82	FISS PROD	REVIEWED

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DIALOG	TANS V43,1982	PRELIMINARY-RESULTS OF THE TMI-2 RADIOACTIVE IODINE MASS BALANCE STUDY	PELLETIER, C.A.	SAI	14-Nov-82	FISS PROD	REVIEWED,F-UP
DIALOG	TANS V43,1982	ANALYSIS OF TMI-2 SAMPLES USING THE MOLECULAR OPTICAL LASER EXAMINER	DOYLE, T.E.	EG&G	14-Nov-82	FISS PROD	REVIEWED
DIALOG	TANS V43,1982	CHARACTERIZATION OF FISSION-PRODUCT DEPOSITION IN THE TMI-2 REACTOR COOLANT AND AUXILIARY SYSTEMS	DANIEL, J.A.	SAI	14-Nov-82	FISS PROD	REVIEWED
NONE	ANS MEET	CHARACTERIZATION OF FISSION PRODUCT DEPOSITION IN THE TMI-2 REACTOR COOLANT AND AUX SYSTEMS	DANIEL, J.A.	SAI	17-Nov-82	FISS PROD	REVIEWED
NONE	NUS-4222-V1	RADIONUCLIDE MASS BALANCE FOR THE TMI-2 ACCIDENT: DATA BASE SYSTEM AND PRELIM MASS BALANCE	GOLDMAN, M.I.	NUS	1-Jan-83	FISS PROD	REVIEWED
NONE	NUS-4222-V2	RADIONUCLIDE MASS BALANCE FOR THE TMI-2 ACCIDENT: DATA BASE SYSTEM AND PRELIM MASS BALANCE	GOLDMAN, M.I.	NUS	1-Jan-83	FISS PROD	REVIEWED
NONE	NUS-4215	TMI-2 MASS BALANCE DATA BASE USER MANUAL	SHAWN, L.W.	NUS	1-Jan-83	FISS PROD	REVIEWED
NONE	NP-2842	POST-ACCIDENT DECONTAMINATION OF REACTOR PRIMARY SYSTEMS AND TEST LOOPS	ANDERSON, L.E.	BATTELLE NW	1-Jan-83	FISS PROD	ON ORD
NONE	LA-9622-MS	TMI-2 FISSION-PRODUCT ELEMENTAL AND ISOTOPIC INVENTORIES	ENGLAND, T.R.	LASL	1-Jan-83	FISS PROD	ON ORD
NONE	NP-2922	CHARACTERIZATION OF CONTAMINANTS IN TMI-2 SYSTEMS	DANIEL, J.A.	SAI	1-Mar-83	FISS PROD	ON ORD!!

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DOE-751	NUREG/CR-0913	GENERATION OF HYDROGEN DURING THE FIRST THREE HRS OF THE TMI ACCIDENT	COLE, R.K. JR.	SANDIA	1-Jul-79	HYDROGEN	REVIEWED,F-UP
DOE-586	CONF-800386	HYDROGEN-RELATED PROBLEMS IN THE CONTAINMENT OF PWRS AFTER HYPOTHETICAL LOCA	HASSMANN	KRAFTWERK	25-Mar-80	HYDROGEN	IN GER-UNOBT
DOE-704	CONF-800403-7	EXPERIMENTS ON HYDROGEN FOR THREE MILE ISLAND	WOOLEY, R.L.	BILLINGS E.C.	8-Apr-80	HYDROGEN	REVIEWED
DOE-048	CONF-801107	ZIRCALOY REACTION IN HYDROGEN-STEAM MIXTURES; IMPLICATIONS FOR TMI-2 CORE DAMAGE	CHUNG, H.M.	ANL	17-Nov-80	HYDROGEN	REVIEWED
DOE-410	LA-UR-81-681	CONTROLLING HYDROGEN BEHAVIOR IN LIGHT WATER REACTORS	CULLINGFORD, H.S.	LASL	26-Jan-81	HYDROGEN	REVIEWED,F-UP
DOE-062	CONF-810606	ASSESSMENT OF HYDROGEN RELEASE INTO THE CONTAINMENT DURING THE TMI-2 ACCIDENT	JOHNSON, D.A.	ANL	7-Jun-81	HYDROGEN	REVIEWED,F-UP
NONE	NSAC-32	WORKSHOP ON HYDROGEN BURNING AND CONTAINMENT BUILDING INTEGRITY	EPRI	EPRI-NSAC	1-Jul-81	HYDROGEN	REVIEWED,F-UP
NONE	SAND81-0661	PROCEEDINGS OF THE WORKSHOP ON THE IMPACT OF HYDROGEN ON WATER REACTOR SAFETY--VOLS. 1-4.	BERMAN, M.	SANDIA	1-Aug-81	HYDROGEN	ON ORD?
DIALOG	NUC SAF-V22-N5	THERMAL-HYDRAULIC AND CORE-DAMAGE ANALYSES OF THE TMI-2 ACCIDENT	IRELAND, J.R.	LASL	1-Sep-81	HYDROGEN	REVIEWED
DOE-091	GEND-INF-023-V1	INVESTIGATION OF HYDROGEN-BURN DAMAGE IN THE TMI-2 REACTOR BUILDING	ALVARES, N.J.	LLNL	1-Jun-82	HYDROGEN	REVIEWED
NONE	SAND82-1246C	HYDROGEN BURN SURVIVAL PROGRAM REVIEW	DANDINI, V.J.	SANDIA	1-Jun-82	HYDROGEN	REVIEWED
NONE	NUREG/CR-2730	HYDROGEN BURN SURVIVAL; PRELIMINARY THERMAL MODEL AND TEST RESULTS	MCCULLOCH, W.H.	SANDIA	1-Aug-82	HYDROGEN	REVIEWED
NONE	ROUGH DRAFT	DATA INTEGRITY REVIEW OF THREE MILE ISLAND UNIT 2 HYDROGEN BURN DATA	JACOBY, J.K.	EG&G	1-Aug-82	HYDROGEN	REVIEWED
NONE	NUREG/CR-2864	IDENTIFICATION OF SAFETY RELATED EQUIPMENT FOR ANALYSIS AND TESTING IN THE HYDROGEN BURN SURVIVAL PROGRAM	DANDINI, V.J.	SANDIA	1-Oct-82	HYDROGEN	REVIEWED

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NONE	SAND82-1215C	MULTIPLE HYDROGEN-AIR DEFLAGRATIONS IN CONTAINMENT AND THE RESULTING THERMAL ENVIRONMENTS	KEMPKA, S.N.	SANDIA	3-Oct-82	HYDROGEN	REVIEWED
NONE	SAND82-2228C	HYDROGEN BURN SURVIVAL PROGRAM	MCCULLOCH, W.H.	SANDIA	12-Oct-82	HYDROGEN	REVIEWED,F-UP
DIALOG	TANS V43,1982	ANALYSIS OF THE TMI-2 HYDROGEN BURN	HENRIE, J.O.	ROCKWELL	14-Nov-82	HYDROGEN	REVIEWED,F-UP
DIALOG	TANS V43,1982	INVESTIGATION OF HYDROGEN BURN DAMAGE IN THE TMI-2 REACTOR BUILDING	ALVARES, N.J.	LLNL	14-Nov-82	HYDROGEN	REVIEWED
NONE	GEND-INF-023	ESTIMATED TEMPERATURES OF ORGANIC MATERIALS IN THE TMI-2 REACTOR BUILDING DURING HYDROGEN BURN	SCHUTZ, H.W.	EG&G	1-Dec-82	HYDROGEN	REVIEWED,F-UP

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DOE-357	GEND-001	GEND PLANNING REPORT	GEND	GEND	1-Oct-80	PLANNING	REVIEWED
NONE	NUS-3808	SOURCE TERMS: AN INVESTIGATION OF UNCERTAINTIES, MAGNITUDES, AND RECOMMENDATIONS FOR RESEARCH	LEVINE, S.	NUS	1-Mar-82	PLANNING	REVIEWED,F-UP
NONE	NP-2625	TMI-2 MECHANICAL COMPONENT INFORMATION AND EXAMINATION PROGRAM PLAN AND PROGRESS REPORT	KURDZIEL, E.P.	IEAL	1-Sep-82	PLANNING	REVIEWED,F-UP
NONE	GEND-INF-036	TASK PLAN FOR THE U.S. DEPARTMENT OF ENERGY TMI-2 PROGRAMS	TIO	EG&G	1-Oct-82	PLANNING	REVIEWED,F-UP
DIALOG	TANS V43,1982	OVERVIEW OF PROGRESS AND PLANS FOR EPRIS TMI-2 MECHANICAL COMPONENT SURVIVABILITY PROGRAM	LEFKOWITZ, S.	PENTEK	14-Nov-82	PLANNING	REVIEWED,F-UP
NONE	NP-2907	JOINT TMI-2 INFORMATION AND EXAMINATION PROGRAM	EPRI	EPRI	1-Feb-83	PLANNING	REVIEWED

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DOE-192	EPRI-NSAC-BIB.4	INDEXED BIBLIOGRAPHY OF TMI-2 DOCUMENTS IN NSAC WORKING FILE	EPRI	EPRI-NSAC	1-Jan-80	BIBLIO	REVIEWED
DOE-153	VANCE BIBLIO.	THREE MILE ISLAND: A PRELIMINARY CHECKLIST	DRAZAN, J.G.	VANCE BIBLIO.	1-Jun-81	BIBLIO	UNOBT
NONE	EPRI-NSAC-BIB.5	BIBLIOGRAPHY OF TMI NUMBER 5	EPRI	EPRI	1-Jan-82	BIBLIO	REVIEWED

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DOE-750	EPRI-NSAC-1	ANALYSIS OF TMI-2 ACCIDENT	EPRI	EPRI-NSAC	1-Jul-79	MISC	REVIEWED
DOE-636	ATOMTECH,V24,N8/9	QUAN. CALC OF FUEL ELEMENT DEFECTS OF TMI-2. RECALC. OF THERMO PROCESSES DURING SUPERHEAT PHASE IN THE TMI-2 PLANT.	BASLER, M.	ATOMWIRTSCH	1-Aug-79	MISC	IN GER-UNOBT
DOE-395	GEND-002-V1	GENERAL REVIEW OF TMI-2 PLANT LAYOUT AND DESIGN	DEVINE, J.	GPU	27-Nov-79	MISC	REVIEWED
DOE-193	EPRI-NSAC-80-1	ANALYSIS OF TMI-2 ACCIDENT	EPRI	EPRI-NSAC	1-Mar-80	MISC	REVIEWED
DOE-427	CONF-800607	THERMAL-HYDRAULIC ANALYSIS OF THE FIRST 16 HRS OF THE TMI-2 ACCIDENT	COLE, R.K. JR.	SANDIA	8-Jun-80	MISC	REVIEWED
NONE	UPDATE	TMI-2 TECHNICAL INFORMATION AND EXAMINATION PROGRAM - UPDATE	EG&G	EG&G	29-Oct-80	MISC	REVIEWED
DOE-110	GEND-022	TMI-2 INFORMATION AND EXAMINATION PROGRAM 1981 ANNUAL REPORT	EG&G-TIO	EG&G	1-Apr-82	MISC	REVIEWED
DIALOG	NUC ENG INT-V27-N329	THREE-MILE-ISLAND PROVIDES A UNIQUE RESEARCH OPPORTUNITY	SCHWARZ, W.F.	EG&G	1-Jul-82	MISC	REVIEWED
NONE	UPDATE,V3,N1	UPDATE PAMPHLET	EG&G-TIO	EG&G	1-Nov-82	MISC	REVIEWED
NONE	CONF-821104-2	TECHNOLOGY TRANSFER AT THREE MILE ISLAND UNIT 2	BURTON, H.M.	EG&G	1-Nov-82	MISC	ON ORD
NONE	ANS MEET	TMI-2 SPECIAL SESSIONS	ANS	ANS	14-Nov-82	MISC	REVIEWED
NONE	CONF-821101-18	TECHNOLOGY TRANSFER IN THE DOE THREE MILE ISLAND RESEARCH PROGRAMS	MELTZER, F.L.	EG&G	14-Nov-82	MISC	ON ORD

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DOE-743	UCRL-52000-79-5	ARAC ADVISES ON REACTOR INCIDENT AT TMI PLANT	DICKERSON, M.H.	LLNL	1-May-79	INFO	REVIEWED
DOE-725	CONF-790745	THREE AREAS OF POTENTIAL INSTRUMENTATION NEEDS AS A RESULT OF TMI ACCIDENT	BETLACK, J.	MPR ASSOC.	24-Jul-79	INFO	REVIEWED
DOE-727	CONF-790745	INSTRUMENTATION NEEDS AS A RESULT OF TMI-2: A REGULATORY VIEWPOINT	VOGLEWEDE, J.C.	NRC	24-Jul-79	INFO	REVIEWED
DOE-728	CONF-790745	INSTRUMENTATION AND CONTROL SYSTEM NEEDS FOR LWRS (LESSONS FROM TMI-2)	SHEPARD, R.L.	ORNL	24-Jul-79	INFO	REVIEWED
DOE-747	UCRL-83489	ARAC RESPONSE TO THE TMI ACCIDENT	DICKERSON, M.H.	LLNL	1-Oct-79	INFO	REVIEWED
DOE-383	GEND-002-V1	ORNL EXPERIENCES IN PERSONNEL MONITORING DURING HOT CELL RECOVERIES	GUPTON, E.D.	ORNL	27-Nov-79	INFO	REVIEWED
DOE-396	CONF-791234	IN SITU MEASUREMENT EXPERIENCES	FRITZSCHE, A.E.	EG&G	4-Dec-79	INFO	REVIEWED
DOE-361	PB-81-100885	THREE MILE ISLAND NUCLEAR ACCIDENT, A SELECTIVE BIBLIOGRAPHY, 1979	WATSON, J.L.	CEGB	1-Feb-80	INFO	REVIEWED
DOE-622	CONF-800218	ELECTRICAL MODIFICATIONS TO TMI-2 DURING THE INITIAL STAGES OF THE ACCIDENT	GONZALEZ, L.C.	BURNS & ROE	3-Feb-80	INFO	REVIEWED
DOE-608	CONF-800403-V2	DIAGNOSTICS AT TMI USING NOISE ANALYSIS	ROBINSON, J.C.	TEC	8-Apr-80	INFO	REVIEWED
NONE	NUREG/CR-1287	INDEPENDENT VERIFICATION TESTING	BONZON, L.L.	SANDIA	1-May-80	INFO	REVIEWED
DOE-438	CONF-800607	ROLE OF INSTRUMENTATION IN THE TMI-2 ACCIDENT	KEATEN, R.W.	GPU	8-Jun-80	INFO	REVIEWED
DOE-459	CONF-800607	LESSONS LEARNED FROM TMI IN-REACTOR INSTRUMENTATION: AN NRC VIEWPOINT	VOGLEWEDE, J.C.	NRC	8-Jun-80	INFO	REVIEWED
DOE-466	CONF-800607	REACTOR DIAGNOSTICS PASSED THE TMI TEST	BUHL, A.R.	TEC	8-Jun-80	INFO	REVIEWED
DOE-351	IEEE TR,V.PAS-99,4	ELECTRICAL MODIFICATIONS TO TMI-2 DURING THE INITIAL STAGES OF THE ACCIDENT	GONZALEZ, L.C.	BURNS & ROE	1-Nov-80	INFO	REVIEWED
DOE-049	CONF-801107	OVERVIEW-SIGNIFICANT ASPECTS OF TMI-2 CORE MATERIAL PERFORMANCE	THOMAS, G.R.	EPRI-NSAC	17-Nov-80	INFO	REVIEWED

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INDEX	REPORT	TITLE	AUTHOR	ORGANIZATION	DATE	KEYWORD	COMMENTS
DOE-392	NUCL SAF, V22, #1	NUCLEAR SAFETY ANALYSIS CENTER	ZEBROSKI, E.L.	EPRI	1-Jan-81	INFO	REVIEWED
DOE-411	EGG/GEND-003	TMI-2 INFORMATION AND EXAMINATION PROGRAM, TIO, ANNUAL REPORT	EG&G	EG&G	1-Feb-81	INFO	REVIEWED
DOE-371	GEND-016	ACCOUNTABILITY STUDY FOR TMI-2 FUEL	GORIS, P.	HEDL	1-May-81	INFO	REVIEWED
DIALOG	CONF-810606	NUCLEAR INFORMATION SINCE TMI - A LITTLE MORE EFFORT, NOT MUCH SUCCESS	DIAMOND, S.	NEWSDAY	1-Jun-81	INFO	REVIEWED
NONE	MEMO	A NUCLEAR INDUSTRY POSITION ON NRC'S PROPOSED TEST FACILITIES ACCREDITATION (TFA) PROGRAM	NSAC	EPRI-NSAC	3-Sep-81	INFO	REVIEWED
DOE-254	ANL-81-75	NEUTRONIC ANALYSIS OF THE TMI-2 EX-CORE DETECTOR RESPONSE	MALLOY, D.J.	ANL	1-Oct-81	INFO	REVIEWED
NONE	INTERNAL	A SURVEY OF COMPUTER CODES FOR CALCULATING EQUIPMENT DOSE RATES	BRYSON, J.W.	SANDIA	16-Nov-81	INFO	REVIEWED
NONE	NONE	GUIDELINES FOR EVALUATING ENVIRONMENTAL QUAL OF CLASS IE ELEC EQUIP IN OPERATING REACTORS	NONE	NONE	1-Jan-82	INFO	REVIEWED
NONE	PROPOSAL	TMI-2 EQUIPMENT EXAMINATION	OTEY, G.R.	SANDIA	20-Jan-82	INFO	REVIEWED
NONE	CD-WO-82-241	ALTERNATIVE TO NRC PROPOSED TEST FACILITY (TFA) ACCREDITATION PROGRAM	WANLESS, J.W.	NUS	25-Jun-82	INFO	REVIEWED
NONE	SECY-82-207C	FINAL RULE, E.Q. OF ELECTRIC EQUIPMENT IMPORTANT TO SAFETY FOR NUCLEAR POWER PLANTS	DIRCKS, W.J.	NRC	27-Jul-82	INFO	REVIEWED
NONE	SAND82-2263	LIGHT WATER REACTOR SAFETY TECHNOLOGY PROGRAM	CARLSON, D.D.	SANDIA	1-Oct-82	INFO	REVIEWED
NONE	SAND82-1910C	STATUS REPORT ON THE QUALIFICATION TESTING EVALUATION (QTE) PROGRAM	BONZON, L.L.	SANDIA	12-Oct-82	INFO	REVIEWED
DOE	GEND-INF-028	DEVELOPMENT OF IN-SITU TEST PROCEDURES FOR TMI-2 AXIAL POWER SHAPING ROD-DRIVE MECHANISMS	GANNON, J.A.	UECI	1-Nov-82	INFO	REVIEWED
NONE	INTERIM	RADIATION AND SIMULATION ISSUES IN EQUIPMENT QUALIFICATION	BONZON, L.L.	SANDIA	15-Dec-82	INFO	REVIEWED
NONE	NONE	IE INFORMATION NOTICE NO. 82-52	NRC	NRC	21-Dec-82	INFO	REVIEWED

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