TERA


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


August 20, 1979

MEMORANDUM FOR: Chairman Hendrie
Commissioner Gilinsky
Commissioner Kennedy
Commissioner Bradford
Commissioner Ahearne

THRU: Lee V. Gossick
Executive Director for Operations

FROM: Harold R. Denton, Director
Office of Nuclear Reactor Regulation

SUBJECT: RESUMPTION OF LICENSING REVIEWS FOR NUCLEAR POWER PLANTS

In May of this year I described a realignment of current and near-term priority tasks within the Office of Nuclear Reactor Regulation (NRR) to deal with activities relating to the accident at Three Mile Island (see SECY-79-344). One consequence of the realignment was a temporary delay in the processing of operating license and construction permit applications for nuclear plants pending completion of certain TMI-2 related tasks.

The short-term TMI-2 tasks are essentially complete, as summarized below, and based on the results of these efforts I have decided to resume staff licensing activities on pending construction permit and operating license applications. It is my judgment that the TMI-2 related actions being taken by NRR on licensee emergency preparedness (see SECY-79-450), operator licensing (see SECY-79-33-E), bulletins and orders followup (primarily in the areas of auxiliary feedwater system reliability; loss of feedwater and small break loss-of-coolant accident analysis; emergency operating guidelines and procedures; and operator training), and short-term Lessons Learned, if accomplished generally on the schedule we have selected, are necessary and sufficient for the continued safe operation of operating plants and for the resumption of staff licensing activities on pending construction permit and operating license applications. It is my intent to bring the staff's first completed review of a pending operating license application to the Commission for review prior to staff issuance of the license. The Lessons Learned Task Force and I also have considered whether the actions associated with these activities would foreclose other actions that subsequently may be shown to be necessary by the Lessons Learned Task Force, the President's Commission or the NRC Special Inquiry. We have no indication that they will.

845008

7908220212

The principal element of the composite of staff activities listed above is the completion of my review and the ACRS review of the first report of the TMI-2 Lessons Learned Task Force (NUREG-0578). The Task Force report contains a set of recommendations to be implemented in two stages over the next 16 months on operating plants, plants under construction, and pending construction permit applications. The Task Force recommended 20 licensing requirements and three rulemaking matters in 12 broad areas (nine in the area of design and analysis and three in the area of operations). All but one of the 23 recommendations had a majority concurrence by the Task Force. The Task Force concluded that implementing its recommendations would provide substantial, additional protection which is required for the public health and safety.

The Advisory Committee on Reactor Safeguards has completed its review of the Task Force report. The several public meetings of the ACRS subcommittee on TMI-2 and the public meeting of the full committee on August 9 provided an opportunity for the presentation and discussion of public comments on the report. The ACRS letter of August 13, 1979, to Chairman Hendrie states that the Committee agrees with the intent and substance of all the Task Force recommendations, except four upon which the Committee offered constructive comments to achieve the same objectives articulated by the Task Force. The Committee also noted that effective implementation will require a more flexible, perhaps extended, schedule than proposed by the Task Force. A copy of the ACRS letter is provided as Enclosure 1.

The ACRS comments on NUREG-0578 concentrate on four of the Task Force recommendations. These are: (a) the revision of limiting conditions of operation to require plant shutdown for certain human or procedural errors; (b) the inerting of MKI and II BWR containments; (c) the provision of recombiner capability at operating plants that do not already have it; and (d) the addition of a shift technical advisor at each operating plant. The first three of these matters require Commission rulemaking, and it is a straightforward matter for the staff to consider the comments in the process of developing the required Commission papers. I will assure that is done.

It is my intent to ask the Office of Standards Development (SD) to proceed expeditiously with a Commission paper proposing a new rule on limiting conditions of operation (item a, above). I will ask SD to include in the paper the alternative approach recommended by the ACRS, and one other approach that I think merits consideration. My alternative would amend the Task Force recommendation so as to differentiate between an isolated occurrence and a repetitive pattern. For example, the forced shutdown aspect of the Task Force recommendation could be reserved for a repeat violation within a relatively short time period, such as two years.

In the case of the two hydrogen control matters (items b and c, above), I intend to follow the advice of the ACRS by asking SD to delay completion of the required staff papers for proposed rulemaking until after receipt and review of the final report of the Lessons Learned Task Force, now scheduled for completion in mid-September. It is likely that the inerting and recombiner requirements recommended by the Task Force will be included in the eventual solution to the hydrogen control problems encountered in the TMI-2 accident. However, in view of the short time until the availability of the overall hydrogen control recommendations by the Task Force, I agree with the ACRS that it is best to not dilute staff effort in this area by prompt pursuit of the two short-term recommendations, one of which was a minority view of the Task Force for these same reasons.

The ACRS comments on the shift technical advisor (item d, above) have resulted in our reassessment of the possible means of achieving the two functions which the Task Force intended to provide by this requirement. The two functions are accident assessment and operating experience assessment by people onsite with engineering competence and certain other characteristics. I agree with the Task Force that the shift technical advisor concept is the preferable short-term method of supplying these functions. However, I have concluded that some flexibility in implementation may yield the desired results if there is management innovation by individual licensees. The Task Force has prepared a statement of functional characteristics for the shift technical advisor that will be used by the staff in the review of any alternatives proposed by licensees. It is provided here as Enclosure 2.

In addition to commenting on four of the Task Force recommendations, the ACRS letter of August 13 recommends three additional instrumentation requirements for short-term action. These are containment pressure, containment water level and containment hydrogen monitors designed to follow the course of an accident. I agree with these recommendations. The Task Force has prepared descriptions of these requirements in the same format as Appendix A of NUREG-0578. They are provided here in Enclosure 3.

I have also decided on one further licensing requirement for short-term action. It is a requirement for remotely operable high point venting of gas from the reactor coolant system. The Task Force has prepared a description of this requirement; it is provided here in Enclosure 4. The Task Force had previously deferred this item for further study, but it is my judgment that design efforts by licensees can and should be initiated now.

Finally, the Task Force has compiled a set of errata and clarifying comments for NUREG-0578. It is provided here as Enclosure 5.

In summary, the Task Force recommended prompt licensing action on 20 items (excluding the three rulemaking matters). I have added the three additional requirements recommended by the ACRS in its August 13 letter and one more on the basis of my own review. This Office will issue letters to all operating plant licensees and all construction permit and operating license applicants within the next two weeks requiring them to commit within 30 days to meet the total of 24 licensing requirements on the implementation schedule provided here in Enclosure 6. Another letter to be issued at approximately the same time, will state the requirements flowing from the work by the Bulletins and Orders Task Force on operating plants which also need to be picked up on the license applications.

Several licensees have advised that some of the hardware changes required in NUREG-0578 can be accomplished at much lower cost during springtime refueling outages in 1980. For good cause shown, we intend to consider such flexibility in the implementation schedules. The end date for full implementation of all licensing requirements has not been changed from the January 1, 1981, date recommended by the Task Force. The implementation dates for the Commission rulemaking actions will be established in the course of rulemaking.

Harold R. Denton

Harold R. Denton, Director
Office of Nuclear Reactor Regulation

Enclosures:
1. ACRS Ltr Carbon to Hendrie dtd 8/13/79
2. Alternatives to Shift Technical Advisors
3. Instrumentation to Monitor Containment Conditions
4. Installation of Remotely Operated High Point Vents in the Reactor Coolant System
5. NUREG-0578 Errata
6. Implementation of Requirements for Operating Plants and Plants in OL Review

cc: Mitchell Rogovin
Saul Levine
Robert Minogue
Victor Stello
William Dircks
Carlton Kammerer
ACRS

ENCLOSURE 1

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D.C. 20555

August 13, 1979

Honorable Joseph M. Hendrie
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: SHORT-TERM RECOMMENDATIONS OF TMI-2 LESSONS LEARNED TASK FORCE

Dear Dr. Hendrie:

During its 232nd meeting, August 9-11, 1979, the Advisory Committee on Reactor Safeguards completed a review of the short-term recommendations of the TMI-2 Lessons Learned Task Force as reported in NUREG-0578. These recommendations had been reviewed, in part, by an ACRS Subcommittee at a meeting in Washington, D.C., on July 27, 1979. During its review the Committee had the benefit of discussions with members of the Task Force. Comments from representatives of the nuclear industry were also considered.

In its review, the Committee has noted that the recommendations in NUREG-0578 are those deemed by the Task Force to be required in the short term to provide substantial additional protection for the public health and safety.

The Committee has considered both the recommendations themselves and the schedules proposed for their implementation. Regarding the latter, the Committee believes that the orderly and effective implementation and the appropriate level of review and approval by the NRC Staff will require a somewhat more flexible, and in some cases more extended, schedule than is implied by NUREG-0578.

With regard to the requirements themselves, the Committee agrees with the intent and substance of all except those discussed below.

2.1.5 Post-Accident Hydrogen Control Systems

a. The Committee agrees with the recommendations relating to dedicated penetrations for external recombiners or purge systems for operating plants that have such systems.

b. and c. The majority of the Task Force has recommended rule-making to require inerting of BWR Mark I and II reactors. A minority of the Task Force has recommended rule-making to require that all operating light water reactors provide the capability to use a hydrogen recombiner.

845012

7908220218

The Committee believes that questions relating to hydrogen generation during and following an accident, the rate and amount of generation, the need to control it, and the means of doing so, need to be reexamined. The Task Force has advised the Committee that it is considering this question further in connection with its longer-term recommendations which are scheduled to be completed by September, 1979. The ACRS believes that decisions concerning possible additional measures to deal with hydrogen should be deferred pending early evaluation of the forthcoming longer-term Task Force recommendations.

2.1.8 Instrumentation to Follow the Course of an Accident

With regard to instrumentation to follow the course of an accident, the ACRS believes that containment pressure, containment water level, and on-line monitoring of hydrogen concentration in the containment should also be considered for implementation for all operating reactors on the same schedule as that recommended by the Lessons Learned Task Force.

2.2.1.b Shift Technical Advisor

The Committee agrees completely with the two closely related objectives of this recommendation. One relates to the presence in the control room during off-normal events of an individual having technical and analytical capability and dedicated to concern for safety of the plant. The other relates to the need for an on-site, and perhaps dedicated, engineering staff to review and evaluate safety-related aspects of plant design and operation. The achievement of these objectives will contribute significantly to the safe operation of a plant.

The Committee believes that there may be difficulty in finding a sufficient number of people with the required qualifications and interest in shift work to fill the Technical Advisor positions. The Committee therefore believes the solution proposed by the Staff should not be mandatory but that alternate solutions also should be considered.

2.2.3 Revised Limiting Conditions for Operation

The Committee agrees with the findings of the Task Force that there are too many human or operational errors resulting in the defeat of an entire safety system, that the number of such occurrences should be and can be reduced, and that the ultimate responsibility for doing this must rest with the licensee.

The Committee, however, is not convinced that the Task Force proposal is the best or only way to increase the licensee's awareness of the need to improve operational reliability, and suggests that measures short of shutdown, such as a rule that requires actions similar to those of a show-cause order, may be equally effective.

Sincerely,

Max W. Carbon
Chairman

References:


1. NUREG-0578, "TMI-2 Lessons Learned Task Force Status Report and Short-Term Recommendations," Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, July 1979.
2. Letter, D. Knuth, President, KMC, Inc., to Harold Denton, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, August 8, 1979, Subject: TMI-2 Lessons Learned Task Force Report (NUREG-0578).
3. Letter, Stanley Ragone, President, Virginia Electric and Power Company, to Joseph M. Hendrie, Chairman, U.S. Nuclear Regulatory Commission, August 8, 1979, Subject: Lessons Learned Task Force on TMI-2, NUREG-0578.
4. Letter, Floyd W. Lewis, Chairman, Ad Hoc Nuclear Oversight Committee, to Harold R. Denton, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, August 1, 1979, Subject: Lessons Learned from TMI-2.
5. Letter, American Nuclear Society, ANS-3 Committee, to Joseph M. Hendrie, Chairman, U.S. Nuclear Regulatory Commission, August 2, 1979, Subject: Lessons Learned Task Force Status Report NUREG-0578.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

August 15, 1979

MEMORANDUM FOR: Chairman Hendrie

FROM: Raymond F. Fraley, Executive Director, ACRS

SUBJECT: ADDITIONAL REFERENCES TO ACRS LETTER ON SHORT-TERM RECOMMENDATIONS OF TMI-2 LESSONS LEARNED TASK FORCE DATED AUGUST 13, 1979

The attached revised Page 3 of the subject letter should be substituted for the one which was originally sent to you. This page incorporates additional references 6, 7, and 8.

Attachment:
Revised Page 3

cc:
Commissioner Gilinsky
Commissioner Kennedy
Commissioner Bradford
Commissioner Ahearne

849015

7908220221

need to improve operational reliability, and suggests that measures short of shutdown, such as a rule that requires actions similar to those of a show-cause order, may be equally effective.

Sincerely,

Max W. Carbon
Chairman

References:


1. NUREG-0578, "TMI-2 Lessons Learned Task Force Status Report and Short-Term Recommendations," Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, July 1979.
2. Letter, D. Knuth, President, KMC, Inc., to Harold Denton, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, August 8, 1979, Subject: TMI-2 Lessons Learned Task Force Report (NUREG-0578).
3. Letter, Stanley Ragone, President, Virginia Electric and Power Company, to Joseph M. Hendrie, Chairman, U.S. Nuclear Regulatory Commission, August 8, 1979, Subject: Lessons Learned Task Force on TMI-2, NUREG-0578.
4. Letter, Floyd W. Lewis, Chairman, Ad Hoc Nuclear Oversight Committee, to Harold R. Denton, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, August 1, 1979, Subject: Lessons Learned from TMI-2.
5. Letter, American Nuclear Society, ANS-3 Committee, to Joseph M. Hendrie, Chairman, U.S. Nuclear Regulatory Commission, August 2, 1979, Subject: Lessons Learned Task Force Status Report NUREG-0578.
6. Letter, Robert Szalay, Atomic Industrial Forum, Inc. (AIF), to Harold Denton, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, August 2, 1979, Subject: "TMI-2 Lessons Learned Task Force Status Report and Short-Term Recommendations," (NUREG-0578).
7. Report by the AIF Policy Committee on Follow-up to the Three Mile Island Accident, July 5, 1979.
8. Memorandum, C. G. Long, Lessons Learned Task Force Member, to R. J. Mattson, Director, TMI-2 Lessons Learned Task Force, July 30, 1979, Subject: Review of LERs for Loss of Safety Function Due to Personnel Error and Defective Procedures, (50-320).


84?016

REVISED

ENCLOSURE 2

## ALTERNATIVES TO SHIFT TECHNICAL ADVISORS

The recommendation by the Lessons Learned Task Force that an on-shift Technical Advisor be required at operating nuclear power plants has received much comment and attention by the ACRS and industry representatives since NUREG-0578 was published. Several alternative approaches have been suggested. The ACRS has advised and the Director of NRR has decided that alternatives be considered and approved if found by the staff to satisfactorily accomplish the functions described by the Task Force for the Shift Technical Advisor. As an aid to evaluating alternatives, a more comprehensive discussion of the purpose and basis of the Task Force recommendation is provided below. The discussion is in terms of the two principal functions intended to be accomplished and the characteristics thought to be necessary to effectively accomplish these functions. It is intended that the licensing review staff make use of this discussion in evaluating alternatives proposed by licensees and license applicants.

### Introduction

As stated in NUREG-0578, the Lessons Learned Task Force has concluded that the need for improved operations is the most important lesson learned from the accident at TMI-2. One key element so far identified is the need to improve the capability in the control room to recognize and diagnose unusual events. Over the next several years, improvements in the capability of the reactor operations staff to respond to unusual events can and will be sought through improvements in plant design, operating procedures and the qualification and training of operators. Improvements in plant design are expected to include improvements in the area of human factors, especially improvements in display and diagnostic systems available to aid operators. For example, the Task Force made a short term recommendation for improvement of the means of assessing inadequate core cooling. The Task Force also made short term recommendations for improvements in emergency procedures and preparations by the plant operations organization. The purpose of these recommendations is to assure that the operators and the onsite operational and technical support personnel are organized both administratively and physically in an effective manner. In addition, improvements in the licensing requirements for operators have been recommended to the Commission. Over the coming months, it is likely that further increases in qualification and training requirements for operators will be developed by the industry's recently announced Nuclear Operations Institute for implementation over the next several years. Because these changes are necessary but difficult to achieve rapidly, the Lessons Learned Task Force has recommended the use of Shift Technical Advisors as a method of immediately improving the operating staff capabilities for response to off normal conditions and for evaluating operating experience.

The consensus of the Task Force is that there are two necessary improvements in the capability to assess the status of a plant during unusual conditions such as a transient or an accident, to realize the significance of the available information such as instrument readings, and to take appropriate action. First, there should be an accident assessment capability based on a comprehensive education in engineering and science subjects related to nuclear power plant design and on training and experience in the dynamic response of the specific plant. This capability must be rapidly available in the control room in the event of an accident. Second, there should be a capability to maintain and upgrade safe plant operations through the cognizance and evaluation of applicable operating experience by an engineering group with diverse technical knowledge, experience, and perspective in relevant areas such as electrical, mechanical and fluid systems and human factors. The addition of Shift Technical Advisors to the plant operating staff is an acceptable means of supplying both of these functions. Alternative manning and organizational schemes will be considered and will be evaluated for satisfaction of the qualifications, training and duty assignment criteria discussed below.

## Discussion

In developing the recommendation for the Shift Technical Advisor, the Task Force concentrated on the two functions that needed to be provided, namely, an accident assessment function and an operating experience assessment function. The proper performance of these functions requires the provision of certain characteristics described in the following paragraphs.

### A. Accident Assessment Function

1. General Technical Education

The technical education of at least one person in the control room under off normal conditions should include basic subjects in engineering and science. The purpose of this education is to aid the operator in assessing unusual situations not explicitly covered in the current operator training. The following is a tentative list of areas of knowledge that are considered to be desirable:

Mathematics, including elementary calculus

Reactor physics, chemistry and materials

Reactor thermodynamics, fluid mechanics, and heat transfer

Electrical engineering, including reactor control theory

These areas of knowledge should be taught at the college level and would be equivalent to about 60 semester hours. Although a college graduate engineer would have many of these subjects and more that would not be essential, some engineers might be deficient in a few of these specific areas, e.g., reactor physics. Although the time to teach these subjects to a licensed senior reactor operator could be as short as two years, depending on the scope and content of the subjects, the selection of a graduate engineer would likely be a more rapid means of fulfilling this characteristic.

2. Reactor Operations Training

All persons assigned to duties in the control room should be trained in the details of the design, function, arrangement and operation of the plant systems. This training is necessary to assure that the meaning and significance of instrument readings and the effect of control actions are known. A licensed operator or supervisor of an operator would not be required to have further training in order to fulfill this characteristic. A graduate engineer not previously licensed or trained as an operator or senior operator would require additional training in order to fulfill this characteristic.

3. Transient and Accident REsponse Training

In addition to the training in normal operations, anticipated transients, and accidents presently required of operators and senior operators, one person in the control room under off normal conditions should be trained to recognize and react to a wide range of unusual situations including multiple equipment failures and operator errors. This training should not be limited to written procedures or specific accident scenarios, but should include the recognition of symptoms of accident conditions such as complex transient responses or inadequate core cooling and possible corrective actions. The purpose of this training is to broaden the ability for prompt recognition of and response to unusual events, not to modify the instinctive, rapid procedural response to transients and accidents provided by reactor operators. The training is required in recognition of the fact that real accidents inherently are initiated and accompanied by unusual and unexpected events. The training is also to emphasize need to focus on the essential parameters that indicate the status of the core and the primary coolant boundary. This additional training would take up to a year to accomplish for a person not already experienced in nuclear plant transient and accident analysis or evaluation. Both inexperienced graduate engineers and currently licensed operators would require additional training to fulfill this characteristic.

4. Detachment from Operations

The plant response assessment function requires a measure of detachment from the manipulation of controls or immediate supervision of operators. This is intended to provide the perspective and the time for assessing plant conditions and advising on appropriate operator actions. It has been called a safety monitor characteristic. Currently only three operators would normally be in the control room at the time an unusual event occurred, and it is allowed that at times there would be fewer. This number is only enough to satisfy the demands for prompt control and supervisory actions under off normal conditions. The time necessary to make a considered assessment and permit independent monitoring of plant safety require one more person in the form of the Shift Technical Advisor or some alternative in the control room.

5. Independence from Operations

In order to provide both perspective in assessment of plant conditions and dedication to the safety of the plant, this function should have a clear measure of independence from duties associated with the commercial operation of the plant. In an accident situation where command authority should not be diluted, complete independence is not desirable and is not necessary to the safety assessment function.

6. Availability

This capability should be readily available in the control room, preferably immediately at all times, but at most within ten minutes. Having this capability on duty for each shift is the best approach.

B. Operating Experience Assessment Function

1. Independence from Operations

A measure of independence is required to provide for effective safety monitoring of operating experience at the individual plant and at plants of like design. The assessment of operating experience at the assigned plant and other similar plants and the routine monitoring of the safety of plant operations is usually compatible with and necessary for efficient operations. However, the demands of commercial operation can sometimes distract from or appear to override safety judgments. An independent monitoring of the safety of plant operations is intended to counter-balance the immediate and pressing needs of commercial operation.

2. Dedication

Personnel should be dedicated to the function of safety monitoring of operating experience as their primary responsibility and duty. Although reactor operating personnel have a commitment to safety that derives from self interest as well as regulatory requirements, it is only one of two primary responsibilities the other being the continuous production of power. The assignment of safety evaluation of operating experience as a primary responsibility for certain specified individuals will reduce potential conflicts and assure adequate time to discharge the duties.

3. Diversity of Technical Knowledge

The technical knowledge of those assessing operating experience should be diverse and encompass all technical areas important to safety. The types of problems that can affect safety include all areas related to the design and operation of nuclear power plants; e.g., mechanical, electrical and fluid systems and reactor physics, chemistry and metallurgy. Recognition and understanding of a problem and its significance requires some knowledge in the relevant technical specialities and cannot depend solely on the descriptions and judgements of the persons identifying and reporting the problem. Because of the broad scope of possible technical areas and the possible interactions of components, equipment and systems, the people engaged in operating experience review should have experience in areas usually designated as systems engineering. They should also be graduate engineers, or equivalent. In addition, because of the importance of operator actions in the safety of plant operations, familiarity with or routine access to persons with the principles of human engineering or human factors should be provided.

<u>Alternatives</u>

As discussed in NUREG-0578, several alternative means of providing the accident assessment function were considered by the Lessons Learned Task Force. They were:

1. Upgrade the requirements for reactor operators and senior reactor operators to include more engineering and plant response training.
2. Provide additional on-shift personnel with science or engineering training and specific traning in plant design and response.
3. Provide on-call assistance to the control room by identified personnel in the plant engineering organization having the training described in alternative 2.

Although the Task Force initially assumed that the accident assessment function would be combined with the operating experience assessment function, it is possible that the two functions could be separated. Some have suggested that people with the education, training, and experience required for both the operating experience assessment function and the safety monitoring function would be more easily obtained and retained if not required to work on shift. Others believe that such people can be retained if sufficient incentives are provided. The advantages and disadvantages of these alternatives are discussed below. Although no alternative other than a group of dedicated Shift Technical Advisors has so far been found acceptable, it is possible that innovative improvements in the other alternatives could be found acceptable.

Discussion of Alternatives

1. Upgrade the training and qualifications of the senior reactor operator. This alternative would require no change in the present number or organization of control room operators. The debilitating feature of this alternative is that the senior operator would be busy directing the reactor operators or taking actions himself during an accident and not have sufficient time or perspective to make the desired assessment of plant conditions; i.e., perform the safety monitor function. This arrangement would also not provide a clear independence from commercial operation. However, the capability would be readily available when needed. It is unrealistic to expect the senior operator to fulfill the operating experience assessment function. A separate group could be established to accomplish that function on the day shift when interaction with offsite experts and utility management would be enhanced. If schemes are proposed to accomplish the two functions separately, then they should include mechanisms

for sufficient coupling of the two to assure continuous feedback of and ready access to the knowledge being acquired in operating experience evaluation.

2. Additional on-shift personnel

This alternative would require the addition of one person to the on-shift control room staff. If the person is to be a Shift Technical Advisor, no license would be required, thus making the position easier to fill quickly. However, detachment from first-line commercial operations decisions can be attained by either a line or advisory position. For example, instead of the Shift Technical Advisor proposed by the Task Force, there may be acceptable methods of using a Shift Engineer, who normally has authority over a Shift Supervisor, to perform the accident assessment function. Either approach would utilize people on shift so they would be readily available. Since the Shift Engineer would have normal duties other than operating experience assessment, a separate day shift group would be required to fulfill that function if the shift engineer was found to be an acceptable source of the accident assessment (safety monitor) function.

3. On-call assistance

This alternative would require no additional on-shift personnel. Others have susggested that provision of the recommended technical education and training would be most easily accomplished with this alternative since degreed engineers with intimate knowledge of the plant design basis and accident response characteristics are available in the utility technical staff. Since these personnel would be remote from the control room, a requirement to be licensed does not appear to be consistent. Knowledge of accident response might also be more easily found among vendor personnel who have extensive experience in accident analysis and systems design. This alternative also provides detachment from actual operation and some independence from commercial operation. However, these people would not be readily available when needed. The use of utility or vendor personnel not at the site would increase the difficulties of communication. Although there is need for backup assistance from these other organizations, it is doubtful that they would be able to provide for the prompt response needs of the accident assessment function and they do not have sufficient plant unique experience and familiarity to satisfy the operating experience assessment function.

# Instrumentation to Monitor Containment Conditions During the Course of an Accident

## 1. INTRODUCTION

General Design Criterion 13, "Instrumentation and Control," of Appendix A to 10 CFR 50, requires instrumentation to monitor variables "for accident conditions ... including containment and associated systems." Specific requirements are included in Standard Review Plan Section 6.2.5, "Combustible Gas Control in Containment," for the capability to monitor hydrogen concentration in the containment atmosphere. Instrumentation to sense or monitor containment conditions already exists to some degree (e.g., automatic containment isolation on high containment pressure at TMI-2). However, it is clear that all information necessary to assess the response of the containment to the accident conditions at TMI-2 was not available to the operator.

It has been the contention of some applicants that General Design Criterion 13 applies to only those accidents listed in Chapter 15 of Regulatory Guide 1.70. Again, based on conditions experienced at Three Mile Island, it is clear that situations can arise which produce containment conditions beyond those postulated for the Chapter 15 events.

## 2. DISCUSSION

Approximately 10 hours after the start of the accident at TMI-2, a 28-psig pressure spike occurred in the containment building. Although it is now believed that the pressure spike was due to the rapid burning of hydrogen gas in the containment atmosphere, the staff on duty in the control room apparently did not attach any special significance to the pressure spike at the time. At the time of the occurrence, the plant staff attributed the event to various causes, including electrical problems and relief valve opening. It is now known that the pressure spike represented a much more serious condition within containment and the pressure indication itself could have been, but was not then accepted as, critical information to the plant operators. The events at Three Mile Island clearly reaffirm the need for containment pressure indication in the control room. Furthermore, it is clearly cost effective and necessary that the instrumentation range include the expected failure level for the containment.

The sequence of events during the accident at Three Mile Island indicate a second item of information which could have been, but was not immediately accepted as, critical information in the diagnosis of the accident. This information was the free liquid inventory in the containment building. During the accident, reactor coolant drain tank quench water and primary coolant water vented through the drain tank relief valve and flowed to the reactor building sump. Water within the containment sump was then discharged to the auxiliary building sump tank and thus resulted in some transfer of radioactive material outside of the containment building. Because sump pump operation was expected several times a day before the accident due to routine accumulation, the transfer process was not recognized as an indication of contaminated water in containment. Furthermore, the accumulation of water in the TMI-2 containment probably contributed to equipment failure due to flooding. The events clearly establish a need for accurate containment water level indication in the control room, with instrument ranges which include accident flooding levels.

The third item of information which was subsequently considered to be of critical importance in determining containment conditions at TMI-2 was the hydrogen concentration in the containment atmosphere. The hydrogen gas was produced as a result of the reaction of zirconium metal and primary coolant water in the reactor core. The gas was vented, to some extent, from the reactor coolant system to the containment atmosphere. The free hydrogen in containment further resulted in a rapid burn and pressure spike event in the containment. Samples of containment atmosphere were taken following the accident at Three Mile Island, but the process involved some risk to workers and did not yield real-time information. The events clearly show a need for such information on a continuous basis following an accident. It is essential that the operator have continuous information as to the hydrogen concentration for an indication of the need and use of reactor pressure vessel venting or containment combustible gas control systems.

It is concluded that containment pressure, containment water level, and continuous indication of hydrogen concentration in the containment atmosphere will provide critical information to the operator on containment conditions during and following an accident. These parameters should be provided in the control room of all reactor power plants.

We further note that an effort is currently underway to revise Regulatory Guide 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident." The revision will include additional parameters that should be provided to the operator in order to assess plant conditions during the course of an accident. The list of parameters will take into account all recommendations, including those from the nuclear industry and the public, and will supplement those itmes recommended by the TMI-2 Lessons Learned Task Force.

3. POSITION

Consistent with satisfying the requirements set forth in General Design Criterion 13 to provide the capability in the control room to ascertain containment conditions during the course of an accident, the following requirements shall be implemented:

(1) A continuous indication of containment pressure shall be provided in the control room. Measurement and indication capability

shall include three times the design pressure of the containment for concrete,

four times the design pressure for steel, and minus five psig for all containments.

(2) A continuous indication of hydrogen concentration in the containment atmosphere shall be provided in the control room. Measurement capability shall be provided over the range of 0 to 10% hydrogen concentration under both positive and negative ambient pressure.

(3) A continuous indication of containment water level shall be provided in the control room for all plants. A narrow range instrument shall be provided for PWRs and cover the range from the bottom to the top of the containment sump. Also for PWRs, a wide range instrument shall be provided and cover the range from the bottom of the containment to the elevation equivalent to a 500,000 gallon capacity. For BWRs, a wide range instrument shall be provided and cover the range from the bottom to 5 feet above the normal water level of the suppression pool.

The containment pressure, hydrogen concentration and wide range containment water level measurements shall meet the design and qualification provisions of Regulatory Guide 1.97, including qualification, redundancy, and testibility. The narrow range containment water level measurement instrumentation shall be qualified to meet the requirements of Regulatory Guide 1.89 and shall be capable of being periodically tested.

ENCLOSURE 4

# INSTALLATION OF REMOTELY OPERATED HIGH POINT VENTS IN THE REACTOR COOLANT SYSTEM

## 1.0 Introduction

10 CFR Part 50.46 requires that after any calculated successful initial operation of the ECCS, the calculated core temperature shall be maintained at an acceptably low value and decay heat shall be removed for the extented period of time required by the long-lived radioactivity remaining in the core. Additionally, Criterion 35 of 10 CFR Part 50 Appendix A requires that a system to provide abundant emergency core cooling shall be provided. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) metal-water reaction is limited to negligible amounts.

During the TMI-2 accident, a condition of low water level in the reactor vessel and inadequate core cooling existed and was not rectified for a long period of time. The resultant high core temperatures produced a metal-water reaction with the subsequent production of significant amounts of hydrogen. The collection of noncondensable gases impaired natural circulation cooling capability. Additionally, the collection of noncondensable gases limited reactor coolant pump operational capability because of coolant voids in the system occupied by the gases. Even when reactor coolant pump operation was possible, the installed plant venting system was capable of removing the non-condensable gases only through an extremely slow process.

The purpose of this recommendation is to provide reactor coolant system and reactor vessel head high point vents remotely operated from the control room for the purpose of removing noncondensable gases collected in the system in order to allow satisfactory long-term core cooling.

## 2.0 Discussion

The collection of noncondensable gases in the reactor coolant system at TMI-2 significantly degraded natural circulation cooling capability. There is indication that tnese gases were predominantly hydrogen and collected at high points in the pressurizer, in the reactor vessel dome, and in the reactor coolant system piping. For other accident sequences, in addition to hydrogen generated by metal water reaction, other noncondensible gases could be of concern. For example, nitrogen is available from PWR accumulators, and helium or other fill gases and fission gases are available from ruptured fuel elements.

Venting of the reactor coolant system was accomplished at TMI-2 through the vent located at the top of the pressurizer, and to some degree through the makeup tank. Neither of these paths provided expeditious venting capability unless the reactor coolant pumps were operational. Reactor coolant pump operation permitted the degassification of reactor coolant through the pressurizer spray in the steam space. As noncondensable gases were collected in the steam space of the pressurizer, they were vented through the vent located at the top of the pressurizer. The reactor coolant pumps provided forced circulation and aided in the dispersion of the noncondensable gases throughout the reactor coolant such that the flow through the makeup tank provided another vent path. Reactor coolant pump operation was not possible for a significant period of time, however, due to voids in the reactor coolant system. These voids were probably the result of noncondensable gases as well as steam voids. Even when the reactor coolant pumps were operational, this rather slow method of venting prevented a more orderly plant cooldown.

Since continued reactor coolant pump operation cannot be assumed during transients or accidents, tha capability for natural circulation cooling must in PWRs must be maintained. The addition of remotely operated high point reactor coolant system and reactor vessel head vents is, therefore, required so that the accumulation of non-condensable gases does not impair natural circulation capability. It is recognized that BWRs provide venting capability through the use of the Automatic Depressurization System (ADS). The requirements below are applicable for BWRs as well as PWRs in order to demonstrate the adequacy of any currently installed venting capability.

3.0 Position

Each applicant and licensee shall install reactor coolant system and reactor vessel head high point vents remotely operated from the control room. Since these vents form a part of the reactor coolant pressure boundary, the design of the vents shall conform to the requirements of Appendix A to 10 CFR Part 50 General Design Criteria. In particular, these vents shall be safety grade, and shall satisfy the single failure criterion and the requirements of IEEE-279 in order to ensure a low probability of inadvertent actuation.

Eash applicant and licensee shall provide the following information concerning the design and operation of these high point vents:

1. A description of the construction, location, size, and power supply for the vents along with results of analyses of loss-of-coolant accidents initiated by a break in the vent pipe. The results of the analyses should be demonstrated to be acceptable in accordance with the acceptance criteria of 10 CFR 50.46.
2. Analyses demonstrating that the direct venting of noncondensable gases with perhaps high hydrogen concentrations does not result in violation of combustible gas concentration limits in containment as described in 10 CFR Part 50.44, Regulatory Guide 1.7 (Rev. 1), and Standard Review Plan Section 6.2.5.

3. Procedural guidelines for the operators' use of the vents. The information available to the operator for initiating or terminating vent usage shall be discussed.

ENCLOSURE 5

NUREG-0578 ERRATA

1. Section 2.1.5.a, page A-16, fifth line from bottom of page:

Change to read, ". . . 25,000 SCFM (Standard Cubic Feet per Minute). . ."

Reason: Editorial change.

2. Section 2.1.5.b, page A-20, first line at top of page:

Change to read, "However, as an interim measure pending the comprehensive longer term review which must be done in this regard, it is prudent to require inerting . . ."

Reason: Clarify intent.

3. Table A-1, page A-25, column entitled "BWRS":

Delete "Shoreham(OL)"

Reason: Plant has recombiners.

4. Section 2.1.6.b, page A-28:

Change title to read, "Design Review of Plant Shielding and Environmental Qualification of Equipment for Spaces/Systems Which May Be Used in Post Accident Operations."

Reason: To more clearly reflect that degradation of safety equipment by radiation during post-accident operation is also a principal concern addressed in this section.

5. Section 2.1.6.b, page A-28, fourth line from bottom of page:

Following "Regulatory Guides 1.3 and 1.4" add "(i.e., the equivalent of 50% of the core radioiodine and 100% of the core noble gas inventory are contained in the primary coolant), . . ."

Reason: Clarify intent.

8410027

6. Section 2.1.8.b, page A-39, paragraph 1.b:

Change to read, "Noble gas effluent monitoring shall be provided for the total range of concentration extending from normal condition (ALARA) concentrations to a maximum of $10^5$ Ci/cc (Xe-133). Multiple monitors are considered to be necessary to cover the ranges of interest. The range capacity of individual monitors should overlap by a factor of ten."

Reason: To better reflect the intent of the Task Force and practical considerations regarding current state-of-the-art for low concentration effluent monitoring.

7. Section 2.1.8.c, page A-41, "Position" paragraph at bottom of page:

Change to read, "Each licensee shall provide equipment and associated training and procedures for accurately determining the airborne iodine concentration in areas within the facility where plant personnel may be present during an accident."

8. Section 2.2.1.b, page A-49, subparagraph 3 under DISCUSSION:

Delete the word "and" between "identified" (in the first line of the sentence) and "personnel" (in the second line of the sentence).

Reason: Typographical error.

9. Section 2.2.2.b, page A-58, second paragraph of position statement:

Change to read, "Records that pertain to the as-built conditions and layout of structures, systems and components shall be stored and filed at the site and accessible to the technical support center under emergency conditions. Examples of such records include system descriptions, general arrangement drawings, piping and instrument diagrams, piping system isometrics, electrical schematics, wire and cable lists,

849038

and single line electrical diagrams. It is not the intent that all records described in ANSI N45.2.9-1974 be stored and filed at the site and accessible to the technical support center under emergency conditions; however, as stated in that standard, storage systems shall provide for accurate retrieval of all pertinent information without undue delay."

10. Table B-1, page B-2, footnote (b):

Change ". . . after July 1, 1982" to ". . . after July 1, 1981."

Reason: Typographical error.

11. Table B-1, page B-4, item 2.1.8.b:

Change abbreviated title from "High Range Effluent Monitor" to "High Range Radiation Monitors."

Reason: Editorial correction to make title consistent with that used in referenced discussion section.

12. Table B-1, page B-5, item relating to Section 2.2.1.b:

Change abbreviated title from "Shift Safety Engineer" to "Shift Technical Advisor."

Reason: Editorial correction to make title consistent with that used in referenced discussion section.

13. Table B-1, footnote a, on pages B-2, B-3, B-4, and B-5:

Add the words, ", whichever is later." after "or prior to OL."

Reason: Clarify intent.

ENCLOSURE 6

IMPLEMENTATION OF REQUIREMENTS FOR
OPERATING PLANTS AND PLANTS IN OL REVIEW

| | Position | | |
|---|---|---|---|
| Sect. No. | Abbreviated Title | Position Description | Implementation Category[a] |
| 2.1.1 | Emergency Power Supply Requirement | Complete implementation. | A |
| 2.1.2 | Relief and Safety Valve Testing | Submit program description and schedule. | A |
| | | Complete test program. | By July 1981[b] |
| 2.1.3.a | Direct Indication of Valve Position | Complete implementation. | A |
| 2.1.3.b | Instrumentation for Inadequate Core Cooling | Develop procedures and describe existing inst. | A |
| | | New level instrument design submitted. | A |
| | | Subcooling meter installed. | A |
| | | New level instrument installed. | B |
| 2.1.4 | Diverse Containment Isolation | Complete implementation. | A |
| 2.1.5.a | Dedicated $H_2$ Control Penetrations | Description and implementation schedule. | A |
| | | Complete installation. | B |

[a]Category A: Implementation complete by January 1, 1980, or piror to OL, whichever is later
Category B: Implementation complete by January 1, 1981

[b]Relief and safety valve testing shall be satisfactorily completed for all plants prior to receiving an operating license after July 1, 1981.

845040

IMPLEMENTATION TABLE (Continued)

| Sect. No. | Position: Abbreviated Title | Position: Position Description | Implementation Category[a] |
|---|---|---|---|
| 2.1.5.c | Recombiners | Review procedures and bases for recombiner use. | A |
| 2.1.6.a | Systems Integrity for High Radioactivity | Immediate leak reduction program. | A |
| | | Preventive maintenance program. | A |
| 2.1.6.b | Plant Shielding Review | Complete the design review. | A |
| | | Implement plant modifications. | B |

[a]Category A: Implementation complete by January 1, 1980, or prior to OL, whichever is later.
Category B: Implementation complete by January 1, 1981

IMPLEMENTATION TABLE (Continued)

| Sect. No. | Position: Abbreviated Title | Position: Position Description | Implementation Category[a] |
|---|---|---|---|
| 2.1.7.a | Auto Initiation of Auxiliary Feed | Complete implementation of control grade. | A |
| | | Complete implementation of safety grade | B |
| 2.1.7.b | Auxiliary Feed Flow Indication | Complete implementation | A |
| 2.1.8.a | Post Accident Sampling | Design review complete. | A |
| | | Preparation of revised procedures. | A |
| | | Implement plant modifications. | B |
| | | Description of proposed modification. | A |
| 2.1.8.b | High Range Radiation Monitors | Installation complete. | B |
| 2.1.8.c | Improved Iodine Instrumentation | Complete implementation | A |
| 2.1.9 | Transient & Accident Analysis | Complete analyses, procedures and training | ** |
| | Containment Pressure Monitor | Installation complete | B |
| | Containment Water Level Monitor | Installation complete | B |
| | Containment Hydrogen Monitor | Installation complete | B |
| | RCS Venting | Design submitted | A |
| | | Installation complete | B |

[a]Category A: Implementation complete by January 1, 1980, or prior to OL, whichever is later.
Category B: Implementation complete by January 1, 1981.

**Analyses, procedural changes, and operating training shall be provided by all operating plant licensees and applicants for operating licenses following the attached schedule.

IMPLEMENTATION TABLE (Continued)

| Sect. No. | Position: Abbreviated Title | Position: Position Description | Implementation Category[a] |
|---|---|---|---|
| 2.2.1.a | Shift Supervisor Responsibilities | Complete implementation. | A |
| 2.2.1.b | Shift Technical Advisor | Shift technical advisor on duty. | A |
| | | Complete training. | B |
| 2.2.1.c | Shift Turnover Procedures | Complete implementation. | A |
| 2.2.2.a | Control Room Access Control | Complete implementation | A |
| 2.2.2.b | Onsite Technical Support Center | Establish center. | A |
| 2.2.2.c | Onsite Operational Support Center | Complete implementation | A |

[a]Category A: Implementation complete by January 1, 1980, or prior to OL, whichever is later.
Category B: Implementation complete by January 1, 1981.

## ANALYSIS AND TRAINING SCHEDULE

| Task Description | Completion Date |
|---|---|
| 1. Small Break LOCA analysis and preparation of emergency procedure guidelines | July-September 1979* |
| 2. Implementation of small break LOCA emergency procedures and retraining of operators | December 31, 1979 |
| 3. Analysis of inadequate core cooling and preparation of emergency procedure guidelines | October 1979 |
| 4. Implementation of emergency procedures and retraining related to inadequate core cooling | January 1980 |
| 5. Analysis of accidents and transients and preparation of emergency procedure guidelines | Early 1980 |
| 6. Implementation of emergency procedures and retraining related to accidents and trainsients | 3 months after guidelines established |
| 7. Analysis of LOFT small break tests | Pretest (Mid-September 1979) |

*Range covers completion dates for the four NSSS vendors