Testimony of Anthony Z. Roisman,
Staff Attorney, Natural Resources Defense Council, Inc.,*
Before the
President's Commission on the Accident at
Three Mile Island

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* The Natural Resources Defense Council, Inc., is a national, nonprofit, tax-exempt environmental organization dedicated to the conservation and wise use of our natural resources. NRDC has approximately 45,000 members.

> The environmental radioactivity monitoring program of the Applicants is inadequate to accurately measure the dose delivered to the public during normal and accident conditions.
>
> The warning and evacuation plans of the Applicants and the Commonwealth of Pennsylvania are inadequate and unworkable. . . . No operating and evacuation plans are shown to be workable through live tests.

These statements were made with reference to Three Mile Island Unit 2. They were not made by the Nuclear Regulatory Commission or any other entity investigating the accident at Three Mile Island. They were not made after March 28, 1979. They were made in 1974 by the York Committee for a Safe Environment and Citizens for a Safe Environment, joint intervenors in the operating license proceeding for the TMI-2 reactor. Both contentions were rejected as unsupportable. We now know how very wrong those conclusions were, but we do not know why. It should be the responsibility of this Commission to answer that question.

Every nuclear plant now licensed to operate has been subjected to an extensive review process consisting of a comprehensive safety review by the Advisory Committee on Reactor Safeguards, the NRC Regulatory Staff, the Atomic Safety and Licensing Board and the Atomic Safety and Licensing Appeal Board prior to issuance of a construction permit, and, in the case of a contested operating license proceeding such as TMI-2, all four of these entities conducted a second

review. This process is the heart of the regulation of nuclear power and provides the only assurance to the public that if a nuclear plant is built and operated there is reasonable assurance of adequate protection for the public health and safety. The TMI-2 accident is dramatic evidence that this process is a total failure. Not only were specific problems now recognized as real rejected as unsubstantiated challenges to the plant, but the principal design and operational defects in the reactor itself were totally ignored.

This failure of the regulatory process to detect and correct significant flaws in the design, construction and opeartion of nuclear plants is in no way limited to TMI-2. The same failures of process are equally applicable to all nuclear plants, as can be seen from the near disastrous fire at the Brown's Ferry nuclear plant, the absence of an Emergency Core Cooling System for plants such as Indian Point Unit 1 (265 Mwe), the inadequate earthquake design approved for the construction of the Diablo Canyon plant, the sloppy procedures to prevent worker exposures to radiation at the Kerr-McGee plutonium facility in Oklahoma, and the West Valley Reprocessing Plant; and the list could continue. A prime function of this Commission should be to uncover the reasons behind the regulatory inadequacies of the Nuclear Regulatory Commission. The regulatory history of TMI-2 provides some valuable clues.

First, we should focus on the two issues which were raised and rejected -- the inadequacy of radiological monitoring in the event of an accident and the inadequacy of emergency planning.

In addressing radiation monitoring, the intervenors focussed on the absence of active, real-time detectors to determine dose. The contention was rejected based on the testimony of witnesses offered by the Regulatory Staff and the Applicant with the ASLB making the following finding (Metropolitan Edison (Three Mile Island Unit 2) LBP-77-70, 6 NRC 1185, 1201-02 (December 19, 1977)):

> With respect to off-normal conditions that might justify the evacuation of members of the public within the low population zone, testimony was offered to the effect that the environmental monitoring program is not intended for use in formulating nor in implementing evacuation plans. With respect to the ability of active, real-time detectors to aid in evacuation plans, such detectors would again be of little or no value. Instrumentation used to determine the severity of an accident, and the need for any offsite emergency action, is located on site and is monitored from the reactor control room. This instrumentation monitors area conditions and process variables such as the reactor coolant temperature and pressure and any abnormal release of radioactivity. In the event that accident conditions arose for which evacuation would be an effective protective measure, necessary measurements and corrective actions to mitigate the consequences, including notification of offsite emergency personnel, would be performed quickly, within 10-15 minutes of the incident. It would, therefore, be unlikely that any offsite active detectors would register any abnormal reading since no release from the containment would as yet have occurred. Only after some period

> of time (to allow the release and transport of radiation emitters) would the detectors be of any use, and even then they would add nothing to the information that the previously dispatched offsite survey teams would not already have gathered.

Significantly, the intervenors offerred no extensive expert testimony on the issue. Equally significantly, the ASLB focussed its inquiry on the advantages of the additional monitoring equipment and not on the adequacy of the existing monitoring system. Not surprisingly, the adequacy of radiation monitoring was not adequately addressed because the only parties with resources sufficient to make their case were advocates of the issuance of the license and the ASLB limited the focus of its inquiry to those issues raised by a party and not corollaries to those issues.

In a post-TMI-2 accident analysis prepared by the Office of Inspection and Enforcement of the NRC (NUREG-0600), in contradiction to the findings of the ASLB, they found the following (Id., pp. 13, 14):

> Less than half of the portable radiation survey instruments were operational. Several installed area radiation monitors and airborne radioactivity monitors, which were not essential for normal operations, but would have been useful during the emergency, were out of service for repair.
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> . . . .
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> Subsequently, there were several radiation monitor alarms indicative of an emergency situation, but no emergency was declared.

It is no answer to the problem exemplified by TMI-2 to require that better and more reliable off-site monitoring be provided

and to provide that public notification of an off-site emergency occur within 10-15 minutes of the initiating event. That is obviously closing the barn door after the horse has escaped.

Before attempting to draw any conclusions from this first example of the breakdown of the regulatory process, let us turn to the second rejected intervenor contention based on the inadequacy of emergency plans. Here the intervenor focussed on the need for real training for state and local officials and the public. In response the Applicant, the Regulatory Staff and the Commonwealth of Pennsylvania produced witnesses to prove that Pennsylvania in general and the Dauphin County Civil Defense in particular had responded promptly to non-radiological emergencies without real drills, that in combination with the Applicant all necessary monitoring and warning of the public would be accomplished in sufficient time to have an orderly evacuation without drills, and that the public would respond better to the evacuation order if they had not been drilled because, according to a Staff witness (Metropolitan Edison (Three Mile Island Unit 2), ALAB-486, 8 NRC 9, 17 (July 19, 1978)):

> "the general population reacts more readily, fears more readily things which it knows nothing about" (Tr. 1352); and that, when confronted with such an event, a person "generally responds to people who tell him what to do to protect his health. . . . It is the fear of the unknown that makes [people] act"(ibid.).

In the face of this testimony, the ASLB concluded that (LBP-77-70, supra, 6 NRC at 1204, 1205-06):

> We see no need to recite here -- as do the proposed findings of the Applicants, the Commonwealth, and the Staff -- those uncontradicted, descriptive characteristics of the Applicants' state of preparedness, nor that of the cooperating state and local agencies upon whom the success of th emergency plans depend. We find these to be adequate.
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> . . . .
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> Examination by the Intervenors and the Board cast no doubt upon the adequacy of the communications equipment and the various modes of communication. The Board finds these matters to be satisfactory.
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> Furthermore, the Staff's witness observed that the Applicants' monitoring capability outside the LPZ would be more than adequate until such time as subsequent or supplemental monitoring teams would be available to the Commonwealth. Indeed, the NRC regional office itself could provide up to 20 additional inspectors, in addition to other teams from Brookhaven Laboratory and radiological teams from western Pennsylvania (Tr. 1306-1309).
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> . . . .
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> The Commonwealth's civil defense witnesses saw no compromise of their own effectiveness of response because of their not having technical knowledge and training concerning radiological matters. Staff witnesses testified that the Commonwealth's BRH possessed the requisite radiological know-how needed to assist with protection of the public health and safety. The Board finds that the evidence adequately supports the conclusion that the effectiveness of state and local officials will not be hampered by not having had technical training in radiological matters.
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> More broadly, we find that the record supports the conclusion that Contention 8, in its entirety, is without merit, and that the Staff

> has properly assessed the adequacy and workability of the emergency response. We also find the emergency and evacuation plans to be both adequate and workable.

These findings must be viewed in light of the following additional finding by the Board (LBP-77-70, supra, 6 NRC at 1203):

> The joint Intervenors presented no prefiled testimony, . . .

It was not surprising that the record supported the rejection of the intervenors' contention when the only evidence offerred was from those who opposed the contention.

When the evacuation planning issue was addressed by the Appeal Board, it confirmed the evidentiary deficiency in the intervenors' case and raised at least three additional roadblocks to a thorough exploration of the issue. First, it found that evidence newly discovered by the intervenors which might shake the credibility of Commonwealth witnesses was not admissible because it was based on a two-year-old publication and could have been explored in the hearing if the intervenor had pressed the issue further when a witness they sought from the Commonwealth initially refused to appear; second, it found that (ALAB-486, supra 8 NRC at 23):

> existing Commission regualtions do not require consideration in a licensing proceeding of "the feasibility of devising an emergency plan for the protection (in the event of an accident) of persons located outside of the low population zone[;]"

and, third, it found that (id.):

> the requirements for evacuation planning are rooted in 10 CFR Part 100, and that Part 100 assumes releases of radiation based upon a hypothetical major accident "that would result in potential hazards not exceeded by those from any accident considered credible." Thus, what accidents might conceivably occur at the particular plant in question is irrelevant to planning for emergency evacuation; that is based solely on the Part 100 hypothetical accident and the assumed releases of radioactivity resulting therefrom.

In its report, the Office of Inspection and Enforcement found (NUREG-0600 at pp. 5, 11-12, 13, 19, 20):

> At approximately 2-1/2 hours into the accident, substantial fractions of the reactor core were uncovered and had experienced sustained high temperatures. This condition would be expected to result in fuel damage, substantial releases of core fission products, and hydrogen generation. The magnitude of these conditions were [sic] not recognized by the plant staff.
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> . . . .
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> The provision of substantive technical support to the management team directing emergency actions on operational matters suffered primarily as a result of communication difficulties. This was evidenced in three ways:
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> - Information (both data and plans) transmitted to offsite support, which had been hurriedly mobilized, suffered from time delays. Thus, the offsite groups were dealing with historical and limited data.
> - The individuals who had to provide data to offsite groups had concurrent duties pertaining to the management of the emergency. The emergency duties always took precedence as would be appropriate.
> - The physical communications facilities were inadequate to handle the volume of information requests and transmittals that this kind of accident required.

The investigation has concluded that these communication problems are related to the misconception that the envelope of the analyzed major accidents for this facility are the limiting events. The duration of these analyzed events are projected to occur in a relatively short time frame. The provision of the mechanisms needed to mobilize and communicate with substantial offsite technical support on a real-time basis as an accident progresses had, therefore, not been warranted as a part of emergency planning.

. . . .

However, some workers who would comprise Emergency Repair Party Teams and Radiological Monitoring Teams had not received adequate training in use of emergency survey instrumentation and in radiation protection procedures. Routine retraining of radiation/chemistry technicians was not up to date. While radiation protection training of the plant staff had been sufficient to maintain personnel radiation exposures within limits during normal operations (when radiation levels were low), it had not prepared workers to cope with the high radiation levels that would soon exist inside the Unit 2 auxiliary and fuel handling buildings.

. . . .

Prior to and during the emergency, the licensee performed his own onsite personnel dosimetry program. No one individual was assigned programmatic responsibility for this program. During the incident, some radiation/chemistry technicians processed their own TLD badges. Beginning March 29, one radiation/chemistry technician, who had not operated the system in over a year, worked without procedures for over 40 continuous hours.

. . . .

In general, the licensee's onsite and offsite survey teams performed surveys in appropriate areas at appropriate times. However, during a five and one-half hour period from 1700 hrs to 2238 hrs on March 28 and a two-hour period from 0340 to 0540 on March 29, no offsite surveys were performed in the plume. Both of these periods of time were within the interval when the majority of the noble gases were released and when a plume was well defined because of sufficient wind speed and almost constant direction.

A memorandum from D. F. Bunch, Director, Program Support Staff, NRR (May 9, 1979) concludes:

> 10 CFR Part 100 requires that the assumed fission product release used for site suitability calculations should be one "that would result in potential hazards not exceeded by those from accident considered credible." The TMI release of 13 million curies of Xe-133 is substantially greater than that which was estimated as the maximum credible release by the staff in its review of the OL for TMI-2 and is probably larger than that which would be predicted to occur in any of the site suitability analyses for plants reviewed by the staff in the last decade.

Before drawing any conclusions from these two rejected and subsequently verified intervenor contentions, we will turn to a second class of deficiencies in the regulatory process -- those issues which were not raised but which we now suspect were the root causes of the accident.

There is no comfort in the existence of a "Lessons Learned" task force for a technology which in the United States has over 70 operating reactors and nearly 70 more under construction or committed. Lessons learned are supposed to be the product of a testing program, not a commercialized technology. But of course there are those who will assert that all technologies are subject to errors being learned after they are commercialized -- e.g., the DC-10. But for nuclear power that argument won't work. First, the consequences of a mistake are too catastrophic: "We almost lost Pennsylvania." Second, today's reactors are being built and operated in the face of dozens of serious

unresolved safety problems identified by both the NRC Staff and the ACRS. Among the 30 generic safety items still listed as unresolved by the ACRS are the following which are relevant to the TMI-2 accident (ACRS letter to Joseph Hendrie, November 15, 1977, Status of Generic Items Relating to Light-Water Reactors: Report No. 6 (Attachment, Group II, items II-4, IIB-1, IIC-1)):

> II-4 - Instruments To Detect (Severe) Fuel Failures
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> In the event of substantial fuel failure, including the possibility of fuel melt, large amounts of fission products could be rapidly released to the reactor coolant and possibly to the environment. Instrumentation capable of early warning and timely response may avert an incident becoming an accident.
>
> Instrumentation related to such diagnostic purposes for limited fuel failure is being used on most power reactors. . . . Further work is required to establish criteria for similar instrumentation for severe fuel failures.
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> . . . .
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> IIB-1 - Computer Reactor Protection Systems
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> The proposed systems would contain some types of components and subsystems not previously used for reactor protection. It is necessary that the required system reliability, both during normal operation and under postulated abnormal conditions, be established through an appropriate combination of tests and analyses. While the issue originated with the B&W Hybrid concept it is equally applicable to the proposed CE and W computer reactor protection systems.
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> . . . .
>
> IIC-1 - Locking Out Of ECCS Power-Operated Valves
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> The physical locking out of electrical sources to specific motor-operated valves required in the engineered safety functions of ECCS has been required, based on the assumption that a spurious

> electrical signal at an inopportune time could activate the valves to the adverse position; e.g., closed rather than open, or open rather than closed. While such an event has a finite probability another probability exists that the valves might be adversely positioned due to operator error.
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> The ACRS believes the matter should be sutdied using a systems approach, and considering such items as: (1) the evaluation of the probability of a spurious signal; (2) time required to reactivate the valve operator; (3) status of signal lights when the circuit breaker is open; (4) the possibility of locking out in an improper position due to a faulty indicator; (5) other designs with improved reliability without lock-out; (6) the advantages and disadvantages of corrective action by an alert operator in case of incorrect positioning vis-a-vis a system with power locked out.

The NRC Staff lists 41 unresolved safety problems which require priority attention because their resolution could "(1) provide a significant increase in assurance of the health and safety of the public, or (2) have a significant impact upon the reactor licensing process." NUREG-0371, Vol. 1, No. 1 (November 1977). One of the items identified by the Staff as requiring further analysis and research is "Instruments for Monitoring Radiation and Process Variables During Accidents."

To these lists of unresolved safety problems must be added all the new items which TMI-2 has uncovered. The ACRS and the NRC Staff have suddenly discovered problems never before anticipated. The ACRS lists these in its various interim reports to the Commission and the NRC Staff lists them in various documents including the "Lessons Learned"

report. But, as if driven by some uncontrollable addiction, all these new problems and their solutions are for "mañana," and, for the operating plants, it is business as usual.

An examination of the docket for TMI-2 does not disclose any serious attention having been given either to the problems previously listed as unresolved which were part of the accident or to problems which subsequently have been identified. Through eight separate reviews by four distinguished groups of experts, the bulk of the problems which lay at the root of the TMI-2 accident were not even discussed, much less resolved.

Finally, in the list of my examples of the failure of the process must be included the fact that the TMI-2 accident was not new. At least as of January 19, 1979, James G. Keppler, Director of the NRC Region III Office of Inspection and Enforcement, identified the accident in a Davis-Besse incident report, noted its relevance for TMI-2 among others, and observed that there was a regulatory requirement to notify the ASLB for the affected reactors. Now we have learned that similar experiences may have occurred with foreign reactors. Nonetheless the notification was not provided and the issue was not developed in the regulatory process.

What do I see as the lessons learned from all of this? They are, I believe, obvious from the preceding discussion:

I. A regulatory process in which those participants who have substantially all the financial resources are in support of licensing the plant does not adequately explore all relevant issues.

II. The role of the NRC Regulatory Staff as an advocate for the licensing action is superfluous and wastes valuable talent which could be better used.

III. The only effective regulatory process for a technology as inherently dangerous as nuclear power is one in which substantial sums of money are made available to competent persons who oppose the technology and who will then have both the resources and the inclination to force out into the decision-making process all the potential flaws of the technology.

To implement these lessons requires, first, that funds be made available for the participation of competent nuclear opponents in the licensing process for every nuclear plant, in every rulemaking and in the daily business of the NRC. The cost of such participation, even if lavishly funded, would be only a fraction of the cost which TMI-2 has caused and will cause. Second, the NRC Regulatory Staff should be prohibited from playing the role of an advocate in the

licensing process but should instead have as its sole responsibility, in addition to reviewing applications, the supplementation of the licensing hearing record with additional relevant information, irrespective of the side which is favored by such evidence. The Staff expertise could be called upon by any party where no comparable expertise existed elsewhere, but, regardless of the ultimate Staff position on the merits of the application, the Staff witness would be directed to present the truth, the whole truth, and nothing but the truth, not to testify in support of Staff conclusions.

These reforms would not guarantee that only safe nuclear plants were built and operated nor that every safe nuclear plant, if any, was built and operated. Due process cannot guarantee perfect results any more than nuclear engineers can guarantee perfect reactors. But the process must be reformed to increase the likelihood that the results reached are correct. The present system, as exemplified by TMI-2, does not fulfill that function. Even issues raised by intervenors are not adequately addressed because the intervenors are nearly always forced to present their case without adequate technical expertise and without the assistance of competent lawyers. There are many experts who, with adequate remuneration could have assisted the TMI-2 intervenors to identify all of the crucial issues and to pursue those issues vigorously with a strong, affirmative case.

If that had happened, I am confident that there would not have been a TMI-2 accident, if for no other reason than because a well-funded opponent would have been monitoring other B&W reactors, including Davis-Besse. Once the existence of a financially viable nuclear opposition is established, more experts will become available and even better opposition will evolve.

Critics of these funding proposals raise a plethora of objections, but repeatedly they return to the argument that funding opponents will delay the process, and delay is bad. The argument is spurious because, as the ASLAB observed many years ago (Vermont Yankee Nuclear Power Corporation, ALAB-124, 6 AEC 358, 365 (1973)):

> . . . delay in the issuance of an operating licensing attributable to an intervenor's ability to present to a licensing board legitimate contentions based on serious safety problems uncovered by the staff would establish not that the licensing system is being frustrated, but that it is working properly. Any delay in such a situation would be fairly attributable not to the intervenors but to the unreadiness of the facility for operation. Delay in the issuance of the license is entirely appropriate -- indeed, mandated -- in that circumstance.

In fact, the ASLAB has been highly complimentary of the efforts of intervenors in the licensing process, a commendation which to the best of my knowledge has never been given to either the applicant or the Staff. Alan S. Rosenthal (Chairman of the ASLAP) in testimony before the Joint Committee on Atomic Energy, April 25, 1974, stated:

"My experience teaches that, as the Appeal Board in the River Bend proceeding recently put it in responding to a disparagement by an applicant of the values of interventions, '[p]ublic participation in licensing proceedings not only can provide valuable assistance to the adjudicatory process, but on frequent occasions demonstrably has done so.' (In the Matter of Gulf States Utilities Company (River Bend Station, Units 1 and 2), ALAB-183 (March 12, 1973, slip opinion, pp. 11-12.)

"In elaboration, that Board pointed out that 'many of the substantial safety and environmental issues which have received the scrutiny of licensing boards and appeal boards were raised in the first instance by an intervenor.' (ibid., slip opinion, page 12).

"It might be added here that, in several instances, the result of such scrutiny has been the imposition of conditions on the permit or license, or some other affirmative board action, designed to insure a safer and more environmentally sound reactor.

"Thus, while intervenors may have had little success to this point in inducing the adjudicatory boards to deny outright a construction permit or operating license, it is not accurate to say that a deaf ear has been turned to their concerns. When a solid foundation has been shown for a particular concern, appropriate relief has been forthcoming.

"It must be emphasized that the Appeal Board's observations in River Bend were made in the context of adjudicatory-type hearings in which all parties, including intervenors, are accorded all of the rights normally associated with such hearings -- most particularly, the right of cross-examination.

"And, in my judgment, the preservation of that right is essential -- at least with respect to most of the basic issues of fact which come to the fore in licensing proceedings. For the crucible of cross-examination can provide an especially effective means of testing the true validity of conclusions which, on the surface, may seem to be unassailable.

"I appreciate, of course, that the issues in licensing proceedings tend to be technical and of enormous complexity. The same can be equally said, however, of many of the kinds of issues which arise in judicial proceedings, where cross-examination has long been recognized as a fundamental ingredient of the fact-finding process.

* * *

"In sum, I believe that adjudicatory-type hearings with a full opportunity for public participation are a decided asset in the ventilation of any safety or environmental questions which may be associated with the particular reactor under consideration. And I am equally convinced that there is no reason why the necessary effect of this approach to licensing adjudication should be wasteful delay."

Atomic Safety and Licensing Appeal Board, In the Matter of Consolidated Edison Company of New York, Inc. (Indian Point Station, Unit No. 2), 8 AEC 850 (November 20, 1974):

"We have in an earlier memorandum stated our opinion that the development of plant security requirements were influenced considerably by the probing questions of CCPE's [Citizens Committee for the Protection of the Environment] counsel (ALAB-177, RAI-74-2, 153, 154, February 26, 1974). We continue to adhere to that opinion. The responses of the applicant's witnesses to that counsel's examination at the November 13, 1974 hearing, together with their responses to our questions, are one of the foundations for our conclusion that the plan is adequate. This constructive participation on an important issue has, in our judgment, contributed to the improvement of the regulatory process, both as an aid to the adjudication of the security issues and in the development of the overall regulatory requirements in an evolving area."

Atomic Safety and Licensing Appeal Board, In the Matter of Florida Power & Light Company (St. Lucie Nuclear Power Plant, Unit No. 1), ALAB-405, October 7, 1977:

"There was need here for careful probing of the staff's efforts, and the intervenors helped initiate and conduct that probe. Thus, although they did not achieve the ultimate result they desired, the intervenors clearly assisted in the search for truth. The contribution they made should not pass unnoticed."

With a thorough and complete program to fund opponents, the opposition can and should be required to raise its objections in the early stages of Staff and ACRS reviews, where changes can be made at minimal cost. Today's hearing process is a culmination of a year or more of Staff/ACRS/Applicant interaction from which intervenors are essentially excluded

by their lack of resources. This, more than anything else, contributes to hearing delays as intervenors voice objections for the first time in the hearing process.

Today, the Staff is a vigorous advocate in the licensing process, yet the Staff almost invariably ends up supporting the position of the Applicant. Thus, the Applicant, which already has the benefit of involuntary payments by ratepayers to fund its case, is augmented by the Regulatory Staff with its costs paid by involuntary payments by taxpayers. As taxpayers, we can expect that the Staff will be more than merely an additional advocate for the Applicant in the process. It must perform a function which transcends any one side in the controversy and serves instead the interests of due process by assuring the existence of a complete and thorough record. This Staff function would reduce the actual time required at hearings by Staff witnesses and would assure that all parties could draw on the Staff expertise when needed to address an issue, if the expertise were not otherwise available.

We would all feel more confident in the Staff positions now being taken on TMI-2 were it not for the fact that it was the Staff who so vigorously supported the TMI-2 license. This Commission was appointed in part because the NRC Staff was thought to be too involved to be truly objective. Significantly the Staff pronouncements of mea culpa since TMI-2 have been limited and have not really examined the Staff or its functions in a broad sense. No one would expect

an advocate to be able to do such a searching reexamination of its own existence. The Staff role should be changed.

In conclusion, my message today, my lesson learned from TMI-2, is that this accident is by no means an isolated event to be examined and treated. It is the latest in a long line of accidents and blunders with nuclear power which are largely attributable to the over-abundance of nuclear proponents and the absence of competent, well-financed nuclear opponents in the regulatory process. If nuclear power is so good, it should welcome vigorous, competent, and funded opposition. If it cannot withstand such opposition, it should be abandoned immediately.

Attachment 11

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, DC 20555

APRIL 5, 1979

IE Bulletin 79-05A

NUCLEAR INCIDENT AT THREE MILE ISLAND - SUPPLEMENT

Description of Circumstances:

Preliminary information received by the NRC since issuance of IE Bulletin 79-05 on April 1, 1979 has identified six potential human, design and mechanical failures which resulted in the core damage and radiation releases at the Three Mile Island Unit 2 nuclear plant. The information and actions in this supplement clarify and extend the original Bulletin and transmit a preliminary chronology of the TMI accident through the first 16 hours (Enclosure 1).

1. At the time of the initiating event, loss of feedwater, both of the auxiliary feedwater trains were valved out of service.

2. The pressurizer electromatic relief valve, which opened during the initial pressure surge, failed to close when the pressure decreased below the actuation level.

3. Following rapid depressurization of the pressurizer, the pressurizer level indication may have led to erroneous inferences of high level in the reactor coolant system. The pressurizer level indication apparently led the operators to prematurely terminate high pressure injection flow, even though substantial voids existed in the reactor coolant system.

4. Because the containment does not isolate on high pressure injection (HPI) initiation, the highly radioactive water from the relief valve discharge was pumped out of the containment by the automatic initiation of a transfer pump. This water entered the radioactive waste treatment system in the auxiliary building where some of it overflowed to the floor. Outgassing from this water and discharge through the auxiliary building ventilation system and filters was the principal source of the offsite release of radioactive noble gases.

5. Subsequently, the high pressure injection system was intermittently operated attempting to control primary coolant inventory losses through the electromatic relief valve, apparently based on pressurizer level indication. Due to the presence of steam and/or noncondensible voids elsewhere in the reactor coolant system, this led to a further reduction in primary coolant inventory.

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5. Tripping of reactor coolant pumps during the course of the transient, to protect against pump damage due to pump vibration, led to fuel damage since voids in the reactor coolant system prevented natural circulation.

Actions To Be Taken by Licensees:

For all Babcock and Wilcox pressurized water reactor facilities with an operating license (the actions specified below replace those specified in IE Bulletin 79-05):

1. (This item clarifies and expands upon item 1. of IE Bulletin 79-05.)

   In addition to the review of circumstances described in Enclosure 1 of IE Bulletin 79-05, review the enclosed preliminary chronology of the TMI-2 3/28/79 accident. This review should be directed toward understanding the sequence of events to ensure against such an accident at your facility(ies).

2. (This item clarifies and expands upon item 2. of IE Bulletin 79-05.)

   Review any transients similar to the Davis Besse event (Enclosure 2 of IE Bulletin 79-05) and any others which contain similar elements from the enclosed chronology (Enclosure 1) which have occurred at your facility(ies). If any significant deviations from expected performance are identified in your review, provide details and an analysis of the safety significance together with a description of any corrective actions taken. Reference may be made to previous information provided to the NRC, if appropriate, in responding to this item.

3. (This item clarifies item 3. of IE Bulletin 79-05.)

   Review the actions required by your operating procedures for coping with transients and accidents, with particular attention to:

   a. Recognition of the possibility of forming voids in the primary coolant system large enough to compromise the core cooling capability, especially natural circulation capability.

   b. Operator action required to prevent the formation of such voids.

   c. Operator action required to enhance core cooling in the event such voids are formed.

4. (This item clarifies and expands upon item 4. of IE Bulletin 79-05.)

Review the actions directed by the operating procedures and training instructions to ensure that:

a. Operators do not override automatic actions of engineered safety features.

b. Operating procedures currently, or are revised to, specify that if the high pressure injection (HPI) system has been automatically actuated because of low pressure condition, it must remain in operation until either:

(1) Both low pressure injection (LPI) pumps are in operation and flowing at a rate in excess of 1000 gpm each and the situation has been stable for 20 minutes, or

(2) The HPI system has been in operation for 20 minutes, and all hot and cold leg temperatures are at least 50 degrees below the saturation temperature for the existing RCS pressure. If 50 degree subcooling cannot be maintained after HPI cutoff, the HPI shall be reactivated.

c. Operating procedures currently, or are revised to, specify that in the event of HPI initiation, with reactor coolant pumps (RCP) operating, at least one RCP per loop shall remain operating.

d. Operators are provided additional information and instructions to not rely upon pressurizer level indication alone, but to also examine pressurizer pressure and other plant parameter indications in evaluating plant conditions, e.g., water inventory in the reactor primary system.

5. (This item revises item 5. of IE Bulletin 79-05.)

Verify that emergency feedwater valves are in the open position in accordance with item 3 below. Also, review all safety-related valve positions and positioning requirements to assure that valves are positioned (open or closed) in a manner to insure the proper operation of engineered safety features. Also review related procedures, such as those for maintenance and testing, to ensure that such valves are returned to their correct positions following necessary manipulations.

6. Review the containment isolation initiation design and procedures, and prepare and implement all changes necessary to cause containment isolation of all lines whose isolation does not degrade core cooling capability upon automatic initiation of safety injection.

7. For manual valves or manually-operated motor-driven valves which could defeat or compromise the flow of auxiliary feedwater to the steam generators, prepare and implement procedures which:

   a. require that such valves be locked in their correct position; or

   b. require other similar positive position controls.

8. Prepare and implement immediately procedures which assure that two independent steam generator auxiliary feedwater flow paths, each with 100% flow capacity, are operable at any time when heat removal from the primary system is through the steam generators. When two independent 100% capacity flow paths are not available, the capacity shall be restored within 72 hours or the plant shall be placed in a cooling mode which does not rely on steam generators for cooling within the next 12 hours.

   When at least one 100% capacity flow path is not available, the reactor shall be made subcritical within one hour and the facility placed in a shutdown cooling mode which does not rely on steam generators for cooling within 12 hours or at the maximum safe shutdown rate.

9. (This item revises item 6 of IE Bulletin 79-05.)

   Review your operating modes and procedures for all systems designed to transfer potentially radioactive gases and liquids out of the primary containment to assure that unassured pumping of radioactive liquids and gases will not occur inadvertently.

   In particular, ensure that such an occurrence would not be caused by the resetting of engineered safety features instrumentation. List all such systems and indicate:

   a. Whether interlocks exist to prevent transfer when high radiation indication exists, and

   b. Whether such systems are isolated by the containment isolation signal.

10. Review and modify as necessary your maintenance and test procedures to ensure that they require:

    a. Verification, by inspection, of the operability of redundant safety-related systems prior to the removal of any safety-related system from service.

    b. Verification of the operability of all safety-related systems when they are returned to service following maintenance or testing.

    c. A means of notifying involved reactor operating personnel whenever a safety-related system is removed from and returned to service.

11. All operating and maintenance personnel should be made aware of the extreme seriousness and consequences of the simultaneous blocking of both auxiliary feedwater trains at the Three Mile Island Unit 2 plant and other actions taken during the early phases of the accident.

12. Review your present reporting procedures for NRC notification to assure very early notification of serious events.

For Babcock and Wilcox pressurized water reactor facilities with an operating license, respond to Items 1, 2, 3, 4.a and 5 by April 11, 1979. Since these items are substantially the same as those specified in IE Bulletin 79-05, the required date for response has not been changed. Respond to Items 4.b through 4.d, and 6 through 12 by April 16, 1979.

Reports should be submitted to the Director of the appropriate NRC Regional Office and a copy should be forwarded to the NRC Office of Inspection and Enforcement, Division of Reactor Operations Inspection, Washington, DC 20555.

For all other reactors with an operating license or construction permit, this Bulletin is for information purposes and no written response is required.

Approved by GAO, B 180225 (R0072); clearance expires 7-31-80. Approval was given under a blanket clearance specifically for identified generic problems.

Enclosures:

1. Preliminary Chronology of TMI-2 3/28/79 Accident Until Core Cooling Restored.

2. List of IE Bulletins Issued in Last 12 months.

Enclosure 1 to
IE Bulletin 79-05A
April 5, 1979

PRELIMINARY

CHRONOLOGY OF TMI-2 3/28/79 ACCIDENT UNTIL CORE COOLING RESTORED

TIME (Approximate)	EVENT
about 4 AM (t = 0)	Loss of Condensate Pump Loss of Feedwater Turbine Trip
t = 3-6 sec.	Electromatic relief valve opens (2255 psi) to relieve pressure in RCS
t = 9-12 sec.	Reactor trip on high RCS pressure (2355 psi)
t = 12-15 sec.	RCS pressure decays to 2205 psi (relief valve should have closed)
t = 15 sec.	RCS hot leg temperature peaks at 611 degrees F, 2147 psi (450 psi over saturation)
t = 30 sec.	All three auxiliary feedwater pumps running at pressure (Pumps 2A and 2B started at turbine trip). No flow was injected since discharge valves were closed.
t = 1 min.	Pressurizer level indication begins to rise rapidly
t = 1 min.	Steam Generators A and B secondary level very low - drying out over next couple of minutes.
t = 2 min.	ECCS initiation (HPI) at 1600 psi
t = 4 - 11 min.	Pressurizer level off scale - high - one HPI pump manually tripped at about 4 min. 30 sec. Second pump tripped at about 10 min. 30 sec.
t = 8 min.	RCS flashes as pressure bottoms out at 1050 psig, hot leg temperature of 554 degrees F
t = 7 min., 30 sec.	Reactor building sump pump came on.

TIME	EVENT
t = 8 min.	Auxiliary feedwater flow is initiated by opening closed valves
t = 8 min. 18 sec.	Steam Generator B pressure reached minimum
t = 8 min. 21 sec.	Steam Generator A pressure starts to recover
t = 11 min.	Pressurizer level indication comes back on scale and decreases
t = 11-12 min.	Makeup Pump (ECCS HPI flow) restarted by operators
t = 15 min.	RC Drain/Quench Tank rupture disk blows at 190 psig (setpoint 200 psig) due to continued discharge of electromatic relief valve
t = 20 - 60 min.	System parameters stabilized in saturated condition at about 1016 psig and about 550 degrees F.
t = 1 hour, 15 min.	Operator trips RC pumps in Loop B
t = 1 hour, 40 min.	Operator trips RC pumps in Loop A
t = 1-3/4 - 2 hours	CORE BEGINS HEAT UP TRANSIENT - Hot leg temperature begins to rise to 620 degrees F (off scale within 14 minutes) and cold leg temperature drops to 100 degrees F. (HPI water)
t = 2.3 hour	Electromatic relief valve isolated by operator after B.B.-B isolated to prevent leakage
t = 3 hours	RCS pressure increases to 2150 psi and electromatic relief valve opened
t = 3.05 hours	RC drain tank pressure spike of 5 psig
t = 3.3 hours	RC drain tank pressure spike of 11 psi - RCS pressure 1700; containment pressure increases from 1 to 3 psig
t = 5 hours	Peak containment pressure of 4.8 psig
t = 5 - 6 hours	RCS pressure increased from 1080 psi to to 2100 psi

TIME	EVENT
t = 7.5 hours	Operator opens electromatic relief valve to depressurize RCS to attempt initiation of RHR at 400 psi
t = 8 - 9 hours	RCS pressure decreases to about 500 psi Core Flood Tanks partially discharge
t = 10 hour	28 psig containment pressure spike, containment sprays initiated and stopped after 500 gal. of NaOH injected (about 2 minutes of operation)
t = 13.5 hours	Electromatic relief valve closed to repressurize RCS, collapse voids, and start RC pump
t = 13.5 - 16 hours	RCS pressure increased from 600 psi to 2000 psi
t = 16 hours	RC pump in Loop A started, hot leg temperature decreases to 550 degrees F. and cold leg temperature increases to 400 degrees F. indicating flow through steam generator
Thereafter	S/G "A" steaming to condenser Condenser vacuum re-established RCS cooled to about 200 degrees F., 1000 psi
Now (4/4)	High radiation in containment All core thermocouples less than 450 degrees F. Using pressurizer vent valve with small makeup flow Slow cooldown RB pressure negative

LISTING OF IE BULLETINS ISSUED IN LAST TWELVE MONTHS

Bulletin No.	Subject	Date Issued	Issued To
78-05	Malfunctioning of Circuit Breaker Auxiliary Contact Mechanism - General Electric Model CR105X	4/14/78	All Power Reactor Facilities with an Operating License (OL) or Construction Permit (CP)
78-06	Defective Cutler-Hammer, Type M Relays With DC Coils	5/31/78	All Power Reactor Facilities with an OL or CP
78-07	Protection afforded by Air-Line Respirators and Supplied-Air Hoods	6/12/78	All Power Reactor Facilities with an OL, all class E and F Research Reactors with an OL, all Fuel Cycle Facilities with an OL, and all Priority I Material Licensees
78-08	Radiation Levels from Fuel Element Transfer Tubes	6/12/78	All Power, Test and Research Reactor Facilities with an OL having Fuel Element Transfer Tubes
78-09	BWR Drywell Leakage Paths Associated with Inadequate Drywell Closures	6/14/78	All BWR Power Reactor Facilities with an OL (for action) or CP (for information)
78-10	Bergen-Paterson Hydraulic Shock Suppressor Accumulator Spring Coils	6/27/78	All BWR Power Reactor Facilities with an OL or CP

LISTING OF IE BULLETINS
ISSUED IN LAST TWELVE MONTHS (CONTINUED)

Bulletin No.	Subject	Date Issued	Issued to
79-01	Environmental Qualification of Class IE Equipment	2/8/79	All Power Reactor Facilities with an OL, except the 11 Systematic Evaluation Program Plants (for action), and all other Power Reactor Facilities with an OL or CP (for information)
79-02	Pipe Support Base Plate Design Using Concrete Expansion Anchor Bolts	3/8/79	All Power Reactor Facilities with an OL or CP
79-03	Longitudinal Weld Defects in ASME SA-312 Type 304 Stainless Steel Pipe Spools Manufactured by Youngstown Welding and Engineering Company	3/12/79	All Power Reactor Facilities with an OL or CP
79-04	Incorrect Weights for Swing Check Valves Manufactured by Velan Engineering Corporation	3/30/79	All Power Reactor Facilities with an OL or CP
79-05	Nuclear Incident at Three Mile Island	4/1/79	All Babcock and Wilcox Power Reactor Facilities with an OL, Except Three Mile Island 1 and 2 (For Action), and All Other Power Reactor Facilities With an OL or CP (For Information)

Attachment 12

Natural Resources Defense Council, Inc.

917 15TH STREET, N.W.
WASHINGTON, D.C. 20005

202 737-5000

New York Office
122 EAST 42ND STREET
NEW YORK, N.Y. 10017
212 949-0049

Western Office
2345 YALE STREET
PALO ALTO, CALIF. 94306
415 327-1080

NRDC Says Funded Intervenors Could Have Prevented Accident at Three Mile Island

FOR RELEASE: August 23, 1979

In testimony before the President's Commission on the Accident at Three Mile Island, Natural Resources Defense Council Staff Attorney Anthony Z. Roisman stated that the most important lesson learned from the Three Mile Island accident is that the Nuclear Regulatory Commission's process for licensing nuclear reactors is "a total failure."

According to Roisman, during TMI-2's operating license proceeding, "specific problems now recognized as real [were] rejected as unsubstantiated challenges to the plant," and "the principal design and operational defects in the reactor itself were totally ignored." Roisman contended that "[a] prime function of this Commission should be to uncover the reasons behind" this failure.

Tracing the history of the unsuccessful efforts of citizen opponents of TMI-2 to raise substantial issues about the adequacy of evacuation planning and radiation monitoring, Roisman noted that "[n]ot surprisingly, [these issues were] not adequately addressed because the only parties with resources sufficient to make their case were advocates of the issuance of the license."

Roisman further charged that post-TMI-2 reviewers are not investigating the real problems. The key to the mistakes made at TMI is not what happened at the time of the accident but how such a flawed plant every got licensed. "Through eight separate reviews by four distinguished groups of experts, the bulk of the problems which lay at the root of the TMI-2 accident were not even discussed, much less resolved," Roisman said.

In order to improve the licensing process, and thereby prevent future TMIs, Roisman proposed that "funds be made available for the participation of competent nuclear opponents in the licensing process for every nuclear plant, in every rulemaking and in the daily business of the NRC. The cost of such participation, even if lavishly funded, would be only a fraction of the cost which TMI-2 has caused and will cause." He also proposed that "the NRC Regulatory Staff should be prohibited from playing the role of an advocate in the licensing process but should instead have as its sole responsibility, in addition to reviewing applications, the supplementation of the licensing hearing record with additional relevant information, irrespective of the side which is favored by such evidence." He noted that under the present system "the Applicant, which already has the benefit of involuntary payments by ratepayers to fund its case, is augmented by the Regulatory Staff with its costs paid by involuntary payments by taxpayers."

If the TMI-2 opponents had been adequately funded, said Roisman, "I am confident that there would not have been a TMI-2 accident, if for no other reason than because a well-funded opponent would have been monitoring other B&W reactors, including Davis-Besse" (where a similar accident was reported in January 1979).

Finally, Roisman, referring to the TMI-2 accident as "the latest in a long line of accidents and blunders with nuclear power" attributable to a lopsided licensing process, challenged the nuclear industry to test the strength of its case in fair hearings against financially viable opponents. "If nuclear power is so good, it should welcome vigorous, competent, and funded opposition. If it cannot withstand such opposition, it should be abandoned -- immediately."

WHAT IS THE ELECTRIC UTILITY INDUSTRY DOING NOW?

More information for media representatives attending the hearings of the President's Commission on Three Mile Island.

In the wake of Three Mile Island, the electric utility industry, coupled with reactor manufacturers, architects and engineers, has intensified its efforts to evaluate and improve nuclear operations, safety, operator training and public information. Some of these efforts are outlined in the attached report, "Industry Response to Three Mile Island."

The industry is not standing still. In light of the energy crisis, new energy policies and increased public concern about nuclear power in particular, the industry must continue to assure that nuclear power is safe, reliable and economical. And, the industry must provide, openly and honestly, as much information as possible to the public.

For details on any of the items outlined on the attached report, and for names of non-industry experts who are willing to speak to the media about energy, contact:

Mike Segal, Edison Electric Institute, 828-7584

~~Scot Peters~~ Carl Goldstein, Atomic Industrial Forum, 654-9260, Ext. ~~289~~ 234

Jim Ghiotto, Committee for Energy Awareness, 296-1304

INDUSTRY RESPONSE TO THREE MILE ISLAND

Committee for Energy Awareness
1899 L St. NW, Suite 605
Washington, D.C. 20036
(202) 296-1304

INDIVIDUAL COMPANY

Immediate response to the Three Mile Island incident began on the individual company level at each of the country's nuclear utilities as soon as bulletins about the accident began to arrive.

Task forces were formed with the purpose of studying TMI events and relating the lessons learned to each individual utility's own nuclear plants.

Communications with both employees and the public began immediately, to report on and interpret what was happening at TMI, so employees and the public would not have to rely totally on media reports for information.

Overall, since the accident, operator training on the individual company level has been reviewed and improved where needed, new training simulators have been put on order and emergency communication plans have been drafted. Some companies are planning emergency drills with local civil defense and other state officials.

COOPERATIVE

Convinced that what could be done on the company level was only a small percentage of what the industry as a whole could do to assure the safety of nuclear power after TMI, utilities, reactor manufacturers, architects and engineers began pooling their efforts. The Edison Electric Institute (EEI) Board of Directors established the Floyd Lewis Committee, an ad hoc oversight committee designed to help coordinate the entire industry's post-TMI efforts.

A Nuclear Safety Analysis Center (NSAC) was established under the Electric Power Research Institute (EPRI) at the request of the utility industry with the purpose of carrying out a detailed technical analysis of what happened at TMI. NSAC is to interpret the lessons to be learned about TMI and about nuclear reactors in general and make sure that information and other safety information can be efficiently communicated in the industry.

NSAC has already:

- completed and distributed a second-by-second technical sequence of TMI events.
- worked on setting up a clearinghouse for nuclear safety information. It is designed to help coordinate the activities of NSAC with those of the President's Commission on the Investigation of Three Mile Island, the Nuclear Regulatory Commission, the Department of Energy, Congressional inquiries and utility and nuclear industry trade publications.
- has decided to help fund a series of health studies on the long and short term physical and psychological effects of TMI on people who live within a five mile radius of the plant. The first study, to define the population, is underway. Interviewers are asking people who live in the area about their health histories and activities the

day of the accident and for nine days thereafter. Future studies include a pregnancy outcome study, long-term disease surveillance, a health benavioral study, a radiation dose assessment study, and a cytogenic study. The studies are coordinated and executed by the Pennsylvania Department of Health. Dr. Leonard Sagan, director of biomedical studies at EPRI, is a member of the advisory panel.

NSAC's director is Dr. Edwin L. Zebroski, head of Systems and Materials Department in the Nuclear Power Division at EPRI. Staff includes both nuclear experts from EPRI and industry experts.

An Institute for Nuclear Power Operations is also being formed by the industry. It will establish standards for performance in operation of nuclear plants and will devise an auditing system for utilities to use in reviewing their own nuclear operational and management performances.

INPO will be an independent organization which will have the benefit of oversight by prominent educators, scientists and engineers from outside the industry. INPO will cooperate with the NRC and other government agencies and laboratories, but will maintain its own identity and independence. Its formation is being directed by Dr. Chauncey Starr, Vice Chairman of EPRI.

INPO will build on strengths that already exist in individual utility programs.

The Atomic Industrial Forum (AIF), recognizing that timely and constructive industry response to TMI is very important, has formed a Policy Committee to consolidate its approach. Under the Policy Committee are a number of subcommittees, which will face the critical issues of TMI. The subcommittees include Emergency Response Planning, Operations, Systems and Equipment, Post-Accident Recovery, Safety Anaysis Considerations, Control Room Considerations and Unresolved Generic Issues.

Six reactor owners groups have been formed. They will allow for deeper analysis and improved models of the behaviors of reactors made by each of the six different manufacturing companies. Several of the groups, including owners of Westinghouse, Combustion Engineering and General Electric reactors, have already met. General Electric and Babcock & Wilcox owners are each forming two separate groups, one covering reactors presently licensed to operate and the other consisting of utilities owning units awaiting operating licenses or construction permits.

The American Public Power Association (APPA) Board of Directors voted May 11 to establish a Nuclear Power Task Force. The Task Force met May 31 and endorsed a resolution which recognized

the need for an open fact finding investigation of TMI, the requirement that public health and safety be properly protected, the desireability of utility industry study of the accident through EPRI, the requirement that consumer interest in continuation of present and planned nuclear power plants be recognized and the necessity to disclose candidly to the public the full costs and all benefits of the continued use of nuclear power. In addition, the Task Force made a number of recommendations on other issues, including preservation of all energy options, upgrading training, and crisis management.

The National Rural Electric Cooperative Association (NRECA) has mobilized to support the industry's post-TMI efforts. The NRECA is cooperating with EEI and EPRI efforts and is attempting to communicate all findings to its directors throughout the industry.

A committee of industry financial specialists is cooperating to form a mutual insurance plan. The plan would apply to extraordinary costs in the event of a future nuclear accident and would help ease the financial impact of a prolonged nuclear shutdown on consumers and investors.

Several utility communications experts have developed an emergency communications plan which consists of a set of comprehensive guidelines that will help provide logical, practical means of getting information out to the public quickly and factually.

POOR ORIGINAL

Attachment 13

CURRENT EVENTS

POWER REACTORS

UNITED STATES
NUCLEAR
REGULATORY
COMMISSION

THIS COMPILATION OF SELECTED EVENTS IS PREPARED TO DISSEMINATE INFORMATION ON OPERATING EXPERIENCE AT NUCLEAR POWER PLANTS IN A TIMELY MANNER AND AS OF A FIXED DATE. THESE EVENTS ARE SELECTED FROM PUBLIC INFORMATION SOURCES. NRC HAS, OR IS TAKING CONTINUOUS ACTION ON THESE ISSUES AS APPLICABLE, FROM AN INSPECTION AND ENFORCEMENT, LICENSING AND GENERIC REVIEW STANDPOINT.

1 SEPTEMBER - 31 OCTOBER 1977

(PUBLISHED DECEMBER 1977)

OPERATOR ERROR

On January 11, 1977 while the Fort Calhoun Station Unit 1 was operating, water from the Refueling Water Storage Tank was pumped into the containment through the containment spray header due to an operator error.

During the performance of a quarterly test of the safety injection and containment spray pumps, the operator noticed an increase in the containment sump level approximately ten minutes after the low pressure safety injection pump had been started. Approximately 3300 gallons of water had been pumped to the containment. About one minute later the ventilation isolation actuation signal was received. At this time the operator realized he had failed to follow the surveillance procedures and had left the discharge valve of the low head safety injection pump open. He immediately secured the pump.

The Reactor Coolant System was checked for leakage and containment entry was made approximately one hour later. Inspection revealed that a discharge from the containment spray nozzles had occurred. A few minutes later power reduction was started. A second containment entry was made about an hour later, after containment air samples confirmed that a full face mask would provide adequate respiratory protection for the levels of radioactivity in the building. A detailed inspection revealed no serious deficiencies and no electrical grounds; the power reduction was terminated at a power level of 83%.

Although the operator had not followed the procedure and the discharge valve was open, the containment spray header isolation valve (HCV-345)

and the low pressure safety injection to containment spray header cross-connect valve (HCV-335) should have prevented the event. The electric/pneumatic converter on HCV-345 had failed and both red and green position indication lights were on, indicating the valve was partially open. Prior to the event the auxiliary Building Equipment Operator had taken local control of the valve in an attempt to completely close the valve. After about 1/2 inch of stem travel, the operator removed the valve pin and the valve went back to its previous position as demanded by the valve positioner. The third valve (HCV-335) in the incident had a leakage problem that had been previously identified but no corrective action had been taken.

The pneumatic relay on valve HCV-345 was replaced and valve HCV-335 repaired. Valve HCV-344 and HCV-345 are now required to be placed in the test mode prior to operating the low pressure safety injection pump or contain spray pump for testing. This mode along with verification of an annunciator will ensure that both of these valves are in the fully closed position prior to pump operation.

VALVE MALFUNCTIONS

1. Primary System Depressurization

On September 24, 1977, Davis Besse Nuclear Power Station Unit No. 1 experienced a depressurization when a pressurizer power relief valve failed in the open position. The Reactor Coolant System (RCS) pressure was reduced from 2255 psig to 875 psig in approximately twenty-one (21) minutes. At the beginning of this event, steam was being bypassed to the condenser and the reactor thermal power was at 263 MW, or 9.5%. Electricity was not being generated. The following systems malfunctioned during the transient:

a. Steam and Feedwater Rupture Control System (SFRCS).

b. Pressurizer Pilot Actuated Relief Valve.

c. No. 2 Steam Generator Auxiliary Feed Pump Turbine Governor.

The event was initiated at 2134 hours, when a spurious "half-trip" occurred in the SFRCS, resulting in closure of the No. 2 Feedwater Startup Valve and loss of flow to No. 2 Steam Generator. Approximately one minute later, low level in the No. 2 Steam Generator caused a full SFRCS trip, closing the Main Steam Isolation Valves

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The reason for the spurious "half-trip" of the SFRCS has not yet been determined. An extensive investigation revealed several loose connections at terminal boards, but nothing conclusive.

Investigation into the failure of the pressurizer pilot actuated relief valve revealed that a "close" relay was missing from the control circuit. This missing relay would normally provide a "seal-in" circuit which would hold the valve open until the pressure dropped to 2205 psig. Without the relay the power relief valve cycled open and closed each time the pressure of the RCS went above or below 2255 psig. The rapid cycling of the valve caused a failure of the pilot valve stem, and this failure caused the power relief valve to remain open.

It was determined that the auxiliary feed pump did not go to full speed because of "binding" in the turbine governor.

The transient was analyzed by the NSSS vendor and determined to be within the design parameters analyzed for a rapid depressurization.

With exception of the above noted malfunctions, the plant functioned as designed and there was no threat to the health and safety of the general public.[2-3]

2. Feedwater Isolation Valves

On two occasions in July, at the Trojan nuclear plant, a hydraulic feedwater isolation valve failed to close upon receipt of a close signal. All other equipment required to operate, functioned normally.

The first failure, July 6, 1977, had been attributed to an improperly assembled solenoid in the hydraulic actuator. Investigation of the second failure indicated that both events were due to a lack of sufficient hydraulic pressure.

Failure of the valve to close was caused by the pressure regulator leaking and failing to close down to regulate the pressure. This caused the hydraulic system on the valve to be drained down to a point that the valve would not operate. Inspection of the regulator revealed that a locking screw on the regulator adjusting knob was loose and would allow the knob to vibrate to any position. With the regulator improperly set it would not close down to regulate pressure and would allow the hydraulic fluid to drain before the hydraulic operator could function. A similar problem was discovered on two other valves, although the maladjustment was not sufficient to prevent these valves from operating.