Session I

OPENING OF CONFERENCE

MONDAY: October 20, 1980
CHAIRMAN: M.W. First
Harvard Air Cleaning Laboratory

WELCOME AND OBJECTIVES OF CONFERENCE
Dade W. Moeller

KEYNOTE ADDRESSES:

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THE IMPACT OF THE ACCIDENT AT TMI-2 ON NEW SAFETY REGULATIONS
John T. Collins

WELCOME AND OBJECTIVES OF THE CONFERENCE

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On behalf of the U. S. Department of Energy and the Harvard Air Cleaning Laboratory, it is my pleasure to welcome you to this, the 16th Nuclear Air Cleaning Conference. This represents the 29th anniversary of the 1st Conference held in Boston in 1951. It is particularly pleasant to return to the west coast for such a meeting. As many of you will recall, the 11th Conference was held in Richland, WA, and the 13th Conference was held in San Francisco.

As part of my opening remarks, let me also express our collective appreciation to the Program Committee who planned this Conference. All of us owe a deep debt of gratitude, in particular, to Melvin W. First, who chaired that group, and who has been the major force in planning and organizing this event.

Although this Conference, because of its sponsorship, has always had a strong U. S. flavor, we are delighted once again to greet and extend a special welcome to our foreign colleagues who are here with us. Although registration is not yet complete, data show we have people here from Austrialia, Belgium, Canada, the Federal Republic of Germany, France, Italy Japan, and the United Kingdom. Data also shows we have a total registration thus far of more than 300 people and that about 80 papers will be presented in the technical sessions.

Much has happened since the 15th Conference was held in Boston two years ago. Most significant was the accident at Three Mile Island, Unit 2, in March, 1979. To assure that everyone is up-to-date on that event, the

Program Committee has scheduled a special session on Thursday morning to cover the air cleaning aspects of that accident. In addition, one of our keynote speakers this morning will address certain aspects of this topic and the luncheon presentation on Wednesday will also be directed to that subject.

In addition to the coverage of TMI, the program for this meeting will include, for the first time critical review papers on the following subjects: Radioiodine Control, Aerosol Filtration and the Noble Gases. We understand that consideration is being given to having the critical review papers published in the Journal, NUCLEAR SAFETY. As in the past, the Proceedings of the Conference, including discussion sessions, will be published as a DOE document and the Editor of NUCLEAR SAFETY has invited us, once again, to prepare a summary of the Conference for publication in that Journal.

As my preceding remarks have implied, one of primary objectives of this Conference is to promote the exchange of information on nuclear air cleaning. In so doing, this Conference will serve as a forum when research results can be reviewed first hand and constructive criticism provided in the discussion sessions which follow. In addition, this Conference will serve as a forum where national and international representatives of government and industry can communicate their air cleaning requirements and where these needs can be addressed on both a formal and informal basis. An example was the government-industry discussion session held earlier this morning.

The agenda and preprints for this Conference show that we have an interesting and stimulating four days in store. We hope that each of you finds this a beneficial experience professionally and that you gain all that you sought in coming here. Welcome to the 16th Nuclear Air Cleaning Conference.

DOE WELCOME

16th DOE Nuclear Air Cleaning Conference
October 20-23, 1980

G. P. Dix, Director
Operational and Environmental Safety Division
Office of Environmental Compliance and Overview
Office of Environment
Department of Energy
Washington, D.C.

On behalf of the Department of Energy, I welcome you to San Diego for this, the 16th Nuclear Air Cleaning Conference. These Air Cleaning Conferences now span more than three decades. Through the years, these conferences have grown in both participation and technical coverage. Today we have over 325 participants. Humphrey Gilbert, Mel First, and Alex Perge have done much to support this activity over the years.

In the first Nuclear Air Cleaning Conference, in 1951, and the next one or two, the reported information came almost solely from contractors of the Department's predecessor agency, the Atomic Energy Commission. Through the intervening years, the participation in these conferences has broadened to include the work of scientists and engineers from other Government agencies, industry, universities, and from international experts. In the case of today's conference, these experts come from France, U.K., Canada, Japan, West Germany, Belgium, Argentina, Australia, and Italy. Truly, these conferences have broadened far beyond DOE. Maybe we should consider renaming them "International Nuclear Air Cleaning Conferences."

A review of the technical programs of the conferences over the past two decades shows that the air cleaning research, in many ways, reflects changing energy commitments and regulatory requirements. One of the most significant impacts upon air cleaning was passage of the National Environmental Policy Act (NEPA) of 1969 and the court's interpretation of that Act in the Calvert Cliffs decision of August 1971. The court's action launched the Nation on a broad program of full compliance with the full intent of NEPA. As a result, more stringent regulations for releases from nuclear facilities were promulgated, resulting in research and development to improve the quality, reliability, and effectiveness of air cleaning systems. In the last decade, several papers have been presented on the effects of accidents, such as fires and natural phenomena forces on air cleaning systems; we had a test of one of our air cleaning systems early this year in an earthquake environment without significant failure. We also had external tests of our systems with Mt. St. Helen's volcanic ash at Richland, Washington.

The Resource Conservation and Recovery Act (RCRA) will have a significant impact on how hazardous wastes are handled. The Environmental Protection Agency has recently prescribed hazardous waste management regulations under the authority of RCRA. We believe that EPA's regulations are unclear as to applicability of mixtures of hazardous wastes containing source, special nuclear, or byproduct materials as these terms are defined in the Atomic Energy Act of 1954, and particularly as applied to the Department's own nuclear operations. The question of applicability is currently being worked between the Department and EPA. However, there is no question of the Act's applicability to all hazardous wastes not subject to the Atomic Energy Act. RCRA will have major impacts on the disposal of hazardous wastes. I am sure these new statutory requirements will be felt in air cleaning and any other technologies that generate hazardous wastes. I might add that the Controlled Air Incinerator for nuclear wastes at Los Alamos will be used by DOE and EPA in a joint program to evolve an incinerator for toxic and hazardous wastes, starting with PCB. Our inventories of PCB contaminated fluids in the DOE complexes alone exceed 28,000,000 pounds (much of it comingled with radioactive materials) and there does not exist in the U.S. a licensed incinerator to thermally decompose this compound.

Efficient and reliable air cleaning systems have always been extremely important to the Department's nuclear operations. Before I close, I would like to share with you some of our actual experiences. Over the past 5 years, we have experienced 14 reported incidents which had the potential for significant releases of radioactive materials to the environment. We had four repeatable incidents this year alone. In three of these accidents, radioactive material was actually released to the environment. The releases were very minor and no environmental damage resulted. Of the three, one was a release of tritium when a stainless steel pot containing uranium tritide was overheated and ruptured, due to inadequate air flow in the hood. The other two incidents involved ventilation or filter systems:

- A release to the environment of 1.2-1.3 millicuries of plutonium oxide occurred when a plutonium storage container ruptured resulting in an airborne release to the building. All components of the ventilation system were housed inside the building. The ventilation system was under a negative pressure differential relative to the room, and leakage into the ducts or blower unit beyond the final HEPA filter escaped directly to the outside environment. The problem was placement of the entire ventilation system, filters, blower, and related ducts inside the building.

- The other release occurred when a glovebox overpressurized resulting in an airborne release of plutonium to a laboratory room. The ventilation system swept the airborne plutonium from the room to a filter, then to the atmosphere. Approximately 0.19 millicuries of plutonium were released to the environment because the HEPA filter was not seated properly, which allowed air to bypass the filter. The problem in this incident was that new filters were not tested and certified. A second problem, long recognized in this particular building, was that backup HEPA filters were needed in the room exhaust system. In fact, the backup filter system was under construction at the time of the occurrence.

Fortunately, these releases were very minor, but they bring into focus some important points that apply to air cleaning, as well as to other safety systems:

(1) The need for good design engineering backed by analysis of the normal and abnormal conditions that the system will operate under; and

(2) The need for "good" quality control, maintenance, and surveillance programs to assure that the system and components operate as designed.

We have had some interesting air cleaning data recently from the Three Mile Island Accident. The accident demonstrated the integrity of the air handling systems on nuclear power plants and showed inherent mechanisms at work that retained the more hazardous fission products, like radioiodine. Xenon 133 and iodine 131 inventories in the Three Mile Island were comparable. Yet 2.4-13 megacuries of xenon escaped to the environment and only 13-18 curies of iodine similarly escaped. Stratton of LASL and Campbell of ORNL have suggested some unusual behavior of iodine in the TMI Accident that resulted in abnormally low releases. This was attributed to an inherent reducing chemistry common to pressurized water reactors. This observation may cause a significant reevaluation of the regulatory guides for nuclear reactors and the safety of civilian reactors.

In closing, I would like to express my appreciation for the efforts put forth by all those who helped organize this Conference. Thank you for your time, and I wish you much success in this meeting.

THE IMPACT OF THE ACCIDENT AT TMI-2 ON NEW SAFETY REGULATIONS

John T. Collins
Deputy Director
TMI Program Office
Office of Nuclear Reactor Regulation

Good morning and thank you Mr. Chairman for those kind remarks.

It is indeed a real pleasure for me to be here and to participate in the 16th DOE Air Cleaning Conference. I am particularly pleased, since, as your Chairman indicated, this is a turning point in my career, for I will be leaving TMI by the end of the year, where I have been since the second day after the accident and will take up a new assignment as Deputy Director of our Regional Office in Arlington, Texas. Although I won't be as close to the air cleaning industry as I have been over the past 25 years, I can assure you that I intend to keep keenly aware of activities that may impact on these systems, and you can expect to see me at future Air Cleaning Conferences.

Your preliminary program indicated that Harold Denton, the Director, Office of Nuclear Reactor Regulation, would be here to give this keynote speech. However, due to circumstances beyond his control, he was not able to attend. He did ask that I convey his regrets and extend to you his best wishes for a successful conference. Over the years Harold has closely followed the formal precedings of past Air Cleaning Conferences and has supported staff participation in its functions and will continue to do so in the future. I can also assure you that the technical papers to be discussed at this conference will receive careful consideration by the staff of ONRR and, as appropriate, will be included in the development of new rules, regulations, criteria and guidelines for air cleaning systems for use in nuclear power plants in the years to come.

If we look back since we adjourned the 15th Air Cleaning Conference, a lot has happened in the nuclear industry that has affected all of us to some degree and will greatly affect the industry in the years to come. Most noteably, of course, was the accident at Three Mile Island Unit-2. It is my intent today to share with you what the impact of the accident at TMI-2 has been on safety regulations, which have been or may be imposed on the nuclear industry by the Nuclear Regulatory Commission.

Following the accident at TMI-2, the NRC developed a comprehensive and integrated Action Plan for the items judged necessary to correct or improve the regulation and operation of nuclear facilities based on the experience from the accident at TMI-2 and the official studies and investigations of the accident. This Action Plan was published in May 1980 as NUREG-0660.

Some of the groups that investigated the accident included the Congress, the General Accounting Office, the President's Commission on the Accident at Three Mile Island (Kemeny Report), the NRC Special Inquiry Group (Rogovin Report), the NRC Advisory Committee on Reactor Safeguards (ACRS), the Lessons-Learned Task Force, the Bulletins and Orders Task Force of the NRC Office of Inspection and Enforcement, the NRC Staff Siting Task Force and Emergency Preparedness Task Force and the NRC Offices of Standards Development and Nuclear Regulatory Research. The Action Plan collects the recommendations of these groups into five main chapters namely: Operational Safety, Siting and Design, Emergency Preparedness and Radiation Effects, Practices and Procedures, and NRC Policy, Organization and Management.

Certain actions to improve the safety of operating nuclear power plants were judged to be necessary immediately after the accident and could not be delayed until an Action Plan was developed, although they were subsequently included in the Action Plan. Such actions came from the Bulletins and Orders issued immediately after the accident, the first report of the Lessons-Learned Task Force issued in July 1979, the recommendations of the Emergency Preparedness Task Force and the NRC Staff and Commission. Before these immediate actions were applied to operating plants, they were approved by the Commission. Many of the required immediate actions have already been taken by licensees and most are scheduled to be complete by the end of 1980.

All the investigations agree that, although the accident resulted from many factors, the most significant was in the broad general area, which is called operational safety. Operational safety includes the number of staff and their organization, qualifications and training, as well as the inspection and licensing of both the operating staff and the management of the plant. The general conclusion is that these areas, which reflect the human element in reactor operation and safety, have been underemphasized relative to the hardware - that is, the components, equipment, systems and structures.

The plan presents actions which are directed toward increasing operational safety with two objectives in mind. The first is to improve the operation of the plant, so that the number of events that could lead to accidents is reduced. The second is to improve the ability of the operating staff to recognize such events and take appropriate corrective actions. The first objective, preventing the causes of accidents, is addressed through improvements in the selection and training of not only the operators, but all the plant staff, and improvement in utility management techniques and capabilities. Specific improvements are required in the content and level of training courses, in the use of plant simulators, in operating procedures, and in the design of the controls and instrument displays in the control room. These specific improvements both reduce the incidence of accident situations and increase the ability of the operating staff to arrest an accident before any serious consequences result. Improvements in the evaluation of operating experience and the auditing of day-to-day plant operations are also to be instituted to help the plant technical support staff and management in preventing accidents.

Although there is general agreement that operational safety merits primary emphasis means of improving current plant designs were also identified in studies of the accident and should not be overlooked. The accident reemphasized the importance of high system reliability, even though there were no significant equipment failures other than the relief valve on the pressurizer. Therefore, the Action Plan contains requirements for the assessment of the reliability of some of the engineered safety features (e.g., auxiliary feedwater, emergency core cooling, containment isolation, and decay-heat removal, including natural circulation) and an overall assessment of accident probabilities and consequences using simplified reliability analyses for all plants. These analyses are directed toward identifying and correcting specific weaknesses in current designs.

The Action Plan also contains studies of the desirability of additional requirements and safety systems to reduce the risk from accidents in which there is significant melting or degradation of the core, such as occurred during the accident at TMI. For example, the plan includes continuation of the NRC work of changing its siting requirements to reestablish distance between population centers and reactors as a safety feature. The plan also contains interim improvements and rulemaking on the capability of nuclear power plants to mitigate the consequences of accidents in which the core is severely damaged, and a long-term study of the possibilities for mitigating accidents. The interim improvements include reducing the possible leakage of highly radioactive material, improving shielding to permit access to important areas, providing better means of sampling the reactor coolant and containment atmosphere, adding or increasing the range of instruments so that accident conditions can be monitored, and providing the operating staff with training in the capability and use of the currently installed systems.

Of major concern during the accident at TMI was the quantity of hydrogen released, which was much greater than the amount that is required to be considered under the current NRC rules. The plan includes an interim rulemaking action to consider the need for interim hydrogen control features for small containment structures where the potential for ignition of hydrogen is the greatest and other interim consequence mitigation features for accidents involving core damage.

The investigations of the accident have shown the need for improvements in the protection of the public from radiation, including improved monitoring of radioactive effluents from plants, better radionanalytical measurements and more rapid estimation of offsite doses, and control of the release of radioactivity into the atmosphere. The investigations have also shown the need to improve radiation protection of workers, particularly under the accident conditions. Thus, the plan includes improvements in radiation protection plants, health-physics operations, inplant radiation monitoring, and the habitability of control rooms, all intended to keep the exposures of workers during both normal operations and accidents as low as reasonably achievable.

In addition to the areas discussed above, which primarily address requirements for licensees, the self-examination by NRC that followed the accident identified necessary improvements in the regulation of nuclear power plants. One area of improvement is the formulation, issuance, and enforcement of NRC requirements. In this area, better rulemaking procedures, periodic reevaluation of rules, and more efficient means of issuing requirements are to be sought. Authority for increased civil penalties is being sought, and currently available sanctions are to be more effectively applied as a means of improving enforcement. Training of inspectors is also being improved.

Another area of improvement is in the early identification, assessment, and resolution of safety issues. Research on the quantification of safety goals, a program to resolve generic issues, and a better means of resolving issues relating to plants under construction are closely associated actions included in the plan.

Studies are also included to determine what actions, if any, should be taken regarding the possible effects on safety of economic factors, such as, Internal Revenue Service and Public Utility Commission rules, the ongoing systematic assessment of the safety of operating reactors, and the extension of the lessons learned from TMI to other areas regulated by NRC.

The plan also contains actions to be taken by the Commission to revise present policies, procedures, and organization to more effectively accomplish the mission of the agency. These include articulation of a safety goal or safety policy objective, evaluation of the licensing process to reduce delays, but permit reasonable review and appeal, increased public participation, and examination of the Commission's role in safety regulation. The need for legislation to modify the Commission's authority and procedures during emergency situations will be studied. Also, included are studies of the role, functions and organization of the Commission and the offices, so as to increase the application of human factors of principles and integrated systems engineering, increase the effectiveness of inspection and enforcement, increase the effective-ness of advisory committees, such as, the ACRS, the increase staff technical capabilities, and more effectively identify and assess safety issues.

As described above, a number of TMI related requirements were approved in the late summer of 1979 and issued to operating reactor licensees. A list of additional requirements was developed in January and February 1980 for use on pending operating license applications. It was tentatively approved by the Commission in early February 1980. The short-term operating reactor requirements and the additional new operating license conditions constitute the complete set of TMI related requirements that must be met before a new plant can receive an operating license. This complete set of requirements has come to be called the near-term operating license requirements list or NTOL list.

In addition to the NTOL list, there are a number of studies and criteria development activities that will eventually lead to additional TMI related requirements to be issued by the NRC in the future. An important question for these additional requirements concerns the timing and other characteristics of their implementation.

In the year since the accident, NRC policy on the short-term urgent actions (the bulletins and orders, the short-term lessons learned, and emergency preparedness actions) have been one of prompt implementation at the possible expense of some operating plants. These urgent actions were judged to be necessary for public health and safety. In the development and refinement of the Action Plan over the past five months, the staff, the Commission and the ACRS have had opportunity to review and reconsider, as appropriate, the urgent short-term requirements in the broad context of the recommendations from all the official studies of the accident and the actions proposed by the staff in response to those recommendations. The result has been that, within the set of additional requirements for new operating licenses, there are only a few short-term requirements to be added to the short-term lessons learned list for operating plants. This tends to confirm a judgment that the most important and urgent actions requiring prompt implementation have been identified.

This in turn leads to a judgment that most of the remaining changes need not be implemented as urgently as those already required. That is, the prompt application of the most important lessons learned over the past year has afforded NRC the opportunity to continue to pursue further changes at a more deliberate pace over the next several years. Such changes may be necessary for long-term improvement in safety or for maintenance of improvements already gained in the short term. Some people have suggested an additional reason to be more deliberate in our development of future changes; that is, the need to avoid counterproductive actions because of finite resources or, worse yet, changes that are unsafe because they were inadequately studied. It is acknowledged, however, that there are some items in the Action Plan (control room design being the best example) that need to be implemented, as quickly as they can be done correctly. Such items require a substantial time period for careful development of soundly based criteria and cannot be rushed without weakening or compromising their effectiveness. In such cases, short-term or interim improvements in safety have been required pending criteria development.

Although the Action Plan specifies the actions required of the licensees, NRC encourages utilities to form groups that would perform the necessary studies and analyses generically. Individual licensees and applicants could then adopt these as necessary.

The accident at TMI-2 told us, among many other things, that we didn't really know all there was to know about air cleaning. In retrospect, we found that the air cleaning systems at TMI-2 behaved pretty much as expected. There were a few surprises, such as the unexpected degree of retention and buildup of radioactive noble gases in the charcoal adsorbtion media, and such as false alarms on particulate and iodine effluent monitors -- also attributable to retention of noble gases. Radioactive gases showed up in places they weren't anticipated and in volumes and concentrations much larger than expected. On the other hand, radioiodine in the plant effluent streams was only a small fraction of what had been expected.

The HEPA systems performed very well and there is no evidence that any significant quantities of particulates escaped from the plant - at least not within the sampling and analytical capabilities of licensee contractors and of the NRC. On the other hand, the release, or generation, of airborne particulates within the plant was so small that there was essentially no challenge of the HEPA system.

Early on in the accident, there was great concern that the charcoal adsorbers had been severely degraded by weathering and by probable exposure to paints, organic solvents, and other industrial contaminants during the latter phases of plant construction. HEPA filters and adsorbers had been installed approximately 18 months prior to the accident -- or approximately 12 months prior to fuel load. Filters and adsorbers had been tested upon installation, but had not been subsequently tested, even though the environment during that period was subject to the contaminants noted.

Early in the TMI-2 accident, lab tests indicated that the charcoal was only removing about 56 to 70% of methyl iodide (NUCON 6 MTG 611/04, May 25, 1979). Subsequent analyses, however, showed the charcoal to be removing about 90% of all I-131 passing through the adsorbers -- but note that this is with what is assumed to be severe degradation of the charcoal.

Sampling of the containment atmosphere at TMI-2 was made very difficult by design conditions relative to the sampling system. NUREG-0578 pointed up some of the problems involved and NRC has implemented a program to improve or replace existing sampling systems. Many plants are going to inline sampling and analysis systems to reduce radiation doses to plant personnel, which was a big problem at TMI-2 in getting the needed samples and analyzing the samples once taken.

<u>TMI-2 Experience</u>

1. Containment concept held up well - no releases attributable to containment leakage.

2. Report of pumpover of fluid from containment to auxiliary building was correct, but this is not a significant source of acitvity. Did contribute to liquid inventory and later problems.

3. In-plant (outside of containment) leakage the main source of plant effluents, both liquid and gaseous, arose principally from systems with leakage problems. Example: letdown system was used for core heat removal in early part of accident. As the fluid was "letdown" to the makeup tank, the dissolved noble gases "degassed" from the fluid, and as the tank level rose, the displaced gas was pumped into the waste gas header. The waste gas header had several leaks, the cumulative effect of which was to release a volume of air or gas containing a high concentration of noble gases, together with a relatively small amount of radioiodine. The released gases

were picked up in the building ventilation system, which treated exhaust gases through HEPA filters and a 2-inch bed depth of KI impregnated activated charcoal. One disturbing factor was inadequate balancing of airflow patterns in the buildings. Gases released in the auxiliary building diffused into the fuel handling building and some radioactive gases entered the Unit 1 auxiliary building. This points up a need for improved balancing of airflow patterns in nuclear facilities. Simply designing buildings to provide for controlled airflow patterns, e.g., flow should always be from clean areas to radioactive areas, is not enough. Plants must assure that doors meant to be closed are actually closed. In some cases, actual physical barriers must be erected between buildings -- the use of open passageways between buildings should be discouraged.

Testing of airflow patterns in TMI-2 exhaust ducts showed that laminar flow conditions existed under circumstances that should have provided for turbulent flow -- but didn't (Jim Cline, SAI). Runs of ducting up to several hundred feet in length maintained laminar flow conditions over their entire length. Of course, this did not contribute in any material way to controlling or modifying the release, but the implications for inadequate mixing in ducts could lead to over or under estimations of radioactive gaseous releases, depending on relative position of probe(s) to location of laminar layer containing a high concentration of gas.

Effluent Monitoring

TMI-2 effluent monitors went off-scale during the accident. Off-scale readings on the iodine and particulate monitors were false alarms in that almost all the activity recorded as iodine or particulate was actually attributable to noble gases.

NRC now requires installation of high range noble gas monitors with range adequate to stay on-scale for any possible accident. Iodine and particulate monitoring under accident conditions is recognized as a problem area. At this time, NRC feels real-time monitors are beyond state-of-the-art and is requiring that plants sample their effluents continuously and have the capability to remove and analyze or measure accident-level samples.

In-Containment Radiation Monitor

The high level in-containment radiation monitor at TMI-2 was a 10,000 R/hr ion chamber, to which a two-inch thick lead shield was added for the purpose of reducing radiation of 10^6 R/hr, by a factor of 10^2 down to 10^4 R/hr. What was not recognized was the fact that much of the radiation present in containment after the accident will be of low energy. The factor of 10^2 reduction was approximately correct for 1 MeV gammas, but was overly conservative for low-energy gammas. The actual radiation level in containment was probably under-estimated by as much as a factor of 10^5 to 10^6. New instrumentation requirements of NRC call for a maximum range of 10^7 R/hr with response down to at least 60 keV.

Noble Gas Retention in Charcoal

It is well known that noble gases are retained by charcoal. What was not well recognized by many was the potential for retention of noble gases in ventilation treatment charcoal adsorbers and sampling cartridges.

NRC is recommending the use of silver zeolite cartridges for sampling/monitoring applications because zeolite has a very low retention for noble gases and high retention for iodine.

What can be expected from the NRC in the years to come that may affect Air Cleaning Systems

1. The Commission has requested that the staff evaluate the feasibility of a transportable noble gas recovery system using the Oak Ridge Fluorocarbon Selective Absorption Technology.

2. We will continue to support research on the effects of weathering of charcoal during accident conditions.

3. We may possibly require licensees to evaluate ventilation/filtration systems in the auxiliary and radwaste buildings.

4. We may even require licensees to install filtration systems in auxiliary and radwaste buildings ventilation exhaust, if not present.

5. We may require surveillance of non-ESF filtration systems.

6. We plan to conduct a study of radwaste systems and the capability of these systems to process accident related liquids and gases and to conduct decontamination.

7. We plan to support research on the phenonmenon associated with core degredation and fuel melting. Included in this would be:

a. In-pile testing to evaluate the effects of conditions leading to severe fuel damage - at RBF.

b. Hydrogen formation and consequences in terms of pressure, time histories and hydrogen deflagration or detonation.

c. Post-accident coolant chemistry.

d. Modeling of severe fuel damage including fission product release.

e. Behavior of core melt.

f. Radiological source term.

g. Fuel coolant interactions.

h. Mitigation features (core catchers and vented/filtered containment purge systems).

In summary, the NRC has been very busy, since the accident, looking into the causes surrounding the events that occurred on the morning of March 28, 1979. To date, we have implemented the Short-Term Lessons Learned and have provided a schedule for implementing the Long-Term Lessons Learned. Some of these requirements have resulted in delays in licensing of new plants and the temporary shutdown of some operating plants. However, the NRC believes these new requirements are essential to increase the safety of nuclear power plants and to protect the health and safety of the public.

Although the accident occurred almost 19 months ago, the cleanup of TMI-2 continues and will continue for the next 5 to 7 years. As the cleanup progresses and ultimately the fuel removed, we will continue to learn from the information generated by this program. This information will be factored into the licensing process.

If nuclear power is to remain a viable option as a source of electrical power in the United States, then we must continue to assure the general public that these plants can be operated safely from the lessons learned at TMI and that systems required to mitigate the consequences of accidents will indeed perform their intended functions. I am confident that you, who represent a significant part of the nuclear industry, will continue to support our efforts in this regard.

Again, I want to thank you for the opportunity to address this group and extend to you the best wishes of the Nuclear Regulatory Commission for a very fruitful and productive conference.