UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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In the matter of: :
METROPOLITAN EDISON COMPANY : Docket No. 50-289 (Restart)
(Three Mile Island Unit 1) :
- - - - - - - - - - - - - - - - - - :

25 North Court Street,
Harrisburg, Pennsylvania

Thursday, February 19, 1981

Evidentiary hearing in the above-entitled matter was resumed, pursuant to adjournment, at 9:05 a.m.

BEFORE:

IVAN W. SMITH, Esq., Chairman,
Atomic Safety and Licensing Board

DR. WALTER H. JORDAN, Member

DR. LINDA W. LITTLE, Member

Also present on behalf of the Board:

MS. DORIS MORAN,
Clerk to the Board

APPEARANCES:

On behalf of the Licensee, Metropolitan Edison Company:

GEORGE F. TROWBRIDGE, Esq.
ERNEST BLAKE, Esq.
DEBORAH BERNSTEIN, Esq.
Shaw, Pittman, Potts and Trowbridge,
1800 M Street, N.W.,
Washington, D. C.

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On behalf of the Commonwealth of Pennsylvania:

ROBERT ADLER, Esq.
Assistant Attorney General,
505 Executive House,
Harrisburg, Pennsylvania
WILLIAM DORNSIFE,
Nuclear Engineer

On behalf of the Pennsylvania Public Utilities Commission:

JOHN LEVIN, Esq.,
Pennsylvania Public Utilities Commission,
P.O. Box 3265,
Harrisburg, Pennsylvania

On behalf of Three Mile Island Alert

LOUISE BRADFORD
JOHN MURDOCH

On behalf of the Regulatory Staff:

JAMES TOURTELLOTTE, Esq.
DANIEL SWANSON, Esq.
Office of Executive Legal Director,
United States Nuclear Regulatory Commission,
Washington, D. C.

Petitioners for leave to intervene _pro se_:

JANE LEE,
R.D. 3, Box 3521,
Etters, Pennsylvania

NORMAN AAMODT,
R.D. 5,
Coatesville, Pennsylvania

MARVIN LEWIS,
6504 Bradford Terrace,
Philadelphia, Pennsylvania

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C O N T E N T S

WITNESS:	DIRECT	CROSS	REDIRECT	RECROSS	BOARD	CROSS ON BO.
William S. Lee						
By Mr. Blake	13,250					
By Mr. Swanson		13,252				
By Mr. Blake			13,255			
By Chairman Smith					13,258	
By Mr. Dornsife				13,262		
By Dr. Jordan					13,263	
By Dr. Little					13,269	
By Dr. Jordan					13,271	
By Chairman Smith					13,273	
By Dr. Jordan					13,275	
By Chairman Smith					13,276	
By Mr. Adler				13,281		
William Wegner						
By Mr. Blake	13,283					
By Mr. Adler		13,285				
Murray Miles						
By Mr. Blake	13,292					
By Mr. Adler		13,295				
By Dr. Little					13,300	
By Chairman Smith					13,309	
By Dr. Little					13,309	
By Chairman Smith					13,314	
By Dr. Little					13,320	
By Mr. Murdoch		13,324				

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WITNESS:	DIRECT	CROSS	REDIRECT	RECROSS	BOARD	CROSS ON BO.
Robert A. Koppe						
By Mr. Blake	13,336					
By Dr. Little					13,339	
By Chairman Smith					13,341	
By Mr. Adler		13,342				
By Mr. Dornsife		13,344				
By Mr. Adler		13,346				
By Mr. Dornsife		13,353				
By Mr. Adler		13,353				
By Mr. Dornsife		13,367				
By Mr. Adler		13,372				
By Mr. Dornsife		13,377				

C O N T E N T S (Continued)

P R O C E E D I N G S

MR. BLAKE: Mr. Smith, one preliminary matter. I have spoken with Mr. Zahler with regard to the schedule on emergency planning. His recollection is that at the time emergency planning schedule was discussed, it was Licensee's position that two weeks would be sufficient. His recollection is also that the Intervenors collectively wanted something like four weeks and that the Board ruled three weeks would be the time period.

With that sort of a history, Mr. Zahler does not think it would be fruitful to go back and reduce it. Anything more than what is established having been filed, I believe on February 9, March 3 would be the three-week interval, and he would rather just establish that it would start next -- a week from next Tuesday, on March 3, and not attempt to go back and try to fit in a day's worth or a couple of days' worth at the end of next week.

He also will undertake to notify the Intervenors that emergency planning will likely begin on that day, on that Tuesday. To the extent we finish TMIA 5 and other management business prior to the end of next week, it will result in a window and study time for everybody in preparation for emergency planning.

CHAIRMAN SMITH: Very good.

MR. BLAKE: Mr. Smith, Licensee calls Mr. William

S. Lee.

Whereupon,

WILLIAM S. LEE

called as a witness by counsel for the Licensee Metropolitan Edison Company, having first been duly sworn by the Chairman, was examined and testified as follows:

EXAMINATION

BY MR. BLAKE:

Q Mr. Lee, would you state your name and business address, please?

A My name is William S. Lee. My business address is 422 South Church Street, Charlotte, North Carolina.

Q Mr. Lee, I show you a copy of a document entitled "Licensee's Testimony of William S. Lee Regarding CLI-80-5 Issue (10)," subtitle "Management Response to TMI-2 Accident," dated LIC 01-19-81, a document comprised of 12 pages, and ask whether or not this document was prepared by you or under your direct supervision?

A This document was prepared by me and under my supervision.

Q Mr. Lee, I ask you whether or not you have any corrections which you want to make to this?

A I have no corrections.

Q I ask whether or not you adopt this as your testimony in this proceeding, including the statement regarding your qualifications and background which appear on pages 1 and 2 in this document?

A I do adopt this.

MR. BLAKE: Mr. Smith, I ask that the document entitled "Licensee's Testimony of William S. Lee Regarding CLI-80-5, Issue (10)" be physically incorporated into the record just as if read.

CHAIRMAN SMITH: The testimony is received.

(The document, the testimony of William S. Lee, follows.)

LIC 01/19/81

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
METROPOLITAN EDISON COMPANY	)	Docket No. 50-289 SP
	)	(Restart)
(Three Mile Island Nuclear	)	
Station, Unit No. 1)	)	

LICENSEE'S TESTIMONY OF

WILLIAM S. LEE REGARDING

CLI-80-5, ISSUE (10)

(MANAGEMENT RESPONSE TO TMI-2 ACCIDENT)

OUTLINE

The purpose and objective of this testimony is to respond to Issue (10) of the Commission Order CLI-80-5, which questions whether the actions of Metropolitan Edison's corporate or plant management (or any part or individual member thereof) in connection with the accident at Unit 2 reveal management deficiencies that must be corrected before Unit 1 can be operated safely. The testimony, by William S. Lee, President and Chief Operating Officer of Duke Power Company and Chairman of the Board of Directors of INPO, describes Mr. Lee's extensive experience in the utility industry and, in particular, with nuclear power plants; his direct involvement as deputy to Mr. Herman Dieckamp, President of GPU, in overseeing the activities relating to the containment of the TMI-2 accident and its consequences; and his conclusions as to the management capability of Licensee. Mr. Lee concludes that based on his first-hand knowledge, as well as standard indices applicable to all nuclear utilities, Licensee has demonstrated that it has the necessary technical qualifications, leadership qualities, and organizational skills to safely operate TMI-1, and that the actions of Licensee in connection with the accident at Unit 2 do not reveal management deficiencies that must be corrected before Unit 1 can be operated safely.

My name is Mr. :illiam S. Lee. I am President and Chief Operating Officer .f Duke Power Company, and Chairman of the Board of Directors of the Institute of Nuclear Power Operations. ..y testimony addresses the following issue:

CLI-80-5, ISSUE (10)

Whether the actions of Metropolitan Edison's corporate or plant management (or any part or individual member thereof) in connection with the accident at Unit 2 reveal deficiencies in the corporate or plant management that must be corrected before Unit 1 can be operated safely.

I am a graduate engineer, having obtained a Bachelor of Science degree in Engineering, magna cum laude, from Princeton University in 1951. Following my graduation from Princeton, I served in the United States Naval Reserve from 1951 to 1954, and was a participant in the Navy's nuclear program. I joined Duke Power Company in 1955, and served as Engineering Manager from 1962 to 1965, Vice President - Engineering from 1965 to 1971, Senior Vice President from 1971 to 1976, Executive Vice President from 1976 to 1978, and President from 1978 to the present time. Duke Power Company is the only privately-owned electric utility in the country that designs and constructs its own generating facilities. Throughout my entire career with the Company I have been actively engaged in those activities.

I am a registered professional engineer in North Carolina and South Carolina, a Fellow of the American Society of Mechanical Engineers (and was awarded the George Westinghouse gold medal by that Society), a Fellow of the American Society of Civil Engineers, and a member of the National Academy of Engineering, the National Society of Professional Engineers (and was named the nation's outstanding engineer by the NSPE in 1980), the American Nuclear Society (and received that Society's Walter H. Zinn award in 1980), the North Carolina Energy Policy Council, the Energy Resources Executive Committee of the Edison Electric Institute and the U.S. Committee on Large Dams. I am chairman of the Board of Directors of the Institute of Nuclear Power Operations ("INPO") headquartered in Atlanta, Georgia. I am past Chairman of the Charlotte Chamber of Commerce, and currently serve as a Director of the Charlotte United Community Services and as a Trustee of Queens College.

At the end of 1979, Duke Power Company's gross assets were approximately $5.6 billion, its generating capacity was approximately 12,000 MW, and the peak load which it had experienced was 9,844 MW. Its 1979 annual revenues were approximately $1.6 billion. By most measures, Duke Power and the General Public Utilities System ("GPU") are roughly equivalent in size.

Duke Power Company is the owner and operator of three nuclear generating units at its Oconee Station which were placed in service in 1973 and 1974. In my various capacities at Duke Power, I have been actively involved in the design, construction and operation of those three Oconee units. Moreover, Duke Power has under construction or in operation six additional nuclear units with an aggregate capacity of 7,000 MW, and I have been actively involved in matters relating to these units.

The three Oconee units employ nuclear steam supply systems manufactured by Babcock & Wilcox ("B&W"). They are essentially similar to the Three Mile Island Units operated by Metropolitan Edison Company ("Met Ed"). Shortly after the Three Mile Island Unit 2 accident on March 28, 1979, the GPU Companies requested my assistance in dealing with the accident and its aftermath. I went to Three Mile Island on April 4, 1979 and, for a time, served in substance as deputy to Mr. Herman Dieckamp, President of GPU, who was overseeing the activities relating to the containment of the accident and its consequences and bringing the unit to a cold shutdown mode. In that capacity, I worked very closely not only with Mr. Dieckamp, but also with Mr. Robert C. Arnold, GPU Service Company Generation Vice President, Mr. Jack Herbein, Met Ed Generation Vice President, and Mr. Gary Miller, TMI Station Superintendent.

One of the activities that Mr. Dieckamp had initiated before I reached Three Mile Island was the assembly from a variety of sources in the United States and abroad of an Industry Advisory Group (sometimes also referred to as the "think tank") designed to bring to bear upon the accident all the knowledge and analytical skills that would be useful in containing the accident and achieving cold shutdown of the

Unit. The members of that group included outstanding engineers, scientists and fuel systems and technology specialists from the National laboratories, major nuclear utilities, equipment manufacturers, and research and testing organizations. In all, there were approximately 250 participants in the Industry Advisory Group at the peak of its activities. As part of my work at Three Mile Island, I also worked with the Industry Advisory Group.

I have been informed that one of the issues in these proceedings is the capability of the management of the Licensee, including whether the actions of Met Ed's corporate and plant management in connection with the accident at TMI-2 reveal deficiencies that must be corrected before Unit 1 can be operated safely. It is the purpose of my testimony to address that issue as it relates to the capability of the GPU Companies' management with respect to the Three Mile Island Units, before, during, and, in important respects, subsequent to the accident.

Based on my experience in working with Messrs. Dieckamp, Arnold, Herbein and Miller, I believe them to be very capable managers of the nuclear activities at Three Mile Island. They possess technical qualifications, leadership qualities, and organizational skills which are outstanding. They also have demonstrated effective abilities to respond to a crisis environment with objectivity and calm.

The Three Mile Island accident and its aftermath presented GPU with a series of problems which had never before been experienced by any nuclear operating organization. Not only were the pressures of the event extreme; they were compounded by the constant demands of the media, the series of investigations by the NRC, and other Federal and State agencies, Congressional and legislative committees, and the like.

By agreement, Mr. Harold Denton of the NRC was the principal spokesman about the progress of activities at the Island. However, the actual conduct of the activities involved in containing the accident and bringing the unit at first to a stabilized condition and then ultimately to a cold shutdown was under the direction of the GPU management drawing, of course, upon the resources available to it from the Industry Advisory Group and others, such as myself, that the GPU companies had assembled to assist them in their efforts. It was a most challenging technical and organizational task. It was accomplished with great skill and steadfast purpose under conditions which were difficult and trying. Everyone involved, and particularly the GPU team, worked extremely long hours seven days a week. The senior GPU personnel provided judgment, leadership, coordination, and an ability to interface with the great number of individuals and organizations that were involved in this extraordinary undertaking.

The assembly of the Industry Advisory Group was an example both of the forsightedness of the GPU management and of the respect which they enjoyed throughout the industry. Very early on, GPU management recognized the wisdom and necessity of mobilizing a great variety of skills and knowledge to be available in diagnosing the nature of the accident and its consequences and the remedial steps to be taken. In virtually no time at all, they had brought into being an effective ad hoc group to supplement their own substantial resources which then addressed the series of problems, both real and potential, that had to be solved in achieving containment of the accident and cold shutdown. Many of the individuals who responded knew members of the GPU team as a result of prior experience in other activities and this both facilitated their early response and made their contributions more effective. When this was not the case, the reputation which the GPU management group had in the industry also helped to bring the Industry Advisory Group and other groups on-site the full complement of talents required.

I now intend to discuss some of the pre-accident activities of GPU as they bear upon the qualifications of the GPU companies' management of the nuclear activities at Three Mile Island.

In my judgment, the GPU companies demonstrated an admirably disciplined and well-conceived approach when they embarked upon the exploration of the employment of nuclear generation in their service area, in response to the National policy expressed in the Atomic Energy Act of 1954. The first GPU nuclear unit was the small experimental unit which they installed at Saxton, Pennsylvania.

In my view, this represented a responsible and prudent way to investigate the practical aspects of a potential promising new technology. I also believe that the decision to minimize investment costs by limiting the new facilities at Saxton to the nuclear steam supply and associated items and utilizing a small existing turbo-generator that was ready for retirement was imaginative and, again, a demonstration of sound management. This matched almost exactly Duke Power's entry into the nuclear business with a small, experimental reactor system hooked onto an existing turbo-generator.

The small Saxton nuclear generating unit was a significant contributor to the development of nuclear technology, and particularly in the training of operators. The GPU companies demonstrated the importance that they attached to operator training and performance by making the Saxton unit available for operator training to a number of other utilities in the United States and abroad.

With the Saxton project in being, the GPU companies explored the question of whether nuclear technology had become economically feasible for their service area. They furnished to the AEC and the Joint Committee on Atomic Energy a detailed report setting forth the basis on which they had concluded that they should proceed with the Oyster Creek project. I have not read that report for some time, but I remember that when it was issued about 15 years ago, I was very much impressed with the efforts that had been made to make an objective evaluation and to set forth all the elements involved so that governmental officials and others could reach their own conclusions. The Oyster Creek generating unit has been an outstanding success. I understand that, in the first decade of its operation, the cost of fuel for Oyster Creek had been about $82 million and that the fuel cost of alternative oil-fired generation during that same period would have been about $670 million, and that the net saving in cost to GPU's New Jersey customers from the operation of Oyster Creek as against an oil-fired unit during this first decade has been in excess of $400 million. I have not independently verified these numbers, but based on my general experience, I regard them as reasonable. From my perspective, this type of performance demonstrates management capability.

The next nuclear generating unit installed by the GPU System was Three Mile Island Unit No. 1, placed in service in September 1974. The nuclear steam supply system for TMI-1 is, as I mentioned earlier, a B&W unit similar to the Oconee units. The NRC "Grey Book" reports that the average capacity factor for the TMI-1 unit through 1978 was 76%, as against an industry average derived from the "Grey Book" of 63%.

In general, the operating efficiency of the Oyster Creek and TMI-1 units was well above the national average. In my opinion, the performance of the Oyster Creek and TMI-1 units demonstrate superior capability on the part of the GPU management. I know that, at Duke, we admired the capacity factor achieved by TMI-1, as it somewhat exceeded the average of our three units at Oconee with similar reactors.

Another yardstick by which to measure capability in the management of the nuclear units would be in the training of operators, staffing level and levels of expenditure for operation and maintenance purposes. For this purpose, it is important to focus on the views held before the TMI-2 accident rather than apply hindsight today.

Before the accident, there was a widely held view that the NRC standards for licensing of operators and their performance were a sound basis for evaluating management capability in that area. Similarly, there was a widely held view that the NRC inspection and audit of operating procedures provided an objective validation of the adequacy of these operating procedures. From my perspective, in the pre-accident period I would have believed that a company was demonstrating management capability and that it was devoting substantial efforts to safe and effective management of its nuclear units in these areas if:

1. The failure rate on licensing examinations of its operators was less than the average failure rate of the industry as a whole; in fact, the failure rate on such examinations of the TMI operators was only half of the industry average.

2. The size of its operating and maintenance staff was larger than the industry average; the 1978 EEI survey disclosed that the TMI staff was the second largest out of 27 similar plants.

3. The level of its expenditures for operations and maintenance was above average; in fact, the FERC reports that the 1975-1977 period indicate that TMI operations and maintenance expenditures were among the highest for similar plants.

4. The NRC inspection and audit review of the plant procedures had not found serious deficiencies in those procedures; in fact, the report of the Office of the Chief Counsel to the Kemeny Commission on the Role of the Utility and its Suppliers states that a team of NRC inspectors had conducted an 11-day audit of TMI-2 procedures and found no items of non-compliance or discrepancies in format. Since the TMI-2 procedures were based on the TMI-1 procedures

and the record of the performance of TMI-1 was outstanding, this favorable result of the NRC audit would have been particularly reassuring.

5. Attention was paid to simulator training of licensed operators; in fact, GPU had provided simulator training to its operators that I understand was at least equal to the average in the industry. Thus, while NRC standards did not require simulator training for all the operators and most companies had not provided such training for all operators, each of the TMI-2 operators on duty at the time of the accident had simulator training.

In the wake of the accident, the entire industry has made, and is making, a number of changes in operator training, size of staff, qualifications of personnel, monitoring and audits of performance, design of safety systems, dissemination of information and emergency preparedness, all to provide greater assurance of safe performance. Starting with the NRC, we have all been busy implementing lessons learned from the accident. As have other utilities, GPU has conducted a comprehensive operator retraining and requalification program.

I have reviewed GPU's proposed organizational structure for consolidating nuclear activities into the new subsidiary GPU Nuclear Corporation. Based upon my management experience, it is my view that this is a strong management concept that can be effective in providing an integrated single minded approach which will give additional assurances of safety.

I also have admiration for the technical and management capabilities of the three top executives of the proposed GPU Nuclear Corporation. Having known Messrs. Dieckamp and Arnold for years, I have personally witnessed their strengths and innovative leadership during both normal times as well as circumstances of uncanny stress. Whereas I have known Mr. Clark for a shorter period, I have personally reviewed his background and experience record and participated in interviewing him. As he knows, we at Duke Power were prepared to offer Mr. Clark a significant management post in our company before he decided to join the GPU organization. I feel that we at Duke have a strong team, and that Mr. Clark could have made us stronger. Thus, with a strong organizational plan and with excellent management capabilities at the top, I conclude that GPU has two of the most important ingredients for success and safety.

In summary, it is my judgment that the GPU management has demonstrated strong capability in the preparation for, and conduct of, its nuclear program, in the handling of the TMI-2 accident and its aftermath, and in organizational planning and top-level manning in preparation for ongoing nuclear activities.

MR. BLAKE: Mr. Smith, I have no additional direct. Mr. Lee is available for cross examination.

CHAIRMAN SMITH: Mr. Adler?

MR. ADLER: We have no questions.

CHAIRMAN SMITH: Mr. Swanson?

MR. SWANSON: I really only have one question.

CROSS EXAMINATION

BY MR. SWANSON:

Q I was wondering, Mr. Lee, if you could in a little more detail describe the relationship that you had with the Licensee following the accident, the type of responsibilities that you exercised?

A I arrived at the accident site on April 4. The recovery team at that point in time was under a reorganization to gear itself for a longer run. I was asked by Mr. Koons and Mr. Dieckamp to assume the role of deputy president to Mr. Dieckamp. The recovery team reported to me and to Mr. Dieckamp.

Q Yes, I understand that from the written testimony. I was wondering if you could perhaps just explain, I guess, the extent of your own personal involvement, you know, the level of -- excuse me, I guess the time, perhaps you could give us an idea as to the time you spent as an adviser, the types of contributions that you made to the effort to -- you know, post-accident effort for recovery.

A Well, I was -- I was totally involved from arrival on April 4 until early in the following week, and either Mr. Dieckamp or I were on site at all hours of those days. In his absence, I would make decisions. If a group was falling behind their committee's schedule to accomplish a task by the time certain, it was my role to find out why and to identify what additional resources might be needed in order to meet certain schedules.

I was very heavily involved in designing and expediting the installation of some alternate means of coolddown. It was a general management responsibility to see that all elements of the organization were performing according to plan and according to our schedule and mileposts that we had established for certain things to be accomplished by a certain time.

When I was on site alone, I was in charge. When Mr. Dieckamp was on site and I was there, I was his deputy. When he was there alone, of course, he was in charge.

Mr. Arnold reported to me as did others on the site.

Q And after that initial period, then, your involvement with the company has been, I guess, what? Excuse me. After the accident, then, or after that period immediately following the accident, your involvement has been as, I guess, a part-time or occasional consultant with the company; is that correct?

A After I left the site, I did return for, I think, two days or three days, Easter weekend. But other than that, my role was by telephone occasionally. I had no continuing responsibilities after I left the site.

Q But your testimony is based, in part, upon a working, a professional or -- I guess professional -- relationship with GPU or Met Ed officials which reaches back prior to the accident, apparently; is that correct?

A That is correct. I have known a number of individuals involved in Three Mile Island 1 for many years in a professional relationship and developed a respect for those individuals and a respect for the track record of Three Mile Island 1, which was outstanding.

Then, of course, I enlarged my knowledge of other individuals during my time on site.

MR. SWANSON: I have no further questions.

MR. BLAKE: Mr. Smith, I should observe that Mr. Lee is prepared to address the question of industry response. And I can ask the question, or the Board can. I was going to leave it to the Board.

CHAIRMAN SMITH: Go ahead. I would prefer if you would inquire.

REDIRECT EXAMINATION

BY MR. BLAKE:

Q Mr. Lee, have you had an opportunity to review those couple of portions of transcript where Mr. Arnold was asked about industry preparations now to respond to -- to in an accident situation? And could you discuss those?

A Yes, I have reviewed those portions of the transcript where Mr. Arnold referred to the industrywide emergency response planning effort. That effort was started in May of 1979. The task force that was appointed to begin that planning process included some alumni of the Three Mile Island site who had been on loan from other utilities.

A generic emergency plan was prepared by that task force and sent to all utilities in July of '79 to trigger the beginning by each utility of its own systematic development of a comprehensive emergency plan.

In October of '79 the Institute of Nuclear Power Operations was incorporated. The first employees came on board in December, and it became operational at that time, at first in a very small way. The coordination of industrywide emergency response is now vested in the Institute of Nuclear Power Operations, sometimes called INPO, I-N-P-O.

Within that organization there is the emergency response and radiological control division. It is a part of the function of that group to maintain an up-to-the-minute inventory of material, equipment, and personnel resources, a wide variety of expertise and disciplines, all of which are on call at a moment's notice to respond to the need of a utility anywhere.

The inventory of those resources is also in the hands of each utility. Utilities vary one from the other in the number of disciplines and expertise in-house and those disciplines which are not present in the existing in-house organization.

It is the role of the utility in developing its own emergency plan to identify responsibilities of those qualified persons in-house in the event of emergency and to identify those outside resources that would be called upon in the event of an emergency.

Those plans are subject to review by INPO. They are subject to on-site evaluation by INPO. And now, in recent months, the utilities have undertaken a program of full-scale emergency drills of those plans which, in turn, are observed by INPO as well as observed by federal and state authorities.

That is a summary of the effort that has gone on. It is up and running and available now.

Q Is there in place a mechanism that would give some assurance of a response in a timely way?

A Yes, there is. INPO is manned 24 hours a day. On several occasions there have been incidents at nuclear power stations since INPO was formed, where that contact was made in off-hours, if you will, and INPO sent a team to help the utility do what -- investigate or assist in whatever the problem was.

There are also occasions when, announced or unannounced, we exercise INPO's capability to respond in a timely way. That is a two-way street. Last year I was testifying before Governor Babbitt's committee, the Nuclear Safety Oversight Committee, and in the middle of my -- a sentence during my testimony, a messenger came and stopped me, and I reported, "Yes, I received this message." This was a simulated emergency at a power plant that was named. This is a message from INPO. And I had a question last night, so I called INPO and said, "This is an emergency drill. I would like someone from the emergency response team to contact me. The time is now 10:07." And I had someone on the phone in six minutes.

So there are many other tests. I do not participate in all of them, by any means.

Q Mr. Lee, is there also in place a cooperative arrangement among utilities related to accidents involving transportation?

A Yes, there is a cooperative arrangement. A standard agreement has been prepared. 18 utilities have signed the agreement. Cthers are studying it. Their lawyers, of course, are reviewing it.

But if Utility A ships a radioactive shipment of spent fuel or waste and are traveling through the territory of Utility B and there should be a transportation accident, Utility B has agreed in advance to respond with resources to help mitigate the consequences of the accident.

My company is a participant, as are many others. And our health/physics teams and other teams are on call and trained as a "SWAT" team, if you will, in order to respond to that type event should it occur.

MR. BLAKE: I have no more questions of Mr. Lee in this regard.

CHAIRMAN SMITH: As long as we are on the subject then, I have a few questions on industry response.

BOARD EXAMINATION

BY CHAIRMAN SMITH:

Q It seems that the program for transportation during emergencies is more highly organized than the program for transients at the plant. Is that a correct inference from what I have heard from you and Mr. Arnold?

A Mr. Smith, I would say that the legal documents for the transportation problem are in a more advanced stage of completion than are the legal documents for emergency response to a site. And that is the only area where the transportation response is in advance of the site response.

The world looks at the situation and sees a plethora of lawsuits, and lawyers are massaging documents in all of the utilities. But the technical resources of people, material, and equipment are up and ready to respond to a site situation.

Q You just touched upon my second question then: Are there legal impediments that prevent full participation by utilities in the INPO program?

A In my opinion, there are not, or there will not be. Ultimately, the attorneys will have to do what management says. In the meantime, they are massaging the words. There was no hesitation from any source -- national labs, vendors, utilities -- there never was anyone reluctant for any legal reason to respond to the situation at Three Mile Island.

Q Were there any adverse legal impacts from other -- upon the utilities from the responses?

A No, sir, there were not.

Q Has GPU participated, to your knowledge, fully in the INPO program?

A Yes, GPU has. It is -- it is an active member of INPO, as is every other utility with a nuclear commitment, whether investor-owned, publicly owned, or cooperatively owned. They are all paying members.

Q The inventory that you referred to on INPO apparently is either by a preagreement available to the utility or is there for negotiation. Could you describe what the status of this inventory of services and equipment and -- well, and whatever else is on the inventory?

A The inventory is physically located at a variety of places. INPO does not yet have any specific inventory managed by INPO. It is available in national labs, in utilities, in manufacturers' shops, in equipment rental companies. You need mobile homes, you need bulldozers, you need Scott packs, you need bulldozers, you need a variety of things.

Some of those things have been identified by the present owner as being available at our cost if called upon. Others, you would have to negotiate at the time. My experience at Three Mile Island indicates those negotiations take just a few minutes over the telephone.

Q What was the result at Three Mile Island; did other utilities and contractors did negotiate quickly? Was the outcome satisfactory? Were bills paid as promised, and were there difficulties flowing from that arrangement, if you are aware of it? I understand that you would not have been necessarily around following the legal cleanup.

A Well, I think I would have heard had there been difficulties, because I committed an awful lot of GPU's money while I was there, just over the telephone by agreement. For example, some charcoal filters from the State of Washington, about $3 million worth were given, loaned, sold to GPU on the basis of a late-at-night telephone call to Washington Public Power Supply, who had some plants under construction. Those filters were flown to the site by the Air Force. The Air Force shipment bill was paid. The filters were paid for, I feel certain, or else they would have come to me.

Q Okay. Well, this -- I will put the question more directly. I think you have already answered it. But did GPU maintain its credibility as far as paying for the help it received during the emergency? I mean if it had an other emergency, would the suppliers of the services and materials they need feel relaxed and free to come forward with help?

A Yes, sir. We respond first and think about paying later.

Q And nothing that you are aware of is inconsistent with that attitude?

A No, sir. I know of no instances of that attitude on the part of any utility or vendor.

Q Could you -- never mind.

CHAIRMAN SMITH: I have other questions of Mr. Lee, but not on the INPO and industry response area. So I will just take and wait my turn in questioning.

(Board conferring.)

CHAIRMAN SMITH: So if anybody else -- if you want to clean up the subject matter with Mr. Lee --

MR. ADLER: Yes, sir. Mr. Dornsife has some questions on this subject.

CHAIRMAN SMITH: All right.

RECROSS EXAMINATION

BY MR. DORNSIFE:

Q I just have one question, Mr. Lee. You touched briefly on the communications link concerning nuclear accidents involving a plant, and I am wondering if you could touch the same way on the transportation accidents, because it would seem to me that typically the state and local people are the first ones to know. And I was not aware of this arrangement. So I would like you to explain briefly how the communications links are established to get this help.

A Mr. Dornsife, I am only partially familiar with how the utility through whose area the shipment is passing learns of the accident. I simply do not happen to know from whom that comes. It may well come from the state and local agency, because that utility has a close communications with that agency because they are shipping from time to time. I would hope that would be the way it would work, so that that state and local agency would know that utility's resources, Le familiar with them, and know specifically what sort of help might be needed. They are already in a cooperative mode.

Q You know of no formal arrangements that have been made with the state and local authorities by utilities in particular districts?

A I happen to know of one which is in our own case, and our folks have been called to assist the state and local agencies when there have been transportation accidents of government shipments, Federal Government shipments. And we have responded.

MR. DORNSIFE: Thank you.

CHAIRMAN SMITH: Now, on the general testimony, do you have -- have you completed -- you had completed your examination?

Mr. Levin, do you have questions?

MR. LEVIN: No, I do not.

BOARD EXAMINATION--Resumed

BY DR. JORDAN:

Q Can you tell me whether through INPO or other means there is now better financial protection for a utility that has a major accident, such as TMI-2? We have heard in the case of TMI-2 that the damages may run as high as $4 billion, which no single utility can possibly stand. Has that situation changed?

A Dr. Jordan, yes, it has changed. One change is now in place and active. Another change is still being studied.

The one that is in place is the formation of Nuclear Energy Insurance Limited, called "NEIL," N-E-I-L. It is a mutual insurance company formed by utilities to cover with certain -- above a certain minimum threshold the cost of purchased power to replace the lost generation after a nuclear accident.

That is in place. NEIL is financially sound, and the coverage exists.

A task force is also working to address the cleanup costs, restoration costs, which can be enormous. That task force has not yet completed its work. But the task force consists of utility persons, financial persons, and the chairman of one state regulatory commission.

Q Is that part of INPO?

A No. That is -- INPO deals with operations. That is a separate undertaking by the utility industry. There is a relationship between INPO and NEIL, a tie; that is, the NEIL insurance will be cancelled if a utility does not comply with INPO's findings.

Q But, of course, NEIL at the moment does not carry such large amounts.

A No. NEIL has $156 million worth of coverage applying only to purchased power.

Q I see. Yes. Do you have some confidence that there will be this mutual insurance thing working out? Does it look fairly optimistic to you?

A Yes. In talking with members of the task force individually -- they have not yet reported -- they seem encouraged by the possibility. I think it is particularly significant that a highly respected member of the task force, who is the chairman of a state utilities regulatory commission -- because if we should come up with coverage, if we cannot buy it, then it is no good.

Q Yes, I see. The question is whether it is to be put in the rate base.

A Put in rates as an operating expense.

Q Yes. Yes. Would you care to speculate at all -- if you don't, please just say so -- on the efforts or possibilities that I read about in the paper for perhaps helping finance the cleanup of TMI-2?

A Dr. Jordan, I am not going to speculate on the outcome, but that is under the purview of the same task force to which I have referred.

Q Oh, it is.

A The retrospective problem with respect to TMI-2 as well as the prospective situation with respect to the future, I do know the task force has had conversations with

DOE and GPU. They are studying. They may have a recommendation sometime this week.

Q It must then include government involvement, since DOE, you say, is part of it?

A They have had conversations with DOE.

Q Oh.

A They have not reported yet. I cannot speculate on what they will recommend.

Q All right. That is fine. Now, getting back a little bit to your involvement at the time of the TMI-2 accident. One of the things we have heard is that -- well, one of the things we know is during the time of the accident the possibility of explosion of a hydrogen bubble loomed large in some people's mind. Hindsight apparently is that it was never really a danger.

Now, were you involved yourself in trying to assess that possible danger from the hydrogen bubble, and so would you tell us about the extent of it?

A My involvement started at the time when the bubble in the top of the reactor, right under the head, had begun to dissolve. I never had any concern about it exploding. My only concern was let's make sure the bubble diminishes rather than increases, because if it keeps on increasing you would have an uncoverage again. That was my only concern about that gas bubble.

Q I see. So that you -- I guess, in a sense, you are answering my question. You say you were not concerned about the explosion. So you think that those concerns were ill-advised, that the data was interpreted wrong?

A I think they were grossly ill-advised, yes, sir.

Q I see. I have asked other witnesses here about why it is that the TMI-2 accident happened at TMI-2. Usually, I get the answer that the operators at TMI-2 were as well trained as any other operators in the industry. There was no gross deficiencies, anyhow. So I guess from that, does it follow that had there been a similar accident, a similar transient, a stuck-open PCRV at other reactors in the country, is it likely that they would have -- it would have happened to any of them?

A Dr. Jordan, in many respects, any utility can say, "There, but for the grace of God, go I."

At that time it was our thinking that complying with this myriad of regulations was meeting safety requirements. With respect to that particular incident, there were two occasions where the PCRV -- at least two -- where the PCRV was stuck open and the operators took the right action by closing the block valve.

But tragically, we did not have in place in the industry a communications system to share with one another the results of unusual events. Had we had it, TMI would not have happened.

We tended to rely on government, but we learned our lesson, that we now have in place an instantaneous sharing communications system of any unusual events, the analysis of every unusual event that happens anywhere, and the feedback into all applicable utilities of corrective actions to be taken with operators or training or hardware or software or whatever, to prevent that event from happening elsewhere.

Q By the "two occasions," are you referring, I presume, to the Davis-Besse incident, for one. Which other incident are you referring to?

A The other incident was at our Oconee station.

Q You had a similar one at Oconee?

A Yes, we did.

Q I heard also, by the way, that there was one in a Swiss reactor, which was also handled very quickly. Do you happen to know about that one?

A I do not happen to know about that one, Dr. Jordan.

Q All right.

A In our case, it was just for a few seconds.

Q I see. The valve, you mean it closed on its own?

A No. The operator said, "I think the PORV is stuck," and he reached over and closed the block valve.

Q When did that happen?

A It was after Davis-Besse, but we did not know of Davis-Besse at the time.

Q All right. Now, can you explain why it is that the Duke Power operators diagnosed it so quickly and the operators and management at TMI stumbled for so long? Is there any explanation?

A No, I do not think there is, because as I look back at our training situation as it was at that time, I could not -- I could not point to you anything in the training that would have said, "Take this action."

Q Fortunately, you had one operator who knew exactly what to do?

A And he did it.

DR. JORDAN: Okay, I think that is all. Thank you.

BY DR. LITTLE:

Q I wanted to follow up on the same lines. In your testimony you spoke to the widely held view that if a plant, if a particular utility had training average or better or the size of operating and maintenance staff was average or better, expenditures average or better, NRC inspection and audit review had not found serious deficiencies, that you would consider that these meant that the utility was performing satisfactorily.

I think this goes back to what Drucker has called the "danger of safe mediocrity;" that is, a mistake of "Conformity means achievement and absence of weakness means strength."

I want to ask you if you perceive any change in the industry as a whole and in TMI-1 management, in particular, which would lead you to think that the emphasis might now be on high performance versus meeting averages or minimum standards?

A Dr. Little, I would say "Yes" to both questions, with respect to both the industry and TMI specifically.

That part of my testimony was -- was the measure of management competence as perceived prior to the accident. Believe me, we have all learned a great deal from this accident. And for example, INPO was born as a result of the accident. Part of INPO's function is to evaluate management to the very top.

I also am aware of what GPU has done in terms of organizing their nuclear activities under one group. I think this is a strong organization. The essential functions are covered in that group. I personally know the persons who fill the top slots in that group, and I have a lot of personal confidence in them. I would be delighted to have either of two individuals filling those two top slots to fill them in my own company.

Q Can you speak to the filtering-down of this emphasis on performance down to the man-machine interface, which is where it really counts?

A You are quite right, Dr. Little. And I cannot speak to that. I have not personally investigated that. I understand that other witnesses that are scheduled have and are prepared to respond to that question.

But you put your finger on the proper place. In my testimony I said, "Two important ingredients are in place." I did not speak to other ingredients that are important; that is, a good organization and good people at the top. That is the extent of my personal knowledge of the situation.

DR. LITTLE: Thank you.

BY DR. JORDAN: (Resuming)

Q Dr. Little touched on one thing I intended to ask. I know that, or I have been told, that INPO is evaluating the management capabilities of all of the utilties. And you say -- I was pleased to learn that all of the utilities have now joined INPO. I understand that that evaluation is confidential, however that there will be a release after it all over with now.

Is this the situation? And can you tell me when we might hear about TMI?

A The evaluation report contains INPO's findings as well as the utilities' commitments in response to those findings, all in one report. So there is some iteration as the report is prepared. Upon completion of the report, it is transmitted by INPO to the committee with INPO's encouragement to the utility that the utility make it public. So far, that has happened. All of the reports have been made public.

Q Oh, there have been instances, then? I had not heard of those.

A Yes.

Q Could you give me an example?

A There is one out. Nine evaluations have been completed. There is one report that has been gone through the iteration and is now on the street, so to speak. And this is a report on the Dresden station of Commonwealth Edison, INPO's findings and the Commonwealth's response to those findings. There are some others in the mill which will be coming out immimently.

The second part of your question, I do not know when INPO has scheduled to evaluate TMI. Those of us who are directors of INPO with intent do not review that schedule for, I think, good reasons. I happen to know the schedule when they are coming to our own plants, but I do not know that with respect to others.

DR. JORDAN: Thank you.

BY CHAIRMAN SMITH: (Resuming)

Q I have just a few. The Contention -- the issue you are addressing appears in your testimony, and that is whether Met Ed's actions of individuals in connection with the accident revealed deficiencies in the corporate or plant management that must be corrected before the unit can be operated safely, and, as I read your testimony, that you feel that management acte. well.

So I would infer from your testimony that the first part of that Contention is answered in positive for Met Ed, that the accident did not reveal management deficiencies.

But then you go on to point out that the new organization structure, organizational structure, is a strong management concept. You have that in writing; you just repeated it again. This has become an important aspect of our hearing. The GPU Nuclear Group and Corporation, have you had an opportunity to learn more than just the concept of the nuclear organization in a single organization, or have you actually looked at the way it is organized?

A I have looked at the way it is organized, Mr. Chairman, and again know the top two people in it as well know some of the other vice presidents. I think the thrust of my testimony was management was highly competent under the criteria of judgment that existed prior to the accident. They behaved strongly and well during the accident. But we all learned, and they have taken the right steps from the lessons the have learned by forming this integrated group.

Q So aside from the people in the group, the concept of the group is a strong step?

A Yes, I think so.

Q Would you -- excuse me. Complete your answer.

A I think that they have -- have assigned the responsibilities in a systematic and good way insofar as a span of management, and they have the technical group, they have the nuclear assurance group, they have the construction and maintenance group, they have the line functions over each of the three stations -- TMI-1, TMI-2, and Oyster Creek.

The structure looks good. The top management looks good. I defer to other witnesses with respect to Dr. Little's question, which is an important ingredient.

Q Of course, the situation is different -- or is it? Does Duke Power have a similar concept?

A No, but we have no subsidiaries.

Q Yes. Okay, if you did have subsidiaries, would you feel that such a concept was important? We may be called upon to find in this proceeding that the GPU Nuclear Corporation concept is either essential finding, or it is a very important aspect of the management when we look at their ability to operate the units safely.

I am trying to learn from you just how important you feel it is. What comments can you make on it?

A It would be my view that the GPU Nuclear Group is very important. Whether or not it becomes a corporation is not very important in my mind.

Q Okay. The concept of an organization, would those functions as they relate to the different utilities of the different states, you think would be an important aspect of a safe organization?

A Yes, I do. They have one nuclear unit on the coast of New Jersey, and they have two here. And I think it is stronger to have one group in charge of those three units than it would be to have them reporting through different channels to the parent company.

BY DR. JORDAN: (Resuming)

Q You point out the situation with GPU is different than Duke Power, but I do not see it is entirely different, because Duke Power also has several places where they operate nuclear plants, several locations. Now, don't you have a central group which backs up these individual stations and it is, therefore, similar in many ways?

A Yes. All of those plants report to the same person, and that person has a very large technical staff also reporting to him in support of those plants.

Q So, therefore, it is similar in many ways?

A It is similar in many ways, yes.

BY CHAIRMAN SMITH: (Resuming)

Q On page 9 of your testimony, Mr. Lee, the second full paragraph, I do not understand the first sentence: "Before the accident, there was a widely held view that the NRC standards for licensing of operators," and then you go on to say, "and the evaluation of the operator's performance." Is that the subject you have there?

A That is correct.

Q And what standards of evaluating performance do you refer to there?

A The number of incidents or reportable events that are due to operator error. The standards, per se -- that is a little sloppily worded there.

Q You put some emphasis in your testimony on the capacity factors and --

(Board conferring.)

Yes, you address it at the top of page -- you begin on page 7, the bottom of page 7, and you go to page 9.

A Yes.

Q Do you offer the implication there that an organization that is able to accomplish the high levels of capacity and the economic objectives is the same type of organization that is needed for safe operation? Do you see a parallel there, in your view?

A I think there is, Mr. Chairman. Good operation goes hand in hand with safe operation. I think there are a number of people that believe this.

Q Are there technical reasons for it, or is it a management concept, if you have good management they know how to be safe; or is it if a plant is running along regularly without changes, then you have less opportunity for transients?

A I saw over a period of years GPU management take some extraordinary steps to make sure that when TMI-1 first ran, it would run well. Oconee-1 was the first B&W reactor; we had a number of problems in startup.

There were Met Ed and GPU people in our plant on a continuous basis from our first startup testing until TMI-1 was running. They were as diligent as I have ever witnessed anyone in learning from our mistakes. And they left no stone uncovered that I could identify.

We had some problems with the pumps. We were working on the problem with the manufacturer. GPU had the same pumps. They were also involved with the manufacture of the pumps, but GPU very quickly went outside and got an expert consultant to sit in and help and give advice in that situation.

The TMI-1 startup and its years of operation that were as successul as they were about led the pack in the nation and certainly was better than any other B&W unit in the nation. It was not by accident.

Q Along that line, you indicated you would be pleased to have some members of the GPU management team with you. Is a part of that judgment based upon the value of their experience in the accident? Do you think that is a positive factor?

A That had not occurred to me, Mr. Chairman, but that is a plus. It is not a minus. But I would say, independent of that, they are very capable individuals, and had I need I would be glad to have them fill the same post in our company.

Q I was referring not only because of your opportunity to observe them under stressful circumstances but as to their experience that they gained.

A That is of value. It is not that increment that makes me say what I said, but that comes along with it.

Q Okay, now we are going to drag you into another dispute, and that is: You testified that you observed the GPU team working extremely long hours seven days a week.

A Yes.

Q Did you feel that -- that that team was able to work effectively under those circumstances, given all the circumstances of the accident and the --

A I think they did a miraculous job. After one week of it, some of them were getting tired. Some on the government side and on the company side were getting irritable at each other. I think this is one of the reasons that I and others were called in to help: they needed some rest. Once we got there and got up to speed, some of them were able to get some rest and they were very effective.

Q So the fatigue factor, you are saying, was recognized and dealt with?

A I did not understand?

Q The fatigue factor, then, you believe, was recognized and properly handled?

A Yes, it was. Yes, it was. I was not called until a week after the accident occurred. I was called --

Q When?

A April 4. And I was there within two hours of the call.

Q At the time you arrived, you believed they were still functioning appropriately?

A Yes, I do. They were functioning appropriately. They were getting a little irritated at each other, particularly the government versus the company. But we were able to straighten that out.

Q The standards that you referred to, beginning on page 10, you state from your perspective in the preaccident period, you would have believed the company was demonstrating management capability and that it was diverting substantial efforts to safe and effective management of its nuclear units in these areas if -- and then you list five standards.

Now, as I understand the context, you go on to say that in the wake of the accident you no longer believed -- these standards are not sufficient anymore, more has to be done. Is that the essence?

A They are not.

Q They are not sufficient. But those standards you referred to, were they generally recognized standards, or are those that you believe were good ones?

A We did not have any such list.

Q Yes.

A But I am testifying as to my perception of some of the indicators of good management at the time. Each of these needs some interpretation. The size of an operating and maintenance staff can be so large as to be wasteful, but it can be too small so as not to have right attention, preventive maintenance, and the full disciplines necessary. Largeness, per se, is not good management. But large enough is certainly good management.

CHAIRMAN SMITH: Okay. Okay, I have nothing further. Any more questions of Mr. Lee?

MR. ADLER: Yes, sir.

RECROSS EXAMINATION

BY MR. ADLER:

Q We have some questions regarding the NEIL program. Is it envisioned that there would be some threshold level of severity for an accident or an incident which would be required for a utility to receive payments under this program?

A Yes.

Q How would that level be set, and have you determined what it would be?

A The outage has to be a result of an accident. The accident is defined. In other words, it cannot be a regulatory-imposed shutdown; it has to be an accident. The coverage begins six months after the accident occurs and only begins then. The coverage has a ceiling of $2 million a week for the first 52 weeks and $1 million a week for the next 52 weeks.

Those are the initial levels of coverage under NEIL. From time to time in the future, it will be reviewed, and maybe they will change.

Q When you say it would not apply to a regulatory-imposed shutdown -- let's take TMI-1 as an example. If there is an accident at a plant of a particular design and other plants of that design are shut down as a result, would they not be included in the coverage?

A They would at a reduced formula from the principal unit at that site. I do not know the percentage reduction, but it is -- if the one involved in an accident is $2 million a week, after the six-month period the second unit would be of some value less than $2 million a week. In other words, not the same coverage. But there is some consideration of multiple-unit sites.

MR. ADLER: Thank you.

CHAIRMAN SMITH: Anything further?

Finally, do you have any advice for us that has not been covered in your testimony?

THE WITNESS: Mr. Chairman, my only advice is I think they are ready to go, and I would hope that these proceedings would be expedited.

CHAIRMAN SMITH: All right. Thank you.

You are excused.

(Witness excused.)

MR. BLAKE: Mr. Smith, the Licensee calls Mr. William Wegner.

CHAIRMAN SMITH: Okay. I think we would like to take our morning break before we begin. We will take an early break this morning.

(Brief recess.)

Whereupon,

WILLIAM WEGNER

was called as a witness by counsel for the Licensee and, having been duly sworn by the Chairman, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. BLAKE:

Q Mr. Wegner, would you state your name and business address, please?

A My name is William Wegner. My business address is 1700 North Moore Street, Arlington, Virginia.

Q Mr. Wegner, I show you a copy of the document entitled "Licensee's Testimony of William Wegner in Response to CLI-80-5, Issues 1, 2, 3, 4, 5, 6, 7, 10, and 11, ANGRY Contention No. IV, Sholly Contention No. XIV(A-)e, Aamodt Contention II, and CEA Contention XIII, subtitled (Independent Review by BETA of Licensee's Management Capability and Technical Resources).

The document is dated LIC-01/26/81 and is comprised of some 37 pages with a two-page attachment entitled "Background of the Four Associates of Basic Energy Technology Associates, Inc."

I ask you whether or not this document was prepared by you or under your direct supervision?

A Yes, it was.

Q And do you have any corrections which you would like to make to this document?

A No, I do not.

Q Do you adopt this document, including the statement of your qualifications and background which appears on page 1 and is also addressed in the attachment as your testimony in this proceeding on the captioned subject?

A Yes, I do.

MR. BLAKE: Mr. Chairman, I ask that this document be physically incorporated in the record as if read as the testimony of William Wegner.

CHAIRMAN SMITH: The testimony is received.

(The prepared statement of William Wegner follows:)

2/17

LIC 01/26/81

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
METROPOLITAN EDISON COMPANY	)	Docket No. 50-289 SP (Restart)
	)	
(Three Mile Island Nuclear Station, Unit No. 1)	)	

LICENSEE'S TESTIMONY OF

WILLIAM WEGNER

IN RESPONSE TO CLI-80-5, ISSUES 1, 2, 4, 5, 6,

7, 10 and 11, ANGRY CONTENTION NO. IV, SHOLLY

CONTENTION NO. 14(a)-(e), AAMODT

CONTENTION 2 AND CEA CONTENTION 13

(INDEPENDENT REVIEW BY BETA OF LICENSEE'S
MANAGEMENT CAPABILITY AND TECHNICAL RESOURCES)

OUTLINE

The testimony of William Wegner, representing Basic Energy Technology Associates, Incorporated (BETA), summarizes the factual findings and conclusions reached by BETA after conducting an independent assessment of the management capability and technical resources of General Public Utilities/Metropolitan Edison Company to restart and operate TMI Unit 1.

The BETA assessment was conducted over a sixteen month period (October 1979 through January 1981), by using detailed one-on-one interviews with over 150 Licensee employees, reviewing onsite and offsite procedures detailing policy, requirements and organizational structure, reviewing a sample of all documents, and witnessing TMI-1 plant operations. BETA also worked with GPU on specific technical issues relating to TMI Unit 1.

After completing this extensive and thorough review process, BETA has concluded that the management capability and technical resources of GPU/Metropolitan Edison are sufficient to assure the safe restart and operation of TMI Unit 1. This overall conclusion is based upon specific factual findings reached on issues one, two four, five, six, seven, ten and eleven identified in the Commission's March 6, 1980 Order, CLI-80-5. The testimony is also responsive to ANGRY Contention No. IV, Sholly Contention No. 14(a) through (e), Aamodt Contention 2 and CEA Contention 13.

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My name is William Wegner. I represent Basic Energy Technology Associates, Incorporated. Our company has been employed by General Public Utilities/Metropolitan Edison to conduct an independent assessment of their management capability and technical resources as they relate to restart of the Three Mile Island Nuclear Generating Station Unit 1. The purpose of my testimony today is to present to you a summary of the findings of our assessment.

As background, Basic Energy Technology Associates, Incorporated, (BETA) is a company consisting of four associates. It was formed in October 1979. At that time, each of the associates had just recently retired from government service and had worked in headquarters positions in the Naval Reactors program for some twenty-five years. In my particular case, I served as the Deputy to the Director, Admiral Rickover, from 1964 until I retired in 1979.

More detailed information on the backgrounds of each of the BETA associates, including my education and professional qualifications, is attached to this testimony.

In early October, just after we began our company, I was contacted by Mr. Dieckamp of GPU requesting our assistance in work at the Three Mile Island nuclear plants. In November, Mr. Dieckamp specifically requested us to undertake an independent review and assessment of the management capability and technical resources of GPU as related to the TMI Unit 1 restart. At the time there were no definitive published criteria by the

NRC or other authorities by which to judge a utility's management capability and technical resources. We started by assembling the various reports issued by the President's Commission on Three Mile Island (Kemeny), the NRC and other groups investigating the accident which had addressed the issue. Each investigative group concluded that what was available and in place at Metropolitan Edison prior to March 28, 1979, was insufficient. However, none of the investigative reports outlined specifically what should exist at a utility in order to be acceptable. Because of this, we had to develop our own basis for the evaluation.

Since we developed our evaluation basis, the NRC and others have issued drafts of such criteria. In February 1980, the NRC distributed draft criteria which were later updated and redistributed in July and again in September 1980. In addition, NRC, in early 1980, contracted with Teknekron Research, Inc., to develop technical resources criteria. After we developed our bases, we were able to compare them with what NRC had produced and found no serious conflicts. If anything, our bases are probably more definitive in a number of areas.

It is important to understand this lack of specificity as regards management capability and technical resources, particularly as I discuss the results of our assessment. In assessing purely technical issues, while there may be disagreement with a given solution and the assumptions made in arriving at it, at least one is generally dealing with the laws of nature. In management capability and technical resources, one is dealing with people, with organizational structure, with attitudes and with many other attributes, none of which conform to any given laws. How one utility may organize itself to handle a given situation may be entirely different from another, yet both may be equally effective. Where one person in a given organization may be capable of handling a certain range of responsibilities, another organization may require two people. The overall capability of an organization must be judged by looking at the entire picture, not just one isolated segment. This is what we attempted to do.

Admiral Rickover made this point when he testified before Congress on May 24, 1979, on the Three Mile Island accident. He said:

> "Over the years, many people have asked me how I run the Naval Reactors Program, so that they might find some benefit for their own work. I am always chagrined at the tendency of people to expect that I have a simple, easy gimmick that makes my program function. They are disappointed when they find out there is none. Any successful program functions as an integrated whole of many factors. Trying to select one aspect as the key one will not work. Each element depends on all the other elements.

> "I cannot overemphasize the importance of this thought in your current deliberations. The problems you face cannot be solved by specifying compliance with one or two simple procedures. Reactor safety requires adherence to a total concept wherein all elements are recognized as important and each is constantly reinforced."

After establishing our guidelines for the assessment, we then determined just how deeply or broadly our review of management capability and technical resources would go. To do this, we defined management capability and technical resources as that overall capability of a utility to own, operate, and be fully responsible for one or more nuclear power plants in such a way as to protect the health and safety of the worker and the public. We decided to cover those elements within the management structure from the corporate level down to the supervisory level and that part of the technical structure wherein decisions are made which could affect the safe operation of the plant.

Our definition is not a narrow interpretation and our assessment was probably more extensive in scope than most would expect. The listing which follows represents the groups or areas we assessed:

1. Corporate headquarters
2. Both offsite and onsite organizations relating to:

a. Overall management

b. Operations

c. Engineering/Technical

d. Licensing

e. Quality Assurance

f. Nuclear Safety Assessment

g. Selection, training, and qualification

h. Radiological control

i. Emergency planning

j. Fiscal management

k. Personnel matters

l. Labor relations

m. Material management

n. Industrial safety

o. Security

p. Facilities management

q. Public relations

r. Radioactive waste management

s. Fire protection

t. Environment

u. Maintenance

v. Records control

w. Water chemistry

Each of these groups was reviewed to determine if it was sufficient in the following areas:

1. Detailed, written procedures

2. Clear lines of responsibility and authority

3. Qualified personnel, number and qualifications

4. Accountability for actions

Since GPU is a multiple reactor site corporation with a remote centralized headquarters organization, particular attention was given in the assessment to the working relationship between comparable offsite and onsite functions. We also attempted to assess the attitude of management in light of the strong comments by the Kemeny Commission in this regard.

In carrying out our assessment, we interviewed over 150 employees of GPU and its affiliated organizations. These interviews were usually conducted on a one-on-one basis and normally lasted no less than one hour each. Some lasted, in repeated sessions, as much as ten hours. Onsite and offsite procedures detailing policy, requirements and organizatonal structure were reviewed. A sampling of all documents was reviewed and operations were witnessed. The detailed assessment began in October 1979 and continued intermittently into January 1981.

In addition to the information obtained from the interview process, BETA has worked with GPU on specific technical issues related to the TMI Unit 1 plant. This presented BETA with an opportunity to judge firsthand the technical and management capability of the GPU organization.

Since our assessment extended over such a long period of time and because after each visit we provided GPU/Met-Ed management with our findings which were then acted on, we found it unproductive to provide written reports. Thus, our assessment can be characterized as a continuing process of auditing and upgrading. We consider this to be not only helpful but encouraging, because in many, if not all, of the areas reviewed, there is no point that is ever reached where situations are perfect--there is always room for improvement. Over the past year or so we have seen this continuing upgrading take place, and we would expect it to continue on into the future.

One reason contributing to the need to extend the assessment over such a long period of time was the changing nature of the GPU/Met-Ed organization and the realignment of responsibilities as the company moved to effect improvements it considered necessary. Thus, an assessment conducted in early 1980 would not have reflected the actual situation which now exists in early 1981. We have attempted to conduct our assessment on the basis of what actually existed at the time of the assessment rather than what GPU/Met-Ed indicated might exist at some future date. However, we did not ignore the plans and preparations which GPU was making in its effort to effect improvement. We feel that our latest assessment, which was completed in January 1981, reflects the organizational plan not only as it was proposed in September 1980, but as it probably will eventually settle out for the restart of Unit 1. For example, much of our review was performed during the time that the GPU Nuclear Group was functioning rather than the not yet authorized GPU Nuclear Corporation. Insofar as effectiveness of operation, personnel assignments and responsibilities are concerned, there should be little difference.

As I previously pointed out, throughout the course of the assessment where we found things that, in our opinion, were wrong, weak or unclear, we brought them to the attention of GPU management. These issues were resolved or action has been undertaken to correct them. Thus, what we might have pointed out as a weakness based on what we saw in January or February of 1980, has since been corrected or is in the process of being corrected.

I will now give you a summary of our findings.

SUMMARY FINDINGS

In its Order CLI 80-5, dated March 6, 1980, to the Licensing Board, the NRC listed a number of specific issues which the Licensing Board was directed to examine relating to GPU/Met-Ed management capability and technical resources. I will use those questions, where appropriate, as a means to present to you the summary findings of our assessment.

Issue 1:

"Whether Metropolitan Edison's command and administrative structure, at both the plant and corporate levels, is appropriately organized to assure safe operation of Unit 1".

Finding:

Our assessment indicates that with the changes made, the command and administrative structure of GPU/Metropolitan

Edison is appropriately organized and, as such, can assure safe operation of Unit 1.

Since the company's reorganization and the creation of a single group totally responsible for its nuclear matters, GPU has established direct lines of authority and responsibility. Written procedures defining these responsibilities and functions are in place and are operating. People with experience and demonstrated ability have been put into these positions. Many of them are new hires.

During the time of our review we were able to witness at closehand the thinking and effort that went into the establishment of the GPU Nuclear Corporation. This close witnessing of the policy formation gave us an insight into what GPU management was attempting to achieve and how they approached the problem. To us it is clear that GPU management has every desire to put in place an organization which will concentrate its nuclear effort into a single, responsible group of people, thus correcting many of the weaknesses which existed prior to the accident. If they have erred in their effort, it will not be because of any reluctance to do the right thing or because they held back. I think that a comparison between the number of technical/professional people working on the plant prior to the accident with the number now assigned demonstrates a dramatic change in philosophy. While my figures may not be exact, they do show what has happened. In March 1979, there were 23 people assigned to the technical functions area for TMI

Unit 1. In December 1980 there were 97. In the nuclear assurance area, there were 33 persons assigned to TMI Unit 1 in March 1979, whereas there were 87 in September 1980 and 103 in December 1980. These numbers indicate a fourfold increase. These are people who are assigned specifically to TMI Unit 1 and are exclusive of pooled talent within the GPU Nuclear Corporation who might work on other plants but could be brought to bear on TMI Unit 1 problems should the need arise.

While it is too early to judge the long-term overall effectiveness of this type of arrangement, a number of observations can be made.

1. The establishment of a single organization, reporting to a high corporate level and responsible for all aspects of nuclear plant operation and support, is in agreement with many of the recommendations contained in post-TMI accident reports.

2. By combining the technical resources of the various GPU utilities, a larger pool of talent has been assembled which can be put at the disposal of the nuclear plants in order to resolve problems and to ensure a better flow of information between the plants.

3. By having a larger base of technical and management talent the GPU-Nuclear organization is less reactive to personnel losses and can afford to move people to gain experience.

4. It can develop and use uniform policies between the plants on matters such as training, procurement and facilities.

5. Because of its combined size and consolidated technical strength it can provide GPU corporate management with a much more professional assessment of matters which might affect reactor safety.

6. All the key technical positions within the GPU Nuclear Corporation are filled by nuclear-experienced personnel and their functions are not diluted with nonnuclear matters.

7. The person at the site responsible for the operation of TMI-1 is a vice president of the GPU Nuclear Corporation and reports directly to the Office of the President of the corporation. He is not encumbered by organizational layers between himself and top management.

8. Those functions which need not be done at the site are performed offsite by personnel not reporting to the TMI-1 Unit Vice President. This provides the Unit Vice President with more time which he can devote to matters directly related to the operation of the plant.

9. For all practical purposes, TMI-1 and TMI-2 have been separated physically and organizationally. This is important in that a separate group of capable people have been assigned to TMI- 1, independent of TMI-2.

10. The new organization makes it very clear who is in overall charge of GPU nuclear matters.

In summary, it is our opinion that the new organization and the management of the GPU nuclear plants through this single, unified structure is probably the most effective way a nuclear utility could be handled. It certainly follows, as closely as practicable, the concepts used by other successful high technology programs by embodying a strong centralized technical organization approach. This new organizational approach is in effect now. However, as previously indicated, additional time will be required for it to work smoothly and efficiently.

Issue 2:

"Whether the operations and technical staff of Unit 1 is qualified to operate Unit 1 safely (the adequacy of the facility's maintenance program should be among the matters considered by the Board)."

Finding:

This question embodies a large segment of our assessment and, for that reason, the answer must be broken down into smaller elements. In an overall sense, it is our opinion that the operations, maintenance, and technical staffs are qualified or will be qualified to operate Unit 1 safely. However, some amplification is necessary.

In the operations area, our assessment did not address the actual state of qualification of the licensed operators. For example, we did not interview licensed operators in order to make a judgment as to whether or not they had been properly trained. Others, including NRC, have done this or are scheduled to do it. Our assessment in the operations area centered on the capabilities of management and supervisory personnel to determine if they possessed the requisite degree of technical knowledge and experience to establish and enforce proper operational methods and procedures. We also reviewed the paper systems used to control the operation of the plant which are in place or are planned to be in place for the restart.

Our review indicates that the Vice President--TMI Unit 1 has the proper background and experience necessary for the job. He has had a highly successful career in the nuclear Navy having held positions which included command of a nuclear ship and having been responsible for the training of hundreds of senior naval nuclear personnel. Based on my own personal knowledge, his standards for training and operating nuclear plants are exceptionally high. His overall effect on the TMI Unit 1 plant has already been dramatic even though insufficient time has passed for it to become evident in all areas.

The second, third and fourth level managers in the TMI Unit 1 operations area appear to have the necessary experience and qualification to perform their jobs. During the time of our review which spanned over a year we witnessed dramatic changes in the overall capability, interest and performance of this middle management group of people. They seem to have settled down with the new organization and they are becoming effective in handling their jobs. This was not the case a year ago.

At the time of our review in August 1980, we noted that the training programs for the licensed operators were in the process of review and upgrading. New managers of TMI Unit 1 training had been hired and a complete review of the training program was being made. Our interviews of these new training managers indicate that they are aware of a number of weak areas in how training is conducted, the material presented, the examination process, etc. We were able to see and discuss their plans for correcting these areas and, if carried out in the time frame and manner indicated, they should be in a position to have sufficient numbers of qualified operators in time for restart of the plant.

During our initial review of the onsite and offsite technical support groups in the fall of 1979, we noted an apparent segregation between the onsite technical group with its operational concerns and the offsite group with its greater analytical and design knowledge. For example, technical procedures prepared at the site were not reviewed by the offsite engineering staff. In addition, the lines of communication between the two groups were such that operating experience was not consistently being fed back to the offsite engineering staff. The present organization corrects these problems and assures a close line of communication between the offsite and onsite technical groups. Additional analytical and design support for plant operation should be achieved by the presence onsite of a permanent staff of engineers who will report to the offsite Vice President, Technical Functions. GPU's management is also emphasizing in this reorganization the need for closer coordination between the offsite and onsite staffs. As a result, the members of the offsite engineering staff will spend appreciable time at the site. In addition, the position of Vice President, Technical Functions has been given to a senior manager with extensive engineering experience associated with the operation of reactor plants. This operational background in the offsite engineering group combined with the onsite satellite staff and a closely coordinated onsite/offsite concurrence system should assure an effective overall technical support organization.

In addition to providing an effective organizational structure, it is necessary to have sufficient numbers of experienced personnel. The total technical support manpower available for all GPU operating nuclear plants has increased from a level of about 100 in March 1979, to a level of greater than 300 some[illegible]ing 1981. The experience and capabilities of the engineering st[illegible] believe consistent with those necessary to support safe reactor operation. It remains to be seen if this level of experience and capability can be maintained as the staff expands. It also may be difficult for GPU to expand as rapidly as they propose. However, we judge that the current pool of inhouse engineering talent, approximately 250, not counting contracted engineering talent, is sufficient to assure that enough manpower will be available to meet TMI Unit 1 needs as well as to support Oyster Creek operations, TMI-2 cleanup, and the minimal effort required for Forked River and the decommissioned Saxton plant.

In stating Issue 2, above, to the Licensing Board, the Commission added parenthetically that the adequacy of the TMI-1 maintenance program should be among the matters considered by the Board. In a manner similar to that described above for assessing the operations area, BETA did not address the actual proven or demonstrated trade skills of the maintenance tradesmen. Rather, we undertook to assess the scheduling of work, assignment of personnel, organization of the department, and control of work, stressing the capabilities of management and supervisory personnel to determine if they possessed the required technical knowledge, experience, and insistence to enforce proper maintenance procedures and methods.

Several significant and constructive changes have been made since the accident which affect and improve the present maintenance capability and performance at Unit 1. Foremost is the assignment onsite of a full time Vice President responsible for TMI Unit 1. In his previous work, this particular assigned person, while new to GPU, has demonstrated his ability to set high standards and maintain control of work for which he is responsible. Also of significant importance is the capability of the new Manager-TMI Unit 1. Again this person is one of demonstrated performance in the industry, and he has clearly demonstrated in the Unit Manager position that he knows how to control the work to the requisite high standards. Prior to the accident at Unit 2, the Superintendent of Maintenance was responsible for all maintenance activities at both Units 1 and 2. Subsequently, and currently, he is assigned exclusively to Unit 1, reporting to the Unit Manager. The Superintendent of Maintenance now has assigned to him, just for Unit 1 work, a maintenance force approximately equal to that previously provided for all maintenance work on both Units 1 and 2. The organization below the Vice President--Unit 1, the Unit Manager, and the Maintenance Superintendent has been enlarged and that people of demonstrated competence have been assigned. The advantages accruing to this restructuring of the maintenance organization are a greater attention to detail, greater emphasis on the control of work, improved training, and an obvious upgrading in the quality and efficiency of work. The backlog of maintenance work including preventive maintenance is of manageable size and is being reduced.

One measure of the effectiveness of these new maintenance management controls is that one can now predict the performance of the Maintenance Department. Work is performed as scheduled. This is traditionally the sign of a well-trained maintenance group that is under control, well-supervised, performing work that has been adequately planned.

Another feature of the current maintenance program is that there is a preventive maintenance group, separate from the corrective maintenance group. About one-third of all Unit 1 maintenance personnel are assigned to this preventive maintenance effort. The group is well-supervised, adequately staffed, and the work is well-planned. A strong preventive maintenance program is a key to a reliable plant.

The assessment revealed a point of intrinsic value: a sense of pride and accomplishment in those responsible for the maintenance of the plant, creating a subtle and desirable difference in the way they approach their work and take care of the systems and equipment for which they are responsible. This is the thing that has changed during the period of this assessment. The plant is much cleaner, the work is under better control, plant maintenance status is known, problems are worked expeditiously.

To further enhance the quality and reliability of the maintenance program, there has been established at the corporate level, a Vice President, Maintenance and Construction. This Vice President is a person with a previously demonstrated outstanding capability to manage and direct large-scale maintenance and construction programs. Thus, for the first time, maintenance becomes a headquarters concern rather than a lesser included function assigned to the Unit Vice President to be accomplished only with plant staff. Under this new concept, the Unit Vice President can direct his principal efforts to the safe operation of the plant while accomplishing preventive maintenance and necessary repairs with the maintenance staff assigned to him. Major and specialized maintenance beyond the capacity or capability of the plant maintenance staff will be assigned to the Vice President, Maintenance and Construction, who will maintain a work force sufficient to ensure that all required maintenance work, as well as required modifications, can be accomplished in the timely and quality manner necessary to support safe operation of the plant.

The concept of a corporate official with specific responsibility in the maintenance area is a new concept at GPU. BETA considers that the work is well-started, the planning is sound, good people will be selected for assignment to the work. Currently, the principal effort of the corporate Maintenance and Construction Division at Unit 1 is on construction--installing approved modifications in the plant. As the organization and staffing of the Division advances, its stated goal of supporting operation of the plant by taking responsibility for major maintenance work and all plant modification work should be fulfilled.

<u>Issue 4</u>:

"Whether the Unit 1 Health Physics program is appropriately organized and staffed with qualified individuals to ensure the safe operation of the facility."

<u>Finding</u>:

BETA considers GPU has organized and staffed the TMI-1 radiological controls organization with enough of the right kinds of personnel who have the necessary capability to achieve high standards of radiological control. The commitment to excellence in radiological controls is apparent in the management of GPU.

The radiological control organization for work associated with TMI Unit 1 has increased to about nine times the size it had been prior to the accident at Unit 2. Seven of these current radiological control personnel have four-year college degrees compared to one previously. Personnel who perform maintenance work (decontamination, for example) are no longer in the radiological control organization so as to avoid the conflict within this organization between getting the work done and getting the best practicable radiological controls. A separate radiological engineering group has been organized within the radiological controls department to ensure radiological aspects of work are planned in advance. The attention to radiological controls at corporate management levels is evidenced by their assigning a corporate director of radiological controls at the vice president level. The TMI-1 manager of radiological controls reports directly to this vice president.

When BETA first went to Three Mile Island in October 1979, it was clear that top management was already firmly committed to high standards of radiological control. However, they were not aware of any particular radiological control problems associated with Unit 1, and they understood the NRC considered their performance in radiological controls at TMI-1 was about average compared to other nuclear power plants.

However, in our review in October 1979, we found that radiologial control personnel were frustrated over their inability to do what they felt should be done to improve radiological control. Some were very upset over the poor radiological control situation and felt they were prevented from exercising good radiological control. A poorly organized radiological control group and poorly defined responsibilities contributed to the problems. Other radiological problems were identified during the October 1979 review, but these problems with attitude and organization overwhelmed all others.

Top management of GPU/Met-Ed moved immediately to improve radiological control. All or almost all of the recommendations made by BETA were undertaken. In some cases they went further. BETA has provided continuing help on radiological control on a frequent basis, with contacts as often as daily and with numerous trips to the plant. This testimony reflects the experience of one year of constant involvement with TMI-1 radiological control, not just one or two brief assessments of their management capability. The changes GPU/Met-Ed has made are summarized in the following paragraphs.

The radiological control organization for Unit 1 was split from Unit 2 so that attention to unusual radiological problems with recovery of Unit 2 would not detract from improving radiological control at Unit 1. The radiological organization was separated from the chemistry organization for a similar reason. A Manager of Radiological Controls was appointed initially directly under the TMI-1 Vice President, which was a higher reporting level than the radiological control organization had in the middle of 1979. A strong manager was selected for this position, but he had no experience in directing radiological controls. However, past experience has shown that a strong manager can learn radiological controls and achieve the necessary program improvements far better than an experienced health physicist who is a weak manager. Nearly one year of further experience has shown this strategy to be correct.

GPU management perceived that the Manager of Radiological Controls would be better able to influence the plant management to achieve high standards of radiological control if he reported to a different vice president than the one who managed the plant. GPU therefore set up the Vice President, Radiological and Environmental Controls, reporting to the President of GPU Nuclear. This reorganization has further strengthened radiological control, and there are no signs that problems have been caused by separating the radiological control function from the maintenance and operational functions. Radiological control personnel in TMI-1 have retained the same office locations and continue to have close contact with daily work independent of the change in corporate reporting level.

A radiological engineering group was set up within the radiological control organization under an experienced health physics supervisor, and five radiological engineers were assigned to him. This increased by a factor of six the radiological engineering manpower on TMI-1. In addition to getting more professionalism in radiological control, this has reduced the paperwork of radiological control technicians and allowed them to increase their time controlling the work. The radiological engineering group has revised 63 of the 66 basic radiological control procedures to make them more specific and to make them understandable, so that personnel can follow these procedures exactly as written. This engineering group follows the planning and performance of individual jobs to ensure they are performed with as little radiation exposure as reasonably achievable.

A measure of success of radiological engineering work, as well as of other radiological control work, has been the total manrem of radiation exposure, determined by adding the exposures of each individual worker over a fixed period of time or for a given job. The initial projection of 325 manrem for 1980 was reduced during the year and the total actual exposure was 201 manrem. A number of major radioactive jobs were performed in 1980. As one example, a steam generator was opened and inspected and one tube was plugged. The total exposure was 2 manrem, far below prior experience at other plants for similar work inside a radioactive steam generator.

A change apparent to all radiation workers has been the large increase in the number of radiological control technicians and their supervisors covering radioactive work. Associated with TMI-1 one year ago were 8 such personnel compared to 36 now. There is a radiological control foreman onsite nearly all the time. These are all Met-Ed employees, not temporary contractor personnel.

Work shifts have been arranged in cycles so that one-sixth of the time radiological control technicians are in training. Qualifications have been strengthened by requiring three different examinations of each radiological control technician and foreman. First is a comprehensive written exam of approximately six hours. Short answers such as multiple choice are not permitted. Second is a practical examination covering work performance, including performance during a drill of an unusual situation. Third is an oral examination conducted by a board of three senior radiological control personnel to evaluate the ability of the technician or foreman to handle unusual situations. Requalification through all three examinations is required biannually. Any technician or foreman who fails to qualify is not allowed to work as a qualified technician.

Other organizational changes were also needed and accomplished. The radiological control organization had been responsible for performing some radioactive work, such as radioactive waste packaging and radioactive decontamination. This potential conflict between those responsible for ensuring proper radiological control and those personnel actually performing work was eliminated by removing these production functions from the radiological control organization. An administrative group of clerks was also added (there were none previously assigned) to reduce the time spent by radiological control technicians and foremen away from the work they are controlling. Radiological support functions of dosimetry, instrument calibration, and respirator testing were consolidated for all workers at TMI. The TMI-2 radiological control organization has these support groups and provides services to TMI-1.

An important step in improving radiological control was for GPU/Met-Ed to obtain a person experienced in evaluating management and performance of a radiological controls program. This continuous assessment function is independent of the Unit 1 radiological control organization and is separate from the audits conducted by quality assurance personnel. The evaluator performing these assessments frequently discusses his findings with the Vice President TMI-1, the Manager of Radiological Controls, and other key managers. BETA has also been in close touch with these assessments.

The most visible improvement in radiological control has been in cleaning up the plant. The first sign to most workers that management was really serious about good radiological control was the immediate efforts to improve housekeeping, and to make sure these improvements continued. Coupled with this was a program to radioactively decontaminate every area practicable. Most of the contaminated areas in the Auxiliary Building have been decontaminated. Emphasis was placed on working clean, each worker picking up after himself, as well as on eliminating the need for special anticontamination clothing in most areas of the plant. Every worker monitors himself thoroughly fr radioactive contamination every time he leaves the contaminated area and radiological control personnel check this monitoring. Whenever contamination is detected on a person, a special investigation is made promptly, no matter how small the amount of radioactivity. The most useful measure of the success of this program to control surface contamination is that the highest radiation exposure to anyone from TMI-1 work in 1980 from radioactivity inside the body, has been less than 1 millirem. This is less than 1 percent of the radiation exposure a person receives from natural background in a year.

GPU has made other improvements by increasing the radiological control staff from about 9 before the accident to 78 in support of TMI-1 work at the end of 1980. The proof of success of this radiological control program does not have to wait until after the reactor returns to operation. The most challenging periods for radiological control are during shutdown when most radioactive work is performed. In 1980, a number of complex jobs were safely and successfully performed on radioactive systems in relatively high radiation areas.

In January 1981, BETA conducted an assessment of radiological controls at TMI Unit 1. Thirty-five key managers and supervisors most important in radiological work were interviewed individually for about one hour each and more detailed further sessions were conducted with five of these.

Seven foremen were also interviewed. Most of those interviewed were in maintenance and operations positions responsible for performing the work. All management personnel in the radiological control department were interviewed. Paying major attention to the management personnel outside the radiological control department is essential, since it is their workers who handle the radioactivity. In principle, a sufficiently aggressive radiological control department might be able to impose its will to achieve a radiological control program meeting the basic requirements. However, in practice high quality radiological control depends heavily on the management of those who perform the radioactive work.

Our latest assessment in January 1981 supports the conclusion that the TMI Unit 1 Health Physics program is appropriately organized and staffed with qualified individuals to assure the safe operation of the facility. Each of the management personnel was knowledgeable, interested, and actively involved in the radiological control program and without exception appeared fully capable of carrying out his part of the program to high standards. Major improvements have been completed and, as in any well-run program, GPU managers have identified further improvements they are making.

GPU/Met-Ed management is aiming toward higher standards of excellence in radiological controls than the requirements imposed by outside agencies. Achieving such performance is a never-ending challenge and requires constant improvement. There is no way in such a program to require the utility to meet its own radiological performance objectives at a given date because the prime objective is to continue improving. There will always be methods to do radioactive work better and to control radiation and radioactivity better. BETA considers there should be no limitations on restart of TMI Unit 1 at this time because of the Health Physics Program.

Issue 5:

"Whether the Unit 1 Radiation Waste system is appropriately staffed with qualified individuals to ensure the safe operation of the facility."

Finding:

Considerable attention had been paid to radioactive waste before the accident. Nothing has been found to show any reduction in this attention or in the staffing. The Radioactive Waste Supervisor has been moved out of the radiological control organization into the operations group in which the operation of radioactive waste systems are also located. This change improves the control of radioactive waste because radiological control personnel review the radiological aspects of radioactive waste processing. The TMI Environmental Controls group is also planning to assess radioactive waste processing.

The staff available for radioactive waste processing under the Radioactive Waste Supervisor will be strengthened by adding an associate engineer. The three foremen have long experience as supervisors, one as the only radioactive waste foreman for several years, and another as a radiological control foreman.

The facilities available have been improved by making modifications to the radioactive waste evaporator. Results are already available from work to reduce the generation of radioactive liquid waste. Leakage inside the plant from sources such as pump shaft seals has been reduced from about 1000 gallons per day to about 300 gallons per day. This reduces the amount of radioactive work associated with processing this waste through the evaporator.

An extensive program has been started to reduce the amounts of solid radioactive waste. One example of the results of this program is that the number of drums of radioactive solid waste packaged was reduced during several months at the end of 1980 from 17 per week to 3 drums per week. Radioactive solid waste is packaged for shipment by Unit 1, but before shipment, packages are double checked and triple checked by other GPU Nuclear organizations at TMI outside Unit 1.

This brief summary provides some of the background for BETA's conclusion that TMI-1 is appropriately staffed with personnel qualified to process radioactive waste safely.

Issue 6:

"Whether the relationship between Metropolitan Edison's corporate finance and technical departments is such as to prevent financial considerations from having an improper impact upon technical decisions."

Finding:

With the creation of the GPU Nuclear Corporation the likelihood of this situation developing is greatly reduced. Major policy/financial decisions are made by the GPU Nuclear Board of Directors which is composed of knowledgeable people, experienced in nuclear matters, who understand the importance of technical integrity. While corporate financial pressures may and do exist, particularly in the case of GPU/Met-Ed, our review indicates that if these pressures became so severe as to deny funds for proper and safe technical action at TMI-1, GPU Nuclear itself would not permit restart or continued operation of the plant. It is also apparent to us that with the restructuring and strengthening of the General Office Review Board (GORB), reaction from them would become evident if such a condition arose. At least through the time of our review, we could find no evidence that undue financial pressures were being applied in the technical areas of TMI-1 even though there was financial stress within GPU.

Issue 7:

"Whether Metropolitan Edison has made adequate provision for groups of qualified individuals to provide safety review of and operational advice regarding Unit 1."

Finding:

During our review of the GPU organization structure, we have observed several changes which have significantly improved the quality of operational advice and safety overview that will be available to support TMI-1 operation. As presently structured we believe the GPU Nuclear Corporation will be able to provide the necessary advice and review.

One of the major factors leading to the conclusion that proper safety review and operating advice will be available for TMI-1 is the changes that have been made to the offsite technical support organization previously discussed. The increased size of the organization, its direct involvement in the preparation of procedures for plant operation, its greater participation in plant operation and testing, and the existence of an onsite technical group will, in our opinion, provide an effective source of technical expertise.

An additional change that we consider important is the redirection of the functions of the onsite safety review committee, the Plant Operations Review Committee (PORC). This group as we found in the fall of 1979, was more a part of the line organization than an independent safety overview group. In the process of doing their work, the PORC became involved in the detailed editing and rewriting of procedures sent to them for review. This evolved to the point where the members of the PORC, rather than being in a position to review a procedure from an overall safety standpoint, became, in effect, the authors of the procedure. They ended up doing the work that others were responsible for. This situation has changed. PORC is now rejecting inadequate submittals and requiring them to be redone so as to permit an adequate independent review.

Eventually it is planned that each group represented on the PORC will function as individuals responsible to approve a procedure in their area of cognizance. Further, a new group or committee is being formed called the Independent Onsite Safety Review Group (IOSRG). This group clearly will function as an independent review group in that none of the members are in line positions. Their charter is clear, and they should assure a broader and more continuous safety overview than has been available in the past.

In addition to this independent onsite safety review group, there continues to be the TMI-1 General Office Review Board (GORB). It will function as it has in the past reviewing matters of nuclear safety not only in detail but from the broadest of viewpoints. The membership of the TMI-1 GORB has been strengthened, there is a permanent chairman, and it meets periodically at the site. It appears to be addressing the proper issues. There also exists the newly formed Nuclear Safety Assessment Department, which by its charter, will have a responsibility to provide yet another independent review of matters which could affect nuclear safety.

What is most important in this area of safety review and operational advice is not so much organization, as it is an overall appreciation for and understanding of the necessity to have technically sound safety reviews by qualified people and the willingness to use them. For example, it is possible to have highly qualified people in the newly created position of the Shift Technical Advisor. Yet, if the shift operations people do not understand and enthusiastically support the Shift Technical Advisor concept then its potential will not be realized. In our view we found at all levels at TMI Unit 1 full support for not only the Shift Technical Advisor concept, but also for all of the other added safety reviews. In some cases we found some uncertainty existing at the site as to how all of these different inputs would be effected in a timely manner, but, as with other situations, these are being resolved as the people become more familiar with their functioning. What we did find is an understanding on the part of the operators as well as management, of the need for independent safety review and advice.

Issue 10:

"Whether the actions of Metropolitan Edison's corporate or plant management (or any part or individual member thereof) in connection with the accident at Unit 2 reveal deficiencies in the corporate or plant management that must be corrected before Unit 1 can be operated safely."

Finding:

Clearly, and as appropriately pointed out in the post-accident investigation reports, there existed a number of deficiencies in the corporate and plant management at TMI prior to the accident at Unit 2. Many of these problems were not unique to TMI or GPU; also they had developed over many years as civilian nuclear power passed through its developmental stages. Not only were these problems not unique to TMI, but in our opinion TMI probably was better than most of the other utilities in this regard.

Because of actions taken by NRC many of these industry-wide problems are being addressed and some have been resolved. However, it is still too early to expect that all of these deep-seated problems will have been corrected to the point where one could be fully satisfied; also, some of these problems, due to their nature, do not have obvious solutions. In our opinion, this describes the situation at GPU/Met-Ed. They have had to make more progress than others; they have had to face up to more of the problems than others for the obvious reason that they are the utility that had the accident and the spotlight is focused on them. This is not to say that GPU is correcting its problems only because of those reasons. However, the notoriety and public attention are certainly added incentives.

As previously stated, our review indicates that there are no deficiencies now existing in the corporate or plant manageme- . of GPU/Met-Ed which must be corrected before Unit 1 can be .ted safely. It is important not only to understand what these findings mean, but what they do not mean. We did not attempt to determine, nor did we, that all of the management problems relating to the entire subject of designing, building and operating nuclear plants identified by the post-TMI accident investigations, have been satisfactorily resolved at

TMI Unit 1 or any other place. This will take much more time and action by GPU as well as groups or agencies external to GPU. It is our opinion that there are sufficient management and technical capabilities within GPU to permit restart of TMI Unit 1.

Issue 11:

"Whether Metropolitan Edison possesses sufficient in-house technical capability to ensure the simultaneous safe operation of Unit 1 and clean-up of Unit 2. If Metropolitan Edison possesses insufficient technical resources, the Board should examine arrangements, if any, which Metropolitan Edison has made with its vendor and architect-engineer to supply the necessary technical expertise."

Finding:

To answer this question, in the context it was asked, would have required us to have assessed the in-house technical capability assigned and being used in the clean-up operation of Unit 2. This we did not do. We are aware that GPU/Met-Ed uses a relatively large number of outside technical resources at Unit 2. Our assessment focused on the issue of the full-time availability of technical resources for safe operation of Unit 1. We are satisfied that, with the existing and planned organizational structure and assignment of personnel, there will be sufficient in-house and outside talent available and specifically assigned to TMI Unit 1 to permit its safe operation.

We were particularly interested in determining the method by which key in-house talent was distributed between Unit 1 and Unit 2, and the extent each of these personnel spent their time on Unit 1 vs. Unit 2. Because of the large number of rather difficult technical problems facing Unit 2, we expected to find that plant getting the majority of the time and talent of the key personnel--and that is what we initially found. The President of GPU Nuclear has his office located at the TMI site and while this is a plus, we found that he tended to be oriented toward Unit 2 problems. We also found that because the President was at the TMI site, the Executive Vice President was concentrating on the Oyster Creek plant. In the early stages of our review we found Unit 1 somewhat short of day-by-day attention from either of these top executives. Since that time, however, the President and the Executive Vice President have readjusted their time and efforts and, in our opinion, they are giving Unit 1 sufficient attention.

At the vice presidential level, it is our opinion that for the most part, the division of time devoted to the three GPU nuclear plants is appropriately balanced. It is also considered that the personnel assignments within the various divisions are such that, on one hand, there are people assigned to handle one plant only, and on the other hand, there are people who can act across all three plants where it is appropriate to do so. While there will undoubtedly be readjustments as time goes by and more experience is gained, the current balance appears satisfactory. It will be the job of management to ensure that this balance is maintained once Unit 1 goes back into an operating mode.

This concludes the summary of our findings. In essence, we conclude that the management capability and technical resources of GPU Metropolitan Edison are sufficient to assure the safe restart and operation of TMI Unit 1.

BACKGROUND OF THE FOUR ASSOCIATES OF BASIC ENERGY TECHNOLOGY ASSOCIATES, INC.

The four Associates of BETA retired from the Department of Energy's Naval Reactors program where they served as senior staff members for Admiral H. G. Rickover, Director, Division of Naval Reactors. In that capacity they were involved in the technical management of the design, construction, and operation of over 150 reactor plants, including the Shippingport Atomic Power Station currently operating with the Light Water Breeder Reactor.

The Associates of the Corporation are:

R. William Bass is a graduate of the United States Naval Academy and holds the degree of Naval Engineer from the Massachusetts Institute of Technology. He was a member of the Department of Energy's Naval Reactors program from 1956 through July 1979. In his position as Associate Director for Commissioned Submarines during the last thirteen years, he was responsible to the Director, Division of Naval Reactors for the maintenance and overhaul of the Navy's nuclear submarine propulsion plants. In that position his responsibilities included providing the support necessary to resolve operational problems on an immediate basis. With respect to the efforts associated with the overhaul, conversion, and refueling of over one hundred nuclear submarine propulsion plants, he had responsibility for scheduling, financial support, industrial capacity, technical direction, and qualification and training of workers. He was also responsible for coordinating the efforts of the fleet, two government laboratories, six naval shipyards, three private shipyards, and supporting tenders and submarine bases. Other experience in the Naval Reactors program includes assignment as the Naval Reactors shipyard representative for the construction of both nuclear-powered submarines and surface ships.

Robert S. Brodsky is a graduate of the Massachusetts Institute of Technology with a degree in Physics. He was a member of the Department of Energy's Naval Reactors program from 1953 through August 1979. For six years he held the position of Assistant Director for Reactor Safety and Computation. In that position he was responsible to the Director, Division of Naval Reactors for matters relating to the safety in design and operation of the Navy's shipboard nuclear propulsion plants, the Department of Energy's naval prototypes, and the Shippingport Atomic Power Plant. These responsibilities included the safety of design, core fabrication, operation, testing, maintenance, refueling, new and spent fuel shipping, and laboratory operations involving fissile materials. In carrying out these responsibilities he worked closely for many years with the Nuclear Regulatory Commission, the Advisory Committee on Reactor Safeguards, and other federal and state agencies.

Murray E. Miles is a graduate of Cornell University with a degree in Engineering Physics. He was a member of the Department of Energy's Naval Reactors program from 1955 through August 1979. For the last thirteen years he was Associate Director for Nuclear Technology. In this position he was responsible to the Director, Division of Naval Reactors for establishing and monitoring the radiological control procedures used during construction, operation, and maintenance of the Navy's nuclear propulsion plants, the Department of Energy's naval prototype plants, and the Shippingport Atomic Power Plant. While in this position he developed the procedures and methods now followed in the naval program to control radioactive discharge and radiation exposure. His reports and methods have become world-wide standards. In addition, he was responsible for the design and technical developments associated with both primary and secondary water chemistry, reactor shielding, decontamination, environmental protection, and emergency planning.

William Wegner is a graduate of the United States Naval Academy and holds degrees of Naval Architecture and Marine Engineering from the Webb Institute of Naval Architecture. In addition, he holds a degree in Nuclear Engineering from the Massachusetts Institute of Technology. He was a member of the Department of Energy's Naval Reactors program from 1955 through August 1979. Since 1964 he held the position of Deputy Director of the Division of Naval Reactors. In that position he was responsible to the Director for all aspects of the Naval Nuclear Propulsion Program, including the design, construction, testi g, and operation of the program's nuclear reactor plants. In addition to his overall broad responsibilities in these areas, he was specifically responsible for the development and operation of the Navy's selection, training, and qualification programs for nuclear power personnel. He was also specifically responsible for the foreign aspects of the naval nuclear propulsion program. In addition, he developed the Navy's senior officer training program which is directed towards assuring that all senior naval officers in major at-sea commands can adequately oversee engineering operations under their cognizance.

In addition to these specific duties, it should be noted that all of the Associates were involved in the selection and advanced qualification of the Navy's reactor engineering personnel. Additional responsibilities included the auditing of contractors' laboratories, shipyards, operating ships, prototypes, and the Shippingport Atomic Power Plant.

MR. BLAKE: Mr. Chairman, I have no additional questions of Mr. Wegner. He is available for cross examination and questions by the Board.

CHAIRMAN SMITH: I would like to note that none of the Intervenors sponsoring these contentions are present. The only Intervenor present is TMIA, represented by Ms. Bradford.

Mr. Adler.

CROSS EXAMINATION

BY MR. ADLER:

Q Mr. Wegner, on page 13 of your testimony you testify as to the qualifications of the Vice President of TMI Unit 1, Mr. Hukill.

Now, the Commonwealth has raised with other witnesses the problem of the past experience of Mr. Hukill as being limited to the Navy, and in particular his experience with the relatively small-scale reactors in the Navy program.

Now, you, of course, are intimately familiar with the type and degree of training received by people in the Navy nuclear program, and we are very interested in your comments as to the applicability of Mr. Hukill's training in the Navy as it relates to the performance of his responsibilities as Vice President of TMI Unit 1, and in particular, in his responsibilities as the emergency director o: Unit 1.

A I think that the capabilities in particular of Mr. Hukill are unique probably in a cross-run of the Navy officers that come out. I had an opportunity to work with Mr. Hukill over a period of years and could observe him in situations where he was responsible for jobs much larger than, say, the commanding officer of a submarine.

For example, he had responsibilities for the training and the selection of all the commanding officers prior to the time that they took their first command at sea of a nuclear ship.

I have also had an opportunity to see him operate in the Naval Sea Systems Command where he had responsibility over several thousand engineering duty officers in their training and their performance and operations such as that.

Insofar as his reactor experience is concerned, and I think that whether a reactor happens to be a large reactor such as TMI or a smaller reactor such as would go into a ship, I think the technical aspects of that are not that different.

Obviously, decisions that are made relative to what you would do under emergency situations in a ship are different than emergency situations that you would do at a place like TMI. In many cases the emergency situations on a ship require in some cases more extraordinary actions; so I do not see that there is that much of a difference.

I would not as across the board -- I don't want it interpreted that way -- that anybody that happens to have been in the Navy or anybody who happens to have been a commanding officer of a nuclear ship per se, that unto itself would qualify that individual to be in the position Mr. Hukill is in.

Q Did you have any opportunity to observe or analyze Mr. Hukill's performance in making an emergency decision with regard to an area that he was not particularly familiar with; for example, an unexpected technical problem where he did not have specific training in that area?

A No, I would not. I would not have had the opportunity.

CHAIRMAN SMITH: Mr. Wegner, could you draw the microphone closer?

THE WITNESS: All right. Is that better?

CHAIRMAN SMITH: Yes. Fine. Thank you.

(Counsel for the Commonwealth conferring.)

BY MR. ADLER: (Resuming)

Q Mr. Wegner, I am sure you are aware that our particular concern is with Mr. Hukill's ability to make public health and safety-related decisions, and our primary concern is the difference between the naval reactors and a large commercial reactor in terms of judging potential releases and potential public health and safety impacts.

How would you assess Mr. Hukill's training as it relates to his ability to make that type of public health decision?

A Again, I -- you know, in the jobs he has had -- for example, he has spent -- had spent four years in command of a nuclear ship. He had also had experience in the role of being over a number of nuclear ships. I cannot from personal experience say that any of his ships or his ship while he had command of it had an emergency such that he would have had to have exhibited the type of thing you are talking about.

But, again, I do not have any hesitation that he has got the intelligence, that he has got the presence of mind, and I think he has the technical background and understanding to do what needs to be done.

(Counsel for the Commonwealth conferring.)

Q I would like to ask you to make something of a personality assessment based on your knowledge of Mr. Hukill.

Now, is he the sort of manager who was inclined to want to make all of the crucial decisions himself, or in the alternative, is he the sort of manager who will rely very heavily on the technical input from the experts that he surrounds himself with?

A I guess I would have to characterize it as a combination of the two, because I think that in watching him perform in the various jobs which I have described earlier, obviously having the military background and having performed in the role of a commanding officer, there is that certain element; and he was a very good commanding officer, I should point out.

But there is that certain element. The commanding officer is in charge, and when it is appropriate, he must make command decisions. But I have also observed him where when a decision had to be made and if it involved a technical matter, and he knew that the technical matter was beyond his capability or that he could go out and obtain the technical advice, then he would do that.

He would not just act all on his own and say I know better than anybody else; I am going to do it -- which, incidentally, that philosophy is very carefully implanted in the Naval Reactors Program, that commanding officers, although they are required and may be required to make a decision, because when the ship is out operating sometimes they cannot always get advice, say from the laboratory or from headquarters or something like that, they have to make a decision, but they are not empowered to make those decisions, and they learn that. And I do not think there is any question that Hukill would turn to the technical experts to get advice, so it doesn't bother me at all.

Q Mr. Hukill has informed us he has embarked on a personal education program to familiarize himself in greater detail with the design of TMI-1 and the operation of TMI-1. Have you analyzed his efforts in that regard in your analysis of his capabilities?

A No, I have not.

Q Have you analyzed any training programs or steps that he has taken in order to increase his abilities as emergency director or his functions?

A Only to -- sorry.

Q I am finished.

A Only to the extent to know that it is being done. What the content of the course, or to the extent that he is doing it, no, I am not.

(Counsel for the Commonwealth conferring.)

Q In your response to the health physics issue item number 4 beginning on page 19, I noted that there was no reference in this entire section to the NRC's Inspection and Enforcement Report which cited Licensee for certain health physics violations.

Did you analyze that report in your analysis of the health physics program?

A I would like to make a couple of comments in that regard. Number one, that this section of the assessment was done primarily by Mr. Miles, who is here today, and if there is a time that you would like to get into the health physics area, it might be more appropriate to have Mr. Miles come up here.

But to very specifically answer that question, unless you want to proceed further down the line, is that obviously we were aware of that report and have analyzed that report, yes. But if you want to get into it deeper, I think it might be beneficial if Mr. Miles gets into that.

Q We did not get into the specifics of the report an the recommendations. Dr. Little may. We were simply interested in whether it was analyzed, and in particular, whether you have analyzed whether the specific violations cited to the Licensee have been corrected and what efforts have been taken to correct those.

A I think I would prefer that if you want to get into that that Mr. Miles respond to that. I think he is much more familiar with it.

MR. BLAKE: Mr. Smith, Mr. Miles is here. We could ask him to be sworn and go right into this at this point.

MR. ADLER: I am sorry. Maybe I should inquire whether Dr. Little has very specific questions. If that is true, we can just wait for yours.

DR. LITTLE: I do have some. I was questioning myself whether this is the appropriate time to address that, since this is not the purpose for which these witnesses -- this witness in particular and this group was offered.

MR. BLAKE: They are certainly in a position to describe in some detail their efforts in assessing the company's response on this subject, and we can have Mr. Miles sworn.

DR. LITTLE: In that case I do think it would be appropriate for Mr. Miles to do so.

MR. BLAKE: I would like to have Mr. Miles come forward.

CHAIRMAN SMITH: All right.

DR. LITTLE: I believe we have his resume also.

MR. BLAKE: You do. It is included in the attachment to Mr. Wegner's testimony.

Whereupon,

MURRAY MILES

was called as a witness by counsel for the Licensee and, having been duly sworn by the Chairman, was examined and testified as follows:

DIRECT EXAMINATION - Resumed

BY MR. BLAKE:

Q Mr. Miles, would you state your name and address for the record?

A (WITNESS MILES) My name is Murray Miles. My business address is 1600 North Moore Street, Arlington, Virginia.

Q Mr. Miles, can you briefly summarize your background in the radiological controls area, as well as your involvement with the Three Mile Island Unit 1 facility, in particular whether or not BETA has assessed Licensee's response to areas of non-compliance cited by the NRC in the health physics area.

A (WITNESS MILES) My background in the Naval Reactors Program in radiological controls is summarized in the attachment to Mr. Wegner's testimony.

For 24 years I worked on, set up the radiological controls in the Naval Reactors Program. I personally wrote about 10 manuals that prescribe the program. I conducted myself more than 200 inspections of radiological controls at various facilities.

In October 1979 I started being involved in the Three Mile Island radiological controls program, conducted an assessment at that time, was asked to help the company improve the radiological controls program.

Last month I conducted an assessment and evaluation of where the company is at that stage, how far they have come, what more improvements should they make to go to the next step.

In this involvement, to answer the Commonwealth's question specifically, I have been involved in evaluating the company's handling of the NRC's findings on their health physics audit that was conducted in two weeks starting the end of July 1980.

Because the Nuclear Regulatory Commission did their review in such extreme detail -- they had established six people who spent about six weeks essentially fulltime on that evaluation, plus several others who were drawn in part-time to help on that -- I did not try to repeat what the NRC did in their evaluation.

I did spend a considerable amount of time evaluating the company's response, how well they reacted to it, what they have done about it. I can answer details if you wish, or in broad general fashion how they responded. They responded actively, interestedly.

The kinds of issues that the Nuclear Regulatory Commission laid out were ones that were in the company's priorities, later in their priority list in general. They were smaller items to fix after the first level of performance items got under control.

The company spent the last year making major changes and adding staff, and it has been difficult the last year to hire the kind of talented people needed. They did not solve their problem just by pouring money into it and just by doubling or tripling or quadrupling staff. That does not solve the kind of radiological problems they have.

They did those things, of course, but they had to get the caliber of people who could lead their program, as is laid out in Mr. Wegner's testimony. There is a summary of the kinds of things in organization and management that the company has done.

I personally am very impressed with the number of things, the type of things, the amount of progress they have made in that period of time.

DR. LITTLE: I just have one question to follow up on something he said at this time.

Why is it difficult for them to get persons trained in radiological hygiene methods?

WITNESS MILES: The country has a severe shortage of health physicists. Everybody is trying to hire health physicists. Yes, you can train your own, and that is the approach the company has taken, to train its own managers and leaders; but that takes time to do. You have to hire the kind of person who can be trained or moving from some other position in the company to one of these positions where you can train him. That takes time. They have done it expeditiously.

CROSS EXAMINATION - Resumed

BY MR. ADLER:

Q Did you agree with the conclusions and recommendations of the NRC's report? Do you feel they were appropriate?

A (WITNESS MILES) I have no problem with the individual findings.

(Counsel for the Commonwealth conferring.)

Q On page 29 of the testimony in the second full paragraph you refer to the extensive program to reduce the amounts of solid radioactive waste.

Can one of you gentleman describe that program and what it entails?

A (WITNESS MILES) Yes, I can. The radioactive waste reduction business is not a scientific business. It is a very common sense management program. The Vice President decided he was going to reduce the amount of solid radioactive waste, Mr. Hukill. He laid out a number of common sense, obvious things that anybody would do, and it did not take any particular invention to go say that when you are bringing in a box of things that you ought to leave the box outside, because when it comes out of a radioactively contaminated area, it is now waste. That is a simple, kind of obvious step.

A permit form was developed and put in place where the trade supervisor, the foreman of the worker, had to approve what things where brought into the radioactively contaminated area. This is a decision now that is controlled by the work force, not the radiological control force.

Any improvements in this area on radioactive waste are the same kind of improvements that were made on radiological control areas in general. The work force has to run it. If you have to set it up to rely on a radiological control technician as a policeman for every step, you will not get there. There is no way to get enough policemen to go cover it all, so the trade foreman controls that.

A major step of this was to radically reduce the number of radioactively contaminated areas and the area, the number of square feet of such areas. The numbers were cut by approximately a factor of five, the number of square feet of radioactively contaminated areas in the auxiliary building.

I cannot avoid talking about radiological improvements when you talk about radioactive waste improvements. They go together, as does radiation exposure, reduction, and so on. Reducing the number of areas in square feet did things on radioactive waste reduction that were important. Working each job clean was important. Instead of wrapping up the person with anti-contamination clothing, wrap up the material so the person can go in in his normal work clothes. That has been done. A lot of these steps go together in the waste reduction business.

(Counsel for the Commonwealth conferring.)

Q One more point. At the bottom of that paragraph you say that "Before-shipment packages are double-checked and triple-checked by other GPU nuclear organizations at TMI outside Unit 1."

Can you tell us who that is, what organizations are involved?

A (WITNESS MILES) The Unit 2 organization actually does the shipment, so that is the next step. The quality assurance organization at Three Mile Island is the triple check in this line. There are additional audits, not one hundred percent checks, done by various surveillance groups, and in particular by the radiological assessment group that does surveillance on anything radiological on the island.

Q So all of these wastes from Unit 1 go through Unit 2 in order to be shipped offsite.

A (WITNESS MILES) Through the Unit 2 organization, yes, for shipping.

Q Have you analyzed the capacity, the shipping capacity of the Unit 2 organization to handle both Unit 1 wastes and Unit 2 wastes?

A (WITNESS MILES) Yes. The capacity is people basically, and the people, the management talent is what counts on this. You can move utility workers from one radioactive waste job to another as the workload changes.

The kind of people who handle these things are the working level -- the numbers go up and down with the amount of work they have to handle.

(Counsel for the Commonwealth conferring.)

MR. ADLER: Thank you. We have no more questions.

CHAIRMAN SMITH: Mr. Levin, do you have questions?

MR. LEVIN: No questions, Mr. Chairman.

CHAIRMAN SMITH: Ms. Bradford, I notice you are sitting at counsel table. Are you participating today?

MS. LOUISE BRADFORD: I think I have some questions of later witnesses.

CHAIRMAN SMITH: Okay. Of this witness?

MS. LOUISE BRADFORD: No. Of Keaton and Long. Is that --

CHAIRMAN SMITH: They are not going to appear.

MS. LOUISE BRADFORD: Oh, thank you.

CHAIRMAN SMITH: Last night, all of the participants in the proceeding who were here looked at their testimony, and no one had questions; so the testimony was stipulated. Mr. Keaton will be returning for another purpose. We will take up your problem later on.

But you have no questions of this witness?

MS. LOUISE BRADFORD: No.

CHAIRMAN SMITH: Mr. Swanson.

MR. SWANSON: No questions.

BOARD EXAMINATION

BY DR. LITTLE:

Q Mr. Wegner, could you speak to the qualifications of BETA to assess managment capability in civilian organizations?

A (WITNESS WEGNER) I assume your question is based on the fact that the four associates of BETA had spent 25 years working in the Naval Reactors Program, and we stepped out and started assessing civilian plans.

Q That is correct.

A (WITNESS WEGNER) You would like to know how we would do that or would there be a relationship between the two? I am not sure I follow your question.

Q We wonder whether your experience in the Navy, which is operated under military discipline, the personnel are controlled by military discipline, and the training programs are somewhat more rigorous, I believe, than some of the ones at civilian plants -- whether you feel that BETA members have the training and experience to make an accurate judgment of the management capability under conditions where you do not have military discipline and the same type of training imposed on the personnel.

A (WITNESS WEGNER) I would add one point to this, that in the Naval Reactors Program there is a civilian element. In other words, one of the programs that was under the responsibility of the Naval Reactors Program was the

Shippingport plant, the light-water breeder located at Shippingport, Pennsylvania. So in that one area we certainly had experience in dealing with a private utility, in seeing some of the management that went -- that connected with that particular project.

But I also think that the analysis we performed, in other words, the experience that you gain in the Navy, most people would think that it only involved military people. But I think it is much broader than that in that our analysis, the assessments that we performed over the period of years in the Naval Reactors Program included private companies such as shipbuilders, which are large industrial organizations, vendors' plants, which again are large laboratories, that that situation would be no different, for example, than any large commercial outfit.

Q You have had opportunity to observe management problems in private institutions such as some of the vendors. Part of your or your associates' job was to look at how vendors manage their operations.

A (WITNESS WEGNER) That is correct.

Q I have some specific pages I would like to address, so if you will bear with me, I will go on through it. I am referring to page 7, in the first paragraph, but I think this same thing permeates throughout all the testimony; and that is, you have seen a continuous upgrading over the past year or so, and then you say that we would expect it to continue on into the future.

And my first question is whether or not BETA or some similar organization will be working with Met Ed to assure that this upgrading continues or whether at this point in time the management personnel of TMI-1 are, so to speak, ready to fly, if they themselves have internalized some of the Lessons Learned as far as management?

A (WITNESS WEGNER) As I pointed out in my testimony, when we first came and were asked to start this work for GPU, we obviously did find, as the testimony points out, a number of areas that needed correction. And I think we have been working not only to assess the capability that exists for TMI, but we were very specifically asked at the time to assist in arriving at the corrections and to put the corrections in place.

Recognizing that there are really only four of us involved in this matter, we have been doing that. And as I point out, many of the corrections or the deficiencies, the problems that we saw when we first came to TMI today do not exist any more. They have corrected many, many of the items.

Many of the items are in the process -- in other words, they are not all in place as of this particular moment, and there are areas where the foundation has been laid, where the proper people have been put into those critical jobs, and now is a period of time when the thing has to settle down. The people have to become familiar with what they are doing.

About a month ago, in a meeting with Mr. Dieckamp and with Mr. Arnold we were very specifically asked -- BETA was asked to continue our efforts, and the contract was extended for an additional year to stay at TMI to assist in -- not only in continuing to poke and look for problems, weak areas, but to stay there long enough to help them get the problems corrected. So we intend to stay there at least for the next year.

However, I think that even if we were not there, I do not see any problem in the fact that they now have, in our opinion, the right caliber of people in the upper levels of management that understand and can carry out what it is they have to do in order to run the plant safely and properly. I do not have any fears about that at all.

Q I am not questioning their ability to make the corrections that have been pointed out to them. I am questioning whether they have the in house capability to, themselves, perceive deficiencies and then correct them.

A (WITNESS WEGNER) Yes, Dr. Little. I think they do have the capability to find the problems that are there. Whether we can point out other problems, that is something that we will have to see.

Q I wanted a little elaboration on the comment on page 13 about seven lines up from the bottom. And you notice that during the time of the review you witnesses dramatic changes, and you say that they seem to have settled down with the new organization, and they are becoming effective in handling their jobs. This was not the case a year ago.

"This was not the case a year ago" was what I wanted some elaboration on.

A (WITNESS WEGNER) Well, I think you are asking me what did we find a year ago.

Q Right.

A (WITNESS WEGNER) What did we find a year ago. Of course, you have to recognize that when we went there in October, November, that time frame, that there was still an awful lot of confusion existing as a result of the aftermath of the accident. I think that management was still attempting to figure out where the priorities were going to be put. They had the problem at Unit 2, the cleanup. They had the problem at Unit 1.

What we found when we got there was that because the separation had not occured as yet between the direction over Unit 1 and Unit 2, that there were not clear signals of priorities, and that when you got into the second, third, and fourth levels of management, there was confusion as to what are we supposed to do today, tomorrow. All of a sudden someone would make a decision such that there was a priority over at Unit 2, and people from Unit 1 would be moved over, and there was a question as to what is the right job, what are we supposed to be doing.

And that was one of the reasons that the Unit 1 and Unit 2 were in fact split physically, organizationally, so that that situation would not occur any more. That is one element of the kind of thing I am talking about. And it was very obvious at the time that the people just had no idea what they were supposed to do the next day or the next week or something like that. They were waiting for someone to tell them, and that is not the way to do it.

Q On page 15 in the second paragraph about two-thirds of the way down the page you indicate that "The experience and capabilities of engineering staff were broad and we believe consistent with those necessary to support safe reactor operation." It says, "It remains to be seen if this level of experience and capability can be maintained at the staff expense. It may be difficult for GPU to expand as rapidly as they propose."

I would like you to explain the implications if the level of capability cannot be maintained. What problems do you see should be prepared for?

A (WITNESS WEGNER) I think that the implication as to what I would expect to see if they did not achieve the level that they propose is a slowing down in the ability to say, for example, have a piece of paper at a given time when they know they need this particular piece of paper. It would slow the operation down to some extent.

I do not think it would put it in jeopardy at all. It would put it back to the time, for example, if you need a particular piece of paper through a certain review process, something coming out of a design engineering, if that piece of paper is needed in four days and you do not have enough technical talent, you do not get it in four days; you get it in six days. So it tends to slow the work down. And, of course, this could have some effect on the scheduling process.

Q What do you see as the controlling factors in whether or not GPU will be able to expand at its proposed rate?

A (WITNESS WEGNER) I think just in its ability to get the qualified talent that they have indicated they need, engineering talent, technical talent. It is a very scarce commodity on the market today. You just cannot go out and get highly qualified engineering talent just by putting an ad in the paper. It is a difficult thing to do.

Q But GPU is prepared in other ways, financially and organizationally, to bring on board such people if they can get them.

A (WITNESS WEGNER) Oh, yes, yes, absolutely. I think the desire is there, and I have witnessed their efforts in attempting to get the people; and I am very much impressed in that they are not just accepting the numbers, but they are being very selective as to make sure that the talent that they do get meets their requirements. This is something new.

Q I think this question would go to Mr. Miles. Page 20 of the testimony, this has to do with problems that were found in the radiological control area, especially as the personnel perceive their responsibilities and difficulties. It is indicated there that they themselves perceived difficulties in carrying out their functions, but these evidently were not perceived by management at the time.

Could you address how that problem was located and corrected?

A (WITNESS MILES) I am trouble following where you are on page 20, Dr. Little.

Q Page 20, at the bottom. "In our review of October 1979, we found that radiological control personnel were frustrated over their inability to do what they felt should be done to improve radiological controls.

A (WITNESS MILES) Yes, I can elaborate on that. This is a year and a quarter ago time frame. The top management level was -- made the right statements regularly to the right people, including to me, about what they wanted. The radiological control people felt very frustrated in trying to get their jobs done, because every time they turned around, they felt that they were stopped by a situation that prevented them from getting done what they ought to do. And it is a feeling that, in shorthand, to explain it, Operations ruled the roost. Operations controlled.

The history of the plant was we want megawatts produced on the grid. Anything that is in the way of that, go away, don't bother us. Operations controlled every step, and Radiological Controls, therefore, would not press as hard as they ought to go get some of the decisions made, because they felt, incorrectly, but they felt that they would be overruled anyway.

At the top management it was not a correct assessment of the situation. It took putting those two together to get those problems solved. They have done such an extremely good job on that particular area that last month when I was questioning amongst Operations, the complaint is exactly the opposite. The Operations people told me, their leaders told me that they lose all the battles with Radiological Controls. They have not won a battle with Radiological Controls in a long time.

I did examine specifics of what they are talking about, and the decisions were correctly made. But it is such a difference in such a short period of time that there is still growing pains tryin to get the close, good working relationship.

The decisions are now being made right. The attention is right. Part of it was an organizational solution to take Radiological Controls out from under the plant and make them report to a different Vice President in the plant.

Q So you see this as part of the strength of the new structure. You see this as one of the strengths of the new organizational structure.

A (WITNESS MILES) Yes.

(Board conferring.)

BY CHAIRMAN SMITH:

Q I did not hear clearly a part of your answer. Did you say that the Radiological Controls felt correctly or incorrectly that --

A (WITNESS MILES) Incorrectly.

Q That were incorrect in their perception that they would not --

A (WITNESS MILES) Yes.

CHAIRMAN SMITH: Okay.

BY DR. LITTLE: (Resuming)

Q One question I had as I read through the whole testimony was what incentives will there be after restart for Met Ed to continue its impetus to improve management capability?

A (WITNESS WEGNER) Well, I think there are a number of things that should come into play that would provide the impetus for continued improvement. Let me mention a few.

I think, number one, the caliber of people that have been put into the leading jobs at GPU are of the nature that they will push for improvements. I think the formation of INPO and the effectiveness of INPO, which is still in its early stages of development, if it is done properly -- and I have every hope that it will -- that this will be the first time in the nuclear industry that the utilities have gotten together and made a commitment to improve their entire operations by having a group which is independent of any pressures that will come in and will continually look over their shoulder and tell them you can do it better, as differentiated from the regulatory process which would still obviously be operated by NRC.

So I have great hope for INPO being able to provide that pressure on a continuing basis.

Q Constructive criticism from a friend, in other words. Construtive criticism from a friendly source.

A (WITNESS WEGNER) Yes, ma'am, that is right.

Q On page --

A (WITNESS WEGNER) But also with a little bit of sting. I think Mr. Lee pointed out this morning they do have a little bit of power. If the utility -- if a particular utility does not come into line, they do have the power to withhold or reject that insurance that he was talking about.

Q On page 33 it was indicated that this has to do now with the added safety reviews or changes that are going on, for example, addition of the shift technical adviser. And in the middle of the first paragraph there the comment is made, "In some cases we found uncertainty existing at the site as to how all of these different inputs would be effected in a timely manner." And this is indicated as an ongoing process.

Do you think the management is settling down so that all of the different corrections can be resolved in a timely manner without uncertainties? I realize that what you are reporting here is a snapshot of what you found last month in your review.

A (WITNESS WEGNER) I do not see where there will be any problem in having it resolved at the time that it would certainly be necessary for the restart of Unit 1. For example, it is not unique to TMI. There still exists throughout certainly the utilities, other utilities that we have been associated with, there still is a certain degree of uncertainty as to the exact role of the STA, what he will do, how he will do it, when he will do it.

There is a lot of settling out that still has to occur. That same settling out has to occur at TMI.

Now, in my looking at the situation at TMI and reviewing and listening to and talking to the STAs, I was very much impressed with their capability, in contrast to what I have seen in other places.

These people are not what I would say young, fresh engineers out of college that have been put into a training program that they learn the technical aspects of the plant, but to put them in the role which has clearly been envisioned by the NRC as more of a consulting, overseeing expert role.

There is reluctance out there in many cases of the shift supervisor who may have had 10, 15, 20 years operating with that plant to turn to seek advice from somebody who, in their opinion, does not really understand the full operation of the plant.

Now, they have not done that at TMI. They have used people with an awful lot of experience, and I think it is going to work out. There still has to be that settling out as to who does what when, and I think they are doing it.

Q You say that at TMI the shift technical advisers are not inexperienced engineers but people who are experienced.

A (WITNESS WEGNER) That is correct.

Q What about at other plants?

A (WITNESS WEGNER) I say I have seen at other plants where they have taken a different approach, where they have gone out and they have hired first of all college graduate engineers, and they are slowly bringing them up with the technical knowledge of the nuclear plants, and then they are trying to fold them into the operational part. And that is going to take years before that person gets to the point where, as I say, they are going to have enough familiarity and overall understanding of the plant to be able to give the shift supervisor some experience. And I think it is just going to take time.

But that is a problem that really, I think, almost all the utilities, the ones that I have been associated with, they are still trying to figure out just how to handle that situation.

Q One problem being whether or not the shift supervisor would have confidence in the technical adviser's advice, even if it were correct.

A (WITNESS WEGNER) That is correct. And what authority. The way it is now, the shift technical adviser theoretically is not in a line position. He is an adviser.

And now the question comes up that if he is there, and if there is a problem, and if the shift supervisor turns to the STA and seeks advice, and the guy says do this, there is no requirement that the shift supervisor do it.

So the question comes up whether he is even going to ask him. It is a problem. But I do not see, as I say, I think at TMI what I have seen, I do not think that problem will come up, because the people that are -- people they are training and putting into the STA roles are as knowledgeable or more knowledgeable than the shift supervisors.

DR. LITTLE: That concludes my questions.

CHAIRMAN SMITH: I have a few.

BY CHAIRMAN SMITH:

Q On page 14 of your testimony, Mr. Wegner, there is a potentially ambiguous statement. At the bottom of the page where it says, "Additional analytical and design support for plant operation should be achieved by the presence onsite of a permanent staff of engineers who will report to the offsite Vice President, Technical Functions."

Do you find that statement?

A (WITNESS WEGNER) Yes.

Q We have heard testimony about the onsite presence, but your statement could be read two ways. One, it is a prediction that that should happen; or another, it is a recommendation which suggests it has not happened.

A (WITNESS WEGNER) It was intended as a prediction.

Q Okay. On page 15 -- on page 35 where you address the issue of level of management order, the Commission intended to approach this issue in two parts. One is first the Board is to determine whether Met Ed possesses sufficient in house capability, and then if it does not, does it have the outside sources available. And your conclusion does not make it clear if you have found that they do not have sufficient in house or that you have found they have sufficient in house.

Then, of course, on page 15 you discuss it more thoroughly. They rely upon contractor personnel.

Could you clarify what your conclusion is more directly to the --

A (WITNESS WEGNER) Yes, Mr. Chairman. In Issue 11, as I point out, to do a completely thorough job of answering that question would have required us to extend our analysis into the entire TMI-2 operation; and as I say, we did not do that.

So what we did was to say we are going to look at just those technical resources and management capability which are clearly identified as being TMI-1 with the clear understanding that they are restricted to Unit 1.

And the question then being, if that is the case and if you are never going to come over and borrow, because this was the thing that was bothering us, and as I pointed out earlier in my testimony today, the fear being that if a problem at Unit 2 develops, a technical problem or something like that -- I am not talking about an emergency but a normal -- the type of work that has to be done at Unit 2 -- if someone that day happened to make a decision saying hey, that is a very important thing, we have to get that done, and strips off out of Unit 1 the talent, then we would consider that to be a problem.

Now, if I just look at -- and assuming that that does not happen -- but if I just look at the talent which is assigned to Unit 1, the conclusion that we came to is that there is sufficient in house technical capability for Unit 1, wi h the assumption that it remains at Unit 1.

Q Okay. We have had supplementary testimony to yours explaining what the plan would be if they ran short of help at TMI-2. I just wanted to clarify your position on it. That is very helpful.

The next question deals with management attitude, and to put my question in context, I am reminded of Deputy Secretary of State Warren Christopher's statement that the hostage problem came up on his shift, and he would like to see it resolved -- on his watch, I mean -- he would like to see it resolved.

Do you detect an attitude in the individuals that you have been in contact with there that compared to other utility officers that they have a special responsibility to assure safety in their plant, because after all, the accident did happen on their watches?

Has that been discussed? Has that been expressly a discussed item?

A (WITNESS WEGNER) Let me see if I can answer it in a little, slightly different manner. Part of our assessment was to spend time talking to the very highest levels within the corporation, which we did. In those discussions I was particularly interested in trying to find out if the commitment to doing things right was genuine or whether it was either forced because of the notoriety, and the pressures, and everything else -- you know, it would be obvious at any stage of the game under these circumstances for the top people to say well, obviously we are going to do things right.

How genuine was that commitment? How deep was it? And long would it last? Would it last a year from now, two years from now, and so forth.

The conclusion that I came to after spending hours and -- many hours with these top people was that I could not detect that they were doing and they were reacting in the right way, because they, number one, were being forced to do it. I think that you have a commitment in their own mind, and just as you have indicated, it happened during their watch, and they are not going to walk away from it until it is fixed and it is working right.

And I go back this morning when you were questioning Mr. Lee relative to the same sort of commitment. I think that when you were talking about whether his desire to hire the two top people had anything to do with the fact that they had been involved in the accident, I do not think there is any question that having lived through it and being present during the accident and the aftermath of the accident, you know, you would like -- you would hope that you would not have to take every utility management through that kind of an experience to teach them.

But you cannot help but walk away from it with the idea that when you have lived through it, you now firmly believe a lot more than you did before. And even in our dealings with other utilities, there is still some element of the accident did not happen to us.

So that there is a very clear difference in talking to Mr. Koons or Mr. Dieckamp or Mr. Arnold than there is talking to counterparts in other utilities. There is a difference.

Q My final question is this. Some measure GPU by presenting you as a witness here, that is, calling upon your personal professional, reputations as a part of the reason why we should allow them to restart.

What would be your reaction, observing that you are observing a changing situation, what would be your reaction if you felt that that -- that you were had, that you loaned your reputations mistakenly?

A (WITNESS WEGNER) I think to answer that I really have to go back to the very first discussion that I had with Mr. Dieckamp when he asked us to do this particular job. There was quite a bit of discussion on the very subject; that if the only reason that we were being asked to step in here was to do what you just got through describing, that number one, it would become very obvious to us very early in the game, that if we came in and found things that were wrong, and if those things -- if we were going to get into an argument on every one of them, or that these things were going to be just passed off so that the net result was that our organization would provide some piece of paper that would give the stamp of approval of our organization and our background, that we would not do that, that we would disassociate ourselves very quickly.

And not only that, but that they should recognize that if that were the case, that we would make very sure that we testified before your committee and would tell you exactly what we thought.

Q That is very reassuring. We do look at your background, your reputations, and we do Mr. Lee's, and the questions could be called perhaps soft pitches easily hit back. But we do depend upon your professional assurances that your testimony is as is stated very much.

I have no further questions.

Anything further?

(Board conferring.)

BY DR. LITTLE: (Resuming)

Q I believe you heard Mr. Lee describe a similar occurrence at one of their plants in which a PORV failed to close, and that it was corrected almost instantaneously by someone who happened to recognize the situation and fix it on the spot. Then this same thing happened at TMI-2. It set off a whole chain of events which are world famous, of course.

Do you think that the problem at TMI-2 was the result of a few individuals, that this was indicative of the presence of a few individuals who failed to correct the problem, or do you think that what happened there was an indication of more pervasive problems throughout the management, training, etcetera, at that time?

Was it a problem that could be fixed by getting rid of a few individuals? Is it the kind of problem that requires the kind of fixes that are being imposed on the nuclear industry as a whole?

A (WITNESS WEGNER) I wish I could answer that question in a very few words. And, of course, these are my personal views, and that should be accepted as that. I think that the events that occurred at TMI-2 were -- the stage was set for that many, many years ago; that to put the blame on any one individual or any group of individuals is incorrect.

To go back a little bit into the naval experience, the naval program when it started out -- and as you correctly pointed out, is milit y; therefore, the conditions are different, the designs are different, how you obtain people and how you train people and how people react are different, situations are different. Yet, in the development of the naval program there was a recognition from the very beginning that for the Navy to have nuclear power, it had to embark upon an entirely new concept, a new way of doing business. And obviously, Admiral Rickover was the father and everything else, the pusher.

That concept was fought very, very hard no matter where he turned, because it was something new. There was the concept that if it was good enough for an oil-fired plant ship, it was good enough for a nuclear ship. He knew differently. He felt differently and obviously forced the changes into the naval program that he felt were necessary.

In my opinion this knowledge was available at the time, but because nuclear power was looked upon as a commercial path to move easily, people were in the business of selling it. It had to be attractive. It had to be attractive commercially. It had to be attractive organizationally and everything else.

I think that by and large utilities walked into the nuclear business unaware that over on the other side the naval program, the massive changes were taking place. But yet, on the commercial side people were saying don't worry about it.

And I could go on and on, but what I am saying is what happened at TMI-2, in my opinion, is a result of that 25 to 30 years of moving to the point where it happened. In one sense I think it is great that it happened and that no one was hurt. Hopefully, it has shocked everybody, and I mean everybody, to the point where now we say okay, now we understand. Now we have got to go make those changes and treat this system differently. It can no longer be treated the way it was treated for the last 25 years.

I know it is a long answer, but that's the way it comes out.

Q So you do think that what happened was indicative of a widespread, pervasive problem and not the problem of a couple of individuals.

A (WITNESS WEGNER) That is correct.

CHAIRMAN SMITH: Any further questions of this panel?

Mr. Blake?

MR. BLAKE: No, sir.

MR. MURDOCH: Mr. Chairman.

CHAIRMAN SMITH: Yes, sir.

MR. MURDOCH: I would like to address two questions to Mr. Wegner.

CHAIRMAN SMITH: All right.

CROSS EXAMINATION--Resumed

BY MR. MURDOCH:

Q Following Mr. Wegner's statement, this may seem anticlimactic, but you previously spoke, I believe, of something of the nature of an oversight group, oversight organization or committee that would look over operations. Do you know to what I am referring?

DR. LITTLE: INPO, I believe he is referring to.

WITNESS WEGNER: Are you referring to INPO, the Institute of Nuclear Power Operations?

BY MR. MURDOCH: I had understood you to testify that, in your view, there would be or should be or could be some sort of a group that would have some sort of independence from operations and could evaluate and make judgments, therefore, on the basis of some sort of independence as to operations at a nuclear facility. Am I correct?

A (WITNESS WEGNER) Included within the written testimony I do discuss the creation of the independent off-site review group.

Q All right.

A (WITNESS WEGNER) Is that the one you are referring to?

Q Yes.

A (WITNESS WEGNER) And that is the group which is there as an independent group out of the line organization at TMI. In other words, it is not down through the operational chain; it is a group of people who are independent of the operation who review the operation and have to pass on safety matters.

Q Would those persons be part of the Met Ed or GPU organization?

A (WITNESS WEGNER) Yes. Those people are all employees of the GPU Nuclear. Now, there is another group which has been formed and has been in operation, which is called the GORB, G-O-R-B. It stands for General Office Review Board. That group is composed of some GPU employees, but it also has been augmented with a number of outside people who are not under the employ of GPU.

Q This is under GPU Nuclear?

A (WITNESS WEGNER) That is correct.

Q How could or how can the independence and freedom of such a group be assured?

A (WITNESS WEGNER) Well, the way I guess I look at the two groups, one is that if I take the ISORG, which are all Met Ed or GPU employees, how I do that is to make sure that when I hire the people that I hire people that have capability, integrity, and tell them what the job is, and they will do it.

But in addition to that, I would certainly make sure by seeing what they do, to make sure that they are retaining their independence.

One of the things, for example, that this GORB does is a constant review of the actions taken by the ISORG. So therefore, that is another check on this independence.

Now, how do I assure that the GORB remains independent? One way, of course, is to put somebody that is not -- put a number of people who are not GPU employees on it. Another way, of course, is -- which I have mentioned before -- is that that is an area that the INPO will look at very carefully. And I know, for example, it is an area that the NRC watches very carefully.

So there are a number of ways that you -- checks and balances that you throw in to make sure that it does its job. Nothing guarantees it, though.

Q Finally, do you have in your mind's eye or in actuality an organizational chart which would show to whom that group would report?

CHAIRMAN SMITH: Let me interrupt here. Mr. Murdoch, we do indeed have a great deal of testimony on that, and we have charts showing the table of organization, who reports to whom. I would be very pleased to point it out to you in the transcript so you could follow it. We have -- we spent many hours on that subject matter. It would be very interesting reading to you.

MR. MURDOCH: That is all.

CHAIRMAN SMITH: I do not want to curtail your questioning of Mr. Wegner, if that is what you want.

MR. MURDOCH: So long as that is available.

CHAIRMAN SMITH: Yes, sir. Anything further?

(No response.)

CHAIRMAN SMITH: Okay, gentlemen, thank you very much for appearing.

(Witnesses excused.)

CHAIRMAN SMITH: Oh --

MR. BLAKE: Mr. Chairman, our next witness is Mr. Robert Koppe. We can call him now and get started or break as the Board sees fit. Based on all of the predictions, I believe we will be able to finish Mr. Koppe, who has been here since Tuesday. I have no other witnesses other than Mr. Koppe today.

CHAIRMAN SMITH: I prefer to begin with Mr. Koppe after lunch.

MR. BLAKE: All right, sir.

CHAIRMAN SMITH: And can we return at 1:00? We will return at 1:00 o'clock today.

(Whereupon, at 11:45 a.m., the hearing was recessed, to reconvene at 1:00 p.m. this same day.)

AFTERNOON SESSION

(1:05 p.m.)

MR. BLAKE: Mrs. Bradford, representing TMIA, had a motion to make with respect to the Keaten-Long testimony.

MS. LOUISE BRADFORD: Since I was unable to be here yesterday afternoon when the decision was made not to bring those witnesses Keaten and Long, and since I understand that Mr. Keaten will be returning, I would ask at this time that I would be able to direct my questions to him at that time.

CHAIRMAN SMITH: During the lunch break you indicated to me that the questions you had would be those that you would direct to Mr. Keaten rather than Mr. Long.

MS. LOUISE BRADFORD: That is correct.

CHAIRMAN SMITH: Are there any objections to that?

MR. BLAKE: Mr. Smith, it does not come easy for me to object, but I do indeed object.

CHAIRMAN SMITH: Okay. Well --

MR. BLAKE: I will be happy to give you the basis for my objection. I do not know the nature of the questions, and I do not know how much additional preparation, if any, might be required at that point in time for Mr. Keaten to again prepare himself.

CHAIRMAN SMITH: Anticipating the objection, Ms.

Bradford has no objections to indicating in advance the nature of the questioning she would have asked Mr. Keaten.

Is that correct?

MS. LOUISE BRADFORD: That is correct.

CHAIRMAN SMITH: Why don't you explain.

MR. BLAKE: Maybe she could just give me a copy of her cross-examination plan. That would suffice.

CHAIRMAN SMITH: I do not -- do you have a formal cross-examination plan?

MS. LOUISE BRADFORD: No, I do not. But I could prepare one if --

CHAIRMAN SMITH: Why don't you state generally what is the area of interest that you would like to address to Mr. Keaten?

MS. LOUISE BRADFORD: Basically, I would like to question Mr. Keaten about some of those Met Ed personnel who were present at the time, on the day of the accident, and who are still part of the GPU management corporation.

I have in mind, in particular, Mr. Herbein. And do you want me to go further into exactly the nature of the questions?

MR. BLAKE: I think at a minimum, I would like to have her go further and understand precisely what she has in mind.

CHAIRMAN SMITH: Well --

MR. BLAKE: Particularly since the claim, as I understand it, is she was not available when they were here, and I would have expected her now to understand and to be able to define what her questions would have been.

CHAIRMAN SMITH: I think we have to balance her absence yesterday when the issue came up with the fact that it did come up rather suddenly, the decision not to bring them on as a panel. They would have been here today if the Board -- if there had been any objections to it. We have to balance that with the significance of the cross examination. And she had indicated to me an example of a question would be: In view of Mr. Herbein's extensive experience, why was he not emergency director?

Is that a type of question?

MS. LOUISE BRADFORD: That is correct.

CHAIRMAN SMITH: And what officials that were involved in the emergency activities, what is their role now in the corporation? Those are the two areas she indicated to me she wanted to inquire into. I think those are important questions.

Also, I pointed out to Ms. Bradford that the Commission issue order is two-part on this issue: A management response, is it indicative of -- what do we learn from the management response about the management today? I think those are important issues. I think Ms. Bradford, representing TMIA, has very sparingly engaged in cross examination, and she has followed the Board's directions to carefully collect the issues she wishes to inquire into.

So you can see the direction we are thinking.

MR. BLAKE: I can see. I would like to be able to state at least the basis of our decision here. I did object reluctantly, for some of the reasons you expressed.

CHAIRMAN SMITH: It is not an easy decision.

MR. BLAKE: No. I realize that.

CHAIRMAN SMITH: We stressed to Ms. Bradford that the hearing will have to move along in its normal course. And we will make objections only for strong reasons. And it is a difficult balance to make but --

MR. BLAKE: It will only take me a couple of minutes to state an understanding.

CHAIRMAN SMITH: I am sorry?

MR. BLAKE: It will only take me a couple of minutes to state the nature of my position and my understanding where I see the Board headed.

First, I would observe that the Keaten-Long testimony was not directed even at any Intervenor Contention, but rather was being put on in response to Commission issue item that not legally avoiding an opportunity for questioning by Intervenors, but at least I am sensitive to the nature of why we were putting on that, and it had not been as a result of any Intervenor expressed interest.

Second, I would observe that on -- to the best of my knowledge, TMIA has expressed no particular interest in this area, has confined itself to its Contention TMIA 5 in the maintenance area.

Third, I would observe that Ms. Bradford, shackled as she was with taking over the case on January 15 when we talked about management schedules, indicated that she thought her -- TMIA's -- involvement would be with TMIA Contention 5 when it came on.

Finally, Ms. Bradford has -- I think I have given her no reason not to approach me. And in fact, she has on several occasions indicated an interest in areas. One of those, for example, is Mr. Dieckamp, where I expect her to come tomorrow.

CHAIRMAN SMITH: Mr. Keaten what?

MR. BLAKE: Mr. Dieckamp. That was one of the areas. In addition to Mr. Dieckamp's schedule, because I had an expressed interest by Ms. Bradford in Mr. Dieckamp by Ms. Gail Bradford as well, that is one of the reasons that I specifically scheduled it for a fixed day, so Intervenors would be there and know in advance precisely when that testimony would come on.

It is just another factor. That is all. I am trying to give you, Mr. Smith --

CHAIRMAN SMITH: I am missing the relevance of that. She is not asking -- she is asking that when Mr. Keaten does come for other purposes, that she be notified of that and be given an opportunity to ask him questions on that testimony that was stipulated.

Is that correct?

MS. LOUISE BRADFORD: That is correct.

MR. BLAKE: And --

CHAIRMAN SMITH: I think I am missing your point on the specific schedule for Mr. Dieckamp.

MR. BLAKE: Well, it was -- it was only by way of expressing to you that wherever I have gotten any indication that an Intervenor has an interest, I have not avoided taking that into account in our scheduling. The Long-Keaten testimony --

CHAIRMAN SMITH: I see.

MR. BLAKE: -- the Long-Keaten testimony was filed January 26th. I have had no indication of any interest by any of the Intervenors in that particular piece of testimony. We had several witnesses waiting around yesterday, and it was, I think, in the interest of balancing, as the Board has to do, of not only party interests but as well this party's interest and in the scheduling of witnesses and their availability that we did what we did last night.

We could have as easily sworn them and said, "No questions." I do not attach any particular significance to the fact that the testimony was stipulated in.

CHAIRMAN SMITH: Well, we would not have arrived at Keaten and Long's testimony yesterday. We simply would not have. And the only possible fault that could be laid to ANGRY is not being present to object to the stipulation. That is the only thing that we can lay to them. And they were present long enough to make a reasonable assessment that we would not have gone to Long and Keaten that day, I believe.

Yes?

MR. BLAKE: Finally, I regard it as a need for some diligence on the part of all the parties' places -- on the part of each of the parties to this proceeding, Mr. Smith, to do such things as express an interest where there has been none shown to provide a cross-examination plan in advance, to have alerted the Board -- not me; they do not have to provide it -- but even a cross-examination plan or any interest had been expressed, we would have avoided this situation.

I felt it necessary to at least state the nature of our position and why for the reasons that you have expressed, countering it that I reluctantly have to approach it.

(Board conferring.)

CHAIRMAN SMITH: Well, I think if we apply the same standards we apply to the Licensee and try to accommodate their schedule, if we apply those standards, we would accommodate Ms. Bradford. She has followed the Board's instructions to narrow her interest into particular areas, to take the time to become competent in those areas. And I think in the long run -- the long run -- the hearing will be expedited if we accommodate occasional slipups like this and allow her to recover from what hardly could be her omission for not being here. I think in the long run we will expedite the hearing by allowing her to narrow her interest and accommodate her when she does.

MR. BLAKE: I can see other opportunities where under other settings I felt it necessary to make this observation, because we may be a good deal more strenuous in our objections as they come up.

CHAIRMAN SMITH: Yes. Yes, of course. We make it clear there are unusual circumstances prevailing here. Otherwise, if they had come up and been available for cross examination, that would have been it. We would not have recalled them unless very, very important matters had been overlooked that were necessary for a decision.

But those -- there are circumstances here which I think we will allow that. So the point is that when Mr. Keaten does return, Ms. Bradford should be given some notice, and then you will have to have a cross-examination plan.

MS. LOUISE BRADFORD: Thank you, Mr. Chairman.

MR. BLAKE: The Licensee would call Mr. Koppe as our next witness.

Whereupon,

ROBERT H. KOPPE

called as a witness by counsel for the Licensee Metropolitan Edison Company, having first been duly sworn by the Chairman, was examined and testified as follows:

EXAMINATION

BY MR. BLAKE:

Q Mr. Koppe, would you provide your full name and business address?

A Robert H. Koppe. 1919 14th Street, Boulder, Colorado.

Q Mr. Koppe, I show you a copy of a document entitled "Licensee's Testimony of Robert H. Koppe in Response to CLI-80-5, Issues 8 and 9 (Licensee's Infraction, LER and Operating Experience History)," and dated LIC 2-2-81. The document is comprised of some 44 pages and includes at the end a two-page document entitled "Witness Qualifications: Robert H. Koppe."

I ask you, Mr. Koppe, whether or not this document was prepared by your or under your direct supervision?

A Yes, it was.

Q Mr. Koppe, do you have any corrections that you would like to make to this document?

A Yes, there is one minor omission on page 31. There is a table consisting of three columns of numbers. And on line item 5, entitled "Surveillance," the number in the second column is missing. And that number should be 1.6.

Q Mr. Koppe, with that correction, do you adopt this document, including the final two pages, as your testimony in this proceeding both on the subject matter, Licensee's infraction, LERs, operating history, and on your background and professional qualifications?

A Yes.

MR. BLAKE: Mr. Smith, I would ask this document be physically incorporated into the record as though read.

DR. LITTLE: I have one question: Is the outline part of Mr. Koppe's testimony?

MR. BLAKE: No. It had not been our intention to either make the index nor the outline actually the witness' testimony. Those items were prepared by us in each of the cases, Dr. Little.

There was one occasion earlier where it was asked in order to get over the hurdle that the witness -- that the witness adopt the outline, and I think it was Dr. Christensen that was asked of. But that has been our approach on all of these. And to the extent, I have been remiss in pointing that out. I thought I observed that earlier. But to the extent I haven't, that was my fault and not the fault of the witnesses. The outlines were our product in response to the Board's request.

DR. LITTLE: I was particularly interested in this specific outline as to whether this was Mr. Koppe's viewpoint.

MR. BLAKE: You are welcome to ask that question of Mr. Koppe. But it was prepared by us and not by Mr. Koppe, the outline itself. I am afraid I may be the one who would have to stand to the questioning.

CHAIRMAN SMITH: We want the outline, if appropriate, to be in the transcript.

MR. BLAKE: Yes, and I have done that with all of them. I just wanted to point out we did it for the Board's -- at the Board's request.

CHAIRMAN SMITH: Okay, we will receive the testimony, the index and the outline.

(The document referred to, the testimony of Robert H. Koppe and attached index and outline, follows.)

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
METROPOLITAN EDISON COMPANY	)	Docket No. 50-289 SP
	)	(Restart)
(Three Mile Island Nuclear	)	
Station, Unit No. 1)	)	

LICENSEE'S TESTIMONY OF

ROBERT H. KOPPE

IN RESPONSE TO CLI-80-5, ISSUES 8 AND 9

(LICENSEE'S INFRACTION, LER AND
OPERATING EXPERIENCE HISTORY)

INDEX

OUTLINE

The purpose and objectives of this testimony by Robert H. Koppe, Manager of Reliability and Safety Projects with the S. M. Stoller Corporation, is to respond to Issues (8) and (9) of Commission Order CLI-80-5, which question whether any conclusions can be drawn regarding Licensee's ability to operate Unit 1 from a comparison of TMI infraction, LER and operating history with industry-wide statistics. Mr. Koppe, using data from TMI and industry drawn ~~from LER's and~~ from OPEC-2 (a data base maintained by the S. M. Stoller Corporation for EPRI) concludes that operating performance of TMI-1 has been considerably better than average for other B&W units, other PWR units and other nuclear units in general. This is attributable to good design and to efficient management. Mr. Koppe details TMI-1's safety-related performance with that of industry by comparing the number of LERs and NRC noncompliances, the rate of occurrence of personnel and procedural errors, and the failure rate of safety-related systems. His conclusion is that TMI-1's history is average or somewhat above, and that operations of TMI-1 prior to the March, 1979 accident at TMI-2 were such as to provide an adequate level of safety.

This testimony, by Robert H. Koppe, Manager of Reliability and Safety Projects with The S. M. Stoller Corporation of Boulder, Colorado, addresses the following issues posed by the Commission in its March 6, 1980 Order, CLI-80-5:

ISSUE (8)

What, if any, conclusions regarding Metropolitan Edison's ability to operate Unit 1 safely can be drawn from a comparison of the number and type of past infractions of NRC regulations attributable to the Three Mile Island Units with industry-wide infraction statistics;

ISSUE (9)

What, if any, conclusions regarding Metropolitan Edison's ability to operate Unit 1 safely can be drawn from a comparison of the number and type of past Licensee Event Reports ("LER") and the licensee's operating experience at the Three Mile Island Units with industry-wide statistics on LER's and operating experience.

The testimony is presented in three major parts. The first part describes the sources of data which I used. The second describes the operating availability of TMI-1, while the third describes the safety performance of TMI-1. Because TMI-2 had been in commercial operation for only three months, the limited amount of data available was not considered useful in performing this analysis. At the time of the accident at

TMI-2, Unit 1 had accumulated four and one-half years of commercial operation. Unit 1 had gone through startup and early commercial operations, and into "mature" operation.

Ultimately the safety of any nuclear unit depends on the reliability of a number of mechanical and electrical systems. Some systems are primarily of importance because they determine the frequency with which a unit will experience transients and accidents which threaten to damage the core. The reliability of other systems is of primary importance because their availability determines the potential to prevent core damage when transients or accidents occur. Stated succinctly the safety of the core for a given design depends on:

- o The frequency of initiating events, and
- o The reliability of systems to respond to these events.

While it is possible to measure the historical frequency of events and reliability of systems, it is extremely difficult to quantify the extent to which design, maintenance and operations each contribute to these results. Recognizing this, I have concentrated on quantitative measures of overall performance (both operating and safety) and have not tried to quantify the effect of plant management on that performance. In all the performance variables I examined, TMI-1 was equal to or better than the average for comparable plants. Whether this was due to design or operations and maintenance, or (most likely) both, I can't be certain. However, I am certain that TMI-1 could not have done as well as it did had it been poorly operated, maintained and managed.

DATA BASES

Data which I used in preparing this testimony came primarily from three sources--TMI-1 LERs, OPEC-2, and LER Data Base.

TMI-1 LER's

This consisted of a complete set of all the LERs submitted by TMI-1 from May, 1974 through April, 1979.

OPEC-2

The OPEC-2 data base is maintained by S. M. Stoller Corporation (SMSC), and consists of three major types of information: gross performance; outage causes; and safety related events. This data may be sorted and aggregated by unit, time period, and problem.

Gross Performance. Data on gross performance cover all U.S. nuclear units rated 400 MW or larger. Data for each unit begins with the first month of commercial operation and continues through December 31, 1979. For each unit data is entered monthly and includes all the standard measures of performance including hours critical, hours on-line and net electric generation.

Outage Causes. Data on outage causes cover all U.S. nuclear units rated 400 MW or larger. Data for each unit begins with the first month of commercial operation and continues through December 31, 1979. For each unit, data is entered for each full outage and partial outage. The data describes the date of the event, its duration and magnitude, whether it was forced or scheduled, and its cause. Each cause (more than one cause can be given for a single event) is described by the system and component which caused the event and the problem which the component experienced.

Safety-Related Events. Data on safety-related events cover all U.S. nuclear units rated 400 MW or larger. Data for each unit begins with January 1, 1978 or the date of commercial operation, whichever is later, and ends with December 31, 1979. The following types of events are entered:

- o All transients experienced by the unit (as reported in LERs and Monthly Operating Reports).
- o All LERs except environmental occurrences.
- o All safety-related maintenance (as reported in Monthly Operating Reports) except minor calibrations and adjustments.

For each event, data includes:

- o the date
- o the unit status
- o the system and component
- o the problem
- o the cause of the problem

- the effect on safety system performance
- the type of transient

Where two or more transients and/or problems occur together, the data is linked together in the computer to show causal or temporal relationships.

LER Data Base

This data base is maintained by SMSC for EPRI's Nuclear Safety Analysis Center. It includes only LERs and covers all U.S. nuclear units beginning with January 1, 1979 through the most recently available data. Data which is entered for each LER includes the unit ID, the LER number, the coded data from the LER form, and an event class indicating the potential significance of the event. Examples of classes of events are:

- Single component failure
- Two or more failures apparently unrelated
- Two or more failures with a common cause
- Minor performance degradation (e.g., set point drift)
- Operator or maintenance error
- Potentially generic equipment problem, etc.

Where two or more classes apply, each is entered.

OPERATING AVAILABILITY

There are many factors which affect a unit's availability. The unit with the best availability is not necessarily the best managed unit, nor is the poorest performer necessarily the unit that is most poorly managed. Nevertheless, there is usually some correlation between how well a unit performs and how well it is managed.

There are a number of indices which provide useful measures of the operating availability of generating units. One of the most common and useful of these indices is the capacity factor. It is with capacity factor that I will be concerned in this section.

When a generating unit is designed and built, it is intended to be able to operate consistently at any power up to some maximum. This power which is the maximum at which a unit could run consistently is called the design net electrical rating of the unit. Because of seasonal variations in condenser cooling water temperatures, the actual maximum output of a unit may be somewhat above or below the design power level on any particular day. The design net electric rating of a unit is equal to the average power which the unit would produce throughout the year if all equipment were working correctly and if the unit were continously run at its maximum capability. A unit may fail to produce some power due to refueling; due to equipment maintenance or failure; due to restrictions imposed by regulatory bodies; or due to lack of need for the power.

For a given time period, the capacity factor for a unit is simply the ratio of the power that it did produce to that which it theoretically could have produced (multiplied by 100 to yield a percent). If a unit actually did run perfectly for a year and required no maintenance or refueling, its capacity factor for that year would be 100%. A unit which did not run at all for a year would have a zero percent capacity factor. In a case where a unit ran perfectly for nine months and was shut down for three months, its capacity factor for that year would be 75%.

Gross Unit Performance Statistics

At the time of the accident at Three Mile Island Unit 2 on March 28, 1979, the capacity factor of Three Mile Island Unit 1 was considerably better than the average for other nuclear units. Table 1 presents the lifetime capacity factors for Three Mile Island Unit 1 and for a number of other groupings of nuclear units. These aggregated capacity factors were calculated by weighting and averaging the lifetime capacity factors of each of the units in the group. The weighting factors that were used correspond to the years of experience for each unit. Thus, each year of nuclear experience is weighted equally in determining the aggregated average capacity factors. The lifetime capacity factors were determined for each unit using data from the unit's first full month of commercial operation through the end of March, 1979. This end date roughly corresponds to the occurrence of the accident at Three Mile Unit 2.

The capacity factors in Table 1 are listed for Three Mile Island Unit 1 and for three groups of nuclear units. Included

TABLE 1

Lifetime Capacity Factors for Units

Weight - Averaged By Unit Years of Experience

(Calculated through March 31, 1979)

	Lifetime Capacity Factors (%)	Unit Years of Experience	Number of Units
Three Mile Island 1	72.3	4.5	1
B&W Units other than Three Mile Island 1	58.7	25.6	7
PWR Units other than* Three Mile Island 1	63.9	154.7	37
All Nuclear Units other than* Three Mile Island 1	61.7	250.0	56

* This included the excellent performance of a number of units in their 7th through 9th years of operation.

are the performance statistics of all large modern nuclear units (all units rated 400 MW or larger). As of March 31, 1979, there were seven such B&W units, 37 such PWR units and 56 such nuclear units in total, excluding the Three Mile Island units.

The strongest similarity of performance should be evident when Three Mile Island Unit 1 and the other B&W units are compared. These units have nuclear system designs that are generally very similar. Generic problems that affect the nuclear systems of B&W units will probably also affect Three Mile Island Unit 1. Conversely, problems affecting the nuclear systems of units designed by a different vendor, but not affecting the B&W units, will probably also not influence the performance of Three Mile Island Unit 1. Thus, the generic cracking problem with the surveillance specimen holder tubes resulted in outages at most B&W units including Three Mile Island Unit 1, while other problems like the BWR feedwater sparger cracking did not cause losses at any B&W units.

Because all PWR units have many design similarities inherent in their reactor systems, one would expect that performances of PWR units would also be similar to that of B&W units and Three Mile Island Unit 1. In fact, the lifetime capacity factor of Three Mile Island Unit 1 is considerably higher than the average lifetime capacity factors for other B&W units, for other PWR units, and for all other nuclear units.

The largest differential is apparent between the performance of Three Mile Island Unit 1 and other B&W units. Apparently, Three Mile Island Unit 1 avoided many of the problems that caused outages at these other units.

As indicated in Table 1, the lifetime capacity factor for Three Mile Island Unit 1 was accrued during only four and one-half years of commercial operations. This data includes a large proportion of experience during the early years of operations. I have taken this early experience to be the first three years since the start of commercial operations. During this period nuclear units characteristically operate with a lower average capacity factor as compared with later experience in commercial year four and thereafter. The reduced performance in the unit's early years results from the debugging of startup problems and the gaining of experience by the unit operators, management and planning personnel.

The experience for other PWR units and other nuclear units in general includes proportionally more experience during the later, more mature years of operation than does Three Mile Island Unit 1. One would therefore expect that the lifetime average capacity factors for these two groups would be higher than that for Three Mile Island Unit 1. Such is not the case. In fact, as Table 2 indicates, the Three Mile Island Unit 1 capacity factor was greater than the corresponding average capacity factor for the three other groups of nuclear units.

Table 2

Capacity Factor By Commercial Year

(through March 1979)

		Commercial Year					
		1	2	3	4	5	6
Three Mile Island 1	Capacity Factor (%)	81.0	60.2	68.[illegible]	79.4	73.1	-
	Unit Years of Experience	1.0	1.0	1.0	1.0	0.5	-
Other B&W Units	Capacity Factor (%)	52.8	51.5	64.0	68.7	61.5	66.2
	Unit Years of Experience	7.0	6.0	5.0	4.9	2.0	0.7
Other PWR Units	Capacity Factor (%)	59.3	57.8	62.2	68.7	71.8	74.6
	Unit Years of Experience	35.5	32.1	26.8	23.6	17.0	10.5
Other Nuclear Units	Capacity Factor (%)	58.4	54.5	59.8	64.1	68.8	73.0
	Unit Years of Experience	54.5	51.1	43.9	38.8	27.6	18.5

Three Mile Island Unit 1 consistently performed with fewer load reductions and outages as compared with these other groups of nuclear units.

The reduced capacity factors in commercial year two is characteristic for all of these units because the first refueling outage usually occurs during this year. This refueling is often lengthy as the result of many inspections and repairs and the inexperience of the operating and planning staffs of the unit. The capacity factor for Three Mile Island Unit 1 in commercial year five includes only six months of experience. Because a complete refueling outage, which usually accounts for a major portion of the losses during a year, occurred during this six months, the capacity factor for year five is somewhat reduced from what it might have been had the unit operated for the remainder of the year. Nevertheless, the Three Mile Island Unit 1 capacity factor for year five is still greater than the corresponding average capacity factors for the other groupings of nuclear units.

Unit Performance Statistics Disaggregated By System

As is apparent from Tables 1 and 2, the lifetime capacity factors and the capacity factors for each year of commercial operation of Three Mile Island Unit 1 were greater than the corresponding average capacity factors for other units. If losses of output are attributed to the system or component that caused the outage or load reduction, a means of comparing unit performances on a more detailed level is provided. Table 3 lists these lifetime capacity factor losses for systems and components at Three Mile Island Unit 1 and the three other groups of nuclear units. The following is a discussion of the capacity factor losses due to system or component problems.

Fuel. Losses due to fuel problems have been less at Three Mile Island Unit 1 than at the other groupings of nuclear units. The only substantial source of such losses at TMI-1 has been outage for control rod repatching procedures. B&W units routinely interchange the regulating and safety control rods at a prespecified fuel burnup. This action promotes a more even fuel burnup and better control characteristics. The losses at Three Mile Island Unit 1 are largely the result of a lengthy outage for such a control rod repatching in May and June, 1975.

Other fuel related losses at Three Mile Island Unit 1 have been very typical of the other groups of nuclear units. The large losses at other B&W units attributed to past fuel problems are the result of the outages at Crystal River Unit 3 and Davis Besse Unit 1 to correct the burnable poison rod vibration and cracking problem. These problems, which were generic to larger B&W units, did not affect Three Mile Island Unit 1. Other B&W units had also experienced some problems with trips caused by power imbalances or tilts in the core. As a result, revisions were made to the trip system limits reducing the number of spurious unit trips. This problem was not very consequential at Three Mile Island Unit 1.

Reactor Vessel: Three Mile Island Unit 1, like many of the other operating B&W units, was affected by the problem of vibration induced wear and cracking of the surveillance specimen holder tubes (SSHT). This generic problem was discovered at Three Mile Island Unit 1 during its first refueling outage in February of 1976. Inspections and modifications were subsequently made at all operating modern B&W units in that year.

The losses that resulted at Three Mile Island Unit 1 were typical of those at the other B&W units. This is somewhat unusual because the unit which first discovers such a major problem does not have the benefit of any past experience and usually experiences greater losses.

Steam Generator: Losses at PWR units due to steam generator tube problems have been a significant contributor to unit unavailability (BWR units do not have steam generators and therefore have experienced no losses). At Three Mile Island Unit 1 these losses have been uncharacteristically low. Most of these losses have been the result of NRC-required inspections of the steam generator tubes. Tube degradation and failures that have occurred at other PWR and B&W units have not been a problem at Three Mile Island Unit 1.

Most steam generators at other B&W units have also performed with fewer tube problems than have steam generators designed by the other PWR vendors. Differences in design and materials in the B&W steam generator which are of once-through design may account for some of this better performance.

Reactor Coolant Recirculation Pumps. Problems with reactor coolant pumps at PWR units, and recirculation pumps at BWR units, have also been a large source of losses. These problems have characteristically taken the form of excessive pump seal leakage, pump motor failures, and other problems. Excessive seal leakage has caused extensive losses at almost all nuclear units, and at B&W units in particular. These seals are designed with close tolerances. They are subjected to a severe environment involving large temperature changes, movement, high pressures, and large fluid flows. As a result the seals are very sensitive to installation problems, wear, cooling system malfunctions, and impurities in the water.

B&W units have reactor coolant pumps that are manufactured by either Bingham, Byron-Jackson, or Westinghouse. The pumps at Three Mile Island Unit 1 were made by Westinghouse and have performed reasonably well with only one failure in June, 1978. Bingham pumps at other B&W units have experienced a more persistent problem with seal leakage, and account for a major portion of the B&W unit losses due to this component.

Another problem that occurred at units with Westinghouse motor drives for the reactor coolant pumps was oil degradation and leakage. These problems have not affected Three Mile Island Unit 1. Instead, TMI-1 has only experienced an outage because of high vibration and an outage due to a pump motor failure.

Control Rods and Control Rod Drives. Many B&W units have experienced a problem with the control rod drive mechanisms (CRDM). The B&W CRDMs are sealed motor driven, roller nut drive units. The principal outage causing problem with these drives has been from electrical shorts originating in the stator winding end turns. B&W identified four contributing causes to the failures: epoxy breakdowns due to incompatibility with the wire, moisture, bifilar design (side by side phasing), and manufacturing defects. Most frequently these shorts caused the power supply fuse for the CRDM to open and resulted in a dropped, inoperable control rod. The faulty CRDM was then repaired or replaced, or operations were resumed at a reduced power level with the dropped rod.

The effects of these problems have been slightly more consequential at Three Mile Island Unit 1 than at other B&W units. A number of lengthy outages in 1975 and 1976 contributed greatly to these losses at Three Mile Island Unit 1. Since 1976 when new stators were installed on the problem CRDMs, the unit has not experienced any more outages.

MSIV and RCS Valves. At Three Mile Island Unit 1 the losses attributed to RCS relief valve problems are principally the result of a lengthy outage in 1974 to correct a seat leak on a pressurizer code safety valve. The nature of this problem and its occurrence so shortly after the unit began commercial operations evidences that it was a debugging-type problem associated with the unit start up. No subsequent outages of consequence are attributable to these valves at Three Mile Island Unit 1. Other B&W units have also experienced seat leakage of the code safety valve and the resulting losses are very similar to that of Three Mile Island Unit 1.

Maintenance to correct packing leakage or stem binding problems with the pressurizer spray valves have caused unit outages at all B&W units. At Three Mile Island Unit 1, these problems have not caused measurable losses.

The losses due to other RCS valve problems at Three Mile Island Unit 1 largely result from an outage to repair a decay heat removal system valve with a bent shaft and a packing leak. The losses are similar to the corresponding losses at the other groups of nuclear units.

RCS Pipes. RCS pipes have not been a significant source of losses either at Three Mile Island Unit T, at other B&W units, or at other PWR units. Cracks in these pipes have been a BWR problem.

Nuclear Instrumentation. Problems with nuclear instrumentation have not been a significant or widespread problem at any type of nuclear unit.

Safeguard Systems. Components in the safeguards systems have not contributed greatly to losses at nuclear units. The pump and piping losses at Three Mile Island Unit 1 resulted from outages in 1975 and 1976 because of problems with a decay heat removal pump and cracks in the emergency cooling river water system pipes.

The losses at Three Mile Island Unit 1 attributed to other safeguard system problems are the result of integrated leak rate testing of the containment building which is required by NRC and is generally performed during refueling outages. Because this testing is a "critical path" job (it cannot be performed in the shadow of other refueling work), it results in losses to the unit's capacity factor. These losses have been similar to the corresponding losses at other groups of nuclear units listed in Table 3.

Pipe Supports and Restraints. Since 1973, losses resulting from inspections and repairs of pipe supports and restrains have been widespread at nuclear units. At that time, a problem was discovered with degraded seals and leaking damping fluid in the "snubbers." As a result the NRC has required periodic inspections of these "snubbers" at all nuclear units. Some of this work has been performed as noncurtailing jobs during refuelings and other outages. Despite that, losses have been relatively large. At Three Mile Island Unit 1 the losses resulting from the inspections and repairs of these snubbers have been typical of those at other nuclear units.

BWR Torus. This component is unique to BWR units.

BWR Off-Gas System. This component is unique to BWR units.

Other Nuclear System Problems. Losses due to other nuclear system problems are largely the result of failures in the chemical and volume control system or the reactor water cleanup system. Three Mile Island Unit 1 has not experienced very consequential losses due to problems in these systems.

Turbine. Losses due to turbine failures and problems in a number of other balance of plant systems have not been aggregated in Table 3 for B&W units or PWR units. These losses are only given for the Three Mile Island Unit 1 and for all other nuclear units. This was done because there is nothing unique about these components and systems to B&W units or to PWR units. It therefore makes sense to only compare the Three Mile Island Unit 1 losses with corresponding losses for all other nuclear units.

With one exception, turbines at all operating nuclear units were manufactured by either Westinghouse or General Electric. (D.C. Cook Unit 2 has a Brown-Boveri turbine.) Three Mile Island Unit 1 has a General Electric turbine. A number of generic problems with blade and rotor cracks at units with Westinghouse turbines account for a large proportion of the losses for this category. General Electric turbines have generally performed with fewer losses than the average unit with a Westinghouse turbine and the Three Mile Island Unit 1 turbine has performed even better than the average General Electric turbine.

The losses at Three Mile Island Unit 1 due to other turbine problems are principally the result of an outage in 1975 to repair a turbine control valve. Turbine blade losses at the unit resulted from inspections and turbine I&C losses resulted from malfunctions of the turbine electro-hydraulic control system.

Generator. The principal cause of losses at nuclear units attributable to the generator have been a number of lengthy outages due to electrical shorts and problems with the cooling and oil systems. Most of these lengthy outages have occurred at units with Westinghouse generators. The Three Mile Island Unit 1 generator, which was made by General Electric, has performed better than even the average General Electric generator with no such lengthy outages.

Moisture Separator - Reheater. Tube failures in the moisture separator reheaters at a substantial number of units have necessitated unit deratings and outages. Apparently the moisture separator-reheaters at Three Mile Island Unit 1 have performed without a problem.

Condenser. Condenser tube failures have been a widespread problem at nuclear units. Some units have even retubed their entire condenser in an effort to reduce the number of these failures. The condenser tubes at Three Mile Island Unit 1 are made of stainless steel. Other units with stainless steel condenser tubes have typically experienced slightly fewer tube failures than have units with tubes of other materials. The Three Mile Island Unit 1 condenser tubes have performed slightly worse than stainless steel condenser tubes at other nuclear units. However, on the average, the Three Mile Island Unit 1 losses due to condenser tube failures are very typical of corresponding average losses at other nuclear units.

Losses attributed to other condenser problems at Three Mile Island Unit 1 are largely the result of an outage in 1976 to stake the lower tube rows in the condenser.

Main Transformer. Catastrophic failures of main transformers have occurred at only a few nuclear units. However, when such a failure takes place a lengthy outage or load reduction usually results. As a result, most of the losses attributable to main transformer problems are concentrated at a few units. The main transformers at Three Mile Island Unit 1 have performed without such a catastrophic failure, and losses due to this component have been small.

Condensate and Feedwater Systems. Losses due to feedwater and condensate system problems have been considerably less at Three Mile Island Unit 1 as compared with the corresponding average losses at other nuclear units. The feedwater pumps at Three Mile Island Unit 1 were manufactured by the Byron-Jackson

Company. These pumps have typically performed better than most other types of feedwater pumps at nuclear units. The Three Mile Island Unit 1 pump performance is better than average for even Byron-Jackson pumps. Feedwater control and regulating valve problems have typically been less frequent and consequential at B&W units. These units utilize an Integrated Control System that is more complex but results in fewer unit trips because of steam generator level instabilities than do feedwater control systems at other PWR units. The losses due to these controls at Three Mile Island Unit 1 are characteristically small. (See also Licensee's Response to Board Question 6.)

Other Balance of Plant Losses. Other balance of plant losses have mainly been the result of problems with the main steam system, plant non-safety electrical systems, the circulating water system, building structural problems and other unit auxiliaries like service air and water systems. These systems have performed without major problems at Three Mile Island Unit 1 and as a result losses for these systems have been less at this unit as compared with corresponding average losses at other nuclear units.

Refueling Operations. Losses due to refueling operations have been slightly higher at Three Mile Island Unit 1 than at other groups of nuclear units listed in Table 3. One reason for this is that Three Mile Island Unit 1 has operated with a

TABLE 3

Total Capacity Factor Losses (%)
(Calculated through March 31, 1979)

	Three Mile Island 1	Other B&W Units	Other PWR Units	Other Nuclear Units
Fuel				
past problems	0	2.35	0.94	1.84
control rod pattern changes	0.74	0.30	0.05	0.19
miscellaneous thermal	0.29	0.48	0.22	0.66
physics testing	0.28	0.34	0.29	0.20
BWR PCIOMR limits	0	0	0	1.07
other problems	0.02	0.04	0.67	0.56
Total fuel problems	1.33	3.51	2.17	4.53
Reactor Vessel				
surveillance specimen holders	2.68	2.61	0.43	0.27
spargers and jet pumps	0	0	0	0.47
vessel nozzles	0	0	0	0.02
other problems	0	1.02	0.29	0.18
Steam Generator				
tube problems	0.46	3.05	3.99	2.44
other problems	0	0	0.15	0.09
Reactor Coolant/Recirc Pump				
pump seal problems	0.57	3.05	1.17	0.95
other pump problems	1.09	1.24	0.84	0.78
Control Rod and Drives				
control rod problems	0	0	0.03	0.09
drive and control problems	1.42	1.02	0.77	0.55
MSIV and RCS Valves				
RCS relief valve problems	0.67	0.50	0.11	0.37
pressurizer spray valve problems	0	0.32	0.19	0.11
other RCS valve problems	0.57	0.44	0.32	0.39
MSIV problems	0	0.01	0.38	0.41
RCS Pipes				
cracks and inspections	0	0.01	0.03	0.71
other problems	0	0.12	0.07	0.12
Nuclear Instrumentation				
incore instrument problems	0	0.06	0.11	0.11
excore instrument problems	0.02	0.01	0.03	0.03
other problems	0.04	0.20	0.06	0.09

	Three Mile Island 1	Other B&W Units	Other PWR Units	Other Nuclear Units
Safeguard Systems				
pump problems	0.37	0.01	0.12	0.13
piping problems	0.48	0	0.14	0.10
containment isolation problems	0	0	0.02	0.06
valve problems	0	0.27	0.09	0.13
I&C problems	0	0	0.02	0.03
electrical system problems	0	0.01	0.30	0.25
other problems	0.55	0.40	0.29	0.40
Pipe Supports and Restraints	0.46	0.52	0.45	0.38
BWR Torus	0	0	0	0.12
BWR Off-gas Systems	0	0	0	0.19
Other Nuclear System Problems	0.07	0.39	0.22	0.27
Turbine				
turbine blade problems	0.07	-	-	1.46
turbine I&C problems	0.22	-	-	0.51
other problems	0.52	-	-	0.47
total turbine losses	0.81	-	-	2.44
Generator	0.21	-	-	0.94
Moisture Separator-Reheater	0	-	-	0.17
Condenser				
tube problems	0.51	-	-	0.53
other problems	0.22	-	-	0.25
Main Transformer	0.09	0.10	0.39	0.39
Condensate and Feedwater Systems				
feedwater pump problems	0.07	-	-	0.32
feedwater reg. valve problems	0	0.02	0.15	0.18
feedwater control system problems	0.02	0.02	0.13	0.12
condensate pump problems	0	-	-	0.08
other problems	0.28	-	-	0.86
Other Balance of Plant Losses	0.97	1.26	1.72	1.72
Refueling Operations	10.43	7.82	9.44	9.47
Thermal Efficiency Losses	2.47	2.93	2.33	2.06
Spurious Reactor Trips	0	0.26	0.22	0.19
Non-plant Related Problems	0.04	0.19	1.59	1.43
Brown's Ferry Fire	0	0	0	1.15
Unknown and Miscellaneous Losses	0.34	0.82	0.79	0.96

Table 4

Refueling Outage Durations in Weeks

(for refueling completed before August 31, 1980)

	Refueling Number					
	1	2	3	4	5	6
Three Mile Island I	13.7	8.3	6.5	6.7*	-	-
Other B&W Units	14.0	10.5	9.8	16.6	13.9	-
Other PWR Units	15.7	10.1	9.6	10.6	11.2	10.3
Other Nuclear Units	15.1	10.1	9.7	10.4	10.1	9.2

*Because of the accident at Three Mile Island Unit 2, a return from this refueling was never accomplished.

relatively higher capacity factor. This fact coupled with the timing of the accident at Three Mile Island Unit 2 (during the recovery from a refueling at Unit 1) has resulted in a large number of refuelings in a relatively short operating period. In only four and one-half years of commercial operation, Three Mile Island Unit 1 has refueled four times. This is a fast pace relative to the average nuclear fuel cycle lengths. Table 4 indicates that the refuelings at Three Mile Island Unit 1 have been consistently and significantly shorter than average refueling lengths at other groups of nuclear units.

Thermal Efficiency Losses. Thermal efficiency losses are caused by operations at net electrical power levels below what is normally expected for the corresponding reactor thermal power levels. These losses may result from frequent load reductions or outages, an excessive use of steam by auxiliaries or because of leaks, operations with degraded equipment, or over-estimates of the core thermal power.

Losses due to thermal efficiency problems at Three Mile Island Unit 1 have been similar to those at other nuclear units.

Spurious Reactor Trips. Spurious reactor trips due to malfunctions of the reactor trip system have been a persistent problem at most nuclear units. Three Mile Island Unit 1 has experienced no outages as a result of this problem.

Non-Plant Related Problems. Load following, fuel conservation, coasting to a refueling outage, transmission system problems and startup testing all comprise non-plant related problems. Three Mile Island Unit 1 has only experienced very minor losses due to these factors.

Brown's Ferry Fire. The Brown's Ferry Unit fire resulted in large losses at two units.

Unknown and Miscellaneous Losses. Losses at Three Mile Island Unit 1 due to unknown (to me) or miscellaneous reasons have been less than corresponding average losses at other nuclear unit groups listed in Table 3.

SUMMARY AND CONCLUSION REGARDING OPERATING AVAILABILITY

Operating performance of Three Mile Island Unit 1 has been considerably better than average for other B&W units, other PWR units and other nuclear units in general. As can be seen in Table 3, all the systems at TMI-1 have performed as well or better than corresponding systems at similar units. To a considerable extent the performance of TMI-1 is attributable to good design. The good turbine experience of TMI-1 is largely attributable to the selection of a GE turbine rather than a Westinghouse turbine while the good Reactor Coolant Pump performance is attributable to having Westinghouse, rather than Bingham, pumps. Nonetheless, the performance of TMI-1 gives the impression of an efficiently run plant. No lengthy outages which might indicate poor planning are apparent, nor are any persistent problems evident that might be indicative of faulty maintenance or operating practices. The generic problems, like those with control rod drives and surveillance specimen holder tubes, that affected Three Mile Island Unit 1 and other B&W units, have typically resulted in losses which are lower than corresponding losses at other units that were affected by these problems. Finally, the shorter refueling outages are indictive of good planning and management of the outage.

SAFETY-RELATED PERFORMANCE

Safety-related problems at U.S. nuclear plants are documented in LERs and in the reports of NRC inspections. In attempting to compare TMI-1 with other units, I looked at three measures of safety performance:

1. The number of LERs and NRC noncompliances
2. The rate of occurrence of personnel and procedural errors
3. The failure rate of safety-related systems

The results of my investigations are described in the following sections.

Number of LERs and Noncompliances

LERs. A simple count of the number of LERs submitted by a unit is a very poor measure of the safety of that unit. Some of the factors which affect the number of LERs, but have no effect on safety, are:

1. Older, and generally smaller, units have fewer pieces of "safety-related" equipment so the same failure rate will result in fewer LERs than for new units.

2. Some units include environmental occurrences in LERs and some do not.

3. Some units report both failures and corrective maintenance of safety equipment while others report only failures.

4. The interpretation of what constitutes a reportable event differs from plant to plant.

5. Other things being equal, the number of LERs will decrease as a unit matures.

In order to minimize the effect of these factors, I compared TMI-1 with those units which could be considered its "peers." Specifically, I looked at PWRs in the same size range (800-1000 MW) and the same vintage (1972-1976 inclusive). This "peer group" includes five B&W units (Arkansas 1; Oconee 1, 2, and 3; and Rancho Seco) and eight CE and Westinghouse units (Beaver Valley 1, Calvert Cliffs 1 and 2, Indian Point 2 and 3, Millstone Point 2, Maine Yankee, and St. Lucie 1). In counting the number of LERs submitted by each unit, I excluded "environmental" LERs, except those involving unplanned releases of radioactivity. Recognizing that the number of LERs decreases with plant age, I divided the experience of these units into the first 2.5 years of operation and subsequent years. The results were:

Number of LERs per Unit-Year

Unit(s)	First 2.5 Years of Operation	Subsequent Years
TMI-1	40	30
Other B&W Units	24	22
CE and W-PWRs	51	38
Total (No TMI)	42	31

It can be seen that the number of LERs submitted by TMI-1 was almost exactly equal to the average for its peers.

I know of no differences in design which would account for the average for B&W units being low relative to CE and Westinghouse units. The most likely explanations involve differences in reporting requirements (or interpretation thereof) and statistical variations in a small sample.

Noncompliances. The number of noncompliances at a unit should be a more uniform measure of performance since the same people inspect a number of plants and since an attempt is made to apply uniform standards to all plants. Unfortunately, most noncompliances involve minor procedural inadequacies with very little direct effect on safety. Due to the lack of an adequate data base, it was not possible for me to identify those noncompliances which I believed were "significant." The following table does however present the results of a simple count of noncompliances. Data for NRC Region I (which includes TMI) was used rather than "peer" units on the theory that there might be more uniformity of inspection standards within a region since the same NRC personnel are involved. The three units rated less than 400 MW were excluded since they are very different from other units and since two of them were shut down for much of the time period being considered. Also, noncompliances involving special nuclear materials accounting and plant security were excluded.

Noncompliances Per Unit-Years

Year	1975	1976	1977	1978	1979	Average
TMI-1	18	26	28	16	16	20.8
All Region I Units (No TMI)	16	22	26	21	16	20.2

Since NRC inspections primarily involve searching plant records for discrepancies, it might be expected that the number of noncompliances would be proportional to the time spent inspecting. Consequently I prepared the following table showing the number of noncompliances per 100-inspector-hours. As with the previous table, inspections and noncompliances dealing with special nuclear materials accounting and plant security were omitted as were data on smaller plants.

Noncompliance Per 100 Inspector Hours

Group/Year	975	1976	1977	1978	1979	Total
TMI-1	2.5	2.1	2.4	2.6	2.1	2.2
All Regions I Units (No TMI)	3.3	2.2	2.7	2.3	1.4	2.2

The spread in the data was quite small. Twelve of the eighteen units (excluding TMI-1) fell in the range of 1.8 to 2.6 with three units below 1.8 and three units above 2.6. The lowest unit was 1.3 and the highest was 3.0. As can be seen, the performance of TMI-1 was almost exactly average.

TMI-1 LERs

During the five-year period, April 19, 1974 to March 29, 1979, TMI-1 generated a total of 187 reports of "reportable occurrences" (LERs). Twelve of these involved environmental occurrences and are not of concern here. An additional nine concerned actual or potential errors in analyses performed by B&W and did not involve any deficiencies in any equipment or personnel performance at TMI. (None of these errors had any significant impact on plant safety.) Of the remaining 166, 100 occurred in the first 2.5 years of operation and 66 occurred in the second 2.5 years. This decrease in the number of events as a unit matures is typical of industry experience.

Looking at the 166 reports, I found that 65 dealt with occurrences which had absolutely no impact on the overall safety of the reactor core at TMI-1. Types of occurrences included in these 65 are:

- o Minor setpoint drifts in safety-related instrumentation.
- o Minor variances in levels and/or chemistry in safety-related tanks.
- o Leaks in systems containing radioactive materials.
- o Personnel and procedural deficiencies which did not affect the performance of any safety-related equipment.
- o Failure to perform required tests in specified times.
- o Minor deviations in core power distribution.
- o Problems with radioactive waste systems.

None of these events caused any increase in the rate of occurrence of transients or accidents at the plant or caused any equipment which would be required to respond to a transient or accident to be inoperable. Thus they had no effect on the safety of the reactor core.

The remaining 101 reports dealt with situations which involved some malfunction of safety-related equipment. These occurrences had very minimal safety significance. The history of safety-system problems at TMI-1 is typical of what is found at similar units. Some systems perform very well while others have a number of problems. Most problems involve single components so that the operability of the entire system is not affected. Many of the failures which do occur involve problems with control and electrical equipment or personnel errors.

Such problems can often be rectified promptly so that the affected component could still function in time to prevent significant core damage in all cases except for the unlikely large LOCA.

Personnel Errors. Personnel errors are responsible at least in part for a substantial fraction of the unavailability of safety-related components at nuclear units and for a larger fraction of the unavailability of safety-related systems. Since many problems are caused by a combination of factors, the distinction between problems caused by personnel error and those not caused by personnel error is blurred. Moreover, the standards used by different plants to assign causes to problems differ greatly. Many plants attribute problems to personnel errors only when the problem could not reasonably be assigned to any other cause. Other plants are assiduous in their quest for any possible contribution of personnel error to equipment failures. Also, the number of components which are reportable and the types of problems which are reported differ from plant to plant. These differences in reporting requirements and philosophy mean that simply counting the number of LERs attributed to personnel error at different units can be very misleading.

Because of these problems and because there are about a thousand LERs throughout the industry involving personnel error each year, I selected a limited sample of operating experience and performed a detailed review of all of the LERs within that experience. Specifically, I looked at the entire five-year history of TMI-1 and compared this with the experience of PWRs the first eight months of 1980. I looked at all PWRs except Indian Point 1, Yankee Rowe, Haddam Neck, San Onofre (all older units), North Anna 2, Salem 2, Sequoyah 1 (all just starting up), and TMI-1 and 2. The remaining 37 PWRs had all operated continuously during the 8 months, so there was a total of 296 unit-months or 24.7 unit-years of experience. I examined each of the LERs which were generated during this time and selected those which the utility had identified as being due to personnel error or which I believe should have been so identified. Next I classified these LERs into a number of groups:

1. Lineup and tagout errors on major safety systems.
2. Operational errors leading to safety parameters (such as tank levels, chemical concentrations, etc.) on major safety systems being out of specification.
3. Errors in maintenance and testing which led to malfunctions in components of major safety systems.
4. Quality assurance and procedural errors regarding major safety systems which did not lead to component malfunction.
5. Failure to perform surveillance tests on major safety equipment in required times.
6. All types of personnel errors involving systems with minimal safety impact (such as liquid or solid radioactive waste systems and radiation monitoring systems).

The following table presents the rate of occurrence (instances per unit-year) for each of these types of error for the 37 PWRs and for TMI-1.

LERS INVOLVING PERSONNEL ERRORS

	LERs Per Unit-Year		
	TMI-1		
	First 2.5 Years of Operation	Second 2.5 Years of Operation	Industry Average PWRs During the First 8 Months of 1980
1. Lineup and Tagout	1.6	1.2	2.3
2. Parameter Control	1.2	.8	.9
3. Maintenance and Test	6.0	2.8	2.0
4. QA and Procedure	.8	-	.1
5. Surveillance	1.2	1.6	2.1
6. Minor Safety Systems	6.0	4.8	3.0
Total	16.8	11.2	10.4

Because units typically have fewer errors after two-to-three years of operation and because all but five of the 37 units which went into the industry average had operated more than two years prior to January 1, 1980, I broke the TMI-1 data into early and mature experience. Comparing the later experience of TMI-1 with industry averages there are three areas with the largest differences.

Lineup and Tagout. This is the type of personnel error which I regard as most important since it can result in the unavailability rates for major safety systems being higher than expected based on unavailability rates of individual trains (in other words, lineup and tagout errors are a source of common-mode unavailability). Many units are reluctant to cite personnel error as a cause of problems. Since tagout and lineup errors are always caused by personnel error, my data on this type of error is undoubtedly more complete than data on other types of errors. The performance of TMI-1 was significantly better than industry average. There are two possible explanations: (1) statistics and (2) superior performance at TMI. I know of no way to determine the extent to which each factor contributed to the observed difference.

Maintenance and Test. Typically maintenance and test errors result in problems with a single component so they are not as serious as lineup and tagout errors. Many component failures may be due partly to design and partly to maintenance and the contribution of each is often not discernable. If an LER does not specifically mention personnel error, it is usually impossible to be sure that such an error existed. TMI-1 LERs reveal a consistent search for possible errors (and an attempt to prevent them in the future). LERs from many units do not reveal a similar zeal. Therefore, I suspect that the error rate at TMI was about average and that the appearance of a higher rate was due to better investigations of the cause of failures and/or better reporting.

Errors on Minor Safety Systems. The incidence of errors on minor safety systems at TMI was above the industry average (12 events in the last 2.5 years where 7.5 would be expected on average). The errors at TMI-1 were varied both in the type of error and system affected, and no pattern is discernable. The better reporting mentioned above is one possible explanation.

Conclusions Regarding Personnel Errors. The pattern of personnel errors at TMI-T was typical of industry experience, *i.e.*, a decreasing rate as the unit matured. The average rate of reported errors at TMI was slightly above average, but this was almost certainly due to a greater willingness at TMI to blame personnel error for component malfunctions. The most serious type of error, those involving tagouts and lineups, occurred less frequently at TMI than at the average PWR. Tagout and lineup errors are generally committed by operators while other errors generally involve maintenance workers and technicians. One possible explanation for TMI's history vis-a-vis other plants would be that TMI operators were above average while other personnel were average. There are other factors such as statistical variations, differences in equipment design, and differences in reporting which also could explain the observed differences between TMI-1 and other PWRs.

Loss of Safety System Function

Since thousands of "failures" of safety-related components are reported every year, it would have been impossible for me to perform a careful analysis and interpretation of all failures. Therefore, I focused on the relatively few occurrences of complete failures of safety systems which have been experienced. There are four reasons why focusing on these system failures is particularly useful:

- It is the reliability of safety systems, rather than the reliability of individual components which determines the safety of a plant.

- Many system failures result from causes other than random component failures. Therefore, the failure rate for systems is generally higher than would be calculated using the failure rates for individual components.

- System failure rates depend not only on the rate of failure of individual components but also on the frequency with which these components are removed from service for preventive maintenance. Most units do not report preventive maintenance on safety components unless failures of redundant components result in a system failure.

- A number of system failures result from personnel errors. While most personnel errors have a minor effect on plant safety, those which cause system failures represent a substantial contribution to the total "unsafety" of the plant. The effect of plant management and personnel on the rate of failure of systems is perhaps the most meaningful measure of their effect on plant safety.

While a number of failures of safety systems are reported each year, most are not as serious as might at first be thought. One reason for this is that many systems are only needed for unlikely events, so very high levels of system reliability are not required to provide an adequate overall level of plant safety. Other reasons are:

1. Many system failures occur during unit shutdowns when the systems are not needed.

2. Many systems are in the failed state for only brief time-periods.

3. Many system failures are such that they could be corrected in time for the system to perform its essential functions if needed.

4. Design diversity may accomplish safety functions in some cases.

<u>1. Failure During Shutdown</u>. Plants are generally allowed to remove many safety components from service during outages. Therefore, the probability that the remaining components will fail and result in a system failure is relatively high. However, many accidents and transients cannot occur during plant shutdowns. Those that could occur would develop slowly, allowing time to restore systems or improvise responses through the use of diverse systems capable of performing safety functions while shutdown. Since safety system failures during operation are much more important than those during shutdown, I have concentrated on those failures.

<u>2. Time-in-Failed-State</u>. When a system fails it is important to know the time that it was in the failed state. This is the time during which the system would not have performed as designed had it been needed. Unfortunately, the

time-in-failed-state is often not known. If a component operated successfully on one day and failed to operate in a test seven days later, all that would be known would be that it had been in the failed state for something less than seven days. Many LERs do not include information on the time that a system was in the failed state, even when this was known, or do not include information on the time since the system was last successfully operated. In order to be able to qualitatively rank the seriousness of system failures, I have distinguished three types of such failures.

Self-Alarming Failures. These are failures which are more or less immediately indicated in the control room. Since the plant operator can immediately initiate repairs and/or begin to shut down the unit, the time in failed state is typically a few hours or less.

Redundant Component Failure. Many failures of safety systems occur because one component fails while another is out-of-service for maintenance. Typically, plants are only allowed to remove a safety component from service for maintenance for a day or two, and then only after having successfully tested the redundant component. Therefore, if a component fails while the redundant component is out-of-service for maintenance, it is generally true that the system has been in the failed state for one day or less.

Test Failure. Failures which are discovered during routine tests may have occurred at any time since the system was last tested. Since most safety systems are tested weekly or monthly, the time in failed state for such failures is generally on the order of a few weeks or less.

3. Time to Restore. Many "failures" of safety systems can be rectified in 20 minutes or less once they have been discovered. Most accidents and transients will not result in significant damage for at least that time, even if all safety systems fail. Therefore, the failure of a safety system in response to an accident or transient will generally not lead to significant core damage if the system can be restored to service within about [illegible] minutes. The only exceptions to this are as follows:

- After a large Loss of Coolant Accident, the Low Pressure Injection System must function in a matter of minutes to prevent significant core damage.
- After a large Loss of Coolant Accident simultaneous with the loss of off-site power, the Diesel Generator System must provide power to the Low Pressure Injection System in a matter of minutes to prevent significant core damage.

All situations which require the Auxiliary Feedwater System and/or the High Pressure Injection System can be adequately dealt with if those systems can be made operable in 20 minutes. All situations requiring the Diesel Generator System, except the simultaneous large Loss of Coolant Accident and loss of off-site power, can also be adequately dealt with if the D-G system is restored to service within 20 minutes.

System Failures of Diesel Generator System. Since Diesel Generator Systems for BWRs and PWRs are very similar, I looked at both types of units for the time period 1/1/79 through 8/31/80. This represented a total of 98.3 unit-years of operating experience. During this time there were a total of seven Diesel Generator System failures while at power and seven more which occurred while the unit was shut down. All seven of the "at power" diesel failures occurred when one diesel was out-of-service for maintenance and the second diesel failed. As mentioned previously, this generally means that the system failure persisted for 24 hours or less. The LERs for these seven failures specifically indicate that three failures persisted for an hour or less while one persisted for 1.5 hours. The times for the remaining three are not stated but appear to be 24 hours or less.

Dividing 98.3 unit-years by 7 failures while at power yields an average of 14 unit-years of operation between at-power system failures.

From a safety point of view, it is system unavailability, rather than time-between-failures which is important. Based on the preceding, I estimate that there were a total of 3.5 unit-days in which diesel generator systems were in the failed state. Assuming that the average unit operated about 260 days per year, the unavailability of diesel generator systems was approximately:

$$\frac{3.5}{260 \times 98.3} = .00014$$

Since all at-power Diesel Generator system failures were counted, .00014 is the average unavailability of a Diesel Generator System for dealing with the unlikely case of a concurrent large Loss of Coolant Accident and loss of off-site power. In four of the seven cases of diesel generator failures, the system was actually restored to operation in less than one hour from the time the problem was discovered. The other three failures persisted for a total of about two days so the unavailability of the Diesel Generator System for dealing with situations other than simultaneous large Loss of Coolant and loss of off-site power was approximately:

$$\frac{2}{260 \times 98.3} = .00008$$

The at-power diesel generator system unavailability for the five years of operation of TMI-1 was zero.

System Failures of High Pressure Injection System. Since HPIS designs for BWRs and PWRs are different, I looked at all PWR units for 1979 and the first eight months of 1980 (a total of 63.3 unit-years). During this time there was one HPIS System failure while at power and one while shut down. In the at-power case, one valve between the HPI pump suction and the

Borated Water Storage Tank was out-of-service for maintenance. The diesel generator which supplied the bus to which the redundant (parallel) valve was connected was taken out-of-service for maintenance for two hours. Dividing two hours by 63.3 unit-years, 260 operating days per year, and 24 hours per day yields a system unavailability of .000005.

This one HPIS failure was such that the HPIS would not have operated immediately in case of a Loss of Coolant Accident and loss of off-site power. If off-site power had been available, the system would have performed correctly. The HPIS System unavailability at TMI-1 was zero for five years of operation.

System Failures of Auxiliary (Emergency) Feedwater System. Since the Auxiliary Feedwater System is peculiar to PWRs, I looked at PWRs for the time period January, 1979 through August, 1980. In this time period there were no instances where the Auxiliary Feedwater System at any plant was incapable of performing its essential functions. There were two cases of system-level problems which I will describe in the following paragraphs:

- The two Cook units share four auxiliary feedwater pumps (two steam driven and two motor driven). With one motor driven pump out-of-service for maintenance, the diesel generator which supplies power to the valves for one steam-driven pump was removed from service for 2.75 hours. There were still two pumps in operation which could have been realigned to supply both units. Also, the steam-driven pump could have been operated manually had off-site power not been available.

- The Trojan unit has only two auxiliary feedwater pumps. Both failed to start automatically on low steam generator level, but were manually started in about one minute.

While I was not including TMI-2 in this evaluation, there was one incident at TMI-2 when all Emergency Feedwater lines were valved out. When the System was needed it was restored to operation in about eight minutes.

Because the auxiliary feedwater system is called upon much more frequently than other safety systems, it needs a high level of reliability and many, but not all, plants were built with three pumps per unit. Therefore, it is not surprising that system reliability has been very good (zero unavailability in the time period investigated).

The unavailability of the Emergency Feedwater System at TMI-1 was also zero for five years of operation.

System Failures of Low Pressure Injection System. There were no reports of system failures in the LPIS at TMI-1 or any other PWRs during the time period investigated.

System Failures of Other Safety-Related Systems. In the preceding sections I concentrated on four safety-related systems (Diesel Generators, High Pressure Injection, Low Pressure Injection, and Auxiliary Feedwater) because I believe these are the most important systems and because they tend to be similar in all PWRs. Other systems (such as Containment and Service Water) differ significantly from plant-to-plant, both in design and in function. Therefore, I did not try to compare TMI experience with these systems with industry experience. However, I did review all of the TMI LERs to identify any incidents of system failures in any system. I found one such incident. This involved a 33 hour time period during which the Nuclear River Water System would not have functioned immediately had there been a loss of off-site power. The system would have functioned correctly had off-site power been available. Therefore, the system would have adequately performed its safety function in all cases except for a simultaneous major accident with loss of off-site power. For this later case, the system unavailability was roughly:

$$\frac{33}{260 \times 5 \times 24} = .001$$

While I did not specifically calculate system unavailabilities for Service Water Systems at other plants, my experience leads me to believe that these would be lower than .001.

Summary and Conclusions Regarding Safety System Failures. The following table shows system unavailabilities for the four systems (D-G, HPIS, LPIS, and AFWS) for TMI-1 and for the industrywide average for PWRs. Also shown are the system unavailabilities (failure rates) for these systems which were used in the WASH 1400 evaluations.

System	SYSTEM UNAVAILABILITY (With No Credit for Restoration)		SYSTEM UNAVAILABILITY (With Credit for Restoration)		WASH 1400 SYSTEM UNAVAILABILITY
	TMI-1	Industry	TMI-1	Industry	
Diesel Generator	0	.00014	0	.00008	.01
High Pressure Injection	0	.000005	0	.000005	.009
Auxiliary Feedwater	0	.000007	0	0	.00004
Low Pressure Injection	0	0	0	0	.005

It can be seen that in all cases, actual experience was better than WASH 1400, even if no credit is taken for the ability of operators to restore systems to service. In fact, for the case of no restoration, the average unavailabilities for the four systems is about 160 times lower than the average of the WASH 1400 numbers. There are several reasons why the actual situation may not be this good:

- o Some types of "system failures" which are considered in WASH 1400 are not included in the statistics I have compiled. An example would be loss of off-site power plus failure of the "A" Diesel plus failure of the "B" LPIS pump. This would be counted as an LPIS System failure in WASH 1400. However, because of the ways LERs are written, such a failure might not be included in my count of system failures.
- o Some system failures might not be recognized or reported.
- o Because I looked at limited operating experience, long-term failure rates might be worse (or better) than what I have calculated, *i.e.*, there is considerable statistical uncertainty in my samples.

The fact that industry experience with safety system reliability has been better than WASH 1400 levels indicates that a more than adequate level of safety is being achieved today. Comparison of TMI-1 history with industry averages indicates that TMI-1 was average or somewhat-above-average. Therefore, I conclude that the operations of TMI-1 prior to March, 1979 were such that they provided an adequate level of safety.

WITNESS QUALIFICATIONS

Robert H. Koppe

Mr. Koppe joined SMSC in 1974 as Manager of Reliability and Safety Projects. While at SMSC, Mr. Koppe has assisted our clients in development of their Safety Analysis Reports (SARs) and in reviewing the design of nuclear facilities relative to operability and radiological safety. He has directed the Company's ongoing projects related to improving productivity of nuclear and fossil power generating units. This work has included:

- Various studies for EPRI directed toward development of a National Data System for unit and component reliability data for power plants. This work has led to detailed specifications of data to be collected and analyses to be performed by the National Data System.

- Development of SMSC's computer program and data base on causes of outages and deratings at U.S. nuclear units.

- Analyses of nuclear and fossil plant operating experience to determine problem areas, effects of problems on unit performance and variations of problems as a function of design, age, etc.

- Applications of operating experience data to selection of equipment vendors and to design improvement programs.

Mr. Koppe also directs a project which SMSC is undertaking for the Nuclear Safety Analysis Center. This involves analysis of operating experience at all U.S. nuclear units to identify and examine events with potential significant economic or safety implications.

Prior to joining SMSC, Mr. Koppe was Manager of the Nuclear Engineering Division and was responsible for licensing and safety analysis for Consolidated Edison's nuclear projects. The design and engineering related to the safety of these projects was under his direction. This work included design review and licensing for the Indian Point 2 and 3 turnkey units, and design review of changes and retrofit modifications and additions to the three Indian Point units. He also directed the efforts of engineers within his division to supply modifications, analysis, and engineering support for the nuclear portion of the Indian Point 1 and 2 units during operation.

Mr. Koppe received his B.S. degree from the State University of New York at Syracuse in 1965 and his M.S. in Nuclear Engineering from Ohio State University in 1966. He completed course work toward a Ph.D. in Nuclear Engineering at the Massachusetts Institute of Technology.

DR. JORDAN: On page 27, the sixth line from the bottom, the sentence starts: "Of the remaining 166,100." It looks kind of peculiar.

CHAIRMAN SMITH: I stumbled over that, too.

MR. BLAKE: We would have done better with a space after the comma, setting of at a minimum the "100."

DR. JORDAN: All right.

MR. BLAKE: Mr. Smith, I have no additional questions of Mr. Koppe. He is available for cross examination and questions by the Board.

(Board conferring.)

CHAIRMAN SMITH: All right, we will begin with Dr. Little inquiring about her interest in the outline.

BOARD EXAMINATION

BY DR. LITTLE:

Q I would like to know if Mr. Koppe agrees with this part of the outline. It says: "Mr. Koppe, using data from TMI and industry drawn from LERs and from OPEC-2, a data base maintained by the S. M. Stoller Corporation for EPRI, concludes operating performance of TMI-1 has been considerably better than average for other B&W units, other PWR units, and other nuclear units in general."

And then it says -- and this is the part I want to know if you agree with: "This is attributable to good design and to efficient management."

A I thought that would be the line.

(Laughter.)

As I read this outline -- and I recall I did not write it -- that statement applies to the operating performance of the unit as opposed to the safety performance of the unit, about which the next few lines deal.

And I do think that the operating performance of the plant was so good -- and was good in ways which require management as well as good equipment -- that you have to conclude that that facet of the overall history of the plant is clearly indicative of both good design and good management.

And the distinction I am drawing is that, you know, the other part which relates to safety performance is much more difficult to ascertain to what extent it is influenced by design or management, because of the greater differences among plants and the amgibuities in the way events are reported and what constitutes a reportable event. It is much more difficult to make that kind of a conclusion from, say, LERs about safety events.

Q The way the paragraph goes it indicates that this refers to a conclusion you drew from data from LERs and OPEC-2.

A As I read that, the first part is saying that I concluded that the operating performance, which comes down to capacity factor of TMI --

Q Okay.

DR. LITTLE: I think I see the distinction.

BY CHAIRMAN SMITH:

Q After you pointed out the distinction, of course, I assumed you were referring to capacity factor, but you do not draw conclusions on capacity factors from LERs; do you?

A That is true.

Q Isn't that the thrust of your --

(Board conferring.)

So to that extent, the outline would not be consistent with your testimony?

A That is true.

MR. BLAKE: Mr. Smith, I would offer to strike that sentence from the outline and avoid this. As I say, it was prepared by us. We can leave it in with the clarification if the Board is satisfied at this point. But I would have no objection to striking that portion from the outline.

CHAIRMAN SMITH: Why don't you just strike "from LERs"? That is the only objectionable feature of it.

(Board conferring.)

MR. BLAKE: I would have no problem with that as well. Strike "from LERs and."

(Board conferring.)

MR. BLAKE: My proposal is to strike "from LERs and."

CHAIRMAN SMITH: I just had a conference with Dr. Little. I do not really understand her point either. So I do not know if I have helped at all.

DR. LITTLE: It is timely information derived from LERs and OPEC-2 to a conclusion that this was related to efficient management and good design.

WITNESS WEGNER: Yes. And striking the reference to LERs in that sentence takes care of that.

DR. LITTLE: All right. Good.

CHAIRMAN SMITH: So we strike "from LERs" on that.

MR. BLAKE: Yes.

CHAIRMAN SMITH: Mr. Adler?

CROSS EXAMINATION

BY MR. ADLER:

Q Thank you. Congratulations.

(Laughter.)

On page 2 of your testimony, Mr. Koppe, you list two aspects of determining plant safety. One is the frequency of initiating events, and the second is the reliability of systems to respond to these events.

Do you consider either of those more important than the other in determining the safe management of a plant, or are they equally important?

A I do not think that one is more important or less important than the other. They go together. If you could do perfectly in either one of them, you would have a perfectly safe plant even if you did very poorly in the other one. Since you cannot do perfectly in either one of them, the better you do in both of them, the safer the plant is. It is a cumulative effect, and it is not that one is more or less important than the other.

Q I would like to clarify: You used no data from TMI Unit 2 in this testimony; is that correct?

A That is correct.

Q And you felt that that was appropriate in light of the language of Issue 8 and Issue 9 which refers to both Three Mile Island units? Did you have any problem not using TMI-2 data in light of that language?

A No, I did not have any problem.

Q Did you look at any TMI-2 data?

A In the course of the work we looked at data from all the plants, and TMI-2 was included in that. I did not specifically spend any significant time looking at TMI-2 data as part of preparing this testimony.

Q When you set out to prepare this testimony, did you look at any TMI-2 data as part of that task?

A No.

(Counsel for the Commonwealth conferring.)

Q Was that your personal decision, or did that derive from your instructions from Licensee in the performance of this task?

A That was my personal decision entirely.

Q Do you know of any differences, based on your other reviews, between the operating history and the safety history of TMI-2 versus TMI-1?

A The startup period at TMI-2 took longer than the startup period at TMI-1. But since TMI-2 had only been in commercial operation for, I think, about three months, you could not draw any conclusions about its similarity or difference to other units with only three months' experience. As far as safety experience, I know that TMI-2 submitted more LERs in its initial period of operation than did TMI-1. And that is a characteristic of industry experience.

All -- there has been a steady trend toward increase in the number of LERs submitted by the unit as a function of the calendar year in which they started up. So I do not have any particular reason to believe that TMI-2 is uncharacteristic of its peers, but I did not specifically look at that.

(Counsel for the Commonwealth conferring.)

BY MR. DORNSIFE:

Q Just to further clarify your data base, Mr. Koppe, did you consider any of the other plants that you used in your data base -- did you include any time before commercial operation in using LERs?

A No.

Q You picked the date of commercial operation as starting?

A For operating experience, operating performance, all of the data in our data base is from the date of commercial operation for all units, including TMI-1. For safety experience, during the time period that we had been entering LERs in the data bases, in the third -- the other data base that we maintain what we call the LEP data base, we put LERs from the date of initial operation, so it is for commmercial operation.

However, very few units have started up in the last year or two, and I excluded those two from consideration at all in this, partly because they are uncharacteristic, partly because there is so little data and they have just started up, and partly because all of them have had uncharacteristically high incidences of LERs, and it would have had, in my opinion, unfairly made the industry numbers that I was comparing TMI with high.

So for both of those reasons, I left those units out. And so it just turns out that none of the units I was looking at had any precommercial operation in the time period I was looking at.

BY MR. ADLER:

Q On page 4, where you describe the data base for safety-related events, you say that data for each unit begins with January 1, 1978. I presume that is true for TMI-1 as well?

A In that data base it is true.

Q So am I correct that there is less than one year of TMI-1 operating data in that data base?

A No. There are -- there are two years of data on TMI-1. Admittedly, it was not operating for all of that time, but the data is in there.

Q I am sorry, I meant operating data.

A Operating data in the sense of?

Q When the plant was operating.

A Producing electricity? That is true. However, remember the section that deals with operating data -- oh, wait a minute, no, we are talking -- this is safety-related events that start with January 1, 1978. Operating data in terms of output from the plant and the causes of outages on all of these plants goes back to 1970.

(Counsel for the Commonwealth conferring.)

Q So your LER data base, which you describe on page 5, you only begin on January 1, 1979. In the preparation of this testimony, couldn't you have gone back to the NRC LER data base and obtained a more substantial data base of LERs, and do you think that would have been appropriate?

A I could have. I did not, for at least two reasons that I can think of. One is that there are so many LERs that in a fairly short time period you get a pretty good sample. And two is that I trust my data base a great deal more.

We do not, as I understand it -- the NRC merely punches in the coded information which utilities have filled in on the LERs. We read each LER. We try to interpret it, sometimes to the extent of pulling out the SAR for that plant and checking the system drawings. And then we code information into our data base, based on our understanding of all of the words as well as the coding. And I think that makes for a much better interpretation of what is going on.

Q When you say here, "through the most recently available data," what is the closing date there?

A I was deliberately a little vague there, because there is no closing date. The information comes in to us in big envelopes every few days, and when I did this for most units we were complete through the end of August of 1981.

Q 1980?

A I am sorry. 1980. Right. We know, however, that there were earlier LERs from units that were missing, there were some LERs from September from some units. And the data base is not set up to sort that out. So we just used them all and said most of these are about complete through the end of August.

Q I am interested in your use of operating availability as a measure of the safety-related type of maintenance that the Commission was interested in asking these two issues. You say on page 5 that "The unit with the best availability is not necessarily the best-managed unit, nor is the poorest performer necessarily the unit that is most poorly managed."

Now, wouldn't you agree that operating availability is a much better indicator of the Licensee's management competence in terms of producing electricity than in terms of their ability to operate the plant safely?

A It is certainly a more direct measure of their ability to produce electricity than it is of their ability to be safe, yes.

Q Isn't it possible that -- that plants may in fact remain on line under some circumstances when it is not safe to do so, when safety systems are not available or when safety-related maintenance has been deferred? And wouldn't that actually increase their operating availability?

A It would. But as a practical matter, it is impossible, because there are technical-specification requirements which generally require shutting the plant down after fairly brief periods, like 24 or 48 or 72 hours, after safety system operability falls below some defined level.

There are also limits on the extent to which -- the extent of the time period for which individual safety components can be removed from service. So it is not really possible to go on operating. It is possible, but it is not something that a utility would do, to go on operating with safety equipment out of service.

I might also say that the vast majority of the safety equipment in the plant can be and normally is repaired on line. It does not require a shutdown. What shuts the plant down is if they do not finish the maintenance of the safety equipment in time and they have to shut down. So, to that extent, you must maintain the plant in a safe condition in order to maintain it on line.

So there is a correlation between the productivity of the unit and its safety.

Q When you say "must," you really mean that is what the NRC requirements require you to do?

A That is what the NRC requirements require.

Q It is not a physical limitation?

A That is correct.

CHAIRMAN SMITH: Are you done with that point?

MR. ADLER: Yes.

CHAIRMAN SMITH: Would there be a difference in the short term compared to the long term? I mean wouldn't it be possible, at least in the short term, to defer improperly safety maintenance and decrease the capacity factor, compared to that catching up with you in the long term?

THE WITNESS: It would be possible to defer preventive maintenance of safety equipment. If the safety equipment has actually failed and you would discover that through tests, then you are required to repair it within a given time period or shut down. You are not required by technical specifications, typically, to do any preventive maintenance. So in that sense, you could defer preventive maintenance. But as soon as that resulted in the equipment actually being inoperable, you would be up against a tech spec limit.

CHAIRMAN SMITH: So we could conclude that it might be possible in the short term for a utility to increase or maintain a high capacity factor by deferring preventive maintenance, but given a longer period of observation that would not be possible?

THE WITNESS: I think that is true. I do not think the effect would be very significant. But to the extent it exists, that is the way it would go.

CHAIRMAN SMITH: You might be able to get past the summer peak, for example, but perhaps improperly, but you cannot do it for years?

THE WITNESS: That is true.

(Counsel for the Commonwealth conferring.)

CHAIRMAN SMITH: You are measuring capacity factor in the sense over years?

THE WITNESS: Yes.

CHAIRMAN SMITH: I would like to have a better explanation, if you have any, of -- we got into it a little bit this morning with Mr. Lee -- of reasons why high capacity factor is indicative of safe operation. Can you add anything? You were here during Mr. Lee's testimony.

THE WITNESS: Yes.

CHAIRMAN SMITH: Can you add anything to that concept?

THE WITNESS: I do not recall exactly what he said. I do not recall disagreeing with it when he said it.

CHAIRMAN SMITH: I guess it is more what I said than -- I asked -- high capacity, is high capacity a good -- industrywide, does that -- related to good safety, good management for safety purposes, because, one, it demonstrates that there is basically good management for all purposes, or, two, there is greater stability in the plant -- that is, it is not up and down and you do not have the risks of the transients which might come about when you are stopping the plant, bringing it on line and off line.

But what other reasons might there be, or are those two reasons valid reasons? I do not know. Can you just comment generally why in industry, has it been recognized or believed to be that a good capacity factor can be equated to good safety management? I have heard it in other proceedings, too.

THE WITNESS: I do not think that good capacity factor can be equated to good safety management. And I certainly do not think that good safety comes from high capacity factors.

I do think that both of those things which you said are true; that is, that a plant which is well managed will do well in both areas. And remember that plants are required to keep the safety equipment serviceable by technical specifications requirements, so they cannot just ignore that. It is something they have to do.

And so a plant that is well managed will do that well just because it is well managed. So to that extent, good capacity factor and good safety are both things which result from good management.

I think to some extent, also, a plant that does not have a lot of transients is a safer plant. It does not challenge safety systems, it does not challenge operators. It is a safer plant.

(Counsel for the Commonwealth conferring.)

BY MR. DORNSIFE:

Q Mr. Koppe, related to that question from the Chairman, in your opinion isn't it true that the length of refueling outages is one of the biggest contributors to good capacity factors? And aren't -- isn't the management practices a direct indication of the length of refueling outages?

A The length of refueling outages is the biggest cause of poor capacity factor performance. Refueling outages alone are responsible for more than one-third of all the outage time of all the equivalent unavailability of nuclear units. And good refueling outages are probably the way in which good management is most effective in improving capacity factor.

There are other things which reflect refueling outage lengths: major backfit requirements and major repairs. And some very well-managed plants have had some very long outages. So, again, there is not a one-to-one correlation. But a plant which consistently has good refueling outages is doing something right.

(Counsel for the Commonwealth conferring.)

BY MR. ADLER:

Q On page 8, the first full paragraph, you discuss -- well, let me read: "The strongest similarity of performance should be evident when Three Mile Island Unit 1 and the other B&W units are compared. These units have nuclear system designs that are generally very similar. Generic problems that affect the nuclear systems at B&W units will probably also affect Three Mile Island Unit 1. Conversely, problems affecting the nuclear systems of units designed by a different vendor but not affecting the B&W units will probably also not influence the performance of Three Mile Island Unit 1."

So, in summary, you are saying that in analyzing management and isolating the management competence of Met Ed in operating TMI-1, it is far preferable to compare them to other B&W units than compare to units from other manufacturers; is that correct?

A A very simplistic level of comparison, that would be the thing you would use first. If you really want to understand the differences in performance between TMI-1 and other units, you have to look, for instance, at whether in fact TMI-1 actually has the same generic problem that the other B&W units did and then look to see if it impacted TMI-1 more or less than other -- than other units were impacted.

Also, you would have to look at the effect of other parts of the plant which were not supplied by B&W and look at the effect -- the difference in performance between

TMI-1 and other units as it related to those pieces of equipment and see how TMI-1 had done in that way.

So, simply comparing TMI-1 with other B&W units might seem like it was better than comparing TMI-1 with other types of plants, but it really would not necessarily be any more accurate a way of measuring the performance of TMI management unless you looked at specific problems and compared them and factored out the effect of design differences, different situations as they apply to that specific problem.

Q So, essentially, you are saying there are very, very many factors to take into account in the analysis of this data?

A Yes.

Q It is a very complex and difficult thing to do.

A Yes.

Q And the level of reliability of that sort of analysis can be expected to be fairly low?

A Yes. The level of reliability that you can expect depends directly on your ability to isolate individual factors and their influence on performance or whatever you are looking at. To the extent you can isolate individual factors, then you can start to get something which is meaningful. To the extent you cannot, comparing the numbers, no matter what group you choose to compare, will not be reliable.

Q Beginning on page 11, you begin "Specific analysis of various different types of causes of outages." Originally, I was going to take you through quite a number of them. But in the interest of saving time, perhaps we can do it in a more efficient manner.

It struck me that many of the causes of outages you explained with respect to generic hardware-related types of causes. And I wonder if you can identify any of these causes where you feel significant conclusions can be reached with respect to the management competence as compared to the hardware-related type of problem.

A The one which is clear-cut in my mind is the length of refueling outages. On the other ones, I think it is not so much that on any one hardware problem TMI-1 did better or worse, but that over a whole range of hardware problems or experience with the same piece of hardware or the same problem, the effect of that problem on TMI was better than or equal to the effect on other units which had that, and that overall consistency of doing fairly well or well in dealing with the individual problems creates a cumulative impression of good management. Much more than you could get from any one occurrence.

DR. LITTLE: That is a thing that has bothered me a little bit. You are relating this to losses from different problems. Would it be possible to avoid a loss with a particular problem by deferring the maintenace to a refueling outage time? That way it would not show up as a loss in capacity. Is it possible to skew the data that way?

THE WITNESS: It is probably possible on occasions, but in the vast majority of these problems it is not possible. Typical examples: the specimen holder problem. I guess it was first discovered at TMI-1, and the plant was not allowed to restart or did not restart until they had fixed it. Other units were required to shut down within a time period by the NRC.

So the differences in impact on unit performance which resulted from that problem were due to two things: One, whether or not a plant was lucky enough to be able to do that work in parallel with something else that they had to do anyway; and, two, how efficiently he did the job.

Similarly, reactor coolant pump seals. There are limits in the technical specifications of all of these units on he amount of leakage which is allowable. When the leakage gets to or near that limit, the plant is going to shut down and replace that seal. The impact which reactor coolant pump seals have on a plant's performance will result from the speed with which they do the repair when it is required and the skill of the people in doing the repair so that it stays fixed. The ability to defer that work does not exist.

The other factor is that if during a refueling outage you replace some seals and do it right, then you presumably have a better chance of running for the next year or two without leakage. If you rush through your refueling outage and do not do seal maintenance, then if anything, your probability of having an outage in the future is increased.

So those are a couple of examples that the vast majority of problems fit that pattern. You cannot get better performance by deferring maintenance; you get better performance by doing the right maintenance during the outages and then by repairing the problems when they do occur as expeditiously as possible.

CHAIRMAN SMITH: Excuse me. Before the testimony proceeds, Ms. Bradford, I hope you appreciate the relevance of this testimony to your Contention 5 and that you appreciate you are entitled to cross examine on these issues.

MS. LOUISE BRADFORD: (Nodding affirmatively.)

BY MR. ADLER: (Resuming)

Q You do not have any specific information, Mr. Koppe, or have not analyzed what actually occurred during the TMI-1 refueling outages, do you? You just have the time numbers. You do not know things like how much maintenance was performed, how rapidly it was done, how many maintenance personnel were on in a given day; that sort of information?

A We have some data on these plants as to what work was done, but it is fairly crude. We know, for instance, that during whichever refueling outage it was, the work on the specimen holders was done. But we do not have complete worklists. We do not have manpower loadings. We do not have outage critical paths.

Q So, looking at your Table 4, refueling outage durations in weeks, where I would note that TMI-1 average durations were considerably shorter on the average than for other plants, you have not analyzed specifically why that was true, have you?

A That is true.

Q Turning to page 24, can you define your use of "environmental occurrences"?

A Yes, I can give you an inclusive definition or an exclusive definition. Environmental occurrences include limits on thermal discharges, on chemical discharges, dissolved solids, nonradiological effluents from the plant, and also include for some plants things like we took a sample of milk from a cow and found iodine from the Chinese bomb test.

And they do not include anything which has to do with safety-related equipment in the plant, with the reactor, with operations or quality assurance as it relates to the control of radiological releases or anything to do with radiological safety.

Q And your item four at the top of the page, where you say, "The interpretation of what constitutes a reportable event differs from time to time," do you have any specific evidence that TMI-1 or Metropolitan Edison's reporting for both Units 1 and 2 is any different from the average, is any more or less liberal?

A I think one could state with absolute assurance that all units are different from the average. There is no pattern observable in the LER's which would indicate any consistency in reporting requirements or interpretation of those requirements.

It is so inconsistent and there is nothing to benchmark a plant against. There are no records of what they did not report.

So it is impossible to discern the extent to which the number of LER's issued by plant reflects on the number of appearances or on the reporting philosophy.

Q So you have no evidence whatsoever to include that TMI-1 reported events more frequently or less frequently than any other plant?

A More or less, that's right, no evidence. I got a feeling from some of the LER's at TMI that they were reporting things which I felt they probably would not have had to report then, but I get that feeling from LER's from other plants.

Q Down towards the bottom of the page you say you excluded environmental LER's. Don't you feel that LER's are at least somewhat pertinent to management's competence in protecting environmental -- against environmental degradation and other health and safety type of effects.

I am curious as to why you eliminated that type of LER.

A Many units do not report environmental violations within the LER system. They report them separately. So that including environmental LER's in a data base simply means that you have all of the environmental problems from some units and none of them from other units, and any comparison you would make would be invalid.

Lacking the resources or the time or whatever to get all of the environmental LER's from the -- or environmental occurrences from the other plants, since we do not keep those in our data base --

Q So your decision related solely to the data base problems and not to your perception of the differences in conclusions that might be reached?

A Well, I guess I personally feel on the units I am familiar with the kinds of occurrences which are typically reported as environmental violations are entirely without environmental consequence. But I do not guess that was the principal reason why I excluded them.

Q Turning to page 25, looking at your table at the top of the page, you have already given your impression that it is the most important discriminating factor in doing your analysis, is comparing it with plants of a dissimilar design, given the qualifications that you later stated.

Do you think it is very significant that TMI-1 performed worse relative to other B&W units than to other PWR's?

A TMI-1 did not at least from this table, did not perform worse than other B&W units. TMI-1 submitted more LER's than other B&W units, which is quite a different thing. And no, I do not see any significance to that. I cannot explain it. I can suggest several possible reasons for it.

But I do not know why it is the case, but I do not regard it as significant any more than I regard it as significant that the small sample of CE and Westinghouse units reported more LER's.

(Counsel for the Commonwealth conferring.)

Q The last sentence on page 25, where you looked at NRC Region I units as peer units on the theory that there might be more uniformity of inspection standards within a region since the same NRC personnel are involved -- first of all, did you look at the peer units throughout the country as you did in your LER analyses in this testimony before you reached that conclusion?

A I think you misread it. I said I used data for Region I rather than for peer units.

Q That is correct. Before you came to your conclusion of using only Region I units in the piece of testimony, did you do a similar analysis for non-compliances across the country?

A Oh, no, I did not. Let me just state what I think the question was. I think you were asking me did I look at non-compliances for the TMI peer units as well as looking at them for Region I.

Q That is correct.

A The answer to that is no, I only looked at Region I.

DR. LITTLE: Mr. Adler, were you going to leave page 25 at this point?

MR. ADLER: I thought I was, but I am not sure.

DR. LITTLE: I want to go back up to the table there. What does that table tell us? What does the table at the top of page 25 really tell us.

It says underneath it, "It can be seen that the number of LER's visited by TMI-1 was almost exacty equal to the average for its peers."

In this case, its peers were considered to be all of the PWR's and not what would be the closest peers, other

B&W units in order to make that statement. Is that correct?

THE WITNESS: Yes. I believe that the number of LER's relates much more strongly to the time at which the unit was licensed, which is ultimately reflected in how much safety equipment it has and what requirements are placed on it, and on the reporting philosophy of the plant, than it does to anything to do with the design of the plant.

So I think that to the extent you can meaningfully compare number of LER's at all, that the thing you can do is compare among units which started out at the same time frame, and that is what I did there.

I really do not think that that result is very significant either, except that it does not show TMI-1 as being way out of line with everyone else, which might make you dig a little bit deeper.

But beyond that, I do not think it has any significance.

DR. LITTLE: Thank you.

BY MR. ADLER: (Resuming)

Q Getting back to the paragraph on non-compliances, you say, "Unfortunately most non-compliances involve minor procedural inadequacies, with very little direct effect on safety."

Then you say, "Due to the lack of an adequate data base." Is that referring back to the fact that most non-compliances are minor, or do you feel there are insufficient numbers of non-compliances to comply an adequate data base?

A No. The reference to an adequacy of a data base is the lack of a data base which would describe each individual non-compliance and give you some idea of its significance, to allow you to compare at a comparable level of significance.

Q Would you say inadequacy reflects poorly on this whole history of non-compliances?

A It does not reflect or not reflect since I did not use the inadequate data base.

(Pause.)

Q I am not sure then how to ask -- the question, is any analysis of non-compliance a valid indicator of the safety-related maintenance competence of nuclear power plant operators?

A At least in theory you could look at all of the non-compliance reports and read in detail what they examined, to what extent they examined it and what they found, and possibly you could draw some meaningful conclusions.

But there is no way by counting non-compliances or putting them in different bins or by doing statistical analyses of them that you can draw meaningful conclusions.

Q But you have not done that here?

A I have not done that. That is correct.

BY MR. DORNSIFE:

Q Mr. Koppe, related to that particular question, are you aware of any types of statistical analyses that have been done on LER's and non-compliances?

A Part of my brain is telling me that I have seen something like that and the other part of me is telling me that I cannot think of what it was.

Q Maybe I can refresh your memory. I showed the NRC witness a document yesterday, Licensee regulatory performance evaluation, and one section has a statistical analysis of both LER's and non-compliances where they rate the LER's in different categories and the non-compliances in terms of severity.

They give a rating factor to it, and then they come up with an overall combined score of non-compliances and LER's, and in this particular case for this particular period, TMI-1 was on the lower -- it was average, but was the low range of the average level.

I was wondering if you do the same type of analysis for your particular period. You may come up with a similar type of -- of results, and how valid do you think this -- if you recall it, how valid do you think this type of approach is compared to yours?

A From --

Q They are all related.

CHAIRMAN SMITH: There are some real problems, too, with the question. Let's hear from Mr. Blake.

MR. BLAKE: I have an objection to the question. As I understand it, although I cannot retrace everything that was in it, and I would have to have it read back to get every point in it, as I understand it, Mr. Dornsife has characterized a document which gives his view of what a document that none of us are looking at might say, and has asked the witness whether or not he went through a similar analysis that those did who put together the document, would he come up with the same conclusion?

It strikes me as a terribly improper question.

CHAIRMAN SMITH: I think he could probably break it down into appropriate sections. The difficulty is -- well, it just so happens I am familiar with the document, but Mr. Moseley was not, and I doubt if anybody else is. So you are going to have to start out by -- let me add what I know about this.

I am familiar with this document. I had it at another hearing. It was the subject of testimony. The NRC, as far as I know, has never blessed it. Even the authors of it have serious doubts about the weighting system that [illegible] there.

In fact, the document itself contains caveats all over the place and footnotes. However, I think it is appropriate for you, if you wish, to show the witness the point you are trying to establish, and if he can independently agree with it or disagree with it or use it in his own expert testimony, it will be all right.

MR. DORNSIFE: The only point I am trying to make, Mr. Chairman, I guess I may have gone in a round about way of getting the point across. Just looking at crude numbers, the way Mr. Koppe did in his testimony, compared to maybe a more sophisticated analysis, regardless of the validity of the analysis, you could come up with any conclusion you want.

I am wondering how valid his conclusion is that the plant behaved above average, average or above using this analysis for this particular time period. It is average or below average as a conclusion.

CHAIRMAN SMITH: If you want to let him familiarized himself with the methods that were used there and ask if that changes his opinion, I think it is all right for you to do it. But I agree with Mr. --

MR. DORNSIFE: If he has to find -- I am not sure he has to see the data or the methodology to just answer a general philosphical question like that.

CHAIRMAN SMITH: All right.

MR. DORNSIFE: If he does --

CHAIRMAN SMITH: If you want to identify it as that. In the first place, maybe we are assuming that you are not familiar with the document. Maybe that is the wrong assumption.

THE WITNESS: I have seen something which I believe NRC submitted in this proceeding that was a statistical analysis of LER's, but certainly whatever this is, I have not seen it.

MR. BLAKE: What he is probably referring to and we made available to him, the SER supplement and the treatment in there. To my knowledge, we have not made this document available.

CHAIRMAN SMITH: This is a January or February 1979 Board notification document which undertakes to weight LER's and assign what they call V-scores or some such thing to it, and he is pointing out that the authors of that report have arrived at a somewhat different conclusion than you have, and he is wondering if this might jog your philosophical approach to it, to explain how this could happen.

I pointed out, I know -- I have read much of this document, and I think we would have a hard time accepting it as evidence because the document itself just warns you all over the place that it is a new experimental testing idea.

MR. ADLER: We have no plans to introduce it into evidence. I have a suggestion. Maybe Mr. Koppe can review the portions of the document Mr. Dornsife has in mind over the afternoon break.

CHAIRMAN SMITH: Do you object to that, Mr. Blake?

MR. BLAKE: I don't know how long the sections are, whether or not it is doable by Mr. Koppe.

CHAIRMAN SMITH: You know, if it affects his own expert opinion, it is his own expert opinion which is affected, not the underlying document which is coming in.

DR. LITTLE: Mr. Koppe, do you know you are not familiar with that? I do not know how -- ten feet, twenty feet or something. Have you ever seen it before or not?

THE WITNESS: I do not know that. I do not recognize it.

(Counsel handing document to witness.)

CHAIRMAN SMITH: Maybe this would be a good time to take the afternoon break. Do you want to proceed and come back to it?

MR. ADLER: Well, it is a bit early. We can proceed.

CHAIRMAN SMITH: All right. Go ahead with your questioning.

(Witness reviewing document.)

MR. DORNSIFE: The methodology is very short.

There is a lot of data.

(Discussion off the record.)

CHAIRMAN SMITH: We will take it up again after the break, so proceed with your questioning.

BY MR. ADLER: (Resuming)

Q Turn to page 26, Mr. Koppe. At the end of the first incomplete paragraph you say that non-compliances involving special nuclear materials accounting and plant security were excluded. Can you tell me why you excluded those two categories?

A Because they are areas that I do not know a whole heck of a lot about and because I believe that -- well, that is not really right. I guess the real reason is that I was trying to concentrate on all of this, on things which affect safety in the sense of protecting the reactor core.

I concentrated on that in the discussion of systems and all of the things where I thought I could get some handle on safety performance in terms of protecting the core, and these particular things are peripheral to that.

And so I thought I would be getting a little bit closer to the heart of the matter. If I excluded them --

Q All right. We will get back to that decision a little bit later. Did you look at the number of non-compliances in these two areas for TMI-1 at all?

A No, no.

Q On the chart in the middle of the page on page 26, I note that you included 1979 non-compliances for TMI-1. TMI-1 was not operating during that year. Do you feel that it is valid to include that year?

A I do not think -- I do not think that it is valid or invalid. I do not know how you could decide.

Q Let's put it this way: Do you have any expectation that a plant that is down with have any more or less non-compliances than a plant that is up?

A Normally I would not. I guess to the extent I would worry about differences with TMI, I would worry about it because of the extraordinary circumstances in terms of number of inspections and other pressures on the people.

As it turns out there does not seem to have been any difference, but being shut down per se should not significantly affect the number of non-compliances because all the non-compliances come from people searching through records, looking for discrepancies in maintenance work and all the other things that generate those records and discrepancies, so on, whether the plant is operating or not.

Q The next paragraph you say that it might be expected that the number of non-compliances would be proportional to the time spent inspecting. Do you have any direct evidence of that correlation or of the nature of that correlation or is that your speculation?

CHAIRMAN SMITH: Those are the only two alternatives you are giving him?

(Laughter.)

MR. ADLER: The two alternatives I gave were whether there was any direct evidence or whether it was pure speculation.

CHAIRMAN SMITH: Okay.

MR. ADLER: I can remove the word, pure.

(Laughter.)

CHAIRMAN SMITH: That is the best kind.

THE WITNESS: It is speculation. It is -- the speculation is based on an understanding of how the NRC comes about getting non-compliances and so I think there is a good basis for the speculation, but in terms of after the fact analyses which demonstrate that that correlation exists, no, I do not have such.

BY MR. ADLER: (Resuming)

Q Would you have any basis to speculate that the proportionality is linear?

A I would expect within reason that it would be linear. Obviously at some point it will saturate if you put hundreds of inspectors on a site. They will spend all their time tripping over each other and not finding violations, and you might eventually get the curve to turn around.

But within reason, within a reasonable number of inspector hours, I think that you would find a pre-linear correlation because if they search twice as many records they will find twice as many problems.

(Counsel for the Commonwealth conferring.)

CHAIRMAN SMITH: Make your answer in terms of the actual inspection practice in force in the industry.

THE WITNESS: My intuition would be that with the way inspections are done that you would see something pretty close to a linear correlation.

BY MR. ADLER: (Resuming)

Q Turning to pages 27 and 28, your analysis of the TMI-1 LER's, down at the bottom of the page you say that 65 dealt with occurrences which had absolutely no impact on the overall fate of the reactor core at TMI-1.

Now you just stated earlier that you felt that the reactor core was your best indicator of the safe operation of the plant. However, in that list on page 28 of what you term minor variances, wouldn't you agree that a number of those variances have potential impacts on public health and safety, regardless of their effect on the reactor core per se?

A No.

Q The third item on that list, leaks in systems containing radioactive materials, might that type of occurrence result in higher personnel exposure on the site?

A They might.

Q Might they result in increased offsite exposures?

A They might.

Q The last item on the list, problems with radioactive waste systems, might they result in potential increased offsite exposures?

A They might. Now that we have completed the list, I would observe, of course, that none of those things threaten to damage the core.

Q I have not finished the list.

A Oh.

Q The one about personnel and procedural deficiencies, although that may not impact directly on safety, wouldn't you say that personnel and procedural deficiencies can lead you to some conclusions about management competence?d

A Yes, they could, and I looked at them separately, but all of the ones that are included here -- I do not think there were very many -- are ones which in fact did not result in any safety equipment malfunctioning.

Q Beginning on page 29, the very bottom of the page, you describe a sampling process. You say you selected a limited sample of operating experience and performed a detailed review of all the LER's within that experience.

Now, can you explain first of all why the comparison to TMI-1 was with PWR's in the first eight months of 1980? Is that just a convenience, or did you have some specific rationale?

A It was primarily a convenience. The data for 1981 was readily available. We had just performed a computer run specifically on personnel errors on that data, and I limited myself to PWR's because they are obviously different regimes for BWR's, and I was trying to reduce the size of the sample to something I could examine LER by LER, which is a very painful and time-consuming thing.

(Counsel for the Commonwealth conferring.)

Q Did you read the NRC's analysis in there, management supplement to the SER in this proceeding, that analyzed personnel errors and the comparison of HELER's to other types of LER's? Did you read and review that analysis?

A I am afraid I have read so many different things that I have a hard time knowing when something is described in that way whether it is something I read or not.

BY MR. DORNSIFE: (Resuming)

Q If I could refresh your memory maybe, the Staff basically took a ratio of human error LER's to all LER's and they said that human error LER's were more indicative of potential safety problems or potential management problems. And I am wondering based on your opinion and your statements and your testimony, do you concur with their opinion, their analysis?

A I think that human error caused problems are much more indicative of management deficiencies than are equipment failures. I do not think that ..king ratios of human error LER's to total LER's or something like that is a meaningful indicator because of the differences in the way in which plants assign blame for problems.

Some plants go to one extreme and some go to the other extreme in the kinds of problems they will assign to human errors. I might add that in reading the TMI LER's, I thought they were extremely zealous in identifying potential contributions of human error to malfunctions.

BY MR. ADLER: (Resuming)

Q On the table on page 31, LER's involving personnel errors, you place one item on line five, the missing data -- on line four you have just a dash. Is that supposed to be a zero?

A A zero, yes. It is a dash, but it means zero.

Q At the top of page 33 -- I am sorry. I withdraw that. I have already asked that. Beginning on page 34 you begin through the end of your testimony, you begin your analysis of loss of safety system function, and you comment that it would have been impossible for you to perform a careful analysis and interpretation of all failures.

Did you make any attempt to look at the gross numbers of failures in performing this analysis, even though you could not perform a careful analysis?

A No, I did not.

Q You didn't, so you do not have any comparison of the gross numbers of component or safety-related component failures for TMI-1 versus any other plant?

A That is right. I guess I -- just to enlighten people, you can count the number of LER's that were written, say, on diesel generators or the high pressure injection pumps.

Your problem is that you do not know what kinds of things people are reporting. So the only way to make a meaningful comparison is to look at all of them and establish some level of deficiency which seems to be bad enough so that everyone is reporting it, and the compare that, and that is what is so time-consuming, and that is what I did not do.

Q I am going to use your table on page 43 just as a summary of this analysis. Would you agree that this table indicates that when considering total safety system function failures, we are dealing with extremely improbable events?

A Extremely improbable?

Q Improbable events.

A Yes.

Q And as a result of that, isn't it extremely unlikely that such an event would occur at any given nuclear power plant?

A It is extremely unlikely that any -- that a given event in one particular system would occur in any one plant. When you look across the board at all systems over a number of years, it becomes pretty likely that one will occur somewhere in that plant, and in fact, there was one at TMI-1.

What you are looking for in this kind of analysis is the occasional plant which has several of them, and there are a few plants like that, and those are the plants that you would worry about.

If you see a plant that has none or that has one or two, you do not know if that is a superplant or an average plant, but you know it is not one of the really bad ones.

Q So in characterizing the limitations of this analysis, would you say that the only real conclusion that you could reach from this analysis is that TMI-1 is not a really bad plant in terms of loss of total safety system functions?

A Well, really bad is a relative thing. There are a number of plants which are clearly worse, and those plants are operating.

(Counsel for the Commonwealth conferring.)

MR. ADLER: Mr. Dornsife just has a few more questions.

BY MR. DORNSIFE: (Resuming)

Q Back on page 32 of your testimony, near the bottom you say that TMI-1 LER's reveal a consistent search for possible errors. I am wondering how you conclude this.

A There are many plants where you weed an LER where something was adjusted wrong, and it just says, "This was adjusted wrong, and we readjusted it." At TMI it will say "We looked back at the procedure for how they adjusted this thing." We checked on how they adjusted other similar ones, and we found that the procedural guidance was not clear enough to ensure that in every case the person adjusted it right.

So we assume that that is why it was wrong now, even though it could have drifted, and we will correct the procedure to try to see that it does not happen again. That sort of thing crops up a lot of time in those LER's.

Q Although in the Staff SER they made any attempt to look for recurring LER's, did you make any attempt to do that?

A Yes.

Q Did you find any pattern of recurring LER's, and could you discuss what significance that would be?

A I found in all of the TMI-1 LER's there were two problems which recurred, and I neglect a couple of cases where a problem happened one week and happened again the next week, and then they fixed it on the grounds that a week is a pretty short time.

But there were two problems which recurred a number of times. One was the containment airlock doors and one was snubbers. I happened to have had experience at Indian Point with both of those problems, and to have done no better than TMI did, so I guess I tend to be understanding about those two problems.

But they were problems. In the case of the airlock door, which had very little safety significance since they happen for a very brief time period, and typically happen when a unit is shut down when many people are going through the doors.

The safety significance of snubber problems is harder for me to judge. Most days I think if you took all the snubbers out the plants would still be perfectly safe, but one cannot be certain of that. But the snubber problem was a very difficult and time-consuming problem to solve, and the fact that it took TMI a while to solve them, as it did other plants, does not surprise me.

CHAIRMAN SMITH: Mr. Dornsife, I am reminded that with respect to the containment airlock findings, this is the same conclusion that I&E arrived at.

I wonder if you could pursue whether this is a coincidence or parallel, or is it reassuring that both -- two independent searchers arrived at the same conclusion, or that type of inquiry.

Now, the I&E I do not think referred to the snubbers.

MR. DORNSIFE: Yes, sir. I think the Chairman asked the question.

CHAIRMAN SMITH: Yes, that is the question. We have similar testimony here from officials of Inspection and Enforcement from NRC that a pattern -- looking for patterns in LER's -- that is one that I recall.

As a matter of fact, that is the only one I recall, the airlock problem. Did you arrive -- were you tipped off to that, by that evidence, or I&E's conclusions, or did you arrive at that conclusion independently?

THE WITNESS: No, I took -- I read every TMI-1 LER, summarized it for myself in brief notes, classified it according to system and problem area, relisted them all and then searched down each grouping for any patterns.

So I am convinced that I identified all the patterns which exist. Within the last few days, sitting over there and waiting for my turn and reading things, I happened to read that I&E conclusion, but I had come to it long before.

CHAIRMAN SMITH: Okay.

BY MR. DORNSIFE: (Resuming)

Q Do you think that this type of analysis has particular significance as far as management competence is concerned?

A I think that if you see good performance, that that is indicative of someone who is doing well. I think that simply counting the number of times that such things happen can be very misleading.

A plant which submits only a few LER's a year for whatever reason will have very few recurs, no matter how well managed it is. Although NRC regulation in the past has put very strong pressures on people to do many things, and not having repeat LER's was not one of them, there are a number of reasons why simply counting the number of these occurrences is not meaningful.

I think the fact that TMI-1 had a fair number of LER's, whether that is reporting requirements or whatever, and that time and time again when they have a problem they seem to have taken reasonable actions to prevent it from recurring, is definitely a positive reflection on their management.

Q We briefly touched on this in the previous question, but you said that you noticed in reviewing the LER's that Met Ed consistently seemed to be willing to blame personnel error as being the cause, and I am wondering, do you base this on the blank that is checked or the reason given for the LER, and then how do you see this as a reflection on management?

A I do not base it on the blank that is checked. I must confess that in reading all these LER's I never looked at whether that blank was checked or not. I read what they said they thought had caused the problem and what they had done about it, what they said they had done about it.

Q How do you see this as a reflection on management?

A I think it is a positive reflection. There is a tendency among operating people to blame equipment for their problems, and to some extent, of course, they are right. But if they do that, then they are justifying in their own minds not doing whatever it is they can do to make the equipment work better.

If they are facing up to the fact that they could have done something and at least saying that they are trying to do better, that is a positive reflection on their attitude certainly.

Q On pages 40 and 41 you talk about system failures of auxiliary feedwater systems and first of all, I am wondering why you only included that particular period that you included, January 1979 to August 1980.

A All of these explanations are mildly

embarrassing. We have two data bases, one of which goes from January of 1979 through August of 1980, and one of which covers 1978 and 1979.

While both of those systems had been set up specifically with the recognition that these kinds of problems, system errors and lineup errors -- I am sorry -- system failures and lineup errors are the single most important contributor to the unreliability of safety equipment in nuclear power plants, and wanting to get as good a handle on those as possible as -- since I had never -- since I had been collecting data, but never actually tried to analyze it for this partcular purpose, I had one of my associates carefully cross-check the two data bases for 1979 where they should have given the same answer, and found that the CPEC data base had missed several things which perhaps in the final analysis might not have been included as system failures, but certainly should have been coded to be in the initial sort.

. I had not the resources at that particular time to identify why OPEC had been deficient, but it shook my trust in its ability to do this particular kind of analysis, so I did not look at 1978, which is the only other thing I could have looked at, and limited myself to '79 and '80.

Q The reason I asked -- because in previous testimony we have had -- we have had testimony that there had been -- most of these had occurred previous to 1978, a total of about eight, eight instances where feedwater systems had been totally -- would have not responded -- the whole system was either -- was disabled for some reason, and it would not have responded if it were called for, and I am wondering based on the number of previous incidents before 1979, the fact that a lot of this data is after some of the lessons learned from the TMI-2 accident, whether you feel that this generally good behavior over the last year is indicative of possibly the lessons learned, and the I&E bulletins that were issued specifically on that system.

A I do not know, but I do not have any reason to believe that it is. The kinds of things that typically have caused system failures -- and since I have not looked at the particular ones you are referring to, or even verified in my own mind that they are what I would consider a system failure -- I do not know specifically what caused them, but I do know that most of the things which in my experience caused system failures are not the kinds of things that are being addressed in the lessons learned.

Q Could you elaborate somewhat on that last answer? What have you found that have caused system failures that have not been addressed?

A System failures come about because of lineup errors. They come about because of an undetected design deficiency, and they come about because if you only have single failure redundancy and you remove one component for maintenance, the failure of the other component causes a system failure.

Those three things together result in 90 some odd percent of all system failures, and the lessons learned are directed towards instrumentation. They are directed towards automatic initiation, this sort of thing, installing single failure protection which really only is necessary for steamline breaks which never happen, and not towards the things which cause system failures.

The other thing, of course, is that some plants -- in the auxiliary feedwater system, some plants such as TMI-1 have three auxiliary feedwater pumps per unit. Other plants only have two.

DR. JORDAN: How was that? I did not hear.

THE WITNESS: I am sorry. Some plants such as TMI-1 have three auxiliary feedwater pumps, while others only have two. The plants which only have two are much more likely to have a system failure than the plants which have three.

MR. DORNSIFE: I have nothing further. Thank you.

DR. LITTLE: Mr. Koppe, on page 44, you have your conclusions and I realize in the first part of your testimony, your written testimony, you indicated why you chose not to look at TMI-2, because of the very small data base.

Would you find it reasonable to assume that operations prior to March 1979 at TMI-2 were quite similar as far as management, et cetera, to those at TMI-1? And do you have any idea that what was going on at TMI-2 was radically different from what was going on at TMI-1?

THE WITNESS: Phrased that way, I have no problem. I have no evidence that they were different. On the other hand, I do not know that they were the same.

DR. LITTLE: What I am wondering is, you say that comparison of TMI-1 history with industry averages indicates that TMI-1 was average or somewhat above average. Therefore, I conclude that the operations of TMI-1 prior to March 1979 were such that they provided an adequate level of safety.

THE WITNESS: Yes.

DR. LITTLE: How did you get there?

THE WITNESS: Well, now you are going to get a speech. I think first off that the performance of all nuclear power plants in the United States to the present day, including TMI-2, have exhibited an adequate level of safety in that the total risk to the public from those plants is far lower than the total risk from alternative methods of generating energy.

That is not to say that I want to see there be more TMI-2 accidents. I think that the TMI-2 accident came about because of a deficiency in the way the industry did business in terms of what it expected of operators and what it taught them to deal with, not because of deficiencies in the design of the equipment or the management of the plant.

Management of some plants may not have been all we wanted it to be, but that fact did not cause the accident. So in terms of the performance of safety equipment, performance of TMI-1 was indeed adequate.

There was in the world this other deficiency in terms of what we expected of operators and how we trained them, which left the possibility of an accident due to any one of several causes, not just steam space small break LOCAs.

There were similar deficiencies of what we expected of operators of BWR's, for instance, which did not adequately tell them what to do in terms of complete loss of high pressure injection, did not adequate tell them how to expect the plant to respond in the case of loop isolation.

That is the deficiency which resulted in the TMI-2 accident, and given that that deficiency is now corrected the safety of plants is now superior, is now improved. But while improving management of all plants more than they were before will improve safety, I think that having removed the deficiency in terms of operator training, management levels and certainly safety system performance levels that were being achieved prior to March of 1979 result in a more than adequate level of safety, maybe not the optimum level, but adequate level.

DR. LITTLE: So if we look at order item nine, it says, "What if any conclusions regarding Metropolitan Edison's ability to operate Unit 1 safely can be drawn from a comparison of the number and type of past LER's, et cetera? It is your testimony that conclusions can indeed be drawn, and that the conclusion is that now and prior to March 1979 you feel there was an adequate level of safety, that there is an adequate level of safety?

THE WITNESS: Yes.

DR. LITTLE: You can draw conclusions from LER's and operating experiences?

THE WITNESS: You can draw the conclusion from the low incidence of system -- of safety system on availability, which is the bottom line. I guess to the extent that safety system unavailability is reported in LER's you are drawing the conclusion from LER's. But that is in my mind a tenuous connection.

If there were no LER's but if there were good data on the rate of failure of safety systems, you would be able to draw the same conclusion.

DR. LITTLE: You can draw that conclusion?

THE WITNESS: Yes.

DR. LITTLE: Okay.

(Board conferring.)

CHAIRMAN SMITH: All right. Let's take an afternoon break.

(A brief recess was taken.)

CHAIRMAN SMITH: Are we going to wait for Mr. Adler?

MR. DORNSIFE: He will not be returning.

CHAIRMAN SMITH: Okay. We have --

MR. DORNSIFE: In fact, Mr. Chairman, it might not be a bad idea, I can just tell you now, we will not be here tomorrow because we have no questions for Mr. Dieckamp. So the Consumer Advocate and the PUC will be representing the Commonwealth tomorrow.

CHAIRMAN SMITH: Okay.

Do you have questions?

MR. SWANSON: No.

CHAIRMAN SMITH: Do you want to follow up now on your -- the question the Board notification of Licensee performance?

MR. BLAKE: Mr. Koppe.

REDIRECT EXAMINATION

BY MR. BLAKE:

Q Mr. Koppe, have you had an opportunity to take a look at the document which Mr. Dornsife earlier referred to?

A Yes.

Q And were you able to have any appreciation for what was involved in that, and would you address that?

A Yes. Maybe I should set the background. I think the key point in all of this discussion of LERs and similar things is that merely counting the occurrences of LERs, say, cannot be meaningful because of the tremendous differences in the rules under which they are reported. That is to say the LERs are not a consistent measure of anything.

The only way you can attempt to get some insight into management capabilities or design adequacy of a plant, like TMI, from its operating history is to look at specific measurements of specific kinds of performance. If you can look at the number of times personnel misalign safety systems and have some confidence that the data base will include at least most of those kinds of occurrences, then you can compare among units with some degree of confidence.

Similarly, if you can isolate the incidences of failures of entire safety systems or the overall output of a plant, in those cases you are measuring something which has some meaning and which you have some confidence you are measuring the ole group of units on the same basis. In that case, com sons can tell you something. A count of LERs, because it s not a consistent measure of anything, is meaningless, whether you do it statistically or simply average them up. So in that sense, I think, the kinds of approaches in this report that we have been talking about are doomed to failure because of the inadequacy in the data base.

I guess the other part of the question was: If one had taken a different approach than the one I took to analyzing the simple kind of LERs and noncompliances at TMI had come out different from the almost dead average rating that it came out in my analysis, then the answer is "Yes." Other approaches might have given a somewhat higher or somewhat lower position to TMI.

I suspect, but cannot verify, that the reason TMI comes out somewhat below average in the analysis done by the NRC is that analysis covers all operating units up until some time and includes a relative preponderance of older, smaller units, and those units have fewer pieces of safety equipment to generate LERs. So even if the equipment runs the same, they will produce fewer LERs. They are more mature units. They are units typically with much less stringent technical specifications.

So I think that that, rather than any difference in technique, is the most likely explanation for why an analysis such as that would show TMI to be somewhat below average. I think if they were to repeat the same analysis including data through 1980 and now picking up a few of the newest units with very high numbers of LERs, TMI would move back towards the center again.

But none of that is telling you anything about the performance of TMI.

RECROSS EXAMINATION

BY MR. DORNSIFE:

Q One follow-up question: When you make the conclusion that TMI-1 was average or somewhat above average, what specific areas are you making that conclusion for?

A In everything I looked at, TMI came out average to somewhat above average. I think that the fact that they came out quite well and the things where the measurements were most reliable, line-up errors, system failures, and the measures of performance give you an impression that the plant was probably managed in an above-average way. And certainly, that is reinforced by the actual reading of the LERs and the philosophy that seems to go through those.

So the answer is: All the measures show TMI average or above average; some of those measures are more reliable than others.

Q Could you just possibly very briefly just list in general order which ones you would put more reliability on of the various things you did analyze?

A If the thing we are looking for is plant safety -- and I think it is -- then the most reliable indicators are the low incidence of system failures and the low incidence of tag-out and line-up errors. The generally good performance -- in fact, the generally outstanding performance -- of the unit as a generator of electricity tends to indicate good management but is not as strongly correlated to safety performance as the first two.

The remaining measures strike me as being much less reliable. I am trying to go through my head and see if there is anything else I should be -- since I am throwing everything else in the other bin without naming them -- that I am not unfairly including something else in a relatively unreliable category. And nothing is coming to mind.

MR. DORNSIFE: Thank you.

CHAIRMAN SMITH: I wanted to note that there is no representative of TMIA present after the afternoon break.

Do you have any more redirect?

MR. BLAKE: One more redirect question.

CHAIRMAN SMITH: Excuse me. Go ahead.

DR. JORDAN: Can I ask my question first?

MR. BLAKE: Sure.

BOARD EXAMINATION--Resumed

BY DR. JORDAN:

Q First, just a few general questions. How many different organizations are doing an analysis of LERs that you are aware of? For example, is NFAC analyzing LERs? I believe that the nuclear safety group at Oak Ridge is doing an analysis of LERs and so on. Are there a number of parallel efforts, or what is going on?

A I cannot keep up with it all. The things in which I am intimately involved, we are one of three contractors who are assisting MFAC in the evaluation of LERs. Oak Ridge is another. And an organization called Nuclear Power Experience is another.

Q What is the last?

A Nuclear Power Experience.

I see reports and read reports in Nucleonics Week of other evaluations, and I would not pretend to be able to give you a reliable list of who is doing what.

Q Well, you have cleared up the effort, that it is part of the MFAC effort.

A What we are doing is part of the MFAC effort, yes.

Q I see. Very well. Now, for what -- as a consequence of your work in LERs, have you, for example, anything to say about B&W plants with respect to steam generator failures? Have you looked at that particular thing, the fact that they are unique in being once-through? And I have seen some analyses that say in that event they are more subject to strain, particularly from overcooling events. But on the other hand, we have heard some data that there have been very few failures. Do you have any data on that?

A We keep data on, of course, any LER related to steam generator tube leakage. And typically, a plant will report an LER if the steam generator tube leakage during operation exceeds some threshold. If there are low levels of leakage and/or if they do tube repairs during refueling outages, those do not necessarily -- do not generally generate LERs.

We also keep data on all the outages caused by steam generator tube leakage. To the extent one can generalize, it is certainly true that the worst steam generator problems are in non-B&W plants.

Q Westinghouse?

A There are -- the worst plants right now are some Westinghouse plants. That is true. There are some CE plants with problems. There are some Westinghouse plants with no problems.

Q I see.

A But the worst problems are in a group of Westinghouse plants.

Q B&W plants look pretty good in that respect?

A Look pretty good in that respect, yes.

Q In your detailed analysis of the industrywide LERs, have you come up with anything unexpected?

A I personally have never come upon an LER where I said, "Oh, my God." So in that sense, I think, the answer is "No."

Q I did not mean a single LER. You have not seen a pattern of failures that has not been looked at before, something new?

A I do not think that with so many people looking at these things that you ever see something entirely new. I have -- there are a number of areas which I have which I feel are deserving of more detailed investigation than has been given or that other people feel are important. Other people have their own pet projects.

Q Tell me yours.

A One of mine is steam-driven pumps. That is especially important for BWRs, where they depend on steam-driven pumps more than the PWRs do. I guess another one is instrument buses, but that is hardly one I can claim is unique to me.

Perhaps the one I am most interested in is the whole question of the interrelationship between high-pressure injection and auxiliary feedwater and the use of one to back up or provide a functional diversity to the other one in the case of transients.

Plants like TMI are in particularly good shape in that area because of having the full pressure, the full-head high-pressure injection pumps. Many of the PWRs in the United States have high-pressure injection pumps which cannot pump against the safety valve set points and, consequently, they can only back up auxiliary feedwater if the operator deliberately opens the PORV.

And I think that that situation has not been, at least in my experience, has not been adequately analyzed to provide reliable guidance to the operators in advance of their being put in that situation.

There is a similar kind of situation on BWRs which would involve the loss of all high-pressure injection and instructions to the operator as to when they should initiate automatic depressurization so that the low-head injection pumps can back up the high-pressure pumps.

Those are -- of my pet peeves, those are the ones that come to mind.

Q You happened to touch on one that I raised as an issue in this hearing.

A I am aware of that.

Q One quick question before I get into the table. On page 41, the one-sentence paragraph in the middle of the page says: "The unavailability of the emergency feedwater system at TMI-1 was also zero for five years of operation." Could you speculate as to how likely it would be that the unavailability of, say, the feedwater system would get an LER -- and I am thinking, say, in particular of the situation at TMI-2 -- where the emergency feedwater system was blocked out? Do you think that would have been, if there had not been an accident, do you think that would have been picked up in an LER?

A Yes.

Q You think it would have been?

A Yes. Of course, one can never say certainly that people -- that the people at the plant would have recognized that they were in the situation. But assuming that it was recognized -- and usually, such things are -- then there is no question.

Q No, I didn't mean -- I was not at all questioning the honesty of reporting it. But whether it would really be picked up.

A Would be reportable, would be recognized?

Q Recognized. Right. And how -- do you think system failures are usually recognized?

A Yes, I think by their very nature they are much more likely to be recognized and reported than -- I was going to say than individual failures. And I guess that is not really true. They are no more likely to be recognized or reported. It is just that anything which could reasonably be construed as a system failure will almost certainly be reportable under the tech specs.

Q Oh, yes.

A And certain types of failures of individual components might not be. And so it is at the level of reportability where I think system failures are, if you will, superior to other kinds of failures, in that they are more likely to be reported.

Q I noticed in talking about, again on page 41, you start the last paragraph with "System failures of other safety-related systems." And you left out, for example, containment failures. Why did you choose to leave out containment failure?

A I chose to include the systems which I believe are most important and which I happen to be most interested in. I hope there is a correlation between those two things. Because I had not previously analyzed our data base for any systems and did not have unlimited time, I chose the systems I was most interested in.

I guess the other thing is -- I think I mention it in here -- that there does tend to be more uniformity in some of these systems that I mentioned among units. But just thinking about it, some of the systems, there is not so much uniformity like auxiliary feedwater. So I am not sure that is a very good reason.

Q All right. I was reminded of, I believe, a purge system that I believe was left open for months or a year or something like that on some plant and wondered if that would have -- the reason you left it out was it would have spoiled your data?

A No, no.

Q I am trying to turn to your last table. Yes, I have it, on page 43. And I am trying to understand a bit as to how and why your system unavailability that you find in your analysis of LERs is so strikingly different from that of WASH-1400. First of all, I want to inquire where the WASH-1400 data came from. And secondly, are we really talking about the same units?

Now, let's take, for example, the diesel generator, which you have -- you show a WASH-1400 system unavailability of .01. Where in WASH-1400 did that number come from?

A I am sure you appreciate how difficult it is to read WASH-1400 --

Q I assure you.

A -- and reconstruct exactly where they got the numbers from.

(Laughter.)

I think I understand in the case of the diesel generators, but this is my reading of a difficult-to-read report. At the time that WASH-1400 was produced, there were relatively few large standby diesel generators in nuclear service in the United States, and those diesel generators were exhibiting a very high failure rate.

Q My first question is now where did the number -- where in WASH-1400? Was it Appendix 3?

A I cannot remember. Oh, I see, you are just looking for the reference. I am sorry.

Q I am trying to understand what that number is in WASH-1400 first.

A Right. I cannot give you the reference right off the top of my head. I would have to look.

Q Well, I guess what I did was to look in WASH-1400 and at least some of the tables. And as I say, I have trouble finding it. Numbers like you have. And, of course, it is very difficult in WASH-1400. But I find for individual diesels they have numbers like 3×10^{2}.

A Right.

Q And I am having a little trouble finding a systems failure rate in WASH-1400. In the second place, the number I find in WASH-1400 is a so-called Q_d, which is the probability of failure on demand.

A Yes.

Q Now, are you quoting -- do you -- what do you purport that number that you are quoting to be, the .01? Is that the system failure rate on demand, or is it the system unavailability, or what do you believe it is?

A All of the numbers in WASH-1400 that I have looked at are quoted in terms of failure rate on demand.

Q All right, I agree.

A The way that -- I think I should step back a little bit here. In the operating data, the LERs, one cannot directly measure or calculate system failure rate on demand, because the number of demands is not known. In any case, the number of demands that occurred may not have been uniformly distributed in time, so that failure rate on demand which actually occurs may not be representative of the failure rate on demand which you would have gotten had you randomly sampled in time.

By looking at the data and determining how much time the system was in a state such that it would have failed had there been a demand, you can calculate what I call the unavailability, that which can also be thought of as the failure rate on demand which would have occurred had there been a sample over time.

And so in that sense, what I am approximating with this measure is equivalent to what WASH-1400 is using, approximating in the best way that I think one can from an operating history what the failure rate on demand would have been under random sampling. And I might say that even if we had data on how many demands there were, this would still be the preferable way to do it.

Q I notice you took a very small length of time for the time in which the diesel generator was out. Most of the time it was a matter of an hour or two, but ordinarily in the case -- aren't diesels ordinarily tested once a month and, therefore, if there is a failure on test, don't you haveto assume, therefore, that the average is about a 15-day outage?

A Yes, that is what you would have to do if the failure were discovered during a periodic test. Remember, I said earlier that most system failures do not occur because of random failures of multiple components. In the case of these ones which I quote as having persisted for a short time, they, I believe, all, and certainly most, came about because of line-up errors, tag-out errors.

Typically, an operator would remove one diesel from service for maintenance and then accidentally start working on a breaker that served the other diesel. Such things are recognized in the control room relatively quickly. Either the person who did it realizes his error or the shift -- end of shift check of system line-ups reveals the problem.

And so those kinds of errors persist typically for short time periods before they are discovered. And that is why those short time periods exist.

The other system failures which occurred were failures where one component is removed from service for maintenance and the second one fails during that time.

Q The second one what?

A Fails during the time the first is out of service for maintenance.

Q How is that discovered?

A Well, typically, what will happen is before -- let's say it is time to do a periodic preventive maintenance on diesel A. It is still operable. Before I can remove it from service to do the maintenance, the tech specs require that the other diesel, diesel B, be verified to be operable. So I know that at the time I start maintenance on diesel A, diesel B is okay.

The specs will then typically require either that diesel A be returned to service within 24 or 48 hours or will be -- or will require that diesel B be tested once every 24 hours; some such combination of requirements. So then one knows on the average those kinds of failures do not persist for 15 days but rather for a half a day or a day.

Q On diesel failures the data I have seen and the papers I have read on it would indicate a failure on demand of a diesel of once in one hundred is not unexpected. As a matter of fact, is that not the -- one of the requirements for qualification of diesels?

A There is a requirement to test diesels for starting reliability, and I cannot remember what the numerical acceptance criterion is. I thought it was somewhat lower than that, but I cannot recall.

Q All right. Now then, this .01 figure that you do quote from WASH-1400, do you believe that is the system -- that that is the WASH-1400 value for system failure rate?

A Yes. The rate of occurrence of system failures on demand, yes.

Q I guess I would like to ask you to send me the source of that, as you say it is very difficult. I believe the Lewis report, that it was inscrutable.

A Yes.

Q And it is almost inscrutable, so is that a request I can ask?

CHAIRMAN SMITH: Sure.

DR. JORDAN: All right. Mr. Blake, I would request that he does send me the source of that number on his table on page 43 for diesel failure rates.

MR. BLAKE: What I would propose to do, Dr. Jordan and Mr. Smith, is ask Mr. Koppe to derive however he can, which I hope would be self-explanatory within the document itself, and have it sent to the Board.

If the Board wants to put it in the record --

DR. JORDAN: That or the parties, I do not know.

MR. BLAKE: That is what I propose to do. I can serve it on everyone.

CHAIRMAN SMITH: Use the process which seems to be the most sensible when you figure out where the data comes from.

DR. JORDAN: Yes.

CHAIRMAN SMITH: I do not hear any objections to this from the parties present.

BY DR. JORDAN: (Resuming)

Q Well, I guess you can see that I am skeptical both of the WASH-1400 number as being too high for a system failure rate. In fact, I have seen numbers like 10 to the minus three for the system failure rates, but on the other hand that is -- that number is by no means impossible.

I could surely have overlooked it, but I am exceedingly skeptical about the figure that you have which is less than 10 to the minus 4 for system failure rates in industry. For that and for the high-pressure injection system or something like 10 to the minus 5, it just seems incredible to me.

A All I can say is these are not the results I expected.

Q I asked you if you were finding anything unexpected. These are the figures which we have for the reactor protection system and --

A I went through an interesting thought process which I might as well tell you about. I was surprised, and I said to myself, "How can I get some confidence in the reliability of these numbers?" and so I said, "One way to do it would be to ask myself how many failures would I have had to have missed to have the actual failure rate had been the WASH-1400 numbers, and how me get the results I got?

And the .01 on the diesel generators with 100 unit years of data being included implies one unit-year of diesel generator system unavailability. If I say 15 days for unavailability, I would have had to have missed 24 system failures to get -- to explain the entire discrepancy.

So that does not prove that my numbers are right or that WASH-1400 was right, but it does indicate to me that it is difficult to explain away the discrepancy on some of the other system failure rates where the WASH-1400 rates are much smaller, like the .00004 for auxiliary feedwater.

I would have only have had to miss one to explain the discrepancy, so those are not merely as -- again, the difference is not nearly as significant. It is clear that to get -- to have missed a very high auxiliary feedwater system failure rate would have required missing an awful lot of data, which I do not believe could have happened.

Q Well, if your numbers turn out to be correct rather than the WASH-1400, then I think the NRC Staff should start changing some of their numbers that they are using. In other analyses and -- well, I will give an example of the recent St. Lucie hearing in which this very question was very strongly raised, and Staff estimate in that hearing for a system failure was 10 to the minus 3, as rather an optimistic figure.

All right. I guess there is nothing that I can do, but as I say, make sure then when you write to me or to the Board that you identify the source of the numbers that you have used under WASH-1400, all of the system unavailability numbers, and verify again that indeed that your numbers -- do you believe correspond most nearly to te challenge rate, as used in WASH-1400?

All right. That is all I have.

CHAIRMAN SMITH: Mr. Blake?

MR. BLAKE: I have one question on redirect.

REDIRECT EXAMINATION RESUMED

BY MR. BLAKE:

Q Mr. Koppe, in the course of some of the questioning, there have been a number of questions from which it could be inferred indirectly or directly that there was selectivity used by you with respect to either the years which you chose to compare TMI-1's experiences with other units in the industry or with respect to the units which you chose to compare TMI-1's experience with.

With respect to any of the comparisons you used, did you select the data which you chose to compare TMI-1 with in order to make TMI-1 fare better in such a comparison?

A No, I did not. The only comparison that I had any idea how it would come out before I started was the operating reliability of TMI, and I knew that no matter how I analyzed that, TMI would be far ahead of the pack.

On all of the other analyses, I really had no idea where the answers would come out. I selected the analyses to be done based on constraints of time and the data base and trying to chose what I thought would be the most representative sample within those constraints.

I have reported all the answers that I got.

(Board conferring.)

CHAIRMAN SMITH: Is that all? Any further questions?

MR. BLAKE: No, sir. I had only the one question.

CHAIRMAN SMITH: Okay. You are excused.

MR. DORNSIFE: Sir? I would like to ask one followup on Dr. Jordan's question.

CROSS ON BOARD EXAMINATION

BY MR. DORNSIFE:

Q With regard to the WASH-1400 numbers, you started to explain, I believe, about the data base of WASH-1400 for diesel generators being single units, and maybe numbers today would be different, I believe something like that.

A Yes.

Q Would this be also applicable to the data base that was used for other systems and your opinion, if the numbers were now re-examined, the data base was re-examined using more recent data -- first of all, has that been done to your knowledge? And do you think it would reveal significantly different figures based on your work?

A [illegible]o not know if it has been done. I am not aware of any systematic attempt to do it. I think that in some areas such as diesel generators, there have been improvements in performance over what we were seeing in the early 1970's.

That would change the results. In some cases the numbers used in WASH-1400 were a judgmental attempt to allow for uncertainties. I think with some systems we are getting to the point where I would feel comfortable reducing some of those uncertainties in other systems such as steam-driven pumps.

Steam-driven pumps at TMI has been very reliable, but at many plants the steam-driven pumps have been very unreliable. We might not find any improvement at all. We might even find a disimprovement. I do not know.

Certainly in the area of diesel generators it seems that WASH-1400 was excessively conservative.

CHAIRMAN SMITH: All right. You are excused then.

(The witness was excused.)

CHAIRMAN SMITH: Anything further this evening?

MR. BLAKE: I have no more witnesses scheduled. I wonder if I might take this opportunity to request, as I said I would, to Dr. Little on her health physics questions. I can get at least halfway there on some of the questions which you asked.

I had an opportunity now to go over the transcript and talk with the health physics people, and I would like to raise with you some of the areas which you addressed earlier, Dr. Little.

If you are looking for the transcript -- if you are looking for the transcript pages, it was on the fifth of February, and they were 11862 through 11869.

DR. LITTLE: What was the first one?

MR. BLAKE: 11862 through 11869.

(Pause.)

Let me address first the two Sholley contentions which you asked us to address in the health physics area, or at least portions of the Sholley contentions as I understood your question.

First, Sholley contention four, which had as its basis -- which had as its basis for a problem with Mr. Sholley saw with offsite monitoring, onsite TLD related problems, Mr. Sholley, through the course of discovery, satisfied himself that that was not the case, and my notes indicate that he was through that contention back in the fall.

It was the subject of some discussion at a prehearing conference. The discussion appears at pages 4410 through 4411, and again 4413 through 4414. And it was also the subject of a Board memorandum and order of November 12, 1980.

The result was Mr. Sholley withdrew that contention but proposed a new one whose number was eight, and then Roman numeral I, or I in parentheses, and Roman numeral capital L in parentheses.

That contention subsequently was withdrawn, and I cannot tell you precisely the reason for it, where Mr. Sholley adopted an ANGRY contention, 2F1 and the Board question number four.

The end result of this history of Sholley contention four is apparently an adoption of the problem as he understood it after going through some discovery and being satisfied on an earlier concern that he had, the adoption of an ANGRY contention and the Board question four, which I understand from Mr. Zahler will be covered in the emergency planning testimony.

DR. LITTLE: You understand from -- I did not understand what you said. You understand from --

MR. BLAKE: I understand from Mr. Zahler it is encompassed in his emergency planning testimony. He tells me he has one large piece on emergency planning per se, and another piece on the REP program which had been provided to the Board.

What I am asking -- if you would look at that and determine whether or not that is going to be the type of information that you wanted us to address, and if so, I would not address it again in the health physics area.

The Sholley contention number five deals with Licensee's ability to monitor effluent discharge paths in compliance with one of the general design criteria. That was the subject which we intended to and thought we had covered during one of the design modification's phases in the testimony by Mr. Broughton, Mr. Dubiel and Mr. Willems in response to Sholley contention and ECNP contention one-D on instrument ranges in the plant.

The Staff also submitted testimony on that contention. Those appear and the discussion around them appear in the transcript of December 4, 1980, at pages 7506 through 7526, our testimony having been put in following 7509, and the Staff's corresponding testimony following transcript 7548, by my notes.

So as to that one, if there remains an open area, then I need more clarification, but in our view we had coped with Sholley contention five at that time.

The remaining concern which you asked us to be prepared to address in the health physics area dealt with or focused on two reports of investigations done by NRC's I&E, the first NUREG 0600, the first large report coming out of the accident; the second, a health physics TAB report, which we referred to last fall.

Our panel, which we proposed to put on in the health physics areas, is indeed familiar, and it is the same individuals who have been working to straighten out the weaknesses and respond to the very non-compliances which have been identified by the NRC people.

We could put it in a direct fashion by providing for you or for the record our written responses to NRC. That is an approach. I suggest though that maybe a more meaningful approach would be that our testimony describe the nature of the health physics program and the types of changes and improvements that have been made in it.

Then on the panel I provide to you individuals who you could explore in any of the specific areas that you wanted to go into, rather than us getting all the various non-compliances.

If I have misunderstood, then I --

DR. LITTLE: I think one of the things is we want an opportunity to see here the people at Three Mile Island, Unit 1, who are directly responsible for radiological safety implementation.

MR. BLAKE: Let me tell you who it is I plan to put on the panel: Mr. Heward, who will be the Vice President in charge of the radiological controls and environmental monitoring division.; Mr. Potts, who at TMI-1 is in charge of radiological controls and reports to Mr. Heward; Mr. Dubiel, whom the Board has seen before who was directly involved at the time and immediately following the accident, and now is in charge of the radiological controls engineering section.

It is those individuals that we had anticipated, and I expect as well to have Mr. Miles available on the day when those fellows testified.

DR. LITTLE: Who?

MR. BLAKE: Murray Miles, who you heard from today, who has also been involved in the radiological controls program. So these fellows have been the ones directly involved in the improvements in the program, and I think would be able to respond to your questions.

I am suggesting, though, that in our direct and their prepared written testimony we give the type of approach that we have on all the others, describing the radiological controls program in place, and why we feel confident in it, but have the fellows equipped to answer and respond to whatever specific questions you have on each of the areas.

DR. LITTLE: I thought I remembered another name, too, for someone who is actually in charge of the radiological hygiene implementation. Maybe I am mistaken.

I will have to look back and see.

MR. BLAKE: If you could look back, and if there is another name -- one does not come to my mind. Mr. Potts is currently in charge there, and Mr. Dubiel in the engineering area and previously ever since the accident. He has been involved in the rad control program there.

I do not know who the other gentleman or lady might have been.

(Board conferring.)

DR. LITTLE: Let me take a quick look at the transcript and see if I can find the conversation I remember on that.

MR. BLAKE: I do not need it today. I am working with these fellows on their testimony, but I did want to at least come back and clarify with you.

CHAIRMAN SMITH: If that is all the business we have, we can adjourn. If you find it, we can just provide it to him. So let's adjourn.

MR. BLAKE: I do want the record to understand where we are going in the future. Tomorrow is Mr. Dieckamp, and next week I anticipate TMI-A-5's case, our portion of the case, and I am going to suggest to the Board, although I have not been able to confirm this, you will recall that Mr. Hepel was a name of an individual who the Board had randomly selected on the overtime question.

Now, I never talked with Mr. Hepel, but we are attempting to locate him, and I thought that maybe that would be the first order of business, and I will undertake to-- I am assuming Ms. Bradford is going to be here tomorrow morning -- notify her.

So I thought I would go with Mr. Hepel and the Board can ask whatever questions they want of him.

CHAIRMAN SMITH: If I recall, Mr. Hepel was located and refused to come.

MR. BLAKE: I do not think that was Mr. Hepel. There were three fellows that we randomly selected, three names. One of them we got on back in October. That was McCurdie.

The other two, one of them was still an employee of the company. That was Hepel, and I am told as of today he is still an employee, and we will be able to provide him.

The third name I cannot give you now without going back to the transcript again, but TMI-A was trying to locate him. He was apparently no longer an employee and somewhere in the environs here.

I don't know any more about that one.

CHAIRMAN SMITH: All right. This was -- the Board acted in furtherance of TMI-A's position. I think perhaps we should have Ms. Bradford's view as to what extent she wishes to pursue that.

MR. BLAKE: Okay.

CHAIRMAN SMITH: The Board did not do it as a matter of its own interest.

MR. BLAKE: Okay. And I will try to take it up tomorrow morning with her, even before we go on the hearing record.

CHAIRMAN SMITH: Yes.

MR. BLAKE: I am a little reluctant to telephone her. She goes to sleep at this time of day. I will try tomorrow morning. I am assuming she is going to be here for Mr. Dieckamp.

CHAIRMAN SMITH: Yes, she will be here.

MR. BLAKE: Then I would anticipate going through the larger piece of testimony on TMI-A-5, and Mr.

Manganero's smaller piece on the smaller piece, the mainenance and construction division, and finally the Board's question on the sample year 1978.

DR. JORDAN: What?

MR. BLAKE: Sample year 1978. That is what I would anticipate.

CHAIRMAN SMITH: We may have a very short week next week.

MR. BLAKE: I am in the least position to judge how long the questioning will take.

DR. LITTLE: When you look at the transcripts, you will find on page 11863, it refers to a NUREG 0580. I have taken that to be NUREG 0680 and Appendix B.

(Pause.)

CHAIRMAN SMITH: Anything further?

MR. BLAKE: No, sir.

CHAIRMAN SMITH: We will adjourn until 8:30 tomorrow.

(Whereupon, at 4:22 o'clock p.m., February 19, 1981, the hearing was adjourned until 8:30 a.m., the following day.)

NUCLEAR REGULATORY COMMISSION

This is to certify that the attached proceedings before the

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in the matter of: METROPOLITAN EDISON COMPANY (TMI UNIT 1)

Date of Proceeding: February 19, 1981

Docket Number: 50-289 (Restart)

Place of Proceeding: Harrisbrug, Pa.

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

David S. Parker

Official Reporter (Typed)

[signature]

Official Reporter (Signature)