50-320

Met-Ed / GPU

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Writer's Direct Dial Number

September 30, 1980

Norman C. Moseley, Director
Division of Reactor Operations Inspections
Office of Inspection and Enforcement
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Moseley:

During my interview by NRC on September 5, 1980, I referred (tr. 41) to an investigation which had been initiated by GPU in 1979 regarding the state of knowledge of various portions of our organization in the days immediately after the accident. Enclosed is a draft of a report on that investigation, pursuant to your request (tr. 43).

The enclosed draft report, dated May 3, 1979, was never reviewed and finalized, although in its draft form it has previously been supplied in connection with other investigations to the President's Commission on August 24, 1979, the NRC Special Inquiry Group on September 5, 1979, and the Hart Committee on October 18, 1979.

Sincerely,

Robert C. Arnold

Robert C. Arnold

RCA/csk
Enclosure
cc: Ernest L. Blake, Jr., Esq.

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Task 13
Draft

TAR TMI-115

DEVELOPMENT OF UNDERSTANDING

1) Introduction

The object of this task is to re-create, as best as possible, the chronology and an on-going status understanding of the TMI-2 accident as it developed.

It is obvious from the sequence of events and the response actions taken by the operators that perception and understanding of the transient were changing, especially in the early hours.

Levels of complication in assessing this developing understanding are introduced by the various communication interfaces which were established about the data source. These interfaces provided data (as well as on-going assessment) to an increasingly growing number of people who inturn contributed to what may be regarded as a common understanding of the accident.

As time wore on the number of communication interfaces grew geometrically and became so intertwined as to give rise to an apparent common pool of understanding. Consequently the task of unraveling the growth of understanding becomes increasingly more difficult as more communication interfaces were established (later in time following the accident).

Necessarily then, the subject assessment must be attacked starting with the TMI-2 operator's understanding and procede through that of the site management, Met-Ed management, GPU management, the GPU response team, and the industry advisory group. Further the peripherical

branches of B&W and NRC understanding could also be examined. Figure 1 attempts to illustrate the challenge and the scope of the above.

Interface 1

An analysis of the perception ofsignificant problems and growth of knowledge during the event can be divided into three areas: A) Efforts to maintain control of the plant during the first four hours, B) Assessment of the radiation emergency, and C) Perception of the non-condensable gas bubble in the reactor vessel.

A. Efforts to Maintain Control of the Plant

During the First Four Hours of the Event, the main concern of the operators was to bring the primary and secondary systems to a stable condition. Several key factors should be discussed to focus on the basis for operator actions. Details used to formulate each of these key factors were derived from interviews with the shift supervisor, shift foreman and two control room operators.

1. Pressurizer Level Indication - From very early into the transient, operations personnel were very concerned with pressurizer level indication.

Within five seconds after the reactor trip the operator had started a second make-up pump in anticipation of the expected rapid decrease in level never occurred, and within six minutes the pressurizer level was off scale high. The operators felt they had caught the expected level decrease with increased high pressure injection. The major concern of the operators at this point was to not take the R.C. system solid. Based on high level indication and concern of taking the system solid, the operator bypassed Safety Injection, stopped MUPIC, and throttled

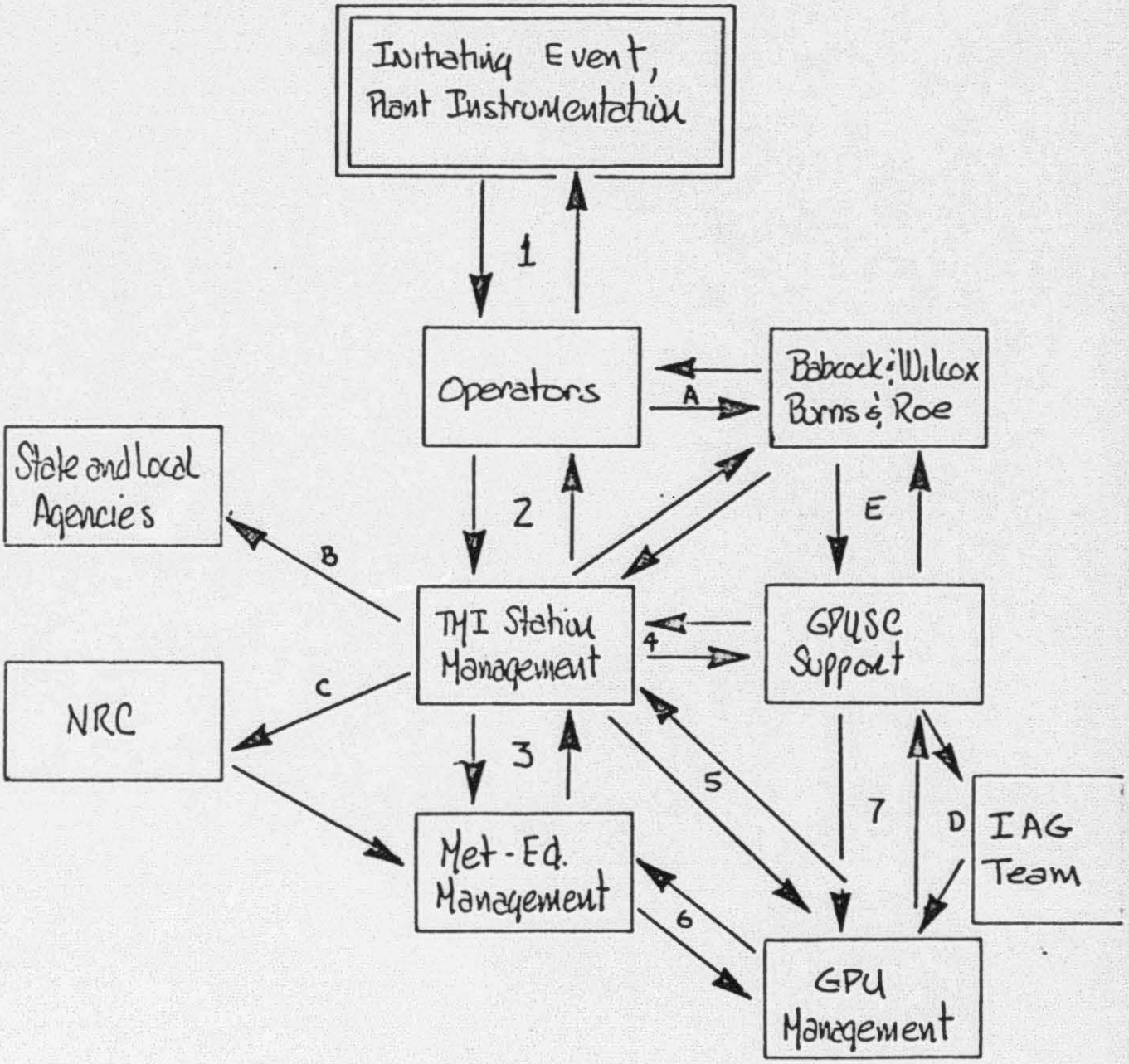

Figure 1. Communication Interfaces which enabled the Development of Understanding

the MU-V16's. At this point RC pressure was still decreasing, and judgments were made primarily on pressurizer level based on either past experience during feedwater transients or reactor trips, training, or procedural guidance.

2. Failure of the Pressurizer Electromatic Relief Valve to Close - During the initial reactor coolant system pressure increase due to the turbine trip, the electromatic relief valve on the pressurizer opened, as designed, at 2255 psi. After the reactor trip, the valve failed to close as pressure decreased through 2205 psi, although the operator did verify that the valve indication did not signal an open valve. This valve remained open for the first two hours and twenty-two minutes of the event. Thus, the control room operators had failed to recognize a constant loss of coolant through the open relief valve for that period. On at least three different occasions, the operators checked the computer output for the thermocouple bands on the relief valve discharge piping to determine whether the valve had properly seated as indicated; however, the computer data was misinterpreted and the block valve was not shut for two hours and twenty-two minutes. Readings from the thermocouple were in the range of 230°-280°. The operator judged these valves to be quite low compared to pressurizer temperature (approximately 600°) and therefore concluded that the electromatic must be closed. The operator did not realize that the temperature indication was from a thermocouple strapped to the outside of the discharge pipe and based on heat losses, readings in the range of 250° were an indication of an open relief valve.

During the time that this valve was open, many other indications of a loss of coolant accident were present in the Control Room, such as rapidly falling RC pressure, rapidly increasing RC drain tank pressure and temperature, increasing RB sump level while both sump pumps running, increasing RB temperature and pressure. Although these indications of a LOCA existed, the operators did not associate them with the stuck open relief valve. The operators continued to focus on the initiating event (loss of feedwater) and attempted to deal with the consequences of that event on the condensate system and the turbine heat sink.

3. Reactor Coolant Pump Operation - At one hour and thirteen minutes into the event, two Reactor Coolant pumps were tripped due to observed "flow fluctuations" and allowable NPSH requirements of operating four RCP's. Approximately thirty minutes later the remaining two Reactor Coolant pumps were tripped based on similar concerns. Approximately two minutes after the Reactor Coolant pumps were tripped, the operator began to raise steam generator level from thirty percent on the start-up range to fifty percent on the operating range to further induce natural circulation. Within the next thirty minutes RC hot leg temperatures were increasing to off scale (greater than 520°). It was realized that natural circulation was not occurring probably due to a steam bubble formation in the A loop (the B loop was isolated). Attempts were made to again start a RC pump to force circulation through the core; however, attempts were aborted due to pump motor low running current. (The 2B RC pump was run for a period of about 19 minutes some 75 minutes after the last pump was tripped.). The 1A Reactor Coolant pump was started

approximately fourteen hours after all pumps had been stopped.

It appears that the actions of securing the Reactor Coolant pumps were taken based on minimizing equipment damage (i.e. to prevent pump cavitation and protection of pump seals) and not based on an understanding of what was occurring in the primary system.

B. Assessment of the Radiation Emergency - The growth of knowledge in this area developed rapidly approximately two hours and forty-five minutes into the event, as the first radiation monitoring alarms were received throughout the plant. This knowledge was accumulated quickly, and used effectively to determine action levels according to the radiation emergency plan. Although the extent of fuel failure was not realized this early in the event, the perception of the significance of the radiation monitoring system readings was accurate.

C. Perception of the Non-Condensable Gas Bubble in the Reactor Vessel - Early in the evening of March 29th, a group of engineers met to discuss present plant status. Two of these engineers reported to the control room to back up the operating staff. By approximately 2100, it was apparent to this group that a non condensable bubble existed in the reactor coolant system. Prior to 2300, a formula was derived to calculate the size of the gas space in the system. Gas bubble volumes were routinely calculated throughout the 30th of March and calculated volumes began to decrease late in the evening of the 30th. Based on analysis of the 3/28 reactor building pressure spike and containment air sample analysis which began at approximately 0400 on 3/31, it was determined that the gas bubble in the reactor coolant

system was primarily hydrogen. Volume of the gas space decreased steadily through April 2. This was confirmed as the increase in hydrogen concentration of containment atmosphere leveled off as the bubble in the reactor coolant system diffused.

Interface 3

The first management communications concerning the TMI-2 accident were drafted in a telephone conversation between Mr. Herbein and Mr. Fabian approximately 7:15 a.m. Wednesday, March 28. At this time, they mutually drafted a statement for response to press inquires that related that the TMI-2 reactor was shutdown due to a malfunction in a feedwater system. The entire unit systematically shutdown and was expected to be out of service for about a week while equipment is checked and repairs were made.

At approximately 9:30 Wednesday morning, Gary Miller called Mr. Troffer to relate his conversations with Lt. Governor Scranton concerning the unit status. During these conversations, Gary indicated that there was some fuel pin leakage, however, he noted that he didn't have any indication of fuel melt. The prepared statement to the press was updated by noon, March 28. This statement revealed radiation levels were being monitored in and around the plant and that there had been no recordings of any significant levels of radiation and none were expected outside the plant. No evacuation of the local population was indicated at that time and that the reactor was being cooled according to design by the reactor coolant system and should be cooled down by the end of the day, March 28. It added there was no danger of a melt down.

During the Met-Ed press conference in Hershey, on March 29, Mr. Herbein said it was too early to tell the extent of the fuel damage at TMI-2. However, he noted that fuel failure had been experienced during the accident. He related this fuel failure to the point of turning off the reactor coolant pumps during the transient. He updated the plant

status to say that a reactor coolant pump was running and cooldown was proceeding and that he expected to be on the decay heat system in approximately 72 hours. In response to questions from the press, Mr. Herbein related perhaps one half to one percent of the rods may have experienced some melting and that the fuel had primarily failed due to the reactor coolant system depressurization and the need to shutdown the reactor coolant pumps. He noted that it was possible for some steaming in the upper core region at that time that lead to the fuel failure.

Early in the evening of Thursday, March 29, Mr. William Lowe, Mr. J. P. Moore had gone to the Unit 2 Control Room to assist the operating staff. Based on observed indications this group assessed that there was a non-condensable gas bubble above the core. Later that evening, calculations began to determine the volume of the gas bubble.

During the press conference given on March 30, Mr. Herbein revealed the evidence of the gas bubble above the core. However, he noted that it appeared that the fuel assemblies were covered at that time and that decay heat removal was progressing. He suggested at this time that the fuel failure was caused by a momentary uncovering of the fuel during the transient.

During the press conference on March 31, Mr. Herbein revealed that efforts were underway to reduce the size of the bubble over the top of the fuel. Initial indications indicated that the venting process was successful and that the bubble had reduced in size. He did mention at this time, however, a concern that the venting process has lead to a build up of hydrogen in the reactor building. During the evening a

sample of the reactor building atmosphere has been taken and that at this time there was no danger of an explosive mixture in the reactor building.

The first results of the reactor coolant analysis were received on March 30th. Based on these results, Mr. Herbein noted in the March 31 press conference that the core was indeed severely damaged and that there was a possibility that a very large percentage of fuel assemblies were in the damaged condition. This March 31 press conference was the last held by Met-Ed. After that time, communications concerning the plant status were handled by the NRC.

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April 15, 1979

50-320

Mr. G. P. Miller
Station Superintendent
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Subject: Review of Unit II's March 28, 1979 Transient

Dear Gary:

As agreed in the Saturday, April 14, 1979, get-together in the Superintendents Conference Room, I submit a few of the thoughts that have passed through my mind during and since those review discussions.

I believe we all got a lot of memory recall benefit out of that session, plus a feeling of being together on so many other thoughts. Personally, I believe that we all really have to pull together more than we ever may have before in order to accomplish an enlightenment of Investigative Groups and the Public in general. Met-Ed and TMI, including in no small bit B&W, have really taken severe shots by the media and the NRC in the public forum. We must also exercise our rights in the same public forum to correct and educate the rest of the world. I know what we did, and I also know that our collective actions and Met-Ed's real (not imagined) image is of a very high technical and moral standard. Our biggest task, as I see it, is to bring out the facts without confusion and embellishment in such a manner (not very technical) that most people will understand what we are saying and thereby change all of the negative impressions. Naturally, the anti-nukes won't listen because their minds are not allowed to be open but there is a very large segment of the general public that will listen because they really do want to know the truth. Any one of us involved must keep it in our minds that the real end of the tunnel is to have both Unit I and II back on the line, a little safer and we operations people a lot smarter because of March 28, 1979; but really in that mode of operation with a lot of the general public really backing us up.

POOR ORIGINAL

If you have any further questions, please do not hesitate to contact me.

Very truly yours,

L C Rogers

L. C. Rogers
Site Operations Manager

POOR ORIGINAL

OTHER REFLECTIONS AND RECOMMENDATIONS

1. (a) During significant occurrences as Station Emergency and General Emergency at the TMI Station, Met-Ed should have a designated individual on the Emergency Bill, that is "qualified" and "recognized" by management, to perform the communication linkup with Met-Ed, GPU, B&W, PA State, NRC, EPA, off-site officials, etc., throughout the emergency time. He should provide status, data, and expected evolutions to all of these outside parties until such time as they are able to provide their own on-site linkups.

   (b) As I observed events in the communications system during the long day and several days subsequently, it was apparent that several of the outside parties were given necessary information but apparently in different sections of their organizations; and they were not talking to each other, thereby, creating additional questions coming from several sources within the same organizations. EXAMPLE: The NRC people on site were on an open telephone line to a "situation room," I believe at the Region #1 office (not sure), and information was flowing in a generous fashion. Yet the NRC headquarters was in turn generating questions to the site independent of their own on-site inspectors. In fact, they were not even talking to them (the NRC people) but in turn asking for plant personnel to provide the answers and also directing questions and demands to B&W Lynchburg. (The Lynchburg source for any answers during any developing crisis is not an acceptable flow path for outside organizations since B&W is by nature and geography not able to be on top of rapidly changing conditions.) Another example was that the commissioner of the NRC, as quoted in the media, was in the dark and thoroughly confused. I submit that he and his deputies have <u>technical advisors</u> closely at hand during significant events to interpret the information already in the NRC at other areas which need a central tie-in mechanism to allow the top decision makers the chance to make good ultimate proclamations.

2. In other taped interviews, the Shift Supervisor identified two B&W people, that were assisting Unit I in their startup program, as arriving in the Unit II Control Room. Subsequent questioning shows that these people were not B&W people. In fact were Scott Wilkerson (Met-Ed Nuclear Engineer) and another Met-Ed employee. There were no B&W personnel on site until I arrived approximately 0710 hours on 28 March 1979 (point of clarification).

3. Respecting the normal human concern and also training towards that concern to not aggravate plant operating conditions or cause damage to plant equipment, any action similar to securing "all" reactor coolant flow during transients must be drilled into the operators and supervisors as an action that should not be automatic but tailored as a case basis. This type of suggestion is going to be difficult to implement since in one transient as example, securing pumps would be absolutely correct and in another it would be an action that would tend to aggravate the problems.

REFLECTIONS & RECOMMENDATIONS

4. A need is identified now to evaluate all possible system communication connections between the reactor building and the outside environment, such as the auxiliary building, fuel building, direct outside, etc. These evaluations need to look at normal pumping systems, D/P driven systems (press in reactor building and not other places), D/P following pumping actions and merely stopping of the pumping (siphoning actions) air-borne paths, and all of this could be a major undertaking. Needs high management type emphasis because of the auxiliary building contamination problem on this transient, although the installed normal systems were not supposedly linedup to allow such flow between buildings. This needs attention and corrective action follow-up.

5. The Site Emergency Plan/General Plan needs review. My personal experience was that when I arrived at the North Bridge Gate, your plan was in effect - entry was being denied to traffic. I was recognized by your guards as being needed for the problems. They gave me my 002 "red" badge and opened the gate allowing me entry. I arrived at the area of the Unit II turbine building access. Steve Drabick was on duty. I went into the Catalytic Building and left my briefcase, picked up my hard hat and walked across the street. Steve Drabick said, "Lee, you cannot go in." I asked him to call the Unit II Control Room on his radio. He did and gave me my "green 025 security entry badge." I went in. However, Steve Drabick was very busy at that time turning back all of the normal day shift craft workers that had entered through the South Bridge entry. In fact, I think I remember a bus being there. I talked to Jim Blanton (Catalytic supervisor) and told him that the plant had tripped and had experienced "complications." The point is that a lot of personnel were coming onto the site from the South Bridge and the "Brass Gate Entry" at a time when the North Bridge was tight and controlled. Needs a serious look at effective closing both bridges and the brass gate with the emergency condition announcement and follow up accountability at some emergency designated area.

6. Need to provide continuous recordable (retrievalbe) instrumentation of the vital nature; incore T/C's is an example of very valuable data not retrievable now and would have solved many of the advertised concerns. A survey of vital, needed instruments is certainly in order. These do not necessarily need to be displayed in an area of the CRO but should be able to be recovered post transient.

7. A thought about corrective maintenance needs on the CRO available instrumentation. Met-Ed needs to establish a procedure for identifying priority of corrective maintenance on critical instrumentation, i.e., pressurizer level instrument, one channel was unreliable due to known panel switch problems. This problem and others like it should have a required repair date and mechanism for repair if plant operations are to continue.

8. I have been informed that B&W Lynchburg has incorporated the TMI-2 transient into the Simulator Programs. Other Utilities are cycling their operators through the simulation on a crash basis during the night shifts. I submit that Met-Ed seriously consider a similar program for their licensed operators acquainting everyone with the indications and actions that can be taken to lessen a reoccurrence. This is in preparation for the Unit I return to operations that we all are looking forward to [illegible] frame.