NUCLEAR REGULATORY COMMISSION

COMMISSION MEETING

In the Matter of: PUBLIC MEETING

MCGUIRE APPLICATION FOR AN OPERATING LICENSE

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

McGUIRE

PUBLIC MEETING

Nuclear Regulatory Commission
Room 1130
1717 H Street, N.W.
Washington, D.C.

Wednesday, June 24, 1981

The Commission met, pursuant to notice, at 2:10 p.m.

BEFORE:

JOSEPH M. HENDRIE, Chairman of the Commission
VICTOR GILINSKY, Commissioner
PETER A. BRADFORD, Commissioner

ALSO PRESENT:

S. CHILK
L. BICKWIT
J. SCINTO
R. MATTSON
D. RATHBUN
J. ~~MILHOORI~~ MILHOAN
M. MALSCH
E. KETCHEN
C. TINKLER
J. RILEY, Carolina Environmental Study Group
M. McGARRY, Duke Power Company
W. RASIN, Duke Power Company
W. PORTER, Duke Power Company

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P R O C E E D I N G S

CHAIRMAN HENDRIE: The meeting will come to order.

The first item of business this afternoon is that I will ask my colleagues to join me in voting to hold this meeting on the McGuire application for an operating license on less than one week's notice. This is a vote which is required by the Sunshine Act and the Commission's regulations on the Act.

Those in favor say aye?

COMMISSIONER GILINSKY: Aye.

COMMISSIONER BRADFORD: Aye.

CHAIRMAN HENDRIE: Aye.

We are then legally in session.

This meeting has been called at Commissioner Gilinsky's request as part of the Commission's consideration as to whether the licensing board's initial decision authorizing full power, full term licenses for McGuire Units 1 and 2 should become effective. The focus of the meeting will be on specific questions which along with notice of today's meeting were yesterday forwarded to the parties by the General Counsel.

I am also advised that Staff and Intervenor, the Carolina Environmental Study Group, were advised of the meeting and questions by telephone Monday evening and the Applicant was so advised by telephone Tuesday morning. I nevertheless give to the assorted parties our apologies for the rather short notice.

The proceeding will be as informal as possible. We plan to ask the Applicant, the Duke Power Company, to first respond to the questions, then the NRC staff and then the intervening party. All will be subject to questioning by the Commissioners. There will be an opportunity for brief rebuttals by each party and again, the Commissioners may wish to ask questions.

I should note that since the parties have been asked to respond to two definite questions, I will ask my colleagues of the parties to stick to the subjects in hand.

The Commission plans to consider the information presented today together with the written comments that have been filed by Applicant and Intervenor in its effectiveness determination under Section 2.764 of the Rules of Practice. That is the Appendix B to Part 2 of the Procedures.

The information will not be considered for any other purpose. In particular, it will not be considered as part of the evidentiary record supporting a decision on the merits of contested issues. Also the Commission is aware that the Carolina Environmental Study Group has moved the Appeal Board for a stay. Any Commission decision on effectiveness will be entirely without prejudice to that motion.

Now let me ask the parties, starting with Duke Power, then the staff and then the Carolina Environmental Study Group, who they intend to have as speakers today. [illegible] in move forward.

Duke?

MR. McGARRY: I am Michael McGarry representing Duke Power Company. I am an attorney. Also representing Duke Power Company is Mr. William Porter who is seated at my right. On behalf of Duke Power Company Mr. William Rasin who testified in the proceedings will present Duke's response to the specific two questions asked by the Commission.

CHAIRMAN HENDRIE: Who will speak for the staff?

MR. SCINTO: Mr. Chairman, I am Joe Scinto with the Office of Executive Legal Director and have participated in this case as counsel for the staff. In response to the two technical questions posed by the Commission to the staff, speaking for the staff will be Dr. Roger Mattson, the director of the division of systems integration.

CHAIRMAN HENDRIE: And for Carolina Environmental Study Group?

MR. RILEY: My name is Jesse Riley. I will be speaking for it.

CHAIRMAN HENDRIE: Before we get started, just let me note for the benefit of all parties that we have scheduled this meeting for an hour and a half. It seems to me ample for the purpose. I will ask the parties to be brief and to the point in their comments so that we can get through this afternoon. I may remind anyone who in my view tends to run on too long and gets off the point.

Now the questions in hand are as follow. The first question is: In view of the fact that substantial quantities of hydrogen were evolved during the TMI accident before containment pressure significantly exceeded 3 pounds per square inch gauge, what is the basis for selecting the 3 pounds per square inch gauge containment pressure signal as the appropriate trigger for energizing the igniter system? Should the trigger instead be safety injection?

The second question is as follows: In view of the fact that the effectiveness of the hydrogen control system depends in part on operation of air return fans and the hydrogen skimmer fans in conjunction with the igniters, is it reasonable to switch on the igniters at a lower pressure than the trigger set point for the air return fans and the hydrogen skimmer fans? Is it feasible to switch on the air return fans and hydrogen skimmer fans at containment pressures less than 3 pounds per square inch gauge without the possibility of negative containment pressure or other adverse factors?

So Mr. Rasin, please go ahead.

MR. RASIN: You have posed these two questions premised on the fact that substantial quantities of hydrogen were evolved during the TMI accident before containment pressure significantly exceeded 3 psig. The following responses to these questions are based upon the record in the reopened proceeding.

At the outset it should be noted that any comparison between the hydrogen generation event which occurred at TMI and a similar event postulated to occur at McGuire must consider the differences between the two plants.

The McGuire containment is an integrated system which includes separate compartments, the ice condenser, the air return fans, the containment sprays and other equipment. The operation of this integrated system must be considered when analyzing a postulated hydrogen generated event at McGuire. The operation of this integrated system was considered in our analysis of a TMI-type event occurring at McGuire.

In the first question you asked, what is the basis for selecting the 3 psig containment pressure as the appropriate trigger for energizing the igniter system, the basis for the 3 psig containment pressure signal as an appropriate trigger for energizing the igniter system is the analysis that has been conducted regarding the occurrence of a TMI-type event at McGuire. This analysis shows that a containment pressure of 3 psig is reached at approximately 90 seconds from accident initiation. This analysis also shows that hydrogen production from a zirconium water reaction does not begin until about 60 minutes into the accident sequence.

In Question 1 you also asked: should the trigger instead be safety injection. We considered the safety injection signal as the initiator for energizing the igniters but rejected this initiator as being unnecessarily stringent and more likely to require unwarranted igniter operation. We do not consider a safety injection signal alone to indicate a transient with potential hydrogen production.

Many system transients may lead to a safety injection signal even though reactor coolant system integrity is maintained. An overcooling transient is one example of a situation where a safety injection signal is received without the loss of coolant inventory which could lead to hydrogen generation.

The 3 psig containment pressure signal indicates a transient involving loss of mass and energy from the reactor coolant system. This situation is therefore indicative of a transient with the potential, however small, for hydrogen production.

In Question 2 you asked: is it reasonable to switch on the igniter at a lower pressure than the trigger set point for the air return fans and the hydrogen skimmer fans. As shown in the answer to the previous question, a containment pressure of 3 psig is reached well before the onset of hydrogen generation. Upon receipt of a containment pressure of 3 psig, a sequence is started that energizes the containment sprays, the air return fans and the hydrogen skimmer fans. This equipment will therefore be in operation well prior to hydrogen generation whether the igniters are energized before or after reaching the 3 psig containment pressure.

In Question 2 you also ask: is it feasible to switch on the air return fans and the hydrogen skimmer fans at containment pressure less than 3 psig without the possibility of negative containment pressure or other adverse factors. It is undesirable to energize the air return fans and skimmer fans at a containment pressure less than 3 psig for the following reasons.

No. 1, this would result in a reduction of the actuation set points and would require a major reanalysis of the design basis accidents for the McGuire plant. The engineered safeguards features of the containment are designed to mitigate the effects of a loss of coolant accident, among others.

The set points and timing sequences of equipment operation are significant factors in the design basis accident analysis. These design basis analyses have been performed in accordance with Commission regulations and are contained in the McGuire FSAR. They have been reviewed by the NRC, and previous licensing actions have been based in part on the results of these analyses.

No. 2, reduction of the actuation set points could give rise to an unnecessary loss of ice. Unnecessary operation of the air return fans results in forced air flow through the ice condenser and a melting of the ice. Ice inventory would be reduced which could decrease safety margins if a subsequent blowdown from the reactor coolant system does occur. If reactor coolant system integrity is maintained, replacing the lost ice would have significant impact on returning the plant to operation.

No. 3, reduction in the actuation set points could give rise to a reduction in ECCS water inventory and to substantial unnecessary cleanup activities. The early operation of the containment spray system would be undesirable. Energizing the sprays without significant blowdown from the reactor coolant system would serve no purpose and would reduce the water inventory in the refueling water storage tank. This inventory reduction would require earlier switchover of ECCS on the recirculation mode if subsequent blowdown were to occur.

If reactor coolant system integrity is maintained, the containment and equipment would have needlessly been subjected to slightly radioactive chemical sprays. The plant recovery would be significantly delayed while the containment was being cleaned and decontaminated.

I would also note that it would be unreasonable to require reduction in the actuation set points because it would not improve the effectiveness of the mitigation system. As previously discussed, the loss of mass and energy from the reactor coolant system will result in a 3 psig containment pressure before hydrogen production begins.

Containment pressures less than 3 psig do not necessarily indicate that a LOCA has occurred. On the other hand energizing the air return fans with no mass and energy loss from the reactor coolant system will result in cooling the containment atmosphere and reducing containment pressure. When containment pressure is reduced to .25 psig, the air return fans, hydrogen skimmer fans and containment sprays are automatically tripped off.

These systems would then have to be manually restarted when containment pressure again exceeded .25 psig or would automatically start when containment pressure reached 3 psig. To assure continued operations of these systems at lower set points, the .25 psig trip would have to be removed. If this trip point were removed, the potential for the creation of a vacuum inside containment is significantly increased.

I hope that is responsive to the questions that you posed to us. I would be happy to discuss my response in more detail.

COMMISSIONER GILINSKY: Can I say a word here?

Let me say something about what lies in my mind behind Question 1. It is true, as you say, TMI is a different reactor. It is larger and McGuire would likely reach higher pressures more quickly. At the same time McGuire has ice chests which would tend to condense steam. It seems to me it is difficult to see your way through all accident sequences.

So if one were to switch on the igniters at an earlier point, for example safety injection, I would think you would capture or protect against the larger class of possibilities at what would seem to me negligible cost. I would be interestd to know how often you would expect safety injection to come on during the operation of the reactor, because you have said if you did it at that point you might needlessly turn on the igniters or too frequently turn on the igniters.

At any rate, that is what lies behind my interest in Question 1. I wonder what your view is about the question of in effect protecting against a larger class of possibilities at what seems to me to be negligible cost.

MR. RASIN: I would agree with you that the significance we attached to this particular trigger for turning on the igniters is to minimize the number of times the systems energized or the challenges to the system. We think that in general it is good engineering practice not to use the system until you need it.

In terms of protecting it against a broader range of accidents, to get into a hydrogen production mode you have got to lose a lot of mass and energy from the primary system. That energy goes into the containment. If one were to look at events which took longer to reach the 3 psig signal, you would find that it also took much longer to go from that point to the point where you had uncovered the core and were in a hydrogen production mode.

So the length of time between when you energize the igniters and when you actually had hydrogen coming out I think would be increased.

COMMISSIONER GILINSKY: How confident can you be that in fact you will reach the 3 psi level before generating hydrogen? At TMI the pressure reached 4 pounds I think somewhere along the way before it ultimately burned the hydrogen. But it seems to me it depends on details of the accident that might easily have been lower than that.

MR. RASIN: If you look at what happened, for one thing at TMI as soon as the operators noticed the increase in containment temperatures, they energized their containment cooling systems and shifted the containment cooling fans to fast speed. Those actions are somewhat akin to our ice condenser air return fan operation. So they in fact actuated their systems prior to their set points. And their set points are much higher because of the larger containment and the larger design pressure.

Our containment system reaches 3 psig much more rapidly. In fact if you look at the pressure that was attained during the early stages of TMI, it is in the range of 2 to 2.5 pounds very early on. That would, if one considered the entire containment volume at McGuire, be at least double that amount in McGuire for the same amount of blowdown from the system just because of the ratio of the volumes.

COMMISSIONER GILINSKY: I understand that. But I would think it would be difficult to calculate with a lot of certainty the interaction of the steam with the ice and so on down to 1 psi plus or minus 1 psig. It just seems to me prudence suggests to take the earlier signal as triggering the igniter system.

I wonder on that point whether you could pursue the question of just what is the disadvantage in doing that other than the general principle of not exercising protective system needlessly. How often would you expect safety injection to come on in the normal course of events?

MR. RASIN: I can't really comment to you in terms of number of expected transients. I guess I would just refer in general to the incidents and transients that occur at other reactors.

COMMISSIONER GILINSKY: How frequently would you say they occur per reactor?

MR. RASIN: I would say over the country per reactor it may be at least half a dozen transients per year through the country that I see with initiation of ECCS for one reason or another.

COMMISSIONER GILINSKY: I would think the number would be larger than that, about or the order of once per year per reactor or less than that at any rate. It does not seem to me that that would be very dangerous to turn on igniters.

MR. RASIN: No, sir. I do not mean to imply at all that it is dangerous. I say our only reason is what we feel is good engineering judgment in not using the system until it is required. With this type of equipment, if I were to expect to have an effect on the equipment I would expect to have it when I energize the equipment, much like a light bulb. It burns out when you turn it on, not when it is sitting there burning. It is on that basis solely.

COMMISSIONER GILINSKY: I guess what I find unconvincing is that there are not events which should be protected against or sequences which are not captured in the procedures that you have recommended. It seems to me that at negligible cost one could achieve greater assurance that in fact those are protected against. I find it hard to see the objection to doing that.

MR. BASIN: I would not have an objection to doing that.

COMMISSIONER GILINSKY: I mean if there is a good objection, I would like to know it. I would not like to force things in a direction that does not make any sense. That is what I am trying to get at.

MR. BASIN: The objection that we have right now, and it is not really an objection. We are just stating to you our basis for choosing this set point. As I said, we considered safety injection, considered Phase B isolation. We considered them from the standpoint of operation of a system to be equivalent, no difference from the standpoint of the way the system would work, because we still feel we will have the igniters. We will have the sprays. We will have the air return fans, the hydrogen skimmer fans all in operation before we get hydrogen.

CHAIRMAN HENDRIE: Peter, do you have anything?

COMMISSIONER BRADFORD: No, sir.

CHAIRMAN HENDRIE: Roger?

MR. MATTSON: I hae a prepared response to each of the questions. But before I get into the formality of reading it I would like to make two general observations from the tone of the questions and the ay I think we are headed.

First of all I would like to point out there may be a slight mistake in your understanding concerning the 3 psi at TMI 2. It is our understanding based on the reading of probably the best analysis of the accident that has been done, that by NSAC, that the containment started at minus 2 psi. That is something that is not allowed for McGuire or the ice condenser plants that was allowed for TMI 2. That means that the differential pressure at TMI 2 had reached 4.8 psi at a half hour into the accident, well before large amounts of hydrogen were generated.

Now you have said, and you are correct, that it is very difficult to make a direct comparison between the 3 psi or the 4.8 psi or any psi at TMI 2 and the corresponding number in an ice condenser plant. The sizes are different. The effect of the ice in suppressing, the pressure of ice has to be accounted for. And so the approach we have chosen, you will see that in my prepared answer, is to use analyses specific to the particular ice condenser plants to arrive at a decision that the initiation scheme that they proposed is adequate.

The second thing I would point out before the prepared remarks is that, as you are aware in the Sequoyah case, we have called our approval of the distributive ignition system an interim approval. We have told you before of the things that we consider that need to be done before final approval of these ignition systems by January 31 of 1982. One of the things that we will continue to consider and had planned to continue to consider is the initiation scheme for the igniters.

COMMISSIONER GILINSKY: At Sequoyah I believe it is the safety injection that is the triggering signal.

MR. MATTSON: That is the way it has been described. That unfortunately is a bit of a shorthand description for the initiation scheme. It is actually a little bit different than that implies. The procedures at Sequoyah call for turning on the igniters for every trip of the reactor. What they say is after the operator has confirmed that the equipment required to automatically respond to a trip is operable, then before entering any emergency procedure for diagnosis and response to an accident, the operator dispatches a person to the igniter panel to turn on the igniters.

So that would be more often than every safety injection signal.

I was just checking with the staff a minute ago. It is our recollection that the number of trips per year ranges from three to ten in the United States per reactor, depending on the design, and that approximately half of those might be expected to result in a safety injection signal.

The point I was trying to make, the second point is that consistent with our requiring a number of additional things to be done beyond the interim approval of the distributive ignition system, some of the details that you have heard today from Duke we have not heard before. Some of the particular reasons for choosing 3 psi rather than some other initiation signal, consistent with our requiring them to look into that further, some of the information that is presented here has not been presented to us for review prior to today.

Let me also say that our position is not a hard one on when the ignition system should be initiated. It could not be. We have approved two initiation schemes, one for Sequoyah and a different one for McGuire.

If I could then, let me read the prepared remarks.

The McGuire emergency hydrogen mitigation system as reviewed and approved for interim operation is manually actuated out [illegible] the main control room upon receipt of an automatically initiated Phase B isolation signal. The Phase

B isolation signal is produced upon reaching a high, high containment pressure signal of 2.9 psig. Duke has chosen the Phase B isolation signal on the basis that the signal will provide an early indication of accidents which have the potential for excessive hydrogen generation.

Furthermore, the selection of a Phase B isolation signal which in turn is derived from high, high containment pressure as the actuation criterion increases assurance that accompanying safety systems, that is the sprays and fans, will be operating.

The staff previously has reviewed this issue and concluded that for the interim period until January 31, 1982 the actuation criterion selected by the Applicant is acceptable. This was based on a preliminary judgment that a containment pressure set point of 2.9 psig is sufficiently low to anticipate hydrogen generation for the S2D accident scenario which was used as a basis for the staff's interim approval.

In that scenario the 2.9 psig pressure set point is exceeded in approximately 200 seconds. The containment pressure analysis indicated that the peak containment pressure prior to hydrogen generation occurs at approximately 800 seconds at a value of about 7.5 psig. At this time operation of safety systems, that is fans and sprays, acts to decrease the pressure. By contrast, the analysis also indicates that the onset of hydrogen generation is at approximately 3500 seconds.

While the pressure analysis was not performed to produce the minimum expected pressure rise which would increase the time period to reach the set point, this time interval appears to be more than adequate since manual actuation of the igniters outside the control room should take no more than several minutes.

While we maintain that the system approved for McGuire is adequate, we intend to continue our review of the operational aspects of igniter systems including actuation modes and set points prior to final approval.

For your second question, actuation of the igniters at a lower set point or earlier on time poses no problem in our judgment so long as the systems are functioning when needed. Reiterating our position, the staff believes that actuation of the igniters on Phase B isolation or earlier, as is the case for Sequoyah, is acceptable for interim approval.

The sprays and fans for Sequoyah and McGuire are actuated on a high, high containment pressure set point which we believe will be reached prior to excessive hydrogen generation. Thus actuation of the igniters at an earlier period should be inconsequential. In any event, even if hydrogen were released with only the igniters operating, a likely result would be that a small quantity of hydrogen would burn causing sufficient pressure rise to reach the set point which causes initiation of the sprays and fans.

Regarding the second point of the question, we see no obvious reason why the fans could not be initiated on a lower pressure. This would however increase the probability of inadvertent operation.

CHAIRMAN HENDRIE: Do you have any questions?

COMMISSIONER GILINSKY: No.

CHAIRMAN HENDRIE: Mr. Riley?

MR. RILEY: Thank you.

I will distribute some copies of material bearing on this point. The first one of these, if I may distribute to the Commissioners and to Matt and the parties, is the hydrogen appendix to the Nuclear Safety Analysis Study that was referred to previously. I have circled in red the initiation of the accident, pressure builders during the accident. This may be an inaccurate chart, but it indicates that the initial pressure was less than one pound, on the order of five-tenths of a pound. It indicates that 3 psi was not reached until four hours out.

Now I agree with the statements by Mr. Rasin and Mr. Mattson, but for the scenario that has been assumed for McGuire there would be a very rapid pressure rise and 3 psi would be exceeded in a matter of minutes.

The thing that went wrong, so to speak, at TMI in terms of our using it as an example in this case were several means of mitigation. Mr. Rasin has referred to the operation of the air cooling system. If you will take a look at the second sheet in the handout, you will see a figure from NUREG-600 which is the staff's analysis of the TMI accident. Encircled in red you will see that during the first four hours that make-up Pump A was operating. It was throttled at some point but it was operating. You will also see that before four hours was reached there were four or five instances of high pressure coolant injection.

All of these things would result in cooling of the content of the reactor coolant system. It would reduce the amount of energy of the liquid that was escaping and the steam that was escaping from the pressurizer. I feel that these unanticipated factors were responsible for this rather slow build-up of pressure in the containment, that and something that we had not mentioned. That is that the containment itself and all the equipment had acted as a huge condenser.

Obtained by discovery on the staff, the temperature record of the atmosphere at TMI never exceeded, as I recall, 170 degrees Fahrenheit, which means that during all that period it was able to act as a condenser and suppress the pressure contribution of water vapor.

I am a bit concerned about the statement in Question 1 initially that hydrogen was present when 3 psi was reached. I would like to know if the staff's evidence was based on an interpretation of the curve in the first figure which shows that rough rise is a little after three hours and a little before four hours, because the first analysis of the content of the atmosphere was made on March 30 after the burn had taken place.

As far as I can tell -- I have not gone over the reactimeter of chart content -- there was no hydrogen monitor in the plant. I am intere ed in the evidence that there was hydrogen present before 3 psi was reached.

With respect to the McGuire situation, I feel that the materiality of whether the igniter system activation is at the present signal or at an earlier signal relates to how well any accident there follows the assume scenario which is an S2D accident which is not identical to the Three Mile Island accident. The Three Mile Island accident probably occurred at a slower rate because the PORV leaking through the long length of pipe conveying it down to the pressurizer relief tank would be slower than a two-inch pipe that was simply broken at a point near a larger line in the reactor system.

If we permit ourselves to depart then from the one scenario that was considered by the Applicant and the staff in the proceeding, it would seem to me because of these unanticipated deviations from that particular script that would be a step of conservatism to initiate early. I would feel that an injection signal would be one of the earliest signals for such initiation and that would be in the interest of conservatism to do so.

I agree with Mr. Rasin that it would cause some clean-ups and some loss of generating time. But the value in terms of prudence, particularly since we are dealing with a thin-shell containment, I feel would be worth it.

I want to note i.. passing, the point was already made, that the volume of Three Mile Island is not quite twice that of McGuire. McGuire corrected for ice is 1.13 million cubic feet. TMI is 2.05 million cubic f.et. That certainly does mean that the pressure rise signal which we see in this first sheet of the handout would be about half what you would expect in McGuire, providing that the scenari? is follows.

Now with respect to Question 2, the air fans are not designed to start until ten minutes after pressure differential 3,000 has been reached. And as the first hydrogen release occurs at a pressure drop of 19.3 pounds absolute which is 4.6 pounds gauge, it would seem that the 3 pounds, again assuming we are following the script, would be early enough, again where scenario depended.

Despite I am sure the effort that was made to train its operators to follow certain procedures, as there is a possibility of attempts at mitigation of pressure increase, I feel that early activation of igniters would be essentially harmless.

With respect to vacuum effects, the containment I feel would be well equal to it. Mr. Rasin I think correctly points out that some systems would start operating with a negative quarter pound being reached, and again it would be a matter of inconvenience.

I would like to indicate, though, a source of concern of turning on the igniters and not making provision for turning them off, because I believe that your analyses in the future are going to show that a time will be reached in which the less hazardous thing to do is to turn off the igniters and permit the recombiners to dispose of the hydrogen in the environment. If it would be a pleasure of the Commission I would like to indicate why I think this is the case.

The second part of the handout indicates some of the situation. There are seven attachments to the pipe which leads to pressurizer relief tanks. One of these is spray nozzle. Three are power relief valves and three are safety valves. I have red-checked the pressures at which these operate.

COMMISSIONER GILINSKY: I wonder if we could return to this after we have completed dealing with the actuation question, or however you want to do it.

CHAIRMAN HENDRIE: Why don't we let them go ahead and get the proposition stated. Then I want to go around the table again, and people will have a chance to comment on the other parties' remarks, including this point.

COMMISSIONER GILINSKY: Good enough.

MR. RILEY: Further information on pressurizer relief tank from the FSAR is given in the following pages.

The next stapled portion of material is from NUREG-CR-1219. I really think that this is the heart of the matter. When the Commission asked a question about 3 percent hydrogen, I assume it meant a uniform concentration throughout the containment of 3 percent. Now it is argued very persuasively in this NUREG report that the hydrogen concentration at Three Mile Island was not uniform, that the place where ignition occurred was a much higher concentration than that on the average of the containment and certainly the same heterogeneity and hydrogen concentration will be true for McGuire.

I really think that this is the heart of the matter. Until our analyses deal with the case of a range of hydrogen concentrations, I feel that we are going to come out with mistaken conclusions with regard to when to turn igniters on and when to turn igniters off.

Now the remaining documents are from McGuire FSAR. They will enable you to visualize where the various elements in the plant are. On the first sheet you will see in elevation the location of the pressurizer. In the second sheet you will see the location of pressurizer plan and of the nine hatches through which return air is provided to the lower compartment which contains the reactor and where the leak would presumably occur.

The elevation of the sheet just referred to is 738. The elevation of the next one is 768. We see where the air return fans are. We see that the inlets for the air return fans are diametrically opposite the location of the pressurizer. If we go on to the next sheet, we see the layout of the ice condensers and we see that the air return fan inlets are between the ends, the open space in the ice condensers. And when we go to the last of these legal-size sheets, we see that the hatches venting the ice condenser correspond to, of course the condensers themselves are uniformly distributed to that section.

Now 21 minutes after hydrogen release begins, it will reach a maximum. This information is for the S2D scenario. You will find it in Duke Power's analysis of hydrogen control measures in Volume 1, and the information is given in Table 2 where the hydrogen release rate, mass release rate is given.

The water release rate is given in Table 1. Some simple calculations show that at the peak of the accident the flow of steam and hydrogen into the lower compartment will be three times that of the return air, which means that three-quarters of the parts into the ice condenser are going to receive hydrogen and steam. Under these conditions the thorough mixing of that one-fourth of air with those three-fourths of steam and hydrogen is certainly not going to be complete. There is going to be a small transition region where there is some mixing.

But what it means is that a very substantial part of the steam and hydrogen is going to go into an ice condenser unaccompanied by any air. Now the steam will condense out. And the air in the portions of the ice condenser adjoining will laterally move toward the close-in to make up for the volume of the steam.

What it amounts to is that there is going to be a channel of approximately 30 feet by 10 feet in the ice condenser emerging at the top on the opposite side of the air return fans where you are getting up to pure hydrogen. There is going to be a transition band but you are going to have an extremely high concentration of hydrogen in the center. That hydrogen has about 7 percent the density of the air atmosphere. It will be enourmously buoyant.

As you can see from the plans, the thing that will happen is that that hydrogen will move to the top of the dome where there are a group of igniters. For a while that hydrogen will burn off because there will be enough oxygen present. In the last sheet of the handout you see the turning diagram which indicates the vicinity in which hydrogen burns in relation to air and steam composition and the region in which it detonates.

But after that portion of the hydrogen which has had sufficient air to combust has combusted and the supply becomes hydrogen which is unburnable because it lacks oxygen, one will accumulate a volume of hydrogen in the dome with the igniters below and nothing happening except that the air return fan system will still be operating, causing some circulation. There is what engineers call a flow net which will have maximum flow in the vicinity of inlets, the air return fans, and minimum flow in the region from which the hydrogen will have issued.

But slowly there will be mixing and there will be diffusion. It is very obvious, if you visualize this, that the minimum concentration of air will be at the top in the vicinity of the igniters and slowly oxygen will rise, increasingly making the mass combustible.

Finally there will be a combustible composition in the vicinity of an igniter with a large combustible and probably detonable volume of hydrogen below it. That I think is what Dr. Berman had in mind when he said the use of the distributive ignition system under certain circumstances ia fraught with danger, and I believe that is the circumstance.

For that reason I would recommend that a study be made by this Commission to determine that point where it is safer to turn off the igniter system and every other electrical device in the containment except the recombiners and allow the recombiners to take care of that hydrogen.

CHAIRMAN HENDRIE: Thank you, Mr. Riley.

Depending on the inclination for questions from this side of the table, I propose to switch back across the parties, asking for comments on one another's remarks. You probably have some more questions as we go along.

MR. McGARRY: Could we have the Commission's indulgence for about one minute so we can caucus, as it were?

CHAIRMAN HENDRIE: I do not see why not. While you are caucusing maybe we can go ahead and ask the staff to comment.

MR. McGARRY: I think we can be ready in about one minute. If you would please hold for that one minute, we would like to hear the comments.

CHAIRMAN HENDRIE: Go ahead and caucus.

(Discussion was held off the record.)

COMMISSIONER GILINSKY: Mr. Rasin, before you start, I want to say a word. I want to say again that I don't know what the particular view is, but where the hydrogen igniter system ought to be turned on, what I wanted to understand was your rationale for picking the signal that you have picked. It does not seem to me however that trying to avoid turning it on once or twice or even three times a year, using the numbers that were given to us a few minutes ago, is a sufficiently good reason for picking the 3 psi as opposed to an earlier point.

I assume that --

MR. RASIN: I guess that --

COMMISSIONER GILINSKY: -- the system more frequently than that anyway. You probably test it several times a year.

MR. RASIN: It is I think tested at least four times a year. It is energized for testing.

In terms of what is a good enough reason for you and what is a good enough reason for me, I suppose there is just a difference. I suppose I have good enough reason to believe that if you are going to need these things, you are going to get the 3 psi and I am confident that safety injection and 3 psi are equivalent on a transient where you are going to need these things.

I would admit, as I said before, that is our only basis. And we agree with the staff in terms of their view that both schemes are at this time acceptable from the standpoint of the operation of the mitigation system. I would agree with that. And our basis is and remains as I have stated.

I would like to take issue with the staff's position with regard to the air return fans. I would not agree that there is no problem with initiating the air return fans earlier than the 3 psi. The air return fans are an integral part of the containment and engineered safeguard features.

The plant was designed with many bases in mind. The mitigation system is put in to handle one event within the whole realm of the plant operation. I do not feel that the rest of the plant should have to bend to the installation of that one particular system by changing those set points.

It would require a reanalysis of the accident to ascertain what e effect of operation of the air return fans at a different time would be, whether there would be any effect, because there would essentially be none if the blowdown had not yet been concluded. And I would not put that in the realm of what you would call a painless or not expensive change to make. I would consider that a very significant and expensive and unwarranted change to make.

CHAIRMAN HENDRIE: Since you turn the igniters on, on the basis that it had reached a certain set point, the procedure, say if you reach that point, is you go and turn them on and the operator then goes to the switch gear and throws the appropriate switches so it is a manual procedure. What would be required then to turn the igniters on at a lower pressure or at some other event such as the initiation of safety injection is just a change in the operating procedures --

MR. BASIN: Yes, sir, that is correct.

CHAIRMAN HENDRIE: -- and a not trivial point, making sure that the operating staff understands the change and some operators are not under the impression the old rules apply and some that the new apply.

But I am inclined to agree that changing the sequence at which other equipment comes on, fans and so on, is a rather more significant matter. One really has to go back then and redo all of the containment analyses to make sure you have not done something unfortunate. So I am included to agree with that.

Are there other questions?

MR. MATTSON: You asked in the question whether it was feasible, and I answered the question: yes, it is feasible to lower the set point. Is it necessary? No. Is the money warranted to redo the analysis to ma . sure all the other reasons that 3 psi was picked for the fans, is that reanalysis warranted by the concern that is expressed here? We do not believe so.

COMMISSIONER GILINSKY: But what about the first question? It seems to me that by using an earlier signal to initiate the igniters, protecting against a larger class of possible accidents, and the disadvantages of turning the igniters on once or at the most several times a year, a couple of times a year, seem pretty slight. Why not do it at the earlier point?

MR. MATTSON: We tend to agree with you. What I said in my statement was that our plan was to take a little longer to look at it but our position is not hard and fast.

Just by way of comment to Mr. Riley's remarks, I would urge you not to select prudence as the sole basis for indiscriminately requiring further actions by control room operators and auxiliary operators in the event of reactor scrams. You will recall how we have cautioned one another since TMI with loading up reactor operating st[illegible] and reactor control rooms with more and more things [illegible]y have to do off the top of their heads every time the bell rings. So prudence itself is not a reason to go turn the igniters on.

If the thoughtful consideration of other accidents that might find a way to produce hydrogen without producing 3 psi leads you to beli ve that you would significantly enlarge the window of protection afforded by the igniters, that is a good reason to turn them on. That is the window we are exploring, and we had simply decided some months ago to take the rest of 1980 to answer that question.

CHAIRMAN HENDRIE: You mean 1981. You have already taken the rest of 1980.

MR. MATTSON: Yes, 1981.

(Laughter.)

MR. MATTSON: The question that Mr. Riley raised on when to turn the igniters off is not a new question and also is included in the work that we have ongoing, principally generated by some of the testimony in the McGuire hearing.

Suggestions have ranged broadly on how igniters ought to be controlled, when they ought to be initiated, should they be turned off in some situations, even so far as the suggestion that individual igniters may need local detection and control devices. That could get rather cumbersome and rather expensive but remains one possibility that is in front of us as we continue to look at what ought to be the required hydrogen mitigation system for the long term and the small containments.

So in addressing those kinds of questions we will have to come to grips with when on and when off. I welcome the suggestion that we look at that question.

In fact the record of this proceeding has on it a considerable discussion of the inerting of hydrogen by steam or fog. He seems to be adding -- this is the first time I have heard his argument -- the additional parameter of accessibility of air to concentrations of hydrogen once the steam goes away. You will leave concentrated areas of hydrogen and how will the air find its way to those concentrations: that is a nuance that was not on the record to my knowledge. But the question of lower plenum inerting followed by dry-out and steam leading to transitions to detonation and things like that you have heard on the record of this proceeding. You have heard us discuss them in the context of the interim rule for hydrogen control. These are questions very much in front of us between now and the end of this year.

Those are the only comments I would make in response to what I have heard.

COMMISSIONER GILINSKY: I do not have much more to add. I guess I would like to ask, are you familiar in detail with the calculations leading to the predictions in pressures dur ng accidents? The question I want to ask is simply this. It seems to me it is one thing to predict that the pressure will be 10 psi or 20 psi or whatever. It is another thing to predict the difference between 1 and 2 and 3 and 4. And it seems to me, I would think that our ability to predict those sorts of things to that sort of detail is limited, given the complexity of the inside of a containment and the ice and so on.

So as I think I have said several times here, it seems reasonable to try to not have these protective measures and our instructions on igniters depend sensitively on the detailed predictions of such calculations but to be based on more general principles. That is why it seems to me, other things being equal, one would want , if there are no other sizable significant costs attached to this step, to have instructions to turn them on earlier.

At some point you said you thought they were equally acceptable signals. I gather you have at least a mild preference for one.

MR. RASIN: Let me speak to the sensitivity of the analyses. I would agree with you that I would certainly not want to defend with my life the exact number of plus or minus the tenth to the psi given in any of our safety analyses for a particular point in time.

However if you look within that containment of the amounts of energy that need to be required to change the pressure of psi or so, they are really not very great for that volume. For instance if one were to just add the hydrogen gas without looking at the burning aspects at all, you would add greater than 3 pounds pressure to the containment. That is just a hydrogen gas taken at the same temperature as the containment atmosphere.

When you begin adding superheated steam with the hydrogen content to the containment, pressure goes up very quickly. And whether it goes to 7 or 7.5 or 8 is immaterial. But it goes up well in excess of 3 psig to at least a factor of 2 in most all of the analyses I have seen. For instance the design basis accident, you are up greater than 7.5 psig within ten seconds of the onset of the accident due to the blowdown. So we are not just barely making 3 on any of these scenarios.

COMMISSIONER GILINSKY: You think this covers small breaks as well?

MR. RASIN: It covers the small breaks that we have looked at. We have done some estimates on looking at what would happen at smaller breaks. They were done some time ago. But we have found that basically about all you do is change the time frame a little bit, even down to what we would consider as excessive leakage rather than a LOCA.

COMMISSIONER GILINSKY: Would these be conservative calculations or realistic ones?

MR. RASIN: The calculations that we have done for this hydrogen work have been done with CLASSIX. We have done them conservatively from an engineering standpoint. We have not conducted them as you would conduct licensing calculations.

COMMISSIONER GILINSKY: Do they take full account of the ice, the possibility of condensation?

MR. RASIN: Yes. They include the affects of the ice. From the beginning of the blowdown we take into account the heat transfer to the ice, the effects of the sprays, the air return fans. The CLASSIX Code also includes the structural heat sinks. So we do look at just heating up the metal and concrete in the containment.

COMMISSIONER GILINSKY: Thank you.

CHAIRMAN HENDRIE: Mr. Riley, it is your turn on this last round.

MR. RILEY: Thank you.

Mr. Rasin, does the CLASSIX Code assume homogeneous compositions within the lower compartment, the ice condenser and the upper compartment with respect to the concentration of hydrogen?

MR. McGARRY: As his counsel I am going to object to that form. I have held off on some objections. I think Mr. Riley of course is free to address the Commission. I did not think this session was an interrogation of one party by another party.

CHAIRMAN HENDRIE: No, it is not.

Tell me where you are aiming and maybe I can help you out and ask him a few questions for you. I am unwilling to be a blind conduit.

MR. RILEY: I will be very glad to oblige.

The entire schema with respect to pressure development and burns and so forth that has been provided by the Applicant in what is known as Exhibit 5-B makes certain code assumptions. What I am trying to determine is if one of these assumptions, the in my judgment the unrealistic one, that throughout the course of the accident the hydrogen concentration is uniform, though increasing and then later decreasing through the lower containment, and then a different one through the ice condensers and still a different one through the upper containment.

CHAIRMAN HENDRIE: I guess your aim would be to reinforce your previous comments about possible inhomogeneity in atmospheric composition at various times in an accident sequence.

MR. RILEY: Not only that; it would be to raise the question of whether or not we can rely on the predictions of CLASSIX, because if CLASSIX is based on faulty major assumptions then I think that we are in a position of distrusting its results.

CHAIRMAN HENDRIE: But with regard to the questions we asked this afternoon about feasibility on the one hand, reasonableness on the other of set points for turning the igniters on, I am not sure where that gets you.

MR. RILEY: I think that is a very fair observation. I will say this. It may relate to the discussion of achieving 3 psi pressure drop and the later pressure drop which I think Mr. Rasin said was 6.5 psi at which point the air return fans went on. It would have to do with predicting those times which have already been stated.

CHAIRMAN HENDRIE: I think once you get enough hydrogen so that questions of hydrogen inhomogeneity are of interest, we have certainly gone past the time and the sequence at which one would have hoped the igniters had been on.

MR. RILEY: The thrust of my testimony was that that assumes a known scenario like S2D. And certainly we did not play out anybody's known scenario at Three Mile Island because of the various interventions that took place. Just because it is a human possibility that if an accident occurs at McGuire it will not play out a precise scenario, I think that it is fair game to ask for mutations with respect to scenarios. That would be one.

CHAIRMAN HENDRIE: It is certainly fair game from your standpoint. But I have a feeling that that discussion leads us back into the merits of issues which have been adjudicated and they are on the record, people's points of view one way or another expressed. And it is not so clear to me that it deals directly with the two questions here about the set point on the igniter triggering.

As I understand the thrust of your remarks with regard to particular questions here, I would assume you would be inclined to vote for a lower set point barring any good reason not thus far discussed for doing it. And I think there is a valid point to be made about trip points on the fans. Would that be an unfair characterization of your view with regard to the particular point on set points?

MR. RILEY: I think it would be a substantially correct view. I would feel more comfortable, all things considered, if the pressure set points were lowered. I am not so sure that I would want to see the fans go on before 3 psig. I am not certain that it would be that relevant.

I do think though that there is some surviving value in the question that I wish to propound to Mr. Rasin. That is it would be helpful I think for the Commission to know whether the underlying assumption of their calculations of events assumes homogeneity of hydrogen within the several containments at any instant in time.

The entire igniter operation is premised I believe on knowing what the hydrogen concentrations are. If at one small point you have a burnable 10 percent and at other points you have an unburnable 5 percent or unburnable 85 percent, our entire reliance on the ingiter thing falls apart. In the sense that I felt we were concerned about the efficacy of the igniter system, I would raise tha question.

CHAIRMAN HENDRIE: I will tell you what I am going to do. I am going to use it in a somewhat different form. Rather than turning to Duke Power, I will turn to the people I have worked with for many years and ask whether I can comment about the way in which those codes currently are being hydrogen concentrations and once more ask him to sort of summarize by seeing whether he sees any significant difficulties in set point, safety objection.

MR. McGARRY: If I can just jump in, Chairman Hendrie, and give Dr. Mattson perhaps 30 seconds to reflect, I would like the record to reflect that during the exhaustive administrative adjudicatory hearing, the Applicant presented well over 20 witnesses and we discussed the CLASSIX Code. We had the people there who developed the CLASSIX Code and the underlying assumptions.

CHAIRMAN HENDRIE: Fair enough I guess to note that.

Roger?

MR. MATTSON: I would think that the fact that the Codes do treat the rather large volumes with single nodes, with homogeneous assumptions, would have little to do with the validity of the 3 psi set point. You are primarily interested in mass addition in the lower plenum. You add it up; you put it in the volume; you calculate what the pressure will be.

The homogeneous assumption would have a lot to do with the question of can you inert large volumes of pure hydrogen with steam, isolate it from air, later remove the steam and then bring the air into the previously isolated volume of hydrogen. That is obviously a heterogeneous question for which the existing codes are not particularly good.

I also point out that that is what is known as multiphase, multicomponent flow at which very few codes in the whole world have ever been any good for any problem. It is a very difficult area of analysis. You often end up with not finite element codes of the sort with which we are accusomed in MOCA and containment analysis but a lot of qualitative arguments and qualitative analysis.

It is a difficult area. It is one we have said we would look into. I do not believe it is particularly germane to picking the 3 psig set point.

CHAIRMAN HENDRIE: Or some other.

MR. MATTSON: Yes.

CHAIRMAN HENDRIE: But the Codes do treat the containment subdivided into a number of nodes, lower compartment I guess, ice condenser, upper compartment at least.

MR. MATTSON: You can think of it as a one-dimensional representation with homogeneity in each node, yes.

CHAIRMAN HENDRIE: But in the calculation, different areas in the containment represented by the single node could have different and do have different compositions as the sequence goes along. It is still less than a highly detailed representation. On the other hand it is not so crude as to consider the containment a single volume either.

MR. MATTSON: For a burning and an energy transfer point of view, it would be important to treat it in multiple volumes so that you could somehow handle the inhomogeneity.

But for a mass, an energy addition to determine the pressure, there is no way to sustain much pressure difference across such a large space. The representation by a single node with an assumption of homogeneity would be very good.

COMMISSIONER GILINSKY: How many nodes are there? Are all the ice chests lumped together or are they treated individually?

MR. MATTSON: You are getting into a little more detail than I am close to. I could ask Mr. Tinkler of the staff to stand up and see if he could address the question.

MR. TINKLER: The original CLASSIX analysis had a one-node volume of the ice condenser region. Revised analyses have modeled that region with two nodes, the separate node for the upper plenum of the portion of the ice condenser region.

CHAIRMAN HENDRIE: Mr. Riley?

MR. RILEY: Mr. Chairman, do I still have an opportunity to resume on our discourse with respect to questions?

CHAIRMAN HENDRIE: Let me allow you about two more minutes, Mr. Riley, because I am running out of time. I have some other appointments, and I sense that the Commissioners have had a fair chance to probe into the items that were of interest here.

MR. RILEY: I think it would be highly desirable to establish the pressure difference between the upper containment and the lower containment at times of maximum flow from the leak. The reason I say this is that the air return fans according to the PSAR have a pressure differential of two pounds per square foot. Psf is the abbreviation used. That adds up to a lttle over one-hundredith of a pound per square inch.

It is my belief that the pressure inside the lower compartment will have a differential much greater than that with respect to the upper compartment and that the fans will be back up if anything. And this aberration in the flow process I do not think has received any consideration. I think it is a fair question.

CHAIRMAN HENDRIE: I will ask the Commissioners to take it under advisement.

Do you have other comments?

Peter?

COMMISSIONER BRADFORD: No, sir.

CHAIRMAN HENDRIE: I think we have then achieved the purpose from the Commission's standpoint of the briefing. I must say I want to thank all of the parties for a useful and, on your part, very focused and timely sort of discussion. I appreciate your coming.

MR. McGARRY: At the risk of sounding like a lawyer and coming in at the last minute, I am going to barge ahead anyway, Mr. Chairman, for 30 seconds.

Discussions with Commissioner Gilinsky and Mr. Rasin, indeed all the parties, centered on two points. The first one was whether or not it is necessary to lower the set point for the igniters. We are aware of course of the Sequoyah situation which is premised upon safety injection.

I would like Mr. Rasin to mention just one point to you because our people think it is very important. It really was not brought to your attention. But if indeed you are inclined to go in that fashion and make that a condition, we would feel strongly that that condition should read that the set point would be at safety injection with an indication of a LOCA. I think that is important, based upon our operator training program. We do not want them, and I am going to turn this over to Mr. Rasin for a second, but there is a reason.

MR. RASIN: We spent all of our time quibbling over our differences of what was a good enough reason, but I wanted to assure that we left you with the fact that I would consider to be equivalent to our 3 psig initiation trigger, a safety injection signal. What the operator does when he receives that signal is to immediately begin a checklist of looking to ascertain whether or not there is leakage of coolant into the containment. That I would consider to be equivalent.

If we went to just the safety injection signal, period, I would consider that unnecessary but essentially equivalent. If we were to go to a criteria of every time you get a reactor trip, I think that is just totally inappropriate for the situation we are dealing with. I do not think the first thing we ought to have in an operator's mind when he gets a reactor trip is to run for the hydrogen igniter switches.

COMMISSIONER GILINSKY: When you say "indication of a LOCA," is that a term of art? Does that represent some specific information that a reactor would receive?

MR. RASIN: There are specific criteria in the procedure. When a safety injection signal is received, the operator begins verifying that certain things have happened and he has a checklist of things to look for to show that there is in fact leakage of coolant into the containment.

COMMISSIONER GILINSKY: That would be a precise instruction.

MR. RASIN: It is a precise instruction, yes, sir.

MR. McGARRY: Thank you, Mr. Chairman.

CHAIRMAN HENDRIE: It turned out you had the last word.

Thank you all very much.

(Thereupon, at 3:30 p.m., the hearing was adjourned.)

NUCLEAR REGULATORY COMMISSION

This is to certify that the attached proceedings before the

COMMISSION MEETING

in the matter of: McGuire Application for an Operating License

Date of Proceeding: June 24, 1981

Docket Number:

Place of Proceeding: Washington, D. C.

were held as herein appears, and that this is the original transcript thereof for the file of the Commission.

Judith F. Richard

Official Reporter (Typed)

Judith F. Richard

Official Reporter (Signature)