NUCLEAR REGULATORY COMMISSION ORIGINAL

COMMISSION MEETING

In the Matter of: PUBLIC MEETING

DISCUSSION OF SECY-80-399 PROPOSED INTERIM AMENDMENTS TO PART 50 RELATED TO HYDROGEN CONTROL AND CERTAIN DEGRADED CORE CONSIDERATIONS

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

PUBLIC MEETING

DISCUSSION OF SECY-80-399
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RELATED TO HDROGEN CONTROL AND CERTAIN DEGRADED CORE
CONSIDERATIONS

- - -

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

Thursday, September 4, 1980

The Commission met, pursuant to notice, at 2:00 p.m.

BEFORE:

JOHN F. AHEARNE, Chairman of the Commission

VICTOR GILINSKY, Commissioner

PETER A. BRADFORD, Commissioner

JOSEPH HENDRIE, Commissioner

NRC STAFF PRESENT:

LEONARD BICKWIT

HOYLE

D. ROSS

W. DIRCKS

M. MALSCH
J. NORBERG
E. HANRAHAN
R. MINOGUE
G. ARLOTTO

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P R O C E E D I N G S

(2:00 p.m.)

CHAIRMAN AHEARNE: This afternoon we meet to address a paper sent to us by Standards Office to the Executive Director. It addresses an item which has sort of achieved prominence as a result of the reviews of what happened in Three Mile Island; and namely, this is just one element of a series of actions. Perhaps we will get to another later during affirmation session. But this particular one is interim amendments Part 50 relating to hydrogen control and certain degraded core considerations.

What we have in front of us is a Commission paper requesting approval for publication of proposed amendments.

Bill?

MR. DIRCKS: I was just going to point out what you just pointed out, John. This is one part of three actions that you are going to be faced with dealing with hydrogen control. The first one was the advanced notice on rulemaking concerning the degraded core rulemaking action.

CHAIRMAN AHEARNE: People seem to be having difficulty hearing you.

MR. DIRCKS: Okay. I was just pointing out these are three actions that the Commission grappled with at the same time. One is the advanced notice of rulemaking on degraded core. The other one is the interim rule today.

The third is the hydrogen control aspects of the license you will be considering for Sequoyah.

That is a subject of discussion on the part of the ACRS this week, and you will be meeting with them on that subject. So while you are listening to this I guess you got to keep in mind the other two aspects, the other three aspects are going on at the same time.

If you had a sequence of decisions I guess to be made in this matter, probably the first one is the decision regarding the Sequoyah license, because that is where the impact of it all will be felt. Second is some of the applications as a result of that decision, the logic of that decision to the hydrogen control aspects of this interim rule, and finally summing it all up is how you apply one and two to the degraded core rulemaking.

So it is an extremely complicated set of trends that are to be woven together here, and I think with that sort of in mind it gives Jim Norberg here a very difficult time of going into this subject.

But I just wanted to point out the interrelationship of all these things.

MR. NORBERG: I am James Norberg of the Office of Standards Development, and I will brief you on the proposed interim rule, or interim amendments to 10 CFR Part 50 related to hydrogen control and certain degraded core considerations.

Dr. Ross of the Office of Nuclear Reactor Regulation is here to assist in answering any questions you may have regarding this rulemaking action.

The presentation I have will run about 30 minutes barring any interruption, so it will give you some feel for the length of it.

In presenting this proposed rule I would first like to briefly discuss its background and then go into the major aspects of the rule, including each of its requirements.

Slide one, please.

As you know, following the TMI-2 accident the NRC initiated a number of actions to assess the design and operational aspects of nuclear power plants and the emergency procedures for coping with potential accidents. One of these actions, the Lessons Learned Task Force, was established by NRR to identify and evaluate those safety concerns from the TMI-2 accident that require licensing actions beyond those already imposed by IE bulletins and Commission orders for presently operating reactors as well as those pending operating licenses and construction permit applications.

In performing its mission, the Lessons Learned Task Force considered investigative information, staff evaluation of responses to IE bulletins and orders, Commission recommendations, ACRS recommendations, recommendations from staff studies such as from NUREG 0560, which was the staff report on feedwater transients in B&W plants, and recommendations from outside the NRC.

The Lessons Learned Task Force was charged with identifying, analyzing and recommending changes to licensing requirements, and the licensing process for nuclear power plants based on the lessons learned from the TMI-2 accident.

The short-term actions recommended by the Lessons Learned Task Force, when combined with the requirements associated with the recommendations of the IE bulletins on TMI-2, including generic status reports by the bulletins and orders task force, are intended to constitute a sufficient set of short-term requirements to ensure the safety of operating plants and those to be operated in the near future.

The initial findings of the Lessons Learned Task Force were published in NUREG 0578 in July 1979. These findings included about 23 recommendations in 12 broad areas. Nine were related to design and three related to operations.

Three rulemaking actions were recommended, two related to hydrogen management and required modification to 10 CFR 50.44. The other concerned limiting conditions for operation and was related to 10 CFR 50.36. Only the rulemaking recommendations related to 10 CFR 50.44 are addressed in this proposed rulemaking.

The final report on the Lessons Learned Task Force was published as NUREG 0585 dated October 1979. This report addressed safety questions of a more fundamental policy nature regarding design, operations, and the regulatory process itself. This report also recommended that an NRC action plan be developed and forwarded to the Commission for approval.

In September 1979 letters were sent by NRR to all licensees of operating nuclear power plants and operating license applicants, licensees with plants under construction, and CP applicants, informing them of the followup actions that should be taken in light of the lessons learned from TMI-2.

These actions basically were those recommended by the Lessons Learned Task Force except for those requiring rule changes to 50.44 and 50.36. In addition, three more instrumentation requirements were added, and the requirement for highpoint vents in the primary coolant system was added. Those additional requirements were developed during the ACRS review of NUREG 0578.

During the week of September 24, 1979 seminars were held in four regions of the country to encourage industry feedback and dialogue on each short-term requirement. As a result of these seminars four topical meetings were held in Bethesda to discuss cer ain issues in more detail.

On October 30, 1979 letters were again sent out to all concerned, further clarifying the short-term NRC staff recommendations.

The TMI-2 action plan, NUREG 0660, dated May 1980, was extensively reviewed and endorsed by the Commission. In this plan Section 2(b), consideration of degraded or melted cores and safety review, identifies a number of actions that involve developing and implementing a phase program to consider core degradation and melting beyond the current design basis.

One of these actions is Section 2(b)(8), rulemaking proceeding on degraded core accidents. As you know, two rulemakings are involved. One is a long-term rulemaking, which is preceded by an advanced notice of proposed rulemaking.

This ANR was provided to the Commission in SECY-80-357 and is one of the items for today's affirmation session. Hopefully.

The other, which is the subject of this briefing, is an interim rule based on a number of recommendations of the above discussed actions that are specifically related to degraded core accidents.

These recommendations have been determined by the staff to be of such safety significance that they should be codified by regulation. The staff believes that the changes resulting from these requirements will improve the capability of nuclear power plants to deal with TMI-2 type accidents.

The requirements being proposed in this interim rule involve hydrogen management and specific design and other requirements to mitigate the consequences of degraded core accidents and LWR's. The staff position on hydrogen management has been presented to the Commission in SECY-80-107, 107-A and 107-B. The proposed interim rule is consistent with these papers and also represents the rulemaking mentioned in Section 2(b)(7) of the action plan.

It should be noted that the implementation dates specified in the proposed rule are consistent with the licensing letters. However, these dates are now being reconsidered and new dates will be provided before the proposed rule is issued.

With this background on the basis for the proposed interim rule, I would now like to discuss the rule itself. The second slide, please.

The TMI-2 accident revealed serious design and operational limitations that existed relative to mitigating the consequences of the accident and determining the status of the facility during and following the accident. The rule covers three general aspects of dealing with degraded core accidents.

First, there are information requirements for timely determination that a degraded core situation could or has occurred and for a decisionmaking relative to how best to cope with the situation and mitigate the consequences.

Second, there are requirements related to in plant radioactivity considerations.

COMMISSIONER GILINSKY: Could you just explain that first one again?

MR. NORBERG: The first? Okay. The three general aspects that the various parts of this rule addressed, the first being that for information requirements for the operators to be able to determine in a timely manner that you are --

COMMISSIONER GILINSKY: Oh, I see.

MR. NORBERG: -- having --

COMMISSIONER GILINSKY: Okay, that in fact they are in that situation?

MR. NORBERG: Yes, you got a problem.

COMMISSIONER GILINSKY: Okay.

MR. NORBERG: And what to do about it.

Third, there are in turn interim requirements for hydrogen management. The staff believes that the specific items addressed by this proposed interim rule along with other actions taken by IE bulletins and orders and other rulemakings represent those short-term requirements that are most important to plant safety and provide time to study the overall question of degraded core accidents more thoroughly.

I would now like to briefly discuss each item of the rule as it relates to the three general aspects of dealing with degraded core accidents.

Next slide, please.

The specific items of the proposed rule that relate to information and decisionmaking are training to recognize control and mitigate degraded core accidents. The TMI-2 accident pointed out the need to train operating personnel to better recognize, diagnose, control and mitigate the consequences of accidents that could lead to or have resulted in a degraded reactor core.

The purpose of this proposed amendment is to require additional training for all operating personnel in the use of all available instrumentation and equipment to properly respond to such accidents.

Detection of inadequate core cooling. As you know, during the TMI-2 accident the condition of inadequate core cooling was not recognized for a long period of time and certainly not before the reactor core sustained severe damage. This problem was the result of a number of factors, including insufficient range of existing instrumentation, inadequate emergency procedures and operator training, and perhaps insufficient instrumentation.

This proposed amendment will require for all LWR power reactors the development and implementation of procedures and training to be used by operators to recognize the existence of degraded cooling in the core using available instrumentation.

It will also require that qualified instrumentation be provided to supply the control room with a recorded unambiguous direct indication of inadequate core cooling, such as reactor vessel water level.

It should be noted that a correction was recently sent down regarding this proposed rule amendment.

The implication in the previous version of this rule, that core exit thermocouples could provide this particular function, is incorrect, and the words "or core exit thermocouples" have been deleted from that particular requirement. What was intended there is a water vessel level indication.

Another is accident monitoring instrumentation. The TMI-2 accident demonstrated that conditions can arise that are more severe than those that were postulated for design purposes. Key information was either not readily available to the operators or not recognized by the operators as being critical to understanding the accident, or in some cases the accident conditions were beyond the measurement capabilities of the instrumentation.

This proposed amendment requires that LWR's shall have the capability during and following an accident for providing and recording in the control room a continuous indication of containment pressure, hydrogen concentration in the containment atmosphere, containment water level, containment radiation level, radioactive noble gas concentration in the plant effluence, and quantifying the concentration of radioiodine and radioactive particulants in the airborne effluence at each anticipated release points.

All of these instruments and monitoring systems shall be designed and qualified with extended ranges to perform their function under anticipated accident conditions.

Reg Guide 1.97, Revision 2, instrumentation for LWR's to assess plant and environment conditions during and following an accident, gives guidance on the ranges and specification of the accident monitoring instrumentation required by this section.

CHAIRMAN AHEARNE: Now I notice you mention in here that that is out for public comment. I knew you were having, or whoever was running it was having extensive discussions with the ACRS.

MR. NORBERG: Yes, that is correct.

CHAIRMAN AHEARNE: But it has, you say, gone out for public comment?

MR. NORBERG: It has been out for public comment. We have received the public comments, and the ACRS comments are now being resolved.

MR. ARLOTTO: The discussion with the ACRS is basically to go effective with the guides --

CHAIRMAN AHEARNE: Well, their latest comments on it were more aimed at it was unclear.

MR. ARLOTTO: Yes.

CHAIRMAN AHEARNE: Previously they had been unable to ge it out and --

MR. ARLOTTO: I would point out that it is in the context of going (inaudible).

MR. NORBERG: Yes.

CHAIRMAN AHEARNE: Yes.

MR. NORBERG: I think the most important thing here is that the ACRS comments really did not address the -- had no disagreement with the ranges of these instruments.

CHAIRMAN AHEARNE: Right.

MR. NORBERG: Or the specifications. It was more in the format and the way this guide was presented and this sort of thing, is my understanding.

So it wasn't the technical content of the guide. It is still correct in the guidance that is referenced here.

Another is sampling during and following an accident. One of the problems faced by the TMI-2 operators during and following the accident was the difficulty they had in obtaining and analyzing samples of the highly radioactive reactor coolant and containment atmosphere.

There was no capability at TMI-2 to obtain and analyze in a timely manner those highly radioactive samples. This lack of sampling capability resulted in significant delays in obtaining critically needed information which could have assisted the operators in recognizing and coping with the accident.

This proposed amendment requires that LWR's are provided with the capability for personnel to promptly and safely obtain and analyze a reactor coolant or containment atmosphere sample during and following an accident.

These capabilities must include either on line or on site radiological and chemical analysis facilities to determine the degree of core damage, hydrogen in the containment atmosphere, total dissolved gasses and dissolved hydrogen in the reactor coolant, and the boron and chloride content of the reactor coolant.

In plant iodine instrumentation. 10 CFR Part 20 provides criteria for control of personnel exposures to radiation in restricted areas, including airborne radioiodine. Whenever airborne radioiodine concentration exceeds specified limits, exposed personnel must take precautions, such as wearing respiratory protective equipment.

Such actions, particularly for control room personnel, can sharply limit communication capability and may even diminish their performance capability.

Because of the method used at TMI to determine radioiodine concentrations, these concentrations were greatly overestimated and resulted in control room personnel needlessly wearing respiratory protective equipment with its associated operational problems.

The purpose of this proposed amendment is to require improved accuracy for the measurement of airborne radioiodine concentration within nuclear power plants.

Next slide, please.

The second area, specifications in the proposed interim rule that relate to in plant radioactive activity considerations are: protection of safety equipment and areas which may be used during and following an accident.

This proposed amendment addresses two aspects of radiation problems encountered at the TMI-2 accident and relative to any degraded core accident.

The release of large amounts of highly radioactive material from the core can result in high radiation fields wherever this material may be carried in the course of the accident.

Systems and components that were not designed to accommodate large radiation fields may be severely degraded. Also, safe access of personnel for operation of vital equipment needed to cope with the accident may be jeopardized because of high radiation fields.

The purpose of this proposed design requirement is to facilitate operations during and following an accident in areas affected by systems that may contain abnormally high levels of radioactivity and to ensure that the equipment, the safety equipment in proximity to the resulting radiation fields are not unduly degraded.

Leakage integrity outside containment. Several of the engineered safety features and auxiliary systems located outside reactor containment will or may be called upon to function during and following a degraded core accident. These systems may carry highly radioactive fluids, and the leakage from such systems must be minimized to prevent the release of significant amounts of radioactivity to the environment.

The purpose of this proposed amendment, purposes, are to require that every reasonable effort be made to eliminate or reduce leakage from these systems by requiring a preventive maintenance program and periodic test to ensure that leakage is kept to the minimum and to provide the plant staff with current knowledge of the system leakage rates.

The source term to be considered for all of the above requirements as may be applicable is specified in the proposed amendment on protection of safety equipment and areas which may be used during and following an accident.

This source term is essentially the same that has been used in evaluating compliance with 10 CFR Part 100. That is --

CHAIRMAN AHEARNE: 75 percent?

MR. NORBERG: No, Part 100.

CHAIRMAN AHEARNE: I know, but --

MR. NORBERG: That is 100 percent release of core equilibrium noble gas inventory, 50 percent of core equilibrium halogen inventory, and 1 percent of the remaining core fission products are released from the fuel to the primary system.

It further specifies that for the containment and areas affected by its atmosphere it shall be assumed that 100 percent of the core noble gas inventory and 25 percent of the core halogen inventory are uniformly dispersed in the containment atmosphere and that an additional 25 percent of the core halogen inventory and 1 percent of the remaining core fission products are uniformly distributed on surfaces exposed to the containment atmosphere.

COMMISSIONER GILINSKY: What is approximately the core halogen inventory?

MR. NORBERG: In terms of curies?

COMMISSIONER GILINSKY: Yes.

MR. NORBERG: Oh, boy, do you know?

MR. ROSS: 100 and some million.

COMMISSIONER GILINSKY: About a 100 million.

MR. ROSS: I could give it to you in pounds.

COMMISSIONER GILINSKY: 150 million curies.

MR. ROSS: I understand it is about 35 pounds.

COMMISSIONER GILINSKY: Well, it is on the order of 100, 200 million, 150 million.

MR. ROSS: It seems to me.

COMMISSIONER GILINSKY: Okay, that is good enough.

MR. NORBERG: It should be noted that this source term will be reevaluated during the long-term rulemaking on the consideration of degraded core or melted core in safety regulations.

Next slide, please.

CHAIRMAN AHEARNE: Are you going to get into in this discussion how you arrived at the eight hour 75 percent?

MR. NORBERG: That comes at the end of this discussion, yes.

CHAIRMAN AHEARNE: Fine.

MR. NORBERG: Early in the course of events of the TMI-2 accident, when it was recognized that substantial core damage had occurred, it was also recognized that a large amount of hydrogen had been generated as a result of fuel clad water reaction.

Subsequent assessments of the accident by the Lessons Learned Task Force and others pointed out the discrepancy in the current regulations on hydrogen control in 10 CFR Part 50.44, and the resulting conditions at TMI-2.

As you know, 10 CFR 50.44 requires that all LWR's must be designed such that one, an uncontrolled hydrogen-oxygen recombination will not take place in the containment, or, two, the plant can withstand the consequences of uncontrolled hydrogen-oxygen recombination without loss of safety. If neither of these conditions can be shown the containment must be provided with an inerted atmosphere or an oxygen-deficient condition in order to provide protection against hydrogen burning or explosions during this time.

Prior to the promulgation of 50.44 in 1978 --

COMMISSIONER GILINSKY: How do you interpret without loss of safety? Is that when you stay within the safety margins, the design margins?

MR. NORBERG: Yes, that is how I would interpret it.

COMMISSIONER HENDRIE: Well, without loss of safety functions.

COMMISSIONER GILINSKY: Yes.

COMMISSIONER HENDRIE: The concern in particular was that a flammable event in the containment might take out essential, both trains of essential safety systems that you needed to control the core, keep it cool after shutdown, et cetera, or in the event of an accident to keep the containment in shape, containment sprays and so on.

MR. NORBERG: Or not fail the containment itself.

COMMISSIONER HENDRIE: Keep the heat --

COMMISSIONER GILINSKY: Well, actually what I am asking is, is it containment failure, is it containment -- in terms of interpreting the rule, or is it staying within design margins?

MR. ROSS: I don't think prior to the last couple of months we had ever focused on beyond design pressure capabilities. As far as pressure would be concerned, it would be design, not failure.

COMMISSIONER GILINSKY: In interpreting 50.44?

MR. ROSS: Yes.

COMMISSIONER GILINSKY: Yes.

MR. NORBERG: Prior to the promulgation of 50.44 in 1978 all Mark I BWR's were required to inert in order to comply with safety guide 7, control of combustible gas concentration and containment.

This guide specifies that a 5 percent fuel clad water reaction should be considered to take place during the LOCA blowdown; that is, within about the first two minutes of a large break LOCA.

The guide recommends inerting of small containments to provide sufficient time for combustible gas control systems to reduce the hydrogen concentration following a LOCA.

10 CFR 50.44 gives credit for ECCS performance. This boils down to the design basis of approximately 1 percent fuel clad water reaction or five times the amount of such reaction as determined in complying with the ECCS acceptance criteria of 10 CFR 5046, whichever is the greater.

Now what this means is that if a plant just complies with the ECCS criteria which specifies a 1 percent metal-water reaction, then this criteria would require that the fuel clad water reaction would be 5 percent. However, as stated before, a lower limit is established of 1 percent in any case.

COMMISSIONER GILINSKY: And typically what is the limit for most plants?

COMMISSIONER HENDRIE: One percent, because all of these ECCS analyses come out well below --

COMMISSIONER GILINSKY: Well below .2 percent?

COMMISSIONER HENDRIE: Below .2 percent, yes.

MR. ROSS: No, there is two types of pla-ts that come close to being limited by the 1 percent metal-water reaction instead of peak clad temperature, the nonjet pump BWR, because it has a long heatup before the core spray turns the temperature around, and the system 80 design. Both of those come very close to being limited by the 1 percent, and in which case times 5 would take them up to 5 percent.

Of course the system 80 has a large dry containment, so even 5 percent is not a big problem for them.

COMMISSIONER GILINSKY: But you say the effective number for most of them is 1 percent, most of the plants?

COMMISSIONER HENDRIE: I think so, yes.

MR. ROSS: Well, no, I think most -- even what I would call a good PWR probably gives more than .2 of a percent corewide metal-water reaction. I would have to check, but some typical number is .3, .4.

COMMISSIONER GILINSKY: I see. So it is somewhere between 1 and 5?

MR. ROSS: Yes.

COMMISSIONER HENDRIE: Denny, I thought it didn't and that there were --

COMMISSIONER GILINSKY: Well, it still sounds like between 1 and 3 percent.

COMMISSIONER HENDRIE: -- the 50.46 calculations typically ended up low enough so that the 1 percent was what counted.

MR. ROSS: I would say generally the numbers, the corewide metal-water reaction is generally above .2 and for later plants it is pushing 1.

COMMISSIONER HENDRIE: Really?

MR. ROSS: Yes.

MR. NORBERG: So you are getting up towards 5 percent then?

MR. ROSS: Yes. The Mark III I don't have a number for. I really don't know what that is. If it is important I could get the number in a few minutes.

COMMISSIONER GILINSKY: This is because of a flattened flux distribution or what?

MR. ROSS: Well, the system 80 just happens to have a low reflood rate and it takes a long time to turn around. Their flux isn't any different than any other PWR.

COMMISSIONER HENDRIE: But those boilers must have been pretty low, because my understanding at the time we made, worked out the revision to Reg Guide 1.7 and that subsequently became 50.44 was that the 50.46 ECCS calculation metal-water was low enough so that they would be working at or slightly above 1 percent metal-water reaction under 50.44 and would be -- and that was low enough to allow them to deinert, not to inert a containment.

MR. ROSS: That is probably true. It is the nonjet pump BWR that I am sure that is near 1 percent. That is the only one I am sure is high.

MR. NORBERG: I think, Dr. Hendrie, that if it calculates somewhere below about .5 percent that they would not have to inert their BWR, their containment.

COMMISSIONER HENDRIE: So a 2 1/2 percent metal-water is accommodated?

MR. NORBERG: Yes, or 3 percent would be accommodated without inerting. So they can come -- you know, in they are well within the ECCS calculation of 1 percent, then chances are they won't have to inert, and it is the staff's view --

COMMISSIONER GILINSKY: What is the crossover point for inerting or not inerting under 50.44?

MR. NORBERG: It is 4 percent.

COMMISSIONER HENDRIE: 4 percent hydrogen in the containment.

COMMISSIONER GILINSKY: So most of the Mark I's --

MR. NORBERG: Most of the Mark I's --

COMMISSIONER GILINSKY: -- must not be making anywhere near the numbers that you are --

COMMISSIONER HENDRIE: Yes, they are.

COMMISSIONER GILINSKY: Then why are they inerted?

COMMISSIONER HENDRIE: Because they hadn't collected themselves speedily when 50.44 was passed in order to come in and ask for deinerting.

COMMISSIONER GILINSKY: Oh, and present the analysis?

MR. NORBERG: That is right.

COMMISSIONER HENDRIE: Yes, just so. And then once we got started --

COMMISSIONER GILINSKY: I see.

COMMISSIONER HENDRIE: Once Three Mile happened, why --

COMMISSIONER GILINSKY: So in a way 50.44 opened the door to deinerting?

COMMISSIONER HENDRIE: That is right.

MR. NORBERG: That is right. That is what it did.

COMMISSIONER GILINSKY: Okay

COMMISSIONER HENDRIE: In fact, the revisions to Reg Guide 1.7 opened the door to deinerting for most of those plants. I have got a notion that the reason most of them didn't come in and do it was -- on the Reg Guide was that it meant that they would have to petition the Commission for reconsideration of their license conditions which would have inerting in it, and then they would be vulnerable to a hearing and there was practically nothing they wanted to do less than come to a hearing.

CHAIRMAN AHEARNE: You don't do it unless it is absolutely necessary.

COMMISSIONER HENDRIE: So there was a reluctance. Then when it became a regulation why it seems to me they --

CHAIRMAN AHEARNE: Well, they were when one of these earlier papers, when these guys were in, industry reps did mention at our meeting here, they were preparing to come in, except then the Three Mile Island came along.

COMMISSIONER HENDRIE: Well, I think GE was encouraging them to do it because they would have liked, I think, to have been relieved of the burden of having inerted containments, at least for most of their plants, and I wouldn't be surprised what they were, had some sort of an owners group that met occasionally and made -- were preparing to move in that direction.

COMMISSIONER GILINSKY: Is Hatch not inerted because it has made an application --

COMMISSIONER HENDRIE: Hatch 2 came along sufficiently late so it rode 50.44 and didn't inert.

COMMISSIONER GILINSKY: I see.

COMMISSIONER HENDRIE: Vermont is not inerted because they beat us before the Appeal Board.

COMMISSIONER GILINSKY: Not us.

(Laughter.)

MR. NORBERG: Those are the only two operating --

COMMISSIONER GILINSKY: What do you mean we?

MR. NORBERG: Those are the only two operating PWR's that are not inerted, Hatch and Vermont.

COMMISSIONER HENDRIE: Yes.

COMMISSIONER GILINSKY: Well, what was the argument of the Appeal Board on why it was okay?

COMMISSIONER HENDRIE: What happened, the staff, before the licensing board, the staff just assumed that they would inert like everybody else, and the Vermont Yankee people grumped about it and the staff just shrugged and said, you know, you will have to do it. It just that all of the others are inerted, and we insist you inert, and that is that.

So the staff didn't bother to present much in the way of evidence. They just said, we the staff think it ought to be inerted. You know, so ordered. And the applicant came in and put on two days of witnesses about how negative for safety it was to inert because of the difficulty of getting into containment. The board allowed the hearing record to close in that fashion, and here was the staff with essentially no substantive evidence on the record versus the applicant's substantial case, and the Appeal Board looked at that and said haha, they win.

COMMISSIONER GILINSKY: Well, how could --

COMMISSIONER HENDRIE: You know, weight of the evidence.

COMMISSIONER GILINSKY: How could they ignore the regulation?

COMMISSIONER HENDRIE: Because there wasn't a regulation at that time.

COMMISSIONER GILINKSY: Oh, I see.

COMMISSIONER HENDRIE: It was Reg Guide 1.7, and the staff and the ACRS were muscling people by saying we won't support your application unless you knuckle under.

COMMISSIONER GILINSKY: Okay.

COMMISSIONER HENDRIE: Vermont on this particular point didn't knuckle.

MR. MALSCH: I think also the Appeal Board went off on a theory that you couldn't assume degraded ECCS performance because that was a challenge of the ECCS criteria and to require inerting somehow entailed that assumption that the ECCS wouldn't work and that wasn't permissible.

COMMISSIONER HENDRIE: Yes. But that was another aspect of the Appeal Board attack on the thing. It was much more troublesome than the specific decision in the Vermont case, because when the Commission later reversed it was to reverse that general philosophical argument and not the particular Vermont decision, which --

COMMISSIONER GILINSKY: How could they avoid inerting after 50.44 came in?

COMMISSIONER HENDRIE: Because they weren't inerted. They were given a license and not required to inert to operate, and when 50.44 came in, if the staff had tried to once more inert them they would have produced an analysis that showed that they fell under -- fell in the clear under 50.44.

MR. ROSS: It would be like Hatch, would it?

COMMISSIONER HENDRIE: Yes, just like Hatch. It would have been just like Hatch.

MR. MINOGUE: During this same period the metal-water fraction that uses the basis change from 5 percent down to effectively for these plants a 1 percent figure.

COMMISSIONER GILINSKY: I see.

MR. MINOGUE: And that swung the balance back the other way.

COMMISSIONER HENDRIE: In fact, we had to go up to the Appeal Board and argue on the one hand that Vermont ought to inert even though we were in the process of promulgating a reg guide under which it could then promptly deinert, and the Appeals Board -- you know, it was all quite clear to us, but the Appeals Board seemed to have some trouble with following the logic.

MR. NORBERG: As we all know, the fuel clad water reaction at TMI-2 may have been considerably higher than what is called for in the current regulations, and it has been estimated it could be as high as maybe 50 percent.

So in view of --

CHAIRMAN AHEARNE: Do we have -- I know each time we hear these kinds of presentations we have that kind of a statement -- are we pinning down any more specifically or will it wait until we actually get a look at the core?

MR. ROSS: I asked our coperformance branch chief, Dr. Johnston, that the other day, if he had any new insight from various, the answer was no and they really didn't get expect to get anything until we start looking at the core. There has been no new information. Speculation only.

CHAIRMAN AHEARNE: And that is a speculative number also of course.

MR. NORBERG: In view of the TMI-2 accident, the staff now believes that 10 CFR 50.44 needs to be modified and that it is prudent to require all Mark I and II containments to be inerted.

COMMISSIONER GILINSKY: Can you tell me how many Mark I's and Mark II's there are?

MR. NORBERG: There are, I think, a total of 36. There are 16 new ones coming in and 20 that are operating now, is my understanding.

MR. ROSS: Did you refer just to operating plants?

COMMISSIONER GILINSKY: Well, no, the total.

MR. ROSS: That is the total, I think.

COMMISSIONER GILINSKY: There are still 16 Mark I's and Mark II's --

MR. NORBERG: But of which about 18 of those --

MR. ROSS: I think there is only one Mark I left, I believe, and I think that is FERMI, that is not running.

COMMISSIONER GILINSKY: Right. So there are 15 Mark II's and they are in the pipeline?

MR. NORBERG: I think that is correct. I think the total -- when we were doing the value impact statement there were a total of something like 36 Mark I and II's, and I believe that --

MR. ROSS: Yes, that is right.

MR. NORBERG: -- 18 of them, like you say, are already inerted.

Going on then, we say for all other --

CHAIRMAN AHEARNE: Yes. I guess the inerting cost of 16 Mark I and II plants, a total of 36 plants, so it must be 20 that are already inerting.

MR. NORBERG: Yes. For all other LWR plants the proposed rule is requiring design analyses for measures to handle large amounts of hydrogen. These design analyses are to consider up to 75 percent fuel clad water reaction that takes place over an eight-hour period.

CHAIRMAN AHEARNE: Could you say a few words about how you chose those two numbers?

MR. ROSS: Well, it is not a very scientific number. When we look at -- it is certainly not related back to the one datapoint we have from Three Mile.

CHAIRMAN AHEARNE: Which, as you have just explained, is a sort of fuzzy datapoint?

MR. ROSS: Right. Well, no, at least we know the time reasonably well, although we may not know the height of the curve. But it could be as short as two hours if you postulated the sequence that is going to take you all the way to core melt.

I don't think the eight hours or two hours is particularly important, and --

CHAIRMAN AHEARNE: It is the rate difference between those two --

MR. ROSS: No, I don't think so, right. At least I would hope that there wouldn't be a facility that could stand eight but not two.

CHAIRMAN AHEARNE: Well, would a recombiner be able to handle eight and not two?

MR. ROSS: No.

CHAIRMAN AHEARNE: Or is that still too fast for them?

MR. ROSS: No, there are several orders of magnitude. They can handle a tenth of a percent per day, so it wouldn't make any difference to a recom or to a purge either one.

So we will probably just put a short period of time in there and have just as good a rule. We just want to make sure it was short.

COMMISSIONER HENDRIE: Well, there may turn out to be a substantial difference between several hours and two minutes.

MR. ROSS: Yes, I agree.

COMMISSIONER HENDRIE: So if you bring the time down to arbitrarily short times you in effect don't allow any measurement of approaching flammability concentration, actions that take place, turn on igniters or run a quench system. And there is no time at all for heat removal either. You have to take the full energy burden all at once. And I suspect that that makes a whale of a lot of difference. My own --

CHAIRMAN AHEARNE: But you are not saying that the two to eight hours --

COMMISSIONER HENDRIE: Well.

CHAIRMAN AHEARNE: Because if you are, if there really is a significant difference, then I guess one ought to at least take into consideration what is the possible impact if it is --

MR. ROSS: Here is the difficulty we are in. We can postulate a sequence, for example loss of all -- complete station blackout, loss of AC, loss of DC, where the only thing that would happen is you just sit there and boil the water off, because you would have no control, no heat removal, nothing.

If you analyze that sequence, you know the thermal capacitance of the core fairly well, and you can calculate reasonably well what the hydrogen production would be and it would, in an hour or two you are going to get essentially all the reaction. And of course this goes to core melt.

You could postulate though at the end -- magically at the end of say 60 percent reaction and just before the thing is --

COMMISSIONER HENDRIE: But that is just on a thermal balance?

MR. ROSS: That is right.

COMMISSIONER HENDRIE: That is not taking into account the availability of water vapor once you boil it out of the core?

MR. ROSS: Well, yes, it is. There is a calculation I was talking about done with a code like MARCH that would have a source of steam, and it accounts for the interchange, plus or minus, with the steam. In other words, some portion of the core the steam would be a heat source and some would be a sink.

But these calculations I think are reasonably fictitious because they suggest that you know how you are going to get the degraded core but not the molten core, and I don't think we are that smart yet. But it can be used to give the lower limit in time, and the lower limit is an hour or two. I don't think it can get any shorter than that.

COMMISSIONER GILINSKY: Are you talking about the time to generate the hydrogen or the time to release it to the containment vent?

MR. ROSS: Well, I am assuming that the release from the core is the same time as the release to the containment, and what I am talking about is the time it would take to boil the system down, heat the core up, in reaction of course with the -- the metal-water reaction -- --

CHAIRMAN AHEARNE: -- negligible time transfer?

MR. ROSS: The transport time would be negligible.

COMMISSIONER GILINSKY: But that wasn't the case at Three Mile Island, was it?

MR. ROSS: No, because there was some storage in the -- because, you see, in this sequence I am talking about the relief and safety valves are open or something that was open, and you are getting a -- it is an uncontrolled release, and of course TMI was a semi-controlled --

COMMISSIONER GILINSKY: Why do you need to get into that at all? Why don't you simply assume a range of times over which the material, hydrogen would be released to the containment from one hour to several hours?

MR. ROSS: That would be okay too. I don't think it would dominate the accident analysis, and over a range of one to eight hours would certainly be an acceptable way to phrase the rule also. It might even be preferable.

CHAIRMAN AHEARNE: It seems to be preferable, given your answer. At least I would think so.

MR. ROSS: Yes.

COMMISSIONER HENDRIE: I think you are driving down to unrealistically short times.

COMMISSIONER GILINSKY: You mean one hour?

COMMISSIONER HENDRIE: Yes. I have got a notion that with that kind of -- by the time you get down to -- as you come down to shorter and shorter times you pose a more and more difficult design problem.

COMMISSIONER GILINSKY: Wasn't that roughly what happened at Three Mile Island?

COMMISSIONER HENDRIE: Well, you got a good chunk of it in that hour early in the morning, but there were some other high temperature periods during the day. I remember there was a time when they had it cut off later in the morning. The high pressure injection cut off. And then there was a time later after that when they spent some hours trying to bring the pressure of the system down, and it is clear that they were, you know, steam --

COMMISSIONER GILINSKY: Well, I would assume there was release during that period. I would assume it was released during that period when they were bringing it down rather than at the earlier time when it was generated.

COMMISSIONER HENDRIE: Well, I think they probably got a little early on, got some of it early on, but the times during which the core must have been, elements of the core must have been at temperature and able to produce substantial amounts of hydrogen, the metal-water reaction, I think at Three Mile was of the order of several hours rather than that initial 140-odd minute period.

COMMISSIONER GILINSKY: Well, in any case I would focus on the release rather than on the generation; I mean if you believe that it is the same that --

MR. ROSS: I think it would be prudent to assume that there is no delay anyway, storage in the system.

MR. NORBERG: I think the answer to Chairman Ahearne's question, the reason that it was specified this way in the rule is that we did not want to try to specify scenarios for this situation, which is about what you would have to do in order to start putting this thing in time sequence.

CHAIRMAN AHEARNE: My concern I guess I try to clumsily state it, is that if the results, the analysis and the interpretation of the analysis is going to be significantly dependent upon the percentage and the time, then you would have to have some pretty good reasons for choosing the specific numbers. And if we don't have those really good reasons, then I would think you would have to at least leave open the possibility of looking at a broader range.

MR. ROSS: I only answered half the question. The 75 percent was based on the general feeling that that is where a degraded core stops. You go much beyond that you are into a molten core, and that is another rulemaking.

CHAIRMAN AHEARNE: Okay, but what you are saying there is that the analysis should look at --

MR. ROSS: Right.

CHAIRMAN AHEARNE: You are not necessarily yet saying that you have reached the conclusion that the mitigating features ought to be put in place to handle that, or are you?

MR. ROSS: Well, that is right. The analysis for some reactor, for example, could well be that we can't stand 85 percent -- 75 percent in eight hours. That doesn't yet mean anything has to be done.

Again, if the results were very sensitive, that I could stand 75 but not a 100, then I think that is trying to play it too close also. If we want protection at a 100 we should want it at 75.

MR. NORBERG: Well, to go on, then --

COMMISSIONER GILINSKY: Could I just ask one more question? When we talk about these percentages, it is a percentage of what? When we say percent metal-water reaction, are we just talking about the clad or are we talking --

MR. ROSS: Fuel clad, yes.

CHAIRMAN AHEARNE: The particular percent here is percent of fuel cladding.

COMMISSIONER GILINSKY: But there are other pieces of zirconium metal in there, aren't there, and certainly --

MR. ROSS: A BWR has a massive amount of zirconium in the --

COMMISSIONER HENDRIE: It is the fuel clad, classically is the fuel clad around the pellets and does not include the end tubes, end plugs or other zirc alloy structural members, and the reason just is that you have much less opportunity to raise that stuff to the kind of temperatures that are needed, a couple of thousand degrees Fahrenheit, to get a fairly rapid chemical reaction going.

In order to get metal-water reaction for the end pieces and zirc alloy structural members in the core, you would have to melt the whole bloody thing down and have essentially a several thousand degree melt somewhere down in the bottom and then in contact with water vapor, and then indeed you would get some zirconium-water reaction. But that is --

COMMISSIONER GILINSKY: Is that true of the pieces in the guts of the core as well?

COMMISSIONER HENDRIE: Oh, yes, I think so. Things like channel boxes --

COMMISSIONER GILINSKY: Yes.

COMMISSIONER HENDRIE: -- frames on the elements, the cladding around the control rod fingers, for instance. You just need that intimate heat transfer contact between the high temperature fuel and the external world in order to get the zirc alloy up there.

COMMISSIONER GILINSKY: And that seems reasonable for end plates, but I guess I am a little surprised that it is also true for zirc alloy in the center of the core.

COMMISSIONER HENDRIE: Companion rods and so on?

Well, the thing that distinguishes the fuel clad in the pellet region from all other material is that that material forms a boundary around the hot fuel, within which the energy is being generated and is therefore the heat conduction path. All the energy has to flow out through that cladding. That is not true of any of the other metal, and you just don't develop then the very large delta T -- -- because the ambient after all is going to be a few hundred, four or five hundred degrees F. or something like that, water and steam and the background temperature of the vessel, as the radiation sink --

COMMISSIONER GILINSKY: Yes, but when you are right in the center you can't see outside, any direction you look you just see rods, I assume.

COMMISSIONER HENDRIE: Yes, but the thing is immersed at least in a steam atmosphere.

CHAIRMAN AHEARNE: Have you done code runs perhaps?

MR. ROSS: Not to answer this question. The only thing that would shed light only goes up to a point. We have heat transfer tests with unfueled rods, but these tests stop around 2000 degrees Fahrenheit. And they suggest that the unfueled, unheated rod would lag the heated temperature by two or three hundred degrees when you have a low, a relatively low cooling rate.

The thing that is inconsistent about the calculations we are talking about, if you don't want to be steam limited you have to supply a lot of steam to convert the zirc alloy. If you supply a lot of steam, then you are probably going to keep these unheated things down near the local saturation. But the thing we haven't done is do individual fuel pin calculations up to the high metal-water reactions, given enough steam so that the zirc alloy is not steam limited. We are just not in a production basis on that. I think we could be but we haven't done it yet.

MR. NORBERG: Well, the measures that we are requiring the people to analyze include inerting, hydrogen recombiners, purging, halon suppressing, filtered vent, hydrogen combustion or ignition systems, water fog-spray systems, and combinations of these or any other things that they believe can handle this problem.

And for operating plants these studies are to be completed six months from the effective date of the rule.

Another proposed modification to 50.44 is to require that dedicated penetrations be provided for plants that rely upon external recombiners or purge systems to meet the hydrogen control requirements.

The TMI-2 plant had capability to connect hydrogen recombiners; however, the design was susceptible to single active failure and possibly even degraded performance of the recombiners.

This modification will eliminate these problems.

CHAIRMAN AHEARNE: What plants does that really cover? Since what, 1970. The plants have been required to have recombiners?

MR. NORBERG: Yes, it would be those plants that now have the capability to hook up a recombiner, but they may not have a dedicated penetration. If you remember in TMI the way they hooked up the --

CHAIRMAN AHEARNE: Yes, I remember that.

MR. NORBERG: -- was through, you know through their main --

CHAIRMAN AHEARNE: No, I was just trying to get a sense of what class of plants was that --

MR. NORBERG: Yes, it is those basically from I guess about November 5th, 1970 on that were required to have recombiner capability.

The ones prior to that only required purge.

CHAIRMAN AHEARNE: All right, and it is --

MR. NORBERG: I am not all of the plants have this problem.

MR. ROSS: I don't have an inventory of which one.

CHAIRMAN AHEARNE: Yes, but this would be requiring though for all plants to rely upon purge to put in external recombiners.

MR. NORBERG: That is another requirement, yes, that is correct.

MR. ROSS: But we wanted to get into a position where if you had hydrogen generation like the rates of 50.44 is today, there was a reasonably small amount, and you had radiolysis and a continuing hydrogen generation, such that in a matter of weeks you were going to have to purge the containment or be up at the lower combustible limit. We wanted that facility not to have to purge.

That would mean he would have to get a penetration, an external hardware shielding, but recognizing that it might be weeks before he needed it, he could move in a recombiner from somewhere else. And the rule as written doesn't require him to have it at his facility but be ready to accommodate in a few days.

CHAIRMAN AHEARNE: Do Hatch and Vermont have recombiner capability?

MR. ROSS: Who, Hatch?

I don't know.

CHAIRMAN AHEARNE: Bob?

MR. TEDESCO: Yes, Hatch does. Vermont (inaudible).

MR. NORBERG: I think we have two things here. We are talking about requiring plants that now have the recombiner capability to have dedicated penetration --

CHAIRMAN AHEARNE: Right.

MR. NORBERG: -- and those that earlier only relied on purge systems to now have capability to hook up to recombiners, which also has to be dedicated.

CHAIRMAN AHEARNE: Right, and so I am trying to figure now, very briefly you have been talking about Mark I and II and we also have the ice condenser issue. What of these requirements would be laid on? I guess the Mark I's that are inerted neither of those apply to. Is that correct?

MR. ROSS: That is right.

CHAIRMAN AHEARNE: All right, Hatch you say already has the recombiner, so there it would be the issue of you would have to make sure it has dedicated penetration.

MR ROSS: That is right.

CHAIRMAN AHEARNE: Vermont Yankee, were it not to be required to be inerted would then have to -- right now it relies upon, would be classed as a plant relying on what? The purge system?

MR. NORBERG: Purge, yes.

CHAIRMAN AHEARNE: All right, how about the ice condensers, which would not be required under this to be inerted? Do they have recombiners?

MR. ROSS: Yes, internal. So they don't have to worry about either one of these.

CHAIRMAN AHEARNE: I see, they all have internal recombiners?

MR. ROSS: Yes.

COMMISSIONER GILINSKY: Why do we have recombiners?

MR. ROSS: For the long-term --

COMMISSIONER HENDRIE: Radiolytic hydrogen.

MR. ROSS: -- hydrogen generation on top -- a radiolysis on top of the threshold of hydrogen from the 50.44 assumption.

COMMISSIONER GILINSKY: How much can get generated that way?

MR. ROSS: How much do you generate? It must be slightly less than a tenth of a percent per day. To me --

COMMISSIONER GILINSKY: Because that is the capacity of the recombiners?

MR. ROSS: It is less of a tenth of a percent per day because the recombiner turns it around, and --

COMMISSIONER GILINSKY: What is the concern about generating a tenth of a percent per day?

COMMISSIONER HENDRIE: Well, just that you build up a flammable concentration over time.

MR. NORBERG: Over a long period of time.

MR. ROSS: There are several sources. There is also a potential for a corrosion source. There is -- some of these plants inject caustic -- -- and there is even a tiny bit from the indigenous hydrogen that was put in there to begin with, not much, but --

COMMISSIONER GILINSKY: Well, so over --

COMMISSIONER HENDRIE: But the main concern here was that with a major accident, fission products distributed in the water so that it wasn't just the radiolytic decomposition from a core with fission products contained in fuel oxide, in fuel rods, and you were just getting the gamut through the shell, but if you had fission products out in the water, the concern was that the radiolytic decomposition rate might be high. So one went and looked at the decomposition rates in various experiments and so on and took you know sort of reasonable upper bound sort of values and then looked at measures to be able to stand that hydrogen generation rate over a long period of time.

MR. ROSS: In some instances 17 --

COMMISSIONER GILINSKY: And the concern is what, that you will somehow harm equipment or what?

COMMISSIONER HENDRIE: No, that you will go flammable in the containment and get a burning --

COMMISSIONER GILINSKY: No, I understand, but --

COMMISSIONER HENDRIE: -- or a detonation.

MR. ROSS: The concern was generally containment pressure.

COMMISSIONER HENDRIE: Containment integrity basically.

MR. ROSS: I don't recall at that time --

COMMISSIONER GILINSKY: Over a period -- I mean it would take many months then to get --

COMMISSIONER HENDRIE: Well, depended on -- it seems to me those -- let's see, help me out, Bob.

MR. ROSS: Several weeks is what I call --

COMMISSIONER HENDRIE: Large PWR's could get flammable, sort of taking, you know sort of worst case generation rates from radiolytic decomposition in what, several weeks?

MR. ROSS: That is what I remember, yes.

COMMISSIONER GILINSKY: Well, it may get flammable, but they are not, they can easily take the pressure.

MR. ROSS: But barely detonable, yes, right.

COMMISSIONER GILINSKY: You are talking about BWR's or PWR's?

COMMISSIONER HENDRIE: But you know, we were regarding, we weren't allowing a flaming in the hydrogen in those days.

COMMISSIONER GILINSKY: So that was just a line you drew?

MR. ROSS: That is right.

COMMISSIONER HENDRIE: We just said 4 percent hydrogen and that is it, you don't go up there.

COMMISSIONER GILINSKY: All right.

MR. NORBERG: Well, regarding the purge, the requirements to put recombiner capability on the old plants, there are about 40 plants with CP applications. Our notice is prior to November 5, 1970 that this requirement would be involved with. And this requirement was not included in the letters to the licensees and applicants. However, the staff now believes that means other than purging and venting should be available to reduce the likelihood of the release of radioactive material to the environment in the event of a degraded core situation.

Another hydrogen-related requirement is proposed in the rule to provide operational capability when needed to enhance primary system cooling capability under accident conditions.

This proposed requirement is for highpoint vents in the reactor primary coolant system. The purpose of this design requirement is to provide the operators with the means for rapidly purging the primary coolant system with noncondensable gasses that could accumulate and possibly degrade or even prevent adequate core cooling flow, particularly under natural circulation conditions. Such a situation as occurred at TMI-2.

COMMISSIONER GILINSKY: What, you told me last time, I am afraid I have forgotten the answer -- what did you do about the two conflicting requirements on the one hand requiring that a vent be available to vent large amounts of hydrogen fairly quickly and the other that they need to demonstrate that in doing so they had to stay below 4 percent? Was the last part dropped?

MR. ROSS: Right, the September 1979 or the

October 1979, whichever, clarification letter had mentioned trying to keep, that you should try to keep the hydrogen down below 4 percent or some number. On further reflection we decided to excise that from the clarification package that we intend to go out -- well, it was due to you today I believe or tomorrow -- such that the plant operator would focus solely on getting rid of the hydrogen and restoring core cooling at whatever rate was appropriate, whatever rate he could do it.

Now if you do certain calculations you could show that at high pressures that would mean getting rid of enough hydrogen to be equivalent to a large percent of core metal-water reaction, and if you distributed it all at once and didn't burn it, then you could have a high containment concentration.

COMMISSIONER GILINSKY: Well, I don't know whether this is the right time to discuss that, but I was wondering how you square that with the rest of the rule.

VOICE: I don't think we do. We just admit that it is in there.

MR. ROSS: Well, I don't think it is --

COMMISSIONER GILINSKY: A rather disarming approach.

MR. ROSS: I don't really think it is agreed it is inconsistency. It says have the ability to get rid of the noncondensable in a short period of time. The alternative, if you had this large amount, the alternative to getting rid of it might be melting the core.

So it is, you know, what it does to the hydrogen, to the containment later on could be the least of your problems, if you had this stuff.

I am not sure it helped any, but there are other places where regulations are not perfectly consistent and that what is conservative for one may be superconservative for another. And in particular, Part 100 releases versus a design basis loss of coolant.

COMMISSIONER GILINSKY: Except I think we have tended to go the other way in conservatism. If I remember correctly, 50.44 or Reg Guide 1.7 or both have got some statements such as it is perfectly consistent with regulatory practice to be more conservative with a containment than with the other parts of the system. And that is where you get the factor of 5 in all that.

And I guess I think that that was a perfectly reasonable approach. Here one is going in the opposite direction.

VOICE: No, I don't really think it is the opposite direction because what you are really trying to do with this vent situation is prevent a meltdown. And if you can't do that, whatever else you have is of no avail. So that is where the most conservative ought to be in your requirement, the way I look at it, even though that conservatism might result mechanistically in loss of the containment. You have got the most conservatism in place.

COMMISSIONER GILINSKY: Well, in terms of the decision as you put it, I mean given that bad choice, you make the best of it, and I guess you are probably making the right decision. But that -- I guess what I am getting at -- we have talked about this a lot, this isn't the first time we have been over this, and my point is that I guess I wouldn't want to be faced with that choice and would impose requirements on the containment in the first place.

MR. ROSS: I think the issue is kind of moot because if you interrupt core cooling, your reactor system pressure is going to go up and lift the relief valve and let the gas out whether you want it to or not, except it may let out more water than you would like it to let out, along with a certain amount of hydrogen.

CHAIRMAN AHEARNE: Bob?

MR. MINOGUE: I think the key is directed at what we are intending to do with this particular division, is to give the operator certain capability. In a sense it is inconsistent, in a sense it is not. But we are really aiming at something different here. It is to provide the operator with certain capability to take action in some extreme case, not that they are helpless and unable to cope with it.

The more normal mode would be to be concerned about the containment. It is a question of an additional element of operational flexibility to deal with an active situation. That is fundamentally what this is aimed at.

COMMISSIONER GILINSKY: But suppose we go back to Three Mile Island and clearly it would have been helpful to have a vent to release the hydrogen, but yet people managed to deal with it without the vent. On the other hand, had there been a weak containment surrounding that primary system the situation would have been very bad. I mean you were telling me how many curies there were roughly in that containment and some fair fraction of the inventory that you gave me the number for.

So it would seem to me that the lesson is, first of all fix up the containments where you need to because -- or at least help them cope with the pressures. That seems to me to be the more pressing item than the core vent.

Now maybe the one is easier to carry out than the other, and there may be reasons for proceeding a little differently. But at least looking at it in a fairly simple way, that is the way I come out.

CHAIRMAN AHEARNE: Well, let me go back to the point that Bob just made, at least one argument for what they are putting forth on the vent is just as Bob said, it is not an instrument that you would automatically use but it does give a capability for use. In the Three Mile Island situation, as you point out, it would have been nice to have that to be used, not saying that it was --

COMMISSIONER GILINSKY: Well, I am not suggesting that we ought not to have the vent.

CHAIRMAN AHEARNE: -- automatic --

COMMISSIONER GILINSKY: I am talking about the priorities.

MR. MINOGUE: If you have a lot of time, there are other ways of getting rid of the hydrogen, play the game of solubility and so on. But the time is relatively short, foresee some change in cooling mode or some transient, you really are concerned about imposing this on the plant. It seems important to me, almost regardless of what this may do to the containment, to give the operator some capability to make sure that whatever else happens that core is not melted.

That really is the intent here. It is an operational capability to be available in some odd set of circumstances where you do not have time to get rid of the hydrogen in a more leisurely way. So you must act fairly promptly.

MR. NORBERG: I have one more slide.

COMMISSIONER HENDRIE: Before you charge off that

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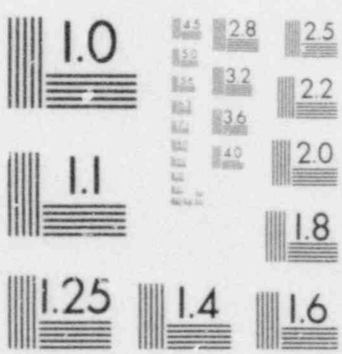

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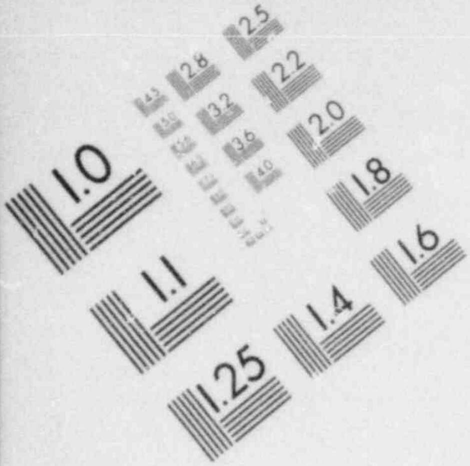
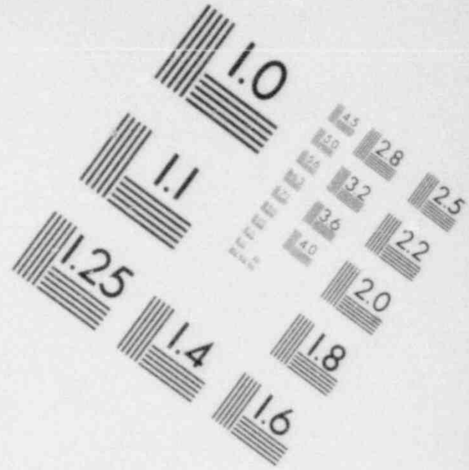
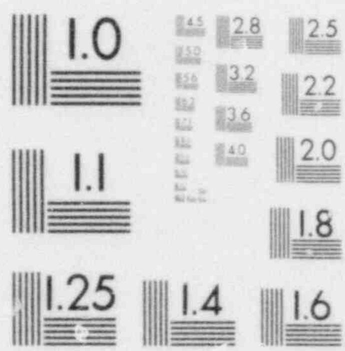
MICROCOPY RESOLUTION TEST CHART

IMAGE EVALUATION TEST TARGET (MT-3)







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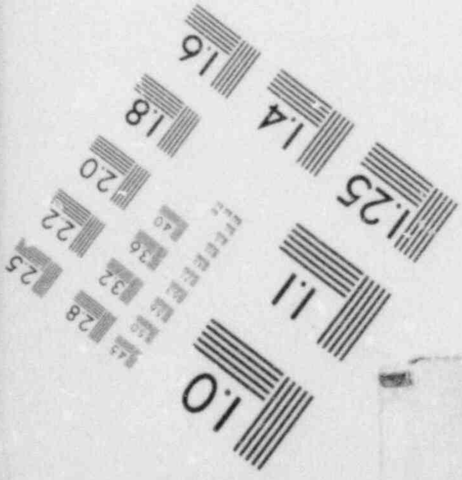
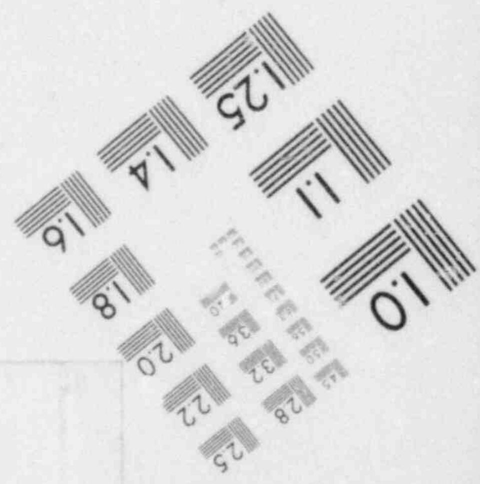
MICROCOPY RESOLUTION TEST CHART





one and before we get off highpoint vents, as I read the language of the supplementary information and then the rule language on the highpoint vents, it sounded like you were going to stick a vent on every high point in the primary system. Could somebody tell me what the intent is? Is that the scheme?

MR. ROSS: I believe that a U-tube boiler, a U-tube PWR --

COMMISSIONER HENDRIE: No, that is dealt with explicitly. The U-tube steam generators are explicitly dealt with when you say you are right, you can't -- -- in every damn tube --

MR. ROSS: No, I am just characterizing --

COMMISSIONER HENDRIE: -- but when I read that thing why it sure sounded like every other high point in the system was going to have a hole and an -- -- line.

MR. ROSS: Let me put it this way: the Westinghouse and CE product line I believe would -- the pressurizer and the upper head, and for the B&W product line the top of the hot leg, in addition. I believe that is a complete set.

And of cours most pressurizers already have a vent. Some people may well be venting the upper head to the pressurizer and then the pressurizer would be kind of a collection point. And since the pressurizer is usually higher than everything else, it is possible that the B&W hot leg might vent to the pressurizer also.

In other words, that is a possible way to get out of it. And we just haven't seen specific designs.

COMMISSIONER HENDRIE: Okay.

MR. NORBERG: Okay, last slide.

I thought I would give some rationale for what we are doing here, and the staff rationale for the hydrogen management position, and particularly the requirements for inerting Mark I and II only and only performing design studies on the other plants is as follows:

Hydrogen control is largely a volume dependent situation, all other factors being more or less equal. That is, hydrogen combustion only occurs for a range of hydrogen-oxygen mixtures, with the lower limit being about 4 percent hydrogen by volume.

It directly follows then that the larger the volume in the containment, the more hydrogen it can accommodate before a combustible mixture is reached.

The BWR Mark I and II containments have the smallest volume; therefore, they can reach a combustible mixture with a relatively small fuel clad-water reaction; i.e., less than 5 percent.

Ice condensers and BWR Mark III containments have larger volumes and are estimated to reach combustible mixture with about 15 -- 10 to 15 percent fuel clad-water reaction, and large containments can accommodate at least 40 percent fuel clad-water reaction without reaching a combustible level.

Thus, the small containments have the least margin for reaching a combustible mixture. Containment strength is another important parameter when assessing hydrogen management.

The staff has performed analyses that compare both containment design pressure and the estimated pressure for structural failure of the containment as a function of the combustion of h irogen from a given percent fuel clad-water reaction. These studies have been extensively discussed in the SECY-80-107 papers.

The bottomline is that large dry containments can take combustion of hydrogen from essentially 100 percent fuel clad-water reaction, Mark III and ice condensers can take combustion of hydrogen from about 20 to 25 percent fuel clad-water reaction and Mark I and II's can take combustion of hydrogen from less than 10 percent fuel clad --

COMMISSIONER GILINSKY: When you say can take, this is what, the failure?

MR. NORBERG: I think it is the failure strength, to the calculated failure point, the yield point.

COMMISSIONER GILINSKY: Oh.

COMMISSIONER HENDRIE: Steady down for about the same --

MR. NORBERG: Sorry, I think it is the ultimate strength, is that right?

COMMISSIONER GILINSKY: Well, anyway something like that.

MR. NORBERG: The failure strength is the ultimate?

MR. ROSS: Yes, right.

MR. NORBERG: Yes, it is the ultimate.

MR. ROSS: Anytime we use the word "failure" -- I think we have mentioned this before; it is a very idealized thing, and local failures around penetrations have not been calculated. A more exact calculation might give you a different number. We are talking about just ideal material.

COMMISSIONER GILINSKY: These are comparative --

MR. ROSS: Yes.

MR. NORBERG: And it is at the ultimate strength, I think, that you calculate to, right?

MR. ROSS: We report two numbers on the structural capabilities, yield and failure.

MR. NORBERG: Yes, right. This is the failure to failure now.

And thus, there is considerable margin for large containments, lesser margin for intermediate containments and even less margin for the smallest containments.

The third factor of the staff's rationale is related to operation with inerted containments. The Mark I containment designs permit inerting, and there is considerable satisfactory operating experience with inerted Mark I containments.

Ice condensers have not been designed for inerting, and the effects of operating in such an environment are unknown. Further studies are needed before such a requirement could be imposed on an ice condenser. These studies should be a part of the proposed rule.

An ignition system has been proposed by TVA for the Sequoyah ice condenser plant. This feature is not called out as a requirement in the rule since the staff feels more analysis is needed.

The staff believes that during the interim period before the long-term rulemaking is completed, the issue of distributed ignition systems for ice condensers should not be treated by rulemaking but should be addressed on a case by case basis once the decision has been reached for the Sequoyah plant.

Probabilistic risk studies have been performed on Mark I plants and conclude that the decrease in residual risk is small due to inerting these containments. It is the staff's view, however, that inerting would be beneficial for other accidents that could lead to a severely degraded but not necessarily melted core condition and that on balance prudent judgment is to require inerting of these containments.

CHAIRMAN AHEARNE: But you are, are you not, in this proposed rule requiring the ice condenser plants to study igniters?

MR. NORBERG: Yes, we are. One of the studies require it.

This concludes my presentation of this proposed rule.

COMMISSIONER GILINSKY: Did you say something about the Mark III's? Are they like the ice condensers in terms of how much equipment is in them?

MR. ROSS: I understand they have quite a bit more stuff inside than the Mark I's and II's. So they would be more like the ice condenser, and the argument about needing to go into Mark III is going to be somewhat stronger than it was for the Mark I and II. I don't have any details beyond that.

COMMISSIONER HENDRIE: Well, it is going to be a hell of a lot stronger unless they move a lot of equipment outside because -- outside the drywell and still inside the containment on the Mark III's you have got all kinds of instrument goodies just as you have in an ice condenser --

MR. ROSS: Right.

COMMISSIONER HENDRIE: -- that you can't stand to have zero access to, or very limited access. So if you tried to inert those containments why, just as with the ice condenser, you are going to have to move all kinds of things out of the containment, and I am not sure, you know in principle you would think that could be done but there may be some knotty problems with the length of pneumatic as well as electrical leads before you get to preamps and transmitters and --

COMMISSIONER GILINSKY: Having crawled through an ice condenser plant, I think I appreciate the difficulties of doing that in the ice condenser plants. But still it seems to me that it is something that one ought to look into and get a firm answer on.

COMMISSIONER HENDRIE: Well, it is part of the proposed analysis and discussion.

CHAIRMAN AHEARNE: That completes your presentation. OPE had sent us a paper commenting on this particular 399. I wonder, Ed, if your chairman --

COMMISSIONER GILINSKY: I have a question which I would like to ask if I may. Do you want to take them first?

CHAIRMAN AHEARNE: Yes. This is a counterpoint, and then I thought we would get to the --

COMMISSIONER GILINSKY: It is just a simple factual question.

CHAIRMAN AHEARNE: Oh, go ahead.

COMMISSIONER GILINSKY: What, in requiring Mark I and Mark II's to inert, do you have somewhere in the back of your mind some equivalent percentage of metal-water reaction at which you are drawing the line? In other words, how do you translate that requirement? Does that mean you are basically sticking with the 5 percent requirement or what?

MR. ROSS: Well, that is all we would have to do. That would be enough to produce the requirement. The 5 percent would be. But the Mark II is a bit --

COMMISSIONER HENDRIE: No, no, but once they are inerted why they can go ahead and have themselves a 100 percent metal-water reaction and as far as hydrogen problems are concerned, why it is just an additional gas in the containment. It adds the pressure, but you aren't going to burn it or --

COMMISSIONER GILINSKY: No, no, but I mean in reaching the decision to inert, you are --

MR. ROSS: We didn't go through the numerical exercise you are talking about. It was more on a value impact basis that --

COMMISSIONER GILINSKY: Well.

MR. ROSS: In other words, we didn't do a calculation that says we are going to get 6 percent hydrogen, you had better inert or you are going to lose the containment. e rather did it on one note, how to inert, and it has been done reasonably successful and doesn't cost much money.

Impending a long-term decision --

COMMISSIONER GILINSKY: But isn't there along with that, and if you don't inert, if you get X percent precisely, as you said, you are going to get into trouble?

MR. ROSS: Yes, in the original SECY-107 paper we sent up here we showed how quickly the Mark I got to a -- for certain stylized access, how quickly it got to combustible, and then a detonable range. It is very quick.

COMMISSIONER GILINSKY: And it is on the order of 5 percent or is it 1 percent, is it 10 percent?

MR. ROSS: Well, I know it is combustible. It is a few percent. It is 3 or 4, right?

COMMISSIONER HENDRIE: Yes, a few percent.

End 3

MR. NORBERG: It's very, very quick. It's like less than 5 percent. You get to the combustible, the 4 percent volume range of hydrogen. But you get -- the other calculation that was done by the staff is to look at if you burned this hydrogen then where would the containment fail. And that's somewhere around a 10 percent fuel clad reaction, if the hydrogen burns that has been released.

COMMISSIONER GILINSKY: So the (WORDS UNINTELLIGIBLE) design pressures is still around 5 percent?

MR. ROSS: It looks like 4 percent, roughly, metal-water reaction would -- well, 5 percent, roughly, metal-water reaction gives about 7 percent containment hydrogen concentration.

MR. NORBERG: Five percent for design pressure, nine percent for failure is what they're asking for.

MR. ROSS: Yeah. But I was trying to convert this amount from hydrogen concentration to corewide metal-water reaction. A few percent, 3, 4 percent, brings you up to combustible levels.

MR. HANRAHAN: But my disagreement is with the decision rationale for Mark I and Mark II containments. You have no other problem with the paper as presented. The rationale as given is one of a small decrease in risk at small cost; counterbalancing that, the ice condenser side, you could have a greater decrease in risk, but the costs are high, in this case that you may have a reduction in safety from other aspects, but nothing in lieu of an adding is suggested for ice condensers. Indeed, it's been concluded that because of safety improvements associated with the implementation of Lessons Learned, hydrogen control requirements beyond those satisfying 10 CFR 50.44 are not required, pending completion of the rule-making. And I would just argue that the Mark I and Mark II that are not inerted would fall into that same, logically fall into the same category, by the staff's own arguments.

There were arguments presented by others, both in favor of immediate inerting and not in favor of inerting, by General Electric and others, which haven't presented themselves here, either; and I would have thought some discussion of those would have balanced the, or supported or not supported the case here.

So I find it bad policy to impose a requirement simply because it may have a small cost and a small benefit. Even the ratio may be one, the cost/benefit ratio may be one, it doesn't follow that that's necessarily a good thing to do.

COMMISSIONER GILINSKY: So where are you coming out?

MR. HANRAHAN: Not requiring that inerting, pending rule-making -- take it up as part of the rule-making.

COMMISSIONER GILINSKY: But we're talking about a rule-making that's going to take years.

MR. HANRAHAN: But, you know, we ought to discuss these --

COMMISSIONER GILINSKY: I mean years and years. I mean, this is going --

MR. HANRAHAN: Before that we weren't even -- we were on the verge of coming into de-inert all over those containments.

COMMISSIONER GILINSKY: I know that. But here we just experienced an accident in which -- well, the numbers are a little uncertain, but, at least, the going number is something on the order of 50 percent metal-water reaction. We've got a rule that fixes the number that we protect against at something on the order of 5; in fact, it seems as a practical matter less than 5. What we're talking about here is going back to maybe 5. You're saying we oughtn't even to do that. I'm horrified that we're stopping at 5, that we're not trying to do more.

CHAIRMAN AHEARNE: Would you inert Sequoyah and the other ice condenser?

COMMISSIONER GILINSKY: Well, it seems that those are pretty difficult to inert. And I'm not prepared to -- well, let me put it this way. I think we have got to have some means to deal with larger amounts of hydrogen than are talked about here.

I just don't think we can let this thing go and to be something we're just going to study for years and years and have comments on and, you know, rounds of proposed rules and hearings, and this is going to take a very long time to come down on the whole degraded core question. It's a very complex matter. And I think this aspect of it is something that we need to do on a shorter time scale.

I think I've expressed that to you before, so it's not going to surprise you that that is my view.

CHAIRMAN AHEARNE: I guess, though, what I think the OPE point is, that just as a basic regulatory policy do we have a better argument than the decrease in risk is small but since the cost is also small that we ought to do it. And that's really the question that --

MR. HANRAHAN: I think that what was presented in the paper didn't sustain the argument. In fact, what's been argued is that actions have been taken to reduce the risk of the TMI type of hydrogen release.

COMMISSIONER GILINSKY: It depends -- here I think I'm th NRR -- it depends on how much weight you attach to these probability estimates that have been generated and to what extent you want to rely on them for your regulations. I think they're useful for some purposes, but they're still at this point rather tentative calculations, and there are just certain rules or standards you need to impose on the basis of experience and just common sense. There's certain notions about containments that don't flow directly from probability arguments but, I think, just sound experience.

You know, you're basically having to decide here whether you're going to rely on calculations of some person in the research office or you're going to take account of what happened last year. And to my mind -- I haven't seen these calculations and I don't want to -- my impression is that there's a certain amount of uncertainty attached to them, and I don't think you can use them to cancel out a fairly strong experience.

CHAIRMAN AHEARNE: Well, I don't think anyone is -- I guess other people -- and I'm not sure where I will come out -- but I would say that it's not to take account of what some research calculator did and forget what happened last year. I think all of us are trying to use experience and common sense and to pull together what happened last year and what is available in the way of calculations, including those on the design strengths and the burn rates and et cetera and then reach a conclusion. It's a -- as you pointed out earlier, it is a complex issue. And I -- perhaps for some -- perhaps you have now, as you say, you, I think you have seen a clear path that you believe we ought to follow. I'm not sure I quite see the path as clearly.

Denny or Mr. Norberg, would you care to make any comments on Ed's point? Or do you believe Commissioner Gilinsky has answered it well?

MR. ROSS: Well, I think it's clear from the collection of papers we've sent up that I felt processors on Mark I or II were not particularly dominated by what the risk studies showed. In fact, we seemingly flew in the face of them, I would say.

One thing that we did not include, however, which is -- which we discussed from time to time, is how would we explain to a mother-in-law or a congressman who happened to live in Baxley, Georgia, why that plant is inerting and that one isn't, when they're both the same plant. That, you know, we did discuss things like that, and it seems, you know, I'm coming back to the consistency argument now, which I --

COMMISSIONER HENDRIE: Steady now.

(Laughter)

MR. ROSS: -- which I threw rocks at a few minutes ago.

COMMISSIONER HENDRIE: You start hiking up that path and you're going to fall in the tiger pit before you get 20 feet up it.

MR. ROSS: Well, I'm only at Baxley, Georgia, looking at those two plants, and I can't see any further than that right now.

COMMISSIONER HENDRIE: I wouldn't get outside Baxley, if I were you. You're not going to like the results.

Look, there's a -- Bob, let me -- and then we'll get you.

There's another aspect to this which hasn't -- which doesn't appear in the interim rule papers. The rationale as presented in the interim rule papers is -- let me do it considerable violence, okay? -- we'd better -- it is, we ought to do something and we ought to do it in a hurry; it's going to take a longer time to understand everything that we might want to do and to have a coordinated and sort of optimized approach to degraded core matters. And there are all kinds of deep regulatory questions about whether it should be in the design basis or in addition to the design basis, et cetera. So I feel a need to do something in a hurry.

Now, some of the things that I want to do in a hurry are already being done out there, by virtue of orders; and if we didn't have this particular rule-making coming down the pike, why, I don't know as we'd particularly feel a need for a rule for those things. They're, already have been ordered on plants and they're being done.

Okay. There are some other things that are not being done in the way you'd like them, some of the hydrogen analysis work and related things. And then there's this question of the Mark I's and II's. Here the containment's at the small end of the volume scale of containments, the most sensitive from a hydrogen standpoint. We've got 20 of them out there operating; 18 of the 20 are inerted, two aren't, and we've got a batch coming down the line. It just seems like why don't we go ahead and inert those things on the gut feeling that it seems like a good idea and it all packages together with this thing we need, feel the need to do in a hurry.

Now, as Ed points out, that isn't an especially stunning line of logic from the standpoint of careful and logical regulatory practice. And if those were the only arguments, why, I think, I guess, I'd end up, as I think I did once before, on the 107 paper, saying, "Wait a minute. Let's understand better where we're going overall." But there is another aspect to it and that s the following.

It seems to me that we are going to end up, sooner or later, with plant features, whether they're in the design basis or in a supplementary category, which will allow all of these plants to ride out metal-water reaction at substantially better than 5 percent. And I won't tell you whether I'm going to end up voting, you know, for 20 or 30 or 40 or 50 or whatever you like, but I'm pretty sure it's going to be more than 5 percent.

If it is more than 5 percent, then these small containments are going to have a big problem. And I think for them, because the Mark I's have been built so that they could -- since, you know, since '67, or something like that, '66, have been arranged so that they could be inerting, in view of where instrument locations are and other equipment that needs maintenance; similarly for the Mark II's, as far as I know. It seems to me that these small containments will find it easiest to deal with whatever eventual level of hydrogen we require by inerting rather than by cranking up halon systems and igniters and God knows what all.

Now, if they're going to have to inert, or going to end up inerting in, you know, if I -- I guess, I come around and say, jeez, if Vermont and HATCH-2 are going to end up having to inert in two years off the degraded core rule-making, I don't know as we've gained a great deal by not getting them started on it now. Similarly, I guess, if that's where the Mark II's that will start coming in pretty quick are going to end up, they may as well get on about it.

So I've come, for myself, to a grudging agreement with the staff thrust on this interim rule, proposed rule, with regard to the Mark I's and II's, not for the reasons the staff gives particularly in this paper, but just because I'm looking down the road and I don't see much place else for these small containments to go within any reasonable range of outcomes of the degraded core rule-making which is to come. So that's what drives me.

I think the ice condensers in Mark III's do have a sufficient capability so one can hold on until the outcome of that rule-making.

COMMISSIONER GILINSKY: But, of course, even there you're, I mean, on the Mark I's and II's you're also flying in the face of these probability estimates, which, I assume, take account of larger --

COMMISSIONER HENDRIE: Yeah.

COMMISSIONER GILINSKY: -- (WORD UNINTELLIGIBLE) and water fractions.

COMMISSIONER HENDRIE: That's right. What they're saying, what the probability calculations are saying, in effect, is that if you get certain accident scenarios going which are going to give you a lot of hydrogen and a problem in the small containment, they're going to give you a problem in that containment because you've lost, because part of the sequence is loss of containment heat removal or whatever and you're going to breach the containment anyway, from causes other than a hydrogen burn, just over-pressure, just brute not taking the energy out fast enough, and that the incremental advantage you get then by not having a hydrogen burn, there's some but it's not dominant as we now calculate the sequances.

That very well -- that aspect of the probability calculations may very well dictate, and I think it is likely to dictate, rather strongly increased requirements on containment heat removal capability and redundancy and redundancy of the power supply and heat sink and so on down the line as part of the degraded core process, because not only for small containments but also for the big ones, I think, we're going to find that a significant fraction of those scenarios that lead to real severe releases, containment breaches and severe releases, could be controlled if you didn't have containment heat removal failure, because, I think, most of those scenarios have as an essential part of the scenario that something happens and you lose your ability to take the energy out of the containment. If you can take the dam after-heat out of the containment as it's generated and then -- and -- and cool on down, you'll come a long way toward those situations even with a meltdown, where, I think, you keep the core inside even though it may be totally in debris.

So I think that those heat removal requirements, we are going to find those very worthwhile to upgrade; in fact, my guess at the moment is that that's going to be a sort of a best buy for public safety and that we'll come eventually to that decision.

So I think down the line, then, you're likely to see containment heat removal upgrading required across the board. But having done that -- and if you do that, why, then the importance of not burning the hydrogen in these small containments will then jump up and become much more significant in terms of the risk assessment sort of calculations.

COMMISSIONER GILINSKY: Now, I'm not sure --

COMMISSIONER HENDRIE: So I don't mind inerting them now.

COMMISSIONER GILINSKY: It seems to me that in the past the whole hydrogen problem got short shrift in part because there was a feeling that if you get that far you'll -- that it's probably an accident that is leading to a core melt and you've got all kinds of other things to worry about.

COMMISSIONER HENDRIE: Yes.

COMMISSIONER GILINSKY: And it turned out at Three Mile Island we discovered that there's a fairly wide range -- in other words, there's an intermediate range of accidents which involve core damage but not yet core melting, and those --

COMMISSIONER HENDRIE: Well, I -- that's right.

COMMISSIONER GILINSKY: -- accidents happen to involve generation of hydrogen.

COMMISSIONER HENDRIE: That's right. I think our guess before Three Mile would have been that that range, measuring the -- measure -- using the parameter metal-water reaction would have been of the order of, I don't know, something like 10, 15 percent, and if it went over that, why, you were gone to hell and just weren't going to save it. I can remember that kind of discussion back in Reg Guide 1.7 revision days. And what's clear from Three Mile Island is that these cores are tougher than we would have guessed and that if you can manage to keep some steam circulation going up into them, why, they'll produce a lot of hydrogen but they may outlive some pretty severe treatment.

Now, what that suggests is that hydrogen mitigation measures assume probably more importance in the overall scale of things than we would have thought before And I think, indeed, there is a substantial range of core damage, heavy core damage, beyond the design basis, in which you'll still be, you still won't go to a full core melt and loss of all cooling situation, but you are likely to get a lot of hydrogen.

COMMISSIONER GILINSKY: What surprises me is that in the past, when we thought that the amount of hydrogen that could be generated was rather small, we took considerable precautions against that, and even though the ECCS code said 1 percent or effective percent, you said, "Never mind, this is serious business, you got to multiply by five, and you got a standard design pressure because we want to have a safety margin there, so altogether you're talking about a safety margin of something like a factor of 10. And you want to stay below flammability limits," and so on. And now that we know that the amount of hydrogen that can be generated can be very much larger than that, we're saying, "Well, we can wait years to study the problem and think about it, and it's not really a pressing matter."

CHAIRMAN AHEARNE: Wait. That's not quite -- Vic, that could be clearly the interpretation to be put on it; and if you desire you can. But there's another interpretation, which might also be wrong, and that is that previously many times -- and I'm not that familiar with the way nuclear reactor regulation works, I'm a lot more familiar with the way analysis works -- that when you are trying to make a case for something you take a conservative estimate or a worst-case analysis and you multiply those factors together, as long as you know you're within some general envelope. And so adding on a factor of five, or adding on a factor of two, while you still were able to contain within the basic framework of the design, may have been viewed as a conservatism which is now being abandoned; on the other hand, it could be viewed as a conservatism which was not significant. Now, you -- in the situation you're in, you're multiplying -- you're taking generation rates and pressures which are now at the driving point of the design, and so one -- as opposed to saying that, well, we'll just, we're not going to take it seriously and we'll wait several years, I think, on the other hand, what it really says is, since you're now going to talk about making major impact upon either operation or design of the systems, that you have to be a little bit more confident that you know what you're doing than you were, could have been, when you were making conservative assumptions that weren't going to drive the system.

COMMISSIONER GILINSKY: Well, I think we want to know what we're doing, yes; and I assume that. But the fact remains that there was that factor of 10, you multiplied the amount of generation that you thought might be there, then you multiplied by five, and now we're dividing by five. And whereas before we were talking about holding at design pressures, now we're talking about failure pressures.

I guess I think there is more urgency attached to this problem than I have seen evidence of here today.

CHAIRMAN AHEARNE: Do you have any questions?

COMMISSIONER GILINSKY: I think I have exhausted my immediate questions.

CHAIRMAN AHEARNE: Joe?

COMMISSIONER HENDRIE: Yeah, I've got a question. Did I read correctly that if one cranks a proposed 50.44(c) out that says notwithstanding the above inert Mark I's and II's wherever they may be, that there's a January 1st, '81, deadline date on it?

MR. ROSS: I think we mentioned earlier that on the dates that we were having a clarification package coming down soon, and those dates we would expect to be dominant over the dates in the proposed rule. The dates in the proposed rule will need changing. They were good a few months ago when we were drafting up the proposal. But events have somewhat overtaken it.

COMMISSIONER HENDRIE: Yeah, well, I recommend attention --

SPEAKER: Yes, it says that in the proposal.

COMMISSIONER HENDRIE: Well, that's what I thought it said. And now this is Labor Day and 30 days' comment and a month to get it out of here for comment and, you know, you're going to publish, at best, a little after Thanksgiving and give them 30 days to put all that stuff in place, and I don't think that's going to wash, unless you want to start writing exemptions right off the bat.

MR. ROSS: Well, but the 1/1/81 appears many places in the draft.

COMMISSIONER HENDRIE: Yes, but, at least, a number of the other places, it's on provisions which were ordered to be done six, eight months, a year ago, even, and so there's been some forward motion, I presume. But I -- okay, dates to be adjusted.

(Pause)

CHAIRMAN AHEARNE: Okay, then I think without -- since there are no further questions, I guess the issue is, we have in front of us a staff proposal to put out a proposed rule. And what is your pleasure?

COMMISSIONER GILINSKY: Well, I guess I would not approve it.

CHAIRMAN AHEARNE: Pardon me?

COMMISSIONER GILINSKY: I would not approve it.

CHAIRMAN AHEARNE: You would not. Would you perhaps, at least, to help me, would you -- is that that you disagree with it or you're not ready to vote on it? Or --

COMMISSIONER GILINSKY: I disagree with it.

CHAIRMAN AHEARNE: All right. Joe?

COMMISSIONER HENDRIE: I'd put it out for 30 day comment as recommended as soon as we get the adjusted dates which the staff thinks appropriate to a time frame, with publication in the Federal Register, say, the end of September.

CHAIRMAN AHEARNE: Peter?

COMMISSIONER BRADFORD: Well, let's see, I'd -- there are aspects of the hydrogen control question that are still of considerable concern. But I don't have, I think, any difficulty with putting this out for comment in the form it's in now. We're going to have to grapple with hydrogen control in a number of areas, but it doesn't seem to me that putting this out for comment prejudices those.

CHAIRMAN AHEARNE: Before I vote, Vic, could you explain what it is that you don't like about the rule? I am surprised, because I thought you were in favor of this.

COMMISSIONER GILINSKY: Well, I would have a rule that -- I mean, I'm in favor of the part of it that I think I said I was in favor of, the inerting the Mark I's and Mark II's, but I would go further and I would require that reactors demonstrate a capability to deal with amounts of hydrogen roughly of the order of those that were generated at Three Mile Island.

So I agree with it as far as it goes.

CHAIRMAN AHEARNE: You don't think it goes far enough.

COMMISSIONER GILINSKY: I don't think it goes far enough.

COMMISSIONER BRADFORD: But do you see the publication of this rule as prejudicing the Commission's ability to impose a requirement like that?

COMMISSIONER GILINSKY: Well, I think so. If this rule only dealt with Mark I's and Mark II's, then it would be fine -- if we were just dealing with Mark I's and Mark

II's. But insofar as you're dealing with hydrogen control for all reactors, then, I think, you're coming down and saying that you think we need to deal with Mark I's and Mark II's but we can leave the others as an exercise for the student. And --

CHAIRMAN AHEARNE: Gentlemen, would you care to -- I'd agree with you if we were adopting it, but I don't know that --

MR. MINOGUE: I was going to make a remark to something (WORDS UNINTELLIGIBLE) I think it's important to realize there's a lot more in this, there's a lot more in this regulation, than we're proposing in the question of inerting one capacity of containment or another. There are a number of measures in here that are intended to deal with an accident of high probability, an accident in which you had extensive damage to the core resulting in release of radioactivity and generation of hydrogen. We ought to be prepared to take steps now to make sure that the plants that are operating now or about to be licensed can handle that kind of accident.

I know it's very glamorous to talk about all these very extreme accidents and talk about risks and meltdown and so on. I'm trying to deal in this rule with something much more direct and much more pertinent -- the high probability that one of these plants will have a degraded cooling situation in which the core will be damaged and release hydrogen and release radioactivity. We ought to be able to handle that with the present plants.

What this rule has in it is the staff's best judgment, after very careful study, of measures that can be taken now with assurance that they do a lot of good.

I think we also all recognize that there's a much bigger question, it's the one that Commissioner Gilinsky keeps referring to, and I'm certainly going to be the last one that says that shouldn't be addressed. But that one's big, it's complex, it goes through the whole range, including core melt. We don't know exactly how we're going to deal with that, and we have to do that more deliberately. But while we're doing it deliberately, we should do something about the plants we have out there now.

MR. ROSS: I think if you asked us about licensing strategy, should we scrap the plants to promulgate an NM rule, I think the net effect would probably be fairly small. If we, indeed, are going to order plants, pursuant to the clarification letter after the round of meetings, to do substantially what's in the rule, if that's what you do, or whoever the issuing order authority is, then that lays on these requirements one way or the other.

As far as ice condensers, we're headed down a case-specific route, and as we discussed at the last meeting, we now have written comments in the McGuire instance to do substantially what is being done in Sequoyah. So whatever the Commission wants to do on ice condensers, it can do there.

The only thing that is left undone as a result of not issuing a rule is Vermont Yankee and HATCH; that's left undone. If we want to, if the Commission wants to do that, it has other ways of doing that also.

CHAIRMAN AHEARNE: I guess where I come out is -- and it is a puzzle, a very complex problem of how to address this hydrogen concern and what to do about the designs -- I'm confused a little bit by, Vic, by at the one hand I thought you were saying is if we don't address the I's and II's in this way, that shows that we're willing to wait for years, but the other hand, here are a bunch of other items that we're -- that, as Bob Minogue tried to point out, we're trying to lay on, which we could go ahead and do; it doesn't mean that we aren't going to still try to wrestle with that larger question, but we aren't yet there, we don't know what the right answer -- how to lay on those requirements. So I would guess that using your admonition to remember what has happened, and reluctant as I am to go into the inerting of I and II, primarily from the basis that I don't share with you and Joe the long-term historical having gone through these previous issues, you were part of these, the existing regulatory development, and so you have a better intuitive grasp of these, analytically I don't think the case has really yet been made to do something to I and II and not do something to III and ice condensers. But I am certainly willing to put this out for public comment. That's what I would say.

So, on that basis, I guess it goes out for public comment.

COMMISSIONER HENDRIE: Get the dates fixed and --

CHAIRMAN AHEARNE: Thank you.

But before we leave, we still have a couple of -- thank you, gentlemen. And if the room could sort of exit quietly, the Commission has a couple of affirmation items to still get to.

(Whereupon the public meeting was adjourned.)

NUCLEAR REGULATORY COMMISSION

This is to certify that the attached proceedings before the

Commission Meeting

in the matter of: Public Meeting - Discussion of SECY-80-399 Proposed Interim Amendments to Part 50 Related to Hydrogen Control and Certain Degraded Core Considerations

Date of Proceeding: September 4, 1980

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.

Suzanne R. Babineau

Official Reporter (Typed)

Suzanne Babineau

Official Reporter (Signature)

POOR ORIGINAL

BASIS FOR PROPOSED INTERIM RULE ON
HYDROGEN CONTROL AND CERTAIN DEGRADED CORE CONSIDERATIONS

- NUREG-0578 - TMI-2 Lessons Learned Task Force Status Report and Short-Term Recommendations - July 1979

- NUREG-0585 - TMI-2 Lessons Learned Task Force Final Report - October 1979

- Followup Action Resulting from the NRC Staff Reviews Regarding the TMI-2 Accident
  Letters to Licensees - Sept. 13, 1979

- Regional Meetings with Licensees to Clarify Letters - Week of Sept. 24, 1979

- Discussion of Lessons Learned Short-Term Requirements
  Letter to Licensees - Oct. 30, 1979

- NUREG-0660 - TMI-2 Action Plan - May 1980

- SECY-80-107 & Supps. - Proposed Interim Hydrogen Control Requirements for Small Containments

MAJOR ASPECTS OF INTERIM RULE

- Information and Decision Making

- In-Plant Radioactivity Considerations

- Hydrogen Management

INFORMATION AND DECISION MAKING

- Training to Mitigate Degraded Core Accidents

- Detection of Inadequate Core Cooling

- Accident Monitoring Instrumentation

- Sampling During and Following an Accident

- In-Plant Iodine Instrumentation

IN-PLANT RADIOACTIVITY CONSIDERATIONS

- Protection of Safety Equipment and Areas Which May Be Used During and Following an Accident
  - Protection of Safety Equipment Against Degradation by Radiation
  - Radiation Protection to Assure Needed Access of Operators to Vital Areas
- Leakage Integrity Outside Containment
  - Leakage of Highly Radioactive Fluids Outside Containment to be Eliminated or Minimized to Maximum Extent Practicable

HYDROGEN MANAGEMENT

- Inerting of Mark I & II BWRs

- Design Analyses for Measures to Handle Large Amounts of Hydrogen

  A. Mark III BWRs

  B. All PWRs

- Dedicated Penetrations for Plants that Rely Upon External Recombiners or Purge Systems

- External Recombiner Capability for All Plants that Rely upon Purge Systems

- High Point Vents in Primary Cooling System

RATIONALE FOR HYDROGEN MANAGEMENT
POSITION IN INTERIM RULE

- Inerting of Mark I & II BWRs
  - Small Volume
  - Designs Permit Inerting
  - Satisfactory Operating Experience

- Ice Condensers and Mark III BWRs
  - Intermediate volume
  - Not Designed for Inerting

- Large Dry Containments
  - Large Volume
  - High Pressure Design