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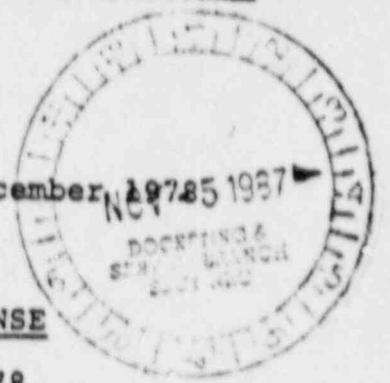
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AN ANALYSIS OF CHAIRMAN HENDRIE'S RESPONSE
TO SENATOR HART'S LETTER OF JUNE 15, 1978

Introduction

The Senate Subcommittee on Nuclear Regulation currently plans a public hearing at which the sole witness to be called is Dr. Joseph M. Hendrie, Chairman, U. S. Nuclear Regulatory Commission. This hearing is being conducted to examine matters related to a memorandum written by Dr. Hendrie in September 1972 when he was the Deputy Director for Technical Review in the Atomic Energy Commission.

In September 1972, Dr. Stephen Hanauer, then Technical Advisor to the Director of Regulation, recommended that the AEC prohibit further construction of pressure suppression containment buildings after some future date because of the safety disadvantages of such designs. Dr. Hendrie's response to the Director of Licensing was that although the idea of banning such designs was attractive, it could not be implemented because it would mean the end of nuclear power and would cause more turmoil than he could stand thinking about.

This memorandum was one of 154 documents written by Dr. Hendrie and withheld by the NRC when responding to a FOIA request prior to Dr. Hendrie's confirmation. The same memorandum was withheld, at Dr. Hendrie's direction, after

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his confirmation when NRC responded to a FOIA request to disclose all responses to Dr. Hanauer's recommendation.

After UCS's testimony before the House of Representatives Subcommittee on Energy and the Environment disclosed the substance of Dr. Hanauer's recommendation,* Dr. Hendrie approved disclosure of his 154 documents. In addition, the NRC disclosed 292 documents written by Dr. Hanauer which had also been withheld in response to another FOIA request.

Pressure Suppression Containments

The containment is the massive structure surrounding the reactor and its cooling system which is intended to prevent the release of radioactive material to the environment in the event of an accident. All boiling water reactors (G.E. is the sole vendor of BWRs), some Westinghouse land-based pressurized water reactors, and all planned floating nuclear power plants (which will use the Westinghouse PWR) have a pressure suppression type containment. In a pressure suppression containment, the steam released during an accident is supposed to be condensed by directing it into a pool of water (G.E. design) or through baskets of ice (Westinghouse design). This would limit (i.e., suppress) the pressure

* Robert Pollard, a nuclear safety engineer on the staff of the Union of Concerned Scientists, was previously employed by the AEC and NRC; therefore, UCS was aware of the substance of Dr. Hanauer's recommendation even though NRC refused to disclose his memorandum.

rise inside the containment structure. Thus, the cost of the containment could be reduced because the containment could be smaller and/or designed to withstand a lower internal pressure.

The lower cost of a pressure suppression containment is essential to successful marketing of boiling water reactors. A BWR contains more energy (in the form of hot water and steam) than a PWR of the same megawatt rating. If pressure suppression containment designs were banned by NRC, the containment for a BWR would have to be larger and/or designed to withstand a higher internal pressure than the containment for a PWR of the same size. Thus, the BWR would not be economically competitive with the PWR.

Similarly, the use of a pressure suppression containment is essential or at least very important to the concept of floating nuclear power plants. In this case, it is the smaller size and weight of the containment rather than its cost that is most important.

Hanauer Memo on Safety Disadvantages
of Pressure Suppression Containments

In a memorandum dated September 20, 1972, Dr. Stephen Hanauer discussed the technical problems affecting pressure suppression containments. He concluded that the safety disadvantages of such containments were preponderant and recommended that the AEC adopt a policy that would lead to no more pressure suppression containments being built. Dr. Hanauer wrote:

"Recent events have highlighted the safety disadvantages of pressure-suppression containments. While they also have some safety advantages, on balance I believe the disadvantages are preponderant. I recommend that the AEC adopt a policy of discouraging further use of pressure-suppression containments, and that such designs not be accepted for construction permits filed after a date to be decided (say two years after the policy is adopted)."

Dr. Hanauer was Technical Advisor to the Director of Regulation in the AEC when he made that recommendation and currently is Technical Advisor to the Executive Director for Operations in the NRC.

Hendrie's Response

In a memorandum to the Director of Licensing dated September 25, 1972, Dr. Joseph Hendrie responded to Dr. Hanauer's recommendation. Dr. Hendrie stated that he found the idea of banning pressure suppression containments an attractive one in some ways. However, he concluded that pressure suppression containments could not be banned because doing so would mean the end of nuclear power and would create more turmoil than he could stand thinking about. Dr. Hendrie was then Deputy Director for Technical Review in the AEC and is now Chairman of the Nuclear Regulatory Commission.

NRC's Repeated Refusals to Release Both Memoranda

The NRC refused to disclose Dr. Hanauer's recommendation and Dr. Hendrie's response despite several FOIA requests by the Union of Concerned Scientists. In the case of Dr. Hanauer's

September 20, 1972 memorandum, NRC withheld it twice--once in response to a FOIA request specifically for that document and again in response to a broader FOIA request for documents written by Dr. Hanauer. In the latter case, a total of 292 documents written by Dr. Hanauer were withheld, in whole or in part.

Dr. Hendrie's memorandum of September 25, 1972 also was withheld along with 153 other documents written by him which UCS requested pursuant to the FOIA prior to Dr. Hendrie's confirmation hearing. It was withheld again after Dr. Hendrie's confirmation when UCS filed a FOIA request for disclosure of all responses to Dr. Hanauer's memorandum. In this instance, the decision to withhold the substance of the memorandum was a personal decision by Dr. Hendrie. NRC claims no other written responses to Dr. Hanauer's recommendation can be located.

Senator Hart's Letter to Dr. Hendrie

In a letter to Dr. Hendrie dated June 15, 1978, Senator Hart made the following points and requests:

1. It is disturbing that NRC deleted portions of the memoranda containing Dr. Hanauer's recommendation and Dr. Hendrie's response when responding to the FOIA requests concerning the memoranda.
2. The Subcommittee on Nuclear Regulation had Dr. Hendrie's response available prior to his

confirmation hearing but was only partially aware of its significance. The Subcommittee honored the Commission's request not to publicly release that document.*

3. The Subcommittee requested that Dr. Hendrie give his present view of pressure suppression containments.
4. The Subcommittee inquired whether Dr. Hendrie would recommend against safety measures simply because they might slow down or hurt nuclear power development.
5. The Subcommittee requested a technical update on the safety of pressure suppression containment systems, including Dr. Hanauer's current opinion as to whether such designs should still be licensed.

Hendrie's Reply to Senator Hart

Chairman Hendrie's reply to Senator Hart consists (as far as UCS is aware) of Dr. Hendrie's letters of June 21 and 22, 1978 and the NRC staff's report, NUREG-0474, dated July 1978.

Analysis of Hendrie's Reply

This analysis of Chairman Hendrie's reply to Senator Hart's letter is arranged in four subject areas--the withholding of information requested pursuant to the FOIA;

* The Subcommittee received all 154 documents written by Dr. Hendrie which were withheld from the public by NRC prior to Dr. Hendrie's confirmation hearing. The Subcommittee honored the Commission's request not to disclose any of those documents.

Dr. Hendrie's comments on the technical issues; Dr. Hanauer's judgement on BWR safety; and the NRC staff's "technical update" on pressure suppression containments. ~

A. Withholding Information

In response to Senator Hart's correct observation that the FOIA clearly intends that information shared with the public should be as complete as possible subject to legal constraints, Dr. Hendrie replied that the deletions were based on a determination that "they met a fair reading of Exemption 5 of the Freedom of Information Act..." A simple statement that the deletions were arguably permissible does not address the point raised. Unless there is a legal constraint, the information should be released. The fact that it was subsequently released shows that there never was such a legal constraint and that the information was withheld for political rather than legal considerations.

Dr. Hendrie states that he did not consider the fact that the information withheld was unfavorable to public acceptance of nuclear power in deciding which documents to release. While it is impossible to determine what factors Dr. Hendrie considered or did not consider, it can be observed that many of the 154 documents written by Dr. Hendrie which NRC refused to disclose prior to Dr. Hendrie's confirmation reflect unfavorably on either the agency or Dr. Hendrie.

In the present case, the safety problems associated with pressure suppression containments which were expressed in 1972 remain largely unresolved today. One major change is that in the intervening years, the agency has issued eleven operating licenses and twenty-seven construction permits for boiling water reactors utilizing pressure suppression containments.

As a final comment, it must be emphasized that public disclosure of Dr. Hendrie's documents in 1978 does not serve the public interest to the extent it would have a year ago. The release of the memorandum would have directly affected the issues considered in Hendrie's confirmation hearings. We believe that these documents cast serious doubt on Dr. Hendrie's fitness to be Chairman of the Nuclear Regulatory Commission. The credibility of Commission decisions will be seriously harmed as long as Dr. Hendrie is a Commissioner, especially if his vote in split decisions is seen by the public as favorable to nuclear power and unfavorable to public safety.

B. Dr. Hendrie's Response to the Technical Issues

In his June 21, 1978 letter, Dr. Hendrie characterizes Dr. Hanauer's 1972 memorandum as setting forth a proposition that the "complexities of pressure suppression containments made them more trouble than they were worth." He goes on to

imply that the thrust of the Hanauer memo related to the difficulty of the review rather than the safety disadvantages of the pressure suppression containments. He states, "From the staff's standpoint, it is a more difficult review task..." It is clear that this is not an accurate characterization of Dr. Hanauer's 1972 memorandum. On its face the Hanauer memorandum is a discussion of the safety hazards unique to pressure suppression containments and hazards common to dry and pressure suppression containments but exacerbated in the latter. The Hanauer memo begins and concludes with references to "safety" and in between is a discussion of technical problems of pressure suppression containments. After weighing the advantages and disadvantages, Dr. Hanauer concluded that the safety disadvantages of pressure suppression containments were preponderant and that, therefore, no more should be built.

With his June 22, 1978 letter to Senator Hart, Dr. Hendrie forwarded another memorandum, dated September 14, 1972, on pressure suppression containments and stated that: "It indicates my thinking at a time just before Dr. S. H. Hanauer's memorandum of September 20, 1972 and my note of September 25th [1972]." In summary, the September 14, 1972 memorandum discusses several serious safety issues pertaining to the third model of pressure suppression containments then being developed by G.E. Despite the fact that G.E. had conducted only very small scale tests (1/2000 scale) and that the information supplied by G.E. was only of a conceptual nature

which left many details unsettled and raised many questions, Dr. Hendrie concluded that the proposed containment appeared to be a feasible scheme and that the safety problems could be resolved in the future. Thus, this earlier memorandum by Dr. Hendrie, a copy of which was sent to Dr. Hanauer, does not dispute the basis for Dr. Hanauer's conclusion--that because the inherent safety disadvantages of pressure suppression containments are preponderant, no more should be built. Nor does the earlier Hendrie memorandum help explain the reasons for his subsequent conclusion that banning pressure suppression containments was an attractive idea that could not be implemented because of the negative impact that it would have on nuclear power development.

In summary, Dr. Hendrie's response to the technical issues consists of his assertions that he always thought pressure suppression containments were safe, that he would not recommend against safety measures simply because this might slow or halt nuclear power development, and that the one instance when he did so was just a casual comment that did not express his true feelings. In evaluating the credibility of that response, it is important to realize that such a response may be necessitated by practical considerations. Any other response by the Chairman of the Nuclear Regulatory Commission would throw into question the continued operation of licensed plants, would make unlicensable the G.E. and Westinghouse ice condenser plants now in review and

would generally create more turmoil than Dr. Hendrie could stand thinking about.

C. Dr. Hanauer's Judgement on BWR Safety

Dr. Hanauer's current opinion on pressure suppression containments is contained in his memorandum to Dr. Hendrie dated June 20, 1978. Dr. Hanauer says that his current opinion is that there is adequate assurance of the safety of pressure suppression containments. He claims that was also his opinion when he recommended, in 1972, that no more be built.

Attached (Enclosure A) is a copy of another memorandum Dr. Hanauer wrote four months after his September 20, 1972 memorandum. In his January 15, 1973 memorandum, Dr. Hanauer identifies what he considers to be the "'Real' Safety Problems" among the ACRS list of unresolved generic items. With regard to the problem of bypass leakage in BWR pressure suppression containments, Dr. Hanauer stated: "I think this is a real problem. Please note my memorandum of September 20, 1972, copy enclosed."

It is therefore clear that Dr. Hanauer meant what he said in his September 20, 1972 memorandum--the safety disadvantages of pressure suppression containments are preponderant and no more should be built. In his January 15, 1973 memorandum he again states that bypass leakage is a "real problem" and recommends that this subject be considered for inclusion in testimony by the Chairman of the Commission. Dr. Hanauer now claims that in 1972 he thought there was adequate assurance of safety. This leaves the public to

decide whether his 1978 memo which was prepared for public consumption of his 1972 memo which the NRC tried to withhold from the public represents the truth. .

It may help to know that this is not the first time that Dr. Hanauer has disavowed the contents of documents unfavorable to nuclear power after they were disclosed to the public. Another example is given in Enclosure B.

Dr. Hanauer also reveals, perhaps inadvertently, a fundamental deficiency that pervades NRC practice: Plants are licensed before safety problems are solved. In his 1978 memo, Dr. Hanauer states that: "Even in 1972, there were enough pressure suppression containments already approved that resolution of their safety problems was required." The public is told that safety problems are solved before approving designs. However, as Dr. Hanauer correctly states, this is not true. Plant licensing schedules are determined to a large extent by the economic pressures that arise after spending large sums on a particular plant design. To accommodate these pressures, the staff makes "judgements" in the absence of proof of safety. Then after plants are licensed, the efforts which continue in an attempt to solve the safety problems are portrayed to the public as "confirmatory in nature."

D. The NRC Staff's "Technical Update" on Pressure Suppression Containments

In NUREG-0474, "A Technical Update on Pressure Suppression Type Containments in Use in U.S. Light Water Reactor Nuclear

Power Plants," the NRC staff traces the history of development and safety problems of the G.E. designs for pressure suppression containments. In so doing, the staff has provided a case study of the major deficiencies in the regulation of nuclear power.

Four conclusions about NRC's "confirmatory testing program" can be drawn from a careful reading of NUREG-0474. The first conclusion to be drawn from the Mark I and II tests is that tests may fail to confirm the confidently claimed conservatisms. At least three "confirmatory" tests of the Mark I or II designs failed to produce expected results. NRC found in confirmatory tests that its judgement that pool swell hydrodynamics would be small was wrong. NRC states that its incorrect judgement that "hydrodynamic loads appear small..." was probably the result of limited instrumentation capability. (NUREG-0474, page 22) Then, in its one-tenth scale test of suppression pool surface response, NRC found that "subsequent scaling analysis has indicated that flow rates into the wet well were not well simulated in these tests." (NUREG-0474, pages 27-28) Further tests of the "magnitude and character of hydrodynamics LOCA related air clearing loads on the Mark I containment system...have revealed that the anticipated load reduction due to three dimensional effects may not be realized."

(NUREG-0474, page VI)

In addition, Dr. Hanauer's September 20, 1972 memorandum discusses the failure of G.E. testing programs. He states:

"Recently we have reevaluated the 10-year-old GE test results, and decided on a more conservative interpretation than has been used all these years by GE (and accepted by us). We now believe that the former interpretation was incorrect, using data from tests not applicable to accident conditions."

It is not clear whether Hanauer is referring to the three referenced failures or to an additional failure of "confirmatory" tests. In either case, it is official recognition that confirmatory tests do not always confirm.

The second conclusion to be drawn from the pressure suppression containment test program is that NRC relied on test facilities that were different from the actual facilities built. For instance, the Bodega Bay G.E. plant was the prototype for all subsequent Mark I plants. It was never built and its test facility differed in many important respects from the Mark I containments that were built. Further, the Mark II series of plants were approved on the basis of the Bodega Bay tests even though a totally new design was involved.

The third conclusion to be drawn from the build first/test later NRC program is that this program makes it extremely difficult, if not impossible, as a practical matter, for the NRC to enforce its regulations. "Confirmatory" tests of the G.E. Mark III pressure suppression systems disclosed that the operating Mark I BWRs did not meet NRC safety regulations. Rather than requiring that the BWRs be immediately shut down and upgraded to meet safety standards, the NRC staff without informing the NRC Commissioners simply waived the regulatory requirements. The requirements waived were not inconsequential regulations. They were important safety regulations governing

a vital barrier to the release of radioactive material to the environment. However, once plants are in operation, the pressures are enormous to allow them to continue in operation. In waiving these regulations, the NRC retreated from safety standards it has long used to assure the public that nuclear power plants are safe.

It has always been true that the AEC/NRC has no comprehensive empirical scientific basis for its safety judgements. In its place, the agency developed a program of design conservatism. With regard to pressure suppression containment systems, at least three conservatisms were built into the regulations and subsequently undermined in the NRC's BWR waiver decision of May 30, 1978.

1. Structural Design Margins. In deciding how strong the containment must be, the NRC required that a safety margin exist above the pressure levels it believed could possibly be produced in an accident. The normal safety margin for safety structures is a factor of four (4).

NRC BWR Waiver Decision. The NRC waiver for regulation of BWR pressure suppression containment systems cut the safety margin by a factor of two (2).

2. Conservative Force Calculations. Normally, in determining the base for its safety margins, NRC requires calculation of the largest loading force considered credible, and then puts a safety margin on top of that.

NRC BWR Waiver Decision. In waiving its design criterion on BWRs, NRC accepted the "most probable" force rather than the largest credible force so that it could still

claim that a safety margin exists. This means NRC is allowing the applicant to assume less severe safety conditions. If the NRC today was applying its normal methods of conservatively computing loads, the BWRs might have no safety margin at all or a negative safety margin.

3. Conservative Material Strength Calculations. In determining the strength of materials, the NRC normally uses "design" values. These design values are what engineers commonly use in estimating the strength of structural materials. The design strength for an I-beam, for example, is normally lower than the actual demonstrated strength of a certain I-beam in tests. "Design" strengths rather than "test" strengths are commonly used by the NRC and engineers in order to provide a conservatism to offset the possibility of defects in fabrication or erection.

NRC BWR Waiver Decision. In order to continue to claim some safety margin for many of the Mark I plants, "test" values rather than the more conservative "design" values were used.

In sum, even when NRC recognizes that a safety research program has failed to confirm its hopes, NRC simply waives its regulations and waters down its safety requirements.

Fourth, NRC should be much more humble about its ability to interpret the safety significance of its tests. For instance, the first two models, Mark I and Mark II, were approved and licensed on the basis of tests performed by G.E. for the sole purpose of measuring containment pressure response. Neither G.E. nor the staff proposed tests to investigate any other

phenomena such as pool swell hydrodynamics and bubble breakthrough. It is especially important to note that pool swell hydrodynamics and bubble breakthrough, which years later were determined to be significant factors affecting the adequacy of the design, were observed in the early tests as "discontinuities" in the pressure response. However, no "confirmatory" tests were proposed by G.E. or required by the staff to investigate the hydrodynamic loads because they "appeared small" and G.E. concluded that they were "insignificant." (NUREG-0474, page 22) It was precisely this type of problem that Dr. Hanauer considered before recommending a ban on further pressure suppression containments. He noted in his September 20, 1972 memorandum that it is difficult to assess the margin needed when applying experimental data to the containment design.

Did the NRC learn from the failures of the Mark I and II testing program when it began the Mark III containment test program. Unfortunately, it did not. First, just as NRC mistakenly began licensing Mark I and II without adequate data, NRC has begun licensing of Mark III without adequate testing. NRC, of course, confidently claimed that after-the-fact tests would confirm its judgements.

Second, the Mark III "confirmatory testing" program has also produced data that undermines rather than confirms. Development of the Mark III model of the G.E. containment began in 1970. (Note that the first Mark II plant is scheduled for operation in late 1979 and the first Mark III plant for 1980.)

As discussed in the preceding section, Dr. Hendrie found the design to be a feasible scheme on the bases of conceptual information and 1/2000 scale tests. The large scale tests of the Mark III design were initiated in 1973 and were intended to "confirm the conservatism in the analytical models" used in the Mark III design. (NUREG-0474, page 25)

In the first Mark III test series, it was discovered that hydrodynamic loads could be significant. Since these loads had not been considered in the design of either the Mark I or Mark II containments, a "reassessment was indicated." (NUREG-0474, page 27)

In 1975, two years after the Mark III large scale tests were initiated, the owners of the Mark I and Mark II plants formed "owners groups" to develop test programs. G.E. was chosen as the testing program manager. The Mark I test program is underway and NRC's evaluation is scheduled for completion in late 1979. In the meantime, the Mark I plants are allowed to continue operation. NRC's evaluation of the Mark II design is likewise incomplete. In the meantime, construction of the eleven plants with Mark II containments continues. Licensed operation of the first BWR with a Mark II containment "is not anticipated before mid-1979." (NUREG-0474, page ii)

In August, 1978, the NRC estimated that its review "to provide confirmation of specific pool dynamic loads" in Mark II designs would be completed in October, 1980. (NRC Status Summary Report - Generic Technical Activities, August 11, 1978, Draft)

In the case of the Mark III design, the staff says that they "consider" the basic design to be well established, that it is their "view" that phenomena being investigated in the Mark III tests do not represent design-governing conditions and that, in their "judgement," no new design considerations will result from those tests. In summary, the staff considers the remaining Mark III tests to be "confirmatory" in nature. (NUREG-0474, pages xii-xiii) The bases, if any, for such optimism are not discussed by the staff.

The staff also states that they will require that the Mark III tests and the staff's evaluation of the test results be completed prior to the issuance of the first operating license for a Mark III plant. In view of the staff's actions granting a regulation waiver to Mark I and Mark II plants, the credibility of that statement is practically zero. The only part of the statement that can be believed is that the staff will issue operating licenses for the Mark III plants. Whether completion of the tests and staff evaluation of the results are truly prerequisites to licensing remains to be seen. However, since the Mark I plants continue to operate with testing still underway, there is no doubt that the staff could find a way to allow Mark III plants to operate if the tests are not completed or if the test results contradict rather than confirm current staff judgements. Consider the magnitude of the problem NRC would face if it did otherwise.

The staff has already issued two Preliminary Design Approvals for standardized plants using the Mark III containment. Twelve plants with Mark III containments are under construction.

(Two of these received construction permits in 1974 and the operating license applications have been submitted to NRC.) Another eight construction permits for Mark III plants are pending. There is every reason to believe that NRC is faced with a fait accompli. It might become necessary for the staff to decide that less conservatism is needed in some calculation, that certain regulations can be waived without endangering the public, that further tests should be done to reconfirm staff judgements or that cosmetic design changes are needed, but the end result will be the same. All plants constructed with pressure suppression containments will be licensed to operate. The NRC has no other option because all others would create more turmoil than the NRC could stand thinking about.

Third, the NRC continues to use test facilities with significant design differences from the reactor it will be licensing. In this case, NUREG-0474 states that the NRC will rely on foreign test facility results even though foreign designs differ from U. S. designs.

In summary, the NRC's build now/research later research program is first, a technical failure because it is based on inappropriate test facilities; second, a failure of regulatory judgement because "confirmatory" tests have not confirmed the expected results; and third, a regulatory enforcement failure because it has allowed such huge capital investments to be made before basic experimental data is obtained that the results of the post-hoc experiments become almost irrelevant to the licensing process.