C09

February 23, 1966

MEMORANDUM

To : Dr. R. L. Doan, Director
Division of Reactor Licensing

From : R. F. Fraley, Executive Secretary
ACRS

Subject: MILLSTONE NUCLEAR POWER PLANT, ACRS SUBCOMMITTEE QUESTIONS

At the ACRS Subcommittee meeting on February 18, 1966, several questions were developed during discussions with representatives of the applicant and their consultants and contractors for the Millstone Nuclear Power Plant. These questions are summarized in the attached list for transmittal to the applicant. It is requested that written answers be provided to these questions for ACRS review of this project.

Several additional topics were also identified at this meeting, and the applicant was asked to be prepared to discuss these items when this project is next reviewed by the Committee. Specific questions which the applicant should be prepared to discuss are listed below:

1. How will it be ascertained whether or not the design conditions have been exceeded if an earthquake occurs? Will there be a seismograph(s) installed?

2. Is it clear that a fire in the control room cannot lead to gross failure of safety systems, e.g., simultaneous withdrawal of rods?

3. What would be the consequences of a postulated accident in which a main steam pipe breaks and both isolation valves remain open, assuming other aspects of the plant function as designed? Consider various positions for the pipe break. How would consequences change if cladding ruptures on 1% of the fuel or if 1% of the fuel elements melt due to improper distribution of core spray?

4. Describe the calculation that leads to the 1C/sec stack emission value. Define the assumed conditions concerning meteorological and population distribution.

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5. Describe the meteorology program that will be performed to determine the characteristics of the long duration "fumigation" condition which may occur with an on-shore wind. Describe the effect this condition may have on stack release rate limits.

6. Discuss the mechanical details which tend to preclude or mitigate the consequences of a rod ejection accident.

7. Discuss the consequences, including reconcentration in marine life, if water is discharged from the facility at the maximum concentration permitted by 10 CFR Part 20.

8. State the usage factor for the principle types of stress cycles to which the pressure vessel will be subjected. Indicate:

   a. The number of times each type of cycle is anticipated.

   b. The maximum number of each type of cycle that the vessel is likely to undergo.

   c. The number of cycles which are acceptable.

   The response to the above should be in terms of the maximum flaw size that can be tolerated.

9. Describe the in service inspection and surveillance program for the pressure vessel in some detail.

10. Discuss whether it is credible that an accident might compromise the electrical distribution and instrumentation systems in such a way as to prevent use of the engineered safeguards.

11. What are the consequences if the control rods were all withdrawn at the same time due to a failure in the instrumentation or drive systems for the rods? Can the pressure vessel withstand this accident?

12. What action would be taken in the event the standby diesel generator were found to be inoperative during reactor operation? Will the reactor be shut down if the generator is not operative?

13. Will the overpower scram set point be lowered during operation with partial recirculation flow to maintain an acceptable burnout ratio at the overpower scram set point? How will this be accomplished?

Attachment:
ACRS Subcommittee Questions on
Millstone Nuclear Power Statio.

OFFICE ▶	cc: All ACRS Members, except S. H. Bush & T. J. Thompson – no cy to W. R. Stanley
SURNAME ▶	D. Duffey
DATE ▶	

ACRS SUBCOMMITTEE QUESTIONS ON
MILLSTONE NUCLEAR POWER STATION

1. Discuss the consequences of an inadvertent rapid startup from low temperature as it relates to allowable pressure vessel stresses and brittle fracture limits which might exist at low temperature.

2. Define the flaw size and type in the pressure vessel which is accepted in the specifications. What flaws larger in size or of special significance might not be detected, particularly in sense of irregular geometry?

3. What flaw size is accepted in the studs of the pressure vessel? What frequencies of stud inspection or replacement is planned? How many studs can fail without threatening the integrity of the closure?

4. Describe how small leaks in the pressure vessel would be detected and the action to be taken, should such occur. How is adequate response assured in the event of a previous existence of small leaks in other parts of the system?

5. Which missiles are protected for and which missiles are not protected for?

6. What are the positive reactivity effects due to fuel relocation? Can this phenomenon affect reactivity transients like the rod ejection accident significantly?

7. If one postulates the rapid propagation of a crack circumferentially, with the contained energy of the system, what would happen to the upper section of the vessel including shearing of pipes, etc.?

8. Can you visualize any problem from the propagation of a crack from top to bottom of the vessel but not through the head?

9. Are you considering procedures for detecting the propagation of cracks within the pressure vessel wall?

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C O P Y

Comments on

Design and Analysis Report
Amendment No. 1
Millstone Nuclear Power Station
Dated February 2, 1966

Prepared by

Environmental Meteorological Research Branch
Institute for Atmospheric Sciences
February 25, 1966

Site Meteorology, Question 1(a)

Because of the lack of applicable data it is difficult to refute or confirm in a quantitative way whether isolated downwind terrain prominences have any effect on decreasing the distance between the ground and the elevated plume centerline, thus affecting the ground concentration. Obviously, laminar air flow approaching an isolated terrain obstacle must either flow around or over the obstacle (1). The streamlines at the level of the elevated plume centerline will be compressed as well as raised to some extent as the flow goes over the obstacle. The figure at the bottom of page 246, reference (1) shows graphically how the distance between the ground and the top streamlines is decreased. From casual observation in the rolling countryside just north of Washington, D. C., elevated smoke plumes on early mornings with strong surface-based radiation inversions tend to move horizontally and are little affected by the undulations of the terrain below. The field experimental data at Humboldt Bay, Eureka, California cited by the applicant include 11 field trails, only one of which was performed under inversion conditions and even that trial was under widely meandering wind directions and wind speeds averaging about 1 mph. It is obvious from the fluorescent particle data that for the trials which went in the direction of Humboldt Hill, relatively good diffusion existed since the maximum ground concentration was always between the stack and Humboldt Hill.

Site Meteorology, Question 1(b)

It has not been demonstrated that at Millstone Point a fumigation condition caused by stable air over cold water moving inland cannot persist for periods in excess of two hours with significant frequency. To various degrees, Hewson, Gill and Walke (2) show this condition to exist numerous times and show a case (run #11) where the stable elevated plume reaches the ground at 1/2 mile. They describe the plume first as "coning in a fashion typical of a stable atmosphere with a low wind speed. Next there appears a region in which there is very little vertical diffusion. After about 1/2 mile the plume shows considerable vertical diffusion" and visibly reaches the ground as shown by their graphic profile of the cloud dimensions.

C O P Y

The existence of transition states of diffusion raises the broader question of how one appropriately describes the meteorology of the site. As was pointed out in our previous comments, this involves not only on-site information (e.g. on-site meteorological tower) but also data at points where a marked transition occurs because of land-water contrasts. This, perhaps, could most easily (and inexpensively) be done by a comprehensive smoke plume photography study. However, this has the disadvantage of being limited primarily to daylight hours because of the photographic requirement, although some successful time exposure photographs of plumes have been made in full moonlight.

Site Hydrology (Original Report)

At the request of the Site Analysis Branch, Division of Reactor Licensing we have been requested to comment on the question of the effect of hurricane storm surge on the maximum expected high water mark. The high water data reported in Table II-13, page II-4-1 of the original report is taken directly from the appropriate figures in U. S. Weather Bureau Technical Paper #48(3). However, on the 1938 and 1954 hurricanes it is noted that "Many of the elevations shown result from averaging from two to ten values obtained within a space of one to two miles of coastline. The range of values combined to obtain a single value is frequently greater than 2 ft. "Also, it should be noted that in the case of Hurricane Carol of 1954 that high water levels of 12.6 and 11.8 were reported along the open coast just west of the hurricane path and about 25 miles west of Millstone Point. Thus, excluding wave runup (computed to be about 5 feet by applicant) in the calculation of a maximum credible high water level, a value of 13 to 14 feet above mean sea level would seem possible. This compares to a value of 9.2 feet excluding wave runup in the original Design and Analysis Report.

References

(1) Scorer, R. S. 1958: "Natural Aerodynamics Pergamon Press, London 313 pp. (see page 246).

(2) Hewson, E. W., Gill, G. C. and Walke, G. J., 1963: "Smoke Plume Photography Study, Big Rock Point Nuclear Plant, Charlevoix, Michigan" Progress Report No. 3, Dept. of Meteorology and Oceanography, University of Michigan (04-015-3-P), 87 pp.

(3) DeMarrais, G. A., Holzworth, G. C., and Hosler, C. R. 1965: "Meteorological Summaries Pertinent to Atmospheric Transport and Dispersion Over Southern California." Technical Paper No. 54, U. S. Weather Bureau, Washington, D. C. 86 pp.

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March 4, 1966

SUMMARY OF EVENTS
RELATED TO DEVELOPMENT OF
ORAL VS. WRITTEN COMMENTS
ON MILLSTONE POINT REACTOR

(1) January 28, 1966 - List of ACRS Questions transmitted to DRL for written reply on Brookwood Reactor (R. F. Fraley memo to E. G. Case following SC Meeting on Jan. 27, 1966). Included questions on quality control of studs and stud failure (#7), a circ. pressure vessel crack (#23) and a long. pressure vessel crack (#24).

(2) February 10-12, 1966, 70th ACRS Meeting - ACRS agreed to ask Millstone Point for written answers to an appropriate list of questions similar to those developed for Brookwood in January. Several questions for an oral reply were also developed for Brookwood and Millstone which dealt with the consequences and containment of the pressure vessel head as a missile and a circumferential pressure vessel crack.

(3) February 14, 1966 - R. F. Fraley telecon to E. G. Case transmitted questions for oral reply by Brookwood and Millstone. Alerted E. G. Case to the written questions being developed for Millstone. Case indicated that the oral questions created a problem of transmittal for BRL.

(4) February 15, 1966 - Memo from R. F. Fraley to R. L. Doan dated 2/15/66 with questions for written reply re liquid waste handling.

(5) February 16, 1966 - E. G. Case indicated that he had obtained approval to orally transmit the questions for an oral reply to Millstone.

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SUMMARY OF EVENTS

(6) February 18, 1966 - Millstone Point Subcommittee Meeting. At the conclusion of the meeting R. Cox (Consultant to Millstone) expressed grave concern to Dr. Zabel over the requirement for written answers to questions dealing with catastrophic pressure vessel failures. Dr. Zabel discussed this with me after the meeting and I agreed to bring the matter to the attention of Dr. Okrent.

(7) February 21, 1966 - I received a telecon from E. G. Case in which he inquired if the ACRS was reviewing its position with regard to the need for written answers to the Brookwood/Millstone questions on catastrophic pressure vessel failures. He indicated that A.Upton (Legal Counsel for Brookwood) had called to make this inquiry based on information he had received concerning the Millstone Subcommittee meeting. (It was not clear how he had obtained this information.) I advised Mr. Case that no decision had been made to modify or withdraw the Committee's questions on Brookwood or Millstone. *(An advanced set of the Brookwood answers was received on Feb. 21, 1966 and the answers in amendment form were received on March 1, ~~1966~~.)

During the day on Tuesday, this subject was discussed among Okrent, Zabel, Etherington, Palladino and Fraley. It was eventually decided that the requirement for written answers to the questions on Brookwood and Millstone dealing with catastrophic pressure vessel failures would be withdrawn and oral replies would be satisfactory. I called E. G. Case to advise him of this decision but he informed me that the answers to the Brookwood questions had already been submitted in writing. Mr. Case suggested that, based on comments by Mr. Upton, Brookwood had decided that it would create more of a problem to try to explain to potential interveners, etc., why they had not been answered in writing than it would to answer the questions.

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SUMMARY OF EVENTS

I brought this to the attention of Dr. Okrent and Dr. Zabel who decided that, in view of the above, the questions to Millstone should include similiar inquiries re catastrophic pressure vessel failure as originally planned.

Dr. Okrent proposed that this subject be scheduled for discussion at the March ACRS meeting.

(8) February 23, 1966 - The questions for a written reply on Millstone were transmitted to BNL by E. F. Fraley memo.

(9) March 2, 1966 - Written answers to ACRS questions on Millstone were received.

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March 8, 1966

Project: Millstone Point (Millstone Nuclear Power Station)

Status: Construction Permit Review - Letter Requested
(Applicants were informed at the February 18, 1966 Subcommittee meeting that a letter might not be written at the March 1966 meeting.)

Background:

The Millstone Point Subcommittee visited the site of the proposed Millstone Nuclear Power Station on July 6, 1965. In its July 19, 1965 letter, following review of the proposed site, the Committee concluded that the site was acceptable for a 2500 MW(t) pressurized or boiling water reactor, if adequate containment and engineered safeguards are provided.

On November 15, 1965, an application for a construction permit was filed accompanied by the Design and Analysis Report for the reactor. This was followed by a DRL/Millstone Point meeting on December 22 and 23, 1965 to consider the application, and a set of DRL questions was subsequently forwarded to the applicants on January 14, 1966. The reply to these questions was received by the AEC on February 2, 1966. On February 18, 1966, a Subcommittee meeting was held; Subcommittee questions were subsequently forwarded to DRL on February 23, 1966 for transmittal to the applicants; and the answers to these questions were received on March 3, 1966. The tentative schedule for the regulatory process, agreed to between the DRL Staff and the applicants, contemplates issuance of a construction permit on June 1, 1966.

Questions:

1. The DRL analysis states that the Regulatory Staff believes that the potential high water problem at the site should be resolved by further information from the applicants and from the DRL consultants. The U. S. Geological Survey report, received after the DRL analysis was forwarded to the ACRS, indicates that a storm surge might cause the water surface to rise to 14.1 - 14.4 feet above mean sea level at the site. The report also indicates that wave and flood damage 5 to 25 feet above this height might occur. Further information from this particular DRL consultant appears to have made the problem of possible high water at the site less resolved. Comments regarding this matter might be asked of the DRL Staff and the applicants.

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2. DRL concludes its report with a list of seven items, in addition to the high water problem, which will require resolution during construction and prior to operation of the facility. These items are:

1. The adequacy of the Control Rod Thimble Support structure.

2. The effects of a failure in the control rod selector system causing the withdrawal of 2 control rods.

3. The effects of a loss of redundancy to the Containment Spray Systems in the event of a rupture of a spray header.

4. The transient effects of a sudden loss of load since the bypass system now has a 100% capacity.

5. The prevention of diesel generator overload.

6. Results of meteorological site tests.

7. Containment integrity in the event of facility stack failure.

Some of the above appear to require early resolution, and perhaps should be resolved at the construction permit stage, especially the effect on containment integrity in the event of failure of the facility stack. DRL might be asked when these items will be resolved.

3. GE was asked at the February 18, 1966 Subcommittee meeting to be prepared to discuss the possibility of the failure of one of the main steam line isolation valves resulting in failure of the other. (This is similar to a question asked regarding Dresden 2.)

4. The February 23, 1966 memorandum to DRL listed 13 ACRS questions that the applicants should be prepared to discuss at the full Committee meeting.

5. It should be noted that the applicants have not really answered the oral ACRS questions (developed at the 70th meeting) with regard to what might be done to contain a catastrophic pressure vessel failure, such as a brittle failure of the pressure vessel wall or loss of the pressure vessel head. Discussion at

the Subcommittee meeting dealt primilarly with the incredibility of such accidents. It appears that answers to these questions will be provided only if the ACRS insists.

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Comments on

Millstone Nuclear Power Station Unit I
Final Safety Analysis Report
Volumes 1, 2 and 3 dated March 15, 1968

Prepared by

Air Resources Environmental Laboratory
Environmental Science Services Administration
May 24, 1968

The Millstone site is unique in comparison to inland sites in that onshore flow, which is of most immediate concern because of the site boundary, is predominantly a stable flow as it passes the top of the reactor stack. Consequently, the atmospheric process which would cause the highest ground concentrations from an initial elevated plume would be one of rapid downward mixing. Such a pseudo-fumigation process has been discussed and documented by Van der Hoven [1] and in our comments of December 29, 1965 and February 25, 1966 and is also discussed by the applicant based on a special study by Bowne and Collins [2] and included as Appendix A-2. A critical factor in computing off-site ground-level concentrations assuming an onshore fumigation model is the inland distance at which the land - induced turbulence reaches the stable plume. An empirical relationship is available [1] which fits very well the measurements reported by Bowne and Collins [2] where for 17 cases of onshore gradient, the height of the mixed layer reached the stack height (114 meters) at an average distance of 3000 meters from the beach with an average wind speed value of 4.5 m/sec and potential temperature difference in the overwater inversion of 2.5°C. However, for an individual case, where for example the wind speed is reduced in the illustration above to 2 m/sec, the empirical relationship indicates fumigation at a distance of 400 m from the source. We would disagree with the applicant that according to their study [2] the closest distance at which possible fumigation would occur is at 2333 meters from the source. Hewson, Gill and Walke [3] show a case (run 611) at the Big Rock Point reactor site where from a 78 meter stack the stable elevated plume reaches the ground at a distance of 800 m. Similarly, Robinson, Eberly and Cramer [4] show a 76 meter high plume reaching the ground at the same distance for the Humboldt Bay reactor site.

From evidence presently available, including the site meteorological data which shows that fumigation conditions could occur inland from the plant about 25 percent of the time and that stable or very stable atmospheric conditions with onshore winds are observed 34 percent of

the total annual hours, we would conclude that persistent (at least 2 hours) fumigation conditions can occur at the nearest off-site boundary about 1/2 mile to the northeast. This effect would be maximized under slightly stable initial plume conditions with low wind speeds. Assuming Pasquill Type E inversion conditions, a wind speed of 2 m/sec, the fumigation model would result in a ground level concentration of 4.4×10^{-5} sec/m^3 which is four times greater than the controlling off-site estimate listed in Table XIV-17 of the FSAR.

References

[1] Van der Hoven, I. (1967), "Atmospheric Transport and Diffusion at Coastal Sites," Nuclear Safety, 8(5), pp. 490-499.

[2] Bowne, N. E. and G. F. Collins (1967), "Summary Report, 1966 Summer Pilot Balloon and Wiresonde Observations, Millstone Point," TRC Service Corporation, Hartford, Conn., 31 pp.

[3] Hewson, E. W., G. C. Gill and G. J. Walke (1963), "Smoke Plume Photography Study, Big Rock Point Nuclear Plant, Charlevoix, Michigan." Progress Report #3, Dept. of Meteorology and Oceanography, Univ. of Michigan (04 015-3-P), 87 pp.

[4] Robinson, L. H., D. L. Eberly, and H. E. Cramer (1965), "Meteorology and Atmospheric Diffusion in the Vicinity of the Humboldt Bay Power Plant, Pacific Gas and Electric Company, Meteorological Office, 85 pp.