UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

COMM
CORR

OFFICE OF THE
CHAIRMAN

September 7, 1979

The Honorable Robert Eckhardt, Chairman
Subcommittee on Oversight and Investigations
Committee on Interstate and Foreign Commerce
United States House of Representatives
Washington, D. C. 20515

Dear Mr. Chairman:

Thank you for your letter dated March 30, 1979, in which you requested certain information for the Subcommittee on Oversight and Investigations. The specific questions listed in your March 30, 1979 letter are discussed below.

Question 1

The radiation level monitoring procedures set up or mandated by NRC both for checking the radiation levels prior to this incident and for determining levels resulting from this or other accidents.

Answer

During normal operations, licensees are required to conduct radiological environmental monitoring programs which are spelled out in the facilities' Environmental Technical Specifications. These programs require that samples be taken from the aquatic, atmospheric and terrestrial environment and that radiation dosimeters be placed around the facility to measure direct radiation levels. For example, at Three Mile Island (TMI) during 1978, about 640 environmental samples were analyzed and some 77 environmental dosimeters were processed.

For emergency situations, licensees are required to have procedures for expanded monitoring capabilities. These plans include designation of special monitoring teams and provisions for utilization of off-site support groups. In the case of the TMI accident, the licensee performed the following types of measurements:

- Ground level dose rate measurements were made to provide quick assessment of environmental impact and to provide information for calculation of the amount of radioactivity being released from the plant.

- Air samples were collected from fixed environmental sampling stations located in the environment around the plant and by survey teams dispatched from the plant.

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- Dose rate measurements from helicopters were made to aid in determining the location of the plume.
- Surface water samples were collected from the Susquehanna River.
- Milk samples were collected from local dairies.
- Thermoluminescent dosimeters (TLD) were used to measure cumulative doses in the public domain.

In addition to the licensee's measurements, samples were collected and measurements were made by the following organizations: Commonwealth of Pennsylvania; Department of Energy; Environmental Protection Agency; Department of Health, Education and Welfare and the Nuclear Regulatory Commission. From the time of the accident to April 23, 1979, the number of environmental samples collected and analyzed by the licensee and the above mentioned organizations totaled about 1475. In addition, about 850 environmental dosimeters were processed and about 80 helicopter flights were flown in the surrounding areas to measure the radiation levels.

For your information we have enclosed an NRC document which should help to further clarify the above question. This document is NUREG-0558 entitled, "Population Dose and Health Impact of the Accident At the Three Mile Island Nuclear Station."

Question 2

The monitoring activities, if any, of other federal or state regulatory agencies regarding radiation levels.

Answer

Following the accident, the Nuclear Regulatory Commission, the Department of Energy, the Food and Drug Administration and the Environmental Protection Agency established monitoring programs. The Commonwealth of Pennsylvania increased its monitoring program and the adjacent States of Maryland and New York increased their monitoring activities.

These monitoring programs include extensive aquatic, atmospheric, terrestrial and direct radiation measurements. Specific monitoring activities included analysis of milk, vegetation, water and processed food samples, measurements of integrated radiation doses via thermoluminescent dosimeters, analysis of atmospheric samples by means of fixed and portable monitors, direct radiation measurements utilizing ground level and aerial survey techniques, and measurement of possible radioactive material ingestion by means of whole body counting.

Question 3

The exposure received by the employees who were in the plant at the time of the cooling system malfunction and the way in which employee exposure is measured and recorded.

Answer

All personnel entering the fenced area on Three Mile Island are provided with a thermoluminescent dosimeter (TLD) badge. These badges are issued and collected at the security gate. The TLD's are being processed daily, weekly and monthly depending on the type of work the individual is performing. Those individuals who are routinely working in high radiation areas are having their TLD's processed daily.

In addition to the TLD badges, individuals who enter radiological areas that require a Radiological Work Permit are required to obtain a self-reading pocket ionization chamber. These are issued at the health physics control points and the readings are recorded prior to entry and upon exiting. Cumulative exposure records for the individuals are also maintained at the health physics control points and are reviewed prior to authorizing entries.

No radiation overexposures occurred as a direct result of the cooling system malfunction, however, several radiation exposures greater than the quarterly limit of 3 Rem per quarter have occurred during the recovery operations; primarily during activities involved in obtaining primary coolant samples for analysis.

A summary of licensee and contractor exposures is as follows:

Dose Range Rem Whole Body-Gamma	Numbers in Range for Period 3/29-5/17/79
no measurable	3137
<0.1	961
.1 - .25	314
.25 - .5	162
.5 - .75	59
.75 - 1.0	33
1.0 - 2.0	28
2.0 - 3.0	5
3.0 - 4.0	3

Question 4

The reason the plant was built only ten miles from Harrisburg as one of the criteria for siting a nuclear power plant is that it not be in close proximity to a populated area.

Answer

It has been the general policy of the Nuclear Regulatory Commission (NRC) to encourage power reactor siting in low population density areas. To that end, the Commission's regulations on reactor site criteria, 10 CFR Part 100, require that every power reactor have an exclusion area immediately surrounding the reactor which is under the control of the applicant, a low population zone outside the exclusion area where appropriate protective measures could be taken to protect the public in the event of a serious accident, and that the nearest densely populated center of about 25,000 or more persons be located no closer than one and one-third times the outer radius of the low population zone.

With regard to the Three Mile Island Unit 2 (TMI-2) facility, the minimum exclusion area distance is 2,000 feet, the low population zone (estimated population of 2,400 persons) outer radius is 2 miles, and the nearest population center, Harrisburg (1970 population, 68,000 persons), is located about 12 miles northwest of the reactor. Also as required by Part 100, the radiological consequences of a postulated serious accident involving a major fission product release within the containment must be shown to be within the guideline values (25 rem to the whole body and 300 rem to the thyroid gland) to an individual assumed to be located at the exclusion area boundary for a two-hour period, and to an individual assumed to be located at the outer boundary of the low population zone for a 30-day period. Both the licensee and the NRC staff analyzed such events and concluded that the combination of plant safety features and site characteristics were such that the consequences of such an event would be within the regulatory guidelines.

In addition, the NRC staff reviews the present and projected population in the site vicinity and has developed criteria for use in its reviews dealing with population density. These criteria, which are not part of the Commission regulations but which do offer guidance on staff review practices, have evolved with time. At the time (1969) that TMI-2 was under review for a construction permit, the NRC staff used the guideline that the population in the vicinity of a proposed site should not be in excess of the values for the previously approved and licensed Indian Point Site. The population values for Indian Point were about 110,000 persons within 5 miles, 330,000 persons within 10 miles, and about 1,400,000 persons within 20 miles. Since the 1970 values for TMI-2 were

about 26,000 persons within 5 miles, 140,000 persons within 10 miles and 625,000 persons within 20 miles, it is clear that the population levels for TMI-2 were within the staff guidelines.

In October 1975, the staff published Regulatory Guide 4.7 "General Site Suitability Criteria for Nuclear Power Stations" which modified the staff criteria with respect to population density as follows:

"If the population density, including weighted transient population, projected at the time of initial operation of a nuclear power station exceeds 500 persons per square mile averaged over any radial distance out to 30 miles (cumulative population at a distance divided by the area at that distance), or the projected population density over the lifetime of the facility exceeds 1,000 persons per square mile averaged over any radial distance out to 30 miles, special attention should be given to the consideration of alternative sites with lower population densities."

As indicated by the staff criteria, a site which exceeds these population density guidelines can nevertheless be selected and approved, if on balance, it offers significant advantages as compared to available and alternative sites by considering all the environmental, safety and economic aspects of the selected site and the alternative sites.

Examination of the present and projected population levels around the TMI-2 site in the light of the more stringent screening levels of Regulatory Guide 4.7 indicates that the site would meet the present criteria as well.

Your Subcommittee may also be interested in knowing that before the TMI-2 accident, the Commission had requested a thorough review and examination of its siting policy and in that regard has requested a staff task force to give its recommendations regarding any changes in the Commission's siting criteria. This task force is expected to report to the Commission shortly.

Question 5

The cause, as far as may be determined, of the March 28 and 30 radiation leaks.

Answer

During the initial stages of the event on March 28, large quantities of water were released from the primary coolant system into the reactor

containment building sump. This water contained xenon and iodine from the core. Sump pumps in the containment building automatically pumped this water into tanks in the Auxiliary Building. Because of the large quantity of water involved, the holding tanks overflowed onto the floor of the Auxiliary Building. Xenon and iodine evolved from this water and were released via the Auxiliary Building Ventilation System.

In addition, radioactive gases were released from the waste-gas handling system. The exact release mechanism is not precisely known at this time.

Question 6

The radiation levels measured at all distances prior to the March 28 accident as well as subsequent to it and the potential health hazard posed by those levels.

Answer

Prior to the March 28 accident the normal background level in all directions from the site ranged from approximately .01-.02 milliroentgens/ hour. In the time frame immediately following the accident the measured radiation levels were substantially higher with the highest readings being measured near the site boundary.

At the time of the accident, Metropolitan Edison had 17 thermoluminescent dosimeters (TLDs) deployed at various distances from the site (out to approximately 15 miles). These TLDs measure the integrated dose over a period of time. The TLDs were collected and replaced with new TLDs approximately 30 hours after the accident. Analysis of the TLDs indicated that the average dose rate in the environs (as measured by the TLDs) during the thirty hours immediately after the accident was generally in the range 0.1-0.2 milliroentgens/ hour above background. Two locations on uninhabited islands near the site indicated a significantly higher dose rate. These islands and dose rates were: Shelley Island (1.1 miles SW of site), 1.3 milliroentgens/hour; and Kohn Island (0.4 miles NNW of site), 25 milliroentgens/hour.

During the period March 29-31, analysis of the results from the same TLD locations indicated that the dose rate was generally in the range of 0.02-0.2 milliroentgen/hour. The highest reading was 0.8 milliroentgen/ hour one-half mile ENE of the site. The dose rate at Shelley Island and Kohn Island had decreased to 0.3 and 1.0 milliroentgens/hour, respectively.

Analysis of the 37 TLDs deployed by the NRC out to 12 miles from the site indicated that the average dose rates on March 31-April 1 generally

ranged from .05-0.1 milliroentgens/hour approximately one-half mile ENE of the site. During the next week the average dose rates were on a generally downward trend and by April 2 they were at normal background levels.

Based on the foregoing radiation measurements, no significant health hazard is expected to result.

Question 7

The factors considered for possible evacuation of the Harrisburg area and the formal decision-making process, if any, by which such decisions are reached.

Answer

In 1975 the U.S. Environmental Protection Agency published as agency guidance, protection action guides for human radiological exposure by an airborne radioactive release from nuclear facilities. These "Protection Action Guides" (PAGs) are numerical ranges of projected radiological dose which serve as trigger levels to take some form of protection measure such as evacuation, sheltering, or the administration of thyroid blocking radioprotective drugs. Thus, in concept, the decision-making process as to whether or not to order or recommend implementing specific protective measures such as evacuation should be based upon PAGs and a consideration of other factors at the time of the radiological release, such as the feasibility of implementing the protective measures.

In the case of the Three Mile Island accident, because of the radiological releases that were occurring on Friday morning, March 30, 1979, the general uncertainty of the magnitude of these releases and the lack of reliable radiological release information, the decision to recommend the selective evacuation of certain sections of the population living within 5 miles of the plant site was made as a precautionary move and not predominantly based upon the concept of applying the EPA PAGs to the Three Mile Island situation.

A decision-making matrix concerning possible measures for various contingencies was initially prepared on April 1, 1979. It defines in some detail the possible options considered after the accident for various scenarios. Modifications to the matrix were made as additional review was completed. A copy of the April 2, 1979, version is enclosed for your information. It is important to note that this is a historical document and does not represent any future decision-making procedure. The need for developing an appropriate decision-making matrix of this type is part of the ongoing NRC review of the TMI accident. Also enclosed is a copy of the transcript of the Commission meeting which discusses the preparation of the matrix (starting at page 51).

If I can be of any further assistance to you, please let me know.

Sincerely,

Joseph M. Hendrie
Chairman

Enclosures:
As stated

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HOUSE OF REPRESENTATIVES
SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS
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MARK J. RAABE
CHIEF COUNSEL/STAFF DIRECTOR

March 30, 1979

Honorable Joseph M. Hendrie
Chairman
Nuclear Regulatory Commission
1717 H Street, N.W.
Washington, D.C. 20555

Dear Mr. Hendrie:

The Subcommittee on Oversight and Investigations has been conducting an inquiry into the health effects of low-level ionizing radiation. As such, we are concerned about the malfunction and subsequent leaks at the nuclear power plant at Three Mile Island outside of Harrisburg, Pennsylvania.

Pursuant to this inquiry and under the authority of Rules X and XI of the Rules of the House of Representatives, we would appreciate receiving the following information concerning the Three Mile Island plant:

IE 1. the radiation level monitoring procedures set up or mandated by NRC both for checking the radiation levels prior to this incident and for determining levels resulting from this or other accidents;

IE 2. the monitoring activiti , if any, of other federal or state regulatory age les regarding radiation levels;

IE 3. the exposure received by the employees who were in the plant at the time of the cooling system malfunction and the way in which employee exposure is measured and recorded;

MRR 4. the reason the plant was built only ten miles from Harrisburg as one of the criteria for siting a nuclear power plant is that it not be in close proximity to a populated area;

IE 5. the cause, as far as may be determined, of the March 28 and 30 radiation leaks;

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IE 6. the radiation levels measured at all distances prior to the March 28 incident as well as subsequent to it and the potential health hazard posed by those levels; and

IE/SP 7. the factors considered for possible evacuation of the Harrisburg area and the formal decision-making process, if any, by which such decisions are reached.

The Subcommittee would appreciate being kept abreast of all developments concerning the Three Mile Island plant. We will anticipate receiving the information delineated above no later than April 6, 1979.

Thank you for your assistance and cooperation.

Sincerely,

Bob Eckhardt

Bob Eckhardt
Chairman
Subcommittee on
Oversight and Investigations

April 2, 1979

NRC PROCEDURES FOR DECISION TO RECOMMEND EVACUATION

Who Decides

1. Combination of consequences and times require immediate initiation of evacuation: Senior NRC Official on site recommends to Governor.

2. Unplanned event with substantial risk takes place or is imminent or situation judged excessively risky but there is time for consultation. Senior NRC Official notified Governor and NRC HQ. Chairman makes recommendation to Governor after consulting with Commissioners if possible.

3. Planned event involving significant additional risk. Chairman and Commissioners makes recommendation.

UNPLANNED EVENTS

EVENT	EXPECTED PLANT RESPONSE	RELEASE AND TIME	WARNING TIME	EVACUATION SCENARIO
1. Loss of vital function or planned leaks.	Restore function within 1 hour	No significant change		Possible precautionary evac 2 mi; stay inside 5 mi
Examples Reactor Coolant Pump Trip; Loss of off-site power; Loss of feed-water;	Switch to Alternate Function involving Primary Coolant in Auxiliary Building	Small leak less than 1 gal/hour		Possible precautionary evac 2 mi; stay inside 5 miles
		Large leak 50 gal/min	2 hours	Evac 2 miles Stay Inside 5 miles
Depressurization to go on RHR; Leak in Auxiliary Building	Serious possibility of failure to restore a vital function See 2			

These tables include a number of assumptions about activity and weather, which are somewhat pessimistic. In an actual release, the release rate and weather should be evaluated as they are at the time, and the decision based on those values.

EVENT	EXPECTED PLANT RESPONSE	RELEASE AND TIME	WARNING TIME	EVACUATION SCENARIO
2. Sequence leading to Core Melt	Maintain Containment Integrity (likely) with Containment Cooling	Design Containment Leak Rate	4 hours	Precautionary Evac 2 mi all around and 5 mi, 90° sector, stay inside 10 mi
	Containment expected to Breach	Significant release of core fission products	24 hours (time for containment failure)	Evac 5 mi all around and 10 mile, 90° sector, stay inside 15 mi
3. Hydrogen flame or explosion possible inside reactor vessel	Serious flammability problem			Precautionary 2 mi plus 5 mi 90° sector, 10 mi stay inside
	Explosion; major damage Core Melt, See 2			
4. Control Room Evacuation	Possible Loss of Control			Precautionary 2 m
Plant Evacuation	Treat like major release			If plant evacuate Evac 5 mi all around and 10 mi 90° sector, stay inside 15 miles
5. Release during cleanup				

PLANNED EVENTS

EVENT	EXPECTED PLANT RESPONSE	RELEASE AND TIME	WARNING TIME	EVACUATION SCENARIO
Planned Manuever that involves a significant risk	Probability of losing vital function	See releases under loss of vital function	Timing of maneuver can be set to provide as much time as necessary	Precautionary evacuation 2 miles, stay inside 5 miles PLUS See outcomes under loss of vital function

Action Guidelines

a. Notify evacuation authorities two hours in advance (if possible) to standby for a possible evacuation.

b Projected doses of 1 rem whole body or 5 rems thyroid stay inside.

c. Projected doses of 5 rems whole body or 25 rems thyroid mandatory evacuation of all persons.

Assumes general warning already that some form of evacuation may become necessary.

Weather

The table is based on a realistic prediction of the weather for the next few days, based on the April 1 forecast which would result in high doses at a given distance. At the approach to decision time for evacuation, the appropriate meterological condition will be factored into the dose estimates to determine the evacuation time, sectors, and distances for the evacuation.

NRC is predicting the dispersion characteristics of the region for the currently measured meteorology as the incident progresses. Rain could lead to higher local radioactivity levels.

Heat Generation

The reactor core is now quite cool compared to the conventional design-basis calculations.

1. The reactor is new, so no fuel has more than 3 months equivalent operation, compared to 12 years average for other plants.

2. The neutron chain reaction has been shut down for over 4 days.

It should also be noted that the concrete basemat of this plant is unusually thick.

As a result of the above differences, calculations for this plant at this time preduct that the core will not melt its way through the containment.

Event 1 — Sprays and Coolers Operative

Time=0 — Flow stops, core and water start heat-up

Time=100 min — Core starts to uncover

Time=150 min — Core begins to melt

Time=200 min — Molten core is in lower head of reactor vessel, pressure is 2500 psia

Time=210 min — Reactor vessel fails, containment pressure goes to 25 psia

Time=210 min — Hydrogen burns, containment pressure goes to 67 psia -- Steam explosion possibility -- minor consequences

CONTAINMENT SURVIVES (Failure assumed 130 psia)

Time=10 hrs — Molten core has melted about 1 meter into basemat

Time=days — Major problem -- handle hydrogen, oxygen -- maintain containment integrity

CAUTION:
- -- Keep sprays running
- -- Keep water many feet over molten debris
- -- WITHOUT RECOMBINERS Hydrogen continues to build up

BASEMAT SURVIVES

Event 1 Conclusion: This event should not produce major releases

Event 2 -- Sprays and Coolers Failed Before Flow Stops

Time=0 to Time=210 min — Same as Event 1 -- containment pressure is 25 psia

Time=810 min — Containment pressure is 70 psia

Time=1 day — Containment fails due to steam (mostly) overpressure -- about 135 psia

CONTAINMENT FAILS

Event 2 Conclusion: This event leads to major releases.

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ENCLOSED:
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ENCL w/ltr 9/7/79
Hendrie to ECKHARDT

NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF:

CLOSED MEETING

DUPE
190 of 250045

Place -

Date - Sunday, 1 April 1979

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Pages 1 - 69

(THIS TRANSCRIPT WAS PREPARED FROM A TAPE RECORDING.)
