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BEFORE THE

UNITED STATES ATOMIC ENERGY COMMISSION

In the Matter of:

METROPOLITAN EDISON COMPANY
JERSEY CENTRAL POWER & LIGHT COMPANY
THREE MILE ISLAND NUCLEAR STATION,
UNIT NO. 2 — Docket No. 50-320

SUPPLEMENT TO

SUMMARY DESCRIPTION OF APPLICATION

FOR REACTOR CONSTRUCTION PERMIT

AND OPERATING LICENSE

DATE: October 1, 1969.

INTRODUCTION

This Supplement to Summary Description of Application for Reactor Construction Permit and Operating License is submitted in response to questions asked by members of the Atomic Safety and Licensing Board at the Pre-Hearing Conference held on September 19, 1969, in Washington, D. C.

This Supplement constitutes a portion of the Applicant's prepared testimony for the public hearing on the Application for a construction permit and is sponsored collectively by the sponsors of the Applicant's Summary Description of the Application for Reactor Construction Permit and Operating License, dated September 3, 1969.

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I

Subject: Alternatives to Containment Purging to Relieve Hydrogen Generation Problem

B&W has reviewed various potential methods of assuring that the hydrogen concentrations do not exceed safe levels. Included in this review were a study of the effects allowing hydrogen to accumulate to various concentrations, the use of flame and catalytic recombiners, hot surface combustion, and the use of chemical additives to the spray solution for scavenging hydrogen.

B&W concluded from this review that purging is a safe, dependable means of preventing excessive hydrogen buildup.

With purging, the active equipment required for a purge system is located outside of the reactor building, thus being separated from the LOCA environment. Also, the purging system equipment is simple, consisting of standard components whose satisfactory performance has been demonstrated by extensive operating experience. Following the initial study, our efforts are being devoted to a more detailed evaluation and design of the purging system.

II

Subject: Discussion of the Status of Iodine Removal Research and Development Program

The B&W research and development program on alkaline sodium thiosulfate research and development has been completed. This work is reported in proprietary Topical Report BAW-10017, "Research and Development Report on the Stability and Compatibility of Sodium Thiosulfate Spray Solutions," which was submitted to the Staff on August 6, 1969. This report includes test data on storage, radiation and thermal stability; iodine retention capability; and materials compatibility.

The test data substantiates that:

a. The solution is stable under long term storage.

b. Under accident conditions the alkaline sodium thiosulfate has sufficient stability to perform its iodine removal and retention function.

c. The solution is compatible with the materials and functions of the containment and safeguards systems.

In the past two years, a large number of spray tests (more than 25) have been conducted in the Nuclear Safety Pilot Plant (NSPP) by Oak Ridge National Laboratory and in the Containment Systems Experiment (CSE) by Battelle Northwest Laboratory. These tests have demonstrated that radioactive iodine is effectively removed by alkaline thiosulfate chemical sprays.

Using an NSPP run made at accident conditions closely approximating those predicted by Three Mile Island Unit 2, the measured iodine half-life was 31 sec; that is, half of the radioactive iodine was removed from the steam-air atmosphere in 31 seconds after starting the sprays. These data have been scaled to the Three Mile Island Unit 2 design. They result in an iodine half-life of 36 seconds with the full spray installed capacity operating and a half life of 72 seconds at half capacity. The iodine half-life reported in the PSAR is 103 seconds at full capacity and 206 seconds at half capacity.

On the basis of calculations presented in Chapter 14 of the PSAR, the iodine removal half-life required to reduce the 2-hour thyroid dose at the exclusion distance to the 300 rem limits of 10 CFR 100 is 905 seconds. Thus, only about 1/8 of the available spray effectiveness reported in the PSAR and only 1/25 of the available effectiveness as indicated by NSPP tests is required to meet the 10 CFR 100 site acceptability requirements.

III

Subject: Discussion of Protection to be Afforded Against the Probable Maximum Flood

The site as developed for Generating Unit 1 was designed to be safe from a flood of 1,100,000 cfs including wave run-up. This is a flood, which, conservatively, has a probability of occurrence in any one year of approximately 1 chance in 30,000, and is slightly in excess of the then current Probable Maximum Flood (PMF) as calculated by the Corps of Engineers. On this basis the plant could continue operation at the peak of the flood.

A revised PMF study has since been completed by the Corps of Engineers and, subject to review and approval, will indicate a calculated PMF discharge of 1,750,000 cfs at Three Mile Island assuming natural river conditions and 1,600,000 cfs considering flood control projects operative in 1969. The rainfall intensities and areal extent of the storm necessary to cause this revised PMF are known and are published by Hydrometeorological Report No. 40 by the U. S. Weather Bureau. Rainfall records are constantly available from Weather Bureau gaging stations. Based on preliminary hydrographs of the proposed new PMF furnished by the Corps of Engineers, the river level would exceed the design river level for a period of approximately 18 hours to 24 hours. Warning of such a flood would be available for about four days prior to the occurrence of the peak.

Complete protection of the plant against this flood could be provided by raising the elevation of the 3½ miles of dike system and sandbagging a short section where the access road and railroad cross the dike. Considering the extreme improbability of such a flood occurring and the assurance of adequate advance warning of its occurrence, it was decided to protect the plant so that it could remain in operation through the design flood of 1,100,000 cfs, but, for a flood of greater magnitude, to maintain the plant in a safe shutdown condition.

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The specific provisions for protection to be applied to each system and each item of equipment required for maintaining the plant in a safe shut-down condition will be developed during detailed design. Wherever feasible, the equipment and systems will be elevated above flood level. Where this approach is not feasible, other approaches will be used, such as the furnishing in the original plant construction, of bulkheads and prepared slots to seal off to above flood level, buildings or portions of buildings enclosing equipment and systems required for decay heat removal.

Access ways including roof hatches, ladders and walkways as required will be included in the original plant construction to permit operating personnel travel above flood level between all protected enclosures. Access to the plant can be maintained by heliocopters or boats.

The integrity of the existing dikes will be preserved during the flood by opening the plant drainage gates, after providing interior protection, and allowing the water to rise to the elevation of the river so that the dikes will be gradually submerged, rather than overtopped. Any damage to the dikes would thus be restricted to local conditions susceptible to immediate repair following the passage of the flood.

All structures enclosing systems that are essential to a safe shut-down of the plant are supported on bedrock and are designed to withstand the hypothetical aircraft impact or tornado borne missiles and thus are inherently protected against structural damage as a result of flood c flood borne missiles.

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IV

Subject: Summary of Applicant's Discussions with the Pennsylvania Department of Health

In January of 1968 there was a meeting with the Pennsylvania Department of Health regarding the proposed environmental program for Three Mile Island Unit 1. There were comments on the program and a mutual agreement was reached regarding how to proceed. This included an agreement to provide the Department of Health with water samples taken from the Susquehanna River simultaneously with the samples analyzed by Met Ed so the Department of Health could perform an independent analysis. There was a subsequent visit by the Department of Health and representatives of U.S.P.H.S. to the site to further discuss the program.

In July of 1969 there was a meeting with the Pennsylvania Department of Health to discuss the draft of the Three Mile Island Emergency Plan. Comments were generated which resulted in mutually agreed upon provisions to the Plan.

To the best of our knowledge, the Pennsylvania Department of Health has not formalized these meetings with written minutes.

V

Subject: Discussion of Effluent Releases and Cumulative Effects of Tritium and Krypton Discharges from a Number of Reactor Plants Including Three Mile Island Unit 2

Tritium concentration in the river attributable to the operation of two units at the Three Mile Island site is expected to average less than 1/100 of MPC[1] at the point of discharge to the river and less than 1/50,000 of MPC after being mixed with the river several miles below the site. This estimate of expected average concentrations is based on average annual river flows at Three Mile Island of 34,000 cfs and expected releases of about 1% of fission product tritium through the fuel cladding and 100% of all other

(1) MPC means Maximum Permissible Concentration as defined in 10CFR20

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tritium totalling about 1,300 curies per year for both units taken together.

Even if all tritium generated by both units at Three Mile Island including 100% of the fission product tritium (most of which would be expected to stay inside the fuel cladding) were released, average tritium concentration, at the point of discharge to the river would be less than one-third MPC and would be less than 1/200 of MPC after being mixed with the average river flow several miles downstream from the site. This estimate is based on the assumption that each unit produces a total of about 11,500 curies of tritium per year.

A discussion of tritium generation and control is given starting at Page 12.6-A-1 of Supplement 3 of the PSAR.

From the above estimates one can conclude (even without accounting for further dilution beyond a point several miles downstream from Three Mile Island) that the average fraction of MPC contributed by Three Mile Island to the river is very small. Therefore, it would seem that a number of downstream plants could be accommodated without approaching even small fractions of MPC in the Susquehanna River or the Chesapeake Bay.

Krypton 85 concentrations in the air, attributable to the operation of both units at Three Mile Island, is expected to average less than 1/200 of MPC at the point of maximum exposure at the site boundary.[1] Within two miles the average concentration is expected to be less than 1/2,000 of MPC and within twenty-five miles to be less than 1/100,000 of MPC. This estimate is based on the assumption that each unit would release 8,500 curies of krypton 85 per year, which is a conservative estimate of K-85 release assuming one percent of the fuel is leaking.

(1) For these purposes this means the boundary of uncontrolled land area: i.e., the eastern edge of the Susquehanna River or the edge of any island other than Three Mile Island.

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The average fraction of MPC for krypton 85 contributed by Three Mile Island is very small and it would seem that a number of other plants could be accommodated in the same general area without approaching even small fractions of MPC limits.

It is AEC policy to limit radioactivity from each nuclear facility so as to provide reasonable assurance that the exposure of the public to ionizing radiation from cumulative effects of multiple facilities and other sources do not exceed radiation protection guides recommended by the Federal Radiation Council and approved by the President. This is done by requiring conformance to 10CFR20 and by establishing specific limits for release in operating licenses. If it appears that daily intake of radioactive materials from air, water and/or food by a suitable sample of an exposed population group would otherwise exceed applicable FRC radiological protection guides, the AEC may limit quantities released to maintain exposures within these guidelines.

VI

Subject: Quality Assurance During Construction

The quality assurance effort at Three Mile Island Unit 2 includes inspection, non-destructive testing, etc., and is in continuous effect while the constructor or fabricator is performing work on the nuclear portions of the plant.

The Architect-Engineer or Construction Manager, as applicable, will have full-time on-site quality assurance personnel who will provide surveillance of the quality control effort of site contractors. Further, the owner has full-time resident quality assurance personnel at the site who are charged with monitoring both the quality assurance program of the Architect-Engineer and the Construction Manager and the quality control program of the site contractors.

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In addition, in order to obtain an independent evaluation of the effectiveness of the entire site quality effort during the construction of the plant, periodic site audits will be conducted by personnel from the GPU-NPAG Quality Assurance Group, Metropolitan Edison Company, and MPR Associates.

VII

Subject: Comments on the Fish and Wildlife Service Letter Dated June 17, 1969

Applicant has reviewed the letter of June 17, 1969 from the Fish and Wildlife Service to the AEC Director of Regulations and has the following comments with respect to each of the recommendations listed starting on Page 2 of that letter: -

1. As indicated in a letter from the Applicant to the AEC dated July 25, 1969, the Applicant has stated he will continue to cooperate with interested government agencies in respect to matters concerning radiological surveys and other concerns of the Fish and Wildlife Service.

2.(a) It is planned to take gamma radioactivity analyses of water prior to its entry to the river and downstream several miles from the site at a location just below the York Haven Dam. The reason for taking samples at these places is that it is expected that radioactivity will be well mixed with the water stream in the first instance and with the river in the second instance.

Sediment samples collected at several points in the river to date have had activity below the limit of detection by the methods now used to assay them and it

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is expected such samples taken by these conventional methods, if measurable, will be erratic. However, the Applicant is aware of studies now in progress to develop an underwater gamma probe capable of assaying radioactivity in place. Should this device prove to be satisfactory, it will be used in the environmental monitoring program to measure the radioactivity of sediment at locations where sediment is most likely to be deposited.

2.(b) Beta and gamma radioactivity analyses of selected organisms located near the reactor effluent outfall will be taken insofar as appropriate organisms can be located.

3. A report of the pre-operational radiological surveys will be provided to the Atomic Energy Commission in sufficient numbers so that five copies can be made available to the Secretary of the Interior.

4. Reports of post-operational radiological surveys will be submitted to the Atomic Energy Commission in sufficient numbers so that five copies can be provided to the Secretary of the Interior.

VIII

Subject: Discussion on how Three Mile Island Units 1 and 2 will be Operated with Regard to the Release of Effluents

The combined releases of radioactivity from both units at the Three Mile Island site will be in conformance with 10 CFR 20 just as though there were only one unit at the site.

More specifically, the long-term (i.e., annual) average radioactivity concentration in liquids as released to the river from Unit 1 outfall will not exceed those specified by Table 2 of 10 CFR 20. Likewise,

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such concentrations as released from the Unit 2 outfall will not exceed those specified by Table 2 of 10 CFR 20.

Release rate limits for gases from Units 1 and 2 will be proposed taking account of atmospheric dispersion between the release points and the boundary of uncontrolled land area, so that considering releases from both units taken together, the long-term (i.e., annual) average concentration anywhere at this boundary will not exceed that specified for gases in Table 2 of 10 CFR 20.

The shorter term average concentrations will be treated in the same way such that the average concentration in liquids or the average release rates of gases will not exceed about ten times the long-term average release rate or concentration limits discussed above.

IX

Subject: Discussion on how the Effluent Releases will be made Batch or Continuous Release

Liquid and gaseous plant wastes will be released in batches. Radioactive liquid wastes from each unit will be diluted in the services cooling water which is discharged to the river. Radioactive gaseous wastes will be dispersed in the atmosphere through separate vents for each unit.

All releases of radioactive liquid wastes from either unit will be made from an evaporator condensate tank in an average batch size of 10,000 gallons. Prior to release each tank will be mixed, sampled for radioactive content and certified for release. Each release will be monitored as it is discharged. It is expected that there will be an average of one batch release per week.

All releases of radioactive gaseous waste will be made from a gas decay tank after it has been sampled and certified for release. Each

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release will be monitored as it is discharged to the vent. It is expected that a number of small batches would be released .very year.

In any event, both liquid and gaseous releases will be controlled within limits discussed in answer to question VIII (pre-hearing transcript, Page 5., Line 12.)

X

Subject: Three Mile Island Exclusion Area

The Susquehanna River passes through the exclusion area on both sides of the site, but is sufficiently far away that any expected use of the river would not interfere with normal operations.

Responsibility for exercising exclusion requirements, should they become necessary, on the river within the exclusion area, lies with the Commonwealth of Pennsylvania. The Three Mile Island emergency procedure provides for a unique signal to be sounded, along with announcements heard within the exclusion boundary, and notification of appropriate governmental authorities which are designated by the Commonwealth. The appropriate governmental authorities will effect the necessary exclusion or evacuation.

XI

Subject: Discussion of Adequacy of Grouted Tendons

There are ample precedents for both grouted and ungrouted tendons. In bridge and building construction, grouted tendons have been used for over twenty years, ungrouted for over fifteen years. In nuclear applications, French practice has been to grout as at Chinon, St-Laurent-des-Eaux, Bugey, Brennilis. Ungrouted tendons have been used in the United Kingdom at Oldbury and Wylfa. The Canadian structure at Gentilly is grouted. Post tensioned nuclear containment structures previously planned or under construction in the United States are to be ungrouted with the exceptions of the vertical tendons at Robinson and the tendons providing rock anchorage at Ginna.

The selection of grouted tendons for this structural application over the alternative of unbonded greased tendons was made primarily to provide corrosion protection through the passivating environment characteristic of the alkalinity of portland cement grout, not available with the alternative, plus the permanent exclusion of corrosive agents. Secondary structural benefits in resisting the design loadings result from the use of bonded tendons. The basis for some prior reservation concerning the use of grouted tendons in similar structures in this country had been the question as to whether the continuous curvature required of the tendons in the shell structure and the consequent unavoidable packing of the tendon elements at the inside radius of the duct would preclude the injection of grout into intimate contact with all elements of the tendon. This question has been satisfactorily answered for strand tendons by the grouted tendon test program undertaken for this project, hence there is no further technical reservation concerning the use of grout.

1. Corrosion Protection

Continuity of coverage with grout is desirable to provide corrosion protection. This feature was the principal objective of the grouted tendon test program, and was achieved with strand tendons. The work with wire tendons in the test program demonstrated that normal grouting procedures would not yield continuous coverage, hence in all probability the grouted curved wire tendons which have performed satisfactorily in other applications for many years do not have continuous grout coverage. Thus, it may be concluded that the passivating environment of grout is effective in inhibiting corrosion even without continuity of coverage. The continuity demonstrate. to be obtainable with strand tendons will provide greater assurance of protection.

2. Exclusion of Corrosive Agents

Corrosive agents; principally chloride, nitrate and sulphate ions; will be excluded by a series of barriers between the tendon and the environment and by the filling of the closed metal duct system, including end caps, with portland cement grout from which corrosive agents have been excluded.

3. Bond

The use of portland cement grout allows the development of bond between the tendon and the concrete structure through the grout and ducts. In Phases I and II of the grouted tendon test program, it was apparent during the cutting out of intermediate test specimens that the steel remained stressed after having been separated from the anchorages despite the packed condition of the tendon elements.

Tests designed to provide a quantitative measure of bond development, included in Phase III of the program, demonstrated transfer of the usual assigned prestress force of 60% of ultimate strength from tendons to the concrete in a length of 7 to 10 feet.

a. Anchorage

Development of bond at the anchorages is further assured by the separation of the strands at the anchor in those prestress systems employing wedge type anchorage. Bond will not be relied upon as a means of stress transfer in this application; the anchorages [illegible] be required to pass static and dynamic test[illegible] to grouting, more severe than could occur in [illegible]ructure. The demonstrated bond length of 7 t[illegible] is less than the planned dimensions of the buttresses, foundation mat and ring girder, where the tendons are to be anchored, thus, the anchorage developed by bond provides redundancy.

b. Crack Control

Flexural tension and stress concentrations such as will occur at discontinuities and structure penetrations can be resisted by the bonded prestressing steel at the point of discontinuity or concentration thus limiting the size of cracks in the concrete.

c. Ruptured Tendon

Before the effectiveness of grouting of strand tendons had been demonstrated, there existed a reasonable question as to whether stress transfer other than at anchorages could be achieved. Now it can be concluded that a ruptured grouted tendon will be fully effective at 7 to 10 feet from the point of rupture.

XII

Subject: Discussion of the Positive Moderator Coefficient

The core for Three Mile Island Unit 2 is expected to have a positive moderator coefficient not in excess of $+1.0 \times 10^{-4}$ $(\Delta k/k)/^{\circ}F$ over the first part of the initial fuel cycle. The positive reactivity associated with this coefficient was used in the evaluation of accidents analyzed in the PSAR. Even with the inclusion of the reactivity effect, the accident analyses resulted in acceptable condition.

Analyses are proceeding to determine the effect of a positive moderator coefficient on the stability of the reactor core with respect to potential for xenon oscillations. If the conclusion of the analyses

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is that the $+1.0 \times 10^{-4}$ $(\Delta k/k)/^{\circ}F$ coefficient is not desirable, then it will be reduced by the use of fixed shims - such as burnable poison rods. These fixed shims would allow a reduction in the soluble poison concentration and thus a reduction in the positive moderator coefficient.

XIII

Subject: The Validity of Assumptions Underlying the Accident Analyses

Environmental doses resulting from the rod ejection, loss of coolant and maximum hypothetical accidents were calculated assuming that fifty percent of the iodine released plated out on equipment and structures located within the reactor building. This assumption of fifty percent plate out is suggested by the Atomic Energy Commission in its guide line document TID-14844. Review of experimental data generated in experiments in which iodine was released indicate that the assumption of fifty percent plate out is conservative. For example, tests conducted in the Containment Research Installation and reported in ORNL-4071,[1] demonstrated that more than 95 percent of the released iodine was deposited on the tank wall. More than 70 percent of the iodine plate out occurred in less than 30 seconds.

XIV

Subject: Report on the Present On-Site Monitoring Program

The attached tables summarize the radioactivity measurements of various kinds of samples in addition to those reported in the PSAR measured from January 1, 1969 to August 1, 1969, by Met-Ed and the Commonwealth of Pennsylvania.

[1] Nuclear Safety Program Annual Progress Report for the period ending December 31, 1966, Oak Ridge National Laboratory, W. B. Cottrell, Program Director.

TABLE I

Commonwealth of Pennsylvania Environmental
Data of the Susquehanna River at Three Mile Island[1]

Month 1968	Gross Beta	Gross Alpha
February	3 pc/l	<1 pc/l
March	- - -	- - -
April	9 pc/l	1 pc/l
May	3 pc/l	<1 pc/l
June	4 pc/l	<1 pc/l
July	6 pc/l	1 pc/l
August	6 pc/l	<1 pc/l
September	4 pc/l	<1 pc/l
October	5 pc/l	<1 pc/l
November	8 pc/l	2 pc/l
December	3 pc/l	1 pc/l

(1) Data reported by M. A. Reilly,
Radiation Health Physicist,
Commonwealth of Pennsylvania

TABLE II

ENVIRONMENTAL DATA FROM THE SUSQUEHANNA RIVER AND THREE MILE ISLAND

Analysis Performed by Isotopes, Inc.,
Westwood, New Jersey

July 8, 1968 - Susquehanna River Water at Three Mile Island

K-40	500 pc/l
Zn-65	<5.6 pc/l
Cs-137	6.1 pc/l
I-131	<4.0 pc/l
Co-60	<7.0 pc/l
Co-58	<5.0 pc/l

September 5, 1968 - Vegetation at Three Mile Island

K-40	8.9 pc/gr
Cs-137	.05 pc/gr
I-131	<.002 pc/gr
Co-60	<.003 pc/gr
Co-58	<.003 pc/gr

June, 1969 - Fish

Cs-137	.11 pc/gr
Co-60	1.39 pc/gr
Co-58	.13 pc/gr
Zn-65	.38 pc/gr
Sr-90	.05 pc/gr
I-131	.07 pc/gr

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