October 25, 1973

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
METROPOLITAN EDISON COMPANY, et al.	)	Docket No. 50-289
	)	
(Three Mile Island Nuclear Station, Unit 1)	)	

APPLICANTS' PREPARED TESTIMONY RELATED TO CONTAINMENT CONCRETE AND RELATED QUALITY ASSURANCE

1. Introduction

The overall quality assurance program, as described in Section 1.6 of the TMI Unit 1 FSAR, has been applied to construction of the containment building, including its ring girder, as well as other areas of plant construction. This quality assurance program complies with 10 CFR Part 50, Appendix B. The specific aspects of this program of particular importance to control of structural concrete construction of the containment and ring girder are summarized in subsequent sections of this testimony. The program included development of quality standards, implementation of the quality standards by means of detailed procedures and performance of numerous inspections

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and tests. It is considered that this quality assurance program led to obtaining a high quality containment building and ring girder which is in complete accordance with the applicable specifications.

2. Quality Standards

The quality assurance program provided for specifying the technical and quality standards that had to be satisfied for all work important to safety before the work could be considered complete. Accordingly, the technical and quality standards applicable to the containment building and ring girder structural concrete, which are described in the TMI Unit 1 FSAR, were specified in Gilbert Associates, Inc., Specification for Structural Concrete, SP-5406. This Gilbert Associates' specification was issued on December 4, 1967, prior to start of work on the containment building by United Engineers and Constructors (UE&C). It required the quality control to be based on the requirements of ACI 301-66, Specifications for Structural Concrete for Buildings, which is the recognized industry standard for structural concrete. Further, although ACI 301-66 does not make it mandatory to comply with related ACI recommended practices such as for cold weather and hot weather concrete processing, ASTM specifications for ready-mixed concrete, and applicable ASTM specification for materials and testing, all of these were in fact followed in order to ensure high quality.

The most important of the specifications and codes applied to the containment building and ring girder are as follows:

A. Gilbert Associates, Inc., Specification for Structural Concrete, SP-5406.

B. American Concrete Institute, Specifications for Structural Concrete for Buildings, ACI 306-66.

C. American Concrete Institute, Building Code Requirements for Reinforced Concrete, ACI 318-63.

D. Commonwealth of Pennsylvania Department of Highways Specification, 1960 Edition.

E. Specifications for Ready-Mixed Concrete, ASTM C94-67.

F. Numerous ASTM material specifications, ASTM testing methods, ACI recommended practices, etc., as specified in the UE&C Quality Control Procedure No.1, General Construction and Quality Control Procedures for Structural Concrete.

It should be noted that these codes and specifications are generally consistent with those specified in a recent AEC regulatory guide (1.55) and in a recent draft industry standard (ANSI N45.2.5) for nuclear power plant

structural concrete, even though the codes and specifications for TMI were developed long before the AEC guide or industry standard were developed.

3. Procedures

At the start of the TMI project, concrete in the initial placements in the containment building base mat failed to meet specifications. As a result, all of the deficient concrete in the base mat was completely removed and a detailed quality control and construction procedure (QC-1) was developed and implemented to ensure that a high quality of structural concrete would be achieved. This procedure served to ensure high quality by requiring detailed inspections and tests of concrete work to be performed as described in the next section. These tests and inspections were intended to minimize the likelihood of further problems occurring during placement of concrete and, of equal importance, ensure that any problems which did occur were detected and corrected.

In addition to the basic quality control procedure, QC-1, two other construction procedures were followed to ensure control of related construction work. These are as follows:

A. UE&C Civil Construction Procedure CCP-1, "Erecting Tendon Conduit System in the Reactor Containment Wall and Dome".

B. UE&C Civil Construction Procedure CCP-6, "The Pump Placement of Concrete".

The quality control checklists for these procedures specified the tests and inspections to be performed to ensure that these activities were properly performed.

Despite the use of the above precautions, occasional errors in concrete placement did occur, but these were detected by quality control and corrected. The most significant problem in this regard involved voids and foreign material in the ring girder. This problem was detected and documented by quality control during placement of concrete in the ring girder and was confirmed upon removal of the concrete forms. A detailed procedure for repair of the ring girder was developed, CCP-9, "Containment Ring Girder Repair" which included detailed requirements to ensure that the quality of the finished ring girder is satisfactory. This procedure was reviewed in detail with the AEC.

4. Quality Control Tests, Inspections and Records

In accordance with the specification and as detailed in the Quality Control Procedure, QC-1, numerous tests and inspections were performed related to concrete placement, and appropriate records of these were generated. The tests, inspections and records are summarized in the following paragraphs.

An on-site testing laboratory was used for concrete materials and compressive strength testing and an on-site

batch plant was used for concrete production. Quality control records were kept on file for each load of concrete placed in the containment building and cover the location of the pour, the actual batch proportions, concrete slump and temperature, and total number of mixer revolutions. Concrete compressive strength cylinders were cast for every 50 cubic yards of concrete placed in the containment building and cylinder strength test results recorded.

Other reports of quality control activities related to concrete placement include concrete placement check-out sheets, inspectors' concrete check-out sheets and concrete status reports, reports of concrete placement and daily concrete curing records. These records demonstrate that quality control inspections were performed for all containment building pours. Results of tests or inspections that did not meet specification requirements were reported to the constructor, UE&C, for appropriate corrective action. Discrepant conditions were resolved by rejection of materials or loads of concrete that did not meet specification requirements and by repair of portions of the structure that did not comply with project specifications.

In regard to inspections and tests of the ring girder repair, the normal requirements of QC-1, as described above, applied and, in addition, the numerous additional inspections and checks called out in the QC checklists to procedure CCP-9, Containment Ring Girder Repair, were

performed. These included documented checks to ensure that all defective concrete had been removed, imbedments were properly installed and/or repaired, concrete placement preparations were satisfactory, concrete placement was controlled, and proper curing conditions were maintained.

5. Stress Analysis

As described in the December 9, 1971, Met-Ed Report, as amended, "Report on Containment Building Ring Girder Construction and Repair", an extensive stress analysis of the ring girder was performed to determine if the repairs could have any detrimental effect. This analysis concluded that the repaired ring girder would fulfill the original design intent and all the requirements in terms of service, durability and safety.

6. Post Construction Tests and Monitoring

Subsequent to construction of the containment and ring girder, the tendons have been stressed. Extensive measurements taken during this tendon stressing demonstrated that the structure was sound.

During the plant test program, and prior to fuel loading, the containment building and ring girder will be subjected to a structural integrity test at 15% above the design pressure associated with the maximum hypothetical accident.