U. S. ATOMIC ENERGY COMMISSION
REGION I
DIVISION OF COMPLIANCE

Report of Inspection

CO Report No. 289/68-2

Licensee: METROPOLITAN EDISON COMPANY
(Three Mile Island Nuclear Station)
Provisional Construction Permit
No. CPPR-40

Date of Inspection: September 18-19, 1968

Date of Previous Inspection: August 22, 1968

Inspected By: F. S. Cantrell, Reactor Inspector — Date: 10/15/68

Reviewed By: N. C. Moseley, Senior Reactor Inspector — Date: 10/18/68

## SCOPE

A routine announced inspection was made of the 2452 Mwt pressurized water power reactor now under construction on Three Mile Island near Middletown, Pa. The inspection effort was directed toward the overall quality assurance program, and a review of the concrete problem reported on the initial inspection. A scheduled meeting was held at the site with operating personnel on preparation of preoperational test procedures.

## SUMMARY

Safety Items - None

Status of Previously Reported Problem - During the initial site visit in August, the contractor was having difficulty preparing uniform concrete as shown by the slump test and the subsequent cylinder break test. Strict limits were established for slump and temperature and United States Testing inspectors were assigned responsibility for accepting each batch of concrete.

## DETAILS

A. Persons Contacted

Mr. Vernon Steubner, Resident Engineer, MET-ED
Mr. Harry Alexander, Field Quality Control Engineer, U.E.&C.
Mr. Arthur Ballschmeider, Vendor Inspector, U.E.&C.
Mr. N. Cole, Quality Control Engineer, MPR Associates
Mr. Jim Bartman, Supt. of Production, MET-ED
Mr. Kick Klingaman, Senior Mechanical Engineer, Three Mile Island (TMI), MET-ED
Mr. Jim Floyd, Station Engineer, TMI, MET-ED
Mr. Harold Morris, Supervisor of Maintenance, TMI, MET-ED
Mr. Joe Colitz, Supervisor of Operations, TMI, MET-ED

B. Preoperational Testing

The inspector discussed the preoperational testing program with Mr. Bartman and other MET-ED supervision assigned to develop procedures for preoperational testing. The Compliance role in the preoperational testing program was explained. Definitions of the categories of procedures in the CO inspection manual were given with examples of each category. It was emphasized that our review of their procedures was for the purpose of a better understanding of the test program, not approval of the procedure.

The reactor is designed to go from full base load to station load without a reactor trip. Mr. Bartman asked if it was necessary to test this ability. He was told that he may want to test this ability in steps, but that the inspector believed that a test from full power would be necessary.

C. Quality Assurance Program

1. Gilbert Associates (GA) is responsible for developing quality control procedures for all elements of construction, except the nuclear components*. GA was not inspected; however, MET-ED said the original concrete procedure was not adequate (Paragraph D)**.

*PSAR Appendix 5D
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2. United Engineers and Constructors (UE&C) as contractor is responsible for all field quality control and shop quality control for equipment and materials other than that supplied by Babcock & Wilcox.* UE&C is discharging their responsibility as follows:

   a. A full time Quality Control Engineer, Harry Alexander, has been assigned to the Quality Control Program. He is responsible for field and vendor inspections, checking inspection reports, and maintaining the records. Prior to the TMI Project he was an Assistant in the Quality Control Program at Indian Point No. 2. He appears to have the records well organized.

   b. U. S. Testing (UST) was hired by UE&C to perform all field inspections and test of concrete work and welding. Since the removal of the low compressive strength concrete from the containment building base,** good results have been achieved with concrete (paragraph D).

      The UST inspectors have sole responsibility for determining that batches of concrete meet specifications. The inspector at the batch plant certifies the mix and the inspector at the pour site makes slump test, prepares cylinders, checks temperature, time, revolutions and placement of concrete per the quality control procedure for concrete. Records show that some batches have been rejected. (So far the rejected batches have been used in other non-critical locations, i.e. concrete pad for service and temporary storage buildings.) UST inspectors are inspecting cadwell joints. Approximately 3% have been rejected visually. All visually accepted production joints tested had a tensile strength greater than the 70,000 psi min.

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*PSAR Appendix 5D

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c. Twenty-seven vendor inspections have been made to determine that the vendor has the necessary Quality Control Program, personnel, and tools needed to assure the quality specified in the order. Action to assure conformity to specifications was taken with two vendors prior to start of the MET-ED order. The inspector looked at the report of the initial visit to one of these vendors and at the follow-up inspection report. The follow-up report indicated workmanship and quality control had been improved, and were now acceptable. The inspector was given a list of the above inspections and a list of the currently scheduled inspections.

3. MPR Associates has been hired by MET-ED to monitor and audit all inspection activities and reports. The reactor inspector briefly discussed MPR activities with one of their engineers (N. Cole) while observing a concrete pour. He was one of five that are assigned to the TMI Project on a part-time basis. They are not required to be present while all concrete is being poured, however to date, they have covered all of the concrete in containment building. MPR activities and reports will be reviewed in more depth on the next inspection.

D. Concrete

Mr. Steubner, Resident Engineer, MET-ED, credits strict adherence to the revised concrete quality control procedure for the improvement in concrete for the containment. He stated that the original procedure did not adequately consider the hot weather experienced during the first pour of the containment base,* and that site personnel were not prepared to control the temperature of the concrete. The new concrete quality control procedure limits the concrete temperature to 70°F maximum, requires a 1" to 4" slump, and assigns UST the responsibility of accepting each batch of concrete. Test cylinders are field cured at least 24 hours before being moved to the field laboratory for stripping and curing.

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The concrete pour observed was a section of the containment base. Conveyor belts and a bucket were used to lower the concrete to the level of the pour. Operation of the conveyor crew appeared to be satisfactory. When the bucket was used to place concrete near the edge where the vertical reinforcing steel had been installed, the concrete was allowed to drop about five feet. When questioned, Mr. Steubner stated that a tremie was used on previous placements when the concrete had further to fall. On the observed placement the concrete was about 3-4 feet from the bottom of the bucket after the concrete was dropped but before compacting with vibrators. This subject is discussed further in the management interview section of this report (Par. I).

A local commercial concrete supplier has been retained to act as "back-up" in the event of a breakdown of the on-site batch plant. If the back-up plant is used, UST will assign an inspector to the back-up plant. Trial runs have been made to assure UE&C that the required quality control can be maintained. Ice will be added at the site batch plant, if needed.

E. Cadweld Splicing

Each man is qualified as an individual to perform cadweld splices instead of two men being qualified as a team. Initially one of each 25 production splices will be removed and tested to destruction. Approximately 3% of the splices have been rejected visually. All of the visually accepted production splices that were tested, failed above 70,000 psi. The inspector observed one cadweld splice being made. Appropriate parts of the procedure in Attachment A were followed.

F. Testing Laboratory

A larger laboratory building is being erected. More space is needed for curing test cylinders. Test equipment has been ordered to make the cylinder break test and to test cadweld splices at the site.

G. Containment

Trumpets are being set in the containment base for both 90 and 170 wire tendons. In order to continue pouring concrete while a decision is being made between the designs. Once a decision is reached, the unneeded trumpets will be plugged.

H. Miscellaneous

One of the cranes used in constructing piers for the bridge across the river fell in the river and caught on fire when a section of the dike under the crane caved in. The crane was travelling along the dike with its boom up at the time. There were no injuries.

I. Exit Interview

An exit interview was held with Vernon Steubner, the Senior MET-ED site representative. The inspector reviewed the item of nonconformance whereby concrete was allowed to drop about 5 feet without a tremie or a pipe for a guide. He stated that the crew had been using a tremie, but at that point, they were in the way of the crew that was compacting the concrete. He said he was aware of the 3 foot limit imposed by the UE&C procedure, but had decided to permit the higher drop near the edge of the pour, since the bucket was being lowered between reinforcing steel until it was stopped by the reinforcing steel. In addition, a crew was cleaning concrete from reinforcing steel above the concrete level being poured. The inspector expressed his concern about deviations from established procedures and the effect it might have on subsequent operations. Mr. Steubner later phoned to report that smaller concrete buckets that could be lowered between the reinforcing steel were modified and put into service the day after the inspection. It was reported that all of the concrete was being placed with less than 3 feet of free fall.

ATTACHMENT A

(Excerpted from U.E.&C. Quality Control Procedure No. 1, Rev. August 30, 1968)

II. PROCEDURES (Continued)

A. Preliminary Tests (Continued)

6. Cadweld Splices

a. Reinforcing steel bars larger than #11 shall be spliced with the "Cadweld" process.

b. Mill test reports for splicing sleeves and powder will be required and reviewed for compliance with Specification requirements. Rejected material will be returned to the Vendor or otherwise removed from the site.

c. Prior to production work, the operator designated to perform "Cadweld" splicing will be qualified by preparing a test joint for each bar size and position he will be required to splice. These test joints will be tested in tension after visual examination. If the test splice develops at least the minimum specified ultimate strength of the bar (A408 bars - 70 ksi) the operator shall be considered qualified to produce that size and position of splice.

d. Using previously qualified operators, approximately fifty splices will be prepared under production conditions. From these splices, at least sixteen will be randomly selected and tested to destruction. Results of these tests will be turned over to the Engineer for evaluation and determination of the initial sampling rate for production splices.

e. In qualification of both pre-production and production splices, each completed splice shall meet the following acceptance standards:

(1) Sound, non-porous filler metal shall be visible at both ends of the splice sleeve and at the top hole in the center of the sleeve. (A single shrinkage bubble present below the riser is not detrimental and should be distinguished from general porosity.)

(2) There shall be evidence of filler metal between the sleeve and bar for the full 360°, however, splice sleeves which are not exactly concentric or axially aligned with the bars are acceptable.

(3) The bar ends shall be clean and free from rust, mill scale, slag, grease, paint, moisture, etc.

(4) Bars shall be longitudinally centered in the sleeves as shown by previously affixed center-punch marks or similar identifiable location marks on the bar.

(5) Bars shall not be scarfed and the portion of the bar in the sleeve shall have uniform deformations along its length consistent with the rolled mill pattern.

E. Field Tests (Continued)

6. Cadweld Inspection - Cadwelding in the containment structure shall be inspected by a representative of the T.L. as follows:

a. No Cadwelding will be permitted if the relative humidity is over 80%.

b. Sleeves and crucibles shall be checked for cleanliness, rust, etc.

c. Molds to be preheated when necessary (new mold or change of shift).

d. Bar ends shall be free from loose mill scale, rust, and moisture.

e. Bars shall not be scarfed.

f. Bars shall be marked by center-punching or other suitable means, so that assurance of centering ends within the sleeve may be made.

g. Completed splices shall be visually inspected in accordance with the following procedure. Any splice which, in the judgment of the inspector does not pass visual inspection, shall be cut out and replaced.

(1) Properly made splices will have filler metal visible at both ends of the sleeve and at the top hole in the center of the sleeve.

(2) Filler metal need not flow to the very edge of the sleeve due to the gasket action of the asbestos wicking used to seal in the molten filler metal.

(3) As a result of the Cadweld process, a shrinkage bubble may be visible at the top hole, where the molten metal is introduced and shrinkage fissures and pinholes may be visible at the top of a vertical splice. These casting flows do not adversely affect the physical performance of the splice and therefore do not constitute cause for rejection.

h. Random samples of visually acceptable splices at a rate to be specified by the Engineer shall be selected, cut from the structure and tested in tension to destruction.

i. For each Cadweld splice, data shall be recorded on rebar data sheets showing:

(1) Splice number (This number shall also be applied to the splicing sleeve using a heat and weather resistant marking pencil.)

(2) Location

(3) Size and orientation of the splice

(4) Operator number (crew number)

(5) Date, weather conditions, and time the splice was made.

(6) Inspectors initials

(7) Sample number and test result, if applicable.

j. Failure of a tension test of a splice selected from the structure as in "h" above (test result less than 70,000 psi will be cause for additional sampling. The next previous or subsequent splice made by the source operator shall be cut from the structure and tested in tension to destruction. If this test result is over 70,000 psi the process will be considered in control. If this splice also fails, an engineering evaluation will be made, during which time the operator/crew responsible shall discontinue Cadwelding.