U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

REGION III

Report No. 50-546/80-30; 50-547/80-30

Docket No. 50-546; 50-547 License No. CPPR-170; CPPR-171

Licensee: Public Service of Indiana
Post Office Box 190
New Washington, IN 47162

Facility Name: Marble Hill Nuclear Generating Station, Units 1 and 2

Inspections At: Marble Hill Site, Jefferson County, IN; Sargent and Lundy Engineers, Chicago, IL; Portland Cement Association, Skokie, IL

Inspections Conducted: July 29 - August 1 and August 26 - 29, 1980

Inspector: F. C. Hawkins 9/11/80
(July 29 - August 1 and August 26 - 19, 1980)

Accompanying Personnel: D. W. Hayes (July 29 - 31 and August 26 - 29, 1980)
C. C. Williams (August 28, 1980)

Approved By: D. W. Hayes, Chief 9/12/80
Engineering Support Section 1

Inspection Summary

Inspections on July 29-August 1, and August 26-29, 1980 (Report No. 50-546/80-30; 50-547/80-30)
Areas Inspected: Follow-up on previously identified items of noncompliance; overview of the PSI concrete evaluation program; review of the Construction Verification Program No. SPP-5 final report and associated documentation; observation of mechanical cadweld splice tensile testing as related to Construction Verification Program No. SPP-6; concrete consultant team inspections at Sargent and Lundy Engineers and Portland Cement Association on August 26 and 27, 1980, respectively; concrete consultant team inspection at the Marble Hill site on August 28 and 29, 1980. The inspection involved a total of 140 hours by three RIII NRC inspectors.
Results: No items of noncompliance or deviations were identified.

DETAILS

Persons Contacted

Public Service of Indiana (PSI)

S. W. Shields, Senior Vice President - Nuclear Division
V. P. McMahon, Acting Project Director
R. J. Kime, Construction Manager
L. O. Ramsett, Quality Assurance Manager
T. R. Burns, Project Engineering Manager
S. Farlow, Chief Construction Engineer
C. S. Togni, Chief Civil Engineer
C. G. Beckham, Quality Engineering Manager
R. P. Kule, Quality Administration Superintendent
M. K. Patel, Supervising Civil Engineer
J. M. Roberts, Superintendent of Inspection
D. B. Ingmire, Construction Verification Program Coordinator
G. T. Warner, Quality Engineering Superintendent - Civil
B. Morrison, Quality Engineering Superintendent - Civil

Newberg Construction Company (N-MH)

D. Stegemoller, Vice President
T. L. Kueck, Superintendent

United States Tes ing Company (UST)

D. Lanham, Site Project Manager
D. Cook, Technician
M. Russell, Technician

Sargent and Lundy Engineers (S&L)

K. Kostal, Assistant Manager - Structural Division
O. Zaben, Senior Structural Project Engineer
A. Morcos, Structural Project Engineer
M. K. Ravindra, Structural Analytical Division
A. Weiss, Concrete Technologist

Portland Cement Association (PCA)

E. Salse, Manager - Structural Section
A. T. Ciolko, Engineer
D. H. Campbell, Petrographer
R. Muenow, Consultant

Other Personnel

J. J. Harrison, RIII Resident Inspector
R. E. Shewmaker, Senior Structural Engineer, NRC Headquarters
A. L. Parme, Independent Consultant for the NRC

R. C. Hamm, Independent Consultant for the NRC
M. A. Cassaro, Public Interest Group Consultant

Licensee Actions on Previous Inspection Findings

(Closed) Noncompliance (546/79-09-05; 547/79-09-05)

1. Two honeycomb areas were not identified, tagged, or repaired as required by QAPN-10.

   Construction Verification Procedure No. SPP-5, entitled Concrete Surface Irregularities, has been completed and the final report submitted to the NRC for review. This procedure required PSI to inspect 100% of the exposed concrete surfaces to identify (1) all patches except tie holes and (2) all unrepaired surface imperfections. In addition, N-MH QCP 10.06, entitled Post-Placement and Patching Inspection, is being developed and will include provisions to require inspection of concrete surfaces after form removal to identify any existing imperfections. This system will provide assurance that future concrete imperfections will be promptly identified and repaired.

2. Thirty defective concrete areas which were superficially patched before complete removal of all defective material.

   The resolution of this item is identical to 1. above.

3. Partially hydrated or "dead" cement stored in 55 gallon drums, was available to cement finishers for use in making concrete repairs.

   PSI personnel stated that Kosmos Type I bagged cement purchased with Certified Material Test Reports, will be utilized when making concrete repairs. This requirement is specified in N-MH Procedure WPN-35. Further, the RIII inspector verified by field inspection, that the use of bulk cement in 55 gallon drums had been discontinued at the Marble Hill site.

   (Closed) Noncompliance (546/80-06-02; 547/80-06-02) Conflicts between specification requirements and PSAR commitments.

   a. S&L Specification Y-2850, Section 411.8Ab. did not require sampling of concrete in conformance with ASTM C172.

      Engineering Change Notice (ECN) No. S-173 revised section 411.8Ab. to require concrete sampling to be in strict conformance with ASTM C172.

   b. Cement was not being sampled and tested every 500 bbls (94 tons) as required by ANSI N45.2.5-1973. Table B. The conflicting requirements of S&L Specification Y-2722, Section 403.3 b., to which work was being accomplished, specified cement sampling and testing be performed every 1200 tons.

The revised PSI Quality Assurance Program now commits to meet the requirements of Regulatory Guide 1.94, Revision 1 (ANSI N45.2.5-1974).

ANSI N45.2.5-1974 specifies the 1200 ton sampling and testing frequency. Additionally, the effort to verify that the 1200 ton frequency was achieved for past work, has been completed and the results of this review documented on Corrective Action Request (CAR) No. PC0661.

c. S&L Specification Y-2850, Section 411.7A did not require initial curing of compressive strength specimens to be in conformance with ASTM C31.

Section 411.7A, which took exception with ASTM C31 requirements, was deleted by ECN No. S-166. S&L Specification Y-2850, Section 411.1 requires the initial curing of compressive strength cylinders to be in strict conformance with ASTM C31. In addition, CAR No. PC0699 was initiated to assure proper disposition of compressive strength specimens which were not initially cured for the proper length of time or which were not cured within the specified temperature range.

d. S&L Specification Y-2722, Table 4-1-5 did not require fresh concrete to be sampled for compressive strength every 100 cubic yards.

Table 4-1-5 was revised by ECN No. S-165 to require the 100 cubic yard sampling frequency in accordance with ANSI N45.2.5-1974.

Functional or Program Areas Inspected

1. Concrete Evaluation Program Overview

The August 15, 1979 NRC Order Confirming Suspension of Construction required PSI to, "review the work completed as of the date of this order to determine whether the . . . quality assurance program was adequate to assure such work was properly performed . . ." To provide this assurance for completed concrete work, PSI has developed three seperate and unique programs.

a. Volumetric Examination: The Marble Hill concrete was examined using a pulse-echo method of nondestructive examination (micro-seismic evaluation technique). The areas to be examined were selected on a statistical basis and are representative of concrete placed in various structural elements (i.e., base mat, walls, columns, beams, and floor slabs) throughout the plant structure. Additionally, eight of these areas were cored (destructively examined) to allow direct visual examination of samples from these areas. This portion of the three part program was monitored and the associated documentation reviewed by RIII inspectors and the results of these inspections documented in IE Reports 79-07, 79-19, and 80-02.

b. Surface Examination: Construction Verification Procedure No. SPP-5 was established by PSI to provide a systematic method for the identification, location, and documentation of all concrete patches and unrepaired concrete imperfections accessible for visual inspection. All concrete patches which are identified will be removed and replaced in accordance with approved procedures. Likewise, all identified unrepaired concrete imperfections will be repaired in accordance with approved procedures. Those concrete surfaces which are not accessible for visual inspection will also be evaluated by PSI. This evaluation is discussed in section 2. of this report. Results of inspections performed by RIII inspectors which deal with SPP-5 activities are documented in IE Reports 80-06, 80-08, 80-11, and section 2. below.

c. Records Examination: Construction Verification Procedure No. SPP-13 established the procedure by which the concrete material test results and inspection records/test results contained in the Category 1 Pour Packages would be reviewed to verify compliance to S&L Specifications Y-2850 and Y-2722. Results of inspections performed by RIII inspectors which relate to SPP-13 activities are documented in IE Report 80-21. This licensee effort is still ongoing.

It will be the evaluation of these three unique elements which will ultimately determine the final disposition of the Marble Hill concrete.

2. Construction Verification Program (SPP-5): Section 5.0 Final Report

As committed to in the Description of Licensee Activities Addressing Order Confirming Suspension of Construction, PSI submitted to RIII on July 18, 1980, section 5.0 of the Construction Verification Program. Section 5.0, entitled Concrete Surfaces Irregularities (SPP-5), is one of twelve sections which will make up the final report on the PSI Construction Verification Program. The scope of the SPP-5 program was to define, identify, and map areas of concrete imperfections and concrete patches which are accessible through visual surface inspection.

Based on a review of the comment sheets and drawings compiled during the SPP-5 inspection, PSI reported in an August 13, 1980 letter to RIII, that 2936 concrete patches and 3060 concrete imperfections (defined in SPP-5 as "repair areas") were identified. PSI has estimated that ninety to ninety-five percent of the concrete patches and imperfections are insignificant and do not compromise the structural integrity of the Marble Hill plant. These areas typically consist of shallow sand streaking, excessive entrapped air voids against the formed surface, formwork seams, tie holds, formwork mismatch lines, embedded contaminants (i.e., wood splinters, nails, duct tape, etc.), and minor honeycomb around embeds, pipe sleeves, and at construction joints resulting from improperly sealed formwork. The remaining five to ten percent are characterized by PSI as minor structural defects or

structural defects. Minor structural defects are 1/2 to 2 1/2 inches in depth and have the potential to cause a decrease in the reinforcing steel corrosion resistance or fire protection if they were to remain unrepaired. Structural defects are defined by PSI as those areas that exceed the 2 1/2 inch depth of the minor structural defect and which present the potential of reducing the load carrying capability of the structure if not properly repaired.

Using the documentation obtained during this SPP-5 inspection, PSI has generated three Corrective Action Requests (CAR) to procedurally identify concrete patches and unrepaired concrete imperfections, specify the necessary repairs, and to establish corrective actions to prevent recurrence.

a. CAR No. PC0309: Identifies unrepaired concrete surface imperfections ranging in severity from sand streaking to honeycomb and specifies that each identified area be re-examined and repaired, if required, in accordance with N-MH QCP 10.06.

b. CAR No. PC0310: Identifies all concrete patches which were located through visual inspection of accessible concrete surfaces. Surfaces which are inaccessible are addressed in detail in the following paragraph (items a. through c.). This CAR specifies that all patches be removed and reinstalled in accordance with N-MH QCP 10.06.

c. CAR No. PC0311: Identifies unrepaired concrete surface imperfections which are located in exposed vertical and horizontal construction joints. These imperfections range in severity from sand streaking to honeycomb. This CAR was written to assure that all concrete imperfections located on exposed construction joints will not be inadvertently covered by a subsequent concrete placement before the necessary corrective actions can be achieved. This CAR specifies that each identified area be evaluated and repaired, if required, in accordance with N-MH QCP 10.02.

Through the implementation of the SPP-5 program, it became evident to PSI that concrete surfaces existed which were inaccessible and would therefore have to be addressed under separate programs. The percentage of inaccessible areas is minimal. It is PSI's plan to inspect and/or evaluate these areas after the resumption of safety-related construction activities. There are two categories of inaccessible concrete surfaces.

a. Inaccessible due to engineered backfill: After removal to establish their severity, the concrete patches and unrepaired concrete imperfections which have been identified through the SPP-5 program will be evaluated. Based on this engineering evaluation, conclusions will be drawn on the condition and acceptability of surfaces inaccessible due to backfilling.

b. Inaccessible due to temporary construction equipment or in-place formwork: It is PSI's intention to incorporate the inspection requirements of SPP-5 into N-MH Category I work procedures. This will assure that these inaccessible areas will be removed and/or evaluated and repaired as committed to in the section 5.0 (SPP-5) final report.

Section 5.0 Concrete Surface Irregularities final report as submitted and accompanied by PSI's letters of May 9, August 13 and 25, 1980, satisfy the SPP-5 program requirements in that the patched and repair areas have been identified and their location documented on drawings and data sheets.

3. Construction Verification Program (SPP-6)

On July 29, 1980 the RIII inspector observed tensile testing of mechanical cadweld splices in accordance UST special procedure, entitled On Site Tensile Testing of Cadweld Splices During Cadweld Reverification Program. The twenty splices tested, identified under the SPP-6 program, represented the most severe failures to meet visual inspection criteria. Typical examples of these failures were excess voids, excess filler metal recess, porosity, slag, and tap hole burn-outs. Cadweld splice numbers and tensile strength results are as follows:

Spiice No.	Tensile Strength (psi)
BV 541	105,000
BV 796	102,308
BV 242	100,641
TV 87	109,764
TV 174	87,402
TV 91	102,835
TV 68	99,591
TV 70	95,276
TV 153	100,787
TV 80	102,205
BV 742	92,564
TV 4	92,444
TV 433	99,556
TV 434	89,333
TV 890	97,500
BV 1139	97,500
TV 729	95,500
BV 635	100,000
BV 68	99,750
BV 626	101,000

4. Concrete Consultant Team Activities

a. Sargent and Lundy Engineers

A meeting was held on August 26, 1980 in the Chicago, Illinois offices of Sargent and Lundy Engineers with representatives from the NRC, S&L, PSI, and the concrete consultant team in attendance. The meeting was held to allow the consultant team to gather more specific information which was pertinent to the Marble Hill concrete issue.

Among the topics discussed were the statistical sampling program methodology, the basis for test area selection, the pulse-echo testing technique, the contributing factors which led to the frequent occurance of concrete imperfections at Marble Hill, and what corrective actions had been planned and implemented to minimize the future occurrence of concrete imperfections.

b. Portland Cement Association

A meeting was held on August 27, 1980 in the Skokie, Illinois offices of the Portland Cement Association with representatives from the NRC, S&L, PSI, N-MH, and the concrete consultant team in attendance.

A detailed explaination of the pulse-echo testing technique was given to the attendees by Mr. R. Muenow. Mr. Muenow is the PCA consultant who performed the nondestructive examination (volumetric) of the Marble Hill concrete. The presentation was followed by a question and answer session.

Other topics concerned the destructive examination (i.e., coring) which was performed, the techniqe and results of compressive strength testing of the cores, and the results of petrographic analyses performed on samples from the core specimens. The core specimens were examined by the meeting participants.

Additionally, the scope of the volumetric program, as defined by the June 27, 1979 Immediate Action Letter (IAL) was discussed at length. Section 1. of the June 27, 1979 IAL requires that, "a statistical sample, representative of both congested and other concrete volumes" be examined to establish that the concrete is properly consolidated. S&L representatives stated that this requirements was the criteria under which the areas to be pulse-echo tested were chosen for the volumetric evaluation program, as reported by S&L in the two volume report Evaluation of In-Place Concrete.

The majority of comments made by the consultant team in reference to Volume II of the S&L report Evaluation of In-Place Concrete concerned clerical errors and the need for clarification as to the status of existing data. PSI is presently planning to sub-

a supplemental response to the report to fully clarify the areas of apparent confusion and correct any clerical errors identified. The specific items of concern to the concrete consultant team and the necessary responses by PSI will be submitted in writing and coordinated through the RIII NRC office.

c. Marble Hill Site Inspection

On August 28 and 29, 1980 an inspection at the construction site was conducted by the consultant team relative to their efforts to address the concrete issue at Marble Hill.

Activities included review of N-MH NCR reports, physical inspection of the pulse-echo examination areas, and inspection of the cored areas.

Additional data pertinent to their effort, was collected by the consultant team and will be reviewed prior to their next site visit.

Exit Interview

The inspectors met with staff representatives during and at the conclusion of the inspection. The inspectors summarized the scope of the inspections.