RELATED CORRESPONDENCE

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

DOCKETED
USNRC

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

'84 AGO 13 A10:56

In the Matter of	
CAROLINA POWER AND LIGHT COMPANY AND NORTH CAROLINA EASTERN MUNICIPAL POWER AGENCY	Docket No. 50-400 OL
(Shearon Harris Nuclear Power Plant, Units 1 & 2)	

OFFICE OF SECRETARY
DOCKETING & SERVICE
BRANCH

NRC STAFF TESTIMONY OF JOHN R. HARRIS, JOSEPH J. LENAHAN AND PAUL R. BEMIS ON EDDLEMAN CONTENTION NUMBER 65, CONCRETE PLACEMENT

Q1. Please state your names, positions, and address.

A.1 Paul R. Bemis, Section Chief, Projects Section 1C

John R. Harris, Civil Construction Inspector, Plant Systems Section

Joseph J. Lenahan, Civil Construction Inspector, Plant Systems Section

Our business address is:

U.S. Nuclear Regulatory Commission
101 Marietta Street
Atlanta, GA 30323

Q.2 Mr. Bemis would you state your professional qualifications?

A.2 My professional qualifications are stated in my testimony on Joint Intervenors Contention Number 1, Management Qualifications.

8408140086 840807
PDR ADOCK 05000400
T PDR

Q.3 Mr. Harris would state your professional qualifications?

I received a Bachelor of Science Degree in Geology from Wayne State University in February 1960 and pursued graduate studies in civil engineering and geology at Wayne State University's graduate school from February 1960 to June 1961.

From February 1960 to August 1961, while attending graduate school full time, I also worked full time with the U.S. Army Corps of Engineers Detroit District on the St. Lawrence seaway project. I was responsible for controlling blasting operations and calculating the amount of material to be evaluated from preexcavation surveys and the amount of material actually removed from post excavation surveys.

From August 1961 to September 1963, I worked for the U.S. Army Corps of Engineers Jacksonville, Florida District. I was involved in foundation and concrete studies for airfields, levees, canals and missile complexes.

From September 1963 to November 1965, I worked for the U.S. Army Corps of Engineers Canaveral District at Cape Kennedy, Florida. I was involved in geotechnical and civil design and construction of the Titan Three complex, Appolo project, and underground atomic test site at Amchitka, Alaska.

From November 1965 to January 1977, I was employed by the U.S. Army Corps of Engineers Philadelphia District. I was involved in geotechnical and civil design and construction of dams, tunnels, levees, highways canals and hydroelectric power plants.

From January 1977 to the present I have been employed by the U.S. Nuclear Regulatory Commission, Region II, Atlanta. My duties involve inspection of nuclear power plants in civil and geotechnical areas.

Q.4 Mr. Lenahan would you state your professional qualifications?

A.4 I received a Bachelor of Science degree in Civil Engineering from Drexel University in June 1969 and a Master of Science degree in Civil Engineering from Drexel University in June 1973. I am registered as a professional engineer in the states of New Jersey and Pennsylvania and I am a member of the American Society of Civil Engineers.

From June 1969 through September 1970, I was employed as a Civil Engineer with the USDA Soil Conservation Service, Upper Darby, Pennsylvania. My duties involved design of small earth dams. From January 1971 through August 1971, I was employed as a Civil Engineer in the Philadelphia Naval Shipyard. My duties involved structural design related to maintenance of shipyard structures, including buildings, piers, drydocks and large cranes.

From September 1971 through June 1976, I was employed as a soils engineer with the Philadelphia District of the Army Corps of Engineers. My duties included preparation of foundation designs and foundation design criteria for earth dams, powerhouses, pump stations, and various other civil work projects.

From June 1976 through June 1978, I was employed as a soils engineer with the Middle East Division of Army Corps of Engineers in Winchester, Virginia and Saudi Arabia. I was responsible for preparation of foundation design, foundation design criteria, and determination of construction material sources for approximately five billion dollars of new construction in Saudia Arabia. The projects included two commercial ports, two naval bases, four large military schools, and several military bases.

In June 1978, I joined the U.S. Nuclear Regulatory Commission. My responsibilities include planning and conducting inspection at operating reactors and at reactor construction sites. Areas I inspect at construction sites are structural concrete, structural steel, installation of post-tensioning systems, earthwork construction activities and quality assurance programs. Areas I inspect at operating plants are surveillance of post-tensioning systems and snubbers, leak rate testing, and actions taken by licensees in response to IE Bulletins pertaining to snubbers and masonry wall design. I have completed NRC's quality assurance, pressurized water reactor, and boiling water reactor courses.

Q.5 Mr. Harris and Mr. Lenahan would you state your experience concerning Shearon Harris?

A.5 We are Civil Construction Inspectors. Our experience concerning Shearon Harris is as follows:

We have been inspecting civil construction activities at the Harris site since 1977 (Harris) and 1978 (Lenahan). These inspections included examination of procedures, specifications, and drawings used for the control of concrete and backfill operations, observation of concrete and backfill placement activities, and examination of records documenting results of inspections, and testing on concrete and backfill activities.

Q.6 What is the purpose of your testimony?

Q.6 The purpose of our testimony is to address Eddleman Contention 65. That contention originally stated:

> "Because Daniel International, CP&L's prime contractor on the Harris project, has a history of building defective base mats and containments (e.g., Callaway, Wolf Creek, Farley) a complete ultrasonic re-examination of the containment and base mat, able to detect voids over 1 inch in size (any dimension over 1") therein, or another type of examination with similar capabilities to detect voids is necessary before Harris 1 is allowed to operate. Otherwise the voids could become (through cracking from thermal stress, concrete aging, or external impact) paths for radioactivity to leak from containment, e.g., reactor and primary system relief valves after a reactor trip or feedwater trip."

On July 12, 1984, in a telephone conference call the Licensing Board revised contention 65 to read:

> "Inspection of CP&L concrete pour package has shown numerous instances of improper concrete placement in the base mat and containment structure. In view of this, a complete examination of the base mat and containment structure for unacceptable voids must be conducted using ultrasonic techniques or, where use of such techniques are not feasible, other appropriate tests." (Transcript page 2171).

The Board went on to explain that they were limiting the scope of the contention to concrete pore packages noted in ar Affidavit of Charles Stokes filed by Mr. Eddleman on June 4, 1984 as a part of his response to the Applicants' Motion for Summary Disposition.

Q.7 Describe NRC's Region II inspection activities relative to concrete at Shearon Harris Nuclear Plant.

A.7 Thirty-nine inspections of concrete operations at the Shearon Harris Nuclear Plant were performed by NRC inspectors between May 1977 and March 1984. Approximately 600 inspector-hours were spent examining the licensee's concrete controls. These inspections included review of PSAR requirements, examination of controlling specifications, procedures, and drawings, observation of preplacement, placement and post placement activities and examination of records documenting preplacement, placement, testing and curing controls on completed placements.

Q.8 What was your personal involvement in those inspections?

A.8 Mr. Harris and/or Mr. Lenahan participated in twenty-nine of these inspections during which we witnessed numerous concrete placements. Our inspections consisted of examination of controlling specifications and procedures, observation of laboratory and field testing, inspection of batch plant operations, interviews of QA/QC inspectors, preplacement inspections, observation of craft placing techniques, observation of curing controls and repair of defects, and examination of reports documenting results of concrete placements. Mr. Bemis reviewed all inspection reports, including inspection reports addressing concrete, as part of his management responsibilities for Shearon Harris.

Q.9 Which NRC inspection reports address concrete inspections?

A.9 The following NRC inspection reports address concrete inspections.

Report Number	Report Number
50-400/77-2	50-400/81-09
50-400/77-3	50-400/81-10
50-400/78-1	50-400/81-18
50-400/78-4	50-400/81-20
50-400/78-5	50-400/81-24
50-400/78-8	50-400/82-12
50-400/79-7	50-400/82-16
50-400/79-13	50-400/82-22
50-400/79-17	50-400/82-25
50-400/79-19	50-400/82-32
50-400/79-22	50-400/82-35
50-400/79-25	50-400/82-37
50-400/80-1	50-400/83-04
50-400/80-5	50-400/83-09
50-400/80-6	50-400/83-21
50-400/80-10	50-400/83-25
50-400/80-11	50-400/83-32
50-400/80-19	50-400/83-11
50-400/81-05	50-400/84-04
50-400/81-08	

Q.10 Would you address the findings from those reports pertinent to Contention 65?

A.10 Yes. Review of controlling QA/QC procedures, specifications, and drawings indicated that the licensee's control for batching and placement of structural concrete meet or exceed industry standards. Observations of placements included placements made in the Unit 1 containment building, fuel handling building, auxiliary building, Unit 2 base mat, and diesel generator building. Placement of the Unit 1 base mat was not witnessed by an NRC inspector, but post placement inspection of the completed Unit 1 base mat was made by an NRC inspector and documented in NRC inspection report number 50-400/78-05. NRC inspections of licensee records for the Unit 1 base mat placement are documented in NRC inspection report numbers 50-400/78-04, 50-400/78-05, and 50-400/84-04. These inspections documented the existence of a significant honeycomb void near the bottom of the last concrete placement in the Unit 1 base mat. Inspections by NRC inspectors showed only one other instance of significant honeycomb voids. These occurred under six pipe penetration sleeves in the primary shield wall on placement 1CB IW 26001. Examination and repair of these voids are documented in NRC inspection report numbers 50-400/80-05 and 50-400/80-06. Discussions with responsible engineers, review of records, and observations showed the above defects were identified by the licensee and repaired in accordance with specification and procedure requirements. Some minor honeycomb was also noted in other structures, but observations showed these were identified and repaired by the licensee in accordance with requirements.

Q.11 Contention 65 specifically mentions voids in the concrete. Could you address that part of the contention?

A.11 Yes. Voids in concrete are referred to as "honeycomb". Honeycomb is defined in Section 201 of the American Concrete Institute Manual of Concrete Practices as voids left in concrete due to failure of the mortar to effectively fill the spaces among coarse aggregate particles. Some honeycomb and voids are expected in large concrete placements because of congestion caused by embedments, penetrations, reinforcing steel and because of the type of concrete mixes that are required to meet specified design strengths. Industry practices recognize the potential for honeycomb and voids and thus methods for identification and repair of the defects are specified in ACI 201 and the Bureau of Reclamations Concrete Manual. The probability of the honeycomb and associated voids occurring internally without any surface manifestation is highly unlikely. Experience has shown that the reinforcing steel located near the outer surfaces of the structures interferes with the flow of plastic concrete and causes a separation of mortar and coarse aggregate. Inadequate vibration in these areas adjacent to the reinforcing steel sometimes results in honeycomb occurring in the space between the steel and concrete surfaces.

Q.12 Has any specific investigation of the possibility of internal voids in concrete structures been done?

A.12 Yes. Investigations conducted by the NRC of honeycomb problems occurring at the Marble Hill site showed that honeycomb voids occur, in general, only

near the surface of the concrete. The investigations included coring and microseismic testing. Although extensive honeycomb voids were manifested at the surface, testing showed no internal voids or honeycomb except for occasional small entrapped air holes. As a result of the investigations conducted at Marble Hill, the NRC in a letter dated July 9, 1980, from W. J. Dircks, Executive Director for Operations to the Honorable Joel Deckard, United States House of Representatives, concluded that it is not at all unexpected that honeycomb voids occur in general only near the concrete surface.

Q.13 Eddleman Contention 65 asks for an ultrasonic re-examination of the containment and basemat. Can you describe briefly how such an examination is conducted?

A.13 Ultrasonic testing is like radar or sonar. Pulses of sound energy are sent into a material and reflected from the boundaries of the material or from parts of the material that have different transmitting qualities. If the material is homogeneous, only the entry surface and back surface of the material will show as reflections. These appear as vertical traces on a TV-like screen called an oscilloscope and the spacing of the traces is proportional to the thickness of the material. If the material contains objects of different densities or transmitting qualities, the sound will be reflected from each of these objects and will show up on the oscilloscope as vertical traces between the front surface reflection and back surface reflection of the material. Ultrasonic testing does not give direct information about the exact nature of the reflection. The nature or cause of the reflection is subject to the interpretation of the operator.

Q.14 How useful would such a method be for detecting voids, if they exist, in the concrete at the S. Harris site?

A.14 Discussions with engineers at the U. S. Army Corps of Engineers Concrete Research Center at Vicksburg, Mississippi, engineers with the Law Engineering Testing Laboratories in Atlanta, and NRC Region II ultrasonic testing experts indicated that the state of the art of ultrasonic testing is such that it is not a reliable testing method for reinforced concrete. This is because reinforced concrete is not homogeneous and contains numerous reinforcing and embedded materials that have different reflective properties. Hence, it is extremely difficult to differentiate defects from structural joints, reinforcing steel or embedments.

Q.15 Has the NRC examined the pour packages referenced by the Licensing Board in revised contention 65? (Those referenced in the Stokes' aAffidavit.)

A.15 Yes. As the Board revised the contention it deals with improper concrete placement evidenced in pour packages. The only pour packages which we are aware of that form the basis for the revised contention are those in the June 12, 1984 affidavit of Charles C. Stokes. We have examined the pour packages referenced in that affidavit.

Q.16 What were the results of that examination?

A.16 The results of the examinations of the concerns regarding each pour package expressed in the Stokes affidavit are presented in NRC inspection report

number 50-400/84-21. Pertinent paragraphs from the inspection report are presented below:

Concerns, Discussions, and Findings

a. Pour package 1CBXW219001 - Exterior wall of Unit 1 Containment Building, Elevation 218.5

Concern

Expressed concerns regarding this placement are: inadequate vibration, slump out of specification, exposed aggregate, and calculations that indicate test strength values do not comply with the EBASCO concrete specification.

Discussion

Review of the affidavit indicates that the concern regarding inadequate vibration is based on the fact that, in three locations on the Concrete Placement Report, reference is made to exposed aggregate, and that out of specification slump is shown on the Concrete Test Report. The affidavit states that the reference to exposed aggregate "could be a serious problem if not monitored and corrective action taken. The out of specification slump is based on the fact that the Concrete Test Report shows that water was added but no corrected slump is indicated. Thus, it was assumed that the mix was too stiff and should be

corrected. Noncomplying test strength values are based on calculations (not submitted with the contention) of average strengths shown on the Concrete Test Report and comparison of the calculated average values with requirements of EBASCO Specification CAR-SH-CH6, Concrete.

The inspectors examined documentation on concrete placement 1CBXW219001; EBASCO specification CAR-SH-CH-6, Concrete; Work Procedure WP-05, Concrete Placement, and Technical Procedure TP-15, Concrete Placement Inspection. Examination of the pre-checkout portion of the Concrete Placement Report shows that the specified finish for the concrete is "Exposed Aggregate." This is a common type of finish specified for construction joints. The purpose is to scarify and roughen the joint surface upon which additional concrete is to be placed. The roughened surface is to ensure a good bond with the next placement. Methods of exposed aggregate preparation are discussed in Section II, 8.3, of EBASCO Specification, CAR-SH-CH-6, and ACI 301, Specification for Structural Concrete. The requirement for an exposed aggregate finish on the construction joint is in accordance with standard industry practice. The type of finish specified for the concrete is not related to or indicative of inadequate vibration. Examination of the placement checklist filled out by the QC inspector shows that consolidation (vibration) of the placement was satisfactory.

Examination of slump data on the Concrete Test Report showed slump values of 2-3/4 inches, 1-1/2 inches, 2-1/2 inches, 3-1/2 inches, 4 inches and 3 inches. Section I, 11.9, of the Concrete Specification

specifies that a maximum slump of 4 inches be used and that a tolerance of +1 inch be allowed. The specification also recommends that the concrete be placed with the lowest slump possible. This is in accordance with standard concrete practices and recommendations of ACI 211-1, Recommended Practices for Selecting Proportions for Normal and Heavy Weight Concrete, and the Portland Cement Association Engineering Bulletin, Design and Control of Concrete mixes. Slump is an indication of the workability and consistency (or fluidity) of the concrete. The slump is determined by testing the concrete in accordance with ASTM C-143. The slump test is conducted by filling a mold 12 inches high with a bottom diameter of 8 inches and a top diameter of 4 inches with three equal layers of concrete and rodding each layer with 25 strokes of a steel rod. The mold is then removed and the amount the concrete slumps below the top of the mold is measured. The use of concrete with high slump is generally avoided because high slump concrete has a tendency to cause bleeding and segregation of aggregate from the mortar in the concrete which could result in voids in the concrete and/or low strengths. Also concrete mixes with high slump are considered inefficient because they usually require excess cement, fines and water. When slumps above the specified maximum are detected during testing, the concrete is usually rejected. Thus, the object is to place the concrete at the slump somewhere between 0 and the maximum, not at the maximum. Review of the above listed slump data shows that the concrete in this placement was within the 0 to 4 inch range. Water was added by the inspector before placement because when he examined the concrete in the truck (as required by procedure TP-15), he judged

that the concrete did not have enough consistency for good placement. Review of batch tickets disclosed that water had been held back at the mixing plant to allow the inspector to add water at the point of placement if needed. Comparison of the batch tickets with the Concrete Test Report showed that the amount of water added was less than or equal to the amount held back during mixing at the batch plant. Thus, the design of the mix had not been changed and no adjustments in the mix were required.

Evaluation of the 28 day test cylinder strength data presented on the Concrete Test Report showed the following compressive strength data:

Test Cylinder Set Number	Compressive Strength of Test Cylinder	Average Compressive Strength of Test Cylinders	Five Percent of Average Compressive Strength	Strength Variation between Cylinders in the Set
3860	7,150 psi 7,220 psi	7,185 psi	359 psi	70 psi
3180	6,330 psi 6,470 psi	6,400 psi	320 psi	140 psi
3640	7,000 psi 7,250 psi	7,125 psi	356 psi	250 psi

Section I, 13.5, of the EBASCO Specification states, "Each 28 day strength test result shall be the average of two cylinders from the same sample. The variation between the two cylinders shall be not more than 5 percent of their average. Examination of the above test results shows that test strength values exceed the 5000 psi design requirement

of this mix and that the variation between cylinder sets is not more than 5 percent of their average.

Findings

Examination of documentation for pour placement number 1CBXW 219001 indicates that vibration was adequate, that slumps were within specifications, and that compressive strength values met specification requirements and exceeded design requirements.

b. Pour package 1CBXW242001 - Exterior wall of Containment Building, Elevation 242

Concern

Expressed concerns regarding this placement are: inadequate vibration, concrete was slow to setup, and concrete defects form not filled out adequately.

Discussion

Examination of the affidavit indicates that the basis for the concern of inadequate vibration is that the Concrete Placement Report references Exposed Aggregate. The concern that concrete was slow to set up appears to be based on the following words appearing on the Concrete Placement Report - "Weather was Hot," "Rate of Rise 2 feet/

hr," and "Extended Cure." The concern that the concrete defects form was not filled out adequately is apparently because the description of the problem under the remarks section on the form was not clear to the author of the affidavit, and that he felt more information was required to adequately document the defect and the resolution.

The inspectors examined the documents in this pour package and discussed the placement with responsible CP&L inspectors. As stated in the concern on concrete placement 1CBXW219001, the reference to exposed aggregate on the preplacement portion of the concrete placement form refers to the specified finish on the construction joint. Its purpose is to ensure a good bond with the next placement and is not related to inadequate vibration. Examination of the placement checklist shows that consolidation (vibration) was observed by the construction inspector and judged to be satisfactory.

The use of terms on the concrete placement report such as "Hot," "Rate of Rise 2 feet/hour," and "Extended Cure," do not imply that the concrete was slow to setup or any type of adverse condition in the concrete placement. The term "Hot" is recorded on the preplacement portion of the Concrete Placement Report as an anticipated weather condition. Its purpose is to notify craft, engineers, and inspectors involved in the placement that the hot weather controls specified by ACI 305, "Recommended Practice for Hot Weather Concreting," are to be followed during the placement. The term "Extended Cure is the specified curing requirement for this concrete placement. This

requirement, which is specified in work procedure WP-17, Concrete Curing, requires that the concrete be moist cured for seven days and that the temperature of the concrete be maintained above 50 degrees for seven days. The requirements are based on exposure conditions during the service life of the concrete and ambient temperature at the time of placement. Extending the curing time of the concrete enhances the strength and service qualities of the concrete. The term "Rate of Rise" is specified on the Concrete Placement Form by the area engineer to control the rate of placement. This rate is determined by the area engineer to ensure that the concrete is not placed in the forms too rapidly. If the rate is exceeded, the forces resulting from the concrete while it is in a fluid state could cause the forms to collapse and endanger the safety of the placement crew.

Examination of the referenced Concrete Defects Form disclosed the following statements listed under remarks: "Metal forms raised 9/29/80. Falsework on the S-58 blister area remained until wrecked (removed) on 10/28/80. The concrete surface in this area will require chipping to allow steel slick rods (vibrator probes) to be cut below the neat line. Cosmetic repairs will then produce a satisfactory surface." These statements were written by the Construction Inspector to document that removal of the steel slick rods, which were used in vibrating the congested blister area of the containment, will produce a cosmetic defect in the surface that will have to be repaired. The blister area is a designed protrusion in the containment wall to accommodate a HVAC penetration. Because of steel congestion and

limited access, the slick rods were inserted in the placement area prior to placement and vibrated during placement to ensure good consolidation and thus prevent voids and honeycomb. These slick rods remained in the concrete. As stated on the concrete defects form, removal of the slick rod protrusions will be accomplished by chipping the concrete surface around the steel rods and then cutting the rods. The inspector correctly determined that this will result in a cosmetic type repair. Structural and cosmetic repairs are discussed in procedure TP-48, Inspection of Concrete and Grout Repairs.

Findings

Examination of documentation for pour placement number CBXW24001 showed that vibration was adequate, that the concrete was not slow to set up, and that the cosmetic defect was documented as required.

c. Pour package 1CBXW256004 Exterior wall of Containment Building, Elevation 251

Concern

Expressed concerns regarding this placement are: incorrect vibration, slump variance is out of specification, and weather is shown as overcast. Concerns are that these conditions indicate that voids are likely below reinforcing steel as well as between forms and reinforcing steel.

Discussion

Examination of the affidavit indicates that the concern of inadequate vibration is based on references to the terms "Exposed Aggregate," and weather was "Hot" appearing on the concrete placement report and to the remarks on the Placement Checklist Form stating that "Workers warned about vibration techniques," and "A most difficult placement." The concern of slump variance is based on the opinion of the author of the affidavit that the 2½ inch difference between slump tests shown on the Concrete Test Report does not meet the requirements of ACI 349. The affidavit states that the ACI 349 Code states that "when laboratory trial batches are made the air content shall be within ±0.5 percent and the slump within ±0.75 inches of maximum permitted by Specification."

The inspectors examined the pour package documentation and discussed the placement with responsible CP&L inspectors. As stated in the concerns discussed above, the term exposed aggregate refers to the specified finish on the construction joint. This finish is specified to ensure a good bond with the next placement and is not related to concrete vibration. The term "Hot" refers to anticipated weather conditions and is intended to notify personnel that hot weather placement controls specified by ACI 305 are to be used. The placement checklist attached to the pour package states that the vibration was satisfactory. Discussions with the responsible inspector regarding the remarks "Workers warned about vibration techniques," and "A most difficult placement," indicated that he wrote these comments because in

his opinion, the placement was difficult because of the rebar congestion and that he was aware that good vibration was needed to ensure a good placement. The construction inspector stated that he documented the comments about workers being warned about vibration techniques to note that he was inspecting for correct vibration techniques and that he corrected workers using improper vibration techniques. He stated that in his opinion, the workers did a satisfactory job in vibrating the concrete.

The M-80 mix used in this placement uses an additive called a super plasticizer to facilitate placement and reduce the possibility of honeycomb and voids in highly congested areas. (Note: A superplasticizer is a special chemical additive placed in concrete which gives high slump and high workability without changing mix proportions or addition of water). The slumps of 6 inches and 3½ inches shown on the Concrete Test Report are within the 0-8 inches specified by the concrete specification for mixes with a superplasticizer. The variance is not in conflict with ACI code requirements. The weather conditions were documented as being overcast during the concrete placement in the concrete placement records. Overcast weather conditions would not affect concrete consolidation (vibration).

The referenced statement "when laboratory trial batches are made, air content shall be within ±0.5 percent and slump within ±0.75 inches of maximums permitted by specification," applies to trial mixes made in the laboratory. These are made to determine the proper proportions for

the mix design which will be used in field operations. The statement regarding laboratory trial batches which appears in the ACI 318-77 building code (not the ACI 349 code referenced in the affidavit) is a revision to the ACI 318-71 code which required laboratory trial batches to be made at the maximum permitted slump and air content with no tolerances permitted. This was unrealistic and, thus, the code was revised. The reason for having the laboratory trial batches at or near the maximum air content and slump is to insure that the concrete strengths of the field mixes will meet design strengths. This is because if the laboratory trial mixes meet design strength using maximum allowable air and slump (a condition which would cause the strength of the mix to be on the low side), then field mixes with slump and air contents at or less than the maximum would be assured of meeting design requirements.

Findings

Examination of documentation for pour package 1CBXW256004 and discussions with responsible inspectors showed vibration was adequate, the slump variance is within specifications, and that placement measures were taken to ensure that honeycomb and voids would not occur.

d. Pour package 1CBXW276002 - Exterior wall of Unit 1 Containment Building, Elevation 276

Concern

Expressed concerns are: inadequate vibration, slump out of specification, and weather conditions were not reported on the Concrete Test Report.

Discussion

Examination of the affidavit indicates that the concern regarding inadequate vibration is based on the reference to a specified finish of exposed aggregate on the concrete placement form. The concern regarding the slump being out of specification is based on the fact that the slump of 3 3/4 inches shown on the Concrete Test Report is less than the specified maximum slump of 4 inches.

The inspector examined the documents in the pour package and discussed the concrete placement with responsible construction inspectors. As stated in concerns discussed above, the specified exposed aggregate finish is to ensure a good bond on the construction joint and is not an indication of inadequate vibration. Discussions with responsible inspectors and examination of the attached placement checklist indicated vibration of the concrete was satisfactory. The slump of 3 3/4 inches shown on the Concrete Test Report meets the specification requirements for slump 0-4 inches. As discussed in previous concerns regarding out of specification slump, a maximum allowable slump is specified because slumps higher than the maximum allowable could result

in the concrete being under strength. This is because slumps higher than specified for that mix indicate excess water in the mix and excess water could cause the mix to be under strength. Mixes with slumps less than the maximum are permissible and are more likely to produce higher strength concrete. The 3 3/4 inch slump shown for this mix is near the maximum and, thus, was a mix which should have had good workability and, thus, been easily placed without any void or honeycomb problems.

Examination of the Concrete Test Report did show that the weather conditions were not checked off. However, weather conditions of normal were recorded on the Concrete Placement Report. Also a check of meteorological data for this placement showed ambient temperatures of 61°F to 69°F. This indicates that weather conditions were ideal and that no special controls would have been required for the placement.

Findings

Examination of documentation in this pour package and discussions with construction inspectors disclosed no problems with inadequate vibration, slump being out of specification, weather or indication of any conditions which could have caused voids or honeycomb.

e. Pour package 1CBXW29001 Exterior wall Unit 1 Containment Building, Elevation 290

Concern

Expressed concerns regarding this pour package are inadequate vibration and out of specification concrete strength.

Discussion

Examination of the affidavit indicates that the concern regarding inadequate vibration is again based on the reference to a specified exposed aggregate finish for the construction joint, the anticipated weather condition "hot" appearing on the concrete placement report, and the comment appearing in the remarks section of the Concrete Test Report that a worker was warned about vibration techniques. The concern regarding concrete strength not being to specification is based on the fact that the 28 day test cylinder data on the Concrete Test Report is less than the design strength of 5,000 psi.

The affidavit also states that the strength value of 4,105 psi for test cylinder number 9323 on the Concrete Evaluation Sheet contradicts the first paragraph on this sheet which states "The 28 day tests are not 500 psi or more below the required strength". The affidavit further states that the results of core tests on this concrete pour indicates that this concrete pour is not acceptable.

The inspectors examined documentation on this pour, discussed the placement with CP&L construction inspectors, and discussed evaluation

of test results with CP&L and EBASCO design engineers. As stated in concerns discussed above, the specified exposed aggregate finish is to ensure a good bond on the construction joint and is not an indication of inadequate vibration. Discussions with the responsible construction inspectors and examination of the concrete placement checklist showed that the vibration of the concrete was satisfactory.

Examination of the Concrete Test Report showed that test cylinders from cylinder set number 9265 which were made from concrete placed in this pour had 28 day strength results of 4,780 and 4,950 psi. The average strength of the two cylinders in this set is 4,865 psi. Specification CAR-SH-CH-6 requires that no individual test result fall more than 500 psi below the required design strength (5000 psi for this mix). Thus the evaluation report is correct in stating that the 28 day strength tests are not more than 500 psi below the design strength of 5000 psi. However, because the average of all groups of three consecutive test results from this mix did not equal the required strength at 28 days (CAR-SH-CH-6 Specification, Section I, paragraph 13.5b), nonconformance number C-508 was issued. The averages of these test cylinder results are shown on the Compressive Evaluation Sheet as being from test cylinder set numbers 8176, 8381, 9265 (only test cylinder from this pour), 9323, and 9397. The average strength test of 4,105 psi from lab test number 9323 is representative of placement 1CBXW296003. Examination of documentation from this Placement showed that this low break was identified on Nonconformance Report C-507. Ninety day test results on reserve cylinder from this set tested at 5040 psi (40 psi above design strength).

The reserve set from test cylinder number 9265 (representing 1CBXW29001) were tested at ninety days. Test results showed an average strength of 5,660 psi which is well above the design strength of 5000 psi. However, because of the back to back low average of three consecutive 28 day breaks for this mix were less than 5000 psi the licensee drilled five cores in this placement for testing. Because of reinforcing steel congestion the diameter of the cores was limited to two inches or less (1.74 inches to 1.76 inches actual). Three of the cores tested above the 75 percent of design requirement specified in ACI 318. Two of the cores did not meet the ACI 318 requirement. One of the failed cores was taken 11 inches from a passing core test and the other failed core test was taken 9 inches from a passing core test. Since the failed cores and passed cores would have been from the same batch of concrete the low strength of the failed cores were considered to be due to the small size of the cores or improper testing. Experience has shown that test results from cores of this size are variable. No more cores were taken because the congested reinforcing steel would not allow the taking of larger cores and because the ninety day test results from the reserve set of cylinders showed that the concrete in this placement was above design strength.

Findings

Examination of documentation for this placement and discussions with responsible engineers and inspectors showed that vibration was adequate and that the concrete strengths met design and specification requirements.

f. Pour Package 1CBXW308001, exterior wall, Unit 1 Containment Building Elevation 308.25.

Concern

Expressed concerns regarding this pour package are inadequate vibration and strength. Voids are possible due to inadequate vibration.

Discussion

Review of the affidavit showed no basis for the concern of inadequate vibration. It is assumed that this concern is again based on the reference to exposed aggregate finish on the concrete placement report. As discussed above this is the specified finish for the construction joint and is not related to inadequate vibration. Examination of the placement checklist in the pour package showed that the construction inspector stated that the vibration was "satisfactory" and that placement was "smooth and satisfactory."

The concern regarding inadequate strength is based on the strength values appearing on the concrete test report which shows 28 day strengths of 4,930 psi and 4,810 psi for each test cylinder in test cylinder set number 10664.

Examination of the documentation and specification shows that the above test data meets specification and ACI 318 code requirements.

Specification CAR-SH-CH-6, Section I 13.50 and ACI 318 Paragraph 4.8.2.3 state that "The strength level of the concrete shall be acceptable if no individual strength test results falls more than 500 psi below the required class strength of 28 days and the average of all sets of three consecutive test equal or exceed design strength." The above test results are only 70 psi and 190 psi below the specified class strength of 5,000 psi at 28 days. Occasional test cylinder results below the specified design strength are anticipated and are permissible as long as the breaks are within the allowable specification limits which were determined in accordance with the criteria in ACI 214 and ACI 318. Examination of the compressive strength evaluation for this placement also showed that the average of the groups of three consecutive tests are 632 psi above the design strength of 5000 psi.

Findings

Examination of documentation on this package and controlling specifications indicate that vibration was adequate and that strength tests results met specification and ACI requirements.

g. Pour Package 1CBXW336003 - Exterior wall Unit 1 Containment Building, Elevation 336

Concern

Expressed concerns in this pour package are vibration problems still not corrected and mix problem of pour number 1CBXW308001 above is still in question as one of the 28 day tests was 4,880 psi.

Discussion

The inspector examined pour package documentation and discussed the placement with responsible inspectors. No basis for the concern of inadequate vibration was provided in the affidavit. From review of concerns expressed in previous pour packages it appears as though the concern may be based on the term "Hot" which appears as the anticipated weather conditions on the concrete placement report. As stated in discussions of previous concerns above, anticipated weather conditions are noted on the concrete placement report to inform responsible engineers, craft, and inspectors as to the type of controls which will apply during placement. Examination of the placement checklist and discussions with the responsible construction inspector indicated that vibration was satisfactory. The specified mix used during this placement contained a superplasticizer additive which gives the mix a high consistency and thus results in an easily worked mixed which can be easily placed and thus avoid the potential of voids and honey-comb-voids.

Examination of the concrete test report showed that the test cylinders representing this placement had strengths of 4,880 psi and 5,110 psi. The average strength of the set is 4,995 psi. Examination of the compressive strength evaluation report for the test cylinder results showed that the average strength of all groups of three consecutive test is 6,120 psi. The EBASCO specification and AC 318 code requirement state that the strength level of the concrete shall be considered satisfactory if: no individual test results falls more than 500 psi below the required class strength at 28 days and if the average of all sets of three consecutive strength test results equal or exceed the required class strength at 28 days. The above test results show one test cylinder result was only 120 psi below design strength and one test cylinder was 110 psi above the 5000 psi design strength. The average of all sets of three consecutive tests was 1,120 psi above the 5,000 psi design strength. Thus the strength test result are in accordance with specification and the ACI 318 code requirements.

Findings

Examination of pour package documentation and discussions with responsible inspectors indicated that vibration was satisfactory and that a special additive was used in the mix to facilitate placement and avoid honeycomb and voids. Review of test data showed that the concrete strength met specification and ACI 318 code requirements.

h. Pour Package 1CBXW386001 Exterior Wall of Unit 1 Containment, Elevation 376 to 386

Concern

Expressed concerns regarding this placement pertain to documentation problems concerning the mix code and required concrete strength. The affidavit appears to question the adequacy of the use of 4000 psi concrete when all previous containment wall concrete placements required 5000 psi concrete. The affidavit questions why the change in concrete strength was made if in fact the 4000 psi specified on the pour package documents is correct.

Discussion

From review of the affidavit and the concrete placement report, it appears that the concern is based on changes in the concrete mix used in the placement. The design mix code originally selected for this placement was M-72 (5000 psi mix without a superplasticizer admixture). This was then changed to mix M-56 (4000 psi mix without a superplasticizer admixture), and later changed to M-81 (4000 psi mix with a superplasticizer admixture), which was the mix placed in the pour.

The inspectors examined documentation on concrete placement 1CBXW386001, EBASCO specification CAR-SH-CH-6, EBASCO drawing number CAR-2167-G-0630, Revision 7, Containment Building Cylinder Wall - Plan

and Section - Unit 1 and Field Change Request (FCR) number C-1525. Examination of Rev. 7 of drawing CAR-2167-G-0630 disclosed that all concrete in the containment wall up to elevation 326.0 was required to be 5000 psi and that concrete above elevation 326.0 was required to be 4000 psi. However, to simplify construction, the licensee requested permission from the architect-engineer, EBASCO, to use 5000 psi concrete above elevation 326 in the Unit 1 containment exterior wall. This change is documented on FCR C-1525, which was approved by EBASCO on June 20, 1980. The FCR approved use of 5000 psi concrete up to elevation 376 and required the licensee to update the drawing to show the actual "as-built" condition on the drawing after construction was completed. The 5000 psi mix was used up to elevation 366. Above elevation 366, the 4000 psi mix was placed in the containment wall and dome except for the 5000 psi mix which was placed between elevations 440' and 444'. Therefore, the 4000 psi mix placed in placement number 1CBXW386001, which was placed from elevation 376 to 386 between azimuths 94° to 184° and between azimuths 274° to 4° was the correct concrete mix, i.e., a mix with a design strength of 4000 psi. Review of the results of the unconfirmed compression tests performed on 28 day test cylinders from the placement disclosed that concrete strength was well above the 4000 psi strength required by design (cylinder test data ranged from 4490 to 5270 psi).

The inspectors discussed the reasons for the change in the concrete design strength at elevation 326 with EBASCO design engineers. These discussions disclosed that the higher concrete strength value

(5000 psi) was used in design of the containment building below elevation 326. A value of 4000 psi was used in design of the containment building exterior wall above elevation 326. The 5000 psi value was used in design below elevation 326 because the concrete in the lower portions of the containment building is subject to high shear stresses around large penetrations (e.g. the equipment hatch) and at the intersection of the containment wall and basement. Therefore the explanation for change in the concrete design strength was based on design considerations and was not the result of an error.

Findings

Examination of drawings, procedures and the documentation for pour placement 1CBXW386001 disclosed that the proper strength concrete was used in the concrete placement.

i. Pour Package 1CBXW396002, Exterior Wall of Unit 1 Containment, Elevation 391 to 396

Concern

Expressed concerns regarding this pour appear to be inadequate vibration and the placement of 4000 psi concrete in the pour.

Discussion

There is no basis in the affidavit for the concern regarding inadequate vibration. It is assumed that this concern is again based on misunderstanding of the reference to the exposed aggregate finish specified for the construction joint on the concrete placement report. As discussed above, the specified finish for the construction joint is not related to inadequate vibration. The inspectors examined the placement checklist in the pour package. Review of the concrete placement checklist disclosed that the construction inspector stated that concrete consolidation (vibration) was satisfactory. Review of the post placement checklist disclosed that except for cosmetic repairs, no other concrete defects were present in the placement.

Concrete placement number 1CBXW396002 was placed in the exterior containment wall from elevation 391 to 396 between azimuths 0° to 90° and between 180° and 270°. As discussed above, the design strength of the concrete required in this placement was 4000 psi. The inspectors reviewed the results of unconfined compression tests performed on 28 day test cylinders from the placement. This review disclosed that the concrete strength is well above the specified 4000 psi design strength (Cylinder test data ranged from 4930 to 5430 psi).

Findings

Examination of documentation for pour placement 1CBXW396002 disclosed that concrete was properly consolidated (i.e. properly vibrated) and that the concrete placed in the pour met design requirements.

j. Pour Package 1CBXW425001 Unit 1 Containment Dome, Elevation 421 to 425

Concern

Expressed concerns regarding this pour appears to be inadequate vibration and the placement of 4000 psi concrete in the pour.

Discussion

There is no basis in the affidavit for the concern regarding inadequate vibration. It is assumed that the concern is again based on misunderstanding of the reference to the exposed aggregate finish specified for the horizontal construction joint in the concrete placement report. As discussed above, the specified finish for the construction joint is not related to inadequate vibration. The inspectors examined the placement checklist in the pour package. Review of the concrete placement checklist disclosed that the construction inspector stated that concrete consolidation (vibration) was satisfactory and that the concrete pour was "a very smooth and satisfactory placement." Review

of the post placement checklist disclosed that except for cosmetic repairs, no other concrete defects were present in the placement.

Concrete placement number 1CBXW425001 was placed in the containment dome from elevation 421 to 425 between azimuths 90° and 180° and between azimuths 270° to 360°. As discussed above, the design strength of the concrete required in this placement was 4000 psi. The inspector reviewed the results of unconfined compression tests performed on 28 day test cylinder from the placement. This review disclosed that the concrete strength exceeds the specified 4000 psi design strength (cylinder test data ranged from 4140 to 4950 psi).

Findings

Examination of the documentation for pour placement 1CBXW425001 disclosed that concrete was properly consolidated (i.e. properly vibrated) and that the concrete placed in the pour met design requirements.

k. Pour Package 1CBXW444001 Unit 1 Containment Dome

Elevation 440 to 444

Concern

Expressed concerns regarding this placement appear to be inadequate vibration, comments on the placement checklist regarding the operation of vibrators, and placement of concrete with an air content slightly below the specification limit (4.5 percent versus specification range of 5 to 9 percent).

Discussion

These is no basis in the affidavit for the concern regarding inadequate vibration. It is assumed that the concern is again based on misunderstanding of the reference to the exposed aggregate finish specified for the construction joint on the concrete placement report. As discussed above, the specified finish for the construction joint is not related to inadequate vibration. The inspectors examined the placement checklist in the pour package. Review of the construction inspector's placement checklist disclosed that the construction inspector stated that concrete consolidation (vibration) was satisfactory and that the concrete pour was "A smooth and satisfactory placement (if somewhat oversupervised). Form vibrators and head box arrangements worked well and produced good results."

There is a statement in the affidavit which expresses concern that this was the only comment in all the packages that the vibrators worked well. This statement appears to imply that the vibrators didn't work well in other placements.

The inspectors discussed these comments with the construction inspector who signed the report. These discussions disclosed that the basis for writing these comments was to summarize that the placement was completed satisfactorily and that construction methods selected based on practice placements were successful. The inspector also stated that he felt the use of form vibrators and the head box arrangement was somewhat unique and therefore felt he should comment on the results of their use. The construction inspector said that these comments weren't written to suggest that concrete vibrators didn't perform well on other placements.

The licensee anticipated that this placement would be a difficult one to complete. In order to avoid any problems during the placement, the licensee made three practice placements to determine best construction methods for placement and consolidation of the concrete. The practice placement were made using full scale models, complete with reinforcing steel and other embedded items. Based on the practice placements, the licensee modified concrete placement methods, changed the concrete mix to a 5000 psi mix with a 7" slump, used form vibrators (i.e. vibrators which are attached to the concrete forms and which vibrate the forms to assure adequate concrete consolidation), and modified the hub plate to assure that the concrete placement would be completed satisfactorily. The inspector reviewed FCR C-3794 which documented these changes to the general placement methods used to complete the placement.

Disposition of the problem pertaining to the low entrained air content is documented on Discrepancy Report (DR) number C-1751. The inspectors reviewed the corrective action and resolution documented on the DR and concur with the statement in the affidavit that the slightly low entrained air content is not a serious problem, that is, it has no safety significance.

Findings

Examination of the documentation for pour placement number 1CBXW444001 and discussions with responsible licensee engineers and construction inspectors disclosed that the concrete in the placement was properly placed. No problems were encountered with concrete vibration (consolidation). The licensee did extensive planning and preparation for this placement. The problem regarding placement of concrete with a slightly low entrained air value was properly evaluated and dispositioned in accordance with licensee QA procedures and NRC requirements.

k. Pour Package 1CBSL216001, Unit 1 Containment Building Basement

Concern

Expressed concerns in the placement pertain to inadequate vibration, damage to the waterstop, clearance between cadwelds and the asbestos board, and out-of-specification slump.

Discussion

The inspectors reviewed the documentation for concrete placement number 1CBSL216001. This package includes documentation for inspection of reinforcing steel, and waterstops and waterproofing for placement numbers 1CBSL216004 and 1CBSL216005. The reason for this is that the original plans for placement of the basement called for six separate placements and involved 5 construction joints. The location of the construction joints are shown on Revision 6 of EBASCO Drawing CAR-2167-G-0610. The licensee revised their construction plans and elected to pour the reactor building basement in two placements. The inspectors reviewed FCR numbers C-137 and C-210 which revised the location of the construction joints and revised the concrete placements to include placement number 1CBSL216004 and 1CBSL216005 as part of placement number 1CBSL216001 and placement number 1CBSL216003 and 1CBSL216006 as part of placement number 1CBSL216002. The inspectors reviewed drawing number CAR-2167-G-0610 and noted that the required design strength of the concrete for the basemat was 4000 psi, which was the strength specified on the concrete placement report.

There is no basis in the affidavit for the concern regarding inadequate vibration. It is assumed that this concern is again based on misunderstanding of the reference to the exposed aggregate finish specified for the placement and the anticipated special precautions for hot weather noted on the concrete placement report. As discussed above, the specified finish for the concrete placement is not related to inadequate vibration. In addition, as discussed above, the purpose of

the reference to hot weather under "Anticipated Special Precautions" on the concrete placement report was to notify craft, engineering and inspection personnel that the hot weather controls specified in ACI 305, "Recommended Practice for Hot Weather Concreting" were to be followed for this placement, and is not related to inadequate vibration.

Examination of the affidavit indicates that the concern regarding slump being out of specification is based on the statement "on the concrete test reports, it is shown tnat 29 out of 64 samples (1/2 approximately) are out of specification. The low values indicate the mix was dry." Specification CAR-SH-CH-6, Section I 11.9 specifies a maximum slump of 4 inches with a tolerance of plus one inch. The specification also recommends that the concrete be placed with the lowest slump possible, i.e., no minimum slump is specified. As discussed in concern a, above, the object was to place concrete with a slump between 0 and 4 inches, with an occasional maximum slump of 5 inches. Examination of the concrete test reports disclosed that, except for two trucks which had slumps of 6 1/2 and 6 1/4 inches, the slump of the concrete ranged from 1 1/2 to 5 inches and therefore complied with the specification requirements.

The two slumps which exceeded the specification requirements were documented on Discrepancy Report (DR) number C-065. DR C-065 also documents that the concrete from one truck had a low entrained air content (2.8 percent versus specification requirement of 4 to 8%). The inspectors reviewed DR C-065 and concurred with its resolution. The

results of unconfined compression tests performed on concrete from the trucks with high slump (i.e. slumps which exceed specification limit of 5 inches) and low entrained air exceeded the 4000 psi design requirement (cylinder test data ranges from 5130 to 6080 psi).

Examination of the affidavit disclosed that concerns regarding the waterstop appear to be based on the fact that the waterstop was damaged during construction, and that the damaged waterstop would potentially lead to a leak of radiation to the environment. A waterstop is a continuous sheet of material which is designed to bridge across either closed or open joints in concrete. The waterstop is fabricated from an elastomeric plastic material. The purpose for the waterstops in the containment building, which is discussed in detail in FSAR Section 3.4.1.1 (pages 3.4.1-2a and 3.4.1-3), is to prevent intrusion of groundwater into the containment building structure and to preclude the buildup of external hydrostatic pressure on the steel liner plate. Any water leakage through the waterstops will be drained through drains constructed from porous concrete. The drains lead to sumps in the reactor auxiliary building. The waterstops are not radiation barriers. The containment building radiation barrier is the leak tight steel plate and the 4 foot thick concrete containment building walls. The steel liner plate will contain any radioactive materials in the containment building. The leak tight integrity of the containment building will be subject to verification by testing prior to fuel loading and periodically during operating life of the plant to verify that the structure meets NRC requirements. The testing is performed in accordance with requirements specified in Appendix J of 10 CFR 50,

"Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors".

The inspectors examined documentation for concrete placement numbers 1CBSL216001, 1CBSL216004, and 1CBSL216005, EBASCO specification CAR-SH-CH-12, Waterstops, CP&L Work Procedure WP-12, Installation of Waterstops, CP&L Technical Procedure TP-21, Waterstop and Waterproofing Membrane Placement Inspections, and EBASCO drawing numbers CAR 2167-G-0610 and 0611, Containment Building Base Mat, Plan, Sections and Details.

Review of Field Inspection Reports for Waterstops and Waterproofing (FIRWW) for pour numbers 1CBSL216001, 1CBSL216004 and 1CBSL216005 disclosed that the waterstop was occasionally damaged during installation of reinforcing steel. These problems were identified and documented by a licensee construction inspector during inspection of the waterstops prior to placement of the concrete. The inspectors discussed these problems with the construction inspector who identified them. These discussions disclosed that the waterstop had been repaired satisfactorily in accordance with specification and procedure requirements prior to placement of concrete. The construction inspector stated that his purpose for documenting the damaged waterstop on the FIRWW was to assure that it would be properly repaired and reinspected prior to concrete placement. The repair of the waterstop was documented on the FIRWW and on the Pre-Placement Checkout section of the concrete placement report.

The affidavit states that acceptance was given for a clearance less than the required 1/2 inch clearance between the asbestos board and Cadwelds. The purpose of the asbestos board was to protect the continuous waterproof membrane, which was placed under the containment building foundation mat, from damage during construction (e.g. installation of reinforcing steel and Cadwelds) in area where it was exposed. The clearance tolerances are specified on EBASCO drawing number CAR-2167-G-0561, Standard Details - Concrete Reinforcing Steel Tolerance. Review of the FIRWW disclosed that this problem was identified and documented by a licensee construction inspector during preplacement inspections. The construction inspector stated that his purpose for documenting this problem on the FIRWW was to ensure the minimum clearances would be met prior to concrete placemet. The construction inspector stated that he reinspected this item prior to concrete placement and verified that the minimum clearances were attained. Review of the records and discussions with inspection personnel show that a clearance of less that 1/2" was never accepted.

Findings

Examination of the documentation for pour placement number 1CBSL216001 disclosed that, except for three trucks, concrete in the placement met specification requirements. The concrete from the three trucks that didn't meet specification requirements, i.e., out of spec slump and entrained air, met design strength requirements. The damaged waterstop was identified and repaired prior to placement of concrete and

reinforcing steel installation tolerances were met. No problems were encountered with concrete vibration (consolidation).

m. Pour Package 1CBSL216002, Unit 1 Basemat, Eastside

Concern

Expressed concerns with this pour package are inadequate vibration, damaged waterstop, slump out of specification and a large void.

Discussion

The inspectors examined the documentation in this pour package and discussed the placement with responsible inspectors. Examination of the quality Control Field Reports attached to the placement indicated that some problems with vibration were noted by QA inspectors during this placement. Discussions with responsible QA inspectors indicated that they documented these observations to show that they were doing their job and correcting any observed deficiencies. The inspectors stated that when they observed inadequate vibration techniques used by a laborer they informed the laborer on proper techniques to be used and had the laborer revibrate the areas where improper techniques had been used. The inspectors stated that except for occasional observed improper techniques which were corrected during the work progress, the overall vibration of the concrete was satisfactory. Examination of the Placement Checklist showed that the construction inspector noted consolidation (vibration) of the concrete was satisfactory.

Examination of the affidavit indicates that the concern regarding slump being out of specification is based on the statement that "In 49 out of 97 (1/2 approximately) samples, the slump is below the minimum allowable." Specification CAR-SH-CH-6 Section I 11.9 specifies that a maximum slump of 4 inches be used and that a tolerance of plus 1 inch be allowed. The specification also recommends that the concrete be placed with the lowest slump possible (no minimum slump is specified). As discussed in concerns in pour package 1CBXW219001 above, the object is to place the concrete at a slump somewhere between 0 and the maximum not at the absolute maximum. This is because slumps higher than the maximum can have excess water which could cause low strength concrete and which could also cause separation of the mortar from the aggregate during placement. Examination of slump data on the concrete test report disclosed that, except for two trucks which had slumps of 5 3/4 and 6 inches, the slump of the concrete ranged from 1 1/2 inches to 5 inches and thus met the specification requirement. Discrepancy Report C-080 was issued to address the two slumps which exceeded the maximum allowable in the specification. Examination of the discrepancy report and concrete test report showed that test cylinders were made from the twenty yards of concrete represented by these high slumps and that the next available trucks were checked and the slump found to be acceptable. Test cylinder data on this high slump concrete showed strengths of 5,730 psi and 5,550 psi (design strength is 4000 psi).

Review of the pour package showed that the affidavit is correct in stating that a "large void is documented as repaired on Quality Control Field Report No. C-160." The affidavit also states "Extensive honeycombing was found at one location and repaired." Examination of documentation in the pour package showed that the void and honeycomb are the same defect. This defect was identified by the licensee on Quality Control Field Report C-160 and Field Change Request C-292. Examination of these documents showed that the area is above the northernmost valve chamber at about elevation 218. Records showed that the honeycomb area was chipped to delineate the extent of the defect and that the defect was repaired in accordance with procedure and specification requirements. Examination of the repaired area by the inspectors verified that the location of the repair and repairs were as specified in the pour package documentation.

Examination of the affidavit indicates that the concern regarding the damage to the waterstop is based on the statement that "Every time the waterstop was damaged and repaired, a possible leak of radiation becomes more possible." The affidavit also indicates that repairs to the waterstop were not "timely corrected." Review of the documentation showed that damage did occur during preparation for the placement. However, as stated in the affidavit, damage to waterstops was reported on the Field Inspection Report for Waterstop and Waterproofing (FIRWW). The documentation also shows that the damage to the waterstop was identified and repaired prior to the pour placement. As discussed in

the concern on waterstops in pour package 1CBSL216001, the purpose of the waterstop is to prevent water leaking into the structure and is not intended to serve as a leak proof barrier for radiation.

Findings

Review of documentation and discussions with responsible inspectors indicated that the overall vibration of this placement was satisfactory. A honeycomb void did occur in the placement, but it was identified and repaired by the licensee. The void location and its repair was verified during this inspection and a previous inspection by NRC inspectors. The void occurred in an area congested with reinforcing steel and between the reinforcing steel and the forms. This is typical of honeycomb defects in concrete and is caused by the separation of motar from the aggregate when the reinforcing steel interferes with the flow of the concrete. It is usually due to insufficient vibration. Thus in this area vibration was probably inadequate. However, honeycomb-voids are normally manifested at the surface and inspection of the concrete surface by NRC inspectors and licensee inspectors showed no other honeycomb-void areas. Previous NRC experience with nondestructive and destructive testing of concrete with extensive honeycomb has shown no evidence of internal voids where honeycomb is manifested at the surface.

Examination of slump data showed that all slump values except two (not half as stated in the affidavit) were within specification and these were identified and resolved by the licensee.

The damage to the waterstop was identified and corrected in a timely manner by the licensee. The purpose of the waterstop is to prevent leakage of water into the structure and is not intended as a barrier to prevent leakage of radiation as stated in the affidavit.

Q.17 What are your conclusions relative to Eddleman Contention 65?

A.17 Based on the results of the inspections conducted by NRC inspectors, it is concluded that structural concrete at the Shearon Harris Nuclear Plant was batched and placed in accordance with NRC requirements and industry standards specified in the PSAR/FSAR. Examination of the pour packages referenced on the Stokes affidavit showed that there is no substance to the concerns stated in the affidavit. The concerns appear to be based on a misinterpretation of data presented on the concrete placement reports and concrete test reports and misunderstanding of requirements stated in the EBASCO Concrete Specification and referenced ACI practices, and codes and standard industry practice. Some significant and minor honeycomb voids did occur. When repaired properly, honeycombing does not affect the structural integrity of a building. Inspections by NRC inspectors showed that honeycomb was identified by the licensee and properly repaired. Experience with concrete placement practices and investigations conducted by the NRC have shown that the probability of honeycomb occurring internally without surface manifestation is highly unlikely. Even if internal voiding did occur and by cracking from stress became interconnected pathways, the steel liner on the inside of the containment would serve as a leak-tight membrane for radioactive effluents released inside the containment. Thus, an ultrasonic examination of the base mat and containment is not warranted. In addition,

extensive testing will be completed prior to fuel loading. This includes the reactor building structural integrity test and the integrated leak rate test (ILRT). During the structural integrity test, the reactor building will be pressurize to 51.75 psi (7452 pounds per square foot) which is 15 percent greater than the containment design pressure. This test will be performed in accordance with standard industry practices outlined in Regulatory Guide 1.18. The purpose of the ILRT is to verify the leak-tight integrity of the containment building. This test is performed in accordance with Appendix J of 10 CFR 50. The ILRT will also be conducted approximately every 3 years during the operating life of the plant. The Staff finds that there is no merit to the allegations contained in Eddleman Contention Number 65.