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Power Supply Engineering and Services

Georgia Power

June 7, 1979

United States Nuclear Regulatory Commission
Directorate of Inspection and Enforcement
Region II
101 Marietta Street, N. W.
Atlanta, Georgia 30303

Attn: Mr. C. E. Murphy

REFERENCE:
IE: II: WBS
50-424/79-07
50-425/79-07
File: X7BG10

Genelemen:

The Georgia Power Company wishes to submit the following information concerning the noncompliance discussed in your inspection report number 50-424/79-07 and 50-425/79-07.

Georgia Power Company Quality Control inspectors have received additional instructions on the necessity for following approved procedures. Accordingly, insulation resistance tests are being conducted as required. A specification change to X3AR01, Section E2, has been received which amends the shaft rotation requirements for safety related motors 50 HP and larger to read: "The rotors of motors rated 50 HP and larger shall be turned at monthly intervals to maintain the bearing oil coating and prevent bowing of horizontal shafts and to prevent fretting of vertical shaft motor bearings. The motors shall be rotated 810 degrees, minimum." Field Procedure ED-T-06 has been revised to establish a control mechanism to preclude a recurrence of this type noncompliance. Full compliance will be achieved by July 16, 1979.

The Georgia Power Company wishes to submit the following information concerning the deviation discussed in your inspection report number 50-424/79-07 and 50-425/79-07.

Georgia Power Company has submitted a letter to the Director of Nuclear Reactor Regulations clarifying our use of 91-day compressive strength concrete operations in the containment structures. Full compliance will be achieved upon concurrence from Nuclear Reactor Regulation.

The information contained in the inspection report is not considered to be proprietary.

Very truly yours,

R. W. Staffa

CWH:aaw
Attachment
xc: M. D. Hunt, NRC - Region II
J. H. Miller, Jr.
W. E. Ehrensperger
F. G. Mitchell, Jr.
C. F. Whitmer
R. J. Kelly
D. E. Dutton
R. W. Staffa
C. W. Hayes
W. M. Johnston, Jr.
C. R. Miles, Jr.
D. L. McCrary
R. A. Thomas
J. A. Bailey
J. L. Leamon
H. A. Sindt
B. L. Lex
K. M. Gillespie

May 11, 1979

Director of Nuclear Reactor Regulation
ATTN: Roger S. Boyd, Director
Division of Project Management
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

NRC DOCKET NUMBERS 50-424 AND 50-425
CONSTRUCTION PERMIT NUMBERS CPPR-108 AND CPPR-109
ALVIN W. VOGTLE NUCLEAR PLANT UNITS 1 AND 2
PSAR SECTION 3.8 CLARIFICATION

Dear Mr. Boyd:

During the Nuclear Regulatory Commission inspection of the week of April 23, 1979, a deviation was noted between the commitment of the Preliminary Safety Analysis Report (PSAR) and the requirement of construction specification X2AP01. This deviation addressed the compressive strength of concrete for the containment.

Please find enclosed the text for clarifying our use of 91-day compressive strength concrete specified in the construction specification versus the 28-day compressive strength concrete referenced in the PSAR for concrete design. The designation of 91-day strength is consistent with the industry practice for massive concrete construction using mixes containing pozzolan.

Since this clarification is consistent with current industry practice and has been approved on other nuclear projects, we would appreciate your early concurrence.

Should you have any questions or concerns, please inquire.

Yours very truly,

W. E. Ehrensperger

WEE:db
Enclosure
cc: Distribution Attached

Sworn to and subscribed before me, this 11th day of May, 1979.

Notary Public

My Commission expires NOTARY PUBLIC GEORGIA STATE AT LARGE MY COMMISSION EXPIRES JULY 21, 1982

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415 150

Dupe

cc: R. A. Thomas
D. E. Dutton
G. F. Trowbridge, Esq.
B. L. Lex
H. A. Sindt
L. T. Gucwa
K. M. Gillespie
C. W. Hayes
J. A. Bailey

CLARIFICATION

Section 3.8.1.6.1. of the Vogtle Nuclear Plant PSAR indicates that the compressive strength of the concrete used for the containment shall be based on 28 days. The section further indicates that the use of a pozzolan is an acceptable option.

It was therefore the intention of the PSAR to specify the necessary data requirements relative to the use of the Portland cement without pozzolan as indicated on page 3.8-37 (ASTM C150-72). The option of pozzolan mentioned at the end of 3.8.1.6.1. on page 3.8-40 was not developed in corresponding detail for the Vogtle Plant since, at the time of production of the PSAR in 1973, it was not known whether pozzolan would be available for use in the project concrete. Since the construction permit was granted and further development was made in the design during 1977-78, it became evident that it was desirable to recommend replacement of a portion of Portland cement with fly ash to improve the overall quality of the concrete. The option of adding pozzolan, namely fly ash, to the Vogtle Nuclear Plant concrete was thereby exercised.

The more recent codes, such as ASME Section III, Division 2, for Concrete Reactor Vessels and Containments require, among other things, that consideration be given to minimizing the temperature rise in concrete due to heat of hydration and that investigations be performed to ensure acceptable long-term creep properties (CC-2211). Prudent design practices of massive concrete structures have consistently accounted for the internal temperature rise due to heat of hydration (see the ACI Committee 207 reports: "Mass Concrete for Dams and Other Massive Structures" and "Effect of Restraint, Volume Change, and Reinforcement on Cracking of Massive Concrete"), and loss of prestressing force due to creep has always been an important element of prestressed concrete design (T.Y. Lin, Design of Prestressed Concrete Structures).

Reduction in cement content by pozzolan replacement, thus reducing heat of hydration, is a practice endorsed by most, if not all, codes, committees, and recognized authorities (ASME Section III, Division 2, ACI 349, etc.). According to Tuthill (1), use of pozzolans in proper amounts could reduce temperature rise by 15 percent.

By reducing the overall cement content of a concrete mix through the use of a pozzolan the ultimate creep values should also be reduced since, for a given set of materials, creep is proportional to the volume of the cement paste (cement + water) per unit volume of concrete. When part of Portland cement is replaced by pozzolan this volume is reduced and so is the creep.

It has been verified that the use of pozzolan minimizes the heat of hydration and attendant thermal cracking as well as reduces ultimate creep. This is accomplished within the framework of all applicable code requirements.

The advantages of using pozzolan are well recognized, and includes the following: (REF: NRMCA Publication 138, February, 1972)

(1) To reduce the water requirement of a mix, especially if using fly ash.

(2) To increase workability, reduce bleeding and segregation.

(3) To change the strength gain characteristics by postponing some strength gain to later ages, thus increasing extensibility and plastic flow at early ages to reduce cracking.

(4) To reduce drying shrinkage.

(5) To improve watertightness of the concrete.

(6) To improve resistance to sulfate active soils and water along with acidic waters.

(7) To inhibit and reduce alkali-aggregate reaction.

(8) To reduce the adiabatic heat of hydration of massive members.

A Corps of Engineers study cited by Philleo (2) indicates that pozzolan concretes attain about the same degree of maturity at age 90 days that Portland cement concrete attains at 28 days. Thus, the two ages provide an appropriate relative time in their curing history for comparisons to be made.

In addition, American Concrete Institute, in their publication SP-46 titled "Proportioning Concrete Mixes," makes the following recommendations:

> On page 149 in section "Extension of Test Age" it is recommended for concrete mixes using fly ash that specifications for compressive strength should be modified from a typical 28-day criterion to either 56 or 90 days (91 days provides 13 complete weeks).

Establishing compressive strengths at ages other than 28 days is an option available to the designer and is in accordance with ASME Section III, Division 2, subparagraph CC 2232.2C. It is common industry practice to specify shorter age periods for high early strength concretes and longer age periods for pozzolan concretes.

The primary reason for evaluating strength bases on a later age is to allow time for the chemical reactions involving the pozzolan with the lime liberated from the cement hydration reaction to proceed. It is this reaction that causes pozzolan concretes to gain strength more slowly and over a longer period of time. To illustrate the difference between Portland cement concrete with and without pozzolan, Figure 1 from the paper by Hatch and Connors, reference (3), is attached.

In conclusion, considering the massive structures of the Vogtle Project, the need to reduce the heat of hydration is deemed essential and is accomplished by utilizing the pozzolanic fly ash in the mix design as provided in the PSAR. Although not defined in detail in the PSAR, the strength criteria based upon 91-day cylinder strength is consistent with the industry practice for mix designs which employ fly ash to enhance the quality of concrete.

The Vogtle construction specifications were prepared to allow the use of pozzolanic fly ash mixes for Category I, structures. Therefore, a 91-day strength criteria was established for pozzolan concrete. These specifications meet the requirements of ANSI N45.2.5 as modified for 91-day strength and also meet the applicable requirements of ACI 359. Testing records are kept at the job site and will be evaluated in accordance with the recommendations of ACI 241 as modified by ACI 349, Section 4.3.

Attachment 1 (enclosed) provides some specific data relative to some concrete placements made at the Vogtle site to date. They are based upon 91 days' cylinder break strength criteria. The construction specification X2AP01 for the Vogtle Plant specifies a minimum of two cylinder breaks for 28-day or 91-day test from each 100 cu. yds. of concrete produced. Additional cylinders will be taken to monitor the quality control of the concrete production.

REFERENCES

(1) Tuthill, L. H., "Quality Attainment and Common Sense in Nuclear Concrete Construction," Concrete International, March, 1979.

(2) Philleo, R. E., "Compressive Strength as a Means for Controlling the Quality of Mass Concrete, "Realism In the Application of ACI Standard 214-65, ACI SP-37.

(3) Hatch, H. P. and Connors, D. N., "Uses of Fly Ash In the American Electric Power System" Paper No. 66F83, presented at the annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers, New York, February 27 - March 3, 1966.

(4) National Ready Mix Concrete Association, Publication 138, February, 1972.

ATTACHMENT 1

SUMMARY OF COMPRESSIVE STRENGTH - 5000 PSI TESTS

TYPE	CLASS	AGE (DAYS)	EXPECTED STRENGTH	FIELD TEST RESULTS		
				MEAN	STD. DEVIATION	NO. CYL.
WITH FLYASH	D-1	28	4900	4930	515	79
	D-1	91	6200	6965	587	158
	D-2	28	4750	4530	471	12
	D-2	91	6200	6185	656	24
NO FLYASH	D-1	28		NONE PLACED		
	D-1	91		NONE PLACED		
	D-2	28	5200	5715	262	24
	D-2	91				

Paper 66F83 presented at the Society of Mining Engineers Annual Meeting, New York, 1966.

LEGEND

- - - 4 1/2 SACKS CEMENT - NO FLY ASH
2 1/2" TOP SIZE GRAVEL
AVERAGE SLUMP 2 1/2"

——— 3 1/2 SACKS CEMENT & 82# FLY ASH
2 1/2" TOP SIZE GRAVEL
AVERAGE SLUMP 2 1/2"

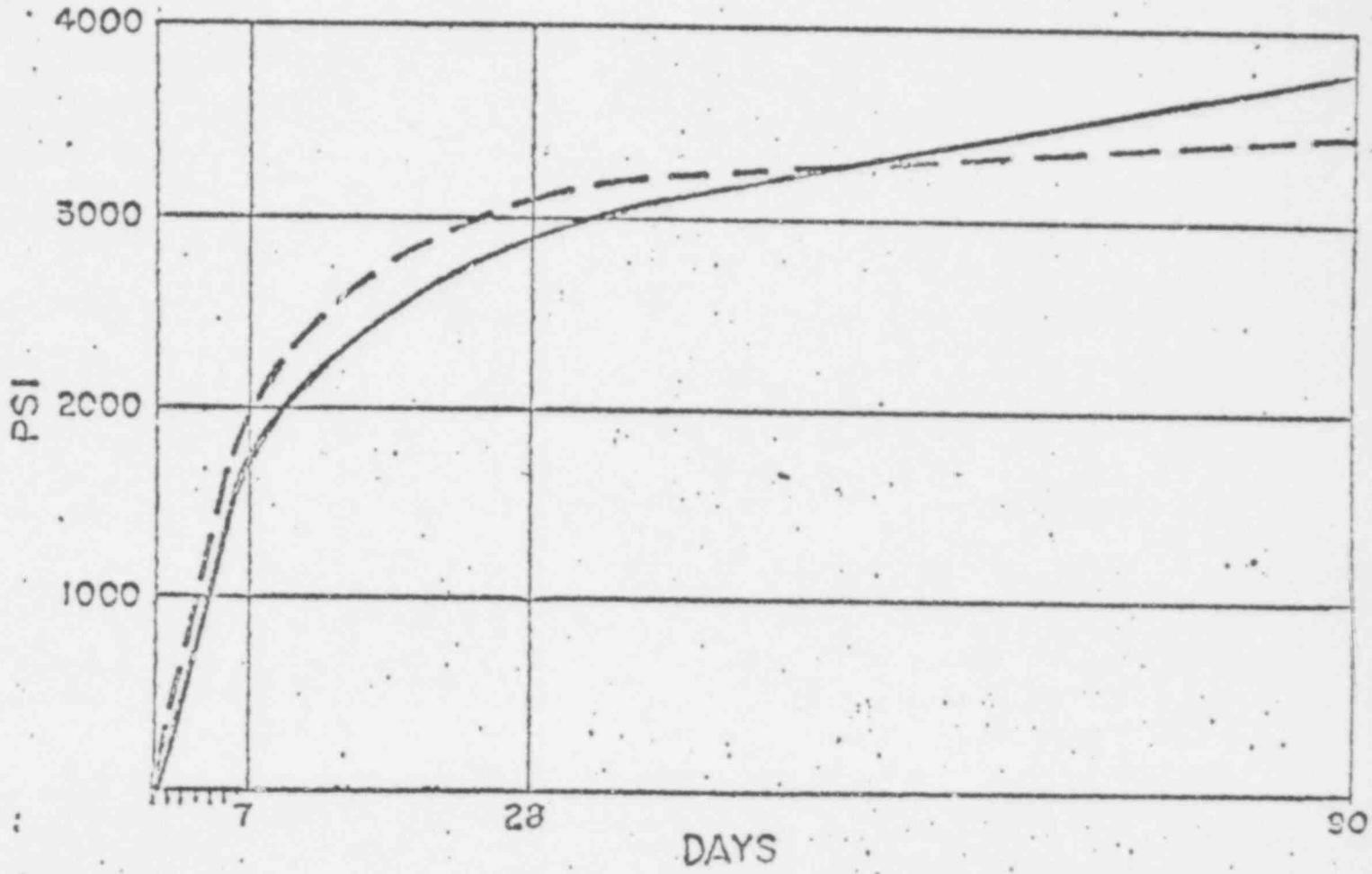

FIGURE 1

TYPICAL COMPRESSIVE STRENGTHS OF 6" X 12" CYLINDERS