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50-387/388

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SUBJECT:

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INFO CONCERNING THE CURING PERIOD AND PROTECTION FROM FREEZING OF CONCRETE  
DURING COLD WEATHER CURING.

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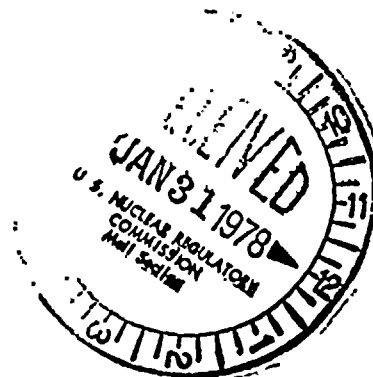
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PHONE (215) 821-5151

January 19, 1978

Director of Nuclear Reactor Regulation

Docket Nos. 50-387  
50-388

Attention: Olan D. Parr, Chief  
Light Water Reactors Branch No. 3  
U.S. Regulatory Commission  
Washington, D.C. 20555



SUSQUEHANNA STEAM ELECTRIC STATION  
COLD WEATHER CONCRETE REQUIREMENTS  
ER 100450 FILES 840-2 & 150-1  
PLA-210

We have received your letter of December 29, 1977, and note that your staff agrees with our proposal to provide a minimum period of 3 days for protection of concrete from freezing.

However, there has obviously been a misunderstanding by your staff of the statements in our letters regarding cold weather curing of concrete. We assure you that we did not have "... the misconception that freezing protection and curing of concrete are one and the same..." This is a misleading conclusion apparently drawn from the combined statement of PROPOSAL in our letter of March 30, 1977, our letter number PLA-168, which is worded "Proposal to reduce the minimum required period of curing and protective measures for concrete members, 2½ feet or less in the least dimension, during cold weather, from seven days to three days and the requirements of Table 1.4.2 of ACI 306."

We particularly must take exception to the accompanying staff statement which reads "Because of this misconception, the stipulations in various ACI specifications have been erroneously interpreted as indicated in the following comments..."

Freeze protection and cold weather curing during the first few days must occur within the same environmental space and must occur simultaneously.

Freeze protection of concrete is defined as the implementation of procedures to ensure that the water in freshly placed concrete does not crystallize due to freezing prior to the time when the concrete has attained a strength level of 500 psi. ACI 306-66 recognizes this, as we previously stated in our letter of June 14, 1977.

Curing of concrete is defined as the protection of new concrete from drying out so that adequate hydration may be achieved.

The rate of hydration which takes place in new concrete generally determines the rate at which the concrete will gain strength, all other mix design features being equal. Hydration is primarily influenced by the cement content, heat, and

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water content in the freshly mixed concrete.

We reiterate the statements of ACI 306-66, Chapter 9, COLD WEATHER CURING REQUIREMENTS AND METHODS:

1) Paragraph 9.1:

"It is essential that new concrete in all weather be protected from drying out so that adequate hydration may be achieved. This requirement normally means that positive measures must be taken to prevent excessive evaporation of moisture from concrete. During the winter, however, when the air temperature is below 50°F (10°C), atmospheric conditions in most parts of the country are such that undesirable drying will not occur. Furthermore, new concrete is vulnerable to freezing in a saturated condition. Therefore, all concrete should be allowed to undergo some drying before being exposed to freezing temperatures."

2) Paragraph 9.2:

"Although concrete exposed to cold weather is not likely to dry out at an undesirable rate, particular attention should be given to concrete that is undergoing the protection required by Table 1.4.2. As long as forms remain in place, surfaces adjacent to the forms are adequately cured in cold weather..."

We have restated these fundamentals because we wish to make it perfectly clear that we have no misconception about the similarities or differences in the requirements for protection from freezing and/or the requirements for cold weather curing.

We have been placing high quality concrete - generally much higher than required by existing codes and regulatory requirements - since the beginning of our construction project in 1973. We have no desire to reduce this high quality standard - either now or in the future. However, when we have sufficient evidence that supports an improvement in field procedures and the implementation of this improvement will meet regulatory requirements as well as reduce project costs, without sacrificing the high quality of our concrete, we are obligated in the interest of maintaining our costs as low as possible, to implement these improvements.

We strongly believe that a minimum cold weather curing time of three days is within the scope of ACI 306-66. We refer to Chapter 9, and in particular, to Paragraph 9.3, "Following the removal of the temperature protection, no positive measures to prevent excessive evaporation are required as long as the air temperature remains below 50°F (10°C). An exception is concrete placed in extremely arid regions where the relative humidity at 50°F (10°C) may be expected to be below 40 percent and at 40°F (4.5°C) below 60 percent...". Weather records from the AVOCA, Pennsylvania Airport weather station confirm that the average winter humidity for the region near our project job site is above these minimums and meets the requirements of this specification. We have submitted extensive test data to verify that our own project concrete mixes will comply with the curing requirements of ACI 306-66, Chapter 9 when



cc-Messrs:

R. W. McNamara	N-5
H. L. Harris	Susq. SES
J. R. Schmiedel	Bechtel
M. R. Muir	Bechtel
R. J. Shovlin	N-4
W. E. Barberich	N-4
E. M. Mead	N-5
A. M. Male	N-5
A. R. Sabol	N-4
J. W. Geiling	N-5
G. E. Shamis	N-2
Letter File	N-3

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cured for the minimum 3-day period.

Although ACI 301-72, Chapter 12, refers to a minimum concrete curing period of 7 days, it also refers to ACI 306 for detailed recommendations concerning cold weather concrete curing procedures.

We have previously submitted justification to you for the use of flyash in our concrete and the establishment of a minimum curing period of 7-days for massive structural concrete, as well as other specific design requirements supplemental to the ACI 301-72, ACI 306-66, and ACI 318-71 specifications. These modifications have been approved by your staff, PSAR changes have been submitted, and the field construction work is being performed accordingly, as verified by your compliance inspectors. Please refer to our letter (PLA-70) to NRC dated July 1, 1975. Amendment #17 to our PSAR, dated March, 1975, Paragraph 5.2.5.1 d states "Admixtures shall conform to ASTM C-618 for pozzolans...". Almost all of our concrete, since the beginning of our project concrete work in 1974, has contained pozzolan (flyash) and has a design strength specified to be attained at 90 days. PSAR Amendment No. 16 dated November 11, 1974, contained this specification, but it was inadvertently omitted from subsequent PSAR Amendments. It has been incorporated into the PSAR Amendment No. 20 which was submitted recently.

We request that you review the above mentioned considerations, including the intent of ACI 306-66, and concur with our proposed minimum cold weather curing period of 3-days for the Susquehanna Steam Electric Station Project concrete. This procedure is also subject to the conditions of Paragraphs 9.3 and 9.4 of ACI 306-66.

If you would like further clarification or justification for our statements on cold weather curing of concrete, we would be happy to discuss these with you, either by telephone or in a meeting at your convenience.

Very truly yours,

*Norman W. Curtis*

Norman W. Curtis

Vice President - Engineering and Construction

Sworn to and subscribed before me this 27<sup>th</sup> of January, 1978.

*David M. Landis*  
Notary Public

My commission expires: March 15, 1980

DAVID M. LANDIS, Notary Public  
Allentown, Lehigh County, Pa.  
My Commission Expires March 15, 1980