FROM:
Wisconsin Public Service Corporation
Green Bay, Wisconsin
(G. F. Hrubesky)

DATE OF DOCUMENT: Sept 20, 1968

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LTR. X MEMO: REPORT: OTHER:

TO:
Dr. Peter A. Morris

ORIG.: 1 CC: 1 add'l signed cy OTHER:

ACTION NECESSARY ☐ NO ACTION NECESSARY ☐ CONCURRENCE ☐ COMMENT ☐ DATE ANSWERED: BY:

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DESCRIPTION: (Must Be Unclassified) Ltr advising that quality of the structures for Kewaunee plant would be improved by the use of more than one type of cement.....req comments on use of Type I cement in some areas.....

ENCLOSURES:

REFERRED TO	DATE	RECEIVED BY	DATE
Knuth	7-24		
w/8 cys for ACTION			
Info Copies to:			
H. Price & Staff			
Dr. Morris/Schroeder			
Boyd			
Dube/Levine			
Rosen			
Moore			
Newell			
DeYoung (2 cys)			
D. Thompson			
Skovholt/Kelly			

ACKNOWLEDGED

REMARKS: Distribution:
1-formal file
1-AEC PDR
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~~4324~~ 4333

U.S. ATOMIC ENERGY COMMISSION

MAIL CONTROL FORM FORM AEC-326S (8-60)

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WISCONSIN PUBLIC SERVICE CORPORATION

P.O. Box 700, Green Bay, Wisconsin 54305

September 20, 1968

Mr. Peter A. Morris, Director
Division of Reactor Licensing
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Morris:

Subject: Wisconsin Public Service Corporation
Kewaunee Nuclear Power Plant
Docket 50-305
Type of cement

As we proceed with the development of detailed plans, procedures and schedules for the Kewaunee Nuclear Power Plant, we find that the quality of the structures would be improved by the use of more than one type of cement. The judicious selection of the proper type of cement for each installation will not reduce the safety aspects of the plant, but would, as explained below, result in a better structure. Since the FD&SAR contains a specific statement on the subject, we think that it is desirable to inform you of our proposed line of action so that if there are any objections they can be discussed immediately rather than at the final operating license stage.

Item 5.18 of your letter dated March 4, 1968 to Mr. G. F. Hrubesky is "Indicate the type of cement to be used and why." This item was answered in Amendment No. 3 to the FD&SAR as follows: "The type of cement to be used will be Portland cement Type II conforming to Specification ASTM C150. Type II cement is used for its lower heat of hydration and slower rate of heat generation."

It has become apparent that there are portions of the concrete work in which it would be advantageous to use Type I cement instead of Type II. The principal difference between Type I and Type II is the time of set and in the amount and rate of generation of the heat of hydration. In Table A is shown typical properties of cement produced at the plant from which the cement for the Kewaunee project is being obtained. The differences between the two types of cement which are of significance with respect to the finished concrete structure are as follows:

A. Time of Set

The Type I cement has a somewhat shorter setting time. This is desirable when the concrete work is being performed at ambient temperatures near or below freezing because the shorter setting

A. Time of Set (Continued)

time means less time during which freezing could damage the concrete. A shorter setting time is also advantageous when slip-form method of construction is being employed because the rate at which the concrete hardens governs the rate at which the slip-form may be moved, other things being equal.

On Figure 1 is shown the time of set for the concrete mix being used on the Kewaunee Project. Final set occurs about 2 hours and 20 minutes earlier for the mix using Type I cement than for the mix using Type II.

B. Rate of Strength Gain

Type I cement gains strength faster than Type II, but the final strength is about the same. The faster rate of gain is of benefit during cold weather for the same reason as outlined in "A".

C. Heat of Hydration

Type I cement has a faster rate of heat generation, and a somewhat higher total amount of heat generated. This is not desirable when the concrete section being constructed is thick, or when the concrete work is being performed during hot weather. It is beneficial when the section being placed is not thick, or when the concrete work is being performed during cold weather.

From the above discussion it is evident that concrete made with Type I cement is as good as or better than that made with Type II in every way except the effects of heat hydration. Therefore, it is proposed that the use of either Type I or Type II cement be allowed except at locations where the heat of hydration might cause harmful effects.

For example, it is planned to use Type I cement in the concrete for the shield building walls because these walls will be constructed by the slip-form method. We calculated the temperatures that can be expected in these walls during hydration of the cement. Assuming a placement temperature of 65°F. and using Type I cement, the maximum temperature would be 109°F. It would be 100°F for Type II cement, a difference of only 9°F. It is reasonable to assume that a month after placement the concrete has cooled to the average ambient temperature. In November this would be about 35°F (See Figure 2-7 in the FD&SAR). Thus, the concrete would have experienced a temperature drop of about 74°F for Type I cement, or about 65°F for Type II. The principal cause for concern is that the contraction caused by this temperature drop would cause cracking of the concrete. But contraction can cause cracking only when the concrete is restrained from contracting. Let us now examine the shield building structure.

The shield building is a cylindrical shell standing on end. Since the dome will not be constructed until much later, the upper part of the cylinder is not restrained in any way. Thus, this portion of the structure is free to expand or contract without restraint. The lower portion of the cylinder is restrained by the base slab on which it stands and to which it is attached. Thus, stresses, called discontinuity stresses can be caused in

this portion of the shell. That there would be discontinuity stresses in this portion of the shell was anticipated during the design stage. The lower portion of the structure is designed and reinforced for the discontinuity stresses that would result from a concrete temperature difference between the base slab and the wall of ± 70°. Thus, the temperature rise to 109°F (+44° over assumed base slab temperature) caused by the heat of hydration, and the subsequent cooling to 35° should not cause any distress in the structure.

To summarize, concrete can be made with Type I cement which is just as strong, durable and impervious as that made with Type II cement, except that under certain conditions the greater heat of hydration of the Type I cement could be detrimental to the final product. We propose to use either ASTM C-150, Type I or Type II cement, whichever is deemed to be best for a particular installation. The determination of which is best will be made by the design engineer on the basis of the considerations outlined above.

If you have any questions or objections to the use of Type I cement on this project as outlined above, we would like to discuss them at your earliest convenience. If we do not hear from you we will assume that you concur with our proposed procedure.

Very truly yours,

G. F. Hrubesky
Vice President, Power Generation and Engineering

GFH:mkn

PROJECT: KEWAUNEE NUCLEAR POWER PLANT

SUBJECT: SETTING TIME OF CONCRETE MIXTURE (ASTM C403)

CEMENT CONTENT = 535 LBS/CY.

WATER CONTENT = 32.5 GAL./CY.

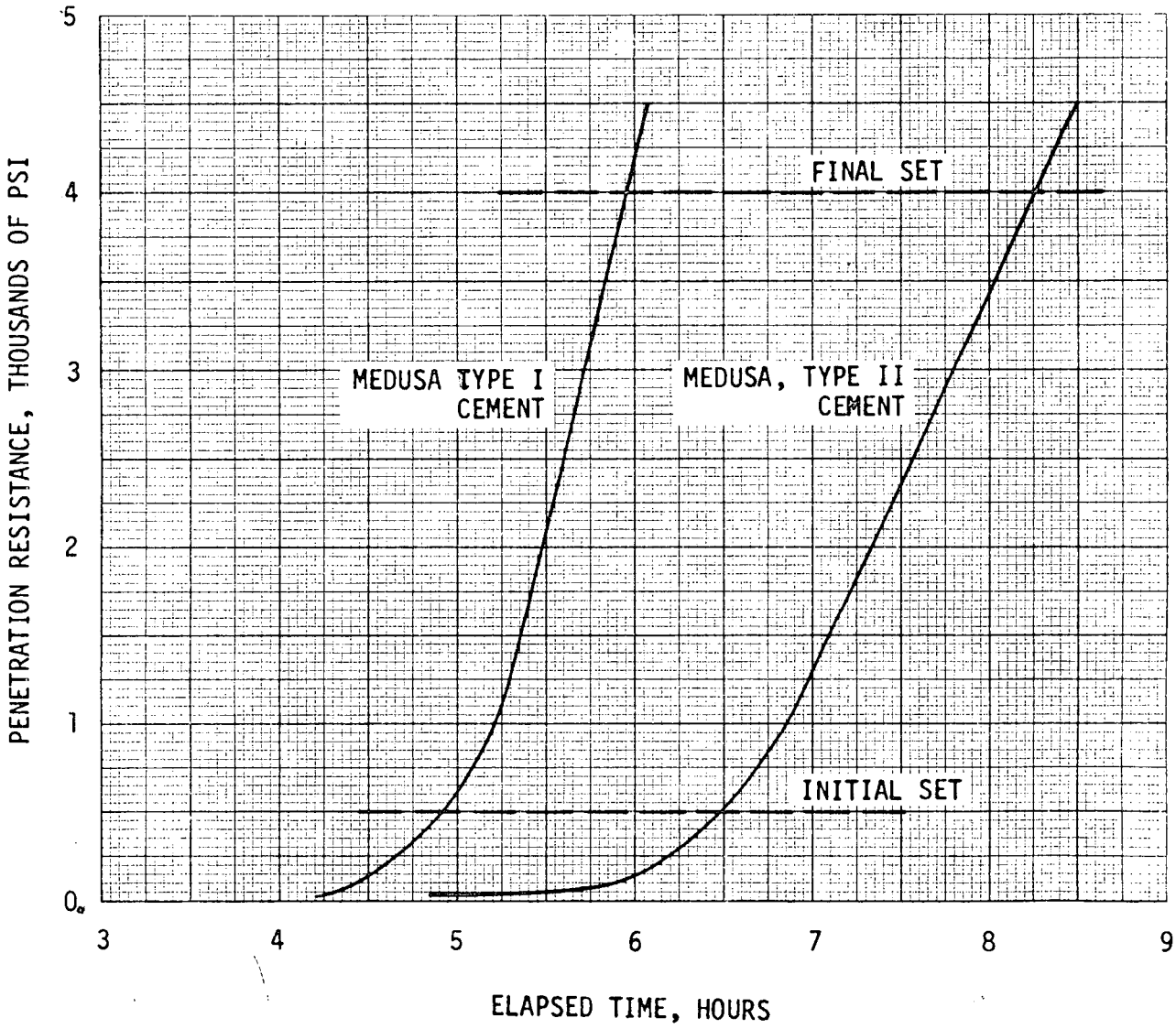

FIGURE 1

Pioneer Service & Engineering Co.

TABLE "A"

MEDUSA PORTLAND CEMENT
CHARLEVOIX PLANT PRODUCTION
Typical Analysis

Chemical Analysis	Type I	Type II
SiO_2	20.71	23.50
Al_2O_3	5.74	4.35
Fe_2O_3	2.38	4.07
CaO	64.44	63.30
MgO	2.88	2.42
SO_3	2.39	1.82
Loss on Ignition	.97	0.59
C_3S	56.2	38.3
C_2S	17.0	38.2
C_3A	11.2	4.7
C_4AF	7.2	12.4
$C_3S + C_3A$	67.4	43.0
Physical Analysis		
% Passing 325 Sieve	91.6	89.7
Wagner Surface Area	2046	1897
Blaine Surface Area	3681	3301
Autoclave Expansion	.11	----
Gillmore Setting Time		
Initial	2:15	3:10
Final	4:30	5:50
Vicat Setting Time	1:45	2:43
Air Content	9.2	
Compressive Strength		
3 Day	3430	1660
7 Day	4270	2740
28 Day	5260	5120
Na_2O	.18	.15
K_2O	.93	.65
Total as Na_2O	.79	.58
Heat of Hydration, 7 days (Cal./Gram)	-----	67.83
Heat of Hydration, 28 days (Cal/Gram)	About 90	80.80

UNITED STATES OF AMERICA

ATOMIC ENERGY COMMISSION

In the Matter of Wisconsin Public Service Corporation, Wisconsin Power and Light Company and Madison Gas and Electric Company (Kewaunee Nuclear Power Plant)	Docket No. 50-305

ADDITIONAL FINANCIAL INFORMATION

The following information is supplied with respect to the financial qualifications of Wisconsin Public Service Corporation and the two other co-owners, Wisconsin Power and Light Company and Madison Gas and Electric Company, to construct the Kewaunee Nuclear Power Plant.

The estimated direct costs of the plant are $85,082,000. In addition, overhead, including engineering and general and administrative costs, will amount to $10,033,000; interest during construction will amount to $13,003,505; and taxes during construction will amount to $3,853,334. Thus, the total project costs to be borne by the three co-owners under the Joint Power Supply Agreement are estimated to amount to $111,971,839. These categories of expenditures are based upon applicable accounting procedures of the Federal Power Commission.

In addition, the cost of purchase of the first core loading is estimated at $15,000,000. This will also be borne by the three co-owners.

A transmission substation associated with the project is estimated to cost $2,991,000. This cost will be borne by Wisconsin Public Service alone.

Respectfully submitted,

Cyril V. Smith, Jr.

Cyril V. Smith, Jr.
701 Union Trust Building
Washington, D. C.

Counsel for Applicants

May 29, 1968