



Consumers
Power
Company

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Harold R Denton, Director
Office of Nuclear Reactor Regulation
Division of Licensing
US Nuclear Regulatory Commission
Washington, DC 20555

MIDLAND NUCLEAR COGENERATION PLANT
MIDLAND DOCKET NOS 50-329, 50-330
EFFECT OF PUMP SEIZURE TRANSIENT ON FUEL INTEGRITY
FILE: 0505.16 SERIAL: 19390

References: (1) J W Cook to H R Denton, CP Co Serial 16627 dated April 14, 1982.
(2) R L Tedesco to J W Cook dated June 25, 1982
(3) J W Cook to H R Denton, CP Co Serial 18809 dated September 1, 1982
(4) "Evaluation Models of Zircaloy Oxidation in Light of Recent Experiments" H Ocken, et al, from Zirconium in the Nuclear Industry, ASTM STP 681 (1979)

Enclosure (1) Calculation of Clad Oxidation for 1100°F

Reference (1) provided information concerning fuel in DNB for the reactor coolant sump seizure analysis. The conclusion drawn from that analysis was that the calculated cladding temperature was sufficiently low as to preclude cladding failure even with 27% of the fuel pins calculated to have a DNBR less than the acceptance criterion. In response to Reference (2), a very conservative bounding analysis was performed assuming that the fuel in DNB failed. The resulting offsite doses associated with this analysis were calculated by CP Co to meet the acceptance criteria.

Based on subsequent discussions with the Staff reviewer, we submit the following in order to amplify the information given in Reference (1) and requested in Reference (2). Again, our conclusion is that this transient does not result in fuel damage since the calculated peak cladding temperature is low and time at temperature is short.

The fuel analysis for the pump seizure accident in Chapter 15 of the Midland FSAR was performed with the RADAR computer code, which has been accepted by the NRC (BAW-10069A). The code calculated a peak cladding temperature after

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DNB of 1100°F and of short duration (FSAR Figure 15.3-11). During the transient, the coolant system remains pressurized, thus the cladding stresses that might be caused by a sudden depressurization are absent. As a result, fuel conditions are well below the criteria given in NUREG-0630 for fuel swelling and rupture.

A review of the work conducted by H Ocken, et al, on Zircaloy oxidation was performed (Reference 4). If we use the equation developed from WPI data shown on page 519 of the subject report, we arrive at clad corrosion of 0.4 μm for a one minute time period at 1100°F (Enclosure 1). To put this in perspective, this is the amount of clad corrosion that would occur at normal operating temperature over a four hour time period.

Thus we conclude that clad failure either by strain or oxidation is not a problem for the conditions calculated to exist for this accident.

James W. Cook

JWC/JRW/fms

CC RJCook, Midland Resident Inspector
RHernan, US NRC
WLJensen, US NRC
Shih-Liang Wu, US NRC
DBMiller, Midland Construction (3)
RWHuston, Washington

CALCULATION OF CLADDING OXIDATION

Given rate constant equation (Ref 4, p 519):

$$K_p \text{ (mg/cm}^2\text{)}^2\text{/sec} = 9.32 \times 10^3 \exp (-27,340/RT)$$

@ 645 K (700 F)

$$K_p = 5.068 \times 10^{-6}$$

@ 866 K (1100 F)

$$K_p = 1.1724 \times 10^{-3}$$

Oxidation follows parabolic rate law:

$$W = \sqrt{K_p t}$$

where $W \equiv$ reaction mass (mg/cm²)

$K_p \equiv$ rate constant ((mg/cm²)²/sec)

$t \equiv$ time (seconds)

@ 866 K for 60 seconds,

$$W = .265 \text{ mg/cm}^2$$

using $\rho_{Zr} = 6.5 \text{ g/cm}^3$

oxidation film thickness is

$$W/\rho = .4 \text{ } \mu\text{m}$$

@ 645 K, to achieve same thickness of oxidation film,

$$.265 \text{ mg/cm}^2 = \sqrt{5.068 \times 10^{-6} t}$$

$$t = 3.85 \text{ hrs}$$

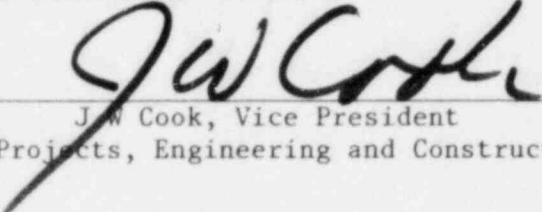
CONSUMERS POWER COMPANY
Midland Units 1 and 2
Docket No 50-329, 50-330

Letter Serial 19390 Dated November 1, 1982

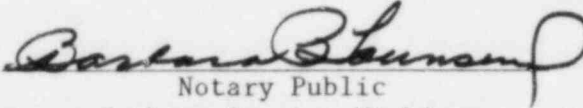
At the request of the Commission and pursuant to the Atomic Energy Act of 1954, and the Energy Reorganization Act of 1974, as amended and the Commission's Rules and Regulations thereunder, Consumers Power Company submits information on fuel integrity after a pump seizure transient.

CONSUMERS POWER COMPANY

By


J.W. Cook, Vice President
Projects, Engineering and Construction

Sworn and subscribed before me this 1 day of November, 1982


Notary Public
Jackson County, Michigan

My Commission Expires September 8, 1984