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
REACTOR COOLANT PUMP SEIZURE SAFETY ANALYSIS
FILE: 0505.16 SERIAL: 18809

Reference: Letter from R L Tedesco to J W Cook dated June 25, 1982

Enclosure: Midland FSAR Change Notice 3496, Offsite Dose Calculation Related to Reactor Coolant Pump Seizure

The referenced letter requested additional information regarding fuel damage during a postulated reactor coolant pump seizure. This subject is Confirmatory Issue 31 in Section 1.8 of the Midland Plant SER (NUREG-0793). Since the information requested would be difficult to obtain, the fuel which is calculated to undergo DNB during the transient has been assumed to fail and a dose calculation performed.

The enclosure is the dose calculation for a reactor coolant pump seizure from a 1/1 pump combination as it will appear in the Midland Plant FSAR. Using the assumption stated above, 27% of the fuel is failed in this analysis. Even so, the offsite doses associated with this bounding analysis are acceptable. The dose calculation does not change the conclusion of the FSAR analysis that the cladding temperature remains sufficiently low to prevent fuel failure.

James W. Cook

JWC/JRW/fms

CC RJCook, Midland Resident Inspector
RHernan, US NRC
DBMiller, Midland Construction (3)
RWHuston, Washington

B001

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QUALITY ASSURANCE PROGRAM
SAR CHANGE NOTICE

1. PSAR / FSAR

JOB NO. 7220   2. DISCIPLINE/COMPANY Nuclear   3. No. 3496

4. ORIGINATOR K C Prasad/J Ramanuja   5. DATE 8-9-82

6. REFERENCED SECTIONS OF SAR

15.3.3.5
List of Tables in Accident Analysis, Chatper 15

7. DESCRIPTION OF CHANGE

1. Changed the write up of 15.3.3.5 on Radiological consequences of reactor coolant pump shaft seizure accident.
2. Added Table 15.3-10 which lists the parameters used in the analysis.
3. Added Table 15.3-11 which lists the resulting offsite doses.

8. REFERENCED SPECIFICATIONS OR DRAWINGS

None

9. JUSTIFICATION

Confirmatory open item of SER

10. BECHTEL DISCIPLINE INTERFACE REVIEW:

- ☐ ARCH
- ☐ CIVIL
- ☐ CONTROL SYS
- ☐ ELEC
- X MECH/NUCLEAR
- ☐ PLANT DSN
- ☐ PQAE
- ☐ STRESS
- ☒ OTHER L&S

INTERFACING STAFF REVIEW:

- ☐ ARCH
- ☐ CIVIL
- ☐ CONTROL SYSTEM
- ☐ ELEC
- ☐ GEOTECH
- ☐ M & QS
- ☐ MECH
- ☐ NUCLEAR
- ☐ PLANT DSN
- ☐ RELIABILITY
- ☐ STRESS
- ☐ OTHER

K C Prasad	8/10	M J Wylie	8/10/82	J R Wahl	8/30/82
11. REVIEWED BY (Group Supervisor)	DATE	12. REVIEWED BY (SAR COORDINATOR)	DATE	13. REVIEWED BY (NUCLEAR ENGINEER)	DATE
N H Eidsmoe	8/23/82	Gary E Clyde	8/26/82		
14. CONCURRENCE BY (PROJECT ENGINEER)	DATE	15. APPROVED BY (CPCo)	DATE	16. CONCURRENCE BY (NSSS SUPPLIER)	DATE

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drops below 1.3, but the hot spot fuel cladding surface temperature is insufficient to initiate an appreciable metal-water reaction or result in clad damage induced by melting. Internal fuel pin pressure does not significantly increase as a result of the fuel temperature change. 44 Therefore, rupture at low cladding temperature is precluded. The percentage of fuel pins which would experience a DNBR less than 1.3 is provided in 16 Table 15.3-9. 44

15.3.3.4 Barrier Performance

The locked rotor accident does not result in excessive reactor coolant system pressure and the cladding temperature does not exceed limits. The integrity of the reactor vessel is maintained.

15.3.3.5 Radiological Consequences

Insert rewrite

This event will result in the release of steam from the secondary side to the atmosphere. It is shown in Subsection 15.3.3.3 that 33 fuel damage will not occur. For this reason there will be no increase in radioactivity in the reactor coolant or in the steam. Because the doses are a function of the amount of steam released, the potential radiological consequences of this event will be less severe than the consequences of [illegible] of nonemergency ac power to the station as discussed in [illegible]ction 15.2.6.

15.3.4 REACTOR COOLANT PUMP SHAFT BREAK

The loss of reactor coolant flow due to a pump shaft breakage or other mechanical malfunction has been examined for its effects on core integrity. The frequency of occurrence of this accident is expected to be the same as that for any gross mechanical failure of the primary system. Therefore, only one pump is assumed to be affected.

The effects of the loss of reactor coolant flow due to a pump shaft break are bounded by the consequences of the locked-rotor accident, discussed in Subsection 15.3.3.3.2. The flow coastdown 33 resulting from the breakage of one pump shaft is less rapid than that resulting from a shaft seizure situation indicative of the locked-rotor accident. In either case, the reactor is tripped if insufficient reactor coolant flow exists for the power level. The margin of core protection indicated by the DNBR during the coastdown is greater for the pump shaft breakage than for the case of shaft seizure since the flow decrease is not as rapid. Thus the power/imbalance/flow trip function of the reactor protection system ensures adequate protection of core integrity.

Insert 1

This event will result in the release of steam from the secondary side to the atmosphere. Even though it is shown in Subsection 15.3.3.3 that fuel cladding failure will not occur, radiological consequences of the accident are estimated by conservatively assuming that all the fuel pins that experience DNB will release their gap activities to the reactor coolant. Following the instantaneous seizure of a reactor coolant pump rotor, the reactor trips on a flux/flow signal. It is assumed that loss of offsite power occurs coincident with the reactor trip. Major assumptions and parameters used in the analysis are itemized in Table 15.3-10 and are listed below:

a. Twenty-seven percent of the fuel pins would experience a DNBR less than 1.3. The gap activity from these pins is instantaneously released to the reactor coolant system. The gap activities are taken from Table 15.A-2. This activity is assumed to mix uniformly in the circulating volume of the reactor coolant.

b. The primary coolant leak rate to the secondary system is 1 gpm.

c. One-hundred percent of the noble gases in the reactor coolant which leak into the secondary side are released to the atmosphere.

d. Some of the leaking reactor coolant flashes to steam as it enters the steam generator. Iodine activity contained in the fraction of the reactor coolant that flashed into steam is released instantaneously. Based upon the energy balance, it is estimated that 13% of the reator coolant will flash into steam. Ten percent of the remaining iodine activity in the steam generator is eventually released to the environment. Therefore, a total of 21.7% of the iodine leaking into the steam generator is released to the atmosphere.

   The fraction of reactor coolant that flashes to steam decreases as the reactor coolant temperature decreases. However, in this analysis it is conservatively assumed that 21.7% of the iodine contained in the leaking reactor coolant is released to the environment for the duration of the accident.

e. No credit is taken for the isolation of the leaking steam generator after 55 minutes following the operations sequence discussed in Subsection 15.2.6.2. It is assumed that releases will occur for 8 hours following the accident.

f. No credit is taken for ground deposition or decay during transit to the exclusion area boundary or the outer boundary of the low population zone (LPZ).

The realistic analysis assumes that the radiological consequences are bounded by the radiological consequences of loss of non-emergency AC power to the station auxiliaries discussed in Subsection 15.2.6.

The activity release pathways are shown in Section 15B.1. The mathematical models used in the radiation doses are given in Section 15B.2. The atmospheric dispersion factors at the site exclusion boundary and at the outer boundary of the LPZ are given in Table 15.3-10 and are based upon site meteorological data as described in Subsection 2.3.4.

The thyroid dose via inhalation and whole-body gamma and skin doses due to cloud immersion have been analyzed for an individual at the exclusion area boundary and the outer boundary of the LPZ. The resulting doses are given in Table 15.3-11 and are found to be well below the guidelines of 10 CFR 100.

The control room ventilation system is designed to isolate and pressurize the control room upon a high radiation signal from the radiation detector located in the contrl room air intake. For this reason, the radiation doses to control room personnel are considered to be bounded by the control room doses calculated for a LOCA as discussed in Subsection 15.6.5. The detailed design of the control room ventilation system is given in Section 6.4 and Subsection 9.4.1.

TABLE 15.3-10

PARAMETERS USED IN EVALUATING THE RADIOLOGICAL CONSEQUENCES OF A REACTOR COOLANT PUMP SHAFT SEIZURE ACCIDENT.

Parameter	Conservative Analysis[1]
Power level, Mwt	2552
Fraction of failed fuel during the accident, percent	27
Core Gap Activity	Table 15.A-2
Reactor coolant equilibrium activities prior to accident	Table 15.A-4
Volume of Reactor Coolant, ft^3	10,679
Density of Reactor Coolant, g/cc	0.718
Activity Release Data	
Release Assumptions	
Fraction of noble gases released, percent	100
Fraction of iodines released	
Fraction flashing as steam, percent	13
10% of iodine remained in steam generator	8.7
Total percent iodine released	21.7

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Table 15.3-10 (Continued)

Parameter	Conservative Analysis
Activity released to atmosphere - 0-8 hours	
Isotope	Curies
I-131	5.13 E+2
I-132	5.57 E+1
I-133	1.00 E+2
I-134	5.97 E+0
I-135	3.20 E+1
KR-83M	1.90 E+1
KR-85M	8.48 E+1
KR-85	7.50 E+2
Kr-87	4.47 E+1
KR-88	1.38 E+2
XE131M	1.53 E+2
XE133M	1.53 E+2
XE-133	1.40 E+4
XE-133	1.40 E+4
XE135M	2.04 E+1
XE-135	3.22 E+2
XE-138	2.39 E+1
Dispersion Data	
Distance to Exclusion Area Boundary, meters	500
Distance to LPZ Outer Boundary, meters	1600
Atmospheric Dispersion Factors, S/m^3	
Exclusion Area Boundary 0 to 2 hours)	4.49 E-4
LPZ Outer Boundary	8.49 E-5

(1) For the realistic analysis, it is assumed that the radiological consequences are bounded by the radiological consequences of loss of non-emergency power to the station au: liaries discussed in Subsection 15.2.6.

TABLE 15.3-11

RADIOLOGICAL CONSEQUENCES OF A REACTOR COOLANT PUMP SHAFT SEIZURE ACCIDENT

	Conservative Analysis[1]
Exclusion Area Boundary Dose (0 to 2 hours), rem	
Thyroid	31.4
Skin	2.9 E-2
Whole Body Gamma	3.8 E-2
LPZ Outer Boundary Dose (Duration), rem	
Thyroid	23.7
Skin	2.2 E-2
Whole Body Gamma	2.9 E-2

[1] For the realistic analysis, it is assumed that the radiological consequences are bounded by the radiological consequences of loss of non-emergency power to the station auxiliaries discussed in Subsection 15.2.6.

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

Letter Serial 18809 Dated September 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 the dose calculation for the reactor coolant pump seizure accident (SCN 3496).

CONSUMERS POWER COMPANY

By J W Cook

J W Cook, Vice President
Projects, Engineering and Construction

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

Barbara P Townsend
Notary Public
Jackson County, Michigan

My Commission Expires September 8, 1984.

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