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RECIP. NAME RECIPIENT AFFILIATION
ADENSAM, E. G. BWR Project Directorate 3

SUBJECT: Responds to 861003 request for info re effects of high control room temp on electronic equipment at facility. No addl action required for facility, based on listed capabilities & encl rept.

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NIAGARA MOHAWK

NIAGARA MOHAWK POWER CORPORATION/300 ERIE BOULEVARD WEST, SYRACUSE, N.Y. 13202/TELEPHONE (315) 474-1511

October 15, 1986
(NMP2L 0907)

Ms. Elinor G. Adensam, Director
BWR Project Directorate No. 3
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Washington, D.C. 20555

Re: Nine Mile Point Unit 2
Docket No. 50-410

Dear Ms. Adensam:

The Nuclear Regulatory Commission's October 3, 1986 letter requested information from Niagara Mohawk Power Corporation on effects of high Control Room temperature on electronic equipment at Nine Mile Point Unit 2. It should be noted that the Unit 2 design utilizes redundant Quality Assurance Category 1 and seismically qualified control room ventilation and chiller units. The control room ventilation system is designed to maintain temperature at or about 75°F with one chiller and, if room temperature is high (about 80°F), the other chiller is automatically initiated. High control room temperatures (104°F ambient) are expected only when both systems are inoperable.

Niagara Mohawk believes the information requested relates to matters beyond the design basis of the facility. While it is believed that such information falls within the purview of 10 C.F.R. §50.109, on behalf of Niagara Mohawk Power Corporation, I am transmitting a response to the Nuclear Regulatory Commission staff's request. The provision of such information should not be considered a waiver of Section 50.109. The results of Niagara Mohawk's study indicate that Unit 2 has unique design features to cope with control room high temperatures caused by failures beyond the design bases.

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A summary of the capabilities of the Nine Mile Unit 2 design include:

1. Redundant Category 1 cross connections from service water to admit service water directly to the air conditioning cooling coils and keep the control room cool.

2. A relatively slow increase in temperature in the control room if all control room ventilation is lost, which permits time for operator action.

3. The ability to shut down the reactor from the remote shutdown room and preclude spurious high temperature effects by the use of the disconnect switches. The remote shutdown room has separate ventilation.

4. All safety-related electronic control room equipment has been designed for a temperature of 120°F, which is greater than the allowable Technical Specification Control Room Ambient Temperature of 104°F. This includes both General Electric and Architect Engineer supplied components.

Based upon these capabilities, as discussed in the attached report, no additional action is required for Unit 2 at this time. Niagara Mohawk would hope that any following-up of the staff's concern be addressed through the appropriate mechanism for resolving generic issues.

Sincerely,

William J. Donlon
President

NLR/pns
2134G
Attachment

xc: W. A. Cook, NRC Resident Inspector
Project File (2)

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
Niagara Mohawk Power Corporation	)	Docket No. 50-410
(Nine Mile Point Unit 2)	)	

AFFIDAVIT

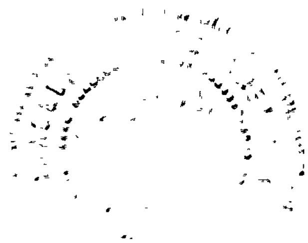
W.J. Donlon, being duly sworn, states that he is President of Niagara Mohawk Power Corporation; that he is authorized on the part of said Corporation to sign and file with the Nuclear Regulatory Commission the documents attached hereto; and that all such documents are true and correct to the best of his knowledge, information and belief.

William J. Donlon

Subscribed and sworn to before me, a Notary Public in and the the State of Maryland and County of Montgomery, this 15 day of October, 1986.

Veronica L. Hubbard
Notary Public in and for
Montgomery County, Maryland

My Commission expires:
VERONICA L. HUBBARD
NOTARY PUBLIC STATE OF MARYLAND
My Commission Expires July 1, 1990



I. Summary

The NRC staff has inquired whether electronic equipment in the control room meets 10 CFR 50 Appendix A General Design Criteria 4. Specifically, the staff raised questions about high temperature effects on electronic components in control room cabinets.

Even though Niagara Mohawk believes that this question is beyond the design bases, this report addresses the staff's question relating to Nine Mile Point Unit 2. The report provides responses to the five main issues raised by the staff which may be summarized as follows:

1. The unique design of the control room heating ventilating and air conditioning system is reliable. It has double redundancy for cooling the control room.

2. Upon loss of control room ventilation, temperature increases are generally slow which allow time for operator action.

3. The unique design of the remote shutdown system in the event of a total loss of control room HVAC permits safe shutdown outside the control room in the event it is necessary.

4. A field study was performed to determine the difference between control room ambient temperature and cabinet temperature. The results show a maximum temperature difference of 23°F.

5. All safety-related electronic control room equipment has been designed for a temperature of at least 120°F.

Nine Mile Point Unit 2 Control Room Equipment fully meets GDC 4.

II. Introduction and Background

By letter dated October 3, 1986, the Nuclear Regulatory Commission staff requested information on Control Room Ambient Temperature Effects on Safety Related Electronic Equipment. The letter indicated that the staff is unable to conclude that the concerns discussed below (associated with control room ambient temperature) have been adequately considered in the design of the main control room at Unit 2. On this basis, the staff requested the additional information.

A. Staff Request

Plant operational history of various nuclear power reactors has shown there is a significant potential problem involving the failure of safety related electronic components housed within cabinets located in the control room environment due to excessive temperature effects. Such failures could lead to the malfunctioning of control systems, inoperability for instrumentation channels associated with protection systems, inadvertent actuations and/or failures of safety systems and erroneous indications and alarms to plant operators. Even though

redundant control room cooling systems typically exist, it is believed that the loss of all control room cooling may be more likely to occur than previously thought as indicated by IE Information Notice No. 85-89, "Potential Loss of Solid-State Instrumentation Following Failure of Control Room Cooling." It appears from various events that control room temperatures can rise quickly (in a matter of minutes) upon loss of control room HVAC. Operational experience has shown that even though design specifications show that equipment is qualified to handle temperatures up to 120°F, an ambient control room temperature of 90°F (technical specification allowed higher temperature) can result in erratic behavior of electronic equipment housed within various enclosures. Cases have been cited where temperatures at the location of cabinet top racks have reached 125°F even though the control room ambient was 72°F and the HVAC was functioning. IE Information Notice No. 85-89 was issued to alert licensees/applicants of potential problems related to excessive temperature effects within cabinets.

Based on the above concerns associated with plant operational history at various operating nuclear plants, the applicant is requested to supply information to the staff which describes what consideration (correlation) was given to the possible temperature effects on safety related electronic equipment housed within the various control room cabinets/enclosures as related to the Technical Specification ambient temperature limit of 104°F and what measures have been taken to preclude similar problems from occurring at the Nine Mile Point 2 facility as have occurred at some operating reactors.

B. Discussion of Resolution Method

Based upon NMPC evaluation of the NRC staff request, five main points need to be addressed. These are:

1. What is the reliability of the ventilation and cooling system for the control room?

2. How does the control room temperature increase with a loss of cooling?

3. What effect does control room temperature have on safe shutdown?

4. What is the difference between ambient room temperature and cabinet temperature?

5. What temperature is the Control Room electronic equipment designed for?

Each of these questions are addressed in subsequent sections. Report Section III discusses control room ventilation design and responds to Question 1. Report Section IV discusses control room heatup due to total loss of ventilation and addresses Question 2. Report Section V discusses remote shutdown capability and addresses Question 3. Report Section VI discusses field studies and addresses Question 4. Report Section VII discusses the design of the control room electronic equipment and responds to Question 5. Report Section VIII describes the overall conclusions.

III. Control Room Ventilation and Cooling System Description

A. System Design

The system consists of two safety-related, 100-percent capacity air conditioning units. Each unit contains a filter assembly, cooling coil, fan, and dampers. Conditioned air is supplied through ductwork to the main control room, relay rooms, office area, instrument shop, training room, corridor, air conditioning equipment room, and Division I, II, and III cable chase areas. Return air from each area is also ducted to the air conditioning units. The air conditioning units also provide makeup air for the kitchen and toilet room exhaust systems. Exhaust air from the kitchen and toilet room is discharged to the atmosphere through a tornado- and missile-protected hood, by separate exhaust fans. System supply air capacity exceeds the combined return air and exhaust capacity to provide a positive pressure in the main control room.

Heating for all areas, except the corridor and the air conditioning equipment room, is provided by duct-mounted electric heaters. Local heating in the corridor and training room is provided by electric baseboard heaters. Local heating in the air conditioning equipment rooms and Division II and III cable chase areas is provided by electric unit heaters.

Return air and outdoor makeup air are mixed before passing through the air conditioning unit filter assembly. Manual dampers within each filter assembly permit air to be diverted through a charcoal filter section for odor removal. The charcoal section is normally bypassed.

Chilled water to each air conditioning unit cooling coil is supplied from the control building chilled water system.

The control building chilled water subsystem is shown schematically on FSAR Figure 9.4-1a. The control building chilled water subsystem supplies chilled water during normal operation, plant shutdown, and design basis accident (DBA) conditions to air conditioning units serving the control room, relay room, remote shutdown room, and computer room.

The subsystem is closed loop, and consists of two redundant chilled water trains, A and B. Each train is capable of meeting total chilled water demand, utilizing one hermetic centrifugal water chiller, one chilled water circulating pump, one expansion tank, controls, and piping.

Water is provided to each chiller from the service water system. Each chilled water train, A and B, has separate condenser water connections to the corresponding A and B loops of the service water system. The service water system is capable of supplying water to the chiller condensers during all modes of plant operation.

Makeup water for the control building chilled water subsystem is normally derived from the plant makeup water system. During accident conditions, makeup water can be manually diverted from the service water system.

The control building chilled water subsystem is designed to perform during normal operation, plant shutdown, or accident conditions without loss of function. Each chilled water train is capable of meeting the total chilled water demand on the subsystem. The subsystem is designed to Category I criteria and conforms to the single-failure criterion. The subsystem receives electrical power from two offsite sources during normal operation and from redundant standby diesel generators if offsite power is lost. Equipment is located in the control building which is a tornado-proof, Category I structure.

The service water system is a safety-related, seismically qualified, fully redundant system, and is designed to assure an uninterruptable supply of water to the chillers. In the unlikely event both chilled water trains fail, service water can be utilized for emergency cooling. Switchover from the chilled water system to the service water system (standby mode) is manual.

The refrigeration system of each chiller utilizes a nonflammable refrigerant, R-11 (trichlorofluoromethane), which is classified in Group 1, the least hazardous, in the safety code for mechanical refrigeration (ANSI B9.1). To prevent a refrigerant barrier failure due to loss of coolant, condenser cooling water temperature is monitored. An increase in the condenser cooling water temperature above a present level initiates an alarm in the main control room. If corrective action is not taken, the refrigerant system high-pressure cutout stops the chiller and another alarm is initiated in the main control room.
The refrigeration system of each chiller has a rupture disc designed to relieve excess pressure. Rupture disc discharge is piped outside the building.

The failure modes and effects analysis (FMEA) of the control building chilled water systems is provided in the Nine Mile Point Unit 2 FSAR FMEA Report.

The control building chilled water temperature control valves are controlled automatically by either control room temperature or humidity. The valves control chilled water flow to the associated air conditioning units. The valves open fully when the control building return air temperature is sensed at high-high.

Monitoring

Alarms are provided for:

1. Chilled water circulating pump auto start, auto trip/fail to start, and flow low.

2. Service water to chiller no flow.

3. Chiller compressor refrigerant pressure low, refrigerant pressure high, oil pressure low, auto start, auto trip/fail to start, oil temperature high, discharge temperature high, and purge high.

4. Chilled water expansion tank water level high/low-low.

5. Chilled water system inoperable.

6. Computer room air conditioning inlet valve closed.

B. NRC Question and Response

Question: What is the reliability of the ventilation and cooling system for the control room?

Response: The Unit 2 control room HVAC system is reliable. In addition to redundant 100% capacity cooling systems, the Unit 2 design also incorporates a redundant service water backup. This service water backup capability allows cooling of the control room if both the refrigerated chiller units are inoperable.

Operating procedures exist and describe the method to cross connect the service water system in the event of the loss of the chiller units. This is a simple manual procedure requiring only the alignment of several valves.

IV. Control Room Heatup

A. Description of the Analysis

The heat loads in the control room may cause a limitation on personnel occupancy or on performance of electronic circuitry. This analysis estimates the conditions in these rooms under certain conditions and determines the time available before a limiting condition occurs. The analysis accounts for all heat sinks and sources which may be realistically expected during a loss of AC power.

An estimate of the total heat load in the Main Control Room is shown on Table 1. The heatup in the control room was estimated based on these heat loads, the expected lighting loads, and an estimated 295,000 lbs. of steel and copper heat sinks provided by the walls, panels, floor sections, and cabling in the room. Ceiling heat sinks were ignored since the roof is insulated.

The calculations show that without shedding of the non-essential loads, the control room temperature exceeds 104°F within about 1.5 hours due to the heat input from the battery supplied loads. Load shedding of non-essential loads was therefore assumed for the calculation. Twenty-eight KW of heat load was assumed for the first hour, based on the loads shown in Table 1. Thereafter, sufficient loads were assumed to be stripped to reduce the control room heat load to 6 KW.

The results of the calculation are shown in Figure 1. The maximum temperature taking credit for the floor section, panel and cabling heat sinks shows that the control room temperature rises to about 100°F at 1.5 hours in the loss of AC power event. The temperature then falls to about 96°F at 6 hours and then rises continuously thereafter at a rate of about .25°F/hour. The control room temperature remains below the design maximum control room temperature (104°F) for a substantial period of time.

B. NRC Question and Response

Question: How does the control room temperature increase with a loss of cooling?

Response: The temperature would exceed 104°F in 1.5 hours unless operator action to shed non-essential loads is initiated. This time permits sufficient time for operator action to re-establish cooling by service water or other activities.

V. Remote Shutdown Capability

A. System Description

During a high room temperature situation, if equipment was reacting erratically, the operator could select an alternative shutdown approach. Using the transfer and disconnect switches, safe shutdown can be accomplished from the remote shutdown system. The remote shutdown system is provided cooling by a separate Category 1 ventilation system. Control building chilled water is used as the cooling medium for these units. Postulating a loss of both chillers, service water can be utilized for emergency cooling. The disconnect switches would prevent spurious operation of equipment in the control room.

B. NRC Question and Response

Question: What effect does control room temperature have on safe shutdown?

Response: High temperature in the control room and erratic operation of the control room equipment could be precluded by operation of the remote shutdown room. Control of the necessary important equipment can be transferred to the remote shutdown room, which has a separate HVAC system. The transfer and the use of the disconnect switches precludes spurious operation that could affect safe shutdown.

VI. Field Studies

A. Study Results

A field study was initiated to determine the difference between ambient air temperature and cabinet temperature. Eight safety-related control room cabinets were randomly selected and monitored hourly. The maximum difference in temperature between the control cabinets (near the top of the cabinet) and the ambient control room temperature is 23°F.

B. NRC Question and Response

Question: What is the difference between ambient room temperature and cabinet temperature?

Response: A field study showed that the maximum difference between cabinet temperature and ambient temperature was 23°F.

VII. Control Room Equipment Design

A. Description of Design

The equipment in the control room was designed for 120°F.

A recent review of documentation indicates that both General Electric and Stone and Webster supplied components are designed for at least 120°F.

B. NRC Question and Response

Question: What temperature is the control room equipment designed for?

Response: All control room equipment is designed for at least 120°F. This provides a substantial margin between normal operating temperature and the maximum design value.

VIII. Conclusion

It is NMPC's position that no additional action is required for Unit 2 at this time because:

1. The Control Room ventilation design provides sufficient redundancy.
2. Control Room heatup on a complete loss of ventilation can be maintained below the maximum design limit of 104°F by operator action.
3. Plant design provides for remote shutdown capability in the event of erratic Control Room component performance.

4. Field studies indicate a maximum temperature differential between control room cabinets and ambient control room temperature of 23°F. This indicates that with a normal control room temperature of 75°F, an adequate margin is maintained below the component design temperature.

5. Control Room component design provides for a substantial margin between normal operating temperature and the maximum design value.

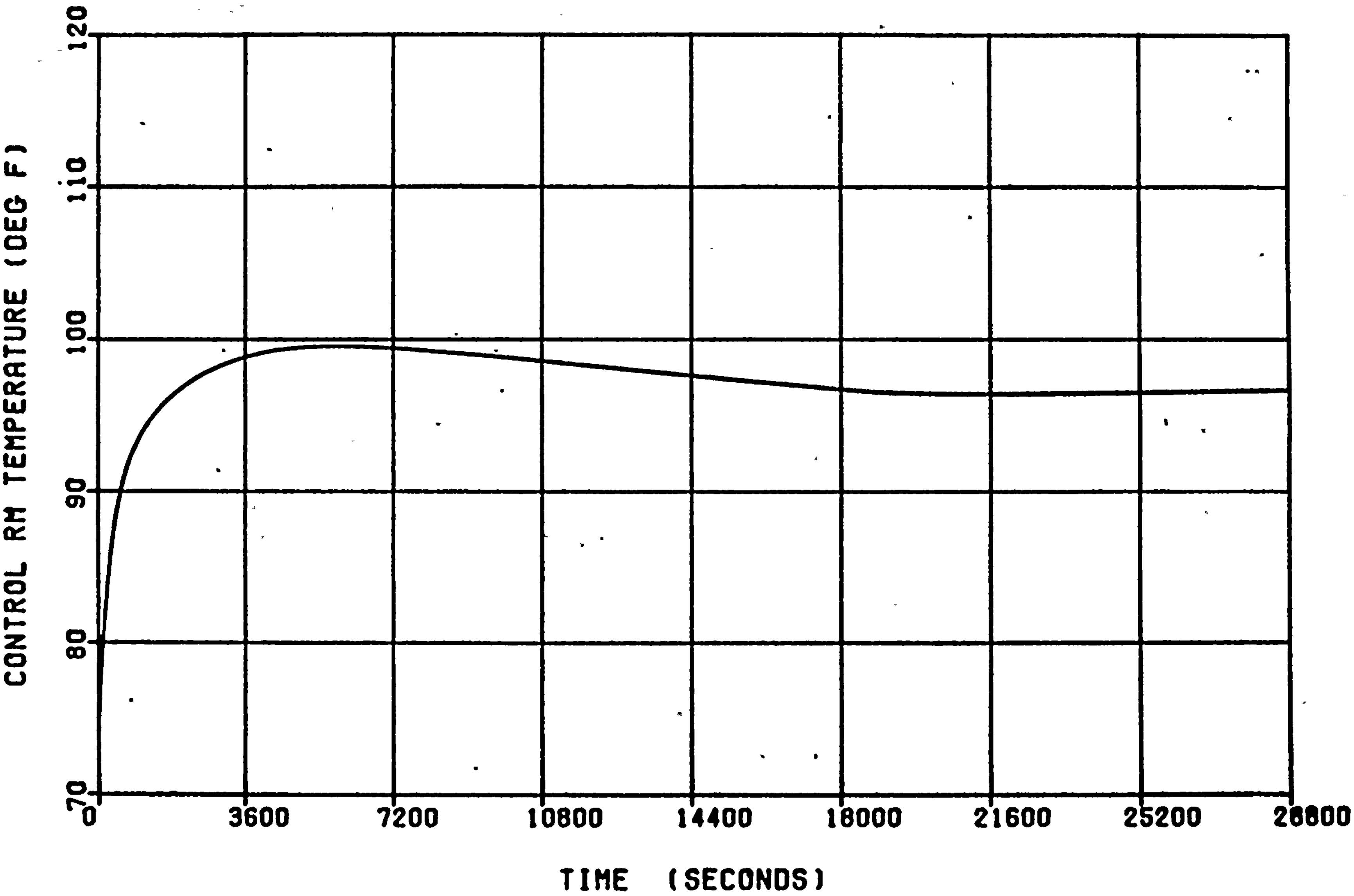
TABLE 1
DC LOADS BY PANEL & BATTERY

CONTROL ROOM	PANEL	BATTERY APPROX LOAD (WATTS) 2A	2B	2C	1A	1B
CCBB	P601	230	105	90		
RWCU/RECIRC	P602				50	90
RX CONTR	P603	50			3800	2000
PRM/SRM/IRM	P606				100	
PRM	P608				1800	1800
PWR RNG MON	P609	25			211	
CRD TEST	P610				100	
RPS B	P611		25			211
FW & RECIRC	P612				175	200
PROC INST	P613				200	1075
NSSS TEMP	P614				40	265
CRD INFO	P615				1440	
CRD RELAYS	P616				6600	
RHR B,C	P618		306			
RCIC	P621	100				250
IB ISOL	P622					100
OB ISOL	P623				100	
HPCS	P625			236.5		
ADS A	P628	150				
LPCS/RHR A	P629	180				
ADS B	P631		100			
LDS A	P632	640			532	
PRM/SRM/IRM	P633					100
LDS B	P642		230			436
RSCS	P659				2400	
D1 CT PG/DW CL	P873	102				
D2 CONT PURGE	P875		102			
PAM PANEL	P898		272			
CR TOTAL (W)		1477	1140	326.5	17548	6527

CR HEAT LOAD 27.01 KW

NOT ENERGIZED

TIP CONTROL	P607	BOP BB	P851
JET PMP INST	P619	ELECTR BB	P852
RX FLOW	P634	D1 HVAC	P870
MSR/TBD PANEL	P824	D2 HVAC	P871
TURB SUPV	P841	RAD MONIT	P880



CONTROL ROOM TRANSIENT
(WITH HEAT SINKS)
CALC NO 12177-ES-198-1

Figure 1