Nebraska Public Power District
Nebraska's Energy Leader

NLS2000011
February 7, 2000

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Gentlemen:

Subject: Licensee Event Report No. 2000-001
Cooper Nuclear Station, NRC Docket 50-298, DPR-46

The subject Licensee Event Report is forwarded as an enclosure to this letter.

Sincerely,

J. A. McDonald
Plant Manager

/elm
Enclosure

cc: Regional Administrator
USNRC - Region IV

Senior Project Manager
USNRC - NRR Project Directorate IV-1

Senior Resident Inspector
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NRC FORM 366 (6-1998) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 06/30/2001

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LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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TITLE (4)

Turbine Bypass Valve Incorrect Setting Results in Operation Prohibited by Technical Specifications.

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
01	08	00	2000	-- 001 --	00	02	07	00	FACILITY NAME	DOCKET NUMBER
										05000

OPERATING MODE (9)	01
POWER LEVEL (10)	015

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

	20.2201(b)		20.2203(a)(2)(v)	X	50.73(a)(2)(i)		50.73(a)(2)(viii)
	20.2203(a)(1)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)
	20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
	20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)		OTHER
	20.2203(a)(2)(iii)		50.36(c)(1)		50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A
	20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
S. R. Mahler, Assistant Licensing Manager	(402) 825-3811

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE).	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

During shutdown on January 8, 2000, Cooper Nuclear Station (CNS) determined turbine bypass valve (BPV) fast-open permissive setting was non-conservatively set at 200 megawatts electric (MWe) Gross, equivalent to 30-33 percent rated thermal power (RTP). It should have been less than 25 percent RTP per Technical Specifications (TS) and transient analysis. Cause was an inadequate correlation between turbine load and reactor thermal power during Digital Electro-Hydraulic (DEH) system design. Original design incorrectly assumed a direct linear relationship between reactor power and generator output over full range of operation. Safety significance was negligible due to the low probability of transients occurring in the susceptible range, and an analysis that showed actual margin to thermal limits would maintain fuel integrity. Immediate actions completed prior to plant startup included calculation of the correct setting, a DEH modification that changed the setting to correspond to 23-24 percent RTP, and issuance of a standing order to avoid testing or operation that may divert steam from the main turbine at loads between 25 and 30 percent power, otherwise enter Limiting Condition for Operation 3.7.7. Other actions to be taken include revising procedures to incorporate standing order provisions and ensure calibration and testing is captured in TS surveillance procedures. The DEH modification will be evaluated to try to add more margin to compensate for diverting main turbine steam between 25 and 30 percent.

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TEXT *(If more space is required, use additional copies of NRC Form 366A)* **(17)**

PLANT STATUS

Cooper Nuclear Station (CNS) was in Mode 1, Power Operation, at approximately 15 percent rated thermal power (RTP) at the time of discovery. Plant shutdown was in progress.

BACKGROUND

At CNS, three automatically regulated bypass valves (BPV's) [EIIS: JI], are connected to the Main Steam equalizing header [EIIS: SB]. These valves are designed to divert any excess turbine inlet supply steam from the Main Turbine [EIIS: TA] to the Main Condenser [EIIS: SG] to dissipate the energy generated by the reactor [EIIS: AC] which cannot be fully utilized by the Main Turbine. The bypass valves are hydraulically opened and use spring pressure to close. The BPV's and turbine control valves (TCV's) [EIIS: TA] are controlled and coordinated by the Digital Electro-Hydraulic (DEH) [EIIS: JI] system to dynamically load the turbine or to bypass steam to the condenser in response to reactor pressure changes. In conjunction with DEH, BPV's and TCV's operate to control Main Turbine throttle inlet pressure to a setpoint adjusted by the operator which, in turn, controls reactor pressure. This is the pressure control mode of DEH. The bypass valves, when fully opened, are capable of passing 25 percent of turbine design steam flow.

In the event of a turbine trip at or above 25 percent RTP, the Main Generator [EIIS: TB] gross electrical output megawatt (MWe) transducer [EIIS: EL] loop sends a signal to de-energize the BPV solenoids [EIIS: JI] to admit hydraulic fluid at high pressure to rapidly open the BPVs. This reduces the pressure wave which propagates back to the reactor on the turbine trip when TCV's and turbine stop valves (TSVs) [EIIS: TA] close. This is the BPV fast-open feature. The setting for the BPV fast-open permissive is established by the resistance value of the resistors installed within the MWe transducer loop. Upon turbine trip and 3 to 5 seconds after generator output drops below the BPV fast-open setting, DEH resumes pressure control of the BPV's. Concurrently with the BPV fast-open response, upon sensing the start of the main turbine trip, the Reactor Protection System (RPS) [EIIS: JC] initiates a reactor scram if power is above 30 percent RTP based on turbine first stage pressure in anticipation of the resultant reactor power rise. Variations in reactor pressure have a direct impact on reactor power via inherent thermal hydraulic feedback phenomena. Under transient conditions, rapid pressure increases or rapid injection of cold water cause steam voids in the reactor to collapse, which, in turn, cause reactor power to quickly rise. This can reduce the margin between the operating point of the nuclear fuel cladding minimum critical power ratio (MCPR) and its thermal limit.

CNS Transient Analyses take credit for the BPV fast-open feature, as well as credit for the anticipatory scrams upon turbine trip. Specifically, the MCPR transient analysis for Feed Water Controller Failure – Maximum Demand (FWCFMD) takes credit for the BPV fast-open response when reactor power is at or above 25 percent RTP. The affected licensing bases include the Updated Safety Analysis Report (USAR) Section XIV-5.8 analysis for FWCFMD as well as assumptions used in the fuel reload analyses. Additional analyses that rely on bypass valves to function include Turbine Trip With Bypass (TTWB), Load Reject With Bypass (LRWB), and High Energy Line Break (HELB) outside the Primary Containment. In 1998, CNS License Amendment #178 added a new Limiting Condition for Operation (LCO), LCO 3.7.7, that requires the Main Turbine Bypass System to be operable when thermal power is greater than or equal to 25 percent RTP.

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EVENT DESCRIPTION

During power reduction on January 8, 2000, CNS determined the main turbine bypass valve (BPV) fast-open permissive setting was non-conservatively set at 200 MWe gross, equivalent to 30 to 33 percent RTP (depending on season of the year). The setting should have been less than or equal to 25 percent RTP as required by LCO 3.7.7 and CNS design basis. Due to plant efficiency seasonal variation at the time of discovery, the fast-open response feature was not functional between 25 percent and 31 percent RTP.

On January 7, 2000 as reactor power was being lowered, the system engineer heard a relay clicking in the DEH cabinet as he passed by and realized that the relay was now bypassing the fast-open feature of the BPVs. Actual indications of reactor power were not readily available to the engineer at that time but he knew that the relay's operation occurred due to generator load dropping below 200 MWe. During review of data the next day (January 8, 2000), Engineering determined that the correlation between MWe and RTP had resulted in the improper setting for the BPV fast-open permissive and that the correlation was non-conservative.

Upon notification of the discovery, the Control Room staff declared BPVs inoperable at 13:45 p.m. on January 8, 2000. Though LCO 3.7.7 was no longer applicable (the plant was below 25 percent RTP), an LCO tracking number was assigned. No safety systems actuated or failed. No other inoperable systems, structures or components contributed to this event, and no equipment failures or degradations occurred. This event did not affect other systems, structures or components. Rather, an incorrect setting was discovered for the fully functional MWe transducer which feeds the BPV fast-open feature. CNS determined at the low power level during which the fast-open feature was not functional, sufficient MCPR margin existed that the condition did not significantly compromise plant safety. Plant restart was prohibited until a DEH system modification replaced a resistor that corrected the correlation between MWe to RTP. To maintain a valid MWe to RTP correlation, a Standing Order was issued to avoid testing activities and operations that divert steam from the main turbine between 25 percent and 30 percent RTP; otherwise LCO 3.7.7 must be entered. This ensures bypass valves will respond as assumed in analyses.

BASIS FOR REPORT

This event has been determined to be reportable under 10CFR50.73(a)(2)(i)(B) as an operation or condition prohibited by the plant's Technical Specifications. Analysis showed that postulated transient consequences are bounded by established safety limits. However, CNS was required under 10CFR50.73 to address violating LCO 3.0.4 during this and the previous operating cycle by entering a condition (i.e., raising power to or above 25 percent RTP) that did not satisfy the LCO 3.7.7 applicability statement. Prior to cycle 18, LCO 3.7.7 was not a part of Technical Specifications.

CAUSE

The root cause for this event was an inadequate correlation between turbine load and reactor thermal power at the time the DEH system was designed, which resulted in the wrong setting. The basis for this is that the original design incorrectly assumed a direct linear relationship between reactor power and generator output over the full range of operation. These two parameters diverge as power is reduced. Also, there was an incorrect assumption that discounted turbine inefficiencies and auxiliary loads at low

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loads. Additionally, seasonal variations that can affect cycle efficiency and therefore the correlation between generator output and reactor thermal power output were not accounted for.

SAFETY SIGNIFICANCE

The risk of a transient that would challenge MCPR limits causing fuel cladding damage while the BPV fast-open feature was inoperable was negligible. This determination is based on the low probability of an initiating event occurring during the time that power level is in the range of concern (i.e., 25 to 33 percent RTP), and an analysis of the actual margin to thermal limits which shows that, even in the unlikely event of a transient while power was between 25 and 33 percent RTP, no thermal limits would have been exceeded.

CNS does not operate at power levels between 25 and 33 percent RTP except for short periods of time (5 to 10 hours) during shutdowns and startups. This was the specific power range where the fast-open response feature of the BPVs was bypassed. The bases for LCO 3.7.7 specify two (2) transients of concern for operability of the BPVs. These transients are a High Energy Line Break (HELB) Outside Primary Containment and Feedwater Controller Failure – Maximum Demand (FWCFMD). The FWCFMD is the limiting transient with regard to the fast-open feature of the BPVs since this transient could challenge the MCPR limits. The probability of a FWCFMD at any power level is low. Therefore, the probability of a FWCFMD between 25 and 33 percent RTP was even lower.

No other systems are available to provide a redundant MCPR protection function to the fast-open feature of the bypass valves. The BPV pressure control mode was still available to control reactor pressure after a short delay of approximately 2 seconds. In addition, the Reactor Safety Relief Valves (SRVs) would have functioned to relieve reactor pressure in this event, if required, as illustrated in the FWCFMD transient analysis to prevent any challenges to the reactor coolant pressure boundary. This condition did not and would not have challenged the fuel, reactor coolant pressure, primary containment, or secondary containment boundaries. Furthermore, this condition did not impact the plant's capability to safely shutdown or maintain the reactor in a safe shutdown condition. This event did not constitute a safety system functional failure (SSFF). This condition did, however, result in operation outside the bounds established by LCO 3.7.7 and design bases.

An evaluation of the thermal limits was conducted for the time frame that CNS was operating between 25 and 30 percent RTP on January 7, 2000. Analysis above 30 percent was not required as a reactor scram results from turbine trip and adds significant margin to MCPR. The thermal limit of interest due to the slow opening or failure of the Turbine Bypass Valves is the MCPR limit. The MCPR limits for Cycle 19 are documented in the Cycle 19 Core Operating Limits Report (COLR) Revision 1. The Actual Operating MCPR can be found on the process computer cases routinely printed in the Control Room. On January 7, 2000 at 26.6 percent RTP, values for Actual Operating MCPR and Operating Limit MCPR (OLMCPR) were found to be 3.574 and 1.919 respectively.

The analysis of a FWCFMD event assumes that the transient starts with the plant operating at the OLMCPR. Transient analysis demonstrates that if the plant is at the OLMCPR and a transient event occurs, the plant will not violate the Safety Limit MCPR (SLMCPR). This analysis assumes proper operation of the BPV fast-open feature.

For the evaluation of as-found conditions on January 7, 2000, the SLMCPR for single recirculation loop operation was used for conservative measure in order to bound this event, since the single loop operation has a higher MCPR safety limit. The plant was in fact operating with both recirculation loops during and after discovery. Without any bypass valve capability, the OLMCPR must be increased by a penalty of 0.5 to afford adequate margin to the SLMCPR. This results in a limit of 2.419 (1.919 + 0.5) at approximately 25 percent RTP and core flow less than 50 percent. This would still allow CNS 32 percent margin from the Actual Operating MCPR (3.574) to the revised OLMCPR (2.419). Should the transient have occurred at an OLMCPR of 2.419, sufficient margin still existed such that the plant would not have violated the SLMCPR. See MCPR Illustration below.

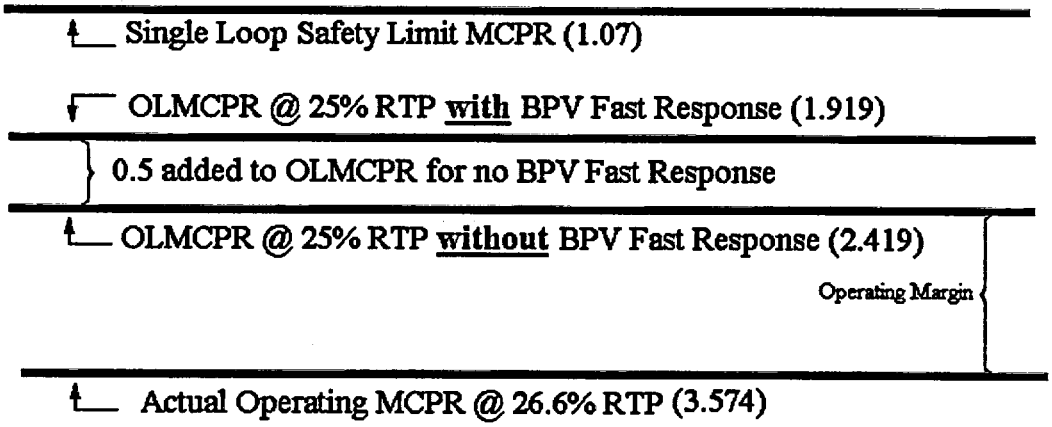

Figure 1 – MCPR Illustration

A review of startup and shutdown cases from each of Cycles 17 and 18 yielded similar conclusions. Since core reloads have become increasingly more reactive, the evaluation above can be assumed to bound past fuel loads. In summary, since the probability of the initiating event is very low and the analyses shows fuel integrity would have been maintained as noted above, the safety significance of this condition is negligible.

CORRECTIVE ACTIONS

The following corrective actions were completed prior to plant start up, to prevent recurrence.

1. Performed a design calculation that determined the appropriate setting for the Bypass valves fast-open permissive signal based on historical plant data.
2. Prepared and implemented a DEH modification that changed the Bypass Valves fast-open permissive setting from 200 MWe to 120-140 MWe which corresponds to a 23-24 percent RTP.
3. Issued a Standing Order which alerted control room operators to avoid testing activities or plant operation that diverts steam from the main turbine at loads between 25 percent and 30 percent power; otherwise LCO 3.7.7 must be entered.
4. Placed associated surveillance procedures on administrative hold pending revisions required by the DEH modification.

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The following corrective actions are in progress to prevent recurrence.

1. Revise the procedures placed on administrative hold to ensure that calibration and testing of the DEH MW transducer loop, including the Bypass valves fast-open permissive setting, implements revisions required by the DEH modification, and is captured in TS surveillance procedures. Due - March 31, 2000
2. Evaluate the need to increase the margin in the design calculation that correlated MWe to RTP to compensate for testing activities or plant operation that diverts steam from the main turbine at loads between 25 and 30 percent power. Due – March 31, 2000
3. Incorporate the Standing Order provisions into plant operating procedures. Due March 8, 2000.

PREVIOUS SIMILAR EVENTS

No previous similar LERs were noted for the past three years.