Nebraska Public Power District
Nebraska's Energy Leader

NLS990113
November 29, 1999

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

Gentlemen:

Subject: Licensee Event Report No. 1999-007, Supplement 1
Cooper Nuclear Station, NRC Docket 50-298, DPR-46

The subject Licensee Event Report Supplement 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

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

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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)

Sump Z Inoperability Results in Technical Specification Required Shutdown

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
09	17	99	1999	-- 007 --	01	11	29	99	FACILITY NAME	DOCKET NUMBER
										05000

OPERATING MODE (9)	1
POWER LEVEL (10)	100

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)
Edward L. McCutchen, Jr., Sr. Licensing Engineer	(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)

On September 17, 1999, at 1350 hours, a plant shutdown was initiated in accordance with Technical Specification 3.0.3, due to both trains of Standby Gas Treatment (SGT) being declared inoperable when both Sump Z pumps, which support the SGT system, failed a surveillance. A one-hour non-emergency report was made pursuant to 10CFR50.72(b)(1)(i). It was later discovered that a hydrogen ignition had occurred in Sump Z during start-up of the Augmented Off Gas (AOG) system, and a Notification of Unusual Event (NOUE) was declared on September 17, 1999, at 2056. The cause of this event was an inadequate conduit seal and a deficient operating procedure which allowed throttling the AOG supply valve for an extended period. This developed a backpressure which resulted in the loss of a drain line water seal, creating a direct path for Off Gas (OG) hydrogen to reach Sump Z and to the Z1 sump pump starter contacts through the inadequate conduit seal. A spark was generated when the contacts changed state which ignited the hydrogen. Necessary repairs were made to damaged sump equipment and to the conduit seals, the deficient procedure was revised, and operating crews were briefed on the event. The NOUE was exited at 0107 on September 18, 1999, and plant operation restored to 100% power on September 27, 1999.

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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 at approximately 100 per cent power steady state at the time of the event.

BACKGROUND

Augmented Off Gas (AOG) system [EIIS: WF] in conjunction with Off Gas (OG) system [EIIS: WF] collects and processes gaseous effluents drawn off by the Steam Jet Air Ejectors (SJAE's) [EIIS: SH] from the Main Condenser [EIIS: SG] prior to release to the atmosphere via the Elevated Release Point (ERP). Together, OG and AOG reduce off-gas activity levels below release limits by using the OG hold-up line [EIIS: PSX] and the AOG charcoal beds [EIIS: FLT]. AOG minimizes the explosion hazard in the off-gas stream by recombining hydrogen and oxygen (products of radiolytic dissociation of water) in the AOG Catalytic Recombiners [EIIS: RCB]. Sump Z [EIIS: TK] collects drains from the OG hold-up line, and from the AOG pre-filters [EIIS: FLT], components which process the radioactive off-gas stream with entrained hydrogen and oxygen prior to admission to AOG. Drain line loop seals provide isolation between the off-gas stream and Sump Z. Sump Z pumps [EIIS: P] also support the Standby Gas Treatment (SGT) system [EIIS: BH] by preventing water accumulation in Sump Z that could flood the SGT discharge lines through the drain piping, resulting in a reduced SGT flow rate that could render SGT unable to maintain required negative pressure in the reactor building [EIIS: NG]. DD Sump [EIIS: TK] collects drainage from AOG post-recombiner condenser water separators [EIIS: SEP], components that process a "clean" effluent stream. Sump pumps remove water from the sumps and pump it to the Radwaste (RW) system [EIIS: WD] by automatically starting and stopping to maintain sump water level within normal limits.

In 1998, Sump Z was modified to address electrical separation of internal components and seismic qualifications to fully support Secondary Containment [EIIS: NG] and Standby Gas Treatment operation. The plant modification installed additional electrical conduit penetrations into the sump to separate power to the pumps and level switches within, and sealed the conduit penetrations with material approved for Secondary Containment penetrations.

In April 1999, the plant began using two sets of second stage SJAE's as allowed by design to improve Main Condenser vacuum and overall plant efficiency.

EVENT DESCRIPTION

On September 14, 1999, AOG was removed from service with the plant at power and two sets of second stage SJAE's in operation for repair of the DD Sump pump alternator, and replacement of Reactor Protection System (RPS) [EIIS: JC] power supply Electrical Protection Assembly (EPA) logic circuit boards [EIIS: JX].

Upon completion of the repair activities for the DD Sump and RPS-EPA's, AOG start up commenced at approximately 2000 hours on September 16, 1999, and proceeded as expected. Five hours into system startup (0130 hours on September 17) off-gas was admitted to AOG by opening the AOG train A supply valve (AOG-AO-903AV) [EIIS: ISV] and closing the OG isolation and AOG bypass valve (OG-AO-254) [EIIS: ISV]. Thirty minutes later, after recombiner temperature reached the expected value of approximately 600 degrees F, the recombiner train supply valve (-903AV) was throttled down to 20 per cent open per the system operating procedure to purge excess system moisture and maintain more effective hydrogen-oxygen recombination. Excess moisture was suspected in the system because both the AOG moisture indicators and the hydrogen indicators were reading off-scale high, which is characteristic of moisture in the flow

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stream (hydrogen analyzers are sensitive to excess moisture). The AOG hydrogen analyzers were declared inoperable at 0530 because they were believed to have moisture intrusion, and appropriate actions were taken.

Control Room operators noted the in-service Sump Z pump (Z1) had been operating for an excessive amount of time. Based on indications that the Z1 pump was not pumping, the alternate sump pump (Z2) was placed in service at 0643 hours. Shortly after starting the Z2 pump, a series of intermittent Off Gas Dilution Fan Flow Low alarms and an AOG Trouble alarm were received in the Control Room and continued for several hours. At approximately 0650, the Shift Supervisor contacted the system engineer to discuss the problems related to AOG and Sump Z. By this time the AOG supply valve had been throttled for about four hours. Main Condenser vacuum indication was normal and steady, but this was misleading because the procedure guided the operators to rely on monitoring vacuum to provide warning of any flow choking in the OG system. However, the operation of the second set of second stage SJAE's was maintaining vacuum masking indication of flow choking. At the system engineer's recommendation, the AOG supply valve was slowly throttled open to 100 per cent to raise flow in AOG.

Due to the anomalous indications of Z1 sump pump, a surveillance of Sump Z pumps was performed. Acceptance criteria of this surveillance test were not met, and both sump pumps were declared inoperable at 1350. Both sump pumps inoperable requires both trains of SGT to be declared inoperable. With both SGT trains inoperable, Technical Specification (TS) Limiting Condition for Operation (LCO) 3.6.4.3 Action D forced entry into LCO 3.0.3, which required placing the plant in Mode 2 within 7 hours. In accordance with TS requirements, a shutdown was initiated at 1437, and the reactor was manually scrammed at 2040. It was later discovered that a hydrogen ignition had occurred in Sump Z during AOG startup, and a Notification of Unusual Event (NOUE) was declared at 2056 on September 17, 1999. The NOUE was exited at 0107 on September 18, 1999.

Engineering analyses of the event determined that throttling the AOG Supply Valve resulted in a back pressure in the OG Holdup Line. This resulted in hydrogen migrating into Sump Z via the water seal on the drains side of the AOG Pre-Filter and/or OG Hold-up Line. The pressure increase overcame the 9-inch water seal associated with the drain on the Pre-Filter resulting in a direct flow path from the Holdup Line into Sump Z. Off-gas was thus allowed to enter the sump, and because of the length of time that the AOG Supply valve remained throttled, hydrogen gas accumulated in the sump eventually reaching a concentration above flammable level.

The hydrogen gas then migrated from Sump Z through an electrical conduit to the pump starter contacts in the Off Gas building due to the differential pressure between the sump and the building. The Off Gas building has a negative pressure with respect to the atmosphere, whereas Sump Z has a slightly positive pressure. The pressure differential between these two areas created the motive force for gas flow between these two spaces, and the electrical conduit that connects the two spaces provided the pathway.

When the Z1 sump pump auto-stopped, the opening of the contactor created a spark which provided an ignition source for the hydrogen flowing from the conduit. The resulting hydrogen gas burn then followed the hydrogen within the conduit back into Sump Z and ignited the hydrogen which had collected there. The fire stop seal in this conduit was insufficient to provide a barrier from an ignition source.

The various penetrations in Sump Z allowed the initial pressure developed by the ignition to dissipate the energy of the deflagration and relieve the overpressurization. However, the resultant pressure spike caused a

spare conduit cap to blow off. The seal and other items perpendicular to the deflagration flow in the conduit were damaged, but the Sump Z pumps, motors and associated internal piping were undamaged.

BASIS FOR REPORT

This event has been determined to be reportable under the requirements of 10 CFR 50.73(a)(2)(I)(A), in that CNS completed a nuclear plant shutdown required by the plant's Technical Specifications.

CAUSE

AOG was operated, in accordance with deficient station procedures, in a manner such that off gas was introduced into Sump Z and through an inadequate conduit seal to an external ignition source. The conduit seal was the result of a plant modification implemented in 1998 which failed to recognize the need to protect Sump Z from an external ignition source.

Significant contributing factors include:

The design bases for Sump Z are not well documented which led design engineers that developed the modification implemented in 1998 to focus on electrical separation, secondary containment/SGT system operability, and seismic qualifications; and the consideration of a hydrogen environment was confined to only components inside the sump.

The guidance in Procedure 2.2.58.3 relative to throttling of AOG-AO-903AV was not clear and was inconsistently interpreted by users of the procedure. In addition, guidance did not take into account the effects during AOG start up of the second set of second stage SJAE's in service (no condenser vacuum perturbations as previously seen). The difference in plant response was not anticipated, and this caused operators to believe no problem existed.

Inadequate pre-job brief of the AOG start up process.

SAFETY SIGNIFICANCE

SGT is a subsystem of secondary containment, and its function is to limit radioactivity released to the environs from the secondary containment in the event of a loss of coolant accident or fuel handling accident. This is accomplished by maintaining the reactor building at a slightly negative pressure relative to the atmosphere and filtering the exhaust prior to release through the ERP. Sump Z pumps support this function by preventing sump in-flows from condensation (and other sources) from impeding (choking) the SGT system flow to the ERP. If water is allowed to accumulate in Sump Z, it could flood the SGT discharge lines through the drain piping, resulting in a reduction in SGT flow rate and the inability to maintain the required negative pressure in the reactor building with the SGT system. SGT is required to be operable during Modes 1, 2, and 3. SGT must also be operable during movement of irradiated fuel assemblies in the secondary containment, during core alterations, or operations with a potential for draining the reactor vessel (OPDRV's). At the time of the event, SGT was functional and available, however the failure of Sump Z pumps to meet surveillance test acceptance criteria following the hydrogen ignition resulted in declaring both trains of SGT inoperable. This resulted in immediate entry into LCO 3.0.3, which requires the plant to be in Mode 2 within 7 hours, Mode 3 within 13 hours, and Mode 4 within 37 hours. SGT is not required to be operable in Mode 4.

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Sump Z also has an integrity function to prevent filtered releases from the ground level during accidents where SGT must be operated (releases would be filtered as Sump Z is on the discharge side of SGT). There is no isolation function of Sump Z from secondary containment; however it is required to ensure the function of the ERP and therefore support of overall secondary containment operation. Secondary containment is required to be operable during Modes 1, 2, and 3. It must also be operable during movement of irradiated fuel assemblies in the secondary containment, during core alterations, or OPDRVs. Visual inspections of Sump Z external area revealed damage following the event, which indicated a potential breach of Sump Z. As a result, secondary containment was declared inoperable due to the increased potential for a filtered ground level release. Technical Specifications allows 4 hours to restore secondary containment to operable status; otherwise the plant must be in Mode 3 within 12 hours and Mode 4 within 36 hours. The plant was already in TS LCO 3.0.3 due to the impact on SGT operation. TS 3.0.3 is more limiting and, therefore, the plant was shut down in accordance with that LCO.

At the time of this event, the plant was in Mode 1 at 100 per cent power, and there was no movement of irradiated fuel within secondary containment, nor were core alterations or OPDRVs in progress. The other two subsystems of secondary containment (reactor building and reactor building isolation and control system) remained operable throughout this event. No design basis accidents occurred during or following this event. Had a design basis accident occurred (i.e. loss of coolant accident), the damage noted external to Sump Z could have allowed a filtered ground level release. An evaluation was conducted to determine if this event constitutes a Safety System Functional Failure (SSFF), as described in NEI 99-02. The postulated dose from the filtered ground release was small and did not exceed 10CFR100 or General Design Criteria (GDC) 19 limits. However, it is larger than the licensed dose in the updated final safety analysis report. Frequently asked questions to NEI 99-02 concerning SSFF determination refers to using reporting criteria per 10 CFR 50.73(a)(2)(v). NUREG 1022 rev. 1) specifies, in part, a safety function as any situation described in the plant safety analysis. Thus, this event is considered to constitute a Safety System Functional Failure.

A probabilistic safety analysis (PSA) was performed to address the loss of Sump Z. Risk significance was evaluated by determining the increase in core damage probability (CDP) and large early release probability (LERP). The event was evaluated in four phases: the time of the event until beginning of shutdown, shutting down the plant, plant in cold shutdown, and startup of the plant. The first and fourth phases were determined to not increase CDP. The second and third phases cause a small increase in CDP; however, the overall increase was less than 1.0E-06. The first, third and fourth phases were determined to not increase LERP. The second phase caused a small increase in LERP; however, the increase was less than 1.0E-07. Therefore, this event was of minimal risk significance. It should be noted that the increase in CDP and LERP were due to shutting down the plant, and not due to the event.

CORRECTIVE ACTIONS

Plant operation was restored to 100 per cent power on September 27, 1999. Several actions were taken prior to plant and AOG startup including the following:

Repaired damage to Sump Z equipment and components, and installed and leak tested additional conduit seals in each additional electrical conduit between Sump Z and the Off Gas building.

Filled all Sump Z loop seals per 15.OG.601, "Off Gas Loop Seal Blowdown and Fill."

"Snoop" tested each of the conduit seals that communicate to Sump Z.

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Revised procedure 2.2.58.3, "AOG System Operation with Recombiner A" to: (a) correct or eliminate previously identified ambiguities including throttling the AOG supply valve, (b) reduce moisture in off gas process stream, (c) fill loop seals prior to and following system start up, (d) reduce challenges to loop seal integrity, and (e) identify critical parameters and limits to be monitored.

Conducted just-in-time training on AOG system to include this event, changes to procedure 2.2.58.3, and a review of primary parameters when placing AOG in service.

Monitored for gas leaks when placing AOG in service. None were found.

Operations Management discussed and reinforced their expectations concerning pre-evolution/pre-job briefings, supervisory oversight, and action when unclear procedural guidance is encountered with each operating crew prior to standing the watch.

On-going Actions:

The following actions were submitted as part of LER 1999-007. There are no new commitments with this supplement.

Define and document the hydrogen design basis/specifications for Sump Z. This will be completed by December 6, 1999.

Prior to placing AOG "B" train in service, CNS will revise procedure 2.2.58.4, "AOG System Operation with Recombiner B," and Special Procedure 97-13, "Post MP 97-068A AOG System Operation with Recombiner B," to: (a) correct or eliminate previously identified ambiguities, (b) reduce moisture in off-gas stream, (c) fill loop seals prior to and following system startup, (d) reduce challenges to loop seal integrity, and (e) identify critical parameters and limits to be monitored. These procedures will remain on Administrative Hold until revised. Procedure 2.2.58.4 and SP 97-13 revisions will be completed by February 6, 2000.

Prior to placing AOG in service, the Operations Department will require a formal briefing in accordance with procedure 2.0.1.1, "Conduct of Infrequently Performed Tests or Evolutions." This requirement will be implemented by adding this action as a prerequisite in procedures 2.2.58.3 and 2.2.58.4. This will be completed by December 6, 1999.

Evaluate the adequacy of procedure 2.0.1.1, "Conduct of Infrequently Performed Tests or Evolutions," to ensure that pre-evolution briefs meet the expectations of station management for infrequently performed activities, and if required, make the necessary changes to ensure quality pre-evolution briefs. In addition, identify and document Operations Department procedures and evolutions (including procedures 2.2.58.3 and 2.2.58.4) that warrant inclusion into procedure 2.0.1.1. This will be completed by December 6, 1999.

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PREVIOUS EVENTS

There have been no recent events of this nature at CNS. Previous similar events were identified as having occurred during the 1970's:

LER 75-032: Excessive quantity of hydrogen accumulated in the sump below the ERP, due to a mis-positioned off-gas valve, which resulted in an explosion.

LER 76-001: Accumulation of hydrogen due to ice blockage in the ERP resulted in an explosion of the off-gas building.

LER 76-018: During pre-operational testing of AOG, an explosion occurred in the off-gas system due to failure of the hydrogen analyzers and personnel not being completely familiar with AOG operation.

Correspondence No: NLS990113

The following table identifies those actions committed to by the District in this document. Any other actions discussed in the submittal represent intended or planned actions by the District. They are described to the NRC for the NRC's information and are not regulatory commitments. Please notify the NL&S Manager at Cooper Nuclear Station of any questions regarding this document or any associated regulatory commitments.

COMMITMENT	COMMITTED DATE OR OUTAGE
NONE	NA