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RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 87-011-01:on 871202,cable room sprinkler sys inoperable due to design deficiency of pressure & flow rates.

W/8 ltr.

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TITLE: 50.73 Licensee Event Report (LER), Incident Rpt, etc.

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NRC Form 366 (9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Oconee Nuclear Station - Unit 1	0 5 0 0 0 2 6 9	1 OF 1 6

TITLE (4)
CABLE ROOM SPRINKLER SYSTEMS INOPERABLE DUE TO DESIGN DEFICIENCY OF PRESSURE AND FLOW RATES

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 NAMES	DOCKET NUMBER(S)
1 2	0 2	8 7	8 7	— 0 1 1	— 0 1	0 4	1 9	8 8	Oconee, Unit 2	0 5 0 0 0 2 7 0
									Oconee, Unit 3	0 5 0 0 0 2 8 7

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 0 0	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	XX 50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
PHILIP J. NORTH - LICENSING	AREA CODE 7 0 4 3 7 3 - 7 4 5 6

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	

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

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

On October 8, 1987 Duke Power's Design Engineering group identified that the Unit 3 Cable Room Sprinkler System could not provide its design flow due to a design deficiency. This was identified while Design Engineering was responding to a May, 1987 fire protection system audit. On March 2, 1988 the inoperability of the Keowee Hydro Station Main Lube Oil Storage Room water spray system was discovered. This incident was determined to be reportable pursuant to the requirements of 10CFR 50.73(a)(2)(i)(B) on December 2, 1987.

The root cause of this incident was determined to be a design deficiency. The inoperability of the Unit 3 Cable Room sprinkler system was originally misclassified as non-reportable to the NRC due to the fact that it was not initially identified as a design deficiency.

Corrective actions included establishing fire watches until the water spray systems were made operable and restoring the systems to an operable condition by modification. Because of the available systems and personnel for detection and control, there is little chance that a fire would have begun and developed into a threat to plant safety. Therefore this event is considered not to be significant with respect to the health and safety of the public.

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☆ U.S.GPO:1984-0-454-481/18759

Background

Sprinkler systems (EIIS:KP) are provided in the cable (EIIS:CBL) rooms for fire suppression. They were installed as a result of a commitment to the NRC in 1978 to provide a sprinkler system with the capability to supply 0.1 gallons per minute per square foot (gpm/sq. ft.) of floor space. Normally, they are valved out of service and require manual action to be placed into service.

The sprinkler system is a part of the High Pressure Service Water (HPSW) System which is provided for fire suppression. The HPSW system is supplied by an elevated storage tank (EIIS:TK) and two HPSW pumps (EIIS:P) which pull suction from the Condenser Circulating Water System (EIIS:BS). A third smaller jockey pump is provided to maintain level in the elevated storage tank. Further references in this report to HPSW pumps refer to the two main pumps.

Oconee Nuclear Station (ONS) Technical Specification 3.17.3 requires the Keowee Hydro Station [EIIS:EK] Main Lube Oil Storage Room [EIIS:LM] water spray system [EIIS:KP] to be operable. If the system is discovered to be inoperable, this specification requires a continuous fire watch with backup fire suppression equipment to be established within 1 hour of the determination of inoperability. In addition, the water spray or sprinkler system shall be restored to an operable status within 14 days or a report shall be submitted to the Commission within the next 30 days outlining the cause of inoperability and the plans for restoring the system to an operable status. Continued operation is permitted if these requirements are met.

The Keowee Hydro Station Main Lube Oil Storage Room water spray system was designed to suppress an outbreak of fire within the confined area of the Main Lube Oil Storage Room. One purpose of Keowee Hydro Station is to provide emergency power to ONS should an emergency power source be needed. This water spray system helps insure that the ability of Keowee Hydro Station to provide emergency power to ONS is not inhibited due to an outbreak of fire in the Main Lube Oil Storage Room.

Brief Sequence of Events

June, 1978

- o A commitment was made to install sprinkler systems in the cable and equipment rooms.

June-September

- o The sprinkler systems were designed and submitted to the Design Engineering Department for approval.

September-October 1980

- o The system design was accepted by Design Engineering.
- o The sprinkler systems were installed and placed in service as a part of a Nuclear Station Modification (NSM).

September-October 1980 (continued)

- o The "M" header was cross-connected to the Auxiliary Building headers at Unit 3 under the same NSM.

February 16, 1981

- o A Design Study of the Asiatic Clam problem was completed.

April 7, 1982

- o The chlorination system [EIIS:CHL] NSM was requested and approved by the Station Manager.

April 1, 1983

- o The design of the chlorination system NSM was completed.

October 25

- o Work on the chlorination system NSM was initiated.

January 15, 1985

- o The chlorination system NSM was completed.

- o The Keowee Hydro Station Main Lube Oil Storage Room water spray system was returned to service.

- o Technical Specification 3.17.3 was violated.

May 15, 1987

- o The Tri-annual Fire Protection Audit was performed by the Quality Assurance Department.

- o The HPSW pump test procedure's acceptance criteria was questioned.

- o It was recommended that the acceptance criteria be recalculated basing it on calculated system demand.

May-October

- o Design Engineering and Performance personnel calculated the system demands.

October 8

- o Design Engineering determined that the Unit 3 Cable Room sprinkler system could not provide its design flow.

- o Design Engineer A informed Oconee Compliance, that the Unit-3 Cable Room sprinkler system was inoperable, not specifying that it was due to a design deficiency.

- o Compliance determined the event to be non-reportable and subject to a Limiting Condition of Operation.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Oconee Nuclear Station - Unit 1	0 5 0 0 0 2 6 9	8 7	— 0 1 1	— 0 1	0 4 OF 1 6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

October 8-15

- o Design Engineer B became concerned about the Unit 3 cross-connect's ability to supply the M-Header sprinkler systems, and discussed this with the Oconee Safety group.

October 9

- o An NSM was written to replace the four-inch pipe (EIIS:PSP) which supplied the Unit-3 Cable Room with a six inch diameter pipe.

October 15

- o An Oconee Safety Associate notified Operations that if either valve (EIIS:V) 2HPSW-14 or 3HPSW-14 was closed, the cable room, equipment room, and personnel hatch areas sprinkler systems were inoperable.

October 22

- o The six inch pipe was installed which made the Unit 3 Cable Room system operable.

October 23

- o Preliminary calculations indicated that the cross-connect would not provide sufficient flow if 2HPSW-14 or 3HPSW-14 were closed.

October 29

- o 2HPSW-14 and 3HPSW-14 were white tagged open to control closing.

- o Compliance requested Design Engineering to formally determine the M-header systems' operability when either 2HPSW-14 or 3HPSW-14 was closed.

December 2

- o Design Engineering informed Compliance of their completed evaluations.

- o During discussions with Design Engineer B, Compliance first became aware that a design deficiency had existed.

- o The NRC Resident Inspector was informed of both cases where the cable rooms were or could have been inoperable.

December 9

- o The Valves were then permanently labeled, warning of the consequences of closing them.

January 4, 1988

- o Revision 0 to Licensee Event Report (LER) 269/87-11 was submitted.

March 2

- o Design Engineering completed hydraulic calculations for the Keowee Hydro Station Main Lube Oil Storage Room water spray system.

March 2, 1988 (continued)

1100 o Design Engineering (DE) determined the Main Lube Oil Storage room water spray system was inoperable.

1120 o DE notified ONS Compliance that the Keowee Hydro Main Lube Oil Storage Room water spray system was inoperable.

1130 o Compliance notified the Shift Supervisor that the water spray system was inoperable.

1140 o A fire watch for the Keowee Main Lube Oil Storage Room was established as well as a continuous monitoring of the fire detection instrumentation.

o A Station Problem Report (SPR) was initiated by Design Engineering.

March 4

o An NSM to modify the Keowee Main Lube Oil Storage Room water spray system was requested and approved for implementation.

March 15

o The NSM was completed which returned the Keowee Hydro Station Main Lube Oil Storage Room water spray system to service.

o The fire watch for the Keowee Main Lube Oil Storage Room was discontinued.

Description of Occurrence

In June, 1978, a commitment was made to the NRC to install sprinkler systems in the cable rooms and equipment rooms of all three units. The sprinkler systems were designed by McNeary Insurance Consulting Services Inc. These systems were designed to be connected to the existing High Pressure Service Water (HPSW) system and were designed to supply 0.10 gallons per minute per square foot of floor area (gpm/sq. ft.). The sprinkler's ability to supply the specified flow was contingent upon the HPSW system supplying 1238 gpm at a pressure of 92.21 psig to the inlet of the sprinkler system. This requirement was included in the design drawings and calculations which were submitted to Duke Power Design Engineering for approval. During September and October of 1978, the design was reviewed and approved by Design Engineering. During this investigation, no calculations or records of any analyses were found which documented a formal review of the HPSW system's ability to supply the designated flow and pressure required to operate the sprinkler systems. The calculations for the sprinkler systems themselves are available.

In 1980, the cable room sprinkler systems were installed and placed in service as a part of a Nuclear Station Modification (NSM). This NSM encompassed a number of enhancements to the station's fire protection and detection systems. Another

part of this NSM, significant to this report, was the installation of a four inch cross-connection pipe from the Turbine Building M-line Header to the Auxiliary Building's (EIIS:NF) headers at Unit 3. A schematic of the M-header leads and Auxiliary Building cross-connect is included as Attachment 1. This modification was to insure that adequate High Pressure Service Water (HPSW) flow and pressure were present in the Unit 3 Auxiliary Building. After installation, these systems were considered operational and placed in service.

Prior to February 1981, a problem developed with Asiatic Clams infesting the Keowee Fire Protection/Service Water System. The presence of these clams in the system piping had the potential to cause clogging and impaired flow which could degrade the Keowee Hydro Station fire suppression system. Because of this problem, a Design Study was conducted to determine a viable solution to this problem. This Design Study was completed on February 16, 1981.

As a result of this Design Study, an NSM was requested and approved for implementation. This modification consisted of adding a chlorination system to the existing Keowee Fire Protection/Service Water System piping. Some changes in the physical configuration of the existing system were implemented by this modification. One of these changes included rerouting the piping for the Main Lube Oil Storage Room water spray system to a new connection point downstream of the chlorination point in the twelve inch supply line. This rerouting of pipe added additional piping to the existing Main Lube Oil Storage Room water spray system. Subsequently, this modification was completed on January 15, 1985.

During the Design phase of this modification, no hydraulic calculations were performed by Design Engineering which analyzed the impact of this modification on the hydraulic characteristics of the water spray system. No written requirement existed requiring these hydraulic calculations to be made during the time this modification was designed. An interview with Design Engineering Management indicated that during that time period, it was considered to be a good engineering practice to perform these calculations. Design Engineering Management agreed that these calculations should have been performed. However, at the time this modification was designed, Design Engineering programs were not sufficient to insure the proper hydraulic calculations were performed. Consequently, an inoperable Keowee Fire Suppression/Service Water System was returned to service.

As required per Technical Specification 4.19.2, each water spray system and associated spray nozzles [EIIS:NZL], listed in Technical Specification Table 3.17-1, which protects safety related systems, shall be functionally tested on an annual basis, except those in cable spreading rooms, equipment rooms, and cable shafts. An Oconee Nuclear Station Maintenance Procedure is used to meet this specification. This procedure is performed on a semi-annual bases which is more conservative than the annual testing requirement of Technical Specifications. However, this procedure does not provide a method to insure the required design flow rate is achieved at the spray nozzles of the water spray system. Only a visual inspection is performed to insure that each spray nozzle in the Main Lube Oil Storage Room is discharging water properly.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Oconee Nuclear Station - Unit 1	0 5 0 0 0 2 6 9	8 7	— 0 1 1	— 0 1	0 7 OF 1 6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

On May 15, 1987 a Tri-annual Fire Protection Audit was performed at Oconee. One of the findings addressed the acceptance criteria for determining HPSW pump operability. Performance procedure, "Fire Protection Annual Flow Test", stipulated a minimum flow rate of 3000 gpm at no specified pressure as the acceptable level of performance. During the audit, it was noted that there was a disagreement between other Oconee documents in listing the minimum required flow. The FSAR specified 3571 gpm, Technical Specification 4.19.2.6.1 specified 3000 gpm and the Oconee response to Appendix A to Branch Technical Position APCSB 9.5.1 specified 3600 gpm. Because of the different specified flow rates and the lack of any criterion in terms of pressure, it was requested that:

1. The actual system demands be reviewed and the maximum demand on the Fire Protection System be determined.
2. That pump test criteria be revised to reflect the above demand in terms of both flow and pressure.

From May to October Design Engineering and Performance personnel determined individual system demands. On October 8, Design Engineering determined that the Unit 3 Cable Room Sprinkler System could not supply the required flow of 0.1 gpm/sq. ft. because of a design deficiency.

Design Engineer A informed Oconee personnel that the Unit 3 Cable Room Sprinkler System was inoperable because it could not supply its design flow. He stated this was discovered during analysis of performance data but did not mention the fact that a design deficiency was involved. Based on the information that was given, Oconee personnel believed the loss of operability was due to aging of the system which resulted in a reduction in system efficiency. This was reinforced by the fact that Design Engineer A had stated that the system had been designed to provide the required flow rate with no "cushion" designed in. Based on his this information, Oconee Compliance determined the inoperability to be non-reportable in nature and subject to a 14 day Limiting Condition of Operation (L.C.O.) as provided in Technical Specification 3.17.3. The L.C.O. allowed a time frame to restore a system to an operable status, if stipulated compensatory actions were taken, without shutting down a unit or reducing power. On October 9, an NSM was initiated which provided for replacing a four inch diameter pipe which supplied the Unit 3 Cable Room sprinklers with a six inch diameter pipe. The increase in pipe diameter reduced flow restriction so that the required flow could be met.

After October 8, Design Engineer B, who worked under Design Engineer A, continued to review the High Pressure Service Water (HPSW) design associated with the sprinkler systems. He noticed on the drawings that if the M-line header was isolated by closing either 2HPSW-14 or 3HPSW-14 (see Attachment 1), it would be logical to consider the Auxiliary Building's HPSW headers as an alternate flow route to supply the isolated loads, including cable room, equipment room and other sprinkler systems through the Unit 3 cross-connect. There was concern about the four inch diameter cross-connect's ability to supply these loads. No

specific calculations had been performed at this time; however Design Engineer A and B felt that there would be problems because of the required flow rates and the length of pipe the water had to travel through.

On October 12, Design Engineers A and B were at Oconee when they mentioned that a problem probably existed with the cross-connect supplying sprinklers to an Oconee Safety Associate who was responsible for fire protection systems at Oconee. Between October 12 and 15, the Safety Associate and Design Engineer B had several conversations concerning operability. At this time, Design Engineers A and B believed all the systems would be determined inoperable and expressed this to the Safety Associate. This was later proven not to be the case.

Based on the conversations with Design Engineer B, the ONS Safety Associate wrote a memorandum on October 15 to the Operations Shift Supervisors stating that if either 2HPSW-14 or 3HPSW-14 were closed, then the sprinkler systems for the cable and equipment rooms and the personnel hatch areas that were isolated from the M-header supply would be inoperable. At that time the Safety Associate felt that no other action was necessary because he knew Design Engineering was actively pursuing the operability questions.

On October 22 the six inch pipe for the Unit 3 Cable Room was installed, which returned the sprinkler system to an operable condition within the 14 day Limiting Condition of Operation.

Design Engineer B completed preliminary calculations on October 23 which showed that the four inch cross-connect would not supply sufficient flow and pressure to the cable room sprinkler systems for all three units if 2HPSW-14 was closed, and that the Unit 3 Cable Room sprinkler system was inoperable if 3HPSW-14 was closed.

After reviewing the memorandum from Safety, the Shift Supervisors asked an Operations Engineer for guidance on what corrective action should be taken. The Operations Engineer questioned whether all the systems listed would be inoperable and contacted Design Engineer A. When he found out from Design Engineering that the operability of the systems had not been completely verified operable or inoperable, a Problem Investigation Report was written on the question of inoperability. White tags were placed on the two valves which administratively required them to be kept open and the Problem Investigation Report described the problem. Subsequently, Compliance requested that Design Engineering formally complete their review and determine the M-line sprinkler system's operability when either 2HPSW-14 or 3HPSW-14 was closed.

The Performance Procedure, "Fire Protection Annual Flow Test" was changed and approved on November 20, 1987, to state minimum acceptance criteria in terms of both flow and pressure. The criteria was based on the calculations performed after the audit.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Oconee Nuclear Station - Unit 1	0 5 0 0 0 2 6 9	8 7	— 0 1 1	— 0 1	0 9 OF 1 6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

On December 2, with evaluations complete, Design Engineering informed Compliance that closing 2HPSW-14 made all 3 cable room sprinkler systems inoperable while closing 3LPSW-14 made only the Unit 3 cable room system inoperable. All other systems would remain operable in either case.

During discussions with Design Engineer B on December 2, Compliance first became aware of the design deficiency which caused the Unit 3 Cable Room system's initial inoperability. The NRC Resident Inspector was subsequently informed of both cases of inoperability and the fact that they were due to a design deficiency.

On December 9, 2HPSW-14 and 3HPSW-14 were permanently labelled, stating that closing them affected cable room sprinkler system operability and referenced the applicable Technical Specification.

On January 4, 1988, Revision 0 to Licensee Event Report 269/87-11 was submitted. As a result of Revision 0 to this LER, a planned corrective action included a requirement for Design Engineering to determine and document each Technical Specification required sprinkler/water spray system's flow and pressure requirements to verify operability. During the response to this corrective action, Design Engineering identified the design deficiency with the Keowee Hydro Station Main Lube Oil Storage Room water spray system on March 2, 1988. This deficiency was discovered by performing hydraulic calculations on the length of piping installed by the chlorination system NSM. These calculations showed a significant flow loss caused by hydraulic friction due to the addition of supply piping to the water spray heads. With the hydraulic friction induced by this modification, the minimum lake level required to supply the required design flow rate changed from 780 feet to 800 feet, 7 inches above sea level. Lake level never reached this required level between January 15, 1985 and March 2, 1988 and averaged approximately 793 feet above sea level during this time.

Upon identifying the inoperable water spray system at the Keowee Hydro Station, a Design Engineer contacted ONS Compliance personnel and informed him of the inoperable condition of this system. This contact was made at 1120 hours on March 2, 1988. Compliance personnel immediately called the Operations Shift Supervisor and informed him of the inoperable system. On March 2, 1988, at 1130 hours, the Shift Supervisor contacted Keowee Hydro Station personnel and informed them of the situation. At 1140 hours, a Keowee Hydro Station Operator was designated as the continuous fire watch for the Main Lube Oil Storage Room in order to meet the requirements of Technical Specification 3.17.3. This continuous fire watch consisted of an hourly inspection of the storage room along with a continuous monitoring of the smoke and heat detectors [EIIS:IC] located in the storage room. In addition, backup fire suppression equipment was available in the area through the use of fire hoses and a booster pump. Thus Technical Specification 3.17.3 was violated from January 15, 1985 to March 2, 1988 due to the inoperability of the Keowee Main Lube Oil Storage Room water spray system.

After notifying Compliance personnel of the inoperable fire protection system, the Design Engineer initiated a Station Problem Report which requested a modification to be made which would correct the system inoperability. Subsequently, another NSM was requested and approved on March 4, 1988. Design work was completed and the modification package was transmitted to Oconee Nuclear Station. On March 10, 1988, work on the NSM was initiated. This modification consisted of shortening the length of piping between the twelve inch supply line and the existing water spray heads. Shortening this length of piping decreased the hydraulic friction losses on the flow of water to the water spray heads. This reduction in hydraulic friction reduced the minimum lake level required for system operability from 800 feet, 7 inches to 780 feet. In addition, valves were added to isolate the piping to be chlorinated from the rest of the system. On March 15, 1988, the NSM was completed which returned the Keowee Hydro Station Main Lube Oil Storage Room water spray system to an operable status.

This incident is reportable pursuant to the requirements of 10CFR 50.73(a)(2)(i)(B).

Cause of Occurrence

It is concluded that the root cause of this incident was a design deficiency due to the failure to assure that the High Pressure Service Water (HPSW) System was capable of supplying the sprinkler systems with adequate flow and pressure. This is evident from the failure of Design Engineering to assure that the HPSW system was capable of supplying adequate flow and pressure to the Unit 3 Cable Room Sprinkler System.

There was also a deficiency in the lack of consideration given to the Unit 3 cross-connect's ability to supply the M-header loads, with the M-header isolated. It is recognized that the original reason for installing the cross-connect was for supplying water to the Auxiliary Building from the Turbine Building's M-header. However, this installation did provide an alternate route for supplying the M-header loads and its ability to do so was not reviewed. Interviews with both Operations and Design Engineering personnel indicated that it is a reasonable conclusion, for someone reviewing flow diagrams, to consider the M-header loads to be operable if they were being supplied by the cross-connect with the M-header isolated. Therefore because the ability of the HPSW system to supply the sprinkler system was not analyzed, and the potential for using the cross-connect as an alternate supply to the sprinklers was not formally reviewed or proven, this event is classified as a Design Deficiency.

It could not be determined during this investigation why the capability of the High Pressure Water System (HPSW) to supply the sprinkler systems was not reviewed more closely by Design Engineering. No documentation of any review of the HPSW system capability was found with the NSM package at the station or in any applicable files at the Design Engineering Offices. During interviews with personnel who were involved in the installation and design, no recollection could be made of any additional information on how the determination was made that the

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Oconee Nuclear Station - Unit 1	0 5 0 0 0 2 6 9	8 7	— 0 1 1	— 0 1	1 1 OF 1 6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

HPSW system could meet sprinkler demand. As for the cross-connect's ability to supply the sprinklers, it was installed to provide water flow and pressure to the Auxiliary Building and its potential use as an alternate supply to the M-Header sprinkler systems was not considered by Design Engineering.

Concurrent with this event was the failure to report the initial inoperability of the Unit 3 Cable Room sprinkler system. Interviews with the Compliance Section representative, determined that he believed that the inoperability was due to a degradation in system capability over time and that it did not involve a design deficiency. He stated that he was not told that a design deficiency was involved. He had been told that the problem was discovered during a review of test data and it was also discussed that the sprinklers were designed to meet the minimum flow requirements only, thus making them subject to being inoperable if overall system efficiency should drop significantly. Based on the above, he considered the inoperability to be due to system degradation over time and therefore not reportable, but subject to Technical Specification 3.17's stipulation of a 14 day Limiting Condition of Operation statement. This required that the system be made operable within 14 days while taking certain compensatory actions.

Design Engineer A's recollection of the conversation when notification was made was the same, particularly that the design deficiency was not mentioned. During the interview, he stated that he was not aware of the significance of the design deficiency in regards to reportability. However, he was aware that it was his responsibility to adequately describe the event so that Compliance could take any necessary action. It was his failure to do so that led to the event not being initially reported.

It is concluded that the Safety Associate's actions in notifying Operations of the problem were appropriate, although they later proved to be conservative. Based on his understanding of the problem at that time, his actions were in order. He took no further action at that time, because 2HPSW-14 and 3HPSW-14 are not routinely closed and the M-header is rarely isolated, and Design Engineering was reviewing the problem.

Operation's action was correct in providing administrative controls on closing the valves and in again informing the Shift Supervisors and Operating Engineers of the potential problems in closing either 2HPSW-14 or 3HPSW-14.

During the Design phase of the chlorination system NSM, Design Engineering should have performed hydraulic calculations which would have prevented an inadequately designed system from being installed. However no specific guidelines existed which required Design Engineers to perform these calculations. Therefore, because of an inadequately defined program for insuring all aspects of engineering were considered during the design of modifications, the chlorination system NSM was designed and installed without an analysis of the impact of the subject modification on the hydraulic characteristics of the Main Oil Lube Storage Room water spray system.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Oconee Nuclear Station - Unit 1	0 5 0 0 0 2 6 9	8 7	— 0 1 1	— 0 1	1 2 OF 1 6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

While a maintenance procedure existed to functionally test the Keowee Hydro Station Main Lube Oil Storage Room water spray system, measuring the actual water flow rate supplied to the water spray heads was not a function of this procedure. Only a visual verification was performed to insure water was sprayed from the water spray heads. This test includes only a partial flow test and not a full flow test. Since direct measurement of system flow was not part of the functional testing procedure, the personnel responsible for performing this procedure had no reason to suspect that the flow rate did not meet the design specifications for the water spray heads. Precise flow measurement is not required to insure flow requirements are met during subsequent periodic maintenance flow testing. Engineering judgement is often used to access the need and scope of Periodic Maintenance testing and may or may not include a flow measurement.

In addition to a lack of flow testing in the Periodic Maintenance procedure, the chlorination system NSM did not include a post modification full flow test either. No instrumentation was included in the system to allow such a test to be performed. In addition, it was not practical to perform such a test at the station because of the system configuration and the unnecessary drenching of the Main Lube Oil Storage Room. If a flow test was mandatory, Design Engineering should have included a means to perform this test. As stated previously, if the proper hydraulic calculations had been performed by Design Engineering, the deficiency with the initial design of the system would have been identified and corrected. By performing these calculations, Design would have insured that an adequate flow rate would be supplied to the water spray heads at any lake level above 780 feet.

As part of the NSM to correct the Keowee Lube Oil Storage Room sprinkler system inoperability, proper calculations were performed to insure the design of this modification restored the required flow rate to the water spray system. In addition, minimum lake level required to maintain the water spray system in an operable status changed from 800 feet and 7 inches to 780 feet as a result of this modification. Since ONS Technical Specifications allows ONS to operate with a minimum lake level of 775 feet above sea level, it is possible that the subject water spray system could be rendered inoperable again. However, the Dispatcher in Charlotte as well as the Keowee Hydro Station Supervisor monitor the lake level and understand that compensatory action must be taken should lake level fall below 780 feet above sea level. In order to insure lake level is maintained above 780 feet, lake level is monitored by the Dispatcher in Charlotte every hour. If lake level were to approach 780 feet, the Dispatcher would take appropriate action. This action could include allowing water from Lake Jocassee to flow into Lake Keowee.

No other High Pressure Service Water System inoperabilities caused by design deficiencies have been discovered during the last three years. Therefore, this event is considered to be non-recurring in nature. Since the installation of the subject NSMs, Design Engineering has implemented the "TOPFORM" program which is designed to insure formal documentation and review of design criteria and engineering decisions. The implementation of this program has raised the level of

awareness concerning the proper engineering design criteria that should be considered when developing modifications to existing systems. This program will further insure that incidents such as the one discussed in this report will not recur.

In addition to the "TOPFORM" program, a task force was developed in January of 1988 to study the adequacy of the post modification testing program and to also assist in developing a more well defined program. This program should insure that all acceptance test criteria for modifications are satisfied following installation. By developing a well defined program for post modification testing, greater assurance will be provided that modifications meet their design bases function. Presentations are scheduled to be made to management as the task force develops recommendations.

No component failure occurred in this incident, therefore, it is not NPRDS reportable. There were no releases of radioactive materials, radiation exposures or personnel injuries involved with this incident.

Corrective Actions

The immediate corrective action was to establish a continuous fire watch for the Unit 3 Cable Room when its initial inoperability was discovered. When the inoperability of the Keowee Main Lube Oil Storage Room water spray system was discovered, a continuous fire watch was established along with continuous monitoring of fire detection instrumentation. Backup fire protection equipment was also made available.

The following subsequent corrective actions were taken.

- o The pipe feeding the Unit 3 Cable Room Sprinkler System was changed from a four inch to a six inch diameter making the system operable.
- o A Performance procedure was changed to require both a flow and pressure acceptance criteria which was based on calculated system demand.
- o Valves 2HPSW-14 and 3HPSW-14 were first white-tagged open and subsequently, permanently labelled describing the consequences of closing either of them and referencing the appropriate Technical Specification. After labeling, white tags were kept on the valves to enhance administrative control on closing the valves.
- o An Operation Information Notice was written describing the consequences of closing 2HPSW-14 and 3HPSW-14.
- o Operability of all the individual M-header sprinkler systems was verified when they were supplied from the Unit 3 cross-connect.
- o Design Engineer A was counseled by management in regards to his error.

- o Operations initiated a Station Problem Report describing the inability of the cross-connect to supply the cable room sprinklers, and requested an alternate supply be provided at the cross-connect.

- o The Appendix A response was changed to show the new calculated minimum flow rate required for the HPSW system to be operable.

- o An NSM was implemented to modify the Keowee Main Lube Oil Storage Room water spray system piping in a way that would provide sufficient water flow the the spray heads with a minimum Keowee Lake level of 780 feet above sea level.

Planned corrective actions include the following:

- o As a result of this event, Design Engineering will determine and document each Technical Specification required sprinkler system's flow and pressure requirements to verify operability and the ability of the longest pathway to supply the demand will be verified. This will be completed by March 1, 1988. The exception to this will be the M-header supplied systems which have already been reviewed.

- o The FSAR will also be revised to show the correct flow rate during its annual review in 1988.

- o Design Engineering will issue a letter to the Keowee Hydro Station Plant Supervisor advising him of the minimum lake level required to maintain the Keowee Hydro Station Main Lube Oil Storage Room water spray system in an operable condition. This action will be taken to allow the Keowee Hydro Station Plant Supervisor to administratively monitor lake level and take compensatory actions should lake level drop below 780 feet above sea level.

Analysis of Occurrence

The sprinkler systems provided in the cable room are for fire suppression when the valves supplying them are manually opened. The sprinklers are supplied by the High Pressure Water System (HPSW) which is designed for fire protection.

Declaring the sprinkler systems inoperable meant that the systems would not supply the stipulated 0.1 gpm/sq. ft. flow rate. However, there would be some flow available when the systems were actuated. Manual hose stations are located in the area of the cable rooms along with portable extinguishers. Ionization detectors are present in the cable rooms to provide for quick notification of a possible fire.

The cable rooms are separated from the rest of the plant by fire barriers and have at least two remote and separate entrances to provide access for fire brigade personnel. Fire brigade personnel are on site continuously and are trained and staffed to be self-sufficient regarding fire protection in the protected area. Finally the Standby Shutdown Facility is designed to provide a

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Oconee Nuclear Station - Unit 1	0 5 0 0 0 2 6 9	8 7	— 0 1 1	— 0 1	1 5 OF 1 6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

means to achieve and maintain a hot shutdown condition in case of fire with subsequent failure of plant systems including those in the cable rooms.

The safety concern for the Keowee Main Lube Oil Storage Room water spray system inoperability involves the affect on the ability of Keowee Hydro Station to provide its intended safety function during a fire. In the event a fire were to break out in this room, the significance of the fire greatly depends on the ability to contain, suppress, and extinguish the fire.

The Keowee Hydro Station Main Lube Oil Storage Room is separated from the rest of Keowee Hydro Station by fire walls on three sides and a twelve inch reinforced concrete block wall with a door. The fire walls and the access door are rated for three hours while the concrete reinforced block wall is rated for two hours. When considering the most conservative amount of time provided by the block wall, if a fire broke out in the storage room, two hours would be available to respond to the fire before it would progress outside of this storage room threatening the ability of the Keowee Hydro Units to provide emergency power to ONS.

While the water spray system in the storage room was technically inoperable, some fire suppression would have been provided by the water spray system at a reduced flow rate. In addition, if a fire were to break out in the storage room, the smoke detectors and/or heat detectors within the room would have alerted Keowee Operators in the control room. In addition, the ONS Operators would have been alerted by a "Keowee Trouble" alarm in the Unit 1 Control Room. Upon being alerted, the ONS Fire Brigade could have responded well within two hours. Also, the Six Mile Fire Department has been contracted to provide assistance should a fire break out at Keowee Hydro Station and they could have responded well within two hours.

As stated, additional backup fire suppression equipment was located at the hydro station. A booster pump and fire hose were available at the station and could have provided approximately the same flow rate as the water spray system would under normal operating conditions. Because of the backup fire suppression systems available, the ability of Keowee Hydro Station to provide emergency power would not have been compromised.

Finally, if for some reason backup fire suppression systems were not available in a timely manner, several backup power sources are available should the Keowee Hydro Station emergency power source be inhibited. Depending on the type of emergency, power could be obtained from the other two nuclear units, the 230KV and 500KV switchyards [EIIS:FK], and Lee Steam Station via transformer [EIIS:XFMR] CT5.

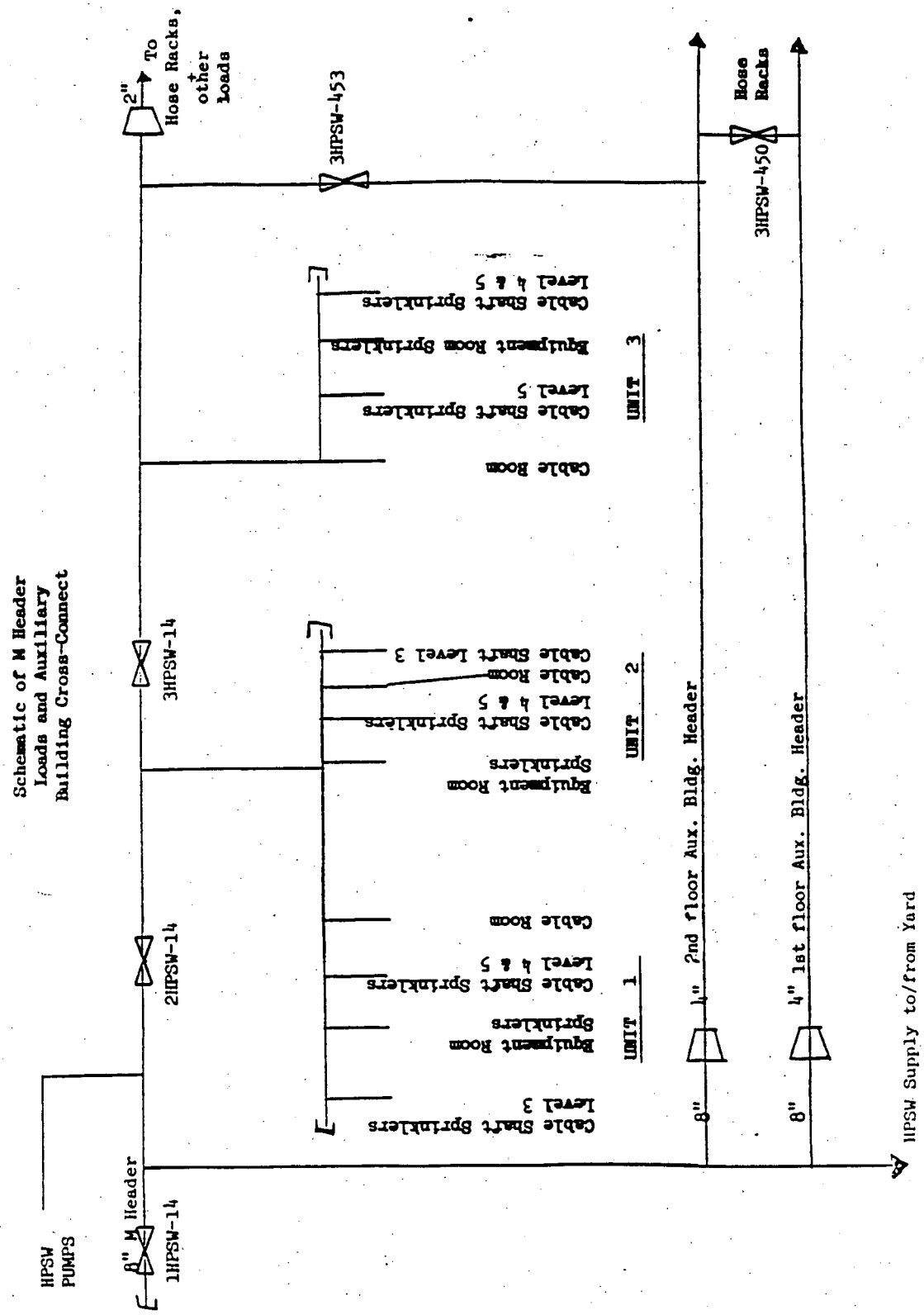
Because of the available systems and personnel for detection and control, there is little chance that a fire would have begun and developed into a threat to plant safety or the ability of Keowee Hydro Station to provide emergency power to ONS. Therefore, this event is considered not to be significant with respect to the health and safety of the public.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Oconee Nuclear Station - Unit 1	0 5 0 0 0 2 6 9	8 7	0 1 1	0 1	1 6 OF 1 6

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Attachment

Schematic of M Header
Loads and Auxiliary
Building Cross-Connect



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April 19, 1988

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
LER 269/87-11 Revision 1

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a) (1) and (d), attached is Revision 1 to Licensee Event Report (LER) 269/87-11 concerning a violation of Technical Specification 3.17.3. This revision includes information about the inoperability of the Keowee Hydro Station Main Lube Oil Storage Room water spray system. Changes included within this revision are indicated by a vertical line in the right margin.

This report is submitted in accordance with Part 50.73(a)(2)(i). This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

Hal B. Tucker

PJN/314/jgc

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