PSE&G

Public Service Electric and Gas Company P.O. Box 236 Hancocks Bridge, New Jersey 08038

Hope Creek Generating Station

December 26, 1990

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington DC 20555

Dear Sir:

HOPE CREEK GENERATING STATION
DOCKET NO. 50-354
UNIT NO. 1
LICENSEE EVENT REPORT 90-029-00

This Licensee Event Report is being submitted pursuant to the requirements of 10CFR50.73(a)(2)(i) and (a)(2)(iv).

Sincerely,

J.J. Hagan
General Manager -
Hope Creek Operations

RBC/

Attachment
SORC Mtg. 90-119

C Distribution

IE22
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The Energy People

LICENSEE EVENT REPORT

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
HOPE CREEK GENERATING STATION	0 5 0 0 0 3 5 4	1 OF 11

TITLE (4): EMERGENCY CORE COOLING SYSTEMS ACTUATION - ELECTRICAL SPIKE ON CHANNEL "A" LOGIC RESULTS IN AUTO START OF CHANNEL "A" COMPONENTS - MULTIPLE CAUSES

EVENT DATE (5)			LER NUMBER (6)					REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	**	NUMBER	**	REV	MONTH	DAY	YEAR	FACILITY NAME(S)	DOCKET NUMBER(S)
1 1	2 6	9 0	9 0	-	0 2 9	-	0 0	1 2	2 6	9 0		

OPERATING MODE (9): 1

POWER LEVEL: 1 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10CFR: (CHECK ONE OR MORE BELOW) (11)

	20.402(b)		20.405(c)	XX	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)
	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
Richard Cowles, Senior Staff Engineer - Technical	6 0 9 3 3 9 3 4 3 1

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS?	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS?
B	EJ	BYC	C173	Y					

SUPPLEMENTAL REPORT EXPECTED? (14)	DATE EXPECTED (15)	MONTH	DAY	YEAR
YES XX NO		0 3	3 1	9 1

ABSTRACT (16)

On 11/26/90 at 1119, while energizing the Channel "A" 125VDC Battery Charger during the performance of an 18 month capacity test, the charger output voltage spiked high and initiated an electrical system response that resulted in actuation of the Channel "A" Emergency Core Cooling System (ECCS) logic. Actuation of the ECCS logic caused the following ECCS responses: initiation of the Core Spray (CS) system, Low Pressure Coolant Injection (LPCI) mode of the Residual Heat Removal (RHR) system, High Pressure Coolant Injection (HPCI) system, "A" Emergency Diesel Generator (EDG), and Loss of Coolant Accident (LOCA) load shedding of the "A" vital electrical bus. During the course of the above ECCS actuations, HPCI injected to the reactor vessel for approximately 4 seconds prior to being secured. An unusual event (UE) was declared at 1143 due to the ECCS injection to the vessel, and was immediately terminated due to the short duration of the injection. All affected systems were returned to a normal, standby status, and the plant returned to a normal operating configuration. Subsequent investigation determined that multiple causes contributed to this event, including failure of a battery charger control logic card, and a less than optimum design of the ECCS actuation instrumentation power distribution scheme. Corrective actions included, scheduling implementation of a previously identified design change on the ECCS instrument power distribution scheme, replacing control logic cards on the Channel "A" Battery Charger, forwarding the failed logic card to the vendor for evaluation, and reviewing the integrated response of plant systems to the event.

PLANT AND SYSTEM IDENTIFICATION

General Electric - Boiling Water Reactor (BWR/4)
Core Spray System (EIIS Designation: BM)
High Pressure Coolant Injection System (EIIS Designation: BJ)
Low Pressure Coolant Injection System (EIIS Designation: BO)
Residual Heat Removal System (EIIS Designation: BO)
Emergency Diesel Generators (EIIS Designation: EK)
Low Voltage DC Distribution System (EIIS Designation: EJ)
Reactor Auxiliaries Cooling System (EIIS Designation: CF)
Safety and Turbine Auxiliaries Cooling (EIIS Designation: CC)
Feedwater System (EIIS Designation: SJ)
Reactor Recirculation System (EIIS Designation: AD)
Reactor Core Isolation Cooling System (EIIS Designation: BN)
Reactor Building Ventilation System (EIIS Designation: VI)
Station Service Water System (EIIS Designation: BI)

IDENTIFICATION OF OCCURRENCE

Emergency core Cooling Systems Actuation - Electrical Spike on Channel "A" Logic Results in Auto Start of Channel "A" Components - Multiple Causes

Event Date: 11/26/90
Event Time: 1119
This LER was initiated by Incident Report No. 90-159

CONDITIONS PRIOR TO OCCURRENCE

Plant in OPERATIONAL CONDITION 1 (Power Operation), Reactor Power 100%, Unit Load 1104MWe.

DESCRIPTION OF OCCURRENCE

On 11/26/90 at 1119, an initiation of all Channel "A" Loss of Coolant Accident (LOCA) Emergency Core Cooling Systems (ECCS) occurred. Control room personnel immediately verified that the initiation signal was invalid, and began responding to various alarms / indications. The following plant responses were noted by control room personnel (listed in chronological order for those responses, where an initiation time is available):

- The "A" Emergency Diesel Generator started and all required non-Class 1E loads received LOCA load shed signals. During the course of the event, various loads were automatically sequenced back onto the bus, as designed.

DESCRIPTION OF OCCURRENCE, CONT'D

- The "A" Reactor Feedpump (RFP) tripped due to its main lube oil pump tripping during the previously described LOCA load shed. This action resulted in an intermediate runback (45% speed; approximately 70% reactor power) of both Reactor Recirculation pumps as vessel level decreased to less than +30".

- The "A" Reactor Auxiliaries Cooling System (RACS) pump tripped during the LOCA load shed.

- The Safety Auxiliaries Cooling System (SACS) to Turbine Auxiliaries Cooling System isolation valves closed during the LOCA load shed.

- The "A" Residual Heat Removal (RHR) pump started.

- The Low Pressure Coolant Injection (LPCI) outboard isolation valve opened.

- The "A" Core Spray (CS) pump started.

- The High Pressure Coolant Injection (HPCI) pump started, and the HPCI system injected to the vessel for approximately 4 seconds prior to being secured.

- The "A" Station Service Water (SSWS) pump auto started.

- Various isolations / actuations of Turbine and Reactor Building Ventilation System components occurred. Additionally, various primary containment isolations occurred.

The Senior Nuclear Shift Supervisor (SNSS, SRO licensed) immediately assumed oversight of recovery from the transient. Two Nuclear Control Operators (NCO, RO licensed) actually performed manipulations necessary to stabilize plant parameters and return all systems to a normal configuration.

Immediate NCO responses consisted of verifying that the initiating signal was invalid, verifying the intermediate runback of the Reactor Recirculation pumps, tripping the HPCI system, and maintaining reactor vessel water level control. Two control rods were inserted per reverse pull sheets to clear Average Power Range Monitor (APRM) upscale alarms that were received during the course of the transient.

DESCRIPTION OF OCCURRENCE, CONT'D

In response to the HPCI injection, per the Hope Creek Event Classification guide, the SNSS declared an unusual event (UE) at 1143. The UE was terminated at the time that required notifications were made, because the HPCI injection had been immediately secured.

Following stabilization of plant parameters, the following actions were taken:

- The ECCS logic was reset to allow the reopening of the various system isolation valves (TACS, RACS, PCIG)
- The "A" RHR and Core Spray pumps were stopped.
- Ventilation systems were returned to a normal configuration.
- The "A" EDG was stopped, and the "A" vital electrical bus was returned to a normal electrical lineup.
- The "A" SSWS pump was stopped, and the SSWS was returned to the pre-transient system alignment.
- The "A" RFP trip was reset, returned to master level control, and the pump was returned to service.
- The Reactor Recirculation runback was reset, and power ascension at a rate of 60MWe per hour commenced.
- The LPCI outboard isolation valve was closed from the control room.

After restoration of all systems, a review of the integrated response of all systems was conducted. The SNSS concluded that, with minor exceptions, all systems had responded as designed, and that the response of control room operators was correct and timely. As previously noted, this event was reported within one hour as required by 10CFR50.72, due to the declaration of an Unusual Event required when the HPCI injection occurred.

ANALYSIS OF OCCURRENCE

The analysis provided in this section discusses the electrical perturbation that initiated the event, response of the Channel "A" ECCS logic to the electrical transient, the RFP trip / Reactor Recirculation runback and the overall effect on actuated ECCS systems and components.

Initiating Transient

During the morning of 11/26/90, a Maintenance Electrician and Operations Department Equipment Operator (EO, non-licensed) were assigned the task of completing an 18 month capacity test on battery charger 1AD414. This charger and a redundant charger on the same Class 1E DC electrical bus provide 125VDC charging power to the Division I 125VDC battery, and normally supply all 125VDC loads on the associated bus. If both chargers trip for any reason, the battery supplies bus power until charger restoration. Refer to Attachment 1 for a schematic of the distribution system.

During performance of the test, while re-energizing the charger per procedure, the charger experienced a high output voltage condition, and tripped (the trip setpoint is 152 VDC). Subsequent investigation by the Maintenance Department and System Engineering determined that two factors contributed to the high voltage shutdown of 1AD414:

- Troubleshooting determined that one of three control logic cards for the charger had failed, and

- There was no electrical load on the charger when it was placed in service due to the redundant charger carrying bus loads. The normal sequence for charger restoration is to close the DC output breaker (effectively tying the charger to the bus) prior to energizing the charger by closing the 480VAC input breaker. With no load, the charger overshot its normal output voltage when initially energized.

It is believed that a combination of these two factors resulted in the charger output voltage spiking excessively high and resulting in the high voltage shutdown of 1AD414.

ANALYSIS OF OCCURRENCE, CONT'D

Response of Channel "A" ECCS Logic

Refer to Attachment 2 for a schematic of the Channel "A" ECCS actuation instrumentation power distribution arrangement (panel H11-P617). As previously noted, power to this distribution bus is provided by the Division I Class 1E 125VDC system. The 125VDC power supply to the bus is inverted to 120VAC by a DC/AC inverter. 120VAC power is then converted to 24VDC via a power supply, and this power supply feeds the Channel "A" ECCS trip units.

The DC/AC inverter (1RLEY-K601A) tripped on overvoltage (140VDC) at the onset of this event, and momentarily de-energized Channel "A" ECCS trip units. Following the high voltage shutdown of the battery charger, 125VDC bus voltage decayed, and 1RLEY-K601A automatically reset (approx. 132VDC input voltage), re-energizing the trip units. When re-energized, the affected Channel "A" trip units recognized the change of state as a valid Channel "A" initiation signal, and initiated the various system responses. The short time duration of this entire transient (a few seconds) afforded no opportunity for operator response to defeat Channel "A" ECCS initiations prior to the affected trip units being automatically re-energized.

Subsequent to the event, Systems Engineering performed an extensive review of individual trip unit responses to the transient, and determined that all trip units responded correctly and as designed. The original vendor design of the trip units assumed a continuous, uninterruptible power supply (UPS) for the trip units.

The current electrical distribution scheme meets the intent of UPS reliability. Two redundant battery chargers, backed by a 125VDC battery, inverted and rectified to 24VDC, met the original design intent. However, Hope Creek previously recognized that the protective nature of the 1RLEY-K601A trip/reset functions render this distribution scheme susceptible to power supply perturbations, and exposes the individual ECCS Channel to unplanned actuations. A design change, identified as a result of previous similar events at Hope Creek and PSE&G's involvement in the BWR Owners Group, is scheduled to be implemented during the stations third refueling outage (scheduled to commence 12/26/90).

ANALYSIS OF OCCURRENCE, CONT'D

Response of Channel "A" ECCS Logic, Cont'd

This design change eliminates all ECCS instrument inverters, and will power each instrument bus directly from a channelized, 120 VAC, battery backed Class 1E UPS to maintain required divisional separation. Additionally, Hope Creek will continue to pursue the review of other potential design enhancements to increase the reliability of ECCS actuation instrumentation power supplies.

Reactor Feedpump Turbine Trip / Reactor Recirculation Runback

During the course of the previously described load shedding, the power supply breaker to the RFPT "A" main oil pump (MOP) was shed. This resulted in a low lube oil pressure trip of the RFPT. The remaining feedpumps (B & C) could not immediately compensate for the loss of the "A" RFP, and vessel level dropped from the normal +35" to below +30". This resulted in an intermediate runback of the Reactor Recirculation System, and reactor power decreased to approximately 70%.

In response to previous similar occurrences (Ref: LER 88-019, LER 89-009), Systems Engineering developed a test to determine if the RFPT auxiliary oil pump (AOP) could be utilized as a backup to prevent RFPT trips on loss of the MOP. The purpose of the test (conducted in June, 1989) was to assess the response of the AOP on decreasing RFPT oil pressure. Results of the test indicated that as presently configured, adjusting the start setpoint of the AOP to a higher cut-in pressure would not prevent the RFPT from tripping on loss of the MOP. However, after consultation with the RFPT manufacturer, it was determined that modifications to the control circuitry could be made such that the AOP would start immediately upon loss of power to the MOP. This modification would prevent tripping of the RFPT under conditions such as noted in this report. A design change request was initiated to accomplish this modification, and is currently being evaluated.

Assessment of Emergency Core Cooling Systems Response

During the course of this event, the "A" Core Spray loop, HPCI, the "A" LPCI loop, and the "A" EDG were actuated. As previously noted, all systems functioned as designed for a Channel "A" ECCS initiation signal. Of particular interest are the HPCI and LPCI initiations.

ANALYSIS OF OCCURRENCE, CONT'D

Assessment of ECCS Response, Cont'd

Submittal of this report satisfies the requirements of Technical Specification 3.5.1, Action g., which directs submittal of a report within 90 days of an ECCS actuation to document the injection.

During the course of this event, HPCI injected to the reactor vessel for approximately four seconds. At the onset of the injection, vessel temperature was approximately 500 deg.F, with a vessel pressure of 1000 PSIG, and a HPCI discharge flow of 169 GPM. As of the date of this event, HPCI has experienced 12 injections to the vessel over the life of the plant. By design, 120 injections are permitted. Because of the early life of the plant, the HPCI nozzle usage factor has not been calculated. Systems Engineering continues to track HPCI injections, so that as nozzle usage factor becomes a potential operational constraint later in plant life, usage history is retrievable.

With respect to the LPCI initiation, a post-transient review of external operating experience determined that one of the principal concerns with the event (as expressed in NRC Information Notice 90-022) centers on the opening of the LPCI Outboard Injection Valve (F017A). Refer to Attachment 3 for a one-line diagram of the "A" LPCI loop.

The F017A valve opens when the following logic sequence is satisfied:

- LPCI initiation signal (high drywell pressure, 1.68 PSIG or low vessel level, -129"). The LPCI initiation signal was satisfied by the LOCA Level 1 signal generated when the trip unit for Channel "A" ECCS instrumentation was re-energized.

- Power available to the "A" Vital Bus. This input was satisfied because the bus remained energized.

- Reactor pressure (as sensed between F017A and the inboard LPCI Injection Check Valve, F041A) is less than 450 PSIG. This logic input was satisfied as F041A is relatively leak tight. Additionally, due to the configuration of the associated ECCS trip unit, were reactor pressure greater than the permissive, it is possible an invalid permissive signal could be generated during an ECCS trip unit re-energization scenario such as described in this report.

ANALYSIS OF OCCURRENCE, CONT'D

Assessment of ECCS Response, Cont'd

When F017A opens, the low pressure LPCI piping is isolated from reactor pressure by F041A (a testable check valve which serves as the inboard containment isolation valve on the LPCI injection line). F041A is designed to ASME Section III, Code Class 1, and is rated for 1500 PSIG service at 575 deg.F.

Testing of the check valve to verify operability is conducted under the station ASME Section XI Inservice Testing program, and consists of verifying seat integrity (leak test), remote position indication, and valve exercising. Additionally, the integrity of F041A is verified every 8 hours by logging pressure between F017A and F041A to establish pressure fluctuation trends. This monitoring ensures the integrity of F041A, ensures that the high pressure/low pressure interface between the reactor vessel and the LPCI system is maintained, and ensures that primary containment integrity is maintained.

In summary, with F017A open and the "A" RHR pump running, the LPCI system is designed to inject to the RPV as reactor pressure decays below pump discharge pressure. In the event that F041A was not properly seated, the logic for opening F017A could not be satisfied under normal conditions (because pressure between the two valves would be greater than 450 PSIG). The integrity of F041A is continuously monitored through trending of pressure between F041A and F017A, thereby assuring LPCI system and containment integrity in the event of a spurious opening of F017A.

ROOT CAUSE ANALYSIS

1. The most probable cause of the initiating event (high voltage shutdown of battery charger 1AD414) was determined to be a failed charger control logic card. Failure of the card contributed to the magnitude of the normal charger voltage excursion when returning the charger to service. The logic card is being forwarded to the vendor for analysis to confirm this determination.

2. The root cause of the ECCS actuation instrumentation logic response is a less than optimum design of the instrument bus electrical distribution scheme. The protective nature of the instrument inverter trip/reset functions renders the distribution scheme susceptible to power supply perturbations, and exposes the individual ECCS channel to unplanned actuations.

ROOT CAUSE ANALYSIS

3. The tripping of the RFPT was a normal system response as a result of shedding the MOP power supply. The control logic for the MOP and AOP was not designed to prevent the pump from tripping on a loss of the MOP. However, testing and vendor consultation has determined that a design change to the control logic could be made to start the AOP on a loss of power to the MOP, thus preventing an RFPT trip. This design change is presently under evaluation for future implementation.

PREVIOUS OCCURRENCES

Three previous reportable events of a similar nature have occurred at Hope Creek (ref: LERs 87-036, 88-019, and 89-009). In all of these instances, the instrument inverter did not automatically reset as DC input voltage decayed, but were manually reset. As such, the overall ECCS system responses were different. Root causes included operating procedure deficiencies, design inadequacies, and personnel error. Corrective actions included procedure enhancements, initiating design changes, and personnel counselling.

SAFETY SIGNIFICANCE

The overall potential safety significance of this event was minimal. All actuated systems and components responded as designed. The brief HPCI injection posed no threat to the safe operation of the plant, as a HPCI injection at power is an UFSAR analyzed event. The previously discussed design of the LPCI injection line ensures that the probability of an intersystem LOCA due to inboard check valve failure is negligible. Additionally, redundant ECCS channels were unaffected and available for service if required.

CORRECTIVE ACTIONS

1. The failed control logic card on battery charger 1AD414 was replaced. Additionally, the logic card will be forwarded to the vendor for analysis to confirm the determination that the failed card contributed to the magnitude of the normal battery charger voltage excursion when re-energizing the charger.

CORRECTIVE ACTIONS, CONT'D

2. As a result of previous similar occurrences, a design change was initiated in 1989 to remove the ECCS instrument inverters from the ECCS actuation instrumentation electrical distribution scheme. This design change is scheduled to be completed during the stations third refueling outage. Additionally, PSE&G continues to work with the BWR Owners in attempting to resolve all reliability issues associated with ECCS actuation instrumentation, including power supplies.

3. A procedure will be initiated to formally document trend analysis and review of the monitored pressures between F017A and F041A. This review is currently conducted, however, it is not formally documented.

4. The Nuclear Training Department will incorporate a review of this event in Maintenance Department continuing training and licensed operator requalification programs. The presentation to licensed operators will focus on the appropriate and timely response of control room personnel to the challenges described in this report.

5. During the upcoming outage, when the ECCS instrument inverters are removed, the trip and reset setpoints of each inverter will be verified.

Sincerely,

J.J. Hagan
General Manager -
Hope Creek Operations

RBC/

SORC Mtg. 90-119

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION			
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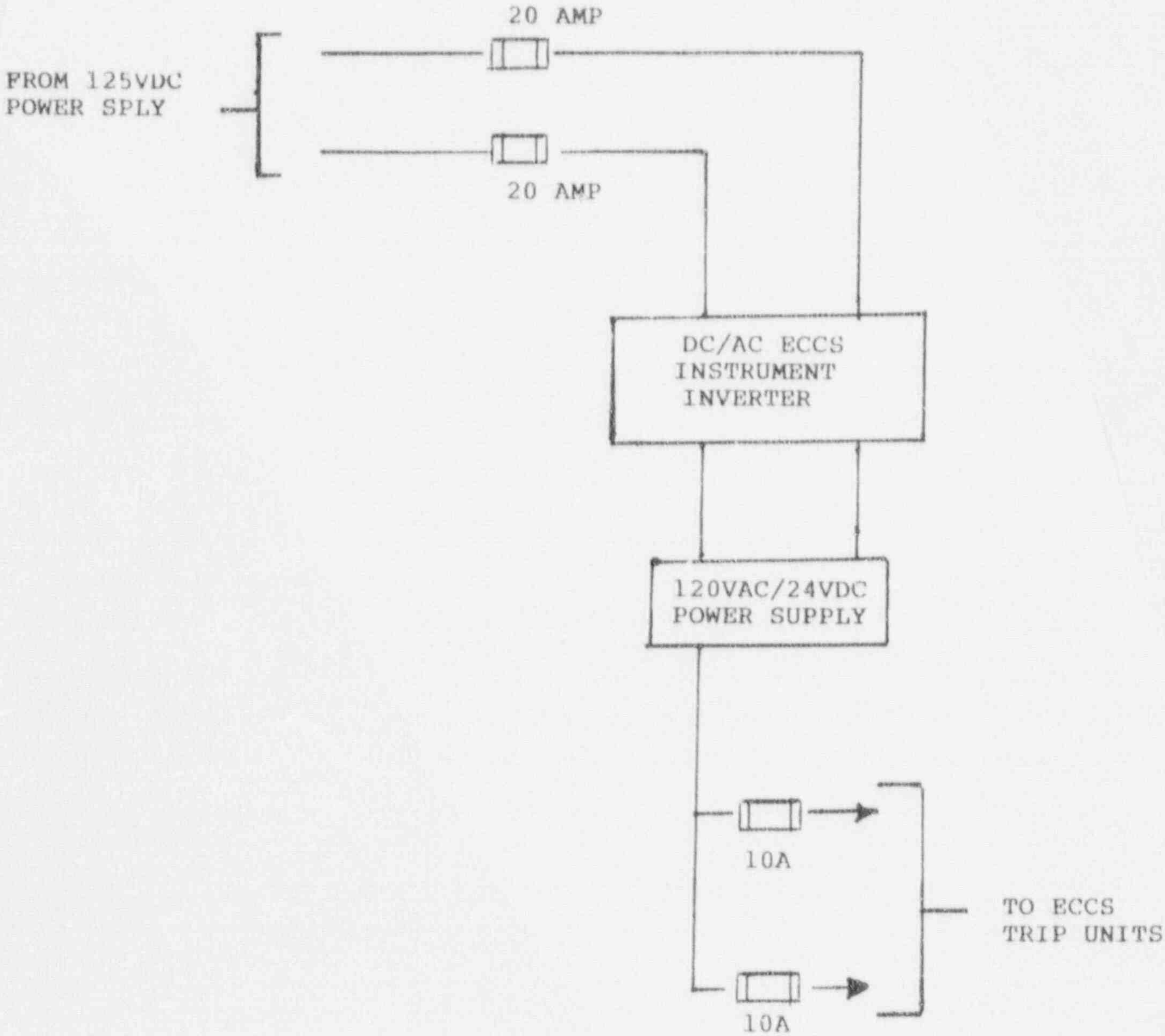
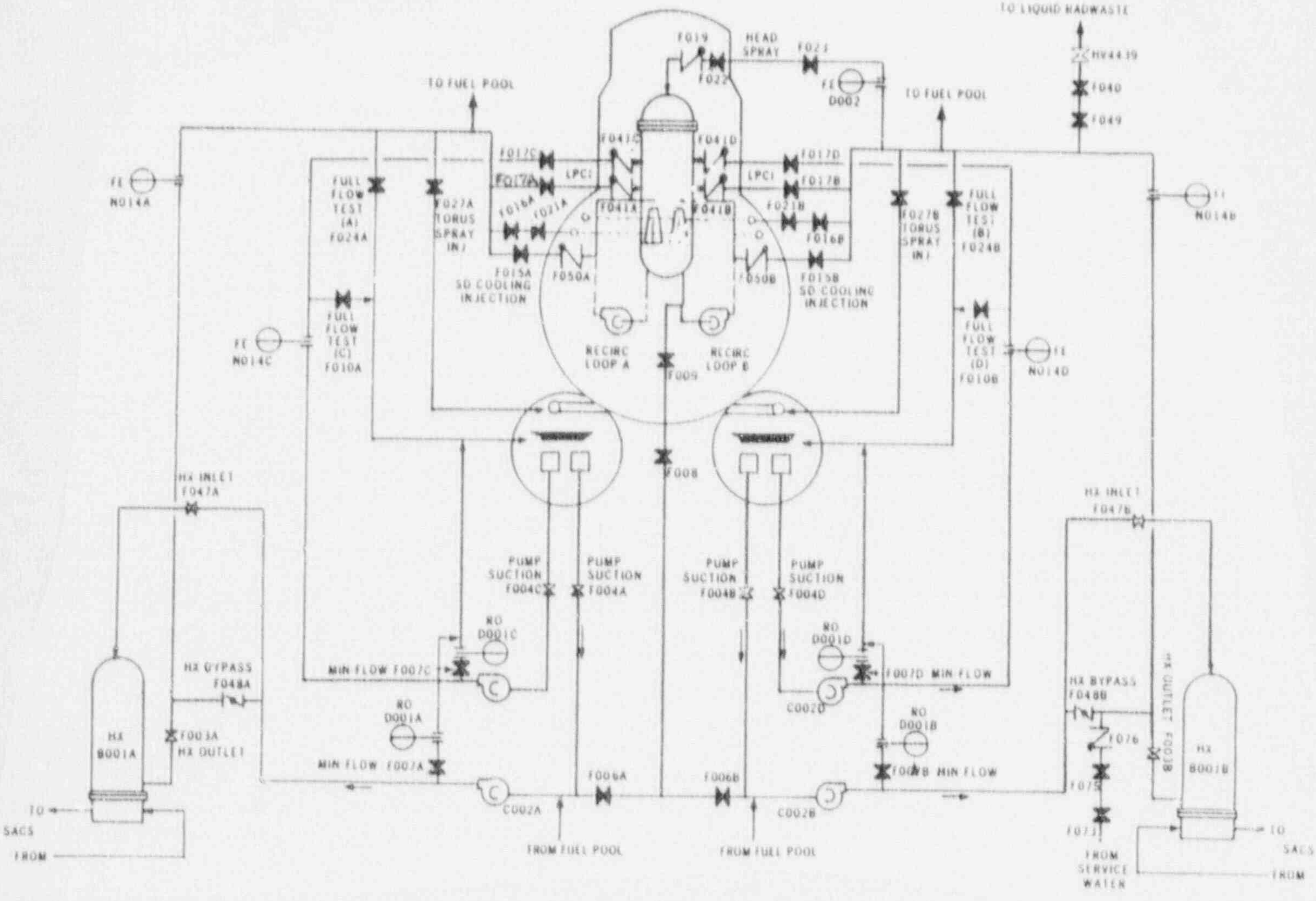
HOPE CREEK GENERATING STATION	05000354	90 - 0 2 9 - 0 0	A 2 OF

TYPICAL ECCS ACTUATION INSTRUMENTATION POWER SUPPLY DISTRIBUTION SCHEMATIC



TYPICAL LPCI INJECTION SYSTEM DIAGRAM



LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)								PAGE (3)			
		YEAR	\\	NUMBER			\\	REV					
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TYPICAL 125 VDC BATTERY CHARGER AND DISTRIBUTION SCHEMATIC