NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

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

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Clinton Power Station	05000461	1 OF 5

TITLE (4)
Inappropriate Use of a Solder Flux Due to Inadequate Control of a Consumable Material and Poor Workmanship During Rework of Main Control Room Neon Indicator Lights Sockets Results in Inoperable Safety Systems

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
									None	05000
12	31	96	97	015	00	07	09	97	FACILITY NAME: None	DOCKET NUMBER: 05000

OPERATING MODE (9)	5
POWER LEVEL (10)	000

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)	X	50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A	
	20.2203(a)(2)(iv)		50.36(c)(2)	X	50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
D. K. Forbes, Maintenance Services Root Cause Investigator	(217) 935-8881, Extension 3577

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
B	JL	IL	D926	N						

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)

An operability determination performed due to repetitive failures of main control room neon indicator light sockets in main control room panels identified that equipment associated with the light socket circuits was inoperable. The determination was based on the potential that light socket circuits could short to ground due to use of an incorrect solder flux during rework of the light sockets. The short to ground would cause control power fuses on affected components to open or trip coils to activate. This condition was determined to be applicable to various safety-related systems including the Residual Heat Removal system, Emergency Core Cooling Systems, Emergency Diesel Generators, Main Steam Isolation and Control Rod Drive system. The causes of this event were a breakdown in the control of a consumable material (solder flux) and poor workmanship. Corrective actions for this event include replacing affected light sockets, clarifying the use of solder flux in the control of chemicals program, evaluating personnel qualifications, training personnel, revising required post maintenance testing, reviewing other uses of solder flux, designating the use of fluxes in the material tracking system, adding management oversight to rework of light sockets, revising procedures, and performing an assessment of the use of consumables.

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

DESCRIPTION OF EVENT

On October 12, 1996, maintenance technicians were performing a pre-job walkdown of main control room panels [JL] for a Maintenance Work Request (MWR) that was initiated to remove panel [PL] indicator lights [IL] and control switches [HS]. During the walkdown, the technicians noted several different configurations of wire terminations on neon indicator light sockets that were not in accordance with design. The technicians initiated condition report (CR) 1-96-11-114 to track resolution of the design deficiency. Because the identified condition did not result in any actual failures, nor would it have prevented performance of a safety function, the identified condition was determined not to be reportable pursuant to 10CFR50.72 and 10CFR50.73. MWRs were initiated and work began on December 12, 1996 to correct the deficiencies which were determined to affect approximately 600 neon indicator light sockets.

Operators noted both during and following post-maintenance testing (PMT) of reworked light sockets that some of the same light sockets were failing. The PMT consisted of operating the equipment associated with the light socket to verify proper indication. Investigation identified a total of eighteen circuits that failed after rework between December 31, 1996, and June 6, 1997, ten of those failures occurred in a five week period from April 30 to June 6, 1997, after successfully passing PMT. Eight of the eighteen failures had been documented on condition reports (CR), the other ten were documented on MWRs.

During review of one of the eight CRs discussed above, the Operations Shift Supervisor recognized the occurrence of repetitive failures. Operations personnel performed an operability determination of the condition and determined that the failure rate was acceptable and based on the information available at that time, it was determined that there was no impact to system operability.

On June 9, 1997, CR 1-97-06-097 was initiated to document the need for an operability determination of light socket rework that was performed for the Divisions I and II Emergency Diesel Generator [EK] output breakers [BKR], the "B" and "C" Residual Heat Removal [BO] system pump [P] breakers, the Low Pressure Core Spray [BM] system pump breakers, and the Divisions I and II Shutdown Service Water [BI] system pump breakers. Illinois Power (IP) suspected that the lights were failing due to the use of an incorrect solder flux used during the rework of the light sockets. The failure mechanism was suspected to be the introduction of a corrosive and conductive solder flux which could cause a short to ground. The operability determination concluded that the systems associated with these breakers were considered inoperable because the light socket circuits could short to ground and cause control power fuses on affected components to open or trip coils to activate. Based on this operability determination, IP concluded that the following additional equipment was considered inoperable because light sockets associated with this equipment were also reworked using the same solder flux: the Residual Heat Removal System "A" Pump breakers, Reactor Recirculation [AD] "A" and "B" Pump breakers, High Pressure Core Spray System [BG] Pump breaker, several Reactor Core Isolation Cooling [BN] system valves, isolation valves in the Main Steam [SB] system, Control Rod Drive [AA] system valves and pump breakers, Division III Emergency Diesel Generator output breaker, and Condensate Booster system [SD]Pump breakers.

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

On December 31, 1996, when the first light socket failure occurred, the plant was in Mode 5 (Refueling) with reactor [RCT] coolant temperature being maintained between 75 and 85 degrees Fahrenheit and pressure was atmospheric. Core alterations and handling of irradiated fuel for the sixth refueling outage (RF-6) had already been completed.

No automatic or manually initiated safety system was necessary to place the plant in a safe and stable condition. No other equipment or components were inoperable at the start of this event to the extent that their inoperable condition contributed to this event.

CAUSE OF EVENT

The causes of this event were a breakdown in the control of a consumable material (solder flux) used on plant components and poor workmanship by some technicians performing the repairs.

The introduction of a corrosive and conductive solder flux to the circuitry of the neon indicating lights of the main control room panels caused numerous circuit failures and subsequently inoperability of various systems. This assessment was substantiated by the results of testing performed by an independent laboratory on several samples of light sockets and wiring removed from the main control room panels. The lab performed a destructive investigation into the amount of damage created by the use of inappropriate solder flux. The results of this test showed that the flux migrated approximately 2.5 inches from the point of solder application.

The Materials Management Information System (MMIS) described the classification of the solder flux as "General Plant Use." The MMIS is used by maintenance personnel to determine the appropriateness of material use. General Plant Use (GP) is defined in an engineering instruction as material allowed to be used in plant applications per design documentation. The definition of GP is not contained in the procedures used by the electricians and was therefore not fully understood. The flux used by the electricians in this event was not labeled or controlled in accordance with the control of chemicals program at CPS. It was also noted that the manufacturer's label did not specify that this particular flux could not be used in electrical applications.

Further analysis of this event identified contributing factors including management oversight and PMT. Appropriate management oversight of the light socket rework activity could have identified the repetitive failures of the light socket circuitry in a more timely manner. Initially, a task manager was assigned to oversee this rework activity, but that individual was reassigned. No other person was assigned to replace the task manager until after June 6, 1997.

The PMT consisted of energizing the associated component to make the neon light illuminate. This testing should have included continuity checks of the finished product prior to release to Operations for their performance of PMT. The continuity checks would have provided a resistance value that would have indicated the existence of a good connection or a short to ground.

CORRECTIVE ACTION

Main Control Room neon indicator light sockets and wiring affected by the inappropriate solder flux and poor workmanship have been replaced. This rework was performed by pre-fabricating light sockets with wires of approximately three feet in length and using a soldering compound that contains a rosin core. The prefabricated light socket was then spliced into the circuitry in a location that facilitated installation. The old light sockets and approximately one foot of wire were removed to ensure no detrimental effects of residual flux.

Prior to performing the rework, the electricians were trained on the prefabrication installation method. The Nuclear Training Department evaluated the qualifications of the electricians performing the rework. Solder qualifications for one technician were suspended. PMT for the light sockets was revised to include resistance checks of the prefabricated sockets and continuity checks after installation.

The control of the solder flux was addressed in the control of chemicals program by adding a caution statement in the description of this particular flux that it is not to be used in electrical applications.

Administrative procedures CPS 1501.02, "Conduct of Maintenance," and CPS 1029.01, "Preparation and Routing of Maintenance Work Documents," will be revised to include the definition and application of General Plant Use items.

The Procurement Engineering department of CPS is performing an evaluation of the materials management information system to determine the appropriate fluxes to be used, applications of those fluxes, and how the use of those fluxes will be designated in the material tracking system.

The maintenance department performed a review of past work documents that required any use of solder flux to determine if rework of additional components will be required. The results of that review concluded that the flux used on the cabling of the Intermediate Range Monitors [MON] and Source Range Monitors was questionable. MWRs D75526, D75555, D75556, D75557, D75558, D75559, and D75562 were generated to further investigate these questionable connections and rework as necessary.

A task manager was assigned to oversee the light socket rework on June 6, 1997.

Quality Assurance will perform an assessment of the use of consumables at CPS.

ANALYSIS OF EVENT

This event is reportable under the provisions of 10CFR50.73(a)(2)(i)(b) because various systems were not operable as required by the Technical Specifications, 10CFR50.73(a)(2)(v) because the condition could have prevented fulfillment of the safety function of systems, and 10CFR50.73(a)(2)(vii) because a single cause resulted in independent trains becoming inoperable in multiple systems.

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An assessment of the safety consequences and implications of this event concluded that this event had the potential for nuclear safety significance. The potential existed for some safety related systems to be unavailable to perform their safety functions if needed. The affected systems include Residual Heat Removal, Low Pressure Core Spray, Shutdown Service Water, High Pressure Core Spray, Emergency Diesel Generators, Reactor Recirculation, Reactor Core Isolation Cooling, Main Steam, and Control Rod Drive. However, only Shutdown Service Water, Main Steam, Reactor Core Isolation Cooling, Low Pressure Core Spray, and Division III of the Emergency Diesel Generator experienced actual circuit failures and those failures did not adversely affect plant safety.

The systems discussed in this report became inoperable on various dates beginning in December 1996. The inoperable conditions were discovered on June 9, 1997. Rework of the sockets is complete.

ADDITIONAL INFORMATION

The equipment that failed during this event were neon light sockets manufactured by the Divesco Company. The socket part number is 911-401x-231xx, which is equivalent to the General Electric light socket, part number 204B6586P001.

Clinton Power Station has not reported similar events in recent history.

IP provided information about the neon light socket and solder flux issues the Regional Administrator, Region III, U.S. Nuclear Regulatory Commission in letters dated June 10, 1997 (U-602759), June 19, 1997 (U-602763), June 20, 1997 (U-602766), and June 30, 1997 (U602770).

For further information regarding this issue, contact D. K. Forbes, Maintenance Services Root Cause Investigator at (217) 935-8881, extension 3577.