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SUBJECT: LER 91-003-01:on 910619,spurious containment spray sys actuation occurred during performance of monthly ESFS surveillance testing of PPS.Caused by incorrect assembly of ESFAS.Pushbutton test switch replaced.W/911023 ltr.

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JAMES M. LEVINE
VICE PRESIDENT
NUCLEAR PRODUCTION

192-00751-JML/TRB/KR
October 23, 1991

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Mail Station P1-37
Washington, D.C. 20555

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Unit 3
Docket No. STN 50-530 (License No. NPF-74)
Licensee Event Report 91-003-01
File: 91-020-404

Attached please find Supplement 1 to Licensee Event Report (LER) 91-003 prepared and submitted pursuant to 10CFR50.73. This supplement is being submitted to provide the results of an APS evaluation pertaining to the response to be taken following an inadvertent Containment Spray System actuation. In accordance with 10CFR50.73(d), we are forwarding a copy of the LER to the Regional Administrator of the Region V office.

If you have any questions, please contact D. A. Johnson, Compliance Supervisor, at (602) 393-3703.

Very truly yours,

James M Levine

JML/TRB/KR/nk

Attachment

cc: W. F. Conway (all with attachment)
J. B. Martin
D. H. Coe
INPO Records Center

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LICENSEE EVENT REPORT (LER)

FACILITY NAME	DOCKET NUMBER	PAGE
Palo Verde Unit 3	0 5 0 0 0 5 3 0	1 OF 1 1

TITLE: Inadvertent Containment Spray Actuation

EVENT DATE			LER NUMBER			REPORT DATE			OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
									N/A	0 5 0 0 0
0 6	1 9	9 1	9 1	0 0 3	0 1	1 0	2 3	9 1	N/A	0 5 0 0 0

OPERATING MODE	POWER LEVEL	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following)			
1	1 0 0	20.402(b)	20.405(c)	X 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)	X 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

NAME	TELEPHONE NUMBER
	AREA CODE
D. Alan Johnson, Compliance Supervisor	6 0 2 / 3 9 3 - 3 7 0 3

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
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SUPPLEMENTAL REPORT EXPECTED		EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

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

On June 19, 1991, at approximately 1002 MST, a spurious Containment Spray System actuation occurred during the performance of the monthly Engineered Safety Features Actuation System (ESFAS) surveillance testing of the Plant Protection System (PPS). Control Room personnel determined that the Containment Spray System actuation was not the result of a valid condition (i.e., high containment pressure) and terminated the containment spray flow. Control Room personnel manually tripped the reactor at approximately 1004 MST and stopped the four reactor coolant pumps at approximately 1007 MST, in accordance with an approved procedure. At approximately 1022 MST, on June 19, 1991, natural circulation cooling was verified and the plant was stabilized in Mode 3 (HOT STANDBY). No other safety system responses occurred and none were required.

The spurious Containment Spray System actuation was the result of the incorrect assembly of a logic matrix relay hold pushbutton test switch in the test circuitry located in the PPS cabinet. The pushbutton test switch was replaced. The other logic matrix relay hold pushbutton test switches in Units 1, 2 and 3 were inspected and found to be assembled correctly.

There have been no previous similar events reported pursuant to 10CFR50.73.

I. DESCRIPTION OF WHAT OCCURRED:

A. Initial Conditions:

On June 19, 1991, at 1002 MST, Palo Verde Unit 3 was in Mode 1 (POWER OPERATION) at approximately 100 percent power.

B. Reportable Event Description (Including Dates and Approximate Times of Major Occurrences):

Event Classifications: An event that resulted in a spurious Engineered Safety Feature (ESF)(JE) actuation and a manual reactor trip. A condition prohibited by PVNGS Technical Specifications.

On June 19, 1991, at approximately 1002 MST, a spurious Containment Spray System (BE) actuation occurred during the performance of the monthly Engineered Safety Features Actuation System (ESFAS) (JE) surveillance testing of the Plant Protection System (PPS) (JC). Control Room personnel (utility, licensed) determined that the Containment Spray System actuation was not the result of a valid condition (i.e., high containment pressure) and terminated the containment spray flow by stopping the containment spray pumps (P)(BE) and closing the containment spray header isolation valves (ISV)(BE). In accordance with an approved procedure, Control Room personnel manually tripped the reactor (RCT)(AB) at approximately 1004 MST, and stopped the four (4) reactor coolant pumps (P)(AB) at approximately 1007 MST.

At approximately 1022 MST, on June 19, 1991, natural circulation cooling was verified to be providing heat removal and the plant was verified to be stable in Mode 3 (HOT STANDBY). No other safety system responses (including ESF actuations) occurred and none were required. The Shift Supervisor (utility, licensed) determined the manual reactor trip to be uncomplicated. The Containment Spray System components responded properly to the actuation signal. An estimated 5000 gallons of borated water was discharged into the containment spray header and piping. No anomalies were noted in the control system or overall plant response to the event which adversely affected plant operation.

Prior to the event, on June 19, 1991, Unit 3 Instrument and Control technicians (utility, non-licensed) were performing monthly surveillance tests on the PPS ESFAS logic matrices. The

logic matrix tests verify proper operation of the six (6) two-out-of-four logic matrices (i.e., AB, AC, AD, BC, BD, and CD), any of which will initiate a system trip for any possible two-out-of-four trip condition from each measurement channels' (CHA) (i.e., A, B, C, or D) signal inputs. At approximately 1002 MST, Instrument and Control technicians were testing the Containment Spray System CD logic matrix. The CD logic matrix relay (RLY) trip path 1 (i.e., Channel A) had been tested and verified to be reset. The CD logic matrix relay trip path 2 (i.e., Channel B) testing was in progress with the trip path 2 de-energized. When the CD logic matrix relay hold pushbutton test switch was released to allow the reset of the CD logic matrix relay trip path 2, the CD logic matrix relay trip path 3 (i.e., Channel C) de-energized unexpectedly, providing the necessary two-out-of-four trip logic, and initiated a Containment Spray System actuation on both Trains A and B Nuclear Steam Supply System Engineered Safety Features Actuation System (NSSS ESFAS) (JE).

Control Room personnel determined that the Containment Spray System actuation was not the result of a valid condition (i.e., high containment pressure). Within approximately 60 seconds of the actuation, Control Room personnel terminated the containment spray flow by overriding and stopping the containment spray pumps and overriding and closing the containment spray header isolation valves in accordance with an approved procedure. This action causes both trains of containment spray to be inoperable and results in entry into Technical Specification (TS) 3.0.3. Control Room personnel manually tripped the reactor at approximately 1004 MST and stopped the four (4) reactor coolant pumps at approximately 1007 MST, in accordance with an approved procedure.

In response to the Containment Spray System actuation, both the reactor coolant pump seal (SEAL) bleed-off and the nuclear cooling water (CC) containment isolation valves automatically close. As expected, reactor coolant pump low nuclear cooling water flow alarms (FA) were received and the nuclear cooling water containment isolation valves were overridden and opened in accordance with the abnormal operating procedure. In addition, the reactor coolant pump seal bleed-off containment isolation valves were overridden and opened to restore reactor coolant pump seal bleed-off. This action causes both automatic containment isolation valves in the same containment penetration for nuclear cooling water and the reactor coolant pump seal bleed-off to be inoperable and results in entry into TS 3.0.3.

At approximately 1022 MST, on June 19, 1991, natural circulation cooling was verified to be providing heat removal and the plant was verified to be stable in Mode 3 at normal temperature and pressure. The Shift Supervisor (utility, licensed) determined the manual reactor trip to be uncomplicated. At approximately 1026 MST, Control Room personnel restored the containment spray pumps to an operable condition and reset the Containment Spray Actuation Signal which restored the containment isolation valves to an operable condition. Both TS 3.0.3 conditions were exited at this time.

Based on guidance provided in the PVNGS Emergency Plan Implementing Procedure, Control Room personnel determined that the event did not require a declaration of a Notification of Unusual Event (NUE). Subsequently, at approximately 1119 MST, on June 19, 1991, a Notification of Unusual Event was conservatively declared by the Plant Manager (utility, non-licensed) for a loss of forced circulation event in combination with an inadvertent Containment Spray System actuation. At approximately 1207 MST, on June 19, 1991, the Nuclear Regulatory Commission (NRC) Operations Center was notified of the ESF actuation, the manual reactor trip, and the declaration of the Notification of Unusual Event. At approximately 1123 MST, on June 19, 1991, the appropriate state and local agencies were notified via the Notification and Alert Network (NAN).

Inspection and testing activities were initiated within Containment to determine if the spray had adversely affected the operation of the reactor coolant pumps. Following inspection, electrical meggar test, and restart of one reactor coolant pump, forced circulation in the reactor coolant system (AB) was restored. The Notification of Unusual Event was terminated at approximately 1339 MST, on June 19, 1991.

C. Status of structures, systems, or components that were inoperable at the start of the event that contributed to the event:

Not applicable - no structures, systems, or components were inoperable at the start of the event which contributed to this event.

D. Cause of each component or system failure, if known:

Engineering analysis and troubleshooting determined that the spurious Containment Spray System actuation was the result of a

malfunction in the Containment Spray System initiation/actuation test circuitry. This malfunction was caused by the incorrect assembly of the CD logic matrix relay hold pushbutton test switch in the PPS cabinet (SALP Cause Code B: Manufacturing Error).

Each of the six (6) ESFAS logic matrix relay hold pushbutton test switches (i.e., AB, AC, AD, BC, BD, and CD) consists of four (4) components: one (1) pushbutton and three (3) contact blocks (BLK). Each contact block has two sets of contacts. Two of the contact blocks contain one normally open contact and one early close/normally open contact. The third contact block contains two normally closed contacts. Visual inspection of the six (6) logic matrix relay hold pushbutton test switches in the PPS cabinet revealed that the CD logic matrix relay hold pushbutton test switch was assembled differently than the other five (5) pushbutton test switches. The center contact block of the CD logic matrix relay hold pushbutton test switch was found to be rotated 180 degrees from the position of the other pushbutton test switches' center contact blocks. The reversed center contact block caused the early close contacts to be switched with the normally open contacts. The vendor was contacted for information regarding the correct orientation of the logic matrix relay hold pushbutton test switches and confirmed that the CD logic matrix relay hold pushbutton test switch should be assembled identical to the other five (5) pushbutton test switches.

E. Failure mode, mechanism, and effect of each failed component, if known:

In the event of Containment pressurization due to a main steam (SB) line break or loss of coolant accident inside Containment, the Plant Protection System (PPS) is designed to initiate a reactor trip, a Containment Isolation Actuation Signal (CIAS) (JM), a Main Steam Isolation Signal (MSIS) (JE), and a Safety Injection Actuation Signal (SIAS) (JE) when Containment pressure reaches 3.0 psig and a Containment Spray Actuation Signal (CSAS) when Containment pressure reaches 8.5 psig. Containment (NH) pressure is continuously monitored to provide signals to the PPS trip bistables. Each of four (4) channels (i.e., A, B, C and D) monitoring Containment pressure has a bistable which will generate a bistable trip signal at the preset limit of 8.5 psig. Whenever a channel trip parameter (i.e., containment pressure) reaches the trip value (i.e., 8.5 psig), the channel bistable de-energizes the bistable trip relay. The output signals generated by these bistable trip relays are arranged to form a logic matrix (i.e.,

AB, AC, AD, BC, BD, and CD), which represent all possible two-out-of-four combinations. The logic matrix requires two or more bistables monitoring the same parameter (i.e., containment pressure) to be in a tripped condition before a coincidence signal can be generated. Each logic matrix is connected in series with a set of four (4) parallel matrix output relays. The contacts of the matrix relays are combined into four (4) trip paths (i.e., 1, 2, 3 and 4), one trip path per channel. The matrix relays are arranged in two trip legs (i.e., trip paths 1 and 3 and trip paths 2 and 4). One contact in each trip leg must be de-energized to de-energize the actuation relays and initiate the Containment Spray System actuation.

On June 19, 1991, Unit 3 Instrument and Control technicians were performing monthly surveillance tests on the PPS ESFAS logic matrices. The logic matrix tests verify proper operation of the six (6) two-out-of-four logic matrices (i.e., AB, AC, AD, BC, BD, and CD), any of which will initiate a system trip for any possible two-out-of-four trip condition from each measurement channels' (i.e., A, B, C, or D) signal inputs. Because of a manual matrix test electrical interlock (IEL) provided during system testing, only the matrix relays (i.e., trip path 1 through 4) in one of the six (6) logic matrix test modules (i.e., AB, AC, AD, BC, BD, or CD) can be held in the energized position.

Actuation of the logic matrix relay hold pushbutton test switch will apply a test voltage to the test system hold coils (CL) of the selected four double coil matrix relays. This voltage will provide the power necessary to hold the relays in their energized position when deactuation of the bistable trip relay contacts in the logic matrix ladder being tested cause de-energization of the primary matrix relay coils. During this test, the matrix relay hold lights (IL) will remain on, indicating that a test voltage has been applied to the holding coils of the four matrix relays of the logic matrix module under test. The test is repeated for the six (6) matrices and for each actuation signal. This test will verify that the bistable relay contacts operate correctly and that the logic matrix relays de-energize if the matrix continuity is broken.

At approximately 1002 MST, Instrument and Control technicians were testing the Containment Spray System CD logic matrix. The CD logic matrix relay trip path 1 (i.e., Channel A) had been tested and verified to be reset. The CD logic matrix relay trip path 2 (i.e., Channel B) testing was in progress with the trip path 2 de-

energized. When the CD logic matrix relay hold pushbutton test switch was released to allow the reset of CD logic matrix relay trip path 2, the CD logic matrix relay trip path 3 (i.e., Channel C) de-energized unexpectedly. The spurious Containment Spray System actuation occurred when the second half leg trip (i.e., trip path 3 of trip path 1 and 3) de-energized coincident with the existing half leg trip (i.e., trip path 2 of trip path 2 and 4) providing the necessary two-out-of-four trip logic.

During troubleshooting, a contact bounce was observed from the CD logic matrix relay hold pushbutton test switch. Further investigation determined that by allowing the pushbutton test switch to snap back to its at-rest position as opposed to releasing the pushbutton test switch gradually, channel(s) other than the one selected would trip frequently. Additional troubleshooting identified that the CD logic matrix relay hold pushbutton test switch was found to be incorrectly assembled. The reversed contact block caused the early close contacts to be switched with the normally open contacts. This change would result in incorrect timing of the test signals causing a matrix relay "race" condition to exist. A quick release of the pushbutton test switch would cause more than the selected single trip path to de-energize and unexpected results would occur frequently.

F. For failures of components with multiple functions, list of systems or secondary functions that were also affected:

Not applicable - no failures of components with multiple functions were involved.

G. For a failure that rendered a train of a safety system inoperable, estimated time elapsed from the discovery of the failure until the train was returned to service:

Not applicable - no failures that rendered a train of a safety system inoperable were involved.

H. Method of discovery of each component or system failure or procedural error:

The incorrect assembly of the CD logic matrix relay hold pushbutton test switch was discovered during troubleshooting performed after the event. There were no procedural errors which contributed to this event.

I. Cause of Event:

Engineering analysis and troubleshooting determined that the spurious Containment Spray System actuation was the result of the incorrect assembly of the ESFAS CD logic matrix relay hold pushbutton test switch in the test circuitry located in the PPS cabinet as described in Section I.D and I.E (SALP Cause Code B: Manufacturing Error).

No unusual characteristics of the work location (e.g., noise, heat, poor lighting) directly contributed to this event. There were no personnel errors which contributed to this event.

J. Safety System Response:

The system responses required by a Containment Spray Actuation System actuated as designed. An estimated 5000 gallons of borated water was discharged into the containment spray header and piping. The following automatic safety system equipment started:

- Emergency Diesel Generators (EK), Trains A and B,
- High Pressure Safety Injection Pumps (P)(BQ), Trains A and B,
- Low Pressure Safety Injection Pumps (P)(BP), Trains A and B,
- Control Room Essential Air Handling Units (VI), Trains A and B,
- Fuel Building Essential Air Filtration Units (VG), Trains A and B,
- Containment Spray Pump (P)(BE)s, Train A and B,
- Essential Cooling Water Pumps (P)(BI), Trains A and B,
- Essential Spray Ponds Pumps (P)(BS), Trains A and B,
- Essential Chillers/Chilled Water Pumps (P)(KM), Trains A and B,
- Spray Chemical Addition Pumps (P)(BE), Trains A and B, and
- Auxiliary Feedwater Pump (P)(BA), Train B.

The following automatic safety system valves opened:

- Spray Chemical Addition to Containment Spray Pumps Trains A and B Suction Valves (V)(BE),
- Spray Chemical Addition Pumps Trains A and B Discharge Valves (V)(BE), and
- Containment Spray Trains A and B Discharge to Spray Headers 1 and 2 Valves (V)(BE).

The following automatic safety system valves closed:

- Reactor Coolant Pump Containment Bleed Off Headers To Volume Control Tank Isolation Valves (ISV)(AB), Trains A and B,
- Nuclear Cooling Water Containment Downstream Return Isolation Valve (ISV)(CC), Train A,
- Nuclear Cooling Water Containment Upstream Return Isolation Valve (ISV)(CC), Train B,
- Nuclear Cooling Water Containment Upstream Supply Isolation Valve (ISV)(CC), Train B, and
- Outside Containment Isolation Valve, Instrument and Service Air (ISV)(LD)(LF), Train A.

K. Failed Component Information:

The logic matrix relay hold pushbutton test switch was manufactured by Cutler-Hammer and distributed by ABB Combustion Engineering and consists of the following four components:

1. One white, vertical, half-shrouded pushbutton operator, Model Number 10250T-506,

2. One contact block for ESFAS auxiliary relay cabinets with two normally closed contacts, Model Number 10250T-3, and

3. Two contact blocks with two sets of contacts, one normally opened contact and one early close/normally open contact, Model Number 10250T-57.

II. ASSESSMENT OF THE SAFETY CONSEQUENCES AND IMPLICATIONS OF THIS EVENT:

An inadvertent Containment Spray System actuation, a reactor trip, and the loss of forced cooling event are analyzed conditions. No safety limits were violated. The event did not result in any challenges to fission product barriers or result in any releases of radioactive materials. All equipment operated as designed. There were no adverse effects caused by the reactor coolant pump seal bleed-off valves being shut. There were no safety consequences or implications resulting from this event.

III. CORRECTIVE ACTION:

A. Immediate:

APS immediately initiated inspection and testing activities within Containment to determine if the spray had adversely affected the operation of the reactor coolant pumps. Following inspection, electrical meggar test, and restart of one reactor coolant pump, forced circulation in the reactor coolant system was restored.

An integrated investigation was initiated in accordance with the requirements of the APS Incident Investigation Program.

The vendor of the logic matrix relay hold pushbutton test switch was contacted for information regarding the correct orientation of the pushbutton test switches. The CD logic matrix relay hold pushbutton test switch was replaced. The other logic matrix relay hold pushbutton test switches in Units 1, 2 and 3 were inspected and found to be assembled correctly.

B. Action to Prevent Recurrence:

APS Engineering performed a root cause of failure investigation. The results of the investigation are described in Section 1.D. Based upon the results of the investigation and inspection conducted for the other logic matrix relay hold pushbutton test switches, no further corrective actions are required for the pushbutton test switches currently installed. Drawings are being made available which show the correct logic matrix relay hold pushbutton test switch configuration to be used for replacement pushbutton test switches.

An Engineering Evaluation was performed to evaluate the response to be taken following an inadvertent Containment Spray System actuation. The evaluation determined that, if cooling water flow to the reactor coolant pumps can be restored within ten (10) minutes and no immediate need (i.e., no apparent indication of damage to the reactor coolant pump thrust bearings or motor) exists to require stopping the reactor coolant pumps, continued operation of the reactor coolant pumps is allowable.

Therefore, the procedure for plant operation following an inadvertent Containment Spray System actuation, with containment spray flow indication, will be changed to direct Control Room personnel to restore cooling water flow to the reactor coolant pumps. If cooling water cannot be restored within 10 minutes, then Control Room personnel will manually trip the reactor prior

to stopping the reactor coolant pumps. If no immediate problems occur that require either a plant shutdown or the reactor coolant pumps to be stopped, appropriate APS personnel will proceed to evaluate the subsequent actions on a case by case basis, depending on plant-specific conditions. The procedure change is expected to be completed by January 31, 1992.

IV. PREVIOUS SIMILAR EVENTS:

There have been no previous similar events reported pursuant to 10CFR50.73 where the Containment Spray System was actuated.

V. ADDITIONAL INFORMATION:

In order to facilitate subsequent troubleshooting, inspections and testing activities, APS initiated a cooldown to Mode 5 (COLD SHUTDOWN). No systems or components within Containment were found to be adversely affected by the spray. Inspection and evaluation results of the consequences of the event on systems and components are summarized in a letter to Mr. J. B. Martin, NRC Region V Regional Administrator dated June 28, 1991 (102-02047-JML/TRB/KR).

Based on the Incident Investigation Team review, unit restart was authorized by the Plant Manager in accordance with approved procedures. Unit 3 entered Mode 2 (STARTUP) at 2000 MST, on June 22, 1991, and was placed back on the grid at 0127 MST, on June 23, 1991.