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ACCESSION NBR:9202050243 DOC.DATE: 92/01/24 NOTARIZED: NO DOCKET # FACIL:STN-50-529 Palo Verde Nuclear Station, Unit 2, Arizona Publi 05000529 AUTH.NAME AUTHOR AFFILIATION BRADISH,T.R. Arizona Public Service Co. (formerly Arizona Nuclear Power LEVINE,J.M. Arizona Public Service Co. (formerly Arizona Nuclear Power RECIP.NAME RECIPIENT AFFILIATION R

SUBJECT: LER 91-004-01:on 910816, reactor trip occurred due to high pressurizer pressure. Caused by generator/turbine trip in combination w/coginitive personnel error. Generrex AC/DC gate board was replaced. W/920124 ltr.

DISTRIBUTION CODE: IE22T COPIES RECEIVED:LTR / ENCL / SIZE: 10 TITLE: 50.73/50.9 Licensee Event Report (LER), Incident Rpt, etc.

NOTES:Standardized plant.

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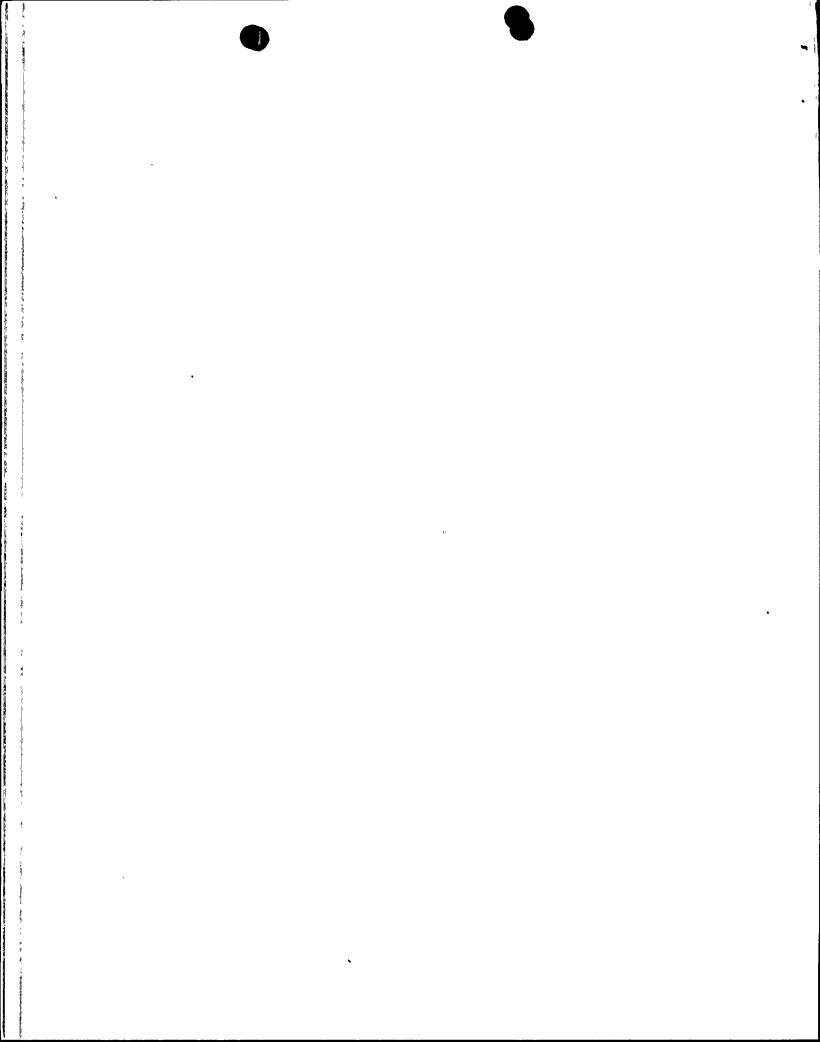
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JAMES M. LEVINE VICE PRESIDENT NUCLEAR PRODUCTION

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192-00768-JML/TRB/KR January 24, 1992

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 2 Docket No. STN 50-529 (License No. NPF-51) Licensee Event Report 91-004-01 File: 92-020-404

Attached please find Supplement 01 to Licensee Event Report (LER) 91-004 prepared and submitted pursuant to 10CFR50.73. This supplement is being submitted to provide the results of an APS Engineering root cause of failure analysis of a Generrex A.C./D.C. gate board's static switch. In accordance with 10CFR50.73(d), a copy of this supplement is being forwarded to the Regional Administrator of the Region V office.

If you have any questions, please contact T. R. Bradish, Compliance Manager at (602) 393-2521.

Jame M Jeine

JML/TRB/KR/nk

Attachment

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

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NRC Form 366 (9-83)			LIC	ENSE	E EVE	NT RE	PORT	(LER)	U.S.	APPRO	REGULATO OVED OMB N ES: 8/31/88		
FACILITY NAME (1)	Palo	Verde Uni	t 2						DOCKET NUMB	,	51219		019
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ABSTRACT (Limit to 14)		SUBMISSION DATE		i Newritten li								II	
4								•	••				
On August 16, 1991, at approximately 0839 MST, Palo Verde Unit 2 was in Mode 1 (POWER OPERATION), operating at approximately 64 percent power when a reactor trip occurred due to high pressurizer pressure. Immediately prior to the reactor trip, the Main Generator tripped initiating a Main Turbine trip. At approximately 0900 MST on August 16, 1991, the plant was stabilized in Mode 3 (HOT STANDBY) at normal operating temperature and pressure. The event was diagnosed as an uncomplicated reactor trip. No other safety system responses occurred and none were required.													
 The reactor trip on high pressurizer pressure has been determined to be the normal plant response to a load rejection at 64 percent power with 7 of the 8 steam bypass control valves (SBCVs) in service. The cause of the reactor trip was a generator/turbine trip in combination with a cognitive personnel error by the Control Room personnel who did not comply with procedural requirements to have the 8 SBCVs in service at power levels below 75 percent. Control Room personnel were disciplined in accordance with the PVNGS Positive Discipline Program. The Main Generator trip was caused when a Generrex A.C./D.C. gate board's static switch failed and the Generrex excitation control system entered an abnormal state (i.e., excessively high field voltage, current and VARS). The gate board was replaced and the Generrex System was successfully retested and returned to service. A previous similar event was reported in Unit 1 LER 528/90-006. 													
A prev	ious si	milar eve	nt was	repo	rted :	in Uni	LT I]	LEK 528/9	90-006.				

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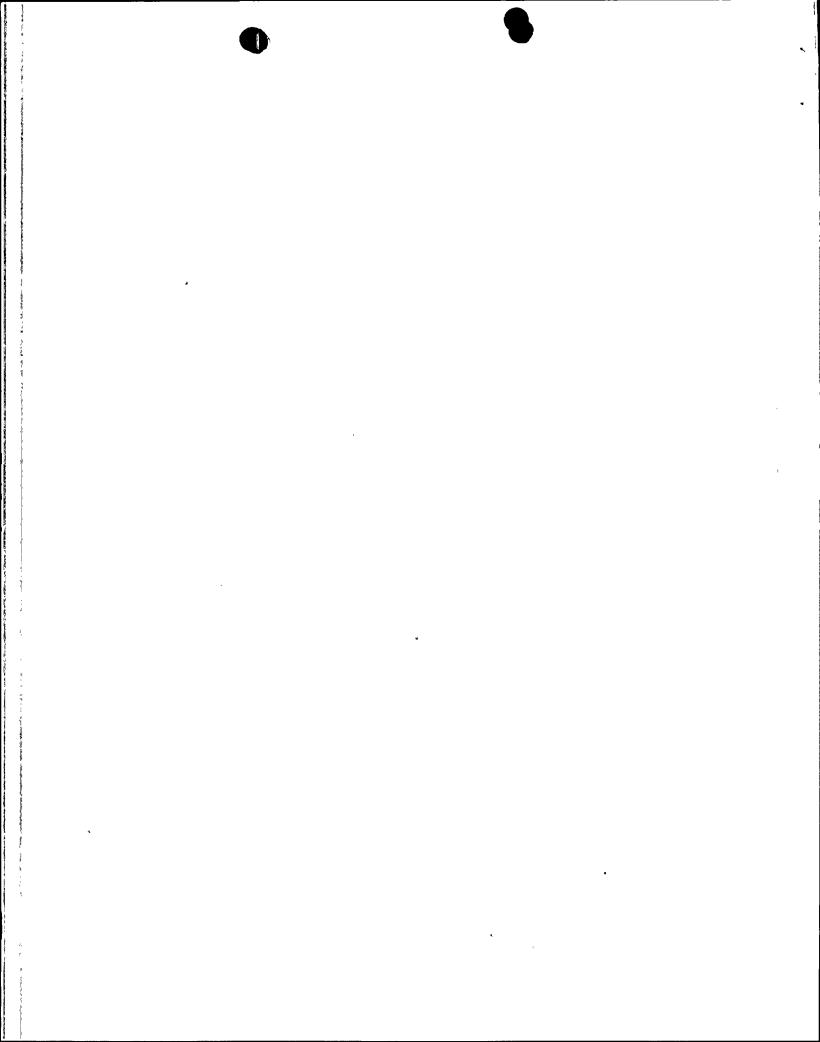
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Palo Ve	rde Unit	2	0 5 0 0	0 15 12 19		1
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I.	DESCRI	PTION OF WHAT OCCURRE	ED:			
	Α.	Initial Conditions:				
		On August 16, 1991, a (POWER OPERATION) at	at 0839 M approxim	ST, Palo Ve ately 64 pe	rde Unit 2 was in Mo rcent power.	de l
		Reportable Event Desc Times of Major Occurr	-	(Including	Dates and Approximat	е
		Event Classification:	:	in automat	or condition that re tic actuation of the rotection System (RPS	
		experienced an automa 64 percent power due Immediately prior to tripped initiating a 0900 MST on August 16 (HOT STANDBY) at norm	atic reac to high y the reac Main Turn 5, 1991, nal opera as an unc	tor (RCT)(A pressurizer tor trip, t bine (TA) t the plant w ting temper omplicated	the Main Generator (T. Trip. At approximate vas stabilized in Mod ature and pressure. reactor trip. No ot	mately B) ly e 3 The
		the process of return a manual reactor trip 529/91-003). The play Feedwater pump (P)(S. (AB). With only one increased up to appro- feedwater pump suction pounds per square ind the reactor power ind due to the inability discharge valve (V)(C At approximately 0700 initiated. The invest between the check val- discharge gate valve opening. The hydrau the approximately set discharge piping betw discharge gate valve expansion of the wate of plant heatup. The	ning to no owhich own ant was s J) to sup main fee oximately on pressu cheage crease wa to open GATE)(P)(0 MST, an stigation lve on th prevente lic lock ween the . The ov er trappe e measure	ormal full ccurred on tarted up u ply feedwat dwater pump 70 percent re is maint (psig). At s stopped a the Train E SJ) [a moto APS Engine determined e discharge d the disch was a resul section of discharge of erpressuriz d between t d pressure	sing the Train A Mai er to the steam gene in service, power m a solong as main aned greater than 3 approximately 0300 is approximately 64 p Main Feedwater pump or operated gate valve ering investigation that a hydraulic lo piping and the down marge gate valve from t of overpressurizat the Main Feedwater	owing n rators ay be 00 MST, ercent e]. was ck stream ion of rmal esult 00

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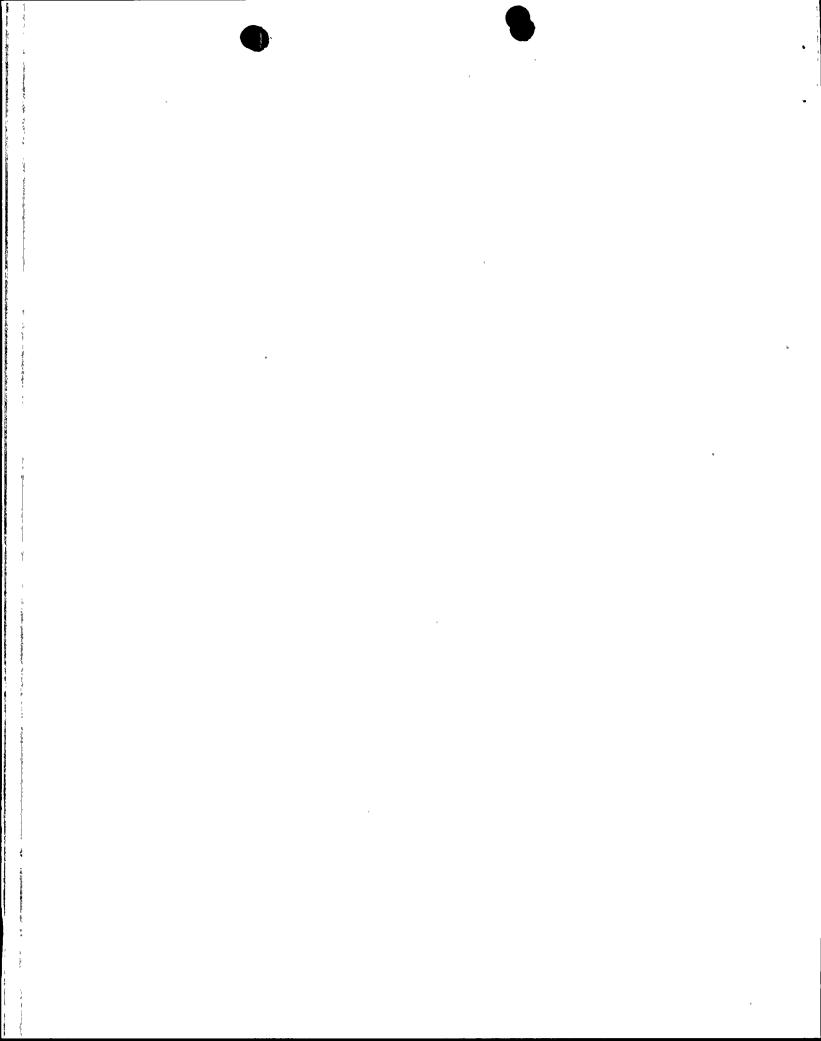
Train A Main Feedwater pump remained in service. Reactor power remained at approximately 64 percent pending resolution of the Train B Main Feedwater System problem and Engineering evaluation of the overpressurized section of Main Feedwater discharge piping (see Section V for additional information).

At approximately 0838 MST on August 16, 1991, Palo Verde Unit 2 was operating at approximately 64 percent power when the Control Room (NA) received a Main Generator excitation trouble alarm (ALM). The Control Room operators (utility, licensed) checked the Generrex excitation control system (TL) and found indications that the Generrex exciter (EXC) cubicle was in an abnormal state (i.e., excessively high field voltage, current and VARS). The voltage/hertz timing light was flashing, indicating an overexcited condition in the Main Generator. The secondary operator (utility, licensed) attempted to lower the A.C. voltage manually. However, the A.C. voltage regulator (RG)(TL) tripped followed by a Main Generator trip which initiated a Main Turbine trip.

When the Main Turbine tripped, the Steam Bypass Control System (JI) (SBCS) generated a quick open signal. The seven in-service steam bypass control valves (PCV)(JI) (SBCVs) automatically opened to 100 percent in response to the quick open signal. The open SBCVs resulted in an excess steam demand and subsequent rapid power increase, generating variable overpower pretrip signals to the four channels of the Plant Protection System (JC) (PPS). The magnitude of the power increase was not sufficient to cause the channels of the PPS to trip on variable over power. The main steam (SB) pressure decreased as a result of the SBCVs quick The SBCVs then began to modulate closed to maintain main opening. steam pressure. Pressurizer pressure and main steam pressure began increasing as the SBCVs modulated closed. The main steam pressure increase due to reactor power operation caused the SBCVs to modulate open. However, the seven SBCVs did not modulate open fast enough to prevent pressurizer pressure from increasing up to the high pressurizer pressure trip setpoint. The high pressurizer pressure pretrips were received on four channels of the PPS. Channels A and D high pressurizer pressure trip signals were generated at approximately 0839 MST, satisfying the two-out-offour trip logic for the Reactor Protection System. This resulted in a reactor trip.

The Control Room Supervisor (utility, licensed) diagnosed the event as a reactor trip and entered the approved reactor trip procedure. At approximately 0900 MST, the plant was stabilized in Mode 3 (HOT STANDBY). No other safety system responses, including Engineered Safety Features Actuations (JE), occurred and none were required. The Shift Supervisor (utility, licensed) declared the

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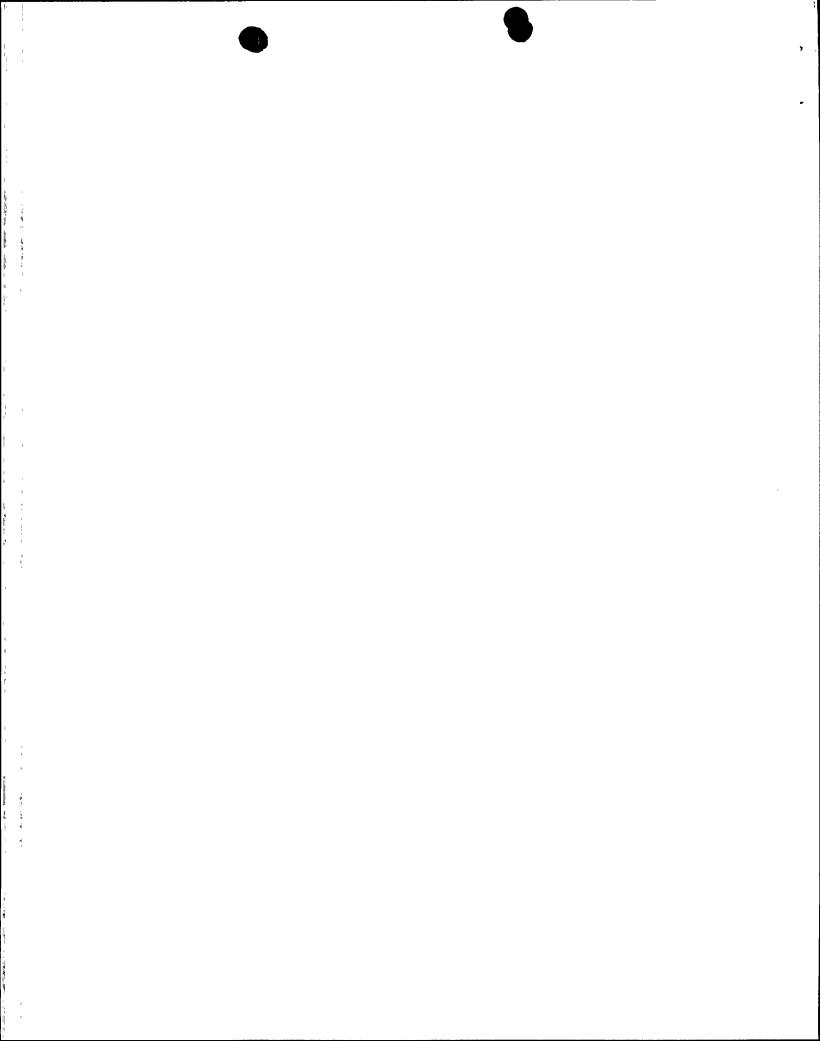
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		event an uncomplicated were noted in the cont event which would adve The Steam Bypass Contr transient (i.e., incre designed. At the time bypass control valves had been placed in per Operations procedure.	rol system or overa rsely affect plant ol System (JI) (SBC ase in Main Steam [of the event, seve (PCV)(JI) (SBCVs) w	11 plant response to operation. S) responded to the SB] pressure) as n of the eight steam ere in service. One	the SBCV		
		Status of structures, systems, or components that were inoperable at the start of the event that contributed to the event: One of the eight steam bypass control valves (SBCVs) was in permissive "off" mode (i.e., the valve would not automatically operate). The procedure requires eight SBCVs to be in automatic at power levels less than 75 percent.					
I	D. (Cause of each componen	t or system failure	, if known:			
Ţ		The cause of the Gener abnormal state (i.e., VARS) was due to the m static switch. A root Engineering personnel, card would be the expe equipment is exposed t period of time.	excessively high fi alfunctioning of th cause of failure a determined that th cted result wheneve	eld voltage, current. e A.C./D.C. gate boar nalysis, performed by e failure to the circ r this type of electr	and d's APS wit conic		

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

The failure of the A.C./D.C. gate board's static switch in the A.C. mode put a high positive output signal into the field voltage regulator card. This condition would turn off the firing of the silicon control rectifiers (SCR), thus allowing all the available current to flow across the generator field. Indications were that the current rapidly exceeded normal values, the field current and voltage increased, the generator output voltage increased, the VARS increased, and the A.C. voltage regulator tripped on maximum excitation limits. The Main Generator trip was a result of the over-excitation of the field. The timing function of the maximum excitation level (MEL) circuitry caused the Generrex protective feature to trip the Main Turbine.

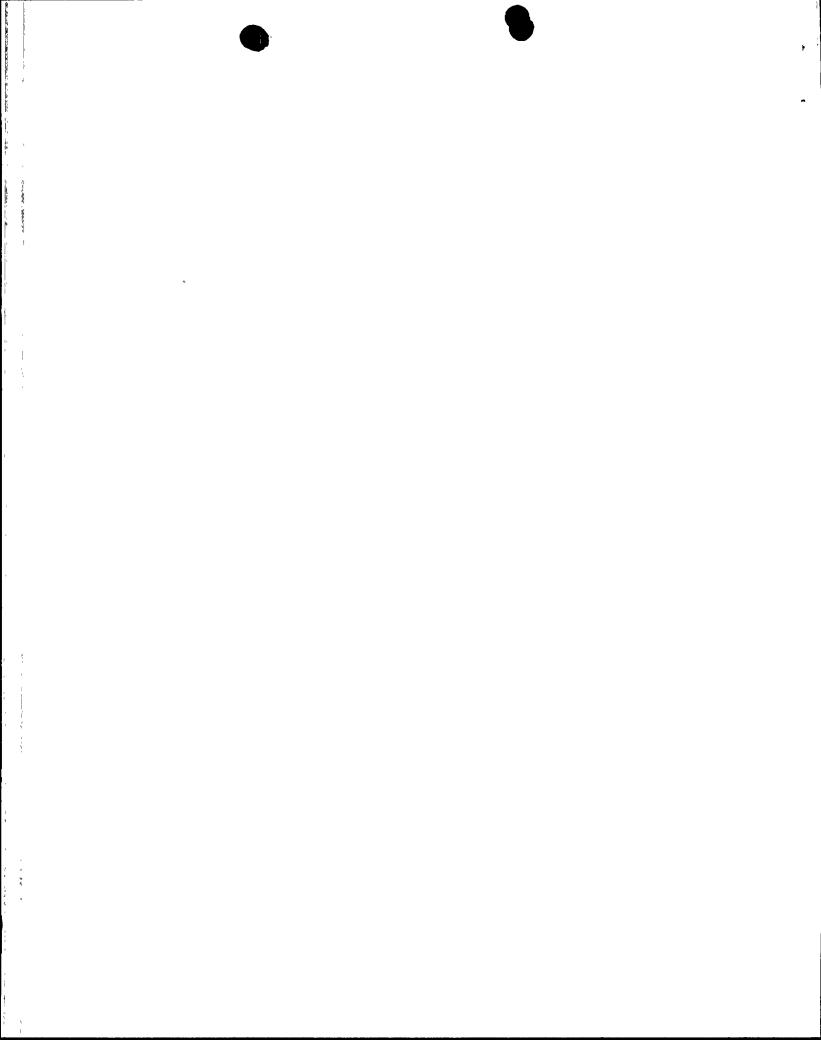
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F.		of components with multip condary functions that we				
×	Not applicable were involved.		nents with multiple functions			
G.	estimated time		f a safety system inoperable, very of the failure until the			
		e - no failures that rend ble were involved.	dered a train of a safety			
н.	Method of discovery of each component or system failure or procedural error:					
	discovered dur		rd's static switch was shooting and evaluation. contributed to this event.			
I.	Cause of Event	::				
	The cause of the reactor trip was a generator/turbine trip in combination with a cognitive personnel error by the Control Room personnel (utility, licensed) who did not comply with procedural requirements to have all eight SBCVs in service at power levels below 75 percent (SALP Cause Code A: Personnel Error).					
	Section I.D. been determine rejection at 6 control valves study predicts large load rej service. The	d to be the normal plant 4 percent power with sev 5 (SBCVs) in service. A 5 that a reactor trip is 6 ect from 64 percent powe 6 c study predicts that p	n pressurizer pressure has t response to a load ven of the eight steam bypass Combustion Engineering (CE) the expected result of a			
	Prior to the r	eactor trip, on August 1	15, 1991, Palo Verde Unit 2			

Prior to the reactor trip, on August 15, 1991, Palo Verde Unit 2 was in the process of returning to normal full power operation. In accordance with an approved procedure for plant startup, the Main Turbine was placed on-line in preparation for the power ascension. After placing the turbine on-line, the procedure requires that eight SBCVs be placed in service. The Assistant Shift Supervisor and Shift Supervisor (utility, licensed) reviewed the procedure and decided to place only seven of the eight SBCVs in service. Seven SBCVs in service is the normal operating configuration at power levels of 75 percent or above. During a

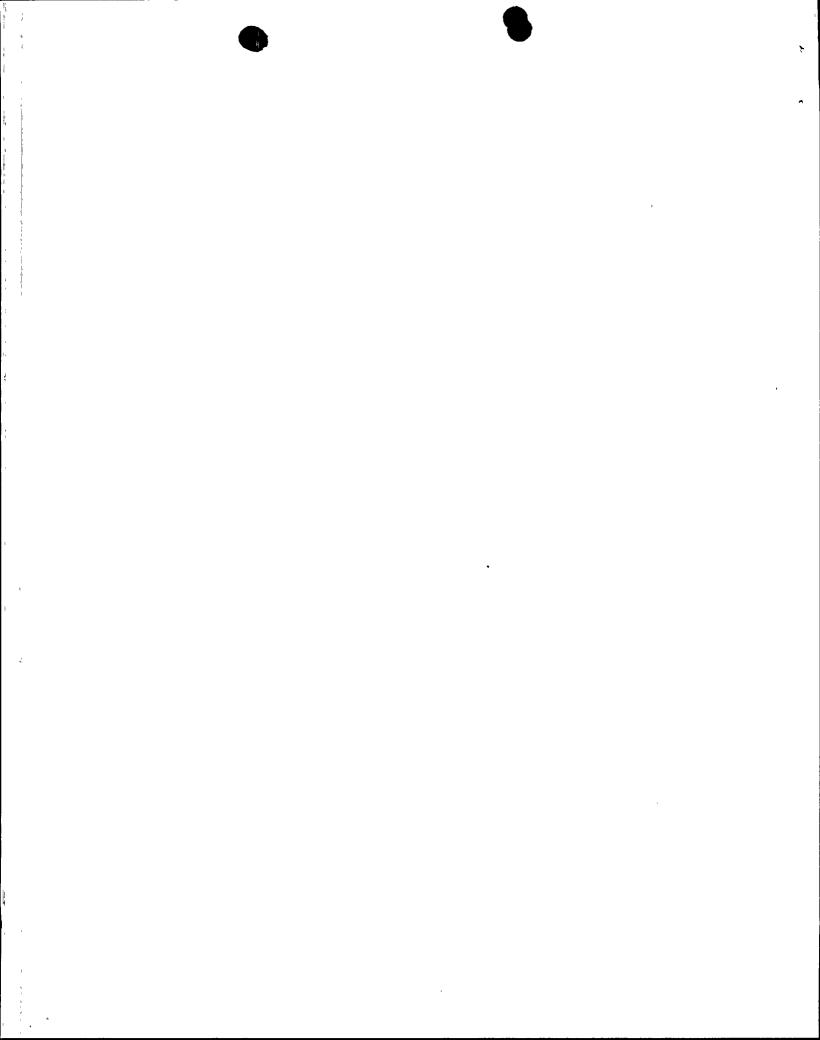


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π			0 15 10 10 10 15 12 19	9 1 - 0 10 4 - 0 1	0 6 0 F 0
	J.	Control Room shift tur coming Control Room per SBCS lineup. The on-co opportunity to identify service). No unusual characteriss heat, poor lighting) of were no procedural err Safety System Response The Plant Protection S designed. The reactor and D high pressurizer satisfying the two-out Protection System. No Engineered Safety Feat required. Failed Component Infor The Generrex A.C./D.C. manufactured by General number is 304A8496 Rev	ersonnel (utility, 1 coming Control Room Ey and correct the construction stics of the work local cors which contributed cors automatically contained to contained t	icensed) reviewed th personnel missed an condition (one SBCV of cation (e.g., noise, to this event. The red to this event. the transient as tripped when Channel als were generated, for the Reactor m responses, includi curred and none were e failed static swit	ne put of ere .s A .ng .s ch is
Π.	A rea deter syste event Bypas press power The e barri the p signi	SMENT OF THE SAFETY CON actor trip following a M mined to be the expecte ms design and the plant and the plant and combustion Enginee s Control System shows urizer pressure after a a and with one steam byp went did not result in ers or result in any re ost trip review and saf ficant safety consequent e public.	ain Generator/Turbi d result based on t configuration at t ring evaluation per that a reactor trip load reject with t ass control valve i any challenges to t leases of radioacti ety assessment of t	ne trip has been he current control he initiation of the formed on the Steam will occur on high he reactor at 64 per n permissive "off" m he fission product ve material. Based he event, there were	cent ode. on no

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12.1			•	·		
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	III.	CORRE	CTIVE ACTION:			
		Α.	Immediate:			
			The Shift Supervisor a disciplined in accorda Program.			
		_	The Generrex A.C./D.C. was replaced and the (returned to service.			
		в.	Action to Prevent Recu	irrence:		•
			An independent investi accordance with the PV of the investigation, Generrex gate board was discussed in Section I investigation, the fai exposure to voltage tr will be performed to o capacitors on a period A memo was written to need for procedural co understand the effects transmitted to Units 1	NGS Incident Invest a root cause of fai as performed by APS I.D. Based on the r ilure was found to b cansients. A preven change the gate boar lic basis. Unit 2 licensed ope ompliance and the ne s of any procedure d	tigation Program. As ilure analysis of the Engineering personnel results of the be the expected result ntive maintenance task rd's power supply erators to emphasize to eed to thoroughly deviations. The memo	l as' t of k the
	IV.	PREVIO	DUS SIMILAR EVENTS:	t		
		Verde percer the re detern reacto result requin	vious similar event was Unit 1 manually trippent nt power. Approximatel eactor tripped on high mined to be the expected or at 65 percent power t of the Unit 1 event, re eight SBCVs to be in 75 percent and seven SB	ed the Main Turbine by 30 seconds after pressurizer pressur ed result of a load and with one SBCV o a procedural revisi n-service when opera	at approximately 65 the Main Turbine trip ce. The reactor trip rejection with the put-of-service. As a lon was incorporated t ating at power levels	p, was to
		(529/9	scussed in Section I.I, 91-004) was a cognitive ns for the previous eve	e personnel error.	Therefore, the correct	ctive

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V. ADDITIONAL INFORMATION:

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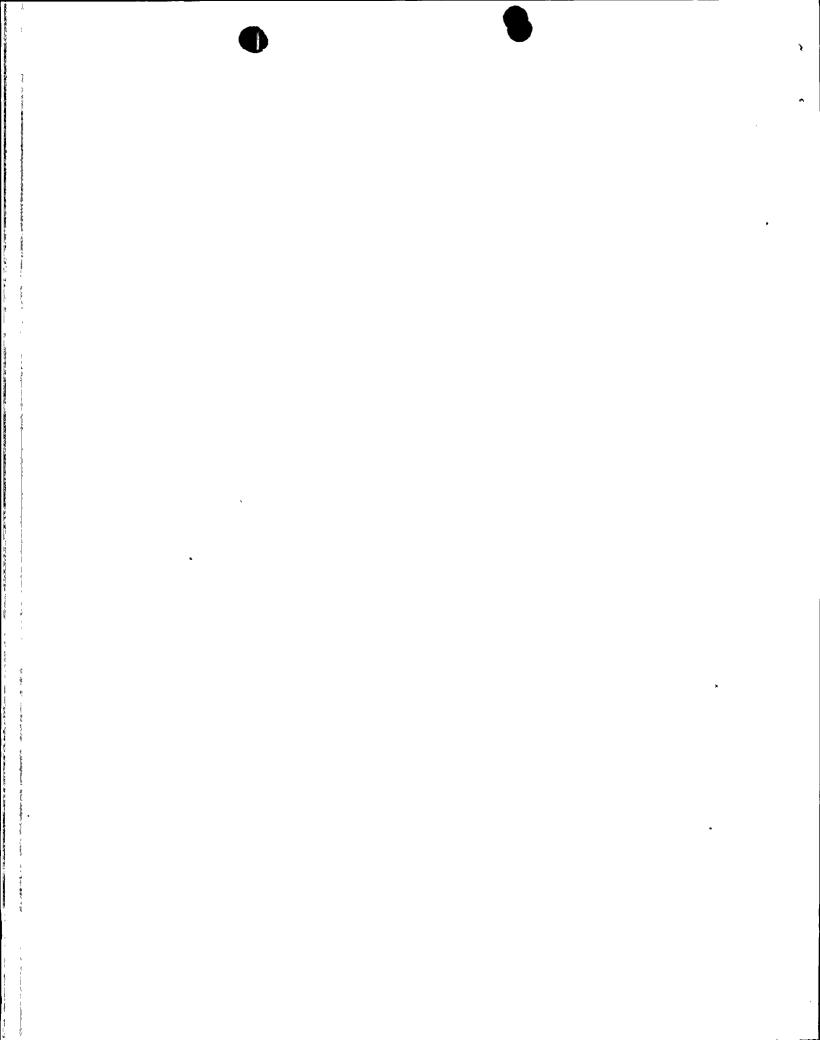
An APS Engineering evaluation was performed for material stress considerations resulting from the overpressurization of a section of the Train B Main Feedwater pump discharge piping between the discharge check valve and the discharge gate valve. The measured pressure was approximately 7000 psig and the valve body surface temperature was approximately 250 degrees Fahrenheit. The piping is designed for 1875 psig and 350 degrees Fahrenheit.

The stresses encountered by the piping section during this overpressurization resulted in a calculated hoop stress of 52,980 psig or 1.68 times the theoretical yield stress of 31,450 psig for the material at 249 degrees Fahrenheit. The predicated strain for this calculated stress level is less than 0.3 percent. Based upon this low strain computation, no visible signs of yielding are anticipated.

In addition, the section of piping was examined for indications of yielding and plastic deformation. The examination results support and verify that straining, if it occurred, was not visible, as the stress calculation predicted. Based upon the approximate strain calculated and the examination results, it is reasonable and practical to conclude that the actual strain fell into the strain hardening range of the stressstrain curve. Therefore, it is likely that the material work hardened to a higher elastic allowable. Strain hardening does not affect the ultimate strength of the material. Its only effect is a slight reduction in the overall ductility or total straining capacity prior to failure. This reduction in ductility has no impact on the piping, since the design stress values for the piping are well below the theoretical yield stress and do not approach this ultimate strain region during normal service conditions.

Based upon visual and non-destructive testing (NDT) examinations of the affected components (i.e., discharge check valve, piping, discharge gate valve, and vent (VTV) and drain valves), technical input from the valve vendors, and stress calculations performed by APS Nuclear Engineering, APS determined that the piping overpressurization did not result in any long term detrimental effects to the components. The components were deemed acceptable for continued unrestricted use in this application. In addition, independent evaluations of the event were performed by Bechtel and Sargent & Lundy. Both of these evaluations reached the same conclusion as APS Engineering.

To prevent recurrence of this event, appropriate Operations procedures were revised to open Train A and B discharge gate valves to prevent piping overpressurization due to thermal expansion of the entrapped water.



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	W. E. Ide	7194
	R. K. Flood	7294
	R. J. Adney	7394
	R. F. Schaller	7194
	T. D. Shriver	7294
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	S. C. Guthrie	6128
	R. J. Stevens	1502
	E. G. Firth (Training)	6990
	R. C. Fullmer	7194
	D. M. Eastman	6794
	M. R. Oren (STA)	6073
	T. E. Matlock (NSD)	1536
	D. N. Stover	1922
	J. R. LoCicero (ISEG)	6054
	R. W. Page	1938
	D. B. Andrews	6345
	M. E. Powell	1515
	A. C. Rogers	1966
	R. G. Hogstrom	6086
	D. A. Hettick	6996
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