



FORT ST. VRAIN NUCLEAR GENERATING STATION
PUBLIC SERVICE COMPANY OF COLORADO

AOP-K-1
Issue 59
Page 1 of 3

RC1

TITLE: ENVIRONMENTAL DISTURBANCES - EARTHQUAKE

RESPONSIBLE
FOR

M. E. Deuster

AUTHORIZED
BY

[Signature]

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REVIEW

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**FT. ST. VRAIN
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(K-1)
ENVIRONMENTAL DISTURBANCES - EARTHQUAKE
SYMPTOM-ACTION MATRIX

ACTIONS	SYMPTOMS					
	1.1 ABNORMAL BUILDING VIBRATIONS	1.2 SEISMIC RECORDER OPERATE ALARM I-06E, 5-5	1.3 LESS THAN 0.05g GROUND ACCELERATION	1.4 GREATER THAN OR EQUAL TO 0.05g BUT LESS THAN 0.10g	1.5 GREATER THAN OR EQUAL TO 0.10g GROUND ACCELERATION	1.6 EARTHQUAKE INDUCED IOFC
<u>OPERATOR ACTIONS</u>						
2.1 Ensure Defueling activities terminated.	XX	XX				XX
2.2 Monitor Critical Safety Functions per EOP's	XX	XX				XX
2.3 Verify authenticity, if desired, by confirming seismoscope motion	XX	XX				
2.4 Process all accelerograph photographs as soon as possible		XX				
2.5 Concurrently, monitor core critical safety functions and complete, within (1) one hour, inspection of piping downstream of valves listed in Tables 1A and 1B		XX XX	XX XX	XX XX	XX XX	
2.6 Complete within (2) two hours, inspection of piping downstream of valves listed in Table 1C		XX XX	XX XX	XX XX	XX XX	

(K-1)
ENVIRONMENTAL DISTURBANCES - EARTHQUAKE
SYMPTOM-ACTION MATRIX

ACTIONS	SYMPTOMS					
	1.1 ABNORMAL BUILDING VIBRATIONS	1.2 SEISMIC RECORDER OPERATE ALARM 1-06E, 5-5	1.3 LESS THAN 0.05g GROUND ACCELERATION	1.4 GREATER THAN OR EQUAL TO 0.05g BUT LESS THAN 0.10g	1.5 GREATER THAN OR EQUAL TO 0.10g GROUND ACCELERATION	1.6 EARTHQUAKE INDUCED 10FC
2.7 Visually inspect all Class I piping and equipment for leaks				XX	XX	XX
OPERATION ACTIONS 2.8 Complete within a 24 hour period, a visual inspec- tion of those valves listed in Tables 2A, 2B and 2C		XX XX	XX XX	XX XX	XX XX	



INTRODUCTION

Earthquakes with an acceleration in excess of 0.05g horizontal could result in damage to plant equipment which would be required for continued safe operation of the plant. Earthquakes with an acceleration in excess of 0.10g horizontal could result in damage to essential plant equipment which would be required for safe shutdown and cooldown. Thus, in the event of an earthquake, immediate action to determine its magnitude and assess its effects on plant equipment is appropriate.

DISCUSSION OF SYMPTOMS

1.1 Abnormal Building Vibrations.

An earthquake of the magnitude required to damage plant equipment will almost certainly be noticed by station personnel. Additionally, smaller tremors may be noted by plant personnel, requiring further investigation at the discretion of the Shift Supervisor.

1.2 Seismic Recorder Operate Alarm.

Action of the seismic recorders is initiated by an acceleration of 0.01g. When the recorders are started by such an acceleration, the Seismic Recorder Operate Alarm is sounded in the control room.

The accelerograph indications will not be readily available to the operator immediately. The accelerograph trace must move quickly to record the rapid vibrations of an earthquake. It is therefore impractical for the trace to run continuously. Thus, the seismoscope recorder trace is recorded by a photograph process that must be developed by the I&C Department to be visible for interpretation by the operator of the magnitude of the earthquake.

1.3 Less Than 0.05g Ground Acceleration

If developed film indicates horizontal ground acceleration less than 0.05g damage to equipment is not likely. Systems/components may be checked for any visual damage, at the discretion of the Shift Supervisor.

1.4 Greater Than Or Equal To 0.05g But Less Than 0.10g.

If developed film indicates horizontal ground acceleration greater than, or equal to, 0.05g, but less than 0.10g equipment required for continued operation may be damaged.



1.5 Greater Than Or Equal To 0.10g Ground Acceleration

If developed film indicates horizontal ground acceleration greater than, or equal to, 0.10g design limits may have been exceeded. All Class I structures, systems and components are designed to withstand an earthquake of 0.10g horizontal acceleration at the site. When an earthquake of this magnitude occurs, it is important that equipment be carefully inspected, as design limits may be exceeded.

1.6 Earthquake Induced IOFC

A major earthquake could result in an interruption of forced cooling.

DISCUSSION OF OPERATOR ACTION

2.1 Ensure Defueling activities terminated

Verify Defueling activities terminated until all follow up activities complete.

2.2 Monitor Critical Safety Functions Per EOP's.

Monitor critical safety functions per EOP's and perform any required steps per EOP's.

2.3 Verify authenticity of alarm by visual examination of seismoscope glass.

If authenticity of recorder operation is questioned, the smoked glass of the seismoscope may be examined to see if motion was recorded.

2.4 Process all accelerograph photographs as soon as possible.

If the seismic recorder operates, indicating acceleration equal to, or greater than 0.01g, process all accelerograph photographs as soon as possible. If the acceleration indicated is greater than 0.10g, follow-up actions will be in accordance with symptom 1.5. If the seismoscope on Level 1 of the Reactor Building indicated equal to, or greater than 0.05g, but less than 0.10g, follow-up actions shall be in accordance with symptom 1.4.



- 2.5 Concurrently, Monitor Critical Safety Functions Per EOP's and complete within one hour, inspection of piping down stream of valves listed in Tables 1A and 1B.

This step is intended to provide a check list of major plant parameters.

This step is also intended to provide a rapid verification of the integrity of piping downstream of boundary valves. Should the integrity be breached, valve operation would be required to stop leakage into the reactor building sump or into the turbine building as quickly as possible.

- 2.6 Complete within two hours inspection of piping down stream of valves listed in Table 1C.

Verification of piping integrity is required so that corrective measures may be initiated should gross leakage be observed. One Table is provided: For the reactor building.

NOTE: If during the damage inspection it is determined that fire water must be utilized, proceed to initiate fire water to the circulator(s) and steam generators per EOP-2 and EOP-3.

This is intended to provide the assistance of all personnel available in preparation for initiating fire water. After conditions have stabilized, the damage inspection must then be completed.

- 2.7 Visually inspect all Class I piping and equipment for leaks.

If seismoscopes and accelerograph photographs indicate that a greater than, or equal to, 0.05g horizontal ground acceleration had occurred, visually inspect all Class I piping and equipment for leaks.

Equipment required for continued operation may be damaged by acceleration of this magnitude. An inspection to determine the condition of the plant is appropriate. Leakage of pressure boundary components is the most likely form of damage.

- 2.8 Complete with a 24 hour period a visual inspection of those valves listed in Tables 2A, 2B, and 2C.

An overall plant inspection is necessary to identify and isolate leakage from sources of lesser consequence than those listed in the Tables.



FORT ST. VRAIN NUCLEAR GENERATING STATION
PUBLIC SERVICE COMPANY OF COLORADO

AOP APP K-1
Issue 59
Page 4 of 12

TABLE 1A REACTOR BUILDING

MUST BE COMPLETED WITHIN 1 HOUR

Sequence	Valve	Service/Location	Conditions for Operation	Position Required
1	HV-21143	Fire water to BUBW coolers/RB 4740' approximately 1' above floor E. of E-2106	BUBW system inoperable or leakage	Close
2	HV-21142-4	Service water supply to BUBW coolers/RB 4740' approximately 3' above floor, W. of E-2106	BUBW system inoperable or leakage	Close
3	HV-21142-2	Service water, return from BUBW coolers/ RB 4740'/4756' NE of E-2106	BUBW system inoperable or leakage	Close
4	V-46819	Fire water to normal or emergency bearing water makeup pumps/RB 4740' NW of trap drain tank, T-2101, overhead	Condensate storage supply unavailable.	Closed
5	V-46281	S.W., to helium transfer compressor/RB 4740' S. of transfer compressor.	Leakage to/ from transfer compressor or if not required	Close



FORT ST. VRAIN NUCLEAR GENERATING STATION
PUBLIC SERVICE COMPANY OF COLORADO

AOP APP K-1
Issue 59
Page 5 of 12

TABLE 1A REACTOR BUILDING

MUST BE COMPLETED WITHIN 1 HOUR

Sequence	Valve	Service/Location	Conditions for Operation	Position Required
6	V-461744	Service water to nitrogen pressurization compressor seal cooler/RB 4756' above E-4702, West valve	Leakage in supply/return nitrogen pressurization compressors or compressors not required.	Close
7	V-45115	Firewater to Reactor Building and Access Bay/RB 4791/ front of elevator.	Leakage of fire water in reactor building or access bay area	Close

END OF TABLE 1A



FORT ST. VRAIN NUCLEAR GENERATING STATION
PUBLIC SERVICE COMPANY OF COLORADO

AOP APP K-1
Issue 59
Page 6 of 12

TABLE 1B TURBINE BUILDING

MUST BE COMPLETED WITHIN 1 HOUR

Sequence	Valve	Service/Location	Conditions for Operation	Position Required
1	V-45113	Firewater to plant from ring header/T.B. 4791' N. of door #3 (W. of Bus Duct Cooling Unit)	Leakage of firewater downstream of valve in turbine building	Close
2	V-45109	Aux. Boiler and Hydrogen Seal Oil area/T.B. 4791' outside N. door to Maintenance Shop	Leakage of firewater in aux. boiler, hydrogen seal oil or other turbine building areas	Close
3	V-4542	Fire water riser column G-3/T.B. 4791' at G-3 column (E. of TMCC-1F)	Leakage on riser and access control area	Close
4	V-4526	Fire water to reactor building and access bay/T.B. 4791' W. of 480 V room (E. of Col. G-4)	Leakage of firewater in reactor building or access bay areas	Close
5	V-42397	Service water booster pump supply (HVAC)/ T.B. 4791' at J wall west of elevator	Reactor building HVAC not required or leakage downstream	Close
6	V-4525	Firewater to emergency cond. header/T.B. 4791' W. of 480 volt room	Emergency condensate supply unavailable (header inoperable), and feedwater and steam inoperable	Closed
7	V-4553	Fire water to access control bay (G-5)/T.B. 4791' directly E. of 1C instrument air compressor	Leakage of firewater in riser column G-5	Close

TABLE 1B TURBINE BUILDING
MUST BE COMPLETED WITHIN 1 HOUR

Sequence	Valve	Service/Location	Conditions for Operation	Position Required
8	V-4589	Firewater to BFP's and turbine bldg. area/T.B. 4791' E. of 1C instrument air compressor	Leakage of fire water in BFP's area or other turbine building area	Close
9	V-45223	Firewater to emergency feedwater header/T.B. 4791' N. & W. of 1C BFP overhead	Feedwater, steam and emergency condensate supply unavailable, header inoperable and spool piece installed.	Closed
10	V-4594	Backup cooling BFP tube oil and EHC heat exchanger/T.B. 4791' S & W of 1C BFP	Cooling not required for BFP's EHC or leakage	Close
11	V-4256	BFP 1C tube oil cooler/T.B. 4791' W. & S. of 1C BFP	BFP 1C inoperable, not required, or leakage	Close
12	V-4264	BFP 1A tube oil cooler/T.B. 4791' N. wall of D/G room.	BFP 1A inoperable, not required, or leakage	Close

END OF TABLE 1B



FORT ST. VRAIN NUCLEAR GENERATING STATION
PUBLIC SERVICE COMPANY OF COLORADO

AOP APP K-1
Issue 59
Page 8 of 12

TABLE 1C REACTOR BUILDING

MUST BE COMPLETED WITHIN 2 HOURS

Sequence	Valve	Service/Location	Conditions for Operation	Position Required
1	V-461535	Service water supply and return hydraulic power units/ RB 4740' above LP 2, power unit	Leakage on cooling System 91	Close
	V-461555	approximately 15' RB 4740' above LP 2, power unit	Leakage on cooling System 91	Close
	V-461536	approximately 15' RB 4740' above LP 1, power unit	Leakage on cooling System 91	Close
	V-461557	approximately 15' RB 4740' above LP 1, power unit	Leakage on cooling System 91	Close
2	V-461514	approximately 15' Service water from nitrogen pressurization compressor seal cooler/ R.B. 4756' above E-4702, East valve.	Leakage in return/supply nitrogen pressurization compressors or compressors not required.	Close
3	V-46612	S.W. return from nitrogen recondenser chiller/ R.B. 4791' through door under stairs to 4801'	Leakage to/from nitrogen recondenser chiller or if not required.	Close
4	V-46338	Service water from helium transfer compressor RV 4740' S. or Trans. Comp.	Leakage to/from transfer compressor or if not required.	Close

END OF TABLE 1C



FORT ST. VRAIN NUCLEAR GENERATING STATION
PUBLIC SERVICE COMPANY OF COLORADO

ADP APP K-1
Issue 59
Page 9 of 12

TABLE 2A REACTOR BUILDING

MUST BE COMPLETED WITHIN 24 HOURS

Sequence	Valve	Service/Location	Conditions for Operation	Position Required
1	HV-21252-5	P-2105 makeup suction/ R.B. 4750' E. of P-2105	As required to provide makeup	Check Position
2	HV-21252-1	P-2105 suction from LP separator/R.B. 4756' NW of P-2105	L.P. Separator system inoper- able.	Close
3	TV-4637	S.W., control for LP 1 PCRVR Cooling/R.B. 4756' NE corner of System 46 heat exchanger	If temperature control is lost.	Close - Control on Bypass V-46151
4	TV-4637-1	S.W. control for LP 1 PCRVR Cooling/R.B. 4756' NE corner of System 46 heat exchanger	If temperature control is lost.	Close - Control on Bypass V-46151
5	V-21867	Condensate quench water to LP separator/RB 4756' in front of LP separator	L.P. separator system inoper- able	Close
6	V-21730	Bearing water removal pump discharge/RB 4771' N. wall, West of RT-6212/6213	LP Separator and/or bearing water removal pumps inoperable	Close
7	TV-4638	S.W., control for LP 2 PCRVR Cooling/R.B. 4771' NE corner of heat exchanger.	If temperature control is lost	Close - Control on Bypass V-46152
8	TV-4638-1	S.W., control for LP 2 PCRVR Cooling/R.B. 4771' NE corner of heat exchanger.	If temperature control is lost	Close - Control on Bypass V-46152

END OF TABLE 2A



FORT ST. VRAIN NUCLEAR GENERATING STATION
PUBLIC SERVICE COMPANY OF COLORADO

AOP APP K-1
Issue 59
Page 10 of 12

TABLE 2B TURBINE BUILDING

MUST BE COMPLETED WITHIN 24 HOURS

Sequence	Valve	Service/Location	Conditions for Operation	Position Required
1	V-9232	Isolation LS-92206-3 D/G 1A day tank/day tank N. and middle valve	Leakage of fuel oil	Close
2	V-9220	Isolation LS-92207-3 D/G 1B day tank/day tank N. and middle valve	Leakage of fuel oil	Close
3	V-46614	Service water booster pump supply T.B. 4791' above booster pumps S. wall of lube oil storage room	Chiller not required or leakage	Close
4	V-4236	S.W. inlet to E-5109SX/T.B. 4791' above EHC unit South	EHC inoperable, not required, or leakage	Close
5	V-4229	S.W. inlet to E-5109X/T.B. 4791' above EHC unit North	EHC inoperable, not required, or leakage	Close
6	V-42390	Gland seal to P-3201 (Ht. #5 drain pump)/T.B. 4791' N. of P-3201	P-3201 inoperable, not required or leakage	Close
7	V-31232	EFW supply to M.S. de-superheaters/T.B. 4791' N & W of 1C BFP	BFP's inoperable or leakage downstream	Close
8	HV-31191	Cond. to emergency condensate header/T.B. 4791' W. of 1C BFP, overhead	Emergency condensate supply unavailable, (header inoperable) or supply leakage	Closed



FORT ST. VRAIN NUCLEAR GENERATING STATION
PUBLIC SERVICE COMPANY OF COLORADO

AOP APP K-1
Issue 59
Page 11 of 12

TABLE 2B TURBINE BUILDING

MUST BE COMPLETED WITHIN 24 HOURS

Sequence	Valve	Service/Location	Conditions for Operation	Position Required
9	HV-31122	Fire water to emergency cond. header/T.B. 4791' W. of 1C BFP, overhead	Emergency condensate supply unavailable, (header inoperable) and feedwater and steam inoperable	Close
10	V-4239	BFP 1B lube oil cooler/T.B. 4791' W. of 1B BFP	BFP 1B inoperable, not required or leakage	Close
11	V-4234	SW to E-3304X and Sample Cooling/T.B. 4791' W. of 1B BFP, overhead	Sample cooling not required or leakage	Close
12	V-42817	Service water to Aux. BFP seals/TB 4791' W & S of 1A BFP	Aux. BFP's inoperable, not required, or leakage	Close

END OF TABLE 2B



FORT ST. VRAIN NUCLEAR GENERATING STATION
PUBLIC SERVICE COMPANY OF COLORADO

AOP APP K-1
Issue 59
Page 12 of 12

TABLE 2C CIRCULATING WATER BASIN PIT

MUST BE COMPLETED WITHIN 24 HOURS

Sequence	Valve	Sequence/Location	Conditions for Operation	Position Required
1	V-41903	Circulating water makeup to blowdown/CW in pit, bottom and to right of ladder	All conditions	Close
2	V-4130	Firewater pit to circulating water/south of door to firewater pump house	Circulating water pit in-operable	Close
3	V-4132	Firewater pit to circulating water/north of door to firewater pump house	Circulating water pit in-operable	Close

END OF TABLE 2C

(K-1)
ENVIRONMENTAL DISTURBANCES - EARTHQUAKE
SYMPTOM-ACTION MATRIX

ACTIONS	SYMPTOMS					
	1.1 ABNORMAL BUILDING VIBRATIONS	1.2 SEISMIC RECORDER OPERATE ALARM 1-06E, 5-5	1.3 LESS THAN 0.05g GROUND ACCELERATION	1.4 GREATER THAN OR EQUAL TO 0.05g BUT LESS THAN 0.10g	1.5 GREATER THAN OR EQUAL TO 0.10g GROUND ACCELERATION	1.6 EARTHQUAKE INDUCED IOFC
OPERATOR ACTIONS						
2.1 Defueling activities terminated.	XX	XX				XX
2.2 Monitor Critical Safety Functions per EOP's	XX	XX				XX
2.3 Verify authenticity, if desired, by confirming seismoscope motion	XX	XX				
2.4 Process all accelerograph photographs as soon as possible		XX				
2.5 Concurrently, monitor core critical safety functions and complete, within (1) one hour, inspection of piping downstream of valves listed in Tables 1A and 1B		XX XX	XX XX	XX XX	XX XX	
2.6 Complete within (2) two hours, inspection of piping downstream of valves listed in Table 1C		XX XX	XX XX	XX XX	XX XX	

(K-1)
ENVIRONMENTAL DISTURBANCES - EARTHQUAKE
SYMPTOM-ACTION MATRIX

ACTIONS	SYMPTOMS					
	1.1 ABNORMAL BUILDING VIBRATIONS	1.2 SEISMIC RECORDER OPERATE ALARM 1-06E, 5-5	1.3 LESS THAN 0.05g GROUND ACCELERATION	1.4 GREATER THAN OR EQUAL TO 0.05g BUT LESS THAN 0.10g	1.5 GREATER THAN OR EQUAL TO 0.10g GROUND ACCELERATION	1.6 EARTHQUAKE INDUCED IOFC
2.7 Visually inspect all Class I piping and equipment for leaks				XX	XX	XX
OPERATION ACTIONS 2.8 Complete within a 24 hour period, a visual inspec- tion of those valves listed in Tables 2A, 2B and 2C		XX XX	XX XX	XX XX	XX XX	

~~2.7~~
~~2.8~~
~~2.9~~



1.5 Greater Than Or Equal To 0.10g Ground Acceleration

If developed film indicates horizontal ground acceleration greater than, or equal to, 0.10g design limits may have been exceeded. All Class I structures, systems and components are designed to withstand an earthquake of 0.10g horizontal acceleration at the site. When an earthquake of this magnitude occurs, it is important that equipment be carefully inspected, as design limits may be exceeded.

1.6 Earthquake Induced IOFC

A major earthquake could result in an interruption of forced cooling.

DISCUSSION OF OPERATOR ACTION

ENSURE
2.1 ~~Verify~~ Defueling activities terminated

Verify Defueling activities terminated until all follow up activities complete.

2.2 Monitor Critical Safety Functions Per EOP's.

Monitor critical safety functions per EOP's and perform any required steps per EOP's.

2.3 Verify authenticity of alarm by visual examination of seismoscope glass.

If authenticity of recorder operation is questioned, the smoked glass of the seismoscope may be examined to see if motion was recorded.

2.4 Process all accelerograph photographs as soon as possible.

If the seismic recorder operates, indicating acceleration equal to, or greater than 0.01g, process all accelerograph photographs as soon as possible. If the acceleration indicated is greater than 0.10g, follow-up actions will be in accordance with symptom 1.5. If the seismoscope on Level 1 of the Reactor Building indicated equal to, or greater than 0.05g, but less than 0.10g, follow-up actions shall be in accordance with symptom 1.4.