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Vice President
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May 26, 2000

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: **Docket No. 50-361**
Revised Licensee Event Report No. 2000-006-01
San Onofre Nuclear Generating Station, Unit 2

Reference: R. W. Krieger (SCE) letter to NRC Document Control Desk, "30-Day Licensee Event Report No. 2000-006", dated May 23, 2000

Gentlemen:

In the letter referenced above, SCE provided a 30-day Licensee Event Report (LER) in accordance with 10CFR50.73(a)(2)(i)(B) to report a violation of Technical Specification 3.7.8, "Salt Water Cooling System." After submittal, SCE found that portions of the data included in "Table 3" of that LER were incorrect. This occurred when a valve-specific parameter (differential pressure) was not appropriately changed when transitioning from the saltwater cooling pump discharge valve calculations to the shutdown cooling heat exchanger component cooling water isolation valve calculations. Although this error would not affect the conclusions of the LER, SCE concluded that a revision is warranted. Therefore, SCE is providing this revised LER.

Neither the health nor the safety of plant personnel or the public was affected by this occurrence.

Any actions listed are intended to ensure continued compliance with existing commitments as discussed in applicable licensing documents; this LER contains no new commitments. If you require any additional information, please so advise.

Sincerely,

LER No. 2000-006-01

cc: E. W. Merschoff, Regional Administrator, NRC Region IV
J. A. Sloan, NRC Senior Resident Inspector, San Onofre Units 2 & 3

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LICENSEE EVENT REPORT (LER)

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

APPROVED BY OMB NO. 3150-0104 EXPIRES MM/DD/YYYY

Estimated burden per response to comply with this mandatory information collection request: 50 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. If a document used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
San Onofre Nuclear Generation Station (SONGS) Unit 2	05000-361	1 of 8

TITLE (4)

Inoperable Salt Water Cooling Valve Causes Violation of Technical Specification 3.7.8, "Salt Water Cooling System"

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
04	26	2000	2000	-- 006 --	01	05	26	2000	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	1
POWER LEVEL (10)	100

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

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
R. W. Krieger, Vice President, Nuclear Operations	949-368-6255

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

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)

Recently, SCE questioned the ability of the SWC valves and certain valves to remain in their safety related position if the instrument air system were to become inoperable. The focus of our efforts was a phenomenon (flow-induced hydrodynamic torque) which could cause certain types of butterfly valves to self-close under flow conditions. Subsequently, SCE determined that for 11 of the 12 valves affected, internal forces that resist closure were greater than the induced hydrodynamic torque, except for one SWC valve (2HV6202). SCE has blocked this valve open.

TS 3.7.8, "Saltwater Cooling" requires two trains of saltwater cooling to be operable. If one train is inoperable, it must be restored within 72 hours, or the plant must be in Mode 3 in 6 hours and Mode 5 in 36 hours. Because there have been times in the past when SCE credited 2HV6202 for compliance with TS 3.7.8, it is possible that we did not comply with the actions required by TS 3.7.8 and SCE is reporting in accordance with 10 CFR 50.73(a)(2)(i).

SCE violated TS 3.7.8 because SCE was not aware that 2HV6202 should have been considered inoperable. SCE has not yet been able to determine the cause of this valve's anomalous behavior. The safety significance was small; this condition screens as "Green".

Plant: San Onofre Nuclear Generation Station (SONGS) Unit 2
Discovery Date: April 26, 2000
Reactor Vendor: Combustion Engineering
Mode: Mode 1 – Power Operation
Power: 100 percent

SUMMARY:

Recently, SCE questioned the ability of the Saltwater Cooling (SWC) (BS) pump discharge valves (V) and certain Component Cooling Water (CCW) valves to remain in their safety related position if the instrument air system (LD) were to become inoperable. The primary focus of our efforts was a phenomenon (flow induced hydrodynamic torque) documented in an Electric Power Research Institute (EPRI) report which could cause certain types of butterfly valves to self-close under flow conditions.

SCE reported this condition to the NRC Operations Center on May 3, 2000, as a condition that was potentially outside the design basis of the plant. Subsequently, SCE determined that for 11 of the 12 valves affected, internal forces that resist closure were greater than the induced hydrodynamic torque. A site-specific Probabilistic Risk Analysis (PRA) of this condition concluded that the actual safety significance of this condition was small.

BACKGROUND:

At the SONGS Units 2 and 3, the Salt Water Cooling (SWC) system, an engineered safety feature (ESF) (JE) support system, provides saltwater from the Pacific Ocean to the Component Cooling Water (CCW) heat exchangers (HX) for cooling ESF components during normal power generation, normal and emergency shutdown and cooldown of the reactor, and during design basis accidents. The SWC system for each unit consists of two 100% capacity trains. Each train contains two 100% capacity pumps (P); one pump is located in the Unit 2 intake structure and the other is located in the Unit 3 intake structure. Each SWC pump discharge line contains a 30 inch air-operated butterfly valve. Table 1 provides a list of the Unit, Pump, and Discharge Valve equipment IDs.

Table 1: SWC Pumps and Discharge Valves

Unit	Intake Structure	Train	Pump	Discharge Valve	"Fail-Safe" Position
2	Unit 2	A	2P112	2HV6200	Open
2	Unit 3	A	2P307	2HV6202	Open
2	Unit 2	B	2P113	2HV6201	Open
2	Unit 3	B	2P114	2HV6203	Open
3	Unit 3	A	3P112	3HV6200	Open
3	Unit 2	A	3P307	3HV6202	Open
3	Unit 3	B	3P113	3HV6201	Open
3	Unit 2	B	3P114	3HV6203	Open

Each SWC pump discharge valve position is controlled by a 4-way 125-VDC solenoid valve. Instrument air pressure is supplied to the solenoid valve through a pressure regulator (RG) at approximately 80 psig. When the solenoid is energized, instrument air is admitted to the top side of the actuator piston and the underside of the piston is vented to the atmosphere, thus closing the valve. When the solenoid is de-energized, the topside of the actuator piston is vented to atmosphere and air is admitted to the underside of the piston, raising the piston and opening the valve. The actuators are Fisher pneumatic piston operators.

Each of the SWC pump discharge valves is equipped with two back-up accumulators (ACC). The accumulators are provided to open these valves on loss of instrument air. A trip valve (V) between the accumulators and the actuator piston opens if the normal instrument air supply pressure from the pressure regulator drops below a specified value. The SWC pump discharge valve is designed to fail in the open position on loss of electric power (EC) and/or loss of

instrument air. SWC pump discharge valves are not equipped with handwheel actuators for manual positioning. Figures 1 and 2 show the actuators in CLOSED and FAILED OPEN positions (see Additional Information).

Because the SWC system supports heat transfer to the ultimate heat sink (Pacific Ocean) during normal and emergency operations, the Updated Final Safety Analysis Report (UFSAR) implies (but does not state) that the SWC system will be available the duration of postulated accidents.

Table 2 provides a list of other safety-related air-operated butterfly valves have similar actuators designed with accumulators to provide motive force in the event of a loss of instrument air.

Table 2: Similar Safety-Related Pneumatic Valves

Valve	Train	Description	"Fail-Safe" Position
2(3)HV6500	B	Shutdown Cooling (SDC) Heat Exchanger CCW Outlet Block Valve	Open
2(3)HV6501	A	SDC Heat Exchanger CCW Outlet Block Valve	Open
2(3)HV6212	A	CCW Non-Critical Loop Isolation Valve	Closed
2(3)HV6213	B	CCW Non-Critical Loop Isolation Valve	Closed
2(3)HV6218	A	CCW Non-Critical Loop Isolation Valve	Closed
2(3)HV6219	B	CCW Non-Critical Loop Isolation Valve	Closed
2(3)HCV6537	A	CCW Miniflow Block Valve	Closed
2(3)HCV6538	S	CCW Miniflow Block Valve	Closed
2(3)HCV6539	B	CCW Miniflow Block Valve	Closed
2(3)HV9948	B	Containment Purge Valves	Closed
2(3)HV9951	B	Containment Purge Valves	Closed

SDC Heat Exchanger CCW Outlet Block Valves

The SDC Heat Exchanger CCW Outlet Block Valves allow plant operators to isolate flow to the shutdown heat exchanger to allow for CCW flow balancing and maintenance activities. These valves are required to open upon receipt of Containment Spray Actuation Signal (CSAS). The UFSAR states that these valves will "fail-open" upon a loss of instrument air. Valves 2HV6501 and 3HV6501 service Train A; valves 2HV6500 and 3HV6500 service Train B. SDC Heat Exchanger CCW Outlet Block Valves are equipped with handwheel actuators for manual positioning.

CCW System Valves

The CCW Non-Critical Loop Isolation Valves provide the means to align the non-critical loop to either train or to isolate the non-critical loop from both trains in the event of a Containment Isolation Actuation Signal (CIAS) or Surge Tank low-low level signal. The UFSAR states that these valves are "fail-closed" upon a loss of control power or a loss of the instrument air. Valves 2HV6212, 3HV6212, 2HV6218, and 3HV6218 service Train A; valves 2HV6213, 3HV6213, 2HV6219, and 3HV6219 service Train B. CCW Non-Critical Loop Isolation Valves are equipped with handwheel actuators for manual positioning. The CCW system is also provided with miniflow loops that are normally closed during plant operation but are not equipped with handwheel actuators for manual positioning. (These valves are not adversely affected by the issue described below.)

Containment Purge Valves

Technical Specification 3.6.3 requires containment purge valves 2HV9948, 3HV9948, 2HV9951, and 3HV9951 to be locked closed during Modes 1 through 4. If these valves are open in Modes 5 or 6, they will close upon receipt of a Containment Purge Isolation Signal (CPIS) signal. (These valves are not adversely affected by the issue described below.)

Technical Specifications (TS)

TS 3.7.8, "Saltwater Cooling" requires two trains of saltwater cooling to be operable. If one train is inoperable, it must be restored within 72 hours, or the plant must be in Mode 3 in 6 hours and Mode 5 in 36 hours.

DESCRIPTION OF THE EVENT:

On March 31, 2000, during a post maintenance check of the integrity of the pneumatic system for valve actuators, Southern California Edison (SCE) discovered that a trip valve on SWC pump discharge valve was leaking air. SCE checked the other SWC pump discharge valves and CCW non critical loop isolation valves and found other valves leaking air. The affected valves required for plant operation were placed in their safety-related position until the air leaks were repaired.

Subsequently, SCE questioned if these valves would remain in their safety-related position if the air accumulator were depleted. Follow-up discussions with the valve manufacturer (Fisher) confirmed that the actuators may leak air past the actuator piston. Potentially affected valves are listed in Tables 1 and 2, above. Based on information found in EPRI document TR-103237-R2, SCE recognized that water flow inside system piping could induce a torque (hydrodynamic torque) which would tend to close the valves. SCE concluded that if the air accumulators became depleted, valve operating friction would hold the valves in their safety-related position. However, frictional forces are not surveilled and SCE could not immediately measure these forces. As valve-specific hydrodynamic torque effects information became recognized over several days, SCE conservatively declared the SWC pump discharge valves and SDC Heat Exchanger CCW Block Valves inoperable. When each SWC discharge valve was declared inoperable, SCE restored operability by blocking it open. The SDC Heat Exchanger CCW Block Valves were declared operable after engaging their manual handwheels in the open position which effectively secures the valve in its as-left position.

SCE also determined that hydrodynamic torque did not adversely affect the operability of the CCW miniflow block valves. These valves are normally closed and will remain closed upon a loss of instrument air. The CCW non-critical loop isolation valves also close following a CIAS and, like the CCW miniflow block valves, are not exposed to flow which could generate opening torque.

EVALUATION OF REPORTABILITY:

When the first valves were declared inoperable on April 26, 2000 (event date) (AR 000401454), SCE recognized that the most likely accident scenarios of concern were those coincident with a loss of offsite power (LOOP) and subsequent unavailability of instrument air; initial reportability discussions centered on that fact. In the event of a LOOP, SCE recognized that it would take some time for the air accumulators to bleed down and therefore, the SWC valves would remain open (Operable) in the initial phases of a postulated LOOP/accident. Even if friction forces were not credited, SCE concluded these valves would remain in their safety-related positions at least until offsite power could be restored or plant operators could take action to reopen one or more valves. Consequently, SCE considered that this condition did not require reporting to the NRC in accordance with 10 CFR 50.72.

Subsequently, given the absence of a clearly defined time these valves are required to remain open following a postulated accident, SCE conservatively concluded that a phone report to the NRC should be made. Hence, on May 3, 2000, at 0924 PDT, SCE reported this condition to the NRC Operations Center (NRC Log No. #36960) as a condition that is potentially outside the design basis of the plant.

FOLLOW-UP INVESTIGATION:

SCE reviewed available valve test data, conducted valve diagnostic testing, and performed valve actuator leak rate testing and concluded that the forces that resist closure internal to all of the SWC pump discharge valves are greater than the closing hydrodynamic torque, with the exception of 2HV6202 (see Table 3 and discussion below).

SCE measured the resistive torque currently existing in these valves and confirmed they are consistent with available plant records. Additionally, applying ERPI research information on valve packing performance (EPRI No. 5697, "Valve Stem Packing Performance") suggests the packing friction for butterfly valves will not change appreciably with service. Therefore, SCE believes the as-found resistive torque values are representative of torque value that existed in the past.

Table 3: Test Data for Affected Valves

Valve	Description	Hydrodynamic Torque (ft-lbf)*	Resisting Torque (ft-lbf)*	Margin to Valve Closure (percent)*
2HV6200	SWC Pump Discharge Valve	258	594	130
2HV6201	SWC Pump Discharge Valve	232	758	226
2HV6202	SWC Pump Discharge Valve	258	145	-44
2HV6203	SWC Pump Discharge Valve	310	630	103
3HV6200	SWC Pump Discharge Valve	258	630	144
3HV6201	SWC Pump Discharge Valve	310	558	80
3HV6202	SWC Pump Discharge Valve	258	474	84
3HV6203	SWC Pump Discharge Valve	232	491	111
2HV6500	SDC Heat Exchanger CCW Outlet Block Valve	63	148	135
2HV6501	SDC Heat Exchanger CCW Outlet Block Valve	75	160	112
3HV6500	SDC Heat Exchanger CCW Outlet Block Valve	63	120	90
3HV6501	SDC Heat Exchanger CCW Outlet Block Valve	75	150	100

* rounded to nearest whole number.

AS FOUND CONDITION OF 2HV6202:

Based on the data provided in Table 3, SCE is not able to conclude that 2HV6202 would have remained open under flow conditions if its air accumulators became depleted. SCE considers that this valve was inoperable in the as-found condition. Because there have been times in the past when SCE credited 2HV6202 for compliance with TS 3.7.8, it is likely that we did not comply with the actions required by TS 3.7.8. Therefore, SCE is reporting this condition in accordance with 10 CFR 50.73(a)(2)(i) as a condition prohibited by the TS.

CAUSE OF THE EVENT:

SCE violated TS 3.7.8 because SCE was not aware that 2HV6202 should have been considered inoperable. SCE has not yet been able to determine the cause of this valve's anomalous behavior.

SCE considers a design that relies upon friction for butterfly valve operability in this application to be weak. To evaluate the cause of this design weakness, SCE researched the original design and testing of the SWC pump discharge valves, reviewed the original startup testing, and reviewed the original purchase order specifications. Based on this review, SCE concludes that the original design specification for the subject valves was not clear. It required that the valves fail to a specific safety position on a loss of instrument air and/or control power, but it did not specify the time period for which they had to remain in that position in order to support the safety function of the associated system. The root cause of this condition is attributed to the Architect/Engineer (Bechtel) inadequately defining the design requirements and communicating them to the equipment manufacturer (Fisher) during the original plant design process.

CORRECTIVE ACTIONS:

For 2HV6202, SCE will complete additional evaluations to determine the cause of the observed behavior and implement corrective actions as needed.

In addition to the actions discussed above, SCE is evaluating the appropriateness of the existing valve actuators. SCE will implement appropriate long-term corrective actions for the valves that are affected by this issue.

SCE also reviewed other pneumatically operated butterfly valves and confirmed that a similar condition would not adversely affect other safety-related systems.

SAFETY SIGNIFICANCE:

The safety significance of this issue is minimal. Of the 12 valves listed in Table 3, SCE confirmed by testing that 11 would have remained in their safety related positions. All of the Unit 3 SWC valves would have remained in their safety-related positions during a LOCA/LOOP. For Unit 2, since only valve 2HV6202 (Train A) experiences a hydrodynamic torque greater than the resistive frictional torque, if a concurrent LOCA/LOOP had occurred, one or more of the remaining 100 percent capacity pump/valve combinations would have been able to supply the required saltwater cooling flow.

SCE also evaluated this event using the NRC's Significance Determination Process (SDP). During Phase 1, it was determined that two cornerstones (Mitigation Systems and Barrier Integrity) were affected. Because two cornerstones were affected, this event was evaluated using Phase 2 of the NRC's SDP. Based on this evaluation, SCE concluded that this occurrence screens as "Green".

Phase 3 evaluations are required if a potential impact from external events (seismic or fire events) exists. Therefore, a plant-specific PRA which includes internal and external initiating events was performed to estimate the actual increase in risk due to this condition. The Phase 3 evaluation determined that the condition reported herein resulted in core damage and large early release risk increases of less than 4E-7/yr and 1E-9/yr, respectively. These risk increase values correspond to a risk significance of "Green".

ADDITIONAL INFORMATION:

In the past three years, SCE has not reported any previous conditions involving induced hydrodynamic torque or valve self-closure.

SCE is providing a copy of this report to the design organization (Bechtel) and the valve manufacturer (Fisher) for their review for generic considerations.

Figure 1: Fisher Pneumatic Actuator in CLOSED Position

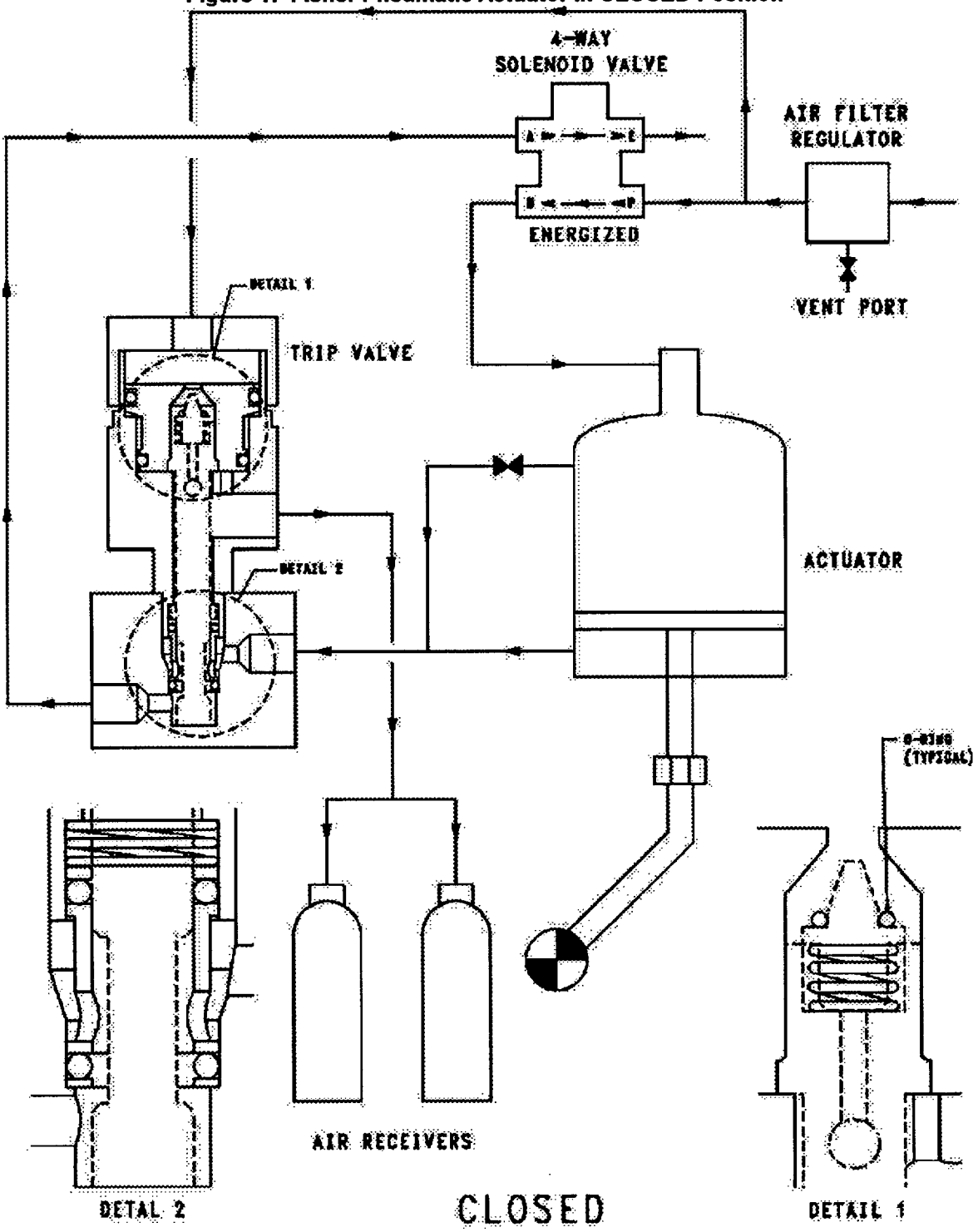

Figure 2: Fisher Pneumatic Actuator in FAILED OPEN Position