COMPRESSED GAS
SYSTEM
EVALUATION AND ANALYSIS
REPORT
REVISION 2

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COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

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COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

EXECUTIVE SUMMARY

This report was generated in response to two issues. First, it documents the results of an off-normal (transient) condition evaluation involving loss of power to the compressed gas system (CGS) at PVNGS Unit 3 that occurred on March 3, 1989. Second, it assesses the adequacy of the CGS and presents a corrective action plan for the enhancement of the system's functionality and reliability.

On March 3, 1989, PVNGS Unit 3 suffered a Loss of Offsite Power (LOP) which resulted in deenergization of non-essential electrical equipment, including the CGS compressors. During the first few minutes of this event, the CGS responded in accordance with its design basis (e.g., when the instrument air subsystem header pressure dropped to 85 psig, the nitrogen subsystem supply valve opened to allow nitrogen to repressurize the system). However, approximately 1-1/2 to 2-1/2 hours into the event, the operators noted that the pressure in the instrument air subsystem header had dropped to approximately 65 psig, significantly below the minimum header design pressure of 80 psig.

Although the CGS is not required for safe plant shutdown, it is desirable that the system be maintained and operated in such a manner that meets system demands under both normal and off-normal conditions. The importance of this system has been repeatedly addressed by the NRC, most recently in Generic Letter (GL) 88-14. APS was in the process of evaluating the operation and maintenance of the instrument air subsystem, as part of the response to GL 88-14, when the Unit 3 incident occurred.

A comprehensive review of system design, operation and maintenance was performed. This review included the following:

- Review of trip reports associated with the Unit 3 event and previous trips to analyze CGS performance, identify common abnormalities and determine if the recently observed response to the loss of power was typical.

- Review of associated PVNGS historical documents to identify whether the CGS design basis has been altered and thus contributed to system performance problems observed during the Unit 3 or previous events.

- Survey of other utilities to compare the configuration of the PVNGS CGS with that of similar nuclear plants and identify industry recognized design and maintenance program improvements for consideration at PVNGS.

- Comparison of the CGS design basis with its performance to determine whether any other potential system problems exist.

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- Comparison of the Main Steam Isolation Valves (MSIVs) and Feedwater Isolation Valves (FWIVs) with the Atmospheric Dump Valves (ADVs) design and function. This was done to determine if any instrument air subsystem design or maintenance deficiencies found on the ADVs could apply to MSIVs and FWIVs.

- Evaluation of compressed gas quality effects on safety related equipment to identify possible adverse system interactions that could impact the performance of safety related components at PVNGS.

- Comparison of the CGS maintenance program with the manufacturer's recommended practices to develop new or revise existing maintenance tasks that would improve system reliability.

The results of the above evaluations were compiled and conclusions were reached regarding the adequacy of the existing system design and current maintenance practices. A comprehensive corrective action plan and schedule for system enhancement was developed. Evaluation results were as follows:

- Review of the nitrogen subsystem performance during the Unit 3 event showed that this system failed to meet its designed header pressure. Furthermore, review of plant trip review reports showed that a reduction in header pressure had been observed on two previous occasions in Unit 1 and in 1985. Corrective action consisted of performing a flow test to determine if the nitrogen subsystem, as currently configured, can provide the projected normal and/or off-normal system demands. The results of this test showed that the system had high pressure drops, but could supply the required backup flow by throttling the manual bypass around the regulators and removing an oversized spring in check valve IAN-V056. 1

- A review of associated PVNGS historical documentation identified two concerns with air quality control at PVNGS. First, a failure in an ADV that occurred in 1988 may have been due to the presence of particulate matter in the instrument air subsystem. Second, a number of Engineering Evaluation Requests (EERs) were written to address moisture accumulation in the system. Since both of these concerns have been linked to component failures at other plants, as noted in Generic Letter 88-14, APS is taking action to develop a systematic air quality control program which will ensure that moisture, particulates and hydrocarbons are maintained at sufficiently low levels and thus not adversely affect the performance of safety related components interfacing with the CGS.

  A pilot inspection program of eight penumatic components was performed and the inspection results showed that none of the components inspected would fail due to air quality. 1

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- Survey of other nuclear plants showed that most plants, including PVNGS, do not have current as-built calculations that reflect normal and off-normal loads on the CGS. In order to determine if the system is properly sized, the existing PVNGS calculation used to size the passive nitrogen subsystem will be revised to reflect the current loads on the system. These loads will then be compared with the rated and tested capacity of the liquid nitrogen storage tank. The survey also showed that three utilities have a non-1E BOP diesel that provides a backup power source to the compressor, two utilities have 1E power to the compressor and three utilities have no backup for their instrument air subsystem. APS will perform an evaluation to determine the benefits and feasibility of providing 1E power to the CGS as an additional or alternate backup system.

- Comparison of system function with its design basis revealed that original design requirements for the nitrogen subsystem are not fully met. APS performed flow testing and will modify some system components in an effort to increase system reliability and meet the intended design basis. 1

- Comparison of the ADVs' with the MSIVs' and FWIVs' design and function revealed that pneumatic component leaks on the MSIVs and FWIVs could affect their performance. APS will perform leak rate calculations and verification tests on the valves' pneumatic components and improve associated maintenance practices. Leak tests will be performed prior to any Unit restart and any leaks which could effect operability will be repaired. 1

- Evaluation of compressed gas quality indicated that it could adversely impact the performance of safety related equipment. Corrective actions will consist of ensuring proper maintenance practices for major CGS components, periodic monitoring of air quality in all three units and selective examination of safety equipment pneumatic components. These actions will ensure that required cleanliness standards for air quality are being met and/or maintained.

- Comparison of the CGS preventative maintenance program with the maintenance requirements of CGS components' manufacturers recommendations, identified a number of areas where the PVNGS program will be enhanced.

The corrective action plan developed varies from activities that will be performed prior to any Unit restart to activities that will become part of the PVNGS lifetime design, monitoring and maintenance program. Implementation of this plan is intended to achieve the improved functionality and reliability reflective of the subject system's importance.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

I. PURPOSE AND OBJECTIVES

The overall purpose of this report is to provide an analysis of findings related to an event that occurred at PVNGS Unit 3 on March 3, 1989, to identify lessons learned from this and previous events, and to document and schedule needed improvements that will establish an acceptable standard of safety and reliability for the compressed gas system (CGS) at PVNGS.

In order to ensure that a comprehensive review of the CGS is performed and that improvements are made thus establishing an acceptable standard of safety and reliability for the system, seven independent reviews of the CGS were performed. Review topics were chosen to ensure that all aspects of system design and maintenance were researched and analyzed. These topics and the review methodology are discussed below:

Analysis of the March 3, 1989 Unit 3 Event

- The post trip report for the Unit 3 event was compared with previous trip reports to determine if the response to the loss of power was typical.
- Corrective action was formulated to address repeated abnormal system responses.

Review of PVNGS Historical Documents

- Historical engineering documents were reviewed to identify any operational concerns or changes to the design basis of the CGS system that might have contributed to the March 3, 1989 Unit 3 trip or previous events.
- These same documents were also reviewed to identify repeated abnormal system responses.
- Corrective action was formulated to address operational concerns, changes to the design basis, or repeated abnormal system responses.

Nuclear Utility Survey

- The following eight nuclear plants were contacted to gather information on the design and maintenance of their CGS:
  - Diablo Canyon
  - Rancho Seco
  - St. Lucie
  - San Onofre (SONGS)
  - South Texas Project (STP)
  - Trojan
  - Waterford
  - Vogtle
- This information was used to develop corrective action for system design, documentation, and preventative maintenance at PVNGS.

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Comparison of System Function and Design

- The design basis of the instrument air and nitrogen subsystems was defined and compared with system performance to identify areas where the plant did not or could not meet its design basis. The following areas were addressed:
  - Air Quality
  - Normal and Transient System Loads
- Corrective action was developed for areas where the plant did or could not meet its design basis.

Comparison of ADVs, FWIVs, and MSIVs

- The valve type, safety function, and actuating system of the ADVs, FWIVs, and MSIVs were compared to determine if these valves are susceptible to a common failure mechanism.
- A failure analysis due to compressed air problems (e.g., low air pressure, dirt, water) was performed to determine if the function of these valves could be compromised due to poor air quality.
- Corrective action was developed to incorporate lessons learned from the ADV response on the loss of the instrument air subsystem to the FWIVs and MSIVs.

Effects of Compressed Gas Quality on Safety Related Equipment

- All safety related equipment that requires compressed gas was identified and tabulated.
- Post trip reports were reviewed to determine if any of this safety related equipment had failed due to air quality.
- Engineering Evaluation Reports (EERs) and failure data trending records were reviewed to determine if the compressed gas system has experienced problems related to air quality.
- The potential impact of these problems was evaluated to determine if gas quality could have contributed to the Unit 3 event or to previous plant trips.
- Corrective action was developed to improve air quality in the CGS.

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II. ANALYSIS AND EVALUATION

A. Background

1. Description of the Unit 3 Event

On March 3, 1989, PVNGS Unit 3 suffered a Loss of Offsite Power (LOP) due to inability of the fast transfer bus to transfer the loads on NAN-S01 and NAN-S02 bus from the auxiliary transformer to the startup transformer. As a result, the non-essential electrical equipment, including the CGS compressors, were de-energized.

The sequence of events was:

- Large load rejection.
- The steam bypass control valves performed irradically.
- Main Steam Isolation Signal (MSIS) was received causing the main steam isolation valves (MSIVs) and feedwater isolation valves (FWIVs) to isolate.
- The unit experienced an LOP.
- There was a loss of power to the instrument air subsystem compressor.
- The ADVs were required for shutdown.

For the time sequence of the CGS performance during the Unit 3 trip, see Table 1. The ADVs, MSIVs and FWIVs require compressed air to recharge their accumulators, after they have performed their safety function. In addition, normal loads would be expected to decrease some; the CGS, however, would continue to support some normal users.

Following loss of the compressors and continuing compressed gas usage, the instrument air subsystem header pressure dropped to 95 psig in 1 minute and 45 seconds. At this time, the low pressure alarm for the instrument air subsystem header sounded in the Control Room. When the instrument air subsystem header pressure dropped to 85 psig (2 minutes and 42 seconds after the LOP), the nitrogen subsystem supply valve (PV-52) automatically opened.

Between 1-1/2 and 2-1/2 hours after the LOP, an operator observed that the pressure in the instrument air subsystem main header had dropped to approximately 65 psig. The nitrogen subsystem of the CGS is expected to maintain the pressure at 100 psig in the nitrogen subsystem header and 80 psig at components in the instrument air subsystem header. Drop in pressure to 65 psig represents a discrepancy with the expected pressure from the nitrogen subsystem.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

2. Safety Significance

The Unit 3 loss of power event demonstrated the importance of a non-safety related (NSR) system such as the compressed gas system to the plant operation. Although the CGS is not required for a loss of power event, it is clear that the system must be designed, maintained and operated in such a manner that ensures a reliable compressed gas supply and will not challenge safety related systems or disable safety related equipment. As presented in Section VI, actions will be taken to improve the functionality and reliability of the CGS. The system is NSR, but interfaces with safety related equipment.

3. Description of Compressed Gas System

The CGS at PVNGS is composed of the instrument air subsystem and the nitrogen subsystem (See Table 2, Figures 1 and 2). Both subsystems and their equipment are classified as non-safety related (NSR) with the exception of the containment isolation valves. Neither subsystem is required for emergency plant shutdown.

Safety related valves and dampers relying on compressed gas are designed to fail in the "safe" position on loss of compressed gas or are provided with individual safety related air/nitrogen accumulators sized to properly operate the valve without reliance on the NSR CGS. The MSIVs, FWIVs and ADVs fall into the latter group. The accumulators are considered part of the system that contains the valves. These accumulators are separated from the NSR CGS by "Q" class check valves, as indicated in Figure 3.

Compressed gas plant demands are normally met by the instrument air subsystem. It is only when the instrument air subsystem header pressure drops below 85 psig that nitrogen is automatically introduced into the air header via valve PV-52 which automatically opens on reduction of air header pressure.

Each compressed medium, air and nitrogen, are supplied by independent and diverse sources. Their configuration, equipment, and interface is discussed in the following sections.

a. Instrument Air Subsystem

The instrument air subsystem is shown on Figure 1. Its primary components (compressors, air receivers, pre and afterfilters, and dryers) can provide a continuous supply of compressed air for pneumatic instruments and valves at a nominal pressure of 110 psig with a lower than -40F dew point.

Each of the three compressors can supply 500 scfm of compressed air at 125 psig. Each compressor is two-stage, double acting, reciprocating type with water cooled non lubricated cylinders. The

compressor pistons are provided with rings made of teflon which do not require lubrication. This ensures oil-free compressed air which minimizes the potential for control system component failures.

During normal operation, one of the three compressors supplies all compressed air requirements while the other two compressors are in standby. In the event of a loss of one operating compressor or heavy air demand, the resulting low pressure initiates automatic start of the standby compressor(s).

After leaving the compressor, the air passes through a water cooled after cooler and a moisture separator to remove condensate entrained in the air flow on its way to its associated air receiver. Three air receivers (one per compressor), each with a capacity of 151 ft^3 at 100 psig (1150 scf each) are installed at the discharge side of the compressors and are interconnected. This capacity provides 30 seconds storage of compressed air to allow a standby compressor to be brought on line. The volume per receiver is sufficient to prevent compressed air pressure to decay below the minimum system pressure of 80 psig during this time.

After leaving the receivers, the compressed air is conducted from the discharge header through one of two 100% capacity prefilters. The prefilters are rated at a removal efficiency 99.9% of particles greater than 0.3 microns. The air continues to one of two dessicant type dryers, each with dual towers. The dryers use activated alumina which lowers the air flow to a dew point lower than -40F.

The desiccant is regenerated periodically by directing a portion of the flow from the discharge of the in-service tower through the other tower to the atmosphere. Tower switching is performed automatically and is initiated by a timer in the dryer's local control panel.

Next, the air passes through one of two 100% capacity afterfilters which is rated to remove 99.9% of particles greater than 1 micron. This compressed air is distributed to the various plant instruments, valves, and components. The distribution system is corrosion-resistant copper tubing and fittings with bronze/brass valves and soldered joints. The main distribution header is 3" diameter.

b. Compressed Gas Interface

When instrument air subsystem header pressure drops below 85 psig such as occurs in the event of a compressor trip (i.e., loss of power), the nitrogen subsystem automatically initiates nitrogen gas flow into the instrument air subsystem header. This occurs when

compressed gas back-up valve PV-52 opens on a low pressure signal from PSL-52. Nitrogen gas is then distributed to components that were served by the instrument air subsystem.

c. Nitrogen Subsystem

As shown in Figure 2, liquid nitrogen from the 3082 gallons (equivalent to 255,000 available scf at a delivery pressure of 100 psig) capacity storage tank passes through the low pressure vaporizer, which can supply a gaseous nitrogen flow of 1000 scfm.

After leaving the low pressure vaporizer, the nitrogen passes through the low pressure regulators where the pressure is reduced from 150 psig to 115 psig. From this point, it is distributed to various equipment (volume control tank and gas stripper for purging and for low pressure blanketing requirements on other equipment) including the instrument air subsystem header when required.

The original (1976) liquid nitrogen storage tank sizing calculation 13-MC-GA-205 evaluated two cases:

i. Refueling shutdown and subsequent startup

ii. Consumption during 30 days normal operation

Case (a) establishes the liquid nitrogen storage tank size at approximately 3000 gallons. Included in case (b) for "normal operation" is an allowance for emergency nitrogen backup to the instrument air subsystem of 350 scfm for one hour (21,000 scf). This is approximately 8% of the capacity of the liquid nitrogen storage tank. (Note: Based on recent measurements in Unit 2 during normal power operation, instrument air subsystem flowrates averaged 301 scfm (see Section IV.D)).

The low pressure vaporizers are rated at 1000 scfm for eight hours of continuous operation. At this rate, the contents of full liquid nitrogen storage tank can be consumed in slightly over 4 hours.

High pressure nitrogen is also supplied by the liquid nitrogen storage tank. Liquid nitrogen from the storage tank is pressurized to 2400 psig by the liquid nitrogen pumps. The pressurized nitrogen is then conducted to the high pressure vaporizer, which can supply 300 scfm of compressed nitrogen gas. High pressure compressed gas is supplied to the high pressure storage cylinders. Approximately 65,300 scf of compressed nitrogen can be stored in the high pressure storage cylinders. After the compressed gas has been regulated to 650 psig, the compressed gas is conducted to the high pressure header for distribution to various equipment to

supply high pressure blanketing gas and makeup to the ADV accumulator. Where nitrogen pressure required by the components is less than the high header pressure, regulating valves are provided in the lines supplying the components.

High pressure compressed nitrogen cylinders (Figure 2) also serves as a backup to the low pressure compressed gas system and, if fully charged, can be used as an alternate source of backup providing approximately 3 additional hours backup to the instrument air subsystem at 350 scfm.

4. Safety Design Basis

The CGS has no safety design basis since its operation is not required for safe shutdown nor is it part of the Reactor Coolant Pressure boundary. The nitrogen storage tank is designed and located such that a tank rupture will not adversely affect any system, component, or structure required for safe shutdown.

During normal operation, the instrument air subsystem supplies filtered, dry, oil-free air for pneumatic instruments dampers and components located throughout the plant including the active safety related pneumatically operated valves located in the main steam support structure (MSSS) building. These valves are atmospheric dump valves (ADVs), main steam isolation valves (MSIV), and feedwater isolation valves (FWIVs). The CGS is used to provide motive force to position valves under normal shutdown, surveillance tests, and trips without loss of the CGS compressors. Upon loss of the instrument air subsystem, the low pressure nitrogen subsystem fulfills this function.

There is industry wide concern relating to adverse affects on safety related equipment caused by instrument air subsystem failure and/or air quality. The effect on the safety related valves due to loss of instrument air subsystem and its quality will be examined in the following paragraphs.

As will be explained in Section IV, the nitrogen subsystem automatically supplies plant pneumatic demands when instrument air subsystem is at 85 psig or below (e.g., large plant demand or loss of power trip).

In the event that the nitrogen subsystem fails, the safety related pneumatically actuated valves (ADVs, MSIVs, FWIVs) can still perform their safety related function since they each are supplied with safety related accumulators. The other safety related equipment will fail in their "safe" position.

Therefore, loss of compressed gas does not affect plant safe shutdown.

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In conjunction with the compressed gas design basis, which requires a -40°F dew point at 125 psig, and 400 SCFM, APS used the standard ISA-S7.3-1975 as a guide to establish instrument air subsystem quality values. These are listed below:

Dew Point - Shall be 18°F below minimum local ambient temperature corrected to line pressure.

Particle Size - Maximum particle size in the air stream shall be 3 microns.

Oil Content - As close to 0 w/w (per weight) or v/v (per volume) as possible and not higher than 1 ppm.

Contaminants - Free of corrosive contaminants and hazardous gases.

Currently, there is no design basis for the quality of the nitrogen in the CGS.

5. Concerns with Compressed Gas Systems

Generic concerns with CGS or instrument air systems have been expressed in the past. The concerns center around the issue that instrument air systems are usually not safety related. They interface, however, with safety related systems, thus creating a potential that a malfunction of a non-safety related system could adversely affect a safety related system.

INPO SOER 88-01 was issued recommending the following:

a. Provide procedures to assist operators in the identification, control and recovery from partial or total loss of instrument air events.

b. Provide classroom and simulator training on loss of instrument air events to operators. Additionally, provide training in the importance of instrument air systems and the potential for common mode failures caused by particulate, hydrocarbon, and water contamination to operators and maintenance personnel who work on air systems and air operated components.

c. Periodically monitor instrument air quality and maintain the air quality at ISA-S7.3 standards. Also, ensure that the station's preventative maintenance program provides for replacing filters and desiccant material on the dryers on a regularly scheduled basis.

d. Verify that safety related accumulators and associated check valves are capable of performing their function on a loss of instrument air.

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A number of regulatory documents address this issue, I&E Information Notice 85-35, and I&E Information Notice 85-35 Supplement 1 identified various occurrences of safety related accumulators bleeding down due to check valve leakage. The original information notice identified a specific type of check valve (Parker Hannifin C Series Catalog 2502) installed in air lines for MSIVs and FWIVs which had experienced this type of leakage. Pertaining to the check valves to the ADVs, APS did not specifically address this as part of our response to I&E Information Notice 85-35. However, APS did evaluate these check valves as a part of our response to INPO SOER 88-01, refer to item d on previous page and Table 5.

NUREG-1275, Volume 2, "Operating Experience Feedback Report-Air Systems Problems" indicates that performance of air-operated safety related components may not be in accordance with their intended safety function because of inadequacies in the design, installation, and maintenance of the instrument air system.

On August 8, 1988, NRC issued Generic Letter 88-14 specifically addressing the concern of a malfunction of a non-safety related instrument air system adversely affecting a safety related system. NRC discussed design of the air systems, the quality of the air supply, testing of the system, and its backup for safety related systems. Specifically, NRC requested that all licensees review NUREG-1275, Volume 2, and perform a design and operations verification of the instrument air system.

6. APS Responses to Generic Letter 88-14

The APS response to Generic Letter 88-14 presented actions taken to address the NRC concerns along with commitments to address items that could not be completed within the required response time. In order to perform the review of the PVNGS instrument air subsystem with the guidelines presented in NUREG-1275, a list of safety related components that rely on instrument air subsystem was developed. Maintenance practices, emergency procedures, and training were verified to assure the functionality of safety related equipment in the event that the instrument air subsystem is lost. Furthermore, the system function, as designed, was verified for adequate performance through a review of pre-operational start-up test data. The testing performed verified that, on a component basis and upon loss of the instrument air subsystem, valves would position themselves to their proper mode, open or closed. However, exception was taken to Regulatory Guide 1.68.3 as documented in the FSAR, and no integrated flow test for the condition of loss of the instrument air subsystem was performed, and there was no gradual bleed-down test of the valves fed by the instrument air subsystem for final valve position.

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In the APS letter dated February 20, 1989, the following commitments were made to improve the reliability of the instrument air subsystem:

- a scope of changes and associated schedule for completion to meet air quality standards will be provided in the supplemental response;
- the abnormal operating procedure for loss of the instrument air subsystem will be revised to address SOER 88-01 recommendations by June 30, 1989;
- additional operator training for loss of instrument air subsystem will be developed as part of simulator certification under 10CRF55;
- the Engineering Design Basis review will be completed during the first quarter of 1991;
- a program quality for periodic testing and preventative maintenance of the instrument air subsystem will be developed.

The APS supplemental response dated April 27, 1989 provided the Unit 2 test results indicating the acceptability of the air quality for the instrument air subsystem. APS has made the following additional commitments:

- reduce the micron rating of the afterfilters before any Unit restart;
- conduct air quality tests during the humid months;
- perform air quality verification tests on a periodic basis;
- the schedule for the commitment to prepare the Engineering Design Basis manual has been advanced to the first quarter of 1990.

APS responses to Generic Letter 88-14 are provided in Appendix A to this report.

PVNGS
INSTRUMENT AIR SUBSYSTEM OF THE COMPRESSED GAS SYSTEM

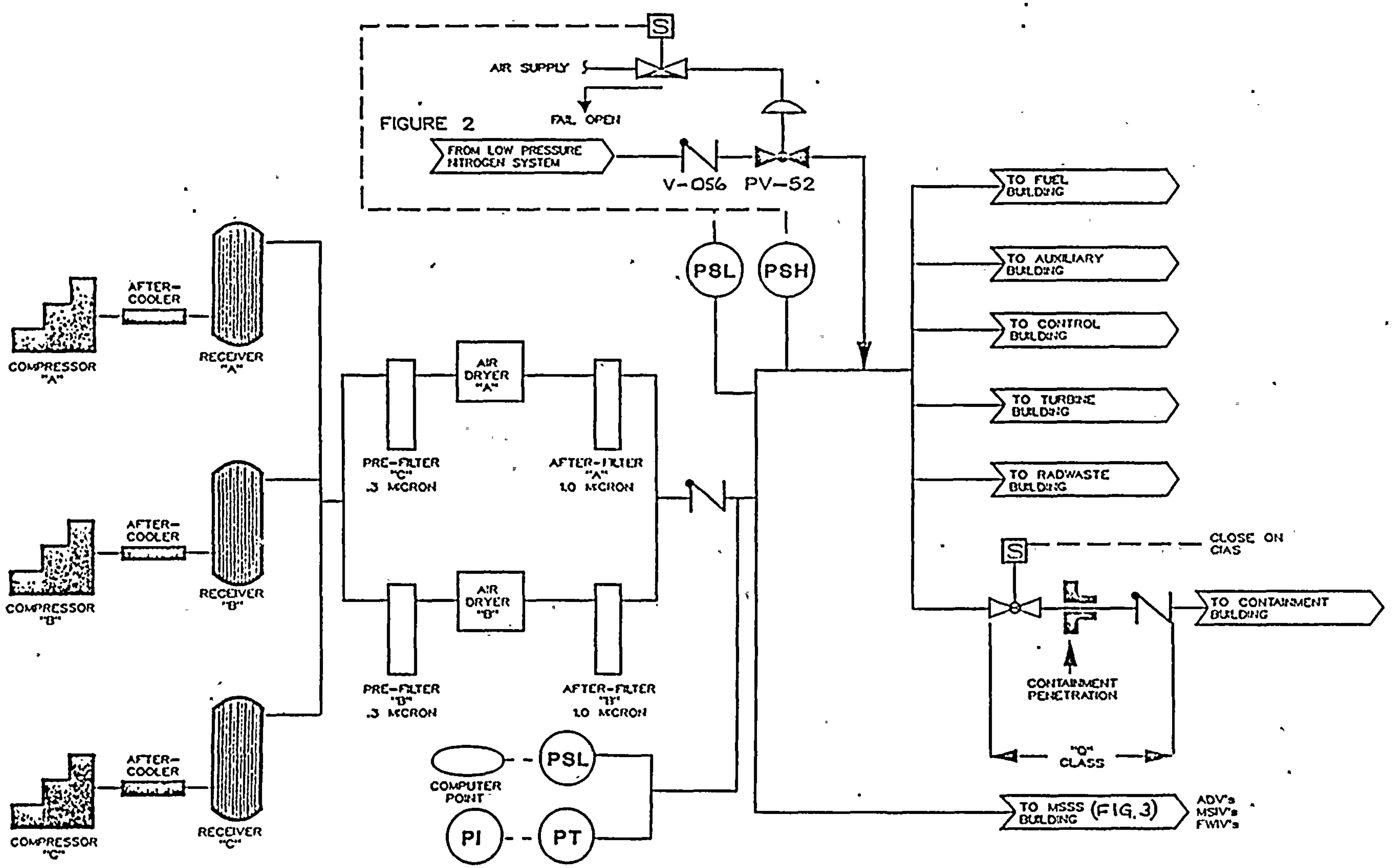

FIGURE 1

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PVNGS
NITROGEN SUBSYSTEM OF THE COMPRESSED GAS SYSTEM

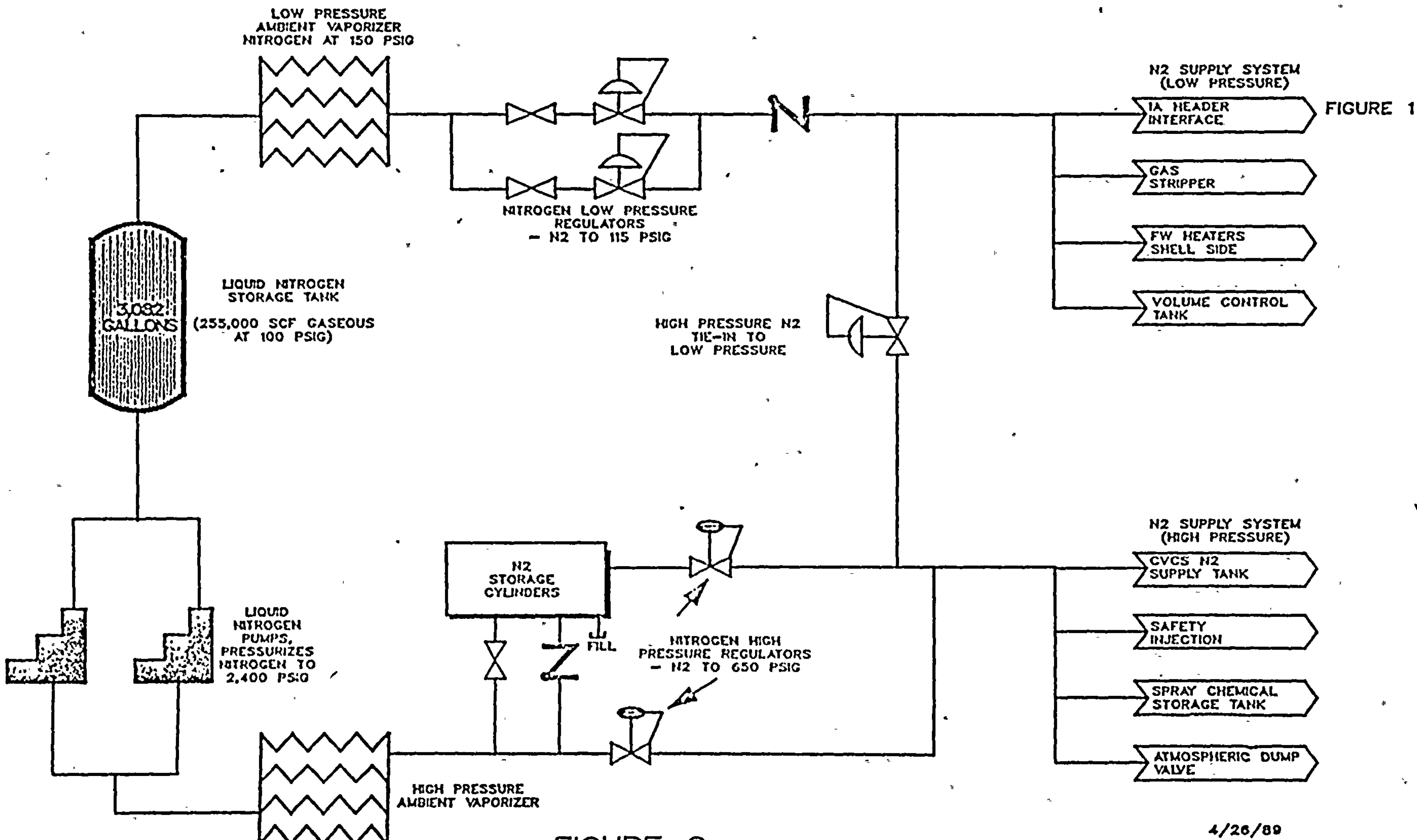

FIGURE 2

MSSS COMPRESSED GAS SUPPLY TO SAFETY-RELATED EQUIPMENT

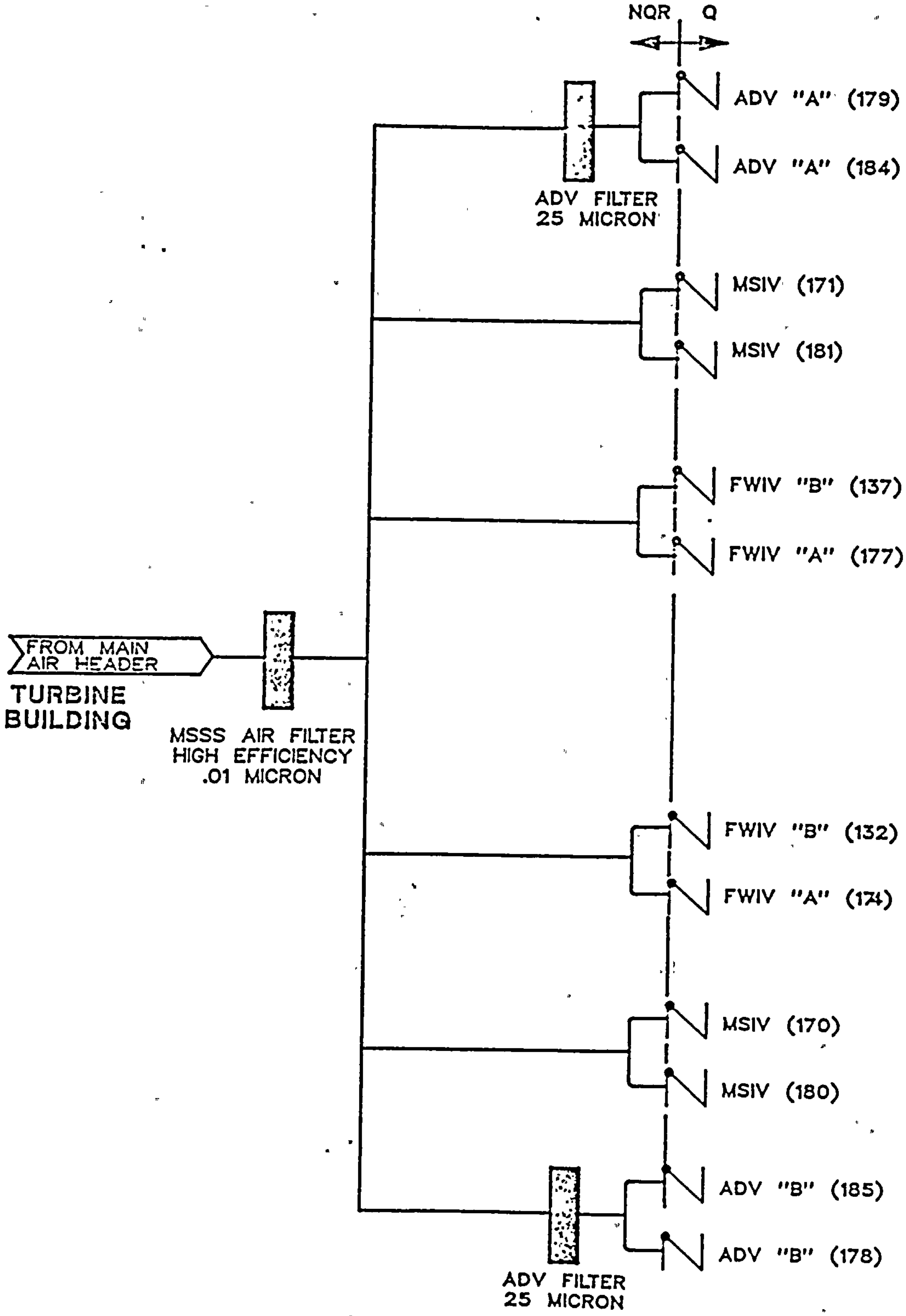

FIGURE 3

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COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 1

TIME SEQUENCE OF UNIT 3 TRIP

EVENT	ALARM TYPER ACTUAL TIME
Main Steam Isolation Actuation Signal	1:03:48
IA Compressor A, B and C Trouble Alarm	1:06:00
IA Header Pressure Low Alarm Was Initiated Due To Header Pressure Dropping to 95 psig	1:07:46
Nitrogen Backup Supply Valve Open Alarm	1:08:42
While on Nitrogen Supply, the IA Header Pressure was Observed at 65 psig	2:30 - 3:00
While on Nitrogen Supply, the IA Header Pressure Was Observed at 67 psig	2:50 - 3:20
IA Compressor B in Auto	4:01:36
IA Compressor C in Auto	4:01:39
Nitrogen Back-Up Supply Valve Closed When IA Header Pressure Reached 105 psig	4:06:23
Air Compressor A in Auto	4:06:23

Note: Document and operator testimony indicates a minimum nitrogen tank level of 95" after the event. This is equivalent to 160,000 scf of nitrogen since the nitrogen liquid in tank is maintained at 150 psig.

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TABLE 2

COMPRESSED GAS SYSTEM DESIGN BASIS

1. The CGS is non-quality related with the exception of containment pentration piping and associated isolation valves.

2. The CGS includes the following equipment:

   A. Three oiless compressors each rated for 500 scfm at 125 psig. The compressors are non-lubricated to ensure oil free air.

   B. Three aftercoolers and moisture separators for moisture-free air.

   C. Three receivers with a total capacity of 453 cubic feet.

   D. Two prefilters designed for 98% removal efficiency for particles of 100 microns or larger at 400 scfm.

   E. Two air dryers, each rated for a -40 deg. F dewpoint at 105 psig (operating pressure).

   F. Two afterfilters designed for 97% removal efficiency of particles 25 microns and larger at 400 scfm.

3. The CGS maintains a minimum system pressure of 80 psig during normal operation, and a maximum system pressure of 125 psig. The compressor normal operating range is 110 psig to 120 psig.

4. The CGS fails during a loss of power event.

5. A CGS failure has no effect on the capability to perform a safe reactor shutdown. All air operated valves in ESF systems are designed to fail in the "safe" position upon loss of instrument air, and as such do not negate the safety related functional performance of the system.

6. All pneumatically actuated active safety related valves which are required for safe shutdown are provided with safety related accumulators (i.e., MSIV, FWIV, and ADV).

7. CGS containment penetrations are provided with Seismic Category I, Quality Group B, Isolation Valves which are located in Seismic Category I Flood and Tornado protected structures. They are also protected from missiles and pipe breaks.

8. The CGS is designed and constructed in accordance with Regulatory Guide 1.26 and Quality Classification Group D.

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TABLE 2

(Continued)
COMPRESSED GAS SYSTEM DESIGN BASIS

9. A nitrogen back-up supply is automatically introduced to supply the CGS header when system pressure falls below 85 psig.

10. The nitrogen subsystem supply includes the following equipment:

    A. One liquid nitrogen storage tank with 3082 gallon capacity at 245 psig. This tank shall allow for a refueling shutdown and startup, or 30 days use by the served systems, whichever is greater, while the gas storage capacity shall be based on 7 days normal usage.

    B. One low pressure vaporizer rated for 60,000 scfh (1000 scfm) at 150 psig.

    C. One high pressure vaporizer rated for 18,000 scfh (300 scfm) at 2450 psig.

    D. Gas storage tanks with a capacity of 66,800 SCF.

11. The high pressure nitrogen header which feeds the safety injection tanks and the atmospheric dump valves are regulated down at 650 psig.

B. Results

1. Analysis of the Unit 3 Event

An evaluation of the CGS performance during the recent Unit 3 trip was conducted to detemine if the system performed as designed. In addition, the CGS performance during the Unit 3 trip was compared with its performance during previous trips in Units 1 and 2 which involved a loss of power to the instrument air subsystem compressors. The purpose of the comparison with other trips was to:

- Identify any common abnormalities in the CGS performance that were observed in the recent Unit 3 trip and the previous PVNGS trips.
- Make recommendations to resolve the causes of the abnormalities identifed above.

Results of the evaluation are provided in Tables 3 and 4. One common abnormality was identified which occurred in two previous trips. The common abnormality is the reduction of CGS header pressure to approximately 65 psig while the system was fed by the nitrogen subsystem. Although the system is not required for safe shutdown of the plant, the intent of the CGS design has been to maintain a header pressure of at least 80 psig at the instruments even after a loss of power to the CGS compressors. This intent was to be satisfied by the passive backup nitrogen subsystem by introducing nitrogen into the air header after the loss of power to the compressors. A review of the nitrogen subsystem design indicates that the major components are sized to deliver as much as 1000 scfm of nitrogen on demand. A review of the Unit 3 data indicates an air consumption rate of approximately 400 scfm between the time when the compressors lost power and the time immediately before the introduction of nitrogen into the air header. This calculated air consumption is after the MSIS actuation which means that the MSIVs and FWIVs had already actuated and were consuming air through the hydraulic pumps. The estimated Unit 3 air consumption rate of 400 scfm is derived using the following parameters:

- instrument air subsystem piping and tank volume (estimated at 545 ft^3)
- initial tank pressure of 120 psig just before compressor loss
- final tank pressure of 85 psig just before nitrogen backup valve opens
- time between the compressor loss and the opening of nitrogen backup valve from the computer alarm typer output provided in Table 1 (2 min. 42 seconds). During this time, the system demand was only met by the volume of air in the instrument air subsystem.

The consumption rate derived from the Unit 3 data shows a much less instrument air use than anticipated by the design calculation for the nitrogen system demand during a transient condition (Reference section IV.D). This is because the calculation assumes that all normal loads are

maintained as part of the demand and the MSIV/FWIV use a maximum vendor specified air usage of 56 scfm each. The condition identified in the calculation for transient condition is very conservative and may not be the true representative of the instrument air header demand at all times. The air consumption rate during the Unit 3 transient is not significantly higher than the air consumption rate during normal condition which has been monitored for the past few months in Unit 2 and documented to be approximately 320 scfm.

An air consumption rate of 400 scfm during the transient in Unit 3, indicates that the possibility of a large air consuming component may not be valid. This relatively normal flow rate also shows that the leakage is relatively small through the system. Analysis of the Unit 3 data points to the failure of the nitrogen subsystem in providing the required demand even at the relatively low flowrates.

The evaluation of the system piping/valves identifies pressure restricting components which lead to a reduced pressure at the interface between the nitrogen backup supply and the main air header.

Other aspects of the CGS performance (with exception of the reduction of pressure to 65 psig while on nitrogen supply) is in accordance with the design as shown in Table 3.

As a result of this review, the following action plan will be taken by APS in order to resolve concerns with the reduction in air header pressure:

> A flow test of the nitrogen subsystem backup to the instrument air subsystem was conducted at the air header interface in order to determine if the nitrogen subsystem can provide the projected air header demands at the required air header pressure. The results of the test are provided in Appendix H.
>
> The nitrogen test showed that the nitrogen subsystem does not supply the adequate nitrogen supply at the required pressure. Components within the nitrogen supply system will be investigated and replaced to comply with the system intended design.

1

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 3

COMPARISON OF THE COMPRESSED GAS SYSTEM IN UNIT 3 TRIP WITH DESIGN

TOPIC	PERFORMANCE
Compressors tripped when NAN-S01 and NAN-S02 lost power	This action is per design. The compressors are fed from load centers that lose power when the two buses lose power.
Air header pressure reduced to 95 psig in 1 minute 45 seconds	This action is per design. The receivers are designed to provide sufficient capacity to allow for tripping of one compressor and subsequent automatic energization of one of the remaining two compressors. The CGS is not safety related and is backed up by nitrogen supply which has sufficient capacity to feed the air demand. The receiver sizing therefore did not consider the rate of pressure loss when all 3 compressors were lost because nitrogen system is expected to operate to supply the air demand.
The nitrogen backup valve opened in 2 minutes and 42 seconds after loss of power to compressors	This action is per design. The nitrogen backup valve is designed to receive a signal from the air header sensor and open when the supply pressure falls below 85 psig. The system is not required for safe shutdown but the intent of the design is to avoid air header pressure reduction below 80 psig at the instruments level
IA pressure was observed between 64-67 psig approximately 2 hours after loss of power to compressors	This action is not consistent with design. The low pressure nitrogen skid is designed to provide a flow rate of 1000 scfm as stated in the purchase specification. This flow rate is above the anticipated air header flow rate which is normally 400 scfm. The nitrogen subsystem in Unit 3 should have maintained the pressure in the air header at or above the minimum required pressure of 80 psig.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 4

COMPARISON OF THE UNIT 3 TRIP WITH PREVIOUS TRIPS IN OTHER UNITS

TOPIC	PERFORMANCE
Nitrogen supply valve opened at 2 minutes and 42 seconds after loss of power to the compressors.	The air pressure in Unit 3 is consistent with the pressure reduction in other trips which involved a loss of power. There are four trips that clearly show the nitrogen supply valve opening between 2.5 - 3.5 minutes upon loss of power to the compressors. References PTRRs 1-85-006, 1-86-001, 1-86-007 and 1-88-004.
MSIV and FWIV operation	The MSIV and FWIV operation in Unit 3 trip is consistent with operation in other trips. None of the post trip reports identified abnormalities in the operation of the MSIVs or FWIVs due to loss of power to the air compressors. Reference PTRRs 1-86-001, 1-86-007, 1-88-004 and 2-86-004.
Atmospheric Dump Valve (ADV) operation	There are five trip reports that indicate that ADVs were required to operate to cool the plant while the electric power to the air compressors was lost. The ADV operation in all cases was satisfactory. However, concerns were raised due to the sluggish response time of the ADVs. Reference PTRRs 1-85-004, 1-85-005, 1-86-001, 1-88-004.
Air header pressure reduced to 65 psig while the header was supplied by nitrogen	There are two other instances where the post trip reviews indicate that the air header pressure was reduced to 65 psig in Unit 1. In both cases the air header was supplied by nitrogen backup. In both cases, the ADV operation was successful and no apparent safety related equipment failure due to reduction in air header pressure was identified. Reference PTRRs 1-85-005 and 1-85-006.

2. Review of PVNGS Historical Documents

A review of historical documents pertaining to the design and operation of the CGS was conducted to determine possible effects on the design basis. Special attention was given to design/operational concerns that were reported or documented previously and again identified or observed during the recent Unit 3 trip.

The types of engineering documents that were reviewed include Plant Change Requests (PCRs), Field Change Requests (FCRs), Licensing Documents (LCTS & IEIN), Non Conformance Reports (NCRs), Start up Field Reports (SFRs), Design Change Packages (DCPs), Site Modifications (S-Mods), Supplier Document Change Notices (SDCNs), Engineering Evaluation Reports (EERs), Post Trip Review Reports (PTRRs), Purchase Specifications for procurement of various compressed gas components, and Special Plant Event Evaluation Report (SPEERs/SPs).

Detailed results of the review are shown in Appendix B. The major concerns are identified in Table 5. These concerns may be summarized as follows:

- EER 85-GA-013 was issued to document a reduction in air pressure in Unit 1 to 65 psig. This occurred as a result of an loss of power to all compressors. The EER was dispositioned as an acceptable pressure and flowrate. Review of this disposition now shows that it was incorrect and that the system should provide the design basis flow of 1000 SCFM and pressure of 80 PSIG. 1

- EER 83-IA-001, 83-IA-002, 84-IA-007 and 84-IA-008 document cases of moisture in the compressed gas header. These early moisture problems were from design problems or system lineups that were corrected to remove the moisture from the header.

- A total of 43 FCRs identify additional piping or air users that are not shown in the existing PVNGS calculations.

APS has identified action plans to address each of the concerns as stated above. Section VI of this report presents a detailed corrective action plan.

Summary of corrective actions are as follows:

- Update PVNGS calculation(s) to reflect the as built condition

- Develop a program to monitor air quality and correct existing conditions as required

- Perform testing to verify the capacity of the nitrogen subsystem

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 5

SUMMARY OF CONCERNS IDENTIFIED BY THE HISTORICAL DOCUMENTATION REVIEW

Document	Concerns
FCR	A total of 43 FCRs have identified installation of additional piping or air users to the plant compressed gas system. This as-built condition is not reflected in the existing calculations.
EERs	An EER was issued to document the air header pressure reduction to 65 psig. A check valve was identified to be the root cause of the problem but no corrective action was initiated. Other EERs were issued to document moisture in the air header.
Generic Letter	Generic Letter 88-14 has been issued to address air quality problems at nuclear power plants. For response to this letter see Section II.F of this report.
I&E Notices	I&E Notice 87-28 address air system problems at U.S. Light Water Reactors. The response to this document is not complete; however, the following reviews are being conducted: ° Air system quality review ° Loss of air system recovery review ° Adequacy of backup air accumulator review ° Adequacy of gradual loss of air pressure I&E Notice 85-35 and Supplement 1 identified varius occurrences of safety related accumulators pressure bleeding down due to check valve leakage. The original notice identified a specific type of check valve (Parker Hannifin C Series Catalog 2502) installed in air lines for MSIVs and FWIVs. APS issued DCPs to remove these check valves.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 5

(Continued)
SUMMARY OF CONCERNS IDENTIFIED BY THE
HISTORICAL DOCUMENTATION REVIEW

Document	Concerns
I&E Notices (Continued)	APS' reponse to I&E Notice 85-35 only discusses the MSIVs and FWIVs. However, we did look at the concerns as part of our response to INPO SOER 88-01 and it was concluded that there was no problems with the check valves to the ADVs. This was based on no plant failures or no documented failures from the manufacturer. We have performed a backleakage test of the check valves to the ADVs to find the leak rate values. This test was done for all 3 Units and the values were found to be very low, <1 scfm. I&E Notice 88-24 identified failure of air operated solenoid valves affecting safety related systems. APS is presently reviewing this IEN for applicability. To date APS has not observed any failures of air supplied ASCO solenoid valves through review of our Failure Data Trending System. I&E Notice 86-50 identified inadequate testing of safety related pneumatic components or systems. PVNGS has had plant trips in which the CGS was lost under slow decay conditions. Problems have not been detected except for sluggish ADVs. I&E Notice 88-51 addresses the adequacy of surveillance testing to ensure operability of valves following maintenance. This IEN is under evaluation. APS will evaluate adequacy of surveillance testing against this problem.

3. Nuclear Utility Survey

A utility survey was conducted to gather information on the CGS of plants that are similar to PVNGS. Details of the survey and its results are presented in Appendix B. This section presents an overview summary of the Appendix.

The purpose of the survey was to gather information on CGS design and preventative maintenance programs and use the information to develop improvements to increase system reliability of the PVNGS CGS. Such reliability improvements would be the result of design modifications and/or changes to operating and maintenance procedures.

Information from other utilities was gathered by means of a of 15-question survey encompassing a broad scope of information. Eight utilities were chosen for survey on the basis of size, age, NSSS manufacturer, location and availability of information sources. Nuclear power installations contacted were Diablo Canyon, Rancho Seco, St. Lucie, SONGS, STP, Trojan, Waterford and Vogtle.

Table 6 compares the PVNGS design with that of other plants surveyed. As can be seen from the table, the PVNGS CGS design, components and maintenance practices are generally consistent with those of similar plants. Areas of potential improvement developed from this survey are as follows:

- Most plants, including PVNGS, do not have current calculations that reflect normal and off-normal loads on the compressed gas system. In order to determine if the PVNGS system is properly sized, the existing calculation should be revised to reflect current loads on the system.

- Tests should also be performed to verify that the nitrogen subsystem is capable of meeting the system demand.

- Two plants surveyed provide a 1E power source to be used if non-1E power to the compressors is lost. Although PVNGS has a passive nitrogen subsystem that functions to restore system pressure if the compressors are lost, a study will be performed of the benefits and feasibility of providing 1E power to the CGS compressors as an additional or alternate backup system.

PVNGS has reviewed its preventative maintenance activities, including those for air quality control to ensure that they are adequate to ensure system reliability. Since this issue has been addressed in other sections of this report (e.g., IV.F, IV.G), specific recommendations are not provided in this section.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 6

COMPARISON OF PVNGS DESIGN WITH SURVEYED PLANTS

Topic	PVNGS Design	Other Plants
Quality Classification	Non-Safety Related.	Non-Safety Related.
Backup for Safety Related Components	Safety related accumulators are provided for ADVs, MSIVs, and FWIVs. All other valves fail safe on loss of compressed air.	Seven of eight plants utilize local accumulators or compressed gas bottles for safety related valves. One plant has all safety related valves fail safe on loss of instrument air.
Backup for Instrument Air System	Passive nitrogen subsystem pressurizes entire system. Compressors are not required.	Three plants have a non-1E diesel. Two plants have 1E power to the IA compressors. Three plants have no overall backup system.
System Design Parameters:		
Normal Operating Pressure	100-120 psig	90-120 psig
Normal Demand Flow Rate	350 scfm	100-1,200 scfm
Design Maximum Flow Rate	1,500 scfm	560-6,000 scfm
Design Dewpoint	-40F	-60F to -34F
System Component Ratings and Capacity:		
Dryer Prefilter Rating	0.3 microns	1-10 microns
Dryer Afterfilter Rating	1 microns	0.3-10 microns
Dryer Capacity	400 scfm	360-900 scfm
Air Quality Control	Currently developing a program for air quality.	Most plants are currently developing an air quality program in response to industry and NRC concerns.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

4. Comparison of System Function and the Design Basis

The purpose of this section is to analyze the CGS performance to ensure that it meets the system's original system design requirements. Performance data was obtained from actual plant data, and manufacturer's test data have been compared to the design basis.

The CGS is comprised of two subsystems; instrument air and nitrogen. The nitrogen subsystem serves as a backup to the Instrument Air subsystem. Data collected from a Unit 2 air quality test from February 12 to March 27 was used to measure the performance of the instrument air subsystem to its design basis. In addition, manufacturer's data was used to compare the performance of both subsystems to the CGS design basis.

a. Instrument Air Subsystem

i. Air Quality

The air quality test conducted in Unit 2 was in response to NRC Generic Letter 88-14, "Instrument Air Supply System Problems Affecting Safety-Related Equipment". The test was run under normal full power conditions for approximately 2 weeks prior to unit shutdown (resulting from ADV concerns). A summary of the air quality test results and their respective design basis values are below:

	LOW	HIGH	AVERAGE	DESIGN BASIS
DEWPOINT	-85	-58	-80	-40
FLOW RATE (SCFM)	170	390	301	400
OIL CONTENT (PPM)	0	1	.03	OIL FREE
PARTICLE SIZE (Microns)	.5	15	.65	25*

* Actual design basis documentation for particle size indicates a 97% removal efficiency for particles 25 microns or larger. Afterfilters' 25 micron rated cartridges were replaced with 1 micron rated cartridges 99.9% efficient. This was based on Filterite recommendation, which is the afterfilter supplier, as documented in vendor correspondence dated February 6, 1984 (Log Number M054-65). Design basis documentation will be changed to reflect as built configuration.

The dewpoint values are corrected to accomodate for actual system pressure (125 psig) since actual readings were taken at atmospheric pressure. The average particle size was calcuated by adding the number of each size particles, and dividing by the total number of particles in their respective size ratio.

Dewpoint

The instrument air subsystem is provided with two desiccant-type dryers with dual towers (see Section II). Each dryer is rated for an outlet flow of 400 scfm of air with a dew point of -40°F at system design pressure. Test values show an average dew point of -80°F, at system design pressure (125 psig) with an average flow of 301 scfm. The test also indicates a dew point of -85°F at the highest recorded value for instrument air demand of 390 scfm (February 24, 1989). Therefore, the CG dryers meet the design basis under normal operation.

Oil Content

The instrument air subsystem is designed to provide a continuous supply of filtered, dry, oil-free compressed air for pneumatic instruments. It has been established per the test results that instrument air meets the filtration and dew point (dry) levels as described in the design basis. Since specific values for oil content are not part of the design basis, ISA-S7.3-1975 "Quality Standard for Instrument Air" was used as a guideline for the determination of the oil content. This standard indicates the acceptable oil content per weight (w) or volume (v) ratios as:

> OIL CONTENT - as close to zero (0) w/w or v/v as possible; and under no circumstances shall it exceed one (1) ppm w/w or v/v under normal operating conditions

One (1) ppm was the highest reading recorded during the test, occurring only once on February 13, 1989. As shown in the test summary, the average oil content of .03 ppm is below the 1 ppm noted in the ISA standard.

Particle Size

The filter efficiency is a ratio of the particles present upstream of the filter to the particles that remain downstream of the filter. Filter efficiencies are usually expressed for a variety of particle sizes. For example, a one micron numerically rated filter may remove 97 percent of all one micron sized particles present in the filtered medium. The same filter may remove 99 percent of all three micron and larger sized particles and only 95 percent of all one-half micron sized particles in the filtered medium. Therefore, a 99% rated filter may pass some particles greater than 3 microns but will remove these larger particles at a greater efficiency (i.e., 99.9% for example).

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

Two airfilters are provided downstream of the air dryers which have a 99.9% removal efficiency for particles 1 micron and larger. Test data indicates that only two particles 15 microns in size were found and no particles greater than 15 microns were encountered in 25 measurements taken in 10 days during the test. Additionally, test data summary shows an average particle size of .65 microns in the air stream downstream of the airfilters. Therefore, design basis of the afterfilters of 97% removal efficiency for particles 25 microns or greater has been met since 1 micron filters are installed. However, based on ISA-S7.3-1975 PVNGS air quality guideline, afterfilter cartridges rated for 0.45 microns 99.98% efficient will be installed before restart to further increase filtration efficiency.

Additionally, filter/moisture separators were installed in the IA line to the MSSS by S-Mod IA-003. This filter/separator provides additional air filtration to the safety related equipment (i.e., MSIV, FWIV, and ADV valves) located in this building. The filter/moisture separators are 99.9% efficient and can remove particles as small as 0.01 microns. Note that a filter/separators have now been installed in all Units.

ii. Normal and Transient System Loads

Instrument air demand flows for normal and transient modes were made in calculation number 13-MC-IA-301. The normal instrument air demand is estimated to be 400 scfm; the transient air demand is estimated to be 884 scfm.

Normal System Loads

The CGS is designed to maintain clean and dry air for an estimated normal load of 400 scfm in accordance with the design basis Table 2. Test data from the air quality test in Unit 2 show system performance exceeding design requirements at an average flow of 301 scfm. The test also showed that the system air quality exceeded the design requirements at the highest recorded flow of 390 scfm during the test. Therefore, the system meets the required air quality at the normal load (400 scfm).

Transient System Loads

The increase in air demand to 884 scfm during the transient condition takes into account the air consumption in the MSSS increasing from 45 scfm to 529 scfm. This is due primarily as a result of the vendor specified maximum at 56 scfm 80 to 100 psig required by each of the four MSIVs and the four FWIVs immediately after the unit is tripped. However, at lower air pressure and higher hydraulic pressure, within the valve components, air consumption will be reduced proportionally. Refer to Section IV.E for description of valve operation.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

A maximum estimate of transient duration time due to MSIV and FWIV recharging is 19 minutes. This is derived by dividing the FWIV (worst case) hydraulic actuator cylinder volume (1805 in^3) by the rate of discharge (97 in^3/min.) for the hydraulic pump with an 80 psig air supply.

As shown by the test results, the system can adequately meet the normal air demand of 400 scfm. For the maximum estimated transient load of 884 scfm, the following parameters are listed in order to determine if instrument air subsystem can still meet design basis:

Compressors - 500 scfm each at 125 psig- total for three (3) is 1500 scfm per calculation number 13-MC-IA-205

Dryers - Each dryer rated at 400 scfm at -40°F dew point, 2 total; however only one (1) used at a time, total flow 400 scfm (calculation number 13-MC-IA-206)

Afterfilter - One per dryer: rated 400 scfm; 25 microns at 97% efficiency

IA Header - Main header capacity is sized to carry about 1000 scfm Capacity per calculation number 13-MC-IA-300

From the above information it can be observed that the IA header and compressor can easily handle estimated transient flow of 884 scfm. However, the dryers and the afterfilters would experience flow greater than twice their capacity for short transient periods (19 minutes).

At the transient flow of 884 scfm, the afterfilter can still meet its design efficiency of 99% for 1 micron rating but with an increase in pressure drop.

Afterfilter manufacturer (Filterite) and dryer manufacturer (C. M. Kemp) were contacted for expected equipment performance at transient conditions.

Filterite stated that the rated filtration can still be met by the afterfilter but with an increased pressure drop. Filterite calculated a pressure drop of about 3 psid for the afterfilter at a 1000 scfm flow with a 0.2 micron rated cartridge. (Per Telex Filterite to APS dated April 13, 1989). For a .4 micron filter, this pressure drop would be less. The 3 psid is less than the 9.77 psid used in Calculation 13-MC-IA-301. Therefore, afterfilter performance during a transient is acceptable.

It is unlikely that the dryers will be able to maintain a dew point of -40°F at 884 scfm. As was observed from the Unit 2 results, there is a built in margin in the dryers since the average dew point was at -80°F for 301 scfm average flow. Additionally, ISA-S7.3-1975 "Quality Standard for Instrument Air" states dew point requirements as follows:

Dew Point - The dew point shall be at least 18°F below the minimum temperature to which instrument air subsystem is exposed at system pressure.

C. M. Kemp, dryer manufacturer indicated that heatless desiccant dryers will experience "moisture breakthrough" when airflow exceeds the dryer's rated capacity (per conversation memorandum dated 4/26/89, File No. 89-175-419.M054). The dew point will rise from its steady state value and may take several days to recover. Based on the calculation parameters and assuming several events a year, C. M. Kemp Co. does not believe that the dew point will rise significantly above its normal flow value. PVNGS has a preventative maintenance task to replace desicant yearly. Therefore, dryer performance during a transient is acceptable.

To be conservative, after a moisture breakthrough occurs, the desiccant in the affected dryer should be replaced. This can be done by isolating affected dryer and switching flow to standby dryer. Saturated desiccant can then be replaced by following approved maintenance procedures.

Based on this review, it is concluded that the instrument air subsystem can meet instrument air plant demand during normal and transient conditions.

b. Nitrogen Subsystem

Upon a reduction in the normal air supply pressure dropping to 85 psig, nitrogen will be automatically introduced to the instrument air supply header. This occurs when the demand exceeds the air supplied or an equipment failure occurs. At this time, back-up nitrogen supply valve PV-52 opens to introduce nitrogen into the system header.

Calculation 13-MC-GA-207 has identified normal and upset conditions pressure drops at the low pressure nitrogen supply interface to the 3" Turbine Building instrument air header. The upset condition initially considered a 1 psid pressure drop across spring loaded check valve IAN-V056. It was later determined that installed valve spring has a 24.2 pound cracking pressure. This force equates to an actual pressure drop across valve of 18.6 psid. For documentation on this matter, refer to BECHTEL-CONVAL letter BE/CO-1805 dated 04/13/89.

Findings in Appendix B (historical research) indicate that CONVAL, the supplier for this check valve, recommended a replacement for the subject valve as its pressure drop was considered high (Ref. EER 85-GA-013). The valve spring was not changed at that time since the system operation was deemed acceptable and funding was not available to change the spring (see Appendix B).

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

Calculated pressure drops, with a 1 psid and 18.6 psid across valve IAN-V056, will be tabulated for comparison. The pressure drop vs. flow rates are shown below.

FLOW (SCFM)	PRESSURE DROP WITH 1 psid ACROSS IAN-V056	PRESSURE DROP OF 18.6 psid ACROSS IAN-V056
400	5.55	24.15
700	16.84	35.44
1000	34.34	52.84

The increased pressure drop was obtained by the additional losses at the higher cracking pressure of 18.6 psid. This provides a close approximation of the pressure drops for the flows indicated.

A nitrogen subsystem pressure of 100 psig was assumed in calculation 13-MC-GA-207. This pressure can be adjusted up or down to reflect variations in system pressure corresponding to the adjustment. Calculation results of 100 psig nitrogen subsystem pressure show the available pressure at the instrument air interface with the previous calculated pressure drop at 400, 700, and 1000 scfm flows. The resulting pressures at the instrument air header are tabulated as follows:

FLOW RATE (SCFM)	PRESSURE (WITH 1 PSID)	PRESSURE (WITH 18.6 PSID)
400	94.45	75.85
700	83.16	64.56
1000	65.76	47.16

Review of the above data indicates that at flow rates of 400 and 700 scfm, with 1 psid across valve IAN-V056, the minimum design pressure of 80 psig can be maintained. It is only at the highest flow of 1000 scfm that the system pressure falls to nearly 65 psig. Plotting the above points produces a curve which intersects at the interface point for the transient flow rate of 884 scfm at about 73 psig. Using actual low pressure regulator setting of 115 psig as the nitrogen subsystem pressure with 1 psid for IAN-V056, results in an available interface pressure of 109.45, 98.16 and 80.76 psig for flows of 400, 700, and 1000 scfm respectively.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

In the actual configuration, corresponding to the low pressure regulator setting of 115 psig and 18.6 psid across valve IAN-V056, the nitrogen subsystem can supply plant pneumatic demands <u>only</u> during normal operation. At 700 and 1000 scfm flows, the minimum 80 psig for pneumatic needs is not maintained. Plotting a parallel curve to previous subsystem configurations, a 69 psig available pressure at the instrument air is obtained at the transient flow of 884 scfm in actual subsystem configuration.

In the above configuration, the 69 psig pressure approaches the reported instrument air header pressure of 65 during the Unit 3 event. However, the plant demand during the trip has been estimated substantially below transient flow of 884 scfm. Plant demand is believed to be closer to 400 scfm (see Section IV).

Based on the above information, it is recommended that a flow test be performed to evaluate actual N_2 performance to verify actual system pressure drop.

It is also recommended that spring in valve IAN-V056 be replaced with a spring corresponding to 1 psid or lower. Additionally, the low pressure regulator setting should be changed from 115 psig to 125 psig to provide for higher nitrogen subsystem pressure. For further details refer to Action Plan Section VI.

5. Comparison of ADVs to MSIVs/FWIVs

Due to the recent problems associated with the ADVs APS compared the ADVs to the MSIVs, and FWIVs to determine if similar compressed gas problems could exist on these valves and to determine any additional preventative maintenance that should be performed on these valves. A comparison of the valves' safety functions, compressed air functions and affects of air quality on equipment is presented in Tables 7, 8, and 9.

The FWIVs and MSIVs have similar designs. The only significant design differences between the two are the valve sizes and the redundant control system on the MSIVs. The FWIVs achieve redundancy by using two valves in series. The design concepts used for the compressed gas components in these valves are identical. Below is a comparison summary of the valves.

	ADV	FWIV/MSIV
1. Valve Type	Offset globe-used for steam flow modulation	Double disk wedge-used for isolation.
2. Safety Function	Used during plant cooldown for extended periods to remove heat from the steam generators if the condenser is not available.	Used one time only in response to a MSIS for system isolation. Valves must reposition from fully open to fully closed in 4.6 seconds for MSIVs and 9.6 for FWIVs.
3. Actuating System	Pneumatic - Uses compressed air to actuate the valve with a safety related high pressure nitrogen filled accumulator as a backup. The nitrogen accumulator pressure is monitored to ensure valve operability. A safety related check valve between the compressed gas and nitrogen backup is used to make the class break from non-safety related to safety related. Refer to Figure 3 and 4.	Hydraulic - Uses a hydraulic system to actuate the valve. Compressed air is required to actuate solenoids which in turn allows the hydraulic system to actuate the valve. A safety related check valve is used to make the class break from non-safety related to safety related. Refer to Figure 3, 5, and 6.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

	ADV	FWIV/MSIV
4. Safety-Related Check Valves	The spring-loaded check valves that form the barrier between nitrogen and instrument air were tested by bleeding down the instrument air and measuring the backleakage. For Units 1 and 2 (Dresser-Hancock valves), the backleakage was below the design leak rate. The APS leak rate test results were confirmed with vendor test data. The Unit 3 valves' (Kerotest) leakage was higher than the Unit 1 and 2 valves. The Unit 3 valve seats will be relapped or replaced prior to restart. Leakage for an off the shelf Kerotest valve was measured by bench test and found to be acceptable, (Ref. Appendix F) therefore, rework of the installed Unit 3 valves will provide an acceptable seal. Depending on the test results and a study of the nitrogen subsystem for the ADVs, change to a soft seat check valves will be considered to provide a tighter seal. These valves will now be included in the ASME Section XI leakage testing program. The leak rate under gradual loss of instrument air will be measured on a regular basis.	Check valves have been replaced under DCP's 1, 2, 3 FM-SG-151 to ensure closure upon gradual loss of compressed air. Reference IE Notice 85-35.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

Description of MSIV and FWIV Operation

To fast close the MSIVs and FWIVs, a signal is sent to select pilot solenoid valves that reposition the 4 way shuttle valves to direct hydraulic fluid into the top of the cylinder and vent the bottom. The fluid is charged in the hydraulic accumulators and is maintained at approximately 5200 psig to ensure sufficient stored energy to fast close the MSIV and FWIV Figures 5 and 6.

The slow open and close modes are non-safety related. Select pilot solenoid valves are required to position the 4 way shuttle valves that allow hydraulic fluid to be pumped from the reservoir into the actuator cylinder. The high pressure hydraulic fluid is not used for the slow positioning modes.

Analysis of the MSIVs and FWIVs for Compressed Gas Problems

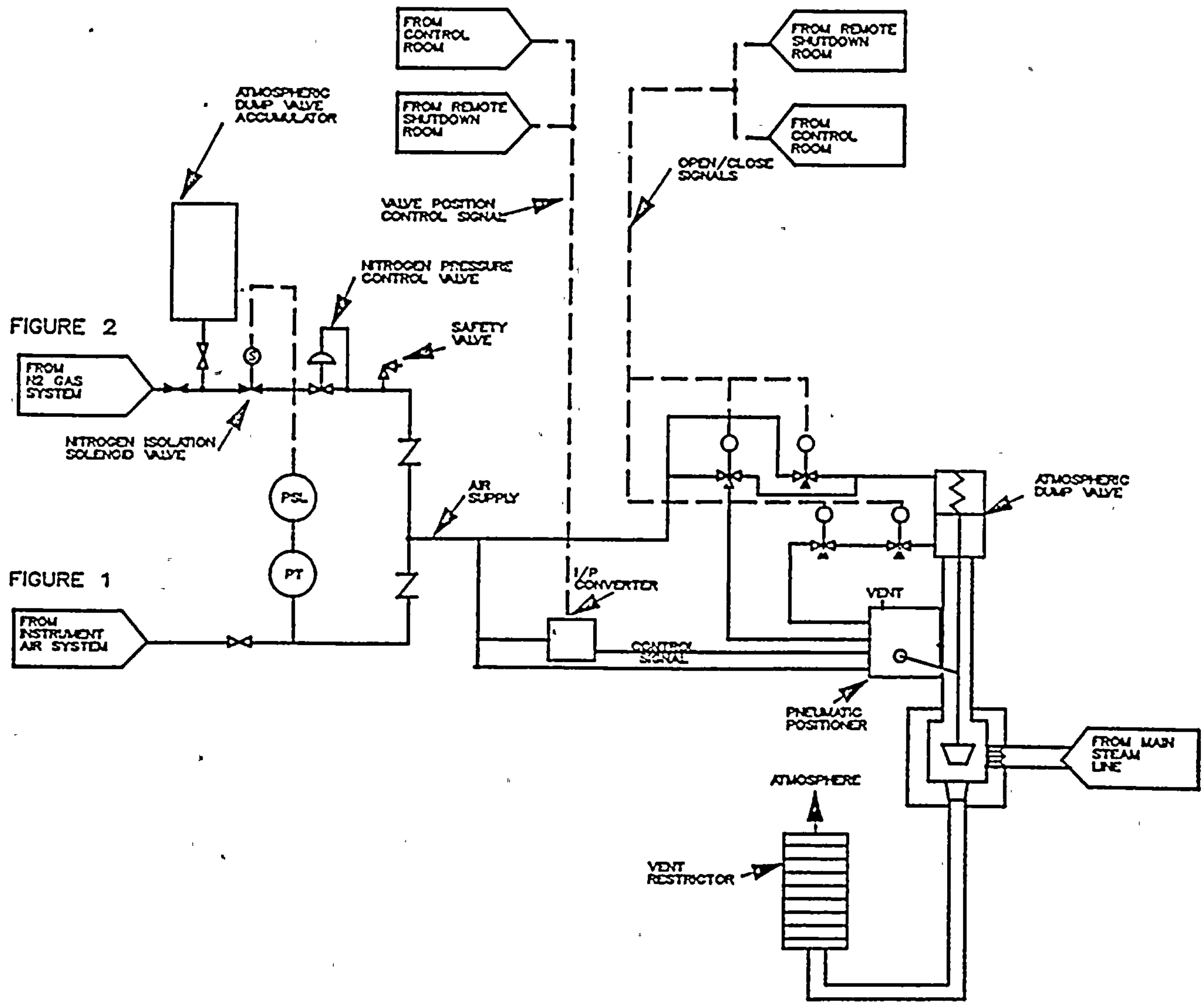
An analysis was performed on the MSIVs and FWIVs to determine if compressed gas system problems (low air pressure, dirt, moisture) could compromise the valves safety function. The results of this analysis are shown in Table 10. The actions that should be taken from this analysis are

1. perform periodic leak checks of the valves' pneumatic fittings,

2. perform periodic compressed air quality tests at the outlet from the instrument air subsystem dryers,

3. perform a leak rate calculation to ensure that the pneumatic accumulators are sized properly.

ATMOSPHERIC DUMP VALVE AND CONTROL EQUIPMENT



4/26/89

FIGURE 4

FWIV CONTROL LOGIC

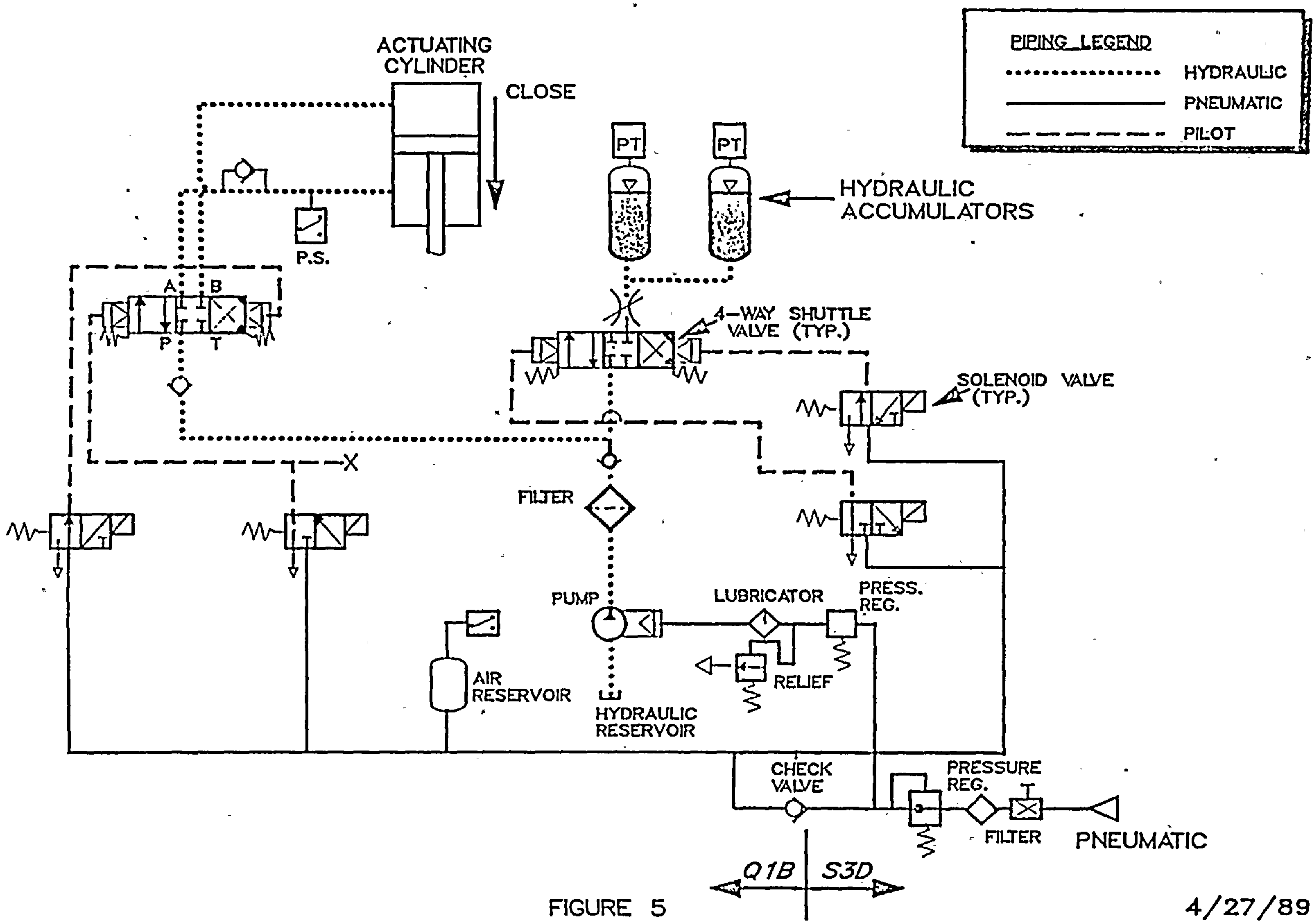
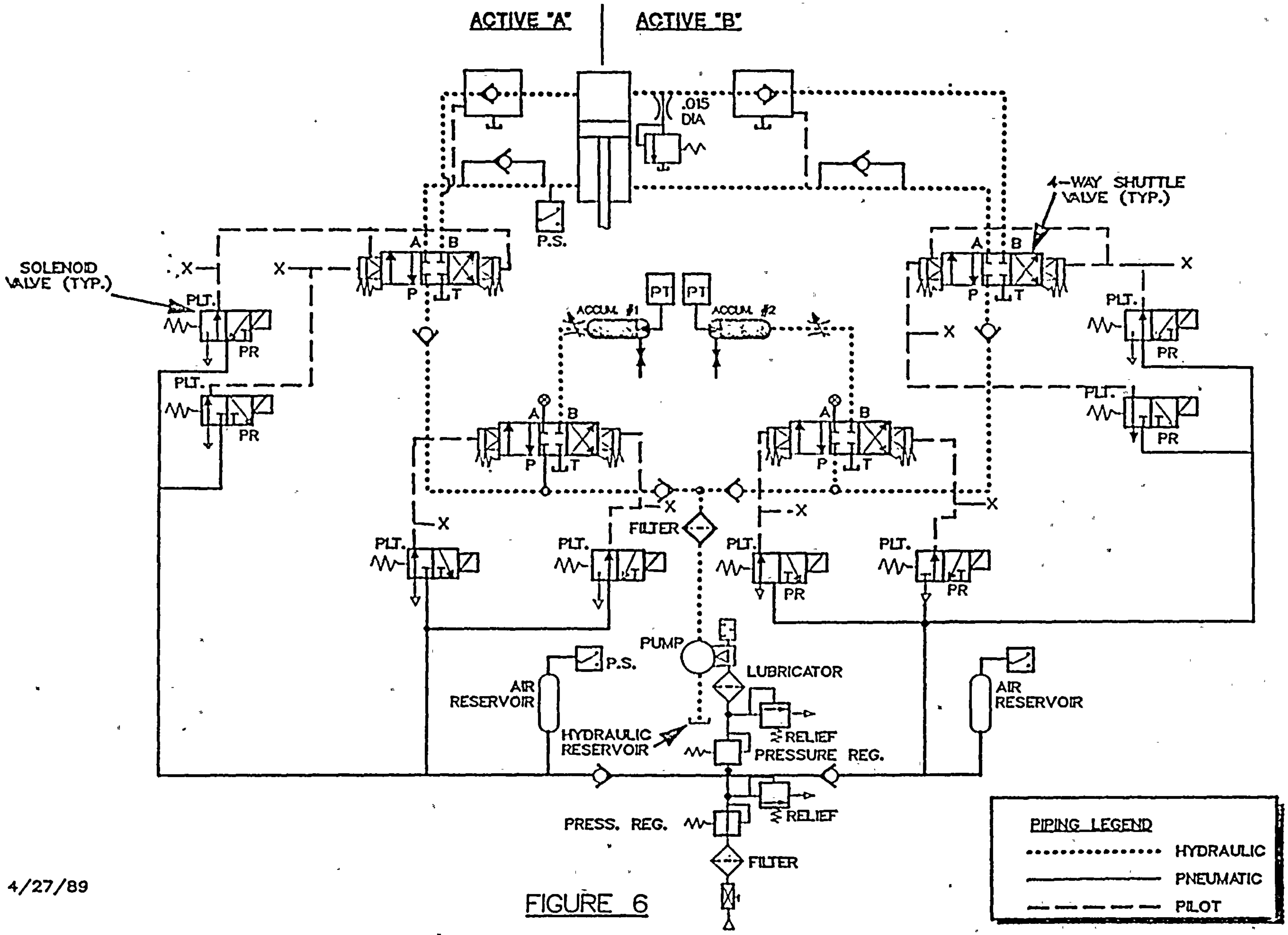


FIGURE 5

4/27/89

MSIV CONTROL LOGIC



4/27/89

FIGURE 6

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 7

MAIN STEAM ISOLATION VALVE

1. COMPONENT DESCRIPTION: Main Steam Isolation Valves

2. COMPONENT TAG NUMBERS: 13JSGEUV170, 13JSGEUV171
13JSGEUV180, 13JSGEUV181

3. COMPONENT SAFETY FUNCTION: Valves are required to close in response response to a Main Steam Isolation Signal.

4. INSTRUMENT AIR SUBSYSTEM FUNCTION:

   A. Provide an air supply to the safety related air accumulators while in turn actuates the safety related solenoids acting as pilots for the valv's hydraulic actuator.

   B. Provide the motive force for the air operated hydraulic pumps.

5. INSTRUMENT AIR SUBSYSTEM CHALLENGES TO COMPONENT SAFETY FUNCTION:

These valves are designed to operate under a loss of the instrument air subsystem. Each MSIV has 2 separate "fast close" actuators; each having one safety related air accumulator that supplies air to four solenoid valves which are used to control the valve's hydraulic actuator. The MSIV's pneumatic system is isolated from the instrument air system by safety related check valves. The MSIV's safety related "fast close" function is maintained by two nitrogen charged accumulators in the hydraulic portion of the valve, see Figure 6.

A loss of the instrument air subsystem will render the MSIVs hydraulic pressurizing pump inoperable. The pumps functions are to: 1) repressurize the MSIV hydraulic system after the MSIV has either opened or closed; or 2) Open and close the MSIV in the "slow" mode. Both these functions are non-safety related.

Contamination in the instrument air subsystem could plug the MSIVs in line filter. Loss of the instrument air subsystem does not compromise the MSIV's safety function. Water in the instrument air subsystem could affect the filter, regulators, check valves, or solenoids and cause the MSIV to not operate properly.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 8

FEEDWATER ISOLATION VALVE

1. COMPONENT DESCRIPTION: Feedwater Isolation Valves

2. COMPONENT TAG NUMBERS: 13JSGAUV0174, 13JSGAUV0177
13JSGBUV0132, 13JSGBUV0137

3. COMPONENT SAFETY FUNCTION: Valves close in response to an MSIS.

4. INSTRUMENT AIR SUBSYSTEM FUNCTION:

   A. Provide an air supply to the safety related air accumulators which in turn actuates the safety related solenoids acting as pilots for the valve's hydraulic actuators.

   B. Provide the motive force for the air operated hydraulic pump.

5. INSTRUMENT AIR SUBSYSTEM CHALLENGES TO COMPONENT SAFETY FUNCTION:

These valves are designed to operate under a loss of the instrument air. The four pilot solenoids, used to control the FWIV's hydraulic actuator, are supplied with air from a safety related accumulator. The FWIV's pneumatic system is isolated from the IA system by safety related check valves. The FWIV's safety related "fast close" function is maintained by a nitrogen charged accumulator in the hydraulic portion of the FWIV, see Figure 5.

A loss of the instrument air subsystem will render the FWIV's hydraulic pressurizing pump inoperable. The pump's functions are to: 1) repressurize the FWIV hydraulic system after the FWIV has either opened or closed; or 2) open and close the FWIV in the "slow" mode. Both these functions are non-safety related.

Contamination in the instrument air subsystem could plug the FWIV's in line filter. Loss of instrument air subsystem does not compromise the FWIV's safety function. Water in the instrument air system could affect the filter, regulators, check valves, or solenoids and cause the FWIV to not operate properly.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 9

ATMOSPHERIC DUMP VALVE

1. COMPONENT DESCRIPTION: Atmospheric Dump Valves

2. COMPONENT TAG NUMBERS: 13JSGAHV0179, 13JSGAHV0184
13JSGBHV0178, 13JSGBHV0185

3. COMPONENT SAFETY FUNCTION: Provides a means of removing decay heat from the NSSS when the condenser is not available, or after MSIS.

4. INSTRUMENT AIR SUBSYSTEM FUNCTION:

The valve is designed to open and modulate in response to varying instrument air control pressures and dedicated nitrogen accumulators will provide motive force during loss of the instrument air subsystem.

5. INSTRUMENT AIR SUBSYSTEM CHALLENGES TO COMPONENT SAFETY FUNCTION:

The valve is designed to operate after loss of the instrument air subsystem. When the air pressure reduces in the supply line, a dedicated safety related nitrogen accumulator supplies the required motive force to operate the valve, See Figure 3 and 4.

Contamination in the air supply could plug the valves' in line filter. Loss of air does not compromise the valves safety function. Water in the instrument air system could affect the filter, check valves, positioner, I/P converters or solenoids and cause the valve not to operate properly.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 10

FAILURE ANALYSIS OF MSIVs AND FWIVS

Postulated Problem	Solutions/Corrective Actions
1. Air components could be degraded by moisture or dirt in the line. (NPRDS data indicate this is a common problem for steam and feedwater isolation valves).	1a. Coalescent air filters (.01 micron) have been installed on the MSSS line to reduce moisture and particle carryover to these components.
	1b. Ensure air quality from the instrument air dryers through regularly scheduled surveillance and preventative maintenance.
2. Leaks in pneumatic system. (PVNGS has experienced leaks on MSIV's and ADV's as evidenced in failure data trending reports. Also, NPRDS data list several examples relating to pneumatic leakage on steam and feedwater isolation valves). The accumulator reservoir may not be large enough for proper solenoid action.	2a. Air reservoir has a low pressure switch that alarms when the pressure falls below 70±6 psig.
	2b. Quality class break check valves have been replaced per vendor recommendation under DCP's 1, 2, 3 FM-SG-151 to ensure proper seating under gradual loss of instrument air.
	2c. Failure Data Trending Reports document many leaks on the valves' pneumatic fittings. Establish a program to periodically check for leaks and repair as necessary.
	2d. The accumulator size has sufficient margin as noted in the PVNGS response to SOER 88-01. A pneumatic pressure vs. leak rate calculation will be performed for the valve pneumatic system to determine the valves functionality including system leakage.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 10

FAILURE ANALYSIS OF MSIVs AND FWIVS
(Continued)

Postulated Problem	Solutions/Recommendations
3. Pneumatic system pressure may not be great enough to actuate solenoid valves.	3. The valve solenoids, air pressure regulator, and air reservoir were supplied as an integrated system by the valve vendor. The low pressure alarm is set at 70±6 psig. The valves require a nominal 40 psi to shuttle (Ref: IE 87-28).

6. Effects of Compressed Gas System Quality on Safety Related Equipment

An evaluation was performed to determine the effects of compressed gas quality on safety related equipment. Safety related equipment that requires compressed gas has been identified and tabulated in Tables 11 and 12. The equipment can be classified into two groups:

a. Valves that require a pneumatic supply to fulfill their safety functions. This group consists of ADVs, MSIVs and FWIVs. These valves use a safety related check valve to isolate their safety related pneumatic supply from non safety related instrument air subsystem.

b. Valves and dampers that do not require a pneumatic supply to fulfill their safety functions (fail safe under a loss of compressed air) - this group comprises all other safety related valves and dampers that are not listed above.

NUREG 1275 Vol. 2 (Dec. 1987) documents events at various nuclear power plants where contamination (particulates, moisture, and hydrocarbons) in the CGS has been responsible for malfunctioning of control valve components. The components listed are E/P or I/P converters, solenoid air pilot valves, and valve air operators. This NUREG was used as a developmental reference for Information Notice 87-28 (Air System Problems at U.S. Light Water Reactors) and Generic Letter 88-14 (Instrument Air Supply Problems Affecting Safety-Related Equipment).

Observations of excessive moisture in the instrument air lines have been documented at PVNGS. Several EER's identify events where moisture has been observed in the instrument air lines. Site Mods 1,2,3-SM-IA-003 installed coalescent filters in response to moisture found in the instrument air lines to the MSSS. Also, failure data trending records indicate that dirt has been found in the compressed gas lines. This is an industry problem as evidenced by a review of NPRDS data.

Until recently, APS did not have a program to monitor compressed gas quality. APS is now developing this program. Prior to testing in Unit 2, maintenance was performed on all significant compressed gas components that were used in the test. Preliminary results of air quality tests in Unit 2 are good. Dew points of -58F at 125 psig line pressure, particulate contamination mainly less than 3 microns in size, and air with no measurable hydrocarbon content has been observed.

APS is using ISA S7.3-1975 (American National Standard Quality Standard for Instrument Air) as its compressed gas guideline. The ISA standard is referenced in ANS 59.3 (safety criteria for Control Air Systems).

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

The liquid nitrogen for the nitrogen gas subsystem is purchased as 99.9% pure nitrogen with less than 5 ppm oxygen. Particulate measurements were taken during the nitrogen subsystem testing. See Appendix H for discussion. 1

Since PVNGS has experienced moisture and dirt in the compressed gas lines the reliability of the compressed gas could be affected.

To address this concern, PTRRs were reviewed for all three PVNGS units. With the possible exception of one occurrence, the instances where safety related pneumatic valves failed to fulfill their safety functions were not related to dirt or moisture in the instrument air subsystem. One incidence in another event, was caused by the improper wiring of a flow switch. The Unit 3 trip of March 1989, shows many valves and one damper that appeared to not completely isolate on a CIAS, SIAS, and MSIS. The cause of this event was found to be failure of the Safety Equipment Status System. The operation of another valve; CH-507, was questioned on this trip. The valve failed open which resulted in damage to a RCP seal. An evaluation determined that the valve operated per the current plant design on loss of instrument air. The present plant design basis of this valve (fail open or fail closed on loss of instrument air) is currently being evaluated. The one case where particles may have affected valve performance is with respect to ADV 1JSGAHV0179 on Trip 1-88-004. As of 4/22/89 the EER documenting this condition was still open. Conversations with the SG system engineer revealed that the EER root cause will be indeterminant with dirt as a suspected cause. This could affect the valve's ability to operate. To eliminate these concerns a sampling program is being developed to determine if long term degradation of pneumatic components could occur.

As a result of the information presented above, the following corrective actions will be taken:

a. Before restart of the three PVNGS units, ensure that the compressed gas system major components (compressors, moisture separators, all drain traps, receivers, air dryers, dryer pre-filters and after filters) receive preventative maintenance in Units 1 and 3. As a minimum, Maintenance procedures that were performed in Unit 2 prior to the air quality test should be completed for Unit 1 and 3 also.

b. Monitor the air quality on all three units every three months for the first year to ensure that the ISA S7.3-1975 standards are maintained. After the first year, based on the test results, adjust the monitoring schedule up or down as appropriate.

c. Before restart of PVNGS Unit 2, select Unit 2 valve pneumatic components were inspected for evidence of corrosion, contamination, or moisture. If contamination is found analyze the material content. Determine the affect of the contamination or corrosion. This task was completed and is documented in Appendix G. No concerns were identified from this inspection. 1

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

d. After restart of PVNGS Unit 2, dissassemble a representative sample, from all three PVNGS units, pneumatic components to ensure that the pneumatic components are clean. Any found particles will be analyzed for chemical content. If significant copper is present in any an analysis of compressed gas pipe sectins will be performed to determine the extent of the problem within the piping. If considerable corrosion is seen, pipe flushing or more additional filters will be evaluated for a corrective action. The amount of components to be sampled will be based on 95 percent confidence that 95 percent of the valves' pneumatic systems are corrosion free and free of damaging particles.

e. For continued monitoring, a letter will be issued to all Engineering Evaluations system engineers and unit maintenance managers. The letter will require that the system engineers document any suspect pneumatic valve failures due to contamination, moisture, or corrosion. Engineering Evaluations will record where the event occurred and save the contamination material in clear containers for analysis. Also, the letter will ensure that maintenance is aware of the contamination concerns and initiates EER's when suspect materials are found in pneumatic components.

TABLE 11

SAFETY RELATED PNEUMATIC EQUIPMENT THAT REQUIRES A PNEUMATIC SUPPLY TO FULILL ITS SAFETY FUNCTION

JSGAHV	0179	SG 2 LN 2 ATM DMP VLV
JSGAHV	0184	SG 1 LN 1 ATM DMP VLV
JSGAUV	0174	SG 1 ECONO FW UPSTR ISOL
JSGAUV	0177	SG 2 ECONO FW DWNSTR ISOL
JSGBHV	0178	SG 1 LN 2 ATM DMP VLV
JSGBHV	0185	SG 2 LN 1 ATM DMP VLV
JSGBUV	0132	SG 1 ECONO FW DWNSTR ISOL
JSGBUV	0137	SG 2 ECONO FW DWNSTR ISOL
JSGEUV	0170	SG 1 LN 1 MSIV
JSGEUV	0171	SG 2 LN 1 MSIV
JSGEUV	0180	SG 1 LN 2 MSIV
JSGEUV	0181	SG 2 LN 2 MSIV

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 12

SAFETY RELATED PNEUMATIC EQUIPMENT THAT DOES NOT REQUIRE A PNEUMATIC SUPPLY TO FULFILL ITS SAFETY FUNCTION (fails safe under loss of IA)

JCHAHV	0507	RCP BLEED-OFF TO RDT
JCHAUV	0506	RCP BLEED-OFF TO VCT ISO
JCHAUV	0516	LETDOWN TO REGEN HX CONT ISOL
JCHAUV	0560	REACTOR DRAIN TNK OUTLET ISOL
JCHAUV	0580	MAKE UP TO REACTOR DRAIN TK
JCHBUV	0505	RCP BLEED OFF TO VCT ISOL
JCHBUV	0515	LETDOWN TO REGEN HX CONT ISOL
JCHBUV	0523	REGEN HX TO LETDOWN HX ISOL
JCHBUV	0561	REACTOR DRAIN TANK OUTLET ISOL
JCHEFV	0204	LETDOWN RAD MONITOR
JCHEFV	0241	SEAL INJECTION TO RCP 1A
JCHEFV	0242	SEAL INJECTION TO RCP 1B
JCHEFV	0243	SEAL INJECTION TO RCP 2A
JCHEFV	0244	SEAL INJECTION TO RCP 2B
JCHEHV	0239	REGEN HX TO CHARGING LINE
JCHEHV	0250	NITROGEN TO PUR FILTER
JCHEHV	0532	RWT TO BORIC ACID MU PUMPS
JCHELV	0110P	REGEN HX TO LETDOWN HX
JCHELV	0110Q	REGEN HX TO LETDOWN HX
JCHEPDV	0240	REGEN HX TO CHARGING LINE
JCHEPV	0201P	LETDOWN BACK PRESS VLV
JCHEPV	0201Q	LETDOWN BACK PRESS VLV
JCHEUV	0231P	CHARGING PPS TO SEAL INJECT HX
JCHEUV	0500	LETDOWN TO VCT/PRE-HU IOX SELECTOR
JCHEUV	0520	ION EXCHANGER BYPASS
JCHEUV	0521	RAD MON & BORONOMETER BP
JCHEUV	0565	PRE HOLDUP ION EXCHANGER INLET DIVERTER VLV
JCHEUV	0566	GAS STRIPPER DIVERTER VALVE
JCPAUV	0004A	CONTM PRG PWR-ACCESS ISO VLV
JCPAUV	0004B	CONTM PRG PWR-ACCESS ISO VLV
JCPBUV	0005A	CONTM PRG PWR-ACCESS ISO VLV
JCPBUV	0005B	CONTM PRG PWR-ACCESS ISO VLV
JRCEPV	0100E	PRZR SPRAY
JRCEPV	0100F	PRZR SPRAY
JRDBUV	0024	EXT CONT ISOL VLV FR RW SUMP
JSGAUV	0172	SG DOWNCOMER FW ISOL VLV
JSGAUV	0175	SG DOWNCOMER FW ISOL VLV
JSGAUV	0500P	SG 1 UPSTM BLDWN ISOL
JSGAUV	0500S	SG 2 DWNSTM BLDWN ISOL
JSGBUV	0130	SG DOWNCOMER FW ISOL VLV
JSGBUV	0135	SG DOWNCOMER FW ISOL VLV

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 12

SAFETY RELATED PNEUMATIC EQUIPMENT THAT DOES NOT REQUIRE A PNEUMATIC SUPPLY TO FULFILL ITS SAFETY FUNCTION
(fails safe under loss of IA)
(Continued)

JSGBUV	0500Q	SG 1 DWNSTRM BLDWN ISOL
JSGBUV	0500R	SG 2 UPSTM BLDWN ISOL
JSGEUV	0169	SG 1 MSIV BYPASS
JSGEUV	0183	SG 2 MSIV BYPASS
JSIAHV	0619	N2 SUPPLY SI TANK 2A
JSIAHV	0629	N2 SUPPLY SI TK 2B
JSIAHV	0639	N2 SUPPLY SI TK 1A
JSIAHV	0649	N2 SUPPLY SI TANK 1B
JSIAUV	0682	RWT RETURN HDR CONT ISOL VLV
JSIBHV	0612	N2 SUPPLY SI TK 2A
JSIBHV	0622	N2 SUPPLY SI TK 2B
JSIBHV	0632	N2 SUPPLY SI TK 1A
JSIBHV	0642	N2 SUPPLY SI TK 1B
JSIBUV	0322	HOT LEG ING CHK VLV LEAK ISOL
JSIBUV	0332	HOT LEG INJ CHK VLV LEAK ISOL
JSIBUV	0611	SI TK 2A FILL/DRN
JSIBUV	0618	SI TK 2A CK VLV LEAK LN ISOL
JSIBUV	0621	SI TK 2B FILL/DRN
JSIBUV	0628	SI TK 2B CK VLV LEAK LN ISOL
JSIBUV	0631	SI TK 1A FILL/DRN
JSIBUV	0638	SI TK 1A CK VLV LEAK LN ISOL
JSIBUV	0641	SI TK 1B FILL/DRN
JSIBUV	0648	SI TK 1B CK VLV LEAK LN ISOL
JSIEHV	0661	SI DRN TO RDT
MHAAM01		AUX BLDG HVAC DAMPER
MHAAM02		AUX BLDG HVAC DAMPER
MHAAM03		AUX BLDG HVAC DAMPER
MHAAM04		AUX BLDG HVAC DAMPER
MHAAM05		AUX BLDG HVAC DAMPER
MHAAM06		AUX BLDG HVAC DAMPER
MHAAM214		AUX BLDG HVAC DAMPER
MHAAM216		AUX BLDG HVAC DAMPER
MHABM01		AUX BLDG HVAC DAMPER
MHABM02		AUX BLDG HVAC DAMPER
MHABM03		AUX BLDG HVAC DAMPER
MHABM04		AUX BLDG HVAC DAMPER
MHABM05		AUX BLDG HVAC DAMPER
MHABM06		AUX BLDG HVAC DAMPER
MHABM215		AUX BLDG HVAC DAMPER
MHABM217		AUX BLDG HVAC DAMPER
MHFAM01		FUEL BLDG HVAC DAMPER

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 12

SAFETY RELATED PNEUMATIC EQUIPMENT THAT DOES NOT REQUIRE A PNEUMATIC SUPPLY TO FULFILL ITS SAFETY FUNCTION
(fails safe under loss of IA)
(Continued)

MHFAM02	FUEL BLDG HVAC DAMPER
MHFAM03	FUEL BLDG HVAC DAMPER
MHFAM04	FUEL BLDG HVAC DAMPER
MHFBM01	FUEL BLDG HVAC DAMPER
MHFBM02	FUEL BLDG HVAC DAMPER
MHFBM03	FUEL BLDG HVAC DAMPER
MHFBM04	FUEL BLDG HVAC DAMPER
MHJAM01	CONTROL BLDG HVAC DAMPER
MHJAM15	CONTROL BLDG HVAC DAMPER
MHJAM16	CONTROL BLDG HVAC DAMPER
MHJAM23	CONTROL BLDG HVAC DAMPER
MHJAM25	CONTROL BLDG HVAC DAMPER
MHJAM28	CONTROL BLDG HVAC DAMPER
MHJAM34	CONTROL BLDG HVAC DAMPER
MHJAM36	CONTROL BLDG HVAC DAMPER
MHJAM51	CONTROL BLDG HVAC DAMPER
MHJAM52	CONTROL BLDG HVAC DAMPER
MHJAM53	CONTROL BLDG HVAC DAMPER
MHJAM54	CONTROL BLDG HVAC DAMPER
MHJAM55	CONTROL BLDG HVAC DAMPER
MHJAM56	CONTROL BLDG HVAC DAMPER
MHJAM57	CONTROL BLDG HVAC DAMPER
MHJAM58	CONTROL BLDG HVAC DAMPER
MHJAM59	CONTROL BLDG HVAC DAMPER
MHJAM62	CONTROL BLDG HVAC DAMPER
MHJAM66	CONTROL BLDG HVAC DAMPER
MHJBM01	CONTROL BLDG HVAC DAMPER
MHJBM10	CONTROL BLDG HVAC DAMPER
MHJBM13	CONTROL BLDG HVAC DAMPER
MHJBM23	CONTROL BLDG HVAC DAMPER
MHJBM24	CONTROL BLDG HVAC DAMPER
MHJBM28	CONTROL BLDG HVAC DAMPER
MHJBM31	CONTROL BLDG HVAC DAMPER
MHJBM32	CONTROL BLDG HVAC DAMPER
MHJBM34	CONTROL BLDG HVAC DAMPER
MHJBM38	CONTROL BLDG HVAC DAMPER
MHJBM52	CONTROL BLDG HVAC DAMPER
MHJBM55	CONTROL BLDG HVAC DAMPER
MHJBM56	CONTROL BLDG HVAC DAMPER
MHJBM57	CONTROL BLDG HVAC DAMPER
MHJBM58	CONTROL BLDG HVAC DAMPER

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 12

SAFETY RELATED PNEUMATIC EQUIPMENT THAT DOES NOT REQUIRE A PNEUMATIC SUPPLY TO FULFILL ITS SAFETY FUNCTION
(fails safe under loss of IA)
(Continued)

MHJBM66	CONTROL BLDG HVAC DAMPER
MHJBM67	CONTROL BLDG HVAC DAMPER

7. Evaluation of the Preventative Maintenance Program for the Compressed Gas System

A review of the plant Preventative Maintenance Tasks was conducted to identify possible additional maintenance tasks that could enhance system reliability.

Supplier documents for maintenance of various components was conducted to identify possible additional maintenance tasks that could enhance system reliability.

Supplier documents for maintenance of various components within the CGS were reviewed to determine the recommended maintenance intervals. The manufacturer's PM requirements were then reviewed against the PVNGS SIMS Repetitive Work Tasks to ensure compliance with the recommended PMs.

The result of the review identified some discrepancies between the PMs recommended by the manufacturer and PMs currently performed by PVNGS. Incorporation of the discrepancies to the PVNGS Repetitive Work Tasks will enhance the system reliability. The recommended additional work tasks to be included in the PVNGS PM program are identified in Tables 13 and 14 attached. These additional PM tasks range from manual operation of safety valves once every refueling to a full tear down of liquid nitrogen pump once every two years.

In addition to the identified discrepancies above, some PM tasks listed in the SIMS Repetitive Work Task data base are not kept current. This means that the task is not performed on the originally scheduled intervals. The review of the supplier documents indicated that the original SIMS PM task interval for the identified components is comparable to the manufacturer's recommended maintenance interval. The affected equipment will be scheduled in accordance with the original SIMS PM task intervals.

TABLE 13

ADDITIONAL PMs REQUIRED FOR INSTRUMENT AIR SUBSYSTEM

ITEM	MAINTENANCE/TEST
Monitor air quality for particles, moisture content, and hydrocarbons.	Test every three months.
Compressor free air regulator.	Revise operations procedure to drain these filters at least once a week.
Compressor after-cooler.	Inspect for plugging yearly.
Safety valves.	Manually "pop" the valves once for refueling to verify proper operation.
Compressor solenoid valves.	Inspect and clean (as necessary) on annual compressor tear down.
Compressor sequence controller PIC-39 and PCV-43	Adjust/verify proper operation during annual compressor tear down.
IA header nitrogen isolation valve. (IAN-PV-52)	Verify proper operation at refueling.
Dryer desiccant	Replace after a transient.

TABLE 14

ADDITIONAL PMs REQUIRED FOR THE NITROGEN SUBSYSTEM

Liquid nitrogen storage tank M-GAN-X01	Visually inspect every 6 months.
Tank pressure buildup regulator J-GAN-PCV-96	Move regulator through 10 PSI of adjustment and reset to original set point every 6 months.
Tank pressure economizer regulator J-GAN-PCV-99	Move regulator through 10 PSI of adjustment and reset to original set point every 6 months.
Calibrate liquid level gage for "0"	Calibrate at every 6 months.
Liquid nitrogen pump M-GAN-P01A & B	Perform maintenance on various sub-components every year or 1000 hour of operation per Tech manual.
Nitrogen regulators J-GAN-PCV-49, 49A and J-GAN-PC-41	Run the control valve through 20 psig of adjustment. Return to setpoints once every three months.
Nitrogen temperature valve J-GAN-TCV-48	Check for shutoff at -20F with refrigerant every three months.
Nitrogen regulators J-GAN-PC-31 J-GAN-PC-38	Run the regulators through 20 psig of adjustments every three months. Return to set point.
Nitrogen safety valves J-GAN-PSV-29 and 36	Test and reset every year.
Rupture Discs J-GAN-PSE-85 & 92	Replace rupture discs every 3 years.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

III. CONCLUSIONS

This section addresses the adequacy of the existing CGS on the basis of information in Sections IV.A to IV.G. It also presents corrective actions that are intended to enhance the functionality and reliability of the CGS.

A. Nitrogen Subsystem

Review of the March 3, 1989 Unit 3 event (Section IV.A) has shown that the CGS did not function as designed during the LOP trip. While the nitrogen subsystem was designed to maintain the pressure in the compressed gas header at or above 80 psig the actual pressure observed was 65 psig to 67 psig one to two hours following the Unit 3 event. Furthermore, review of plant trip reports showed that, while on nitrogen backup, a reduction in header pressure had been observed on two previous occasions.

Since the CGS did not function as designed, corrective action will be taken to ensure that the pressure in the compressed gas header meets its minimum design value under all plant events. This corrective action consists of the following:

- A flow test of the nitrogen subsystem downstream and including the nitrogen backup isolation valve to the CG header was performed to determine if the nitrogen subsystem provides the projected demand. The flow test was performed first since the analysis indicates that the nitrogen subsystem is not functioning in accordance with its intended design. This is determined by the approximate rate of flow of 400 scfm between the time when the compressor power was lost and the time when the nitrogen backup valve opened. This flow does not appear to be excessive. This is also confirmed by the review of the system which identifies components that may result in significant pressures drop in the system. Also, the liquid nitrogen tank had 95 inches (equivalent to 160,000 scf nitrogen gas) reserve when the compressor power was restored. All of the observed and calculated data, point to the failure of the nitrogen subsystem to provide the required demand even at the relatively low (400 scfm) flow rate. 1

- The nitrogen tests showed that the nitrogen system does not provide an adequate supply of nitrogen, therefore, individual components which caused the reduced pressure in the header will be repaired or replaced during the next available outage.

See Appendix H.

B. Documentation of System

A survey of other nuclear power plants with similar designs shows the PVNGS design to be comparable to that of other plants. However, a concern was identified with a lack of design basis calculations for normal and off-normal (transient) loads on the CGS in that the original calculations performed in 1975 to size the CGS have not been updated to reflect new pipe routing and loads that have been added to the system since the original design. This calculation is necessary to determine if the system is properly sized for the present loads. To correct this situation, the calculation for sizing will be revised.

The nuclear utilities survey showed that three utilities have a non-1E BOP diesel that provides a backup power source to the compressor two utilities have 1E power to the compressor and three utilities for no backup to their instrument air system. PVNGS will perform a study to evaluate the benefits and feasibility of providing 1E power to the compressed gas system compressors.

Review of post trip review reports for Units 1, 2 and 3 identified one instance of safety related pneumatic valve failure that appeared to be due to poor air quality. This failure involved an ADV valve that did not respond to an open signal. Although the root cause of this event was indeterminate, the failure may have been due to the presence of particulate matter (e.g., dirt). In addition, a number of observations of excessive moisture in the compressed gas lines have been documented at all three units.

To ensure that air quality does not adversely impact the performance of safety related components that rely on the CGS, APS is developing a systematic air quality control program. This program is designed to ensure that moisture, particulates, and hydrocarbons in the compressed gas system are kept to low levels that will not adversely affect the performance of safety related components that rely on compressed gas for their operation. In addition trending of any components suspected of air contmination failure will assist in finding any foreign materials that was not removed by this program.

C. Preventative Maintenance

Review of preventative maintenance programs currently in existence against the PMs required by the manufacturer also identified a number of areas where the PVNGS program for the instrument air and nitrogen subsystems could be enhanced. These enhancements are shown on Tables 13 and 14.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

IV. ACTION PLAN

As a result of this study, an action plan has been developed to ensure that the CGS and its interfaces to safety related components are designed and maintained to appropriate standards. This plan includes tasks that will be accomplished before and after any Unit restart, and any compensatory measure. Projected completion dates for the tasks after restart are provided.

The action plan presented in Table 15 was developed following a complete review of the CGS. Although the system is non-safety related, it is recognized that the reliability and improved functionality of the system would enhance overall plant performance. The implementation of this plan is intended to achieve this goal.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 15

PVNGS ACTION PLAN

SYSTEM	TASK TYPE* AND NUMBER	ACTION	
		BEFORE RESTART	AFTER RESTART
Compressed Gas Instrument Air Subsystem	1 PM	Compressor Free Air Regulator - Revise operations procedure to drain this regulator at least once a week or ensure drain valves are cracked open to drain moisture.	
	2 PM	All System Drain Traps (Moisture Separators, Air Receivers, Air Dryer Prefilters) - Clean and repair as required.	
	3 PM	Instrument Air Dryer - Replace desiccant in active and standby dryers.	
	4 PM		After transient air flows are observed, switch to standby air dryers and replace the desiccant in the affected dryers. This task will be evaluated based upon the results of task 15 which will determine the magnitude of the transient.
	5 PM	Verify proper operation of air dryer cam settings and tower transfer solenoid valves.	Verify proper operation of air dryers cam settings and tower transfer solenoid valves annually.

*Ensure any referenced Preventative Maintenance task has been performed within its appropriate repetitive scheduled time period or perform before restart.

TABLE 15
(Continued)

PVNGS ACTION PLAN

SYSTEM	TASK TYPE* AND NUMBER	ACTION	
		BEFORE RESTART	AFTER RESTART
	6 PM	Instrument Air Dryer Prefilter and Afterfilter Differential Pressure Switches - Calibrate.	
	7 PM	Monitor air quality downstream of the afterfilters for moisture content, particulates, and hydrocarbons for each unit.	Monitor air quality downstream of the afterfilters for moisture content, particulates, and hydrocarbons every three months for first year. Subsequently evaluate for future test frequency based upon first year test results (see Page 45).
	8 PM		Aftercooler - Inspect for plugging yearly. Initiate by 08/01/89.
	9 PM	Ensure maintenance procedures allow only one Air Compressor to be removed from service at any one time.	
	10 PM		Safety Valves - Manually "pop" the valves once each refueling to verify proper operation. Initiate by 08/01/89.
	11 PM		Compressor Solenoid Valves - Inspect and clean as necessary on annual compressor teardown. Initiate by 08/01/89.

*Ensure any referenced Preventative Maintenance task has been performed within its appropriate repetitive scheduled time period or perform before restart.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 15
(Continued)

PVNGS ACTION PLAN

SYSTEM	TASK TYPE* AND NUMBER	ACTION	
		BEFORE RESTART	AFTER RESTART
	12 PM		Compressor Sequence Controller - Adjust/verify proper operation during annual compressor teardown. Initiate by 08/01/89.
	13 PM		IA Header Nitrogen Isolation Valve - Verify proper operation at refueling. Initiate by 08/01/89.
	14 Design		Phase I - Completed compressed gas system flow demand database for calculation by 08/30/89. Phase II - Complete pressure drop requirements, flow diagram and complete calculation by 12/29/89.
	15 Design		Complete an evaluation or test to determine the effects of off-normal (900 scfm) instrument air subsystem flowrates on the instrument air dryers. This evaluation or test is tied to task #14. Complete by December 30, 1989. If the evaluation or test determines that the dryers are undersized due to system demand and dew point levels, additional dryer capacity will be added. Reference Memo 167-03963 MFH/HWR dated June 6, 1989.

*Ensure any referenced Preventative Maintenance task has been performed within its appropriate repetitive scheduled time period or perform before restart.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 15
(Continued)

PVNGS ACTION PLAN

SYSTEM	TASK TYPE* AND NUMBER	ACTION	
		BEFORE RESTART	AFTER RESTART
	16 Design		Complete instrument air subsystem formal design basis review and finalize the subsystem design basis manual by 03/31/90.
	17 Design		Perform a study to determine if it is desirable to use 1E power for one or more compressors, complete by 12/31/89.
	18 Inspection	Inspect two of the pneumatic system valves in Unit 2 for evidence of dirt/moisture/corrosion of the valve components or instrument air subsystem piping. Analyze any contaminations found. Depending on the valve's filter-regulator, solenoid, positioner, and modulator, repair as applicable.	Initiate a sampling inspection program to determine the effects of moisture and particles in the instrument air subsystem. The program will be structured to give 95% confidence that 95% of the components have not been affected by moisture or particulate contamination. This program will also determine the affect air quality in the instrument air subsystem piping.
Compresed Gas Nitrogen Subsystem	19 Test	Perform a test on the Nitrogen subsystem to determine why the pressure in the instrument air subsystem piping dropped to 65 psig. Refer to Appendix H for more details.	Complete the long term actions in Appendix H to ensure system complies with design basis.

*Ensure any referenced Preventative Maintenance task has been performed within its appropriate repetitive scheduled time period or perform before restart.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 15
(Continued)

PVNGS ACTION PLAN

SYSTEM	TASK TYPE* AND NUMBER	ACTION BEFORE RESTART	ACTION AFTER RESTART
	20 PM	Liquid Nitrogen Storage Tank - Visually inspect.	Liquid Nitrogen Storage Tank - Visually inspect every 6 months.
	21 PM	Tank Pressure Buildup and Economizer Regulator - Run the regulators through 10 psi of adjustment. (J-GAN-PCV-096 and J-GAN-PCV-099).	Tank Pressure Buildup and Economizer Regulators - Run the regulators through 10 psi of adjustment and reset to original setpoint every 6 months.
	22 PM	Calibrate tank liquid level gauge for "0".	Calibrate tank liquid level gauge for "0" every 6 months.
	23 PM		Liquid Nitrogen Pump - Perform maintenance for various subcomponents every year or 1000 hours of operation per the Tech. Manual. Initiate by 08/01/89.
	24 PM	Nitrogen Regulators - Run the regulators through 20 psig of adjustments. Return to setpoint.	Nitrogen Regulators-Run the regulators through 20 psig of adjustments every 3 months. Return to setpoint.

*Ensure any referenced Preventative Maintenance task has been performed within its appropriate repetitive scheduled time period or perform before restart.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 15
(Continued)

PVNGS ACTION PLAN

SYSTEM	TASK TYPE* AND NUMBER	ACTION: BEFORE RESTART	ACTION: AFTER RESTART
	25 PM		Nitrogen Safety Valves - Test and reset every year. Initiate by 08/01/89.
	26 PM		Rupture Discs - Replace rupture discs every 3 years. Initiate by 08/01/89.
	27 Design		Complete the Nitrogen subsystem design basis review and finalize the design basis manual by 03/31/90.
Steam Generator MSIV's, FWIV's (ADV's are covered on their specific report)	28 CM	Check these valves' pneumatic components and piping for leaks. Repair as necessary.	Include a pneumatic leak check during regularly scheduled diassembly of the valve's air regulator. This PM task was generated as a Generic Letter 88-14 response.
	29 Test	Perform a leak rate test in the check valves by a release of instrument air pressure.	Determine if rate of instrument air depressurization effects the leak rate through the check valves. Reperform test if necessary. Refer to EER 89-SG-209. (2)

*Ensure any referenced Preventative Maintenance task has been performed within its appropriate repetitive scheduled time period or perform before restart.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

TABLE 15
(Continued)

PVNGS ACTION PLAN

SYSTEM	TASK TYPE* AND NUMBER	ACTION: BEFORE RESTART	ACTION: AFTER RESTART
	30 Design		Perform a pneumatic pressures vs. leak rate calculation to determine the time period that the valve will remain functional after a loss of the instrument air subsystem. Complete by June 30, 1989.
Nitrogen Temperature Valve J-GAN-TCV-48	31 PM		Check for shutoff of -20°F with refrigerant at refuelings. Perform further evaluation to determine the optimum method of calibration.

*Ensure any referenced Preventative Maintenance task has been performed within its appropriate repetitive scheduled time period or perform before restart.

APPENDIX A

APS RESPONSE TO GENERIC LETTER 88-14

Arizona Nuclear Power Project
P O BOX 52034 • PHOENIX, ARIZONA 85072-2034

161-01697-DBK/JMQ
February 20, 1989

Docket Nos. STN 50-528/529/530

Document Control Desk
U.S. Nuclear Regulatory Commission
Mail Station P1-137
Washington, D.C. 20555

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2 and 3
Generic Letter 88-14, "Instrument Air Supply System Problems Affecting Safety-Related Equipment"
File: 89-010-026; 89-056-026

Reference: Letter from NRC to All Holders of Construction Permits for Nuclear Power Reactors Dated August 8, 1988; Subject: Generic Letter 88-14.

The referenced letter requested a review of NUREG-1275, Volume 2 and a design and operations verification of the instrument air system. In order to accomplish this task a list of safety related components that rely on instrument air was produced. The total number of components identified was 144 for each unit. Attachments 1 and 2 provide the PVNGS response to Generic Letter 88-14.

If you have any questions, please contact Mr. A. C. Rogers of my staff.

Very truly yours,

D. B. Karner
Executive Vice President

DBK/JMQ/vlb
Attachments

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	J. R. LoCicero	(6144)	

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, Donald B. Karner, represent that I am Executive Vice President of Arizona Nuclear Power Project, that the foregoing document has been signed by me on behalf of Arizona Public Service Company with full authority to do so, that I have read such document and know its contents, and that to the best of my knowledge and belief, the statements made therein are true.

Donald B. Karner

Sworn to before me this 20 day of [illegible], 1989.

Notary Public

My Commission Expires:

My Commission Expires June 5, 1992

ATTACHMENT 1

RESPONSE TO VERIFICATION ACTIONS OF GENERIC LETTER 88-14

ACTION 1

Verification by test that actual instrument air quality is consistent with the manufacturer's recommendations for individual components served.

APS RESPONSE

The major suppliers of the affected components were contacted and although the vendors did not commit to any specific document in writing, the PVNGS test procedures for air quality were developed using ISA-S7.3, 1975 - "Quality Standard for Instrument Air" for guidance.

Because all three Units at Palo Verde are of standard design the test results and design changes for the Units are expected to be similar. Therefore, the air quality test results from Unit 2 will determine the design modifications for all 3 units.

In order to perform this verification by test, equipment was procured to test air quality and test connections were installed in Unit 2.

An air quality test is currently being conducted on Unit 2. Preliminary results after 4 days are as follows:

- The dew point is approximately -10°F at 120 PSIG. The measured dew point is greater than the design value. Compensatory measures are currently in place to open low point drains on the air distribution piping on a periodic basis to prevent moisture accumulation.
- The particulates are predominatly less than 3 micron in size, however there are particulates in the 3 to 5 micron size and no significant quantity of particulates greater than 10 microns.
- Hydrocarbons are less than 1 ppm.

The air quality data will be taken for approximately one month in order to obtain adequate test data.

After sufficient data is collected, it will be evaluated to determine what improvements or modifications may be required to ensure maintaining the instrument air quality. The test data will also be used to adjust the frequency of preventative maintenance tasks as noted in Attachment 2. A supplemental letter will be provided by April 28, 1989 indicating if any improvements or modifications will be made and providing the schedule for completion.

ACTION 2

Verification that maintenance practices, emergency procedures and training are adequate to ensure that safety-related equipment will function as intended on loss of instrument air.

APS RESPONSE

Maintenance Practices

Preventative maintenance tasks were reviewed and are provided in Attachment 2 "Program for Maintaining Instrument Air Quality".

Emergency Procedures

APS has reviewed the abnormal operating procedure for loss of instrument air and is making enhancements to the existing procedure to further address the following recommendations from Significant Operating Experience Report (SOER) 88-01 "Instrument Air System Failures:" The revision of this procedure is currently in the review and approval process. It is expected that the procedure will be revised by June 30, 1989.

* indications of loss of instrument air, such as alarms, automatic actions, functions lost.

* identification of critical components operated by instrument air and the position in which they fail.

* expected system and plant responses to a loss of instrument air and the consequences of these responses.

* actions to take if critical components do not fail in the intended position.

* manual actions the operator should be expected to take to respond to a loss of instrument air event.

* restoration actions to be taken after instrument air is regained.

Training

The Operations staff is trained on the abnormal operating procedure for loss of instrument air. The training consists of a walk through and discussion of the procedure in the simulator.

At the present time the simulator is not modeled to illustrate loss of instrument air. The malfunction scenarios for the Basic Simulator and Requalification Courses will be developed in conjunction with the simulation certification under 10CFR55.

Lesson plans have been revised to sensitize plant operations and maintenance personnel on the vulnerability of safety related equipment to common mode failures that could result from air degradation.

ACTION 3

Verification that the design of the entire instrument air system including air or other pneumatic accumulators is in accordance with its intended function, including verification by test that air-operated safety-related components will perform as expected in accordance with all design-basis events, including a loss of the normal instrument air system. This design verification should include an analysis of current air operated component failure positions to verify that they are correct for assuring required safety functions.

APS RESPONSE

Verification of Instrument Air System Design

Verification of the design of the instrument air system will be performed in conjunction with our Design Basis Review Program. Since the instrument air system is classified as non-safety related but interfaces with safety related systems, it will be reviewed immediately after the safety related systems. Due to the large scope of the program, the review is expected to be completed during the first quarter of 1991.

Verification of Pneumatic Accumulator Design

Verification of the design of the pneumatic accumulators was done as a result of SOER 88-01. APS utilizes three safety related air or gas reservoir systems. They are the Main Steam Isolation Valve/Feedwater Isolation Valve air accumulators, atmospheric dump valve nitrogen gas accumulators, and the Diesel Generator air start accumulators. The accumulator capacities were reviewed for these valves and found to be adequate. The accumulator pressures are continuously monitored with an in-place "low accumulator pressure" type alarm which causes an audible and visual alarm to annunciate in the respective unit's Main Control Room. The Emergency Diesel Generator Starting Air Flasks and the Atmospheric Dump Valves have installed local pressure indicators. These pressure indicators are monitored periodically by auxiliary operators.

Verification by Test

Verification by test was accomplished through the preoperational testing program and surveillance tests. Out of the 144 safety related valves and dampers which rely on instrument air, 135 were tested by the preoperational testing program and nine were tested by surveillance tests. The tests verified the failure position of the equipment by isolating the air supply and/or air signal then noting the positions the valve/damper assumed.

Analysis of Failure Positions

The failure modes of the 144 valves and dampers were analyzed to ensure that they failed in a position of least risk to reactor safety.

The preoperational tests results for the failure mode of the 135 valves and dampers for Unit 1 were pulled and compared to the analyzed failure modes.

All the components tested satisfactorily except that a discrepancy was found on one damper. The individual who performed the test on that damper determined the test to be acceptable, however, he documented an incorrect failure position. A retest of the damper has been performed verifying it does fail in the proper position.

The nine components tested by the Unit 1 surveillance tests have been verified that their failure positions from the surveillance test was the same as the analyzed failure positions.

Due to the standardization in design and the same preoperational and surveillance test program applied to all three units, it may be assumed that this verification applies to all three units.

ATTACHMENT 2

PROGRAM FOR MAINTAINING AIR QUALITY

The program for maintaining air quality will primarily be a function of a periodic test of air quality and the preventative maintenance program.

The air quality test procedure shall be performed in each unit on a periodic basis to be determined from the results of the initial air quality test as described in ACTION 1 of Attachment 1. The procedure will be effective in all three units after completion of the design modifications described in ACTION 1. This procedure will measure such parameters as total air flow, humidity/dew point, particulates and contaminants including hydrocarbons and water vapor.

A review of the existing, preventative maintenance tasks was performed which include the following:

- Inspect, clean or replace air compressor inlet filter; performed annually.
- Remove and replace instrument air prefilters; performed semi-annually.
- Remove and replace instrument air after filters; performed annually.
- Replace dessicant; performed annually.

The frequency of these tasks may change dependent on the results of the analysis of the air quality test.

In addition to these tasks being performed on a regularly scheduled basis, supplemental tasks such as disassembly of drain traps including inspection and cleaning of the internals are also performed on the prefilter, moisture separator and receiver on a quarterly basis along with a multitude of other tasks performed on related instruments, relays, motors, bearings, vibration monitoring equipment and similar equipment.

In addition, preventative maintenance tasks are currently scheduled to be written by March 31, 1989 to change the filters inside the air regulators supplying safety related valves and components. This work is scheduled to be implemented every two years. The frequency of this work may change depending on the air quality test analysis.

Arizona Nuclear Power Project
P.O. BOX 52034 • PHOENIX, ARIZONA 85072-2034

161-01881-DBK/JMQ
April 27, 1989

Docket Nos. STN 50-528/529/530
U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Mail Station P1-137
Washington, D. C. 20555

References: (A) Letter from NRC to all Holders of Construction Permits for Nuclear Power Reactors dated August 8, 1988. Subject: Generic Letter 88-14
(B) Letter from D. B. Karner, APS to NRC dated February 20, 1989. Subject: Generic Letter 88-14.

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2 and 3
Supplemental Response to Generic Letter 88-14
"Instrument Air Supply System Problems Affecting Safety-Related Equipment"
File: 89-010-026; 89-056-026

Generic Letter 88-14, Item 1 recommended verification by test that actual instrument air quality is consistent with manufacturer's recommendations for individual components served.

Reference (B) stated that the air quality data will be taken for approximately one month in Unit 2 in order to obtain adequate test data. It also stated that a supplemental letter would be provided by April 28, 1989, indicating whether any improvements or modifications will be made and providing the schedule for completion. See Attachment 1 for response.

Also, Generic Letter 88-14, Item 3 recommended a verification of the design of the entire instrument air system. Reference (B) stated that the review is expected to be completed during the first quarter of 1991.

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Page 2

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April 27, 1989

However, a limited scope design review has already been performed, also the schedule for completion of the formal review has been advanced and is expected to be completed during the first quarter of 1990. See Attachment 2 for details.

Very truly yours,

D. B. Karner
Executive Vice President

DBK/JMQ/jle

Attachments

cc: T. J. Polich (all w/attachments)
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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Page 3

161-01881-DBK/JMQ
April 28, 1989

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Attachment 1
Unit 2 Test Results/Evaluation

Dewpoint, particulate and hydrocarbon tests were conducted on the Instrument Air System to ascertain the quality of instrument air delivered by air compressor/dryer system.

The design dewpoint for the instrument air system at Palo Verde is -40° F at 125 PSIG and the test data obtained supports this temperature requirement. The dew point temperatures, as measured, are quite acceptable as they range between -58° F to -85°F corrected to a line pressure of 125 PSIG. The minimum winter design temperature as described in Section 9.4.2 of the PVNGS FSAR Table 9.4-1 is 11° F. The ISA-S7.3-1975 "Quality Standard for Instrument Air" recommends that the dewpoint at line pressure be at least 18° F below the minimum temperature (11° F) to which any part of the instrument air system is exposed at any season in the year. Therefore, the maximum allowable dewpoint at PVNGS is -7° F and we are well within the guidelines of the ISA Standard. However, tests will be conducted during our most humid months to verify that dewpoints can be maintained at -40° F, or below, at a line pressure of 125 PSIG at a normal flow rate.

ISA-S7.3-1975 recommends that the particle size in the air stream shall not exceed 3 microns. The test runs have given particle sizes ranging from .5 microns to 15 microns. Only two particles of the 15 micron size were encountered in 25 measurements taken in 10 days during the test. On the average, the particle size was approximately .65 microns.

The oil content shall be as close to zero per weight ratio (w/w) or volume ratio (v/v) as possible per the ISA Standard and under no circumstances shall it exceed one ppm w/w or v/v under normal operating conditions. The average oil content in the air samples taken was 0.03 ppm.

The following action resulted from the evaluation of the air quality data:

> Change the afterfilter internals (cartridge) from the current 1 micron rated filter to a .45 micron rated filter or smaller in Units 1, 2, and 3. This task will be completed before the Unit 1, 2, and 3 restart from the current outages. Following the upgrade of the filters, the air quality test will be performed on a periodic basis.

Attachment 2
Design Review of the Instrument Air System

A limited scope design review of the instrument air system has been performed using the documents that represent the actual installation at the plant. The design basis documents reviewed were Regulatory Guides, 10 CFR 50 and the Design Criteria Manual. A number of design output documents, design modification packages and other associated engineering documents were also reviewed.

This limited scope review indicates that the system delivers, as designed, quality air to meet or exceed the requirements of the design basis. The complete review for the adequacy of the existing design basis and development of the Design Basis Manual for Instrument Air will be completed during the first quarter of 1990.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

APPENDIX B

HISTORICAL DOCUMENT REVIEW

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

APPENDIX B

HISTORICAL DOCUMENTATION REVIEW

A review of the historical engineering documents pertaining to the design and operation of the CGS was conducted to determine the effects of the documents on the design basis of the CGS . Attention was given to identifing design/operational concerns that were reported or documented previously and again identified or observed during the recent unit 3 trip.

The types of documents that were reviewed are as follows:

- Plant Change Requests (PCRs)
- Field Change Request (FCRs)
- Licensing Documents (LCTS & IEIN)
- Non conformance Reports (NCRs)
- Start up Field Reports (SFRs)
- Design Change Packages (DCPs)
- Site Modifications (S-Mods)
- Supplier Document Change Notices (SDCNs)
- Engineering Evaluation Reports (EERs)
- Post Trip Review Reports (PTRRs)
- Purchase Specifications for Procurement of Various Compressed Gas Components
- Special Plant Event Evaluation Reports (SPEERs) and Special Reports (SPs)

Necessary information is provided in the following pages.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

PCR

ITEM	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
1.	10 of 39 PCRs	Corrections to the Instrument Data Calibration List to reflect as-built plant conditions.	All were PCO/PCRs applicable to all three units, 1 PCO/PCR was for Unit 1 only.
2.	21 of 39 PCRs	Corrections to P&IDs and other plant drawings to reflect as-built conditions, i.e., correct/add missing valve and line numbers, correct line connecting points or valve locations, indicate proper line routing, show capping that was not indicated, correct symbols used, add or correct notes, indicate or correct pipe support configurations, etc.	All were PCO/PCRs applicable to all three units, 2 PCO/PCRs were for Unit 1 only.
3.	1 of 39 PCRs	To change a time delay rate.	No affect on system pressure.
4.	1 of 39 PCRs	To change the contact development chart.	No affect on system pressure.
5.	1 of 39 PCRs	Non-applicable to the CGS.	No affect on system pressure.
6.	1 of 39 PCRs	To correct the IA compressor motor space heaters type utilized. Unit 1 only.	No affect on system pressure.
7.	2 of 39 PCRs	To allow for tubing adaptor size change which was different than what was initially specified. One PCR was for Unit 1 only.	No affect on system pressure.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

PCR

ITEM	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
8.	2 of 39 PCRs	One PCR was to revise a valve specification so that it's design pressure is lowered. The valve in question is on the line connected to the EDT Refer to PCR No. 85-13-GA-012). The other PCR, No. 86-13-IA-003, was issued to increase the deadband and tolerance for a pressure switch.	No affect on system pressure.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

FCR

ITEM	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
1.	685 of 810 FCRs	These did not have anything to do with system pressure, they involve with pipe supports, indices revison, removal of peripheral/ support equipment, hanger removal or addition, revision of weld symbols, etc.	No affect on system pressure.
2.	125 of 810 FCRs	Over 90% of these have been issued as DCNs to 13 type drawings.	
2a.	10 of 125 FCRs	Are "paper change" type, and involve changes to valve numbers, line numbers, general notes, references, etc.	No affect on system pressure.
2b.	36 of 125 FCRs	These involved minor additions or removals of piping sections due to the rerouting of piping; the original design provided interferences with structural components, junction boxes, supports, other lines, etc.	No affect on system pressure.
2c.	36 of 125 FCRs	These change dealt with changes that do not affect system pressure or supply because they involve minor components changes such as a valve, addition of a cap, drain removal, etc.	No affect on system pressure.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

FCR

ITEM	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
2d.	28 of 125 FCRs	These added piping to improve accessibil-ity, branching of ing of existing lines, facilitate other equip-ment, etc. The piping added is somewhat more than in the case of plain rerouting. These FCRs are: 23368-M, 23369-M, 23370-M, 23372-P, 23373-P, 26964-P, 26969-P, 27136-M, 27137-M, 27138-M, 27142-M, 27143-M, 27144-M, 27145-M, 27561-M, 28275-P, 28405-P, 74084-P, 75572-P, 63778-P, 63953-P, 64375-P, 24452-M, 25362-P, 25363-P, 33968-P, 35328-P, and 36094-P.	Total increase of system demand will be estimated with completion of detail calculations.
2e.	15 of 125 FCRs	These were to add new supply of air to different points in the plant. These are primarily for use in vendor equipment and areas that had been overlooked such as pneumatic valves, HVAC system components, etc. These FCRs are: 23599-P, 26714-P, 26809-P, 26809-P, 26810-P, 27560-P, 27798-M, 27800-M, 27803-P, 27804-P, 28087-P, 28088-M, 28172-P, 28273-P, 25352-M, and 26160-P.	Total increase of system demand will be estimated with completion of detail calculations.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

LICENSING

ITEM	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
1.	RCTS #38462 IEIN 85-35 5/17/88 IEIN 85-35 Supplement	Failure of air check valve to seat in response to gradual decreasing of air pressure.	Faulty check valves in MSIV and FWIV actuator assembly was replaced with reliable units which are not prone to leak. See Section IV.E for additional review of ADV check valves.
2.	RCTS # 36100 IEIN 86-51	Excessive pneumatic leakage in the automatic depressur-ization system (ADS).	IN 86-51 was considered closed since it address ADS/BWRs problem and PVNGS does not have this system.
3.	RCTS # 38048 and LCTS # 38050, IEIN 87-28,	Air systems problem at U.S. Light Water Reactors.	ANPP LTR. 161-00514 WFQ/JBW. 9/17/87 for departments review. Review to include: 1. Air system quality 2. Loss Air Sys. Recovery 3. Adequacy of backup air accumulators 4. Adequacy of gradual loss of IA Sys Pressure. This IEN parallels Generic Letter (GL) 88-14. The APS response for this IEN will be covered in GL 88-14. Also see Section IV.E for check valve discussions and Section II.F for generic letter.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

LICENSING

ITEM	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
4.	RCTS # 39139 IEN 87-57	Loss of energency boration capability due to nitrogen gas intrusion.	EAR 88-1256 This specific problem has been investigated and found not to be specifically applicable at PVNGS. APS will review gas intrusion possibilities as part of our continuing INPO SOER 86-03 check valve program.
5.	RCTS #38072 IEIN 88-24	Failures of air operated valves affecting safety related systems.	Results of IEN 88-24 review may affect IA component performance. This problem concerns over-pressure of safety related solenoids because they were not noted for the IA subsystem pressure. APS is presently reviewing this IEN for applicability. To date, we have not attributed any failures of air supplied ASCO solenoids through review of our Failure Data Trending System.
6.	RCTS # 30623 IE Bulletin 80-01	Operability of automatic depressurization system valve pneumatic supply.	Address ADS/GE BWR problem and PVNGS does not have this system.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

LICENSING

ITEM	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
7.	RCTS # 38350 NRC Letter GL-88-14	Review NRC Generic Letter 88-14, Instrument Air Supply System problem affecting safety-related equipment.	Refer to Section II.F. of the report.
8.	RCTS #38477 IEN 89-26	Instrument Air Supply to Safety-Related Equipment	This IEN refers to design problems which primarily rely on IA system to provide containment isolation valves. This IEN is presently being reviewed. Refer to Sections IV.A and F for discussions of the PVNGS design which have been evaluated to date.
9.	IEN 86-51	Excessive Pneumatic Leakage in the Automatic Depressurization System.	This IEN concerns pneumatic leakage from accumulator and their appropriate systems. This concern is addressed for the ADVs in the ADV report, for the MSSVs, FWIVs in Section IV.E of this report and for the check valve isolating the CGS from the accumulators in Section IV.E of this report.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

LICENSING

ITEM	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
10.	RCTS #36390 IEN 86-50	Inadequate testing to detect failure of safety related pneumatic components or systems.	This IEN concerns testing safety related pneumatic components under slow degrading air conditions. This concern was also raised by GL 88-14. PVNGS has had several trips in which CGS was lost under slow decay conditions. Problems have not been detected except for sluggish ADVs. See Sections II.F, IV.A, and IV.F of this report for evaluations.
11.	IEN 88-51 RCTS #038423	Failure of MSIVs	This IEN addresses the adequacy of surveillance testing to ensure operability of valves following maintenance. This IEN is under evaluation. The fail closed MSIV at Dresden didn't close on slow loss of IA due to overtorqued packing. Surveillance testing was not rigorous enough to detect. Engineering will evaluate adequacy of surveillance testing with this problem.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

NCR

UNIT	DATE	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
3	08/10/82	NCR PC-4382 NCR PC-4383	3" Check Valve Cont. Isolation	Work performed to close out DER 82-33.
1	11/06/81	NCR NA-586	GA-Pr Reg. Valve CH-831	N_2 PRV cannot meet design pressure DER 81-44.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

DCP

ITEM	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
U2 U3	DCP 2SJ-IA-055 3CJ-IA-055	Alarm settings were lowered for differential pressure for IA prefilters and afterfilters.	Will enhance the reliability and availability of the IA system by facilitating timely detection of filter clogging and prevent pressure drop in the IA supply header.
U1, U2 & U3	DCP 1SJ/2SJ/3CJ-GA-022	Faulty operation of programmable controller in the Panel J-GAN-E01 due to overheating.	Will enhance GA system reliability.
U1, U2 & U3	DCP 1OJ/2SJ/3CJ-GA-025	Change valve PCV-023, 024 and 025 from hard seat and plug to soft seat and plug.	The change was made to stop leakage of nitrogen gas past these valves.
U1, U2	DCP 1CP-IA-005 2CP-IA-005	Drains for removal of condensate.	1" drain lines were added to remove condensate from air compressor discharge piping.
U1, U2 & U3	DCP 1SJ/2CJ/3CJ--IA-023	Added instrumentation.	For nitrogen backup, control valves were added.
U1, U2 & U3	DCP 1SM/2CM/3CM-IA-044	The regulation air and control air was piped from a point upstream of the air dryers which caused moisture collection.	Instrument air compressor control air and regulation supply air lines were repiped from downstream of the air dryers.
U1 & U3	1SM/3CM-IA-051	Replace purge air ball check valves with swing check valve.	The ball check valve required much higher DP for full opening and were not suitable for the service.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

S-MOD

UNIT	DATE	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
13	08/08/87	1,2,3-SM-GA 001	GA Sys Setpoint changes	Revise setpoints for PSV-80 and PSE-147.
13	10/31/87	1,2,3-SM-IA 003	Moisture problem in IA lines.	Installed a permanent moisture filter in the IA line to MSSS.
13	01/12/88	1,2,3-SM-IA 004	IA line excessive moisture and vibration.	Installed test connection on each IA dryer to monitor performance. Installed intake silencers on each IA compressor.
13	12/08/87	1,2,3-SM-IA 005	Compressor loads resulting in nuisance alarm actuation in control room.	Provide separate power supply to Breathing Air CO & O_2 monitors.
13	12/24/87	1,2,3-SM-IA 007	Improve reliability of air supply to SG nozzle dams.	Add local compressed N_2 backup and pressure alarms to air supply.
13	04/20/88	1,2,3-SM-IA 008	Improve reliability of air supply to fuel pool gate seals.	Add backup N_2 supply, alarms, and panel.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

SDCN

UNIT	DATE	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
13	03/08/88	SDCN A00795 (M104-55)	Use of stem globe valves in N_2 system.	Extended stem globe valves may be used over standard stem globe valves.
13	07/30/84	SDCN 1250 (M104-8)	Air Dryer Cam Timer Settings.	Change factory set-points.
13	07/30/84	SDCN 1251 (M050-52)	Air Dryer Cam Timer Settings.	Change factory set-points.
13	12/14/84	SDCN 2541 (M050-52)	Discharge PS relocation at air compressor.	Location prevents actuation on high discharge pressure.
13	11/06/85	SDCN 5114 (M050-11)	Compressor Maintenance Information revised.	Routine maintenance information added.
13	10/14/87	SDCN 8938 (M104-55)	Liquid Nitrogen System Instr. Manual Changes.	LP Header setpoint changes.
13	10/14/87	SCDN 8939 (M104-1)	Liquid Nitrogen H and L setpoint changes.	PSV 80 and PSE-147 setpoint changes.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

EER

ITEM	DATE	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
1.	02/18/82	EER 82-IA-004	How long can the nitrogen system supply the IA loads during normal plant operation.	Nitrogen system can supply IA system loads for one hour. Reference Bechtel letter to ANPP dated 5-13-80.
2.	07/20/84	EER 84-IA-003	Nitrogen backup to instrument air and plant service to be removed because of the need for breathing air.	No nitrogen back-up for service air which may be used for breathing air. Tie between service air and nitrogen system was removed by DCP-IA-062.
3.	01/30/85	EER 84-IA-006	Remove nitrogen backup connection to instrument and service air.	Service air for breathing air and use of portable compressor during outages. Nitrogen is a backup for instrument air system DCP.IA-062 broke the tie-in.
4.	10/19/84	EER 84-IA-007 84-IA-008	Excessive water in the IA system.	Engineering recommended no action as no moisture was found. Engineering recommended blowing down low point drains once per 24 hours.
5.	03/21/83	EER 83-IA-001	Moisture in the air system upstream of the air dryer.	Those valves were identified which were to be kept fully closed during periods when IA compressor is not in operation.
6.	08/07/86	EER 86-IA-011	Instrument air system capabilities are insufficient to adequately insure safe shutdown during prolonged blackouts.	As nitrogen is a back-up for instrument air system, no diesel driven air compressors are justified.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

EER

ITEM	DATE	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
7.	01/06/83	EER 83-IA-002	Instrumentation Air Compressor Unloader Control Air Supply	Excessive moisture collection control air lines going to the unloader causing operator problems. DCP IA-044 rerouted control air to downstream of dryers to eliminate moisture problem.
8.	10/07/85	EER 85-GA-013	During LOP, N_2 tank observed to be decreasing at a rapid rate.	Determine the time available with various usage for liquid N_2 levels. Determined concerns with a check-valve (IAN-V056) that could be restricting flow. System Engineers determined flow to be acceptable. Checkvalve would not be replaced due to funding problems.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

PTRR

ITEM	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
1.	PTRRs 1-85-006, 1-86-001, 1-86-007, and 1-88-004.	PTRRs show a rate of consumption of air such the time span between the compressor trip and to the nitrogen supply valve opening is anywhere from 2.5 to 3.5 minutes. The nitrogen supply valve open signal in unit 3 was received at 2 minutes 42 seconds into the event which is consistent with the previous PTRRs.
2.	PTRRs 1-86-001, 1-86-007, 1-88-004, and 2-86-004	PTRRs indicate that the MSIV and the FWIV operated without any apparent problems. MSIV and FWIV accumulators are normally charged and are maintained charged during the normal operation of the plant. The loss of IA header pressure does not result in loss of hydraulic charge and does not degrade the operation of the valves since it is only required to close once to fulfill its safety function.

Note 1. PTRR were reviewed for failure of air-operated valves after receipt of an ESFAS signal.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

PTRR

ITEM	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
3.	PTRRs 1-85-004, 1-85-005, 1-86-001, 1-86-007, and 1-88-004.	PTRRs indicate that ADV were equired to operate to cool the plant. The ADV operation in all cases was satisfactory. However, concerns were raised due to the sluggish response time of the ADVs. An observation of the data in PTRRs stated above show that the primary mode of force for the ADV operation was the ADV nitrogen accumulators and not the IA system.
4.	PTRRs 1-85-005 and 1-85-006.	PTRRs indicate the similar condition as identified in the unit 3 trip. The IA header pressure was reduced to approximately 65 psig while the system was on nitrogen backup. In both cases, the ADV operation was successful and no apparent safety related equipment failures were identified. The concern were identified in the PTRR and the resolution of the concern indicated satisfactory operation of the IA system during the plant trip.

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

P.O./SPECS/CORRESPONDENCE

UNIT	DATE	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS · SYSTEM IMPACTS
13	06/27/84	Letter B/ ANPP-E-116691 (MOC 322116)	Instrument Air Dryer Adjustment (Spec. MM-054).	Change factory settings and change pre and after filter setpoints from 20 to 5 PSFD. (Note 1)
13	12/08/83	Telex 391 (Ref. No. 218218)	Incorrect prefilter and afterfilter installation (Spec. MM-054)	Vendor recommends reinstallation. Operation of dryer will be impaired if large amounts of water enter the system.
13	01/14/82	Letter B/ ANPP-P-83800	FW Control Valve Design (Spec. MM-100)	Instrument Air and Nitrogen Gas Valve usage discussed. No system impact-design INFO only.
13	03/16/82	Letter (Ref. No. 163117)	Safety Relief Valves in Nitrogen Supply System.	Valves are incapable of relieving over-pressures. Use of rupture discs is recommended by vendor. (Note 2.)

Note 1. Implemented in DCPs 10J-IA-055, 2SJ-IA-055, 3CJ-IA-055.
2. Rupture Discs. installed per P&ID 13-M-GAP-002

COMPRESSED GAS SYSTEM EVALUATION AND ANALYSIS

SPEER/SP

ITEM	DATE	TYPE OF DOC OR EVENT	DOCUMENT DESCRIPTION OR TITLE	CONCLUSIONS/COMMENTS SYSTEM IMPACTS
1	01/07/88	SPEER NO. 88-01-001	Inadvertent opening of an MSIV due to air leakage in the solenoid piping and missing O-rings in the air supply tubing to the valve solenoids.	This is a valve tubing problem and not an IA System problem.
2	07/21/87	SP Number SP-87-02-006	Loss of IA service on two separate occasions due to valves related to the air dryers.	Cause of the valve problems were due to valve maintenance or the wrong position of the solenoid valve.

APPENDIX C

REFERENCE MATERIAL ASSOCIATED WITH THE NUCLEAR UTILITIES SURVEY

13-MS-A20

APPENDIX C

Bechtel Power Corporation
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BE/ANPP-1791
April 10, 1989

Arizona Nuclear Power Project
P. O. Box 52034 - Mail Station 7034
Phoenix, Arizona 85072 - 2034

Attention: Mr. E. C. Sterling
Nuclear Engineering Manager

Subject: Arizona Nuclear Power Project
Bechtel Job 18601
ANPP Master Agreement PV86-10638
Job Order 264 Instrument Air Utility Survey
File: E.60.02.64

Dear Mr. Sterling:

Enclosed is the Final Report on the Utility Survey of Instrument Air Design Bases and Practices. As requested by H. Riley, the survey covers St. Lucie, Waterford and SONGS, the balance of the NRC Region V plants, plus two others. The survey data was collected over a period of three days and compiled into the enclosure.

The survey data was tabulated to facilitate comparison with other plants. A brief list of potential enhancements to the IA System was developed based, in part, on information obtained during the survey.

If there are any questions, please contact me at 842-8504.

Very truly yours,

BECHTEL POWER CORPORATION

S. H. Freid
Project Engineering Manager

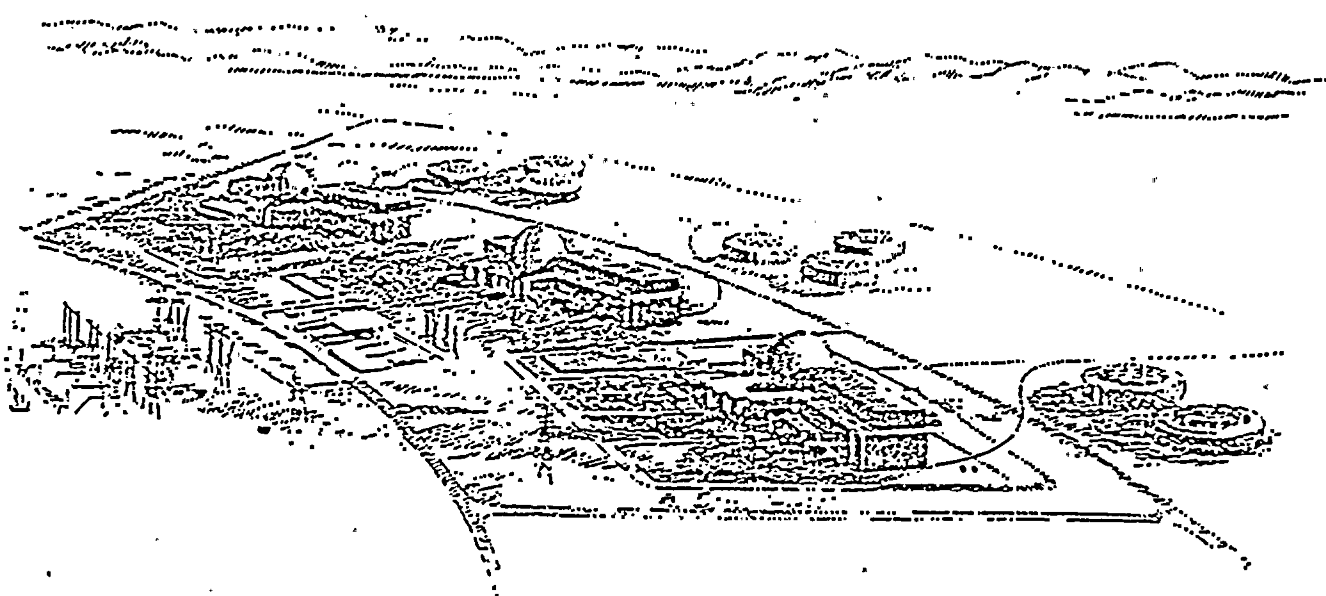
SHF:TGB:ph

Enclosure: Final Report on the Utility Survey of Instrument Air Design Bases and Practices

cc: J. E. Allen w/encl. M. F. Hodge w/encl. A. N. Howard w/o encl.
D. B. Karner w/o encl. H. W. Riley w/encl. J. N. Tench w/o encl.

Arizona Nuclear Power Project

Final Report on the Utility Survey of Instrument Air Design Bases and Practices



for the
Palo Verde Nuclear Generating Station
April 1989

Bechtel Power Corporation, 10040 North 43rd Avenue Suite 1-I, Glendale, Az 85302
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APPENDIX C

FINAL REPORT ON THE UTILITY SURVEY OF INSTRUMENT AIR DESIGN BASES AND PRACTICES

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INTERNAL CONTROL NO.
18601 - 264 - REPT - 053

APPENDIX C

FINAL REPORT ON THE UTILITY SURVEY OF INSTRUMENT AIR DESIGN BASES AND PRACTICES

Introduction

The Instrument Air System (IAS) at nuclear power plants is typically a non-safety related system. As such it is considered to be more vulnerable to failure than safety related systems.

Because of recent events at PVNGS Unit 3 and increased industry and NRC concern with the IAS, APS is evaluating options for design modifications and for changes to operating and maintenance procedures in order to make the IAS system more reliable. This survey is designed to provide input for this evaluation process.

Scope

The survey includes information on system design and maintenance practices. It does not contain information on operations or training.

Purpose

The specific purposes of this survey are as follows:

- o Understand the design approach and bases for the Instrument Air Systems employed at other large PWR nuclear power plants
- o Learn of successful practices used by other plants that may be applied to Palo Verde
- o Avoid problem areas encountered by other utilities

Methodology

In order to obtain detailed information on the instrument air systems at other nuclear power plants, a questionnaire was developed that includes 15 questions covering a broad scope of information on design, operations, and maintanence. This questionnaire is included in Appendix A.

Concurrent with the development of the questionnaire, eight plants were chosen to be surveyed. Selection criteria for these plants was based on the following:

- o Similar size and age C-E plants
- o NRC Region V plants
- o Availability of sources of information (e.g., contacts, P&IDs, Systems Descriptions, responses to

Generic Letter 88-14).

Based on this selection criteria, the plants surveyed were:

- o Diablo Canyon
- o Rancho Seco
- o St. Lucie
- o San Onofre (SONGS)
- o South Texas Project (STP)
- o Trojan
- o Waterford
- o Vogtle

The survey was largely performed on the telephone, although personnel involved in the survey also used P&IDs, Systems Descriptions, UFSARs and other materials to gather information where these sources were available. A copy of responses to Generic Letter 88-14 was also obtained, when available, and used to supplement information gathered over the telephone and from plant documents.

Results

Results of the survey are presented in Appendix B and are presented on the summary table included with this report. In some cases the individual(s) contacted for the survey did not know a particular answer. This is indicated on the table as a question mark. Appendix C contains copies of the responses to G.L. 88-14 submitted by the plants in the survey. The G.L. 88-14 response for San Onofre was not available.

Potential Enchancements

Based on information gathered from the 8 plants surveyed, a number of design and maintenance enhancements to the IAS are included for consideration. These are meant to be used for developmental purposes only and are not final recommendations.

System enhancements:

Suggested system enhancements include the following:

- o Demonstrate capacity of nitrogen backup system
- o Improve nitrogen backup system capability
- o Consider wiring one or more compressors to a 1E power source
- o Isolate non-vital IA loads in event of low IA header pressure
- o Increase dryer capacity
- o Add receivers downstream of the dryers to smooth surge demand on the dryers

Most plants provide only one form of backup for the IAS. Either they backup the entire instrument air system (e.g., by diesel-driven compressors or by 1E power to the compressors) or they backup only components necessary for safe shutdown with a local backup system (e.g., nitrogen or air bottles). The PVNGS design actually provides both backup for entire system and local backup for components required for safe shutdown. This design should be conservative.

Since, in spite of the conservatism, a lower than expected pressure was observed in the IAS, it has been proposed that the nitrogen backup system be tested to ensure that it is capable of providing a flow that is adequate for the system demand during an upset event. If the nitrogen system is tested and found to be inadequate for the actual upset demands, consideration could be given to providing a 1E power source for one or more of the compressors, to providing a diesel-driven compressor for use when non-1E power is lost, or to adding the capability to cut unnecessary loads, such as those in the yard area.

Also, since the normal IA dryer demand is at the limit of the PVNGS dryer capacity and since an upset condition may result in higher demands on the dryer and lead to higher dewpoints, it is suggested that consideration be given to increasing the dryer capacity. Also consideration should be given to adding additional receiver capacity downstream of the dryers to smooth the surge demand on the dryers.

Maintenance Enhancements:

Suggested maintenance enhancements include the following:

- o Develop air quality monitoring program
- o Evaluate adequacy of dryer filters for particulate removal
- o Consider periodic inspection for check valves that provide isolation between the IAS and backup air or nitrogen

Most utilities are developing procedures to monitor air quality as a result of G.L. 88-14. This would include continuous monitoring of dewpoint at the dryer outlets, and periodic monitoring for particulates and hydrocarbons.

Some utilities have or are planning to replace their pre and or post filters to those with a lower micron rating to meet ISA-7.3. If PVNGS is not meeting the requirements of this standard, this could be a consideration.

A number of plants have or are planning to initiate periodic inspection programs for the check valves that provide isolation between the IAS and the backup air or nitrogen source. This includes both functionality tests and leak

testing and appears to be done on an annual basis or at refueling outages. These valves could be added to the PVNGS Section XI program, if they are not currently included.

Conclusion

The existing PVNGS design bases and practices appear to be generally consistent with the utilities surveyed. However, G.L. 88-14 has heightened industry awareness of the vulnerabilities of the IA system. For this reason, it is recommended that PVNGS evaluate the above suggestions to enhance the overall reliability of the IA system.

TABULATION OF INSTRUMENT AIR SURVEY RESULTS

TOPIC/UTILITY	PVNGS	DIABLO CANYON	RANCHO SECO
SIZE OF PLANT	1300 MWE	1200 MWE	880 MWE
PREVENTATIVE MAINTENANCE	1. Dessicant replaced annually 2. Instrument air prefilters replaced semiannually 3. Instrument air postfilters replaced annually 4. Air compressor inlet filter inspected annually	1. Dewpoint monitored monthly 2. Dessicant monitored through dewpoint 3. Filters monitored per delta P monitors with annunciators 4. Currently no monitoring for compressors 5. Sample air quality every six months	1. Dewpoint monitored continuously at the dryer output 2. Dessicant is inspected annually 3. Filters are on a 120 day PM cycle 4. Air compressors receive monthly and quarterly PM 5. Dryers are monitored every 30 days 6. System is checked monthly for moisture and blown down 7. Currently no air quality testing
METHOD OF RESTORING SYSTEM ON LOSS OF POWER	Plant uses passive liquid nitrogen supply as backup for IA. Compressors cannot be connected to 1E bus.	Cannot be connected to 1E bus. Backup diesel-powered is used only during outages.	Cannot be connected to 1E bus. There is a non-safety related backup diesel-driven compressor lined up with IA that can be manually started.
SYSTEM PARAMETERS	Design Pressure: 125 psig Normal operating: 105-110 psig Minimum: 85 psig Dewpoint: -40 F	Design pressure: 120 psig Normal operating: 90-120 psig Minimum: 90 psig Dewpoint: -40 F (T.S.: -18)	Design pressure: 125 psig Normal operating: 100 psig Minimum: 50 psig Dewpoint: -40 F
SYSTEM REQUIREMENTS	Normal demand: 300-400 scfm	Normal demand: 1200 scfm* * Includes service air	Normal demand: 250 scfm

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TABULATION OF INSTRUMENT AIR SURVEY RESULTS

TOPIC/UTILITY	ST. LUCIE	SONGS	STP
SIZE OF PLANT	900 MWE	1100 MWE	1200 MWE
PREVENTATIVE MAINTENANCE	1. Dewpoint monitored monthly 2. Dessicant monitored annually 3. Filters monitored every six months 4. Valves monitored every six months 5. Will sample air quality in the future. Frequency not established.	?	1. Filters monitored and replaced when delta P is 5 psi 2. Dryer moisture traps and moisture separators inspected annually. 3. Monitor air quality to ISA-7.3 every refueling outage unless test results require more frequent monitoring.
METHOD OF RESTORING SYSTEM ON LOSS OF POWER	Two small original IA compressors can be connected to the 1E bus	Cannot be connected to 1E bus.	One IA compressor is connected to the non-1E BOP diesel. Operator action is required to restart the compressor.
SYSTEM PARAMETERS	Design pressure: 145 psig Normal operating: 100-115 psig Minimum: 100 psig Dewpoint: -40 F	Design pressure: 110 psig Normal operating: 102-110 psig Minimum: 70 psig Dewpoint: -34 F	Design pressure: 150 psig Normal operating: 105 psig Minimum: 90 psig Dewpoint: -40 F
SYSTEM REQUIREMENTS	Normal demand: 100 scfm	Normal demand: 380 scfm	Normal demand: 658 scfm

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TABULATION OF INSTRUMENT AIR SURVEY RESULTS

TOPIC/UTILITY	TROJAN	WATERFORD	VOGTLE
SIZE OF PLANT	1100 MWE	1100 MWE	1200 MWE
PREVENTATIVE MAINTENANCE	1. Dewpoint monitored continuously 2. No programmed maintenance to filters or point of use regulators 3. Dryer postfilters changed approximately once a year 4. No maintenance of dryers 5. Plan to start measuring air quality quarterly	1. There is preventative maintenance for all main components--dryers, accumulators, regulators--approximately annually 2. Plan to start measuring air quality	1. There is no formal preventative maintenance program applied to the instrument air system
METHOD OF RESTORING SYSTEM ON LOSS OF POWER	One compressor is wired to the 1E system. Must be manually loaded after loss of power (LOP).	The IA compressors are tied to the 1E system. They must be manually restarted after LOP.	Cannot be connected to 1E bus.
SYSTEM PARAMETERS	Design pressure: 135 psig Normal operating: 110-119 psig Minimum: 80 psig Dewpoint: -40 F	Design pressure: 120 psig Normal operating: 100 psig Minimum: 60-80 psig Dewpoint: -40 F	Design pressure: 132 psig Normal operating: 100 psig Minimum: 80 psig Dewpoint: -60F
SYSTEM REQUIREMENTS	Normal demand: 325-350 acfm* * 550 if service air included	Normal demand: 280 scfm* * 400 if dryer demands incl.	Normal demand: 1700 scfm* * Includes service air

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TABULATION OF INSTRUMENT AIR SURVEY RESULTS

TOPIC/UTILITY	PVNGS	DIABLO CANYON	RANCHO SECO
EQUIPMENT	Compressors: 3 Ingersoll rand, 500 scfm Receivers: 3 - 151 cuft each Dryers: 1 - 400 scfm, dessicant heat-less	Compressors: 2 Atlas Copco, capcity ? 4 Joy Mfg, 334 scfm each Receivers: 2 - 631 cuft at 120 psig Dryers: 2 - ?, dessicant heatless	Compressors: 3 - 300 cfm at 125 psi 1 - 600 cfm diesel driven Receivers: 3 - Capacity? Dryers: 4 - 900 scfm, dessicant heatless (Service Air) 2 - 900 scfm, dessicant heatless (Instrument Air) 1 - 340 scfm (Standby)
DRYER FILTER RATINGS	Prefilters: micron rating ? Postfilters: micron rating ?	Prefilters: 1 micron Postfilters: 1 micron	Prefilters: Not used Postfilters: 5 microns
USE FILTER REGULATORS?	Yes	No	Yes
IA SYSTEM BACKUP	Safety related valves necessary for safe shutdown are provided with nitrogen or air accumulators Passive nitrogen supply used to backup the entire IA system is not safety related	Nine types of valves are safety related and use nitrogen or air bottles as backup. There is no backup for the system as a whole	Backup air bottles are provided for some valves. The system as a whole is backed up by a diesel-driven compressor

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TABULATION OF INSTRUMENT AIR SURVEY RESULTS

TOPIC/UTILITY	ST. LUCIE	SONGS	STP
EQUIPMENT	Compressors: 2 Chicago Pneumatic, 162 scfm 2 Atlas Copco, 400 scfm Receivers: 2 - Capacity? Dryers: ? - dessicant heatless	Comprssors: 3 Ingersol Rand, 800 scfm Receivers: 3 - Capacity? Dryers: 2 - 650 scfm, refrigerant	Compressors: 2 Ingersoll Rand, 670 scfm Receivers: 1 - 670 cuft Dryers: 2 - 650 scfm, dessicant
DRYER FILTER RATINGS	Prefilters: Coalscent Postfilters: 0.9 microns	Prefilters: Not used Postfilters: 5 microns	Prefilters: 1 micron Postfilters: 1 micron
USE FILTER REGULATORS?	Yes	No	Yes, by some user components.
IA SYSTEM BACKUP	The MSIVs are provided with air accumulators Two IA compressors are diesel driven	The ADVs are provided with separate stand-alone nitrogen accumulators There is no backup for the system as a whole	Valves which must function are provided with safety-related motor operators or electrohydraulic operators The IA compressors are backed up by the SA compressors. The SA compressors do not have 1E power

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TABULATION OF INSTRUMENT AIR SURVEY RESULTS

TOPIC/UTILITY	TROJAN	WATERFORD	VOGTLE
EQUIPMENT	Compressors: 3 Joy Mfg, 337 acfm 1 Sullair, 650 acfm Receivers: 3 - 57 cuft 1 - 96 cuft Dryers: 1 - 600 scfm, regenerative dessicant heated	Compressors: 2 Nash, 280 scfm Receivers: 1 - 100 cuft Dryers: 2 - 360 scfm, dessicant heatless	Compressors: 4 Sullair, 885 scfm 3 Ingersoll Rand, 750 scfm Receivers: 7 - 150 cuft Dryers: 8 - 740 scfm, regenerative dessicant
DRYER FILTER RATINGS	Prefilters: 10 microns Postfilters: 10 microns* * Being changed to 0.3 microns	Prefilters: 10 microns Postfilters: 3 microns	Prefilters: 3 microns Postfilters: 3 microns
USE FILTER REGULATORS?	Yes, 10 - 40 microns.	Yes, upstream of every valve.	Yes, 35-50 microns.
IA SYSTEM BACKUP	The auxiliary feedwater valves and the PORVs are provided with safety related accumulators The IA system has one diesel-driven compressor that can be manually started in the event of a LOP	Thirty-seven valves that are required for safe shutdown have either air accumulators or automatic nitrogen backup. The IA compressors are wired to the 1E bus and can be manually restarted after LOP	All safety related valves are designed to fail safe in the event of loss of instrument air There is no backup for the system as a whole

TABULATION OF INSTRUMENT AIR SURVEY RESULTS

TOPIC/UTILITY	PVNGS	DIABLO CANYON	RANCHO SECO
CONFORMANCE TO ISA-7.3	Yes, they are close to meeting ISA-7.3 Monitoring ?	Air quality not monitored prior to G.L. 88-14. Utility does not feel they can meet ISA-7.3, but will begin monitoring as follows: - Check pressure continuously - Check dewpoint monthly - Sample particulate and oil every six months	The utility attempts to meet ISA-7.3, although they have not tested for air quality. Breathing air is monitored monthly for hydrocarbons and particulates. Dewpoint is continuously monitored The utility is designing sampling equipment now for air quality.

TABULATION OF INSTRUMENT AIR SURVEY RESULTS

TOPIC/UTILITY	ST. LUCIE	SONGS	STP
CONFORMANCE TO ISA-7.3	The utility currently monitors dew point. They are developing a procedure for monitoring particulates and hydrocarbons and are working the meet ISA-7.3	Air quality requirements are: - Dewpoint >-34 F - Particulates <= 5 microns	System is currently required to meet ISA-7.3 per surveillance procedure. Testing is as follows: - particulate counter @ 1 cfm - Dregger analysis tube for oil - Dewpoint hydrometer Ten test locations are utilized.

APPENDIX C

13-MS-A20

TABULATION OF INSTRUMENT AIR SURVEY RESULTS

TOPIC/UTILITY	TROJAN	WATERFORD	VOGTLE
CONFORMANCE TO ISA-7.3	To date, utility has not tested for air quality. They are now striving to meet ISA-7.3. They are planning to test for particulates and hydrocarbons quarterly	The utility did not monitor air quality prior to G.L. 88-14. They will not attempt to meet ISA-7.3. Acceptance criteria will be: - Particulates <= 10 microns - Dewpoint <= - 10 F - Hydrocarbons <= 3 ppm	System is currently required to meet ISA-7.3 per FSAR commitments. Testing was performed during preop testing of the plant. Acceptance criteria is: - Oil <= 1 ppm - Dewpoint , = - 15 F

APPENDIX C

APPENDIX A

SURVEY QUESTIONNAIRE

APPENDIX C

Instrument Air Design Basis Questionaire
Utility Comparison

Purpose:

Assist APS in understanding the design approach and bases for Instrument Air used in other large nuclear power plants.

To learn of successful practices used in other plants that may be applied to Palo Verde.

To avoid problem areas encountered by others.

Contact:______________________________ Location:______________________________
Phone:(____)__________________________ Title:______________________________

1. Is the Instrument Air (IA) system dedicated to instrument air, or is it also used for other purposes such as service air, lab air, etc? Describe any other uses.

2. Is power to the IA system lost during a loss of non 1-E power (LOP)? How does the system respond? Can the IA compressors be connected to a 1-E power source? How? Describe source?

3. Is the IA system or any portion of it safety related (i.e. "Q")? If so, describe the safety related interfaces and functions.

4. What safety related active valves (e.g. FWIV, MSIV, SG blowdown, ADVs) require air to fulfill their safety related function?

   Do any of these valves have IA or Nitrogen accumulators to ensure their safety related function? Describe them and their accumulator gas source.

5. Do the IA compressors have a backup system in the event of a loss of IA (e.g. liquid nitrogen with a vaporizer)? If so, what is it and how does it work? Is the backup "Q" ? What is the air quality of the backup supply? Obtain portion of system description manual if possible via telecopy.

APPENDIX C

Instrument Air Design Basis Questionaire
Utility Comparison

6. Number _______ capacity _________ and manufacturer __________ of IA compressors?

Number _______ and volume _____________ of the air receivers?

Number _______ capacity _____________ required dewpoint _____ of the IA dryers?

Type of dryer (e.g. refrigerant, dessicant heatless or heated, etc.)________________________________

7. Does the dryer have prefilters and/or post filters? Describe type of media and micron rating in each.

If filter regulators are used, what type of media and micron rating is generally used?

Are there any applications where finer filters or filter regulators are used? Describe those applications. Describe th type of media and micron rating for each application.

Are there any other miscellaneous inline filters and/or moistu separators installed in the IA system? What is their purpose? What is the media and micron rating?

8. Describe the preventive maintenance program applied to the dryers, filters, filter regulators, moisture sepparators etc. described above. What is done and at what frequency to each item?

APPENDIX C

Instrument Air Design Basis Questionaire
Utility Comparison

9. For the dryers, filters, filter regulators etc described above, have there been any problems?

Frequent change outs?

High amount of corrective maintenance (i.e. malfunction or unexpected failures?

10. What air quality do you require and/or achieve routinely? How does your air quality compare to ISA-7.3?

Describe the air quality monitoring program you use? How do you determine the quality? What is the frequency?

Does moisture accumulate in the IA system? Does it present a problem? How is it dealt with? (e.g. blowdown, traps, moisture separators, secondary dryers, etc)

11. What materials are used in the IA system?

Piping and tubing ______________________________

Valves ______________________________

Vessels ______________________________

Filter bodies ______________________________

Other ? ______________________________

12. What is the IA design pressure? ______ Normal operating Pressure? _____ Minimum operating pressure? __________

13. Is IA pressure and/or flow monitored (periodically or continuously)? If so, how is done? Where? How frequently?

APPENDIX C

Instrument Air Design Basis Questionaire
Utility Comparison

14. What is the IA demand (scfm) during normal operation? ________
During upset/abnormal conditions (e.g. LOP, MSIS, SIAS, AFAS, etc) ? ________________

What is the source of the data (e.g. calculations, operating measurements, etc)? Describe it.

Has there been any correlation of IA demand/consumption data obtained from plant tests, upsets or trips to the "design basis or normal or expected upset IA demand? Describe it.

15: Characterize the utility's response to I&E Bulletin 88-14. Summarize actions taken and commitments made. What is the schedule for future actions and commitments?

APPENDIX B

UTILITY RESPONSES TO SURVEY ON INSTRUMENT AIR

APPENDIX C

UTILITY RESPONSES TO SURVEY ON INSTRUMENT AIR

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safety related. The quality of gas from these sources is not known.

6. Compressors: 2 Atlas Copco, capacity unknown, but both are 100% capacity
   4 Joy Mfg., 334 scfm at 100 psig, all 25% capacity (These are seldom used)
   1 Altas Copco, located outside, used for outages only

   Receivers: 2 - 631 cuft at 120 psig

   Dryers: 2 - One will be replaced shortly (dessicant is damaged). Dewpoint is -40 F (Design). Technical Specification limit is -18.

   Dessicant heated.

7. The dryers have both pre- and post-filters. They are both rated at 1 micron.

   No filter regulators are used.

   No finer filters or filter regulators are used.

   Other filters are used throughout the plant, for example when the instrument line comes off the header have pressure regulators with filters and some instruments have their own filters.

8. The dessicant is monitored monthly since G.L. 88-14. Actually the dessicant is monitored via the dewpoint. If there is a problem with moisture, then the dessicant is checked.

   Filters are monitored per delta p monitors with annunciators.

   Generally, the plant relies on the annunciators (see Question 13).

   The plant is also in the process of ordering new water-cooled compressors. They will ask the vendor for a maintenance schedule and program.

9. Yes, there have been some problems with the dryers. The dessicant in the dryers was not checked between 1976 and 1988. It had deteriorated during this time. Also, when they inspected the IA lines, they found crud (e.g., rust, scaling) in the IA headers. The rust is assumed to be from the SA portion of the system which was previously not isolated from IA and consists of carbon steel piping.

   There have been no problems with the filters.

There has also been very high maintenance on the Joy compressors. There has also been a quantity of water (e.g., gallons) in the system from improper connections.

10. Air quality was not monitored prior to G.L. 88-14. Contact does not feel that they can meet ISA-7.3. They are finding 300 particles > 3 microns in spite of their small filter size.

    Dewpoint is maintained >= -18 F.

    They have no problems with oil. Compressors are oil less.

    The new air quality monitoring program is as follows:

    - o IA pressure is checked continuously
    - o Dewpoint is checked at the dryer outlet monthly
    - o Every six months particulate and oil are sampled

    They are in the process of installing sample taps and have been blowing down the system since December.

    Yes, moisture has been accumulating in the IA system. It has presented a problem. They are rewriting the procedure to look for moisture and blowdown the system if it is found.

11. Piping and Tubing are copper.

    Valve material is not known.

    Vessels (receiver tanks) are thought to be carbon steel.

    Filter body material is not known.

    Other materials contained in the system may be stainless steel.

12. Design: 120 psig

    Normal: 90-120 psig

    Minimum: 90 psig

13. Yes, pressure is continuously in the control room. One panel contains all IA indications. They continuously monitor dewpoint and alarm with high dewpoint. Also alarm for high delta P across filter in the control room. Also high temperature in the air header, air dryer problems, and alarms on the compressor (e.g., low oil, high oil, temperature).

APPENDIX C

14. Demand: 1200 scfm including the SA system

Abnormal: Not known

Source: Estimate

15. The response to G.L. 88-14 indicated that there was a problem with the IA system at Diablo Canyon. The utility was aware of the problem prior to the generic letter. The plant had been tripped once due to IA system problems. They have purchased new compressors and new dryers to improve the system.

They did not commit to meet ISA-7.3 in the generic letter response.

APPENDIX C

PVNGS INSTRUMENT AIR SURVEY BASELINE DATA

Source: Tom Ballweg, Bechtel (602) 342-8524 Glendale Mechanical Lead

1. The instrument air system is dedicated solely to instrument air.

2. Yes, power to the IA system is lost during a loss of non 1E power. A backup system consisting of liquid nitrogen with an ambient vaporizer is provided and designed to provide a passive backup in the event that pressure in the IA system drops below 85 psig. There is no way to restore the compressors in the event that non-1E power is unavailable.

3. No, there are no safety related portions of the IA system. Accumulators are provided to safety-related valves as needed. These accumulators are considered to belong to the same system as the valve, not to the IA system.

4. There are 144 safety related valves and dampers which rely on instrument air. Most of these are designed to fail safe on loss of IA. The safety-related active valves that require air to fulfill their safety related functions are the following:

   - MSIV
   - ADVs
   - FWIV

   These valves are provided with accumulators to ensure their safety related function. The ADVs have nitrogen accumulators, the MSIVs and FWIVs have small air accumulators used to position a shuttle valve.

5. Yes, the entire IA system is provided with a liquid nitrogen back up source as described in #2. This source is not safety related. The air quality of the nitrogen is not monitored.

6. Compressors: 3 - 500 scfm at 125 psi, Ingersoll Rand

   Receivers: 3 - 151 cuft

   Dryers: 1 - 400 scfm twin tower with dewpoint of -40 F, dessicant heatless manufactured by Kemp

7. The dryer has both prefilters and post filters. They are cartridge type. The micron rating is unknown.

Filter regulators are used for instruments. The micron rating is not known.

Moisture separators and filters are used in various portions of the lines, for example in line to the ADVs.

8. The existing preventative maintenance tasks include the following:

   - Inspect, clean, or replace air compressor inlet filter annually
   - Remove and replace instrument air prefilters semi-annually
   - Remove and replace instrument air postfilters annually
   - Replace dessicant annually

   In addition to these tasks, supplemental tasks such as disassembly of drain traps including inspection and cleaning of the internals are also performed on the prefilter, moisture separator, and receiver on a quarterly basis along with a multitude of other tasks performed on related instruments, relays, motors, bearings, vibration monitoring and similar equipment.

   Additional maintenance items are being considered.

9. Call maintenance

10. The air quality that is measured is close to meeting ISA-7.3.

    See G.L. 88-14.

    Yes, moisture does accumulate in the IA system. Engineering requests prepared for the IAS over the last four years indicate moisture occurs.

11. Piping and tubing: Carbon steel from the compressor up to the prefilter. Copper or brass for the rest of the system. Nitrogen system up to the isolation valve is carbon steel.

    Valves: Brass

    Vessels: The ADV accumulators are stainless steel. The IA receivers are carbon steel. The dryer is carbon steel.

    Filters: Dryer pre and post filters are stainless steel

APPENDIX C

Other: Moisture separator in line to MSSS has an aluminum body

12. Design: 125 psig

Normal operating: 105-110 psig

Minimum: 85 psig

13. IA pressure is continuously monitored and alarmed in the control room. A local flow indicator was recently added in Unit 2. This will provide a local readout. There is also a nitrogen pressure monitor. There are local delta p monitors on the pre and post filters which alarm indirectly in the control room.

14. The IA demand during normal operations is 300-400 scfm. During upset conditions this demand may reach 880 scfm.

The normal demand was measured in unit 2 and agrees with the original calculation (13-MC-IA-204) used to size the dryer.

The upset demand is based on a calculation that assumes that the hydraulic accumulators for the 4 MSIVs and 4 MFIVs are being recharged simultaneously.

15. PVNGS was in the process of conducting an air quality test on Unit 2 at the time of the response to Generic Letter 88-14. Preliminary results are as follows:

- o Dew point is approximately -10 F at 120 psig. Since this is greater than the design value, compensatory measures are in place to open low point drains on the air distribution piping on a periodic basis to prevent moisture accumulation.
- o Particulates are predominantly less than 3 microns in size with some particulates in the 3-5 micron range.
- o Hydrocarbons are less than 1 ppm.

The utility will evaluate the data and determine if modifications or changes in preventative maintenance are required.

PVNGS is also in the process of revising its emergency procedures to consider:

- o Indications of loss of instrument air, such as alarms, automatic actions, functions lost.
- o Identification of critical components operated by

instrument air and the position in which they fail.

- o Expected system and plant responses to a loss of instrument air and the consequences of these responses.
- o Actions to take if critical components do not fail in the intended position.
- o Manual actions the operator should be expected to take to respond to a loss of instrument air event.
- o Restoration actions to be taken after instrument air is regained.

Simulator training is being enhanced to include loss of instrument air.

Frequency of preventative maintenance tasks related to air quality is being reviewed and may change depending on the results of the air quality test.

APPENDIX C

RANCHO SECO RESPONSE TO IA SURVEY

Source: Masa Nakao (Bechtel) San Francisco
(415) 768-2363 Mechanical Engineer

Gary Aron (SMUD) Rancho Seco
(209) 333-2935, x 4759 Systems Engineer

1. Instrument air is fed from the service air system. The service air system is also used for respirators in containment. The system line up is such that there are 3 air compressors, 3 receivers, then the line splits. A priority air operated valve in the system cuts off service air loads if necessary.

2. Yes, power to the instrument air system is lost during a loss of non-1E power. There is a back-up diesel-driven compressor lined up with the instrument air system which can be manually started in the event of a LOP, however this compressor is not safety related. There are no connections to 1E power available.

3. No portion of the IA system is safety related, but there is Seismic I (non-Q) backup air to some valves, including the following:

   - ADVs
   - Main Feedwater Isolation Control Valves
   - Emergency Feedwater Isolation Control Valves

   In addition, there is Appendix R backup to the same components plus the CCW valves, Feedwater valves, and the Turbine Bypass Valves. This Appendix R backup consists of air bottles that are set to provide air when a certain minimum system pressure is reached. There is an alarm for low bottle air pressure.

   Two Safety Features Valves (the Letdown Isolation and Reactor Coolant Pump Seal Return Isolation) are backed by accumulators.

4. Safety related active valves which rely on instrument air include the following:

   - Main Feedwater Isolation Valves
   - Aux Feedwater control valves
   - ADVs

   All of these valves have air bottle backup. They do not have accumulators. Nitrogen is not used because of the need to use the air for respirators.

5. The instrument air compressors are backed up by a diesel-powered air compressor and by backup air bottles (to some

valves). The diesel must be manually started. The operation of the back-up air bottles is automatic. There are two alarms, one for loss of IA, one for low bottle pressure.

Although the P&ID indicates that the backup system is "Q", this is not assumed to be the case and was not indicated as such to the NRC in the response to G.L. 88-14.

6. Compressors: 3 service air compressors rated at 300 cfm at 125 psi. Manufacturer not known. In normal operation two compressors are running, one fully loaded and one cycling with demand, with the third unit in auto-start standby.

   1 diesel-driven compressor. Rating, manufacturer not known.

   Air Receivers: 3 for the service air compressors. Capacity, manufacturer not known.

   1 for the diesel-driven instrument air compressor. Capacity, manufacturer not known.

   Dryers: 4 associated with the service air system, rated at 900 cfm with a required dewpoint of -40 F.

   2 associated with the instrument air system, rated at 900 cfm at 100 psig. There is also a standby dryer with a capacity of 340 cfm at 100 psig.

   Type of dryer is dessicant heatless.

7. The dryers associated with the service air system have post filters only. The rating is 1 micron. The type of media is not known.

   No information on the diesel-driven compressors for the IA system.

   Filter regulators are used upstream of approximately 90% of the valves. They are rated at 40 microns.

   There are moisture separators in the service air system. There is an absorber in the diesel-driven IA system.

8. Surveillance is as follows:

   o Air compressors receive a monthly PM where the blow by is checked and the filters are checked. This is

considered a "mild trending". There is also a 120 day inspection where compressor valves are opened and checked for wear. Vibration is monitored quarterly.

- o Dryers are monitored every 30 days and the system is lubed. The dessicant is inspected annually.
- o Filters are on a 120 day PM cycle.
- o The system is blowndown monthly and checked for moisture or other abnormal conditions.

9. There have been no problems in years.

10. The utility attempts to meet ISA-7.3. They feel they do meet this standard for dewpoint, particulate, and hydrocarbons although they have not tested for air quality. There is a constant monitoring of in-line dew point (no recorder, but this can be used). Dew point is alarmed in the control room. The utility is designing sampling equipment now. Breathing air is already monitored monthly for hydrocarbons and particulates, using filter paper. They also have a monthly blowdown of the IA system. There used to be moisture years ago, but not at this time.

11. Piping and tubing:
Valves:
Vessels:
Filter bodies:
Other:

12. Design pressure: 125 lbs
Normal operating pressure: 100 lbs
Minimum operating pressure: 50 lbs (verify with Gary)

13. Instrument air pressure is monitored continuously and alarms in the control room. It is not data logged; however, they do plan to do this in the future. There are also local indicators around the compressors, dryers, filters, headers. There is also annunciation in the control room for compressor malfunction. The IAS dewpoint is monitored continuously at the output of the air dryers and filters via a digital readout meter. The dewpoint is recorded at least once per shift and there is control room annunciation on high dewpoint.

14. The demand is approximately 250 cfm (+-20%). This is estimated based on air compressor usage. Calculations of demand are outdated. The system may be undersized.

APPENDIX C

15. Rancho Seco has implemented a number of improvements to the IA system since 1981:

- o Installation of a new, high capacity desiccant air dryer
- o Installation of a continuous readout dewpoint monitor with control room annunciation
- o Complete revisions to the normal and casualty operating procedures
- o An aggressive preventative maintenance program

The following modifications were made to improve reliability and control of critical valves:

- o An auto-start (on low system pressure), diesel-driven air compressor with a complete instrument grade air filtration and dryer package
- o Compressed air bottle back-up system that passively supplies two hours of instrument grade air to several critical valves upon loss of the normal air supply

The IAS at Rancho Seco is designed and operated to maintain air quality that meets or exceeds ISA-7.3.

A portable dewpoint meter is being purchased to verify air moisture content at the points of use of the IAS.

Instrument Air Design Basis Questionaire
Utility Comparison

Purpose:

Assist APS in understanding the design approach and bases for Instrument Air used in other large nuclear power plants.

To learn of successful practices used in other plants that may be applied to Palo Verde.

To avoid problem areas encountered by others.

Contact: Victor Mendoza
Phone: (407) 465-4755
Location: PSL - St. Lucie Plant
Title: Tech Staff Engineer

1. Is the Instrument Air (IA) system dedicated to instrument air, or is it also used for other purposes such as service air, lab air, etc? Describe any other uses.

   Ability to cross-tie station air to instrument air.
   Inst. Air also supplies lab air

2. Is power to the IA system lost during a loss of non 1-E power (LOP)? How does the system respond? Can the IA compressors be connected to a 1-E power source? How? Describe source?

   Not powered by vital bus. Two original instr. air compressors powered by diesel.

3. Is the IA system or any portion of it safety related (i.e. "Q")? If so, describe the safety related interfaces and functions.

   No However, we do treat as if S.R.

4. What safety related active valves (e.g. FWIV, MSIV, SG blowdown, ADVs) require air to fulfill their safety related function?

   FWIV, MSIV

   Do any of these valves have IA or Nitrogen accumulators to ensure their safety related function? Describe them and their accumulator gas source.

   MSIVs have accumulators (air)

5. Do the IA compressors have a backup system in the event of a loss of IA (e.g. liquid nitrogen with a vaporizer)? If so, what is it and how does it work? Is the backup "Q"? What is the air quality of the backup supply? Obtain portion of system description manual if possible via telecopy.

   Station air (poorer quality, however, has moisture separators) Not "Q"

Instrument Air Design Basis Questionaire
Utility Comparison

6. Number 4 compressors/unit capacity 2 - 162 SCFM 2 - 400 SCFM (new) and manufacturer Chicago Pneumatic Atlas Copco of IA compressors?

Number 2 dual Instr. air towers/unit and volume ______ of the air receivers?

Number ______ capacity ______ required dewpoint -40°F of the IA dryers?

Type of Dryer (e.g.) refrigerant, (dessicant heatless) or heated etc.) ______

7. Does the dryer have prefilters and/or post filters? Describe type of media and micron rating in each.

pre and after filters
pre - coalescent (after - paper .9μ 100% removal)

If filter regulators are used, what type of media and micron rating is generally used?

Generally, ~~Cellulose~~ cellulose

Are there any applications where finer filters or filter regulators are used? Describe these applications. Describe the type of media and micron rating for each application.

Not answered at this time

Are there any other miscellaneous inline filters and/or moisture separators installed in the IA system? What is their purpose? What is the media and micron rating?

Not answered @ this time

8. Describe the preventive maintenance program applied to the dryers, filters, filter regulators, moisture sepperators etc. described above. What is done and at what frequency to each item?

Semi-annual on valves
Annual - Dryer dessicants
Semi-Annual - pre-filter / after-filters & dryers
Dew-Point readings (monthly)

Page

Instrument Air Design Basis Questionaire
Utility Comparison

5. For the dryers, filters, filter-regulators etc described a have there been any problems?

NO

Frequent change outs? (New Units)

NA

High amount of corrective maintenance (i.e. malfunction or unexpected failures?

NO

10. What air quality do you require and/or achieve routinely? does your air quality compare to ISA-7.3?

Preparing & to do air-quality - May - June 89. Working to meet ISA-7.3

Describe the air quality monitoring program you use? How d determine the quality? What is the frequency?

Dew Point

Procedure soon to be developed for particulates and hydro carbons

Does moisture accumulate in the IA system? Does it present problem? How is it dealt with? (e.g. blowdown, traps, mois separators, secondary dryers, etc).

YES, YES, case-by-case blow down low points

11. What materials are used in the IA system?

Piping and tubing galvanized piping, stainless, copper

Valves brass

Vessels carbon-steel

Filter bodies

Other ?

12. What is the IA design pressure? 145 (145 working pressure) Normal operating Pressure? 110-115 Minimum operating pressure? 100 backup compressor starts

13. Is IA pressure and/or flow monitored (periodically or continuously)? If so, how is done? Where? How frequently?

shiftly logs - instr. air hdr. pressures

Instrument Air Design Basis Questionaire
Utility Comparison

14. What is the IA demand (scfm) during normal operation? ~100 SCFM During upset/abnormal conditions (e.g. LOP, MSIS, SIAS, AFAS, etc) ? ____

What is the source of the data (e.g. calculations, operating measurements, etc)? Describe it.

Do not Know

Has there been any correlation of IA demand/consumption data obtained from plant tests, upsets or trips to the "design basis" or normal or expected upset IA demand? Describe it.

Do not Know

15. Characterize the utility's response to I&E Bulletin 88-14. Summarize actions taken and commitments made. What is the schedule for future actions and commitments?

- FPL is in process of upgrading instr. air systems @ PSL 1 & 2
- Maintenance practices, EOPs and training are considered to be adequate
- Instr. air systems meet design basis reqmts.
- Lucie 2. pre-operational testing used to show performance as expected
- Lucie - Verification/testing about May, 1990
- Air operated component failure positions are the correct fail safe or SR position.
- The parameters to be sampled will include dew point, particulates, hydrocarbons (June 1989)

APPENDIX C

SONGS RESPONSE TO IA SURVEY

Source: Ramsey Clark, SCE — SONGS Systems Engineer
(714) 368-9169

Don Watkins, SCE — SOMGS
(71) 368-9829

1. The instrument air system is dicated to instrument air. There is a separate system i service air and breathing air.

   The instrument air system is provided with three compressors that are located in SONGS Unit 2. Two of these compressors are powered from separate Unit 2 buses; one compressor is powered from a Unit 3 bus. Thus the power for the instrument air system comes from three separate sources.

2. Yes, power to the IA system is lost during a loss of non-1E power event. There is no provision for 1E backup.

3. No portion of the IA system is safety related.

4. Safety related active valves that require air to fulfill their safety related function are as follows:

   - ADVs
   - CCW Non-Critical Loop Isolation
   - See G.L. 88-14 response (not available)

5. The ADV valves are provided with separate stand-alone nitrogen accumulators to ensure their safety related function for the required time the valves must function.

   A smaller accumulator is used to take the CCW valves to their safety related position (below 70lbs)

   The remainder of the valves fail to their safety related position on loss of instrument air.

6. Compressors: 3 rated at 800 scfm at 110 psi, Ingersol Rand. All three are 100% capacity, but they normally operate at 50%.

   Receivers: 3 Capacity and manufacturer not known.

   Dryers: 2 rated at 650 scfm. Refrigerant type with required dewpoint of -34 F.

7. The dryers have only post filters. They are rated at 5 microns. The filter is a cartridge type.

APPENDIX C

Filter regulators are not used.

There are no applications where finer filters are used. They are not required for the valves. Valves only require < 50 microns.

There are no other miscellaneous inline filters and/or moisture separators in the IA system.

8. Contact: Butcher, Maintenance, (714) 768-6607, for information on maintenance.

9. The answer to each section of this question is no. There has been one problem, a loss of refrigerant in the dryers.

10. Air quality requirements are as follows:

   - Dewpoint > 34 F
   - Particulates <= 5 microns

   San Onofre blowsdown the system every outage. Basically the system remains dry and clean. The only item that is regularly monitored is dewpoint. This is monitored using a temperature gage, once a shift or once a day.

11. Piping and tubing: Before dryer is carbon steel schedule 80, ASME SA-106B. Beyond the dryer is copper, seamless, ASTM B-88, Type L, and bronze.

   Valves: Carbon Steel, ASME SA 216 or SA 105 (P&ID) Bronze (SCE)

   Vessels: ?

   Filter Bodies: ?

   Other: ?

12. Design: 110 psi

   Normal: 102 - 110 psi. Compressor starts at 102, cuts out at 110.

   Minimum: 70 psi

13. There is a pressure differential (delta p) gauge in line. They also keep watch on the compressor. There are compressor trouble alarms and pressure alarms in the control room. Also, if one compressor fails to start, the next one starts.

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14. Normal IA demand is 380 scfm. This includes both units. Compressors are tested daily by blowing down the receivers to make the compressors load at 100%.

The instrument air system (compressors) was originally designed for SA and IA. Now the system (compressors) is only required to handle IA.

The demand is based on observation of the time the compressor runs. There was a calculation performed "long ago". The actual demand agrees very will with the measured demand.

15. As a result of G.L 88-14, the utility did the following:

- o Started monitoring dewpoint temperature
- o Justified the type of dryer used
- o Committed the ADVs would be added to the test program (This is because, although the ADVs are backed up by nitrogen, they are only separated from the remainder of the IA system by a check valve. If the check valve leaks, the actual available pressure is not known. They have now added leak tests to the Section XI test program.

Instrument Air Design Basis Questionaire
Utility Comparison

Purpose:
Assist APS in understanding the design approach and bases for Instrument Air used in other large nuclear power plants.

To learn of successful practices used in other plants that may be applied to Palo Verde.

To avoid problem areas encountered by others.

Contact: AL GUIDRY / JOHN SANCHEZ Location: BECHTEL, STP
Phone: (512) 972-7603 Title: MECH. EGS

1. Is the Instrument Air (IA) system dedicated to instrument air, or is it also used for other purposes such as service air, lab air, etc? Describe any other uses.
THE IA SYSTEM AT STP IS STRICTLY DEDICATED TO INSTRUMENT AIR. SERVICE AIR SYSTEM AND AIR BOTTLES ARE USED FOR OTHER SERVICES.

2. Is power to the IA system lost during a loss of non 1-E power (LOP)? How does the system respond? Can the IA compressors be connected to a 1-E power source? How? Describe source?
ONE IA COMPRESSOR IS CONNECTED TO THE NON-1E LOOP DIESEL. THEREFORE UNDER LOP, IA MAY STILL BE AVAILABLE. OPERATOR ACTION REQUIRED TO RESTART THE COMPRESSOR.

3. Is the IA system or any portion of it safety related (i.e. "Q")? If so, describe the safety related interfaces and functions.
ONLY THE CONTAINMENT PENETRATION PORTION OF THE IA SYSTEM IS SAFETY RELATED. IA IS PROVIDED TO SAFETY RELATED COMPONENTS (VALVES & DAMPERS) HOWEVER THE COMPONENTS FAIL SAFE ON LOSS OF IA. IA SYSTEM SERVES NO SAFETY RELATED FUNCTION.

4. What safety related active valves (e.g. FWIV, MSIV, SG blowdown, ADVs) require air to fulfill their safety related function?
NONE OF THE SAFETY RELATED COMPONENTS REQUIRE IA TO FULFILL THEIR SAFETY RELATED FUNCTION.
Do any of these valves have IA or Nitrogen accumulators to ensure their safety related function? Describe them and their accumulator gas source.
AT STP SAFETY RELATED MOTOR OPERATORS OR ELECTRO-HYDRAULIC OPERATORS ARE USED IN PLACE OF AIR OPERATORS AND SAFETY RELATED AIR ACCUMULATORS.

5. Do the IA compressors have a backup system in the event of a loss of IA (e.g. liquid nitrogen with a vaporizer)? If so, what is it and how does it work? Is the backup "Q"? What is the air quality of the backup supply? Obtain portion of system description manual if possible via telecopy.
THE SERVICE AIR SYSTEM COMPRESSORS (2, NON-1E) SERVE AS BACK-UP TO THE IA COMPRESSORS. WHEN IA PRESSURE DROPS BELOW 100 PSIG A CROSS CONNECT VALVE UPSTREAM

Instrument Air Design Basis Questionaire
Utility Comparison

6. Number 2 capacity 670 SCFM and manufacturer INGERSOLL-RA of IA compressors?

Number 1 and volume 670 FT³ of the air receivers?

Number 2 capacity 650 SCFM required dewpoint -40°F of the IA dryers?

Type of dryer (e.g. refrigerant, dessicant heatless or heated, etc.) DESSICANT

7. Does the dryer have prefilters and/or post filters? Describe type of media and micron rating in each.
THE DRYERS EACH HAVE A PRE-FILTER AND AN AFTER-FILTER THEY ARE BOTH CARTRIDGE TYPE MANUFACTURED BY CM KEMP (MODEL NO. 12FMO-2-MC150), THE MICRON RATING IS 1 MICRON.

If filter regulators are used, what type of media and micron rating is generally used? FILTER REGULATORS ARE USED BY SOME OF THE USER COMPONENTS. THE MEDIA AND MICRON RATING VARY WITH EACH MANUFACTURER.
Are there any applications where finer filters or filter regulators are used? Describe those applications. Describe the type of media and micron rating for each application.

THERE ARE NO APPLICATIONS WHICH REQUIRE CLEANER AIR THAN PROVIDED BY THE IA SYSTEM. THE MOST STRINGENT REQUIREMENT IS TO ISA-7.3.

Are there any other miscellaneous inline filters and/or moisture separators installed in the IA system? What is their purpose? What is the media and micron rating?
THERE ARE NO IN-LINE MISCELLANEOUS FILTERS AND/OR MOISTURE SEPARATORS IN THE IA SYSTEM.

☆

8. Describe the preventive maintenance program applied to the dryers, filters, filter regulators, moisture separators etc. described above. What is done and at what frequency to each item?
THE FILTERS ARE REPLACED WHEN THE DP GETS TO 5 PSI. THE DRYERS, MOISTURE TRAP AND MOISTURE SEPARATORS ARE CHECKED ABOUT ONCE A YEAR UNLESS IA TESTING REQUIRES A MORE FREQUENT SCHEDULE.

☆ INPUT PROVIDED BY PLANT ENGINEERING
STEVE HART (512) 972-7419

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P2

Instrument Air Design Basis Questionaire
Utility Comparison

9. For the dryers, filters, filter regulators etc described have there been any problems?
AS FAR AS BECHTEL ENGINEERING AND PLANT ENGINEERING A[RE] AWARE THERE HAVE BEEN NO PROBLEMS WITH THE IA COMPON[ENTS]
Frequent change outs?
NO

High amount of corrective maintenance (i.e. malfunction o[r] unexpected failures?
NO

10.* What air quality do you require and/or achieve routinely? [How] does your air quality compare to ISA-7.3?
PER SURVEILLANCE TEST PROCEDURE OTSP07-IA-0001 T[HE] IA REQUIRES TO MEET THE REQUIREMENTS OF ISA-7.3,

Describe the air quality monitoring program you use? How [do you] determine the quality? What is the frequency?
IA IS TESTED PER ABOVE PROCEDURE EVERY REFUELING OUTAGE, W[HEN] TEST RESULTS REQUIRE MORE FREQUENT INTERVAL. THE T[EST] USES 1) AUTOMATIC PARTICULATE COUNTER (@1 CFM), 2) DRAEGER AN[ALYZER] TUBE FOR OIL (@1 CFM), 3) DEWPOINT HYGROMETER, AT 10 TEST LOCA[TIONS] IN THE IA SYSTEM TEST PERFORMED

Does moisture accumulate in the IA system? Does it present [a] problem? How is it dealt with? (e.g. blowdown, traps, moi[sture] separators, secondary dryers, etc)
AT THIS TIME NO MOISTURE ACCUMULATION HAS BEEN REPORTED. THE IA SYSTEM HAS MOISTURE TRAPS AND THE SYSTEM WOULD BE BLOWN-DOWN OR FLUSHED IF AIR IS BAD.

11. What materials are used in the IA system?

Piping and tubing GALVANIZED CARBON STEEL

Valves CARBON STEEL

Vessels STAINLESS STEEL (AIR RECEIVER)

Filter bodies CARBON STEEL

Other ?

12. What is the IA design pressure? 150 Normal operating Pressure? 105 Minimum operating pressure? 90 *
* ISOLATION OF YARD IA PIPING.

13. Is IA pressure and/or flow monitored (periodically or continuously)? If so, how is done? Where? How frequentl[y]?
THE IA PRESSURE IS INDICATED IN THE CONTROL ROOM AND LOW PRESSURE ALARMED IN THE CONTROL ROOM. IA FLOW INDICATION IS PROVIDED LOCALLY.

* INPUT PROVIDED BY PLANT ENGINEERING

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Instrument Air Design Basis Questionaire
Utility Comparison

14. What is the IA demand (scfm) during normal operation? 650 SCFM
During upset/abnormal conditions (e.g. LOP, MSIS, SIAS, AFAS, etc)? U-1 MAX – 715 SCFM, U-2 MAX – 815 SCFM

What is the source of the data (e.g. calculations, operating measurements, etc)? Describe it.

CALCULATION NO. MC5091

Has there been any correlation of IA demand/consumption data obtained from plant tests, upsets or trips to the "design basis" or normal or expected upset IA demand? Describe it.

NO.

15. Characterize the utility's response to I&E Bulletin 88-14. Summarize actions taken and commitments made. What is the schedule for future actions and commitments?

RESPONSE LETTER TO I&E BULLETIN 88-14 HAS BEEN SUBMITTED.

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TROJAN RESPONSE TO INSTRUMENT AIR SURVEY

Source: Pietro Martinelli, Bechtel (415) 768-0445 — San Francisco Mechanical Engineer

Jack Siebel, PG&E (503) 464-7527 — Trojan Plant Engineer

1. Instrument air is used for both safety and non-safety related instruments, for service air, breathing air and to agitate the resin beads. The system splits after the compressors into service air and instrument air. These two systems are automatically isolated at a preset pressure.

2. Yes, power is lost to 3 of the 4 compressors associated with the system. One 100% compressor is lost along with two 25% compressors. There is one 25% compressor which retains power, since it is wired into the 1E system; however, this compressor must be loaded manually onto the diesel generator from a remote station. Also, the compressor requires water which is obtained by manually hooking up to fire water at a dedicated area. The 25% compressor is adequate for all instrument air needs (it is 25% when service air, breathing air, etc are added in). Per Jack Siebel, the compressors are actually approximately 85%, not 25%. On loss of power the IA system does not immediately lose all pressure because of the presence of the receivers. Instead, the pressure decays.

3. The accumulators for auxiliary feedwater and the accumulators for the PORVs are safety related. Interface with the non-safety related portion of the system is provided by double check valves.

4. There are two types of valves that are required to receive air to fulfill their safety related functions: the steam admission valves for the auxiliary feedwater turbine and the PORVs. The steam admission valves are required to open and may need to close later. The PORVs need air to open to mitigate a low temperature/overpressurization event and to function as high point vents on the pressurizer.

   There are other valves, such as the feedwater isolation valves, that are designed to fail closed and are not required to open, and valves, such as the ADV valves, that are assumed to fail and are not provided with backup air.

   As noted in Question 3, the auxiliary feedwater valves and the PORVs are supplied with accumulators. The accumulators are small tanks with double check valves

that store the air in the event of IA loss. They are periodically tested for air retention about once a year.

5. The ADVs have non-safety grade nitrogen backup. There is no back up for any other valves.

6. Compressors: 4 - 3 337 acfm rated at 100 psi (Joy Mfr)
   1 650 acfm rated at 100 psi (Sullair)

   Receivers: 4 - 3 57 cuft
   1 96 cuft

   Dryers: Two non-redundant trains. One twin dryer is rated at 600 scfm at 125 psig at -40 F is a regenerative dessicant heated dryer. The other train consists of a temporary dryer with no documentation. The utility has committed to document this dryer per G.L. 88-14.

7. The dryer has both prefilters and postfilters. They are both rated at 10 microns. The prefilter consists of porous stone. The post-filter is glass fiber. The utility is in the process of changing the rating of the post-filter to 0.3 microns. The new media not known.

   Filter regulators are used. They are rated at 10 and 40 microns and are supplied by Fisher as part of a standard package. No credit is taken for these filter regulators. Filtering will be handled at the dryer.

   There are no other miscellaneous inline filters and/or moisture separators in the IA system.

8. There is no programmed maintenance to the filters or point of use regulators. The dryer postfilters are changed approximately once a year. There is no significant maintenance of the dryers themselves.

9. There have been some problems:

   Corrosion was found on the inside of the dryer vessels last year during the outage. It resulted in a through-wall hole.

   There were no other general problems. One brand of regulator may have leaked. Mr. Siebel was not aware of the brand.

10. To date, Trojan has not tested for air quality. They are now striving to meet ISA-7.3. To do this, they will implement three new procedures as follows:

   - Blowdown system periodically
   - Measure air quality (e.g., particulates,

hydrocarbons) quarterly

o Perform leakage testing

They already monitor dewpoint continuously.

11. Piping and Tubing: Copper and galvanized carbon steel

Valves: Cast iron in galvanized carbon steel piping, brass and bronze in copper piping

Vessels: Accumulators are stainless steel in containment, carbon steel outside of containment

Filter bodies: Filter bodies are galvanized carbon steel downstream of the dryers. If used in regulators they are steel or bronze

Other: Some stainless steel is used in system

12. Design Pressure: 135 psig
Normal Operating Pressure: 110-119 psig
Minimum Operating Pressure: 80 psig

At 95 psig, the service air and breathing air headers are isolated.

13. Pressure is continuously monitored. There is a local alarm and a trouble light in the control room to indicate low pressure. Flow is not monitored.

14. The estimated instrument air demand during normal operation is 325-350 acfm (550 if SA is included). This has not been tested but is estimated based on compressor usage time in the field. There has been no correlation from formal tests. There is no calculation.

The IA demand during upset/abnormal conditions is not known.

15. The utility's response to G.L. 88-14 is attached.

The utility committed to verify the design of the safety-related portion of the system by test during the next outage (4/89-6/89). Response to gradual and sudden loss of air will be recorded.

The utility also committed to verifying the adequacy of maintenance practices, emergency procedures and training on the instrument air system and to developing a program for maintaining proper instrument air quality.

Also, in November, the utility voluntarily issued a LER

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to the NRC because a 1" IA line opened up at a bad solder joint. This incident almost tripped the plant. All four compressors came on and could barely supply adequate air. They ran the system bypassing the dryers and still almost went over pressure in containment. They are now doing a 5% sample test on solder joints. The problem seems to be that there was no procedure in existence for soldering at the time the work was performed.

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WATERFORD RESPONSE TO INSTRUMENT AIR SURVEY

Contact: Doug Urciuoli Location: Waterford, LA
Phone: (504) 467-8228, X3670 Title: Licensing Engr.

1. Is the Instrument Air (IA) system dedicated to instrument air, or is it also used for other purposes such as service air, lab air, etc.? Describe any other uses..

   IA totally dedicated to IA. Will connect to Service Air air compressor if pressure drops below setpoint.

2. Is power to the IA system lost during a loss of non-1E power (LOP)? How does the system respond? Can the IA compressors be connected to a 1E power source? How? Describe source.

   Yes, power to the IA system is lost during a loss of non-1E power. However, the IA compressors are permanently wired to a 1E bus. The IA compressors tied to 1E will trip on LOP, but they may be manually restarted on the diesels.

3. Is the IA system or any portion of it safety related (i.e., "Q")? If so, describe the safety related interfaces and functions.

   No, however, SR nitrogen and N_2 accumulators are tied into system. The nitrogen automatically starts after IA pressure decreases to the setpoint. The N_2 accumulator is set to 600 lbs. Valves will never see loss of pressure.

4. What safety related active valves (e.g., FWIV, MSIV, SG blowdown, ADVs) require air to fulfill their safety related function?

   There are 173 SR air operated valves and dampers that use the IA system. 37 are needed for safe shutdown or accident mitigation. All 37 either have air accumulators or nitrogen backup:

   3 valves (2 SI recirculation isolation valves and one heat exchanger valve) have air accumulators.

   34 have nitrogen backup.

   Do any of these valves have IA or nitrogen accumulators to ensure their safety related function? Describe them and their accumulator gas source.

Yes - 3 valves have air accumulators as noted above.

5. Do the IA compressors have a backup system in the event of a loss of IA (e.g., liquid nitrogen with a vaporizer)? If so, what is it and how does it work?

Yes - accumulators, liquid N_2 with vaporizer to 34 valves. IA accumulator to other 3 valves.

Is the backup "Q"? What is the air quality of the backup supply? Obtain portion of system description manual if possible via telecopy.

No, the backup is not "Q". The air quality is not known.

6. Number 2 capacity 280 scfm at 100 psig and manufacturer Nash of IA compressors?

Number 1 and volume 100 cf of the air receivers?

Number 2 capacity 360 scfm required dewpoint -40°F at dryer discharge of the IA dryers?

Type of dryer (e.g., refrigerant, dessicant heatless or heated, etc.) Dessicant heatless

7. Does the dryer have prefilters and/or postfilters? Yes, pre- and post-. Describe type of media and micron rating in each. Cartridge type filters, pre- 3 micron, post- 10 micron.

If filter regulators are used, what type of media and micron rating is generally used?

Do use these - upstream of every valve. Does not know size. Type = cartridge.

Are there any applications where finer filters or filter regulators are used? Describe those applications. Describe the type of media and micron rating for each application.

Only as noted above.

Are there any other miscellaneous inline filters and/or moisture separators installed in the IA system? What is their purpose? What is the media and micron rating?

Not to Doug's knowledge.

8. Describe the preventive maintenance program applied to the dryers, filters, filter regulators, moisture separators, etc., described above. What is done and at

What frequency to each item?

Preventative maintenance for all main components - dryers, accumulators, regulators.

Does not know durations. Thinks 6-18 months.

Also, annunciation is provided in the control room for the following conditions:

- o Instrument air receiver pressure Hi/Lo
- o Instrument air compressor A(B) trip/trouble
- o Instrument air compressor A(B) separator level Hi/Lo
- o Instrument air dryer A(B) trouble
- o Instrument air dryer bypassed
- o Instrument air pressure backup valve open
- o Instrument air compressor A(B) locked out
- o Valve operator nitrogen backup actuated/trouble

9. For the dryers, filters, filter regulators, etc., described above, have there been any problems?

No. (Big problem with compressors. Information from vendor not adequate to rebuild oil-free compressor.)

Frequent change-outs?

No.

High amount of corrective maintenance (i.e., malfunction or unexpected failures?

No.

10. What air quality do you require and/or achieve routinely? How does your air quality compare to ISA-7.3?

Not inspected until GL 88-14. Accept criteria particles $\leq$ 10 microns, dewpoint $\leq -10^{o}F$, hydrocarbons $\leq$ 3 ppm.

Not committed to ISA-7.3. Waterford will not attempt to use criteria in ISA-7.3.

Describe the air quality monitoring program you use. How do you determine the quality? What is the frequency?

Take air samples from 4-5 points through IA system once a fuel cycle (18 months); analyze per Q10, part 1.

Does moisture accumulate in the IA system? Does it present a problem? How is it dealt with? (e.g.,

blowdown, traps, moisture separators, secondary dryers, etc.)

No - no problems to date. Very small if any - N/A.

11. What materials are used in the IA system?

Piping and tubing Brass

Valves Brass or compatible

Vessels Air receiver - CS (?)
Filter bodies Brass or compatible (?)

Other? ?

12. What is the IA design pressure? 120 lbs. Normal operating pressure? 100 lbs. Minimum operating pressure? 60-80 lbs. (Must trip plant per off normal procedures if pressure drops below this point.)

13. Is IA pressure and/or flow monitored (periodically or continuously)? If so, how is it done? Where? How frequently?

There is continuous indication in CR.

Alarmed at three setpoints:

1 pt - 2 IA compressors kick in
2nd pt - 1 SA compressor kicks in
3rd pt - bypass filter dryers (disabled now)

As final backup could manually load on 2 SA.

14. What is the IA demand (scfm) during normal operation? (260-300) 280 scfm plant and 120 scfm (purge flow) for dryers. During upset/abnormal conditions (e.g., LOP, MSIS, SIAS, AFAS, etc.)? Does not know.

What is the source of the data (e.g., calculations, operating measurements, etc.)? Describe it.

Tests for GL 88-14 review.

Has there been any correlation of IA demand/consumption data obtained from plant tests, upsets or trips to the "design basis" or normal or expected upset IA demand? Describe it.

Did not find original design basis. Assumed it was 280 scfm and they forgot flow requirements due to dryers.

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15. Characterize the utility's response to NRC Bulletin 88-14. Summarize actions taken and commitments made. What is the schedule for future actions and commitments?

Problems: Rebuilding compressors
Air dryer taking more air than expected
Few minor questions

Minor Commitments: IA Sampling program
Minor procedure changes
More surveillance testing

Plan to address these items by next outage (8/89)

Also found procedural deficiencies as follows:

- o Did not call for blowdown of system whenever dryer is bypassed.
- o Did not list components whose position on an ESF signal is different than the failure position on loss of IA
- o Did not describe how to set the purge rate on the instrument air dryers
- o Did not provided for blowdown in the event moisture is detected

Several items are planned to increase system reliability:

- o Replace 10 micron dryer postfilters with 0.3 micron filters
- o Install automatic drain valves in the dryer prefilters
- o Install manual drain valves on instrument and service air receivers
- o Reevaluate the filter/dryer bypass setpoint value

The generic letter response also contains an extensive discussion of safety-related valves, including a discussion of those which are required to actuate during a safe shutdown. To ensure that valves that must function do function the utility will make revisions to procedures as follows:

- o Two separate tests will be performed on each nitrogen accumulator, one check valve operability test (quarterly) and one system leakage test (every 18 months)

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04

Instrument Air Design Basis Questionnaire
Utility Comparison

CONTACT: R. ERNEL x7512 / C.B. HEARD x7232

LOCATION: YEP.
TITLE: DEGS / S

1. Is the Instrument Air (IA) system dedicated to instrument air, or is it also used for other purposes such as service air, lab air, etc? Describe any other uses.

Answer: The compressed air supply line in each unit branches to supply both the service air system and the instrument air system for that unit. The service air system consists of a prefilter, a dryer, and an after-filter, from which the air flows to the various service air loops. A bypass line around the dryer and filters allows for maintenance and also provides overflow protection during periods of high plant maintenance activity, such as refueling. The instrument air system consists of two dryers in parallel, each having a prefilter and afterfilter. The air from the system flows to the various instrument air loops in the plant.

2. Is power to the IA system lost during a loss of non 1-E power (LOP)? How does the system respond? Can the IA compressors be connected to a 1-E power source? How? Describe source.

Answer: Power to the air compressors supplying instrument air is lost upon loss-of-offsite-power. The system is not required for safe shutdown or accident mitigation, therefore the system is not provided with power from a 1-E bus.

3. Is the IA system or any portion of it safety-related (i.e. "Q")? If so, describe the safety-related interfaces and functions.

Answer: The piping which penetrates the containment is Safety Class 2 and Seismic Category I. No part of the system is required to perform an active safety-related function. All safety-related valves which are supplied air by the instrument air system are designed to assume a fail-safe position upon loss of instrument air.

4. What safety-related active valves (e.g. FWIV, MSIV, SG blowdown, ADV's) require air to fulfill their safety-related function?

Answer: See attached list for all safety-related pneumatically operated valves for Plant Vogtle (FSAR Table 9.3.1-2).

Do any of these valves have IA or Nitrogen accumulators to ensure their safety-related function? Describe them and their accumulator gas source.

Answer: See answer to question 15.

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5. Do the IA compressors have a backup system in the event of a loss of IA (e.g. liquid nitrogen with a vaporizer)? If so, what is it and how does it work? Is the backup "Q"? What is the air quality of the backup supply? Obtain portion of system description manual if possible via telecopy.

Answer: There is no backup system for the instrument air system. Some air-operated valves are supplied with accumulators or other independent air source for the purpose of increased reliability for normal operation. None of these components are required for safe shutdown or accident mitigation.

6. Number, capacity, and manufacturer of IA compressors?
Number and volume of the air receivers?
Number, capacity, and required dewpoint of the IA dryers?
Type of dryer (e.g. refrigerant, dessicant heatlessor heated, etc.)

Answer: For Units 1 and 2:

Compressors:
- Quantity: 4
- Capacity: 885 SCFM
- Manufacturer: Sullair

- Quantity: 3
- Capacity: 750 SCFM
- Manufacturer: Ingersoll-Rand

Air Receivers:
- Quantity: 7
- Volume: 150 cubic feet

Instrument Air Dryers:
- Quantity: 8
- Capacity: 740 SCFM
- Required Dewpoint: -60 F
- Type: Regenerative dessicant

7. Does the dryer have prefilters and/or post filters? Describe the type of media and micron rating in each.

Answer: Prefilters: Coalescing; 3 microns
Afterfilters: Particulate; 3 microns

If filter regulators are used, what type of media and micron rating is generally used?

Answer: Filter regulators are typically metal-element with a micron rating of 35-50.

Are there any applications where finer filters or filter regulators are used? Describe those applications. Describe the type of media and micron rating for each application.

Answer: No other applications

Are there any other miscellaneous inline filters and/or moisture separators installed in the IA system? What is their purpose? What is the media and micron rating?

Answer: The system does not contain filters or moisture separators other than those associated with the compressors, receivers, and dryers at the compressor stations.

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13. Is IA pressure and/or flow monitored (periodically or continuously)? If so, how is it done? Where? How frequently?

Answer: The instrument air system is provided with instrumentation to measure flow and pressure continuously. This instrumentation is located in the header downstream of the dryers and prior to the air distribution loop. Flow is monitored by a local meter while pressure is monitored in the main control room and the plant computer.

14. What is the IA demand (scfm) during normal operation? During upset/abnormal conditions (e.g. LOP, MSIS, SIAS, AFAS, etc) ?

What is the source of the data (e.g. calculations, operating measurements, etc). Describe it.

Has there been any correlation of IA demand/consumption data obtained from plant tests, upsets, or trips to the "design basis" or normal or expected upset IA demand? Describe it.

Answer: Plant operating experience (Unit 1) shows that the normal compressed air demand for instrument and service air (combined) is approximately 1700 SCFM. This is based on the fact that one unit operates with one compressor in service and a second in a cycling mode to meet demand fluctuations. No tests or measurements have been made to test the performance of the instrument air system other than pre-operational tests to confirm the operability of the system.

15. Characterize the utility's response to IE Bulletin 88-14. Summarize actions taken and commitments made. What is the schedule for further actions and commitments?

Answer: Refer to attached letter number ELV-00197 dated 2/17/89: Hairston to NRC.

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UTILITY RESPONSES TO GENERIC LETTER 88-14

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UTILITY RESPONSES TO GENERIC LETTER 88-14

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

AUG 0 8 1988

TO ALL HOLDERS OF OPERATING LICENSES OR
CONSTRUCTION PERMITS FOR NUCLEAR POWER REACTORS

SUBJECT: INSTRUMENT AIR SUPPLY SYSTEM PROBLEMS AFFECTING SAFETY-RELATED EQUIPMENT (GENERIC LETTER 88-14)

The NRC has been studying the problems associated with instrument air systems for a number of years. The results of these studies, including concerns relating to adverse effects on safety-related equipment caused by instrument air system failures, were most recently identified in NRC Information Notice 87-28, Supplement 1, dated December 28, 1987. This information notice transmitted to all licensees and applicants a report that addresses these concerns, NUREG-1275, Volume 2 "Operating Experience Feedback Report-Air Systems Problems." This report indicates that the performance of the air-operated safety-related components may not be in accordance with their intended safety function because of inadequacies in the design, installation, and maintenance of the instrument air system. The report also indicates that anticipated transient and system recovery procedures are frequently inadequate and that operators are not well trained for coping with loss of instrument air conditions.

The purpose of this generic letter is to request that each licensee/applicant review NUREG-1275, Volume 2, and perform a design and operations verification of the instrument air system.

This verification should include:

1. Verification by test that actual instrument air quality is consistent with the manufacturer's recommendations for individual components served.

2. Verification that maintenance practices, emergency procedures, and training are adequate to ensure that safety-related equipment will function as intended on loss of instrument air.

3. Verification that the design of the entire instrument air system including air or other pneumatic accumulators is in accordance with its intended function, including verification by test that air-operated safety-related components will perform as expected in accordance with all design-basis events, including a loss of the normal instrument air system. This design verification should include an analysis of current air operated component failure positions to verify that they are correct for assuring required safety functions.

In addition to the above, each licensee/applicant should provide a discussion of their program for maintaining proper instrument air quality.

The NRC staff requires each licensee/applicant to provide a response to the staff within 180 days that confirms that verification as described above has been performed. The staff recognizes that some instrument air system testing as indicated in Item 3 above may have potentially adverse consequences on plant power operation, and therefore, such testing should be performed at a refueling or other scheduled outage in order to avoid adverse system interactions. If instrument air system testing cannot be completed within 180 days, it may be deferred until the next scheduled outage. However, the licensee/applicant should indicate in its response those tests which have been completed and those which will be completed at a subsequent outage.

In accordance with the provisions of 10 CFR 50.54(f), the response should consist of a submittal signed under oath or affirmation which indicates that the above actions have been completed or that the licensee's plan/schedule has been provided. The submittal should also identify any components that cannot accomplish their intended safety function, and state the corrective action taken or to be taken. When all requirements of this generic letter have been implemented, a written notification should be provided stating that all actions are complete. Each licensee/applicant should retain the documentation assembled for this verification for future audit by the staff. This documentation should be maintained for a minimum of two years from the date of the licensee's/applicant's submittal.

This request is covered by the Office of Management and Budget Clearance Number 3150-0011, which expires December 31, 1989. Comments on burden and duplication may be directed to the Office of Management and Budget, Reports Management, Room 3208, New Executive Office Building, Washington, D.C. 20503.

Any questions regarding this letter should be directed to William LeFave, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555, (301) 492-0862.

Sincerely,

Frank J. Miraglia, Jr.

Frank J. Miraglia, Jr.
Associate Director for Projects
Office of Nuclear Reactor Regulation

Pacific Gas and Electric Company
77 Beale Street
San Francisco, CA 94106
415/972-7000
TWX 910-372-6587

James D. Shiffer
Vice President
Nuclear Power Generation

February 21, 1989

PG&E Letter No. DCL-89-041

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

Re: Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Response to Generic Letter 88-14, "Instrument Air Supply System Problems Affecting Safety-Related Equipment"

Gentlemen:

In accordance with Generic Letter 88-14, "Instrument Air Supply System Problems Affecting Safety-Related Equipment," dated August 8, 1988, PG&E hereby submits the enclosed report describing PG&E's actions in implementing the request of this generic letter.

Kindly acknowledge receipt of this material on the enclosed copy of this letter and return it in the enclosed addressed envelope.

Subscribed to in San Francisco, California this 21st day of February 1989.

Respectfully submitted,

Pacific Gas and Electric Company

By ______________________
J. D. Shiffer
Vice President
Nuclear Power Generation

Howard V. Golub
Richard F. Locke
Attorneys for Pacific
Gas and Electric Company

By ______________________
Richard F. Locke

Subscribed and sworn to before me
this 21st day of February 1989

____
Therese Toliver, Notary Public in and for the City and County of San Francisco, State of California

My commission expires December 25, 1990.

OFFICIAL SEAL
THERESE TOLIVER
NOTARY PUBLIC - CALIFORNIA
CITY AND COUNTY OF SAN FRANCISCO
My Comm. Expires Dec. 25, 1990

cc: J. B. Martin
M. M. Mendonca
P. P. Narbut
B. Norton
H. Rood
B. H. Vogler
CPUC
Diablo Distribution

2507S/0067K/DJH/2152

A045
1/1

ENCLOSURE

PG&E RESPONSE TO GENERIC LETTER 88-14

Generic Letter (GL) 88-14, "Instrument Air Supply System Problems Affecting Safety-Related Equipment," dated August 8, 1988, requests that licensees review NUREG-1275, Volume 2, and perform a design and operations verification of the instrument air system. The evaluation that has been performed for the Diablo Canyon Power Plant (DCPP) instrument air system has identified several areas of concern. These concerns are: the existence of contaminants in the instrument air, insufficient procedural guidance, insufficient preventive maintenance, insufficient surveillance testing, degraded air dryer desiccant, marginal back-up system capacity on four safety-related valves, and insufficient air quality monitoring.

PG&E has been developing long term improvements to the instrument air system since April 1988. These improvements were initiated in part by NRC IE Information Notice 87-28, "Air System Problems at U.S. Light Water Reactors," and in part by the plant improvement program. The purpose of the plant improvement program is to perform integrated operations, design, and maintenance review of selected systems. The results of the plant improvement program for the compressed air system will be presented in a report which will be completed in July 1989.

Provided below are PG&E's responses for the items requested to be verified in GL 88-14 and a discussion of the program being used at DCPP for maintaining proper instrument air quality.

Item 1 of GL 88-14

> Verify by test that actual instrument air quality is consistent with the manufacturer's recommendations for individual components served.

Response

PG&E is in the process of obtaining and reviewing the manufacturers' instrument air quality recommendations. This effort will be completed by March 31, 1989. For those recommendations which have been obtained, manufacturers have specified instrument air quality requirements of a maximum allowable particulate size of 5 microns with no oil or moisture present.

Air sampled at DCPP was found to exceed manufacturers' recommendations for particulates. The primary source of this contamination was determined to be from the service air system which is cross-connected to the instrument air system. The service air system consists of carbon steel piping, which has a potential for corrosion, while the instrument air system is composed of copper piping, which is resistent to corrosion. A common set of permanent indoor compressors/dryers/air receivers feed both the instrument air and service air systems. A temporary outdoor air compressor/dryer unit connected to the service air system is occasionally used to supplement service air

requirements. In the past, this temporary outdoor compressor/dryer unit had less stringent moisture and filtration control standards than those for the permanent compressors. These less stringent controls on moisture and filtration contributed to the corrosion in the service air system. During the period of heavy air demand on the instrument air system, the particulates migrated from the service air system into the instrument air system.

In order to prevent a recurrence of this contamination, Operating Procedure, K1-I, "Compressed Air System Make Available and Place in Service," is being revised to require isolation of the service air system from the instrument air system prior to use of the temporary outdoor air compressor. This will prevent contamination of the service air piping. In addition, the moisture and filtration requirements for the temporary compressor/dryer have been upgraded to that of the permanent compressor/dryers.

In order to remove accumulated particulate, the instrument air headers are now being blowndown. As of January 16, 1989, 10 of the 76 major headers have been blowndown. The cleanup process is continuing at the maximum rate of about five headers per week. During the performance of this task, it has been observed that virtually all headers produce rust and scale at the beginning of the blowdown, but eventually produce clean air. After all headers have been cleaned, tests will be performed to determine if additional actions are necessary based on the air quality survey results.

Item 2 of GL 88-14

> Verify that maintenance practices, emergency procedures, and training are adequate to ensure that safety-related equipment will function as intended on loss of instrument air.

Response

As recommended in the November 8, 1988, NUMARC letter on GL 88-14, PG&E is adopting the INPO SOER 88-1, "Instrument Air System Failures," recommendations 1 through 5 to satisfy this item. A summary of the actions is provided below:

Maintenance: Maintenance practices have been improved to assure that clean dry air is provided to safety-related equipment. This will maintain the equipment in a condition to perform their intended function or loss of instrument air. A new preventive maintenance (PM) program has been adopted for the compressors. The DCPP air dryer desiccant was observed to be partially deteriorated from age and the dryer was damaged by rust. The desiccant has been replaced and the dryer modified and tested to assure adequate performance. The new PM program for the dryer includes periodic dew point monitoring of discharge air to determine desiccant condition so it can be trended and replaced when necessary. A temporary dryer has been installed to improve capacity and reliability. DCPP is now in the process of

investigating system upgrades which would include new water-cooled compressors and possibly a vendor-supplied maintenance package. In addition, as described in item 3 below, testing of air-operated valves is performed to ensure they function as intended on loss of instrument air.

Procedures: Procedural changes have been made to assist the operators in responding to a loss of instrument air. Changes were made to reflect system upgrades made in 1988, specifically, inclusion of the continuous dew point monitor, new arrangement of rental air compressors and air dryer, and different filters. The loss or degradation of instrument air pressure response procedure was updated to include a list of valves affected by loss of pressure and the positions to which they are designed to fail. Instrument air operating procedures are also being revised to include actions to be taken when moisture is suspected in the system. Specifically, blowdown locations were identified at low points to remove water.

Training: Operations and maintenance training programs have been revised to incorporate the information described in SOER 88-1. Partial and complete loss of air scenarios are being conducted on the DCPP simulator to increase the awareness of plant operators to various system and plant responses and further to increase their familiarity with using plant drawings to locate leaks. Abnormal Operating Procedure AP-9, "Loss of Air," which includes a description of the components that fail on loss of instrument air, has been included in the Operators requalification program.

Item 3 of GL 88-14

Verify that the design of the entire instrument air system including air or other pnuematic accumulators is in accordance with its intended function, including verification by test that air-operated safety-related components will perform as expected in accordance with all design-basis events, including a loss of the normal instrument air system. This design verification should include an analysis of current air-operated component failure positions to verify that they are correct for assuring required safety functions.

Response

A complete review of the entire instrument air system design, including air or other pneumatic accumulators, is in process and will be complete by the end of 1989.

To meet SOER 88-1 recommendations, the compressed air supply to the instrument air header has a 1 micron afterfilter located downstream of the air receiver

tanks and upstream of all instruments. This filtering process and the use of oil free compressors and continuous dew point monitoring provide for proper air quality to the instrument air system. See Item 4 below for a discussion of how instrument air quality will be monitored in the future.

The Generic Letter notes that the testing referred to in this item may have adverse consequences on plant operation, and hence may be postponed to the next scheduled outage after the submittal of this response. Therefore, in accordance with GL 88-14, the following paragraphs provide a schedule of the tests to be performed during future outages and a discussion of those tests that have been performed.

During the last DCPP Unit 2 refueling outage, the back-up nitrogen supply system to the 10 percent steam dump valves and the pressurizer PORVs, PCV-456 and PCV-455C, was tested. In addition, the air supply check valves to the MSIVs were tested (this practice was initiated by an earlier INPO SOER concerned with MSIV reliability). The successful operation of these components has been demonstrated.

Surveillance test procedures have been approved to test the air supply back-up systems for all air-operated valves required to function to achieve safe shutdown. The test procedure includes testing with a gradual loss of air pressure. The valves included in this test program are in the back-up pneumatic systems for the pressurizer PORVs, PCV-455C and PCV-456; the spray and charging valves, 8145, 8146, 8147, and 8148; the RCS sample isolation valves, 9351A, 9351B, 9356A, and 9356B; and the charging header flow control valve, HCV-142. In addition, surveillance test procedures are being developed for the following valves with backup air: the ASW supply to the CCW heat exchangers, FCV-602 and FCV-603; and the CCW supply to the RHR heat exchangers, FCV-364 and FCV-365. These tests will be performed at the next refueling outage of each unit and at all subsequent refueling outages.

Design verification to confirm that the capacity of the back-up systems is sufficient to support the necessary number of valve operation cycles over the necessary time duration is still in progress as part of the overall design review. When PG&E has completed its design verification, appropriate actions, if required, will be taken to ensure adequate back-up capacity is available to support the necessary number of valve operation cycles.

The current failure positions of air-operated valves were reviewed and all safety-related component failure positions were verified to be correct.

Demonstration that air-operated valves will move to their design failure positions was accomplished after the initial valve installation or after major maintenance. These tests include a modulation of the air pressure; the air pressure at which the valve begins to open or close is recorded and confirmed to be acceptable.

<u>Item 4 of GL 88-14</u>

> Each licensee/applicant should provide a discussion of their program for maintaining proper instrument air quality.

APPENDIX C

Response

Several features of the PG&E instrument air quality program practices have been described above. These include: the adoption of new preventative maintenance tasks; the revision of operations and maintenance training programs; the revision of procedures; and the preparation of surveillance tests that will be performed each refueling outage. Furthermore, future system improvements are under development as part of the plant improvement program.

In addition, instrument air quality is being monitored in three ways. First, the instrument air moisture content is checked by continuous dew point monitoring. Annunciator window PK-1316 has been changed to alarm on detection of an unacceptabe dew point condition. Second, on a monthly basis, the outlet dew point of each plant dryer will be monitored to evaluate the desiccant condition and efficiency. Third, routine sampling for particulates and oil content will be performed on a six-month frequency initially. Since the oil content is expected to be low (DCPP uses oil free compressors), the frequency of oil sampling may be lessened based on the results of the first year of sampling. As recommended by SOER 88-1, ANSI Standard ISA-7.3 should be met at the exit of the air receivers.

Arizona Nuclear Power Project
P O BOX 52034 • PHOENIX, ARIZONA 85072-2034

161-01697-DBK/JMQ
February 20, 1989

Docket Nos. STN 50-528/529/530

Document Control Desk
U.S. Nuclear Regulatory Commission
Mail Station P1-137
Washington, D.C. 20555

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2 and 3
Generic Letter 88-14, "Instrument Air Supply System Problems Affecting Safety-Related Equipment"
File: 89-010-026; 89-056-026

Reference: Letter from NRC to All Holders of Construction Permits for Nuclear Power Reactors Dated August 8, 1988; Subject: Generic Letter 88-14.

The referenced letter requested a review of NUREG-1275, Volume 2 and a design and operations verification of the instrument air system. In order to accomplish this task a list of safety related components that rely on instrument air was produced. The total number of components identified was 144 for each unit. Attachments 1 and 2 provide the PVNGS response to Generic Letter 88-14.

If you have any questions, please contact Mr. A. C. Rogers of my staff.

Very truly yours,

DBKarner

D. B. Karner
Executive Vice President

DBK/JMQ/vlb
Attachments

cc: A. C. Gehr (all w/a)
T. J. Polich
T. L. Chan
M. J. Davis
J. B. Martin

U.S. Nuclear Regulatory Commission
Page 2

161-01697-DBK/JMQ
February 20, 1989

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APPENDIX C

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, Donald B. Karner, represent that I am Executive Vice President of Arizona Nuclear Power Project, that the foregoing document has been signed by me on behalf of Arizona Public Service Company with full authority to do so, that I have read such document and know its contents, and that to the best of my knowledge and belief, the statements made therein are true.

[signature]
Donald B. Karner

Sworn to before me this 20 day of [illegible], 1989.

[signature]
Notary Public

My Commission Expires:
My Commission Expires June 5, 1992

APPENDIX C

ATTACHMENT 1

RESPONSE TO VERIFICATION ACTIONS OF GENERIC LETTER 88-14

ACTION 1 — Verification by test that actual instrument air quality is consistent with the manufacturer's recommendations for individual components served.

APS RESPONSE — The major suppliers of the affected components were contacted and although the vendors did not commit to any specific document in writing, the PVNGS test procedures for air quality were developed using ISA-S7.3, 1975 - "Quality Standard for Instrument Air" for guidance.

Because all three Units at Palo Verde are of standard design the test results and design changes for the Units are expected to be similar. Therefore, the air quality test results from Unit 2 will determine the design modifications for all 3 units.

In order to perform this verification by test, equipment was procured to test air quality and test connections were installed in Unit 2.

An air quality test is currently being conducted on Unit 2. Preliminary results after 4 days are as follows:

- The dew point is approximately -10°F at 120 PSIG. The measured dew point is greater than the design value. Compensatory measures are currently in place to open low point drains on the air distribution piping on a periodic basis to prevent moisture accumulation.
- The particulates are predominatly less than 3 micron in size, however there are particulates in the 3 to 5 micron size and no significant quantity of particulates greater than 10 microns.
- Hydrocarbons are less than 1 ppm.

The air quality data will be taken for approximately one month in order to obtain adequate test data.

After sufficient data is collected, it will be evaluated to determine what improvements or modifications may be required to ensure maintaining the instrument air quality. The test data will also be used to adjust the frequency of preventative maintenance tasks as noted in Attachment 2. A supplemental letter will be provided by April 28, 1989 indicating if any improvements or modifications will be made and providing the schedule for completion.

APPENDIX C

ACTION 2 — Verification that maintenance practices, emergency procedu[res] and training are adequate to ensure that safety-rela[ted] equipment will function as intended on loss of instrument air.

APS RESPONSE

Maintenance Practices

Preventative maintenance tasks were reviewed and are provid[ed] in Attachment 2 "Program for Maintaining Instrument A[ir] Quality".

Emergency Procedures

APS has reviewed the abnormal operating procedure for loss [of] instrument air and is making enhancements to the existi[ng] procedure to further address the following recommendations fr[om] Significant Operating Experience Report (SOER) 88-[0] "Instrument Air System Failures:" The revision of th[is] procedure is currently in the review and approval process. [It] is expected that the procedure will be revised by June 30, 198[9]

* indications of loss of instrument air, such as alarms automatic actions, functions lost.

* identification of critical components operated by instrumen[t] air and the position in which they fail.

* expected system and plant responses to a loss of instrumen[t] air and the consequences of these responses.

* actions to take if critical components do not fail in the intended position.

* manual actions the operator should be expected to take to respond to a loss of instrument air event.

* restoration actions to be taken after instrument air is regained.

Training

The Operations staff is trained on the abnormal operating procedure for loss of instrument air. The training consists of a walk through and discussion of the procedure in the simulator.

At the present time the simulator is not modeled to illustrate loss of instrument air. The malfunction scenarios for the Basic Simulator and Requalification Courses will be developed in conjunction with the simulation certification under 10CFR55.

Lesson plans have been revised to sensitize plant operations and maintenance personnel on the vulnerability of safety related equipment to common mode failures that could result from air degradation.

APPENDIX C

ACTION 3

Verification that the design of the entire instrument ai system including air or other pneumatic accumulators is i accordance with its intended function, including verificatio by test that air-operated safety-related components wil perform as expected in accordance with all design-basi events, including a loss of the normal instrument ai system. This design verification should include an analysi of current air operated component failure positions to verif that they are correct for assuring required safety functions.

APS RESPONSE

Verification of Instrument Air System Design

Verification of the design of the instrument air system will be performed in conjunction with our Design Basis Review Program. Since the instrument air system is classified as non-safety related but interfaces with safety related systems, it will be reviewed immediately after the safety related systems. Due to the large scope of the program, the review is expected to be completed during the first quarter of 1991.

Verification of Pneumatic Accumulator Design

Verification of the design of the pneumatic accumulators was done as a result of SOER 88-01. APS utilizes three safety related air or gas reservoir systems. They are the Main Steam Isolation Valve/Feedwater Isolation Valve air accumulators, atmospheric dump valve nitrogen gas accumulators, and the Diesel Generator air start accumulators. The accumulator capacities were reviewed for these valves and found to be adequate. The accumulator pressures are continuously monitored with an in-place "low accumulator pressure" type alarm which causes an audible and visual alarm to annunciate in the respective unit's Main Control Room. The Emergency Diesel Generator Starting Air Flasks and the Atmospheric Dump Valves have installed local pressure indicators. These pressure indicators are monitored periodically by auxiliary operators.

Verification by Test

Verification by test was accomplished through the preoperational testing program and surveillance tests. Out of the 144 safety related valves and dampers which rely on instrument air, 135 were tested by the preoperational testing program and nine were tested by surveillance tests. The tests verified the failure position of the equipment by isolating the air supply and/or air signal then noting the positions the valve/damper assumed.

Analysis of Failure Positions

The failure modes of the 144 valves and dampers were analyzed to ensure that they failed in a position of least risk to reactor safety.

The preoperational tests results for the failure mode of the 135 valves and dampers for Unit 1 were pulled and compared to the analyzed failure modes.

APPENDIX C

All, the components tested satisfactorily except that a discrepancy was found on one damper. The individual who performed the test on that damper determined the test to be acceptable, however, he documented an incorrect failure position. A retest of the damper has been performed verifying it does fail in the proper position.

The nine components tested by the Unit 1 surveillance tests have been verified that their failure positions from the surveillance test was the same as the analyzed failure positions.

Due to the standardization in design and the same preoperational and surveillance test program applied to all three units, it may be assumed that this verification applies to all three units.

APPENDIX C

ATTACHMENT 2

PROGRAM FOR MAINTAINING AIR QUALITY

The program for maintaining air quality will primarily be a function of a periodic test of air quality and the preventative maintenance program.

The air quality test procedure shall be performed in each unit on a periodic basis to be determined from the results of the initial air quality test as described in ACTION 1 of Attachment 1. The procedure will be effective in all three units after completion of the design modifications described in ACTION 1. This procedure will measure such parameters as total air flow, humidity/dew point, particulates and contaminants including hydrocarbons and water vapor.

A review of the existing, preventative maintenance tasks was performed which include the following:

- Inspect, clean or replace air compressor inlet filter; performed annually.
- Remove and replace instrument air prefilters; performed semi-annually.
- Remove and replace instrument air after filters; performed annually.
- Replace dessicant; performed annually.

The frequency of these tasks may change dependent on the results of the analysis of the air quality test.

In addition to these tasks being performed on a regularly scheduled basis, supplemental tasks such as disassembly of drain traps including inspection and cleaning of the internals are also performed on the prefilter, moisture separator and receiver on a quarterly basis along with a multitude of other tasks performed on related instruments, relays, motors, bearings, vibration monitoring equipment and similar equipment.

In addition, preventative maintenance tasks are currently scheduled to be written by March 31, 1989 to change the filters inside the air regulators supplying safety related valves and components. This work is scheduled to be implemented every two years. The frequency of this work may change depending on the air quality test analysis.

APPENDIX C

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT ☐ 6201 S Street, P.O. Box 15830, Sacramento CA 95852-1830, (916) 452-3211
AN ELECTRIC SYSTEM SERVING THE HEART OF CALIFORNIA

AGM/NPP 89-033

FEB 15 1989

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Docket No. 50-312
Rancho Seco Nuclear Generating Station
License No. DPR-54
RESPONSE TO GENERIC LETTER 88-14: INSTRUMENT AIR SUPPLY SYSTEM PROBLEMS AFFECTING SAFETY-RELATED EQUIPMENT

Attention: George Knighton

The District hereby provides information requested in Generic Letter 88-14 "Instrument Air Supply System Problems Affecting Safety-Related Equipment." SMUD received the Generic Letter on August 23, 1988.

Members of your staff with questions requiring additional information or clarification may contact Mr. Steve L. Crunk at (209) 333-2935, extension 4913.

State of California

SS

County of Sacramento

OFFICIAL SEAL
ELIZABETH L. GANDY
NOTARY PUBLIC-CALIFORNIA
SACRAMENTO COUNTY
MY COMM. EXP. NOV. 20, 1992

Dan R. Keuter, being first duly sworn, deposes and says: that he is Assistant General Manager, Nuclear Plant Manager of Sacramento Municipal Utility District (SMUD), the licensee herein; that he has executed the foregoing document; that the statements made in this document are true and correct to the best of his knowledge, information, and belief, and that he is authorized to execute this document on behalf of said licensee.

Dan R. Keuter
Assistant General Manager
Nuclear Plant Manager

Subscribed and affirmed to before me on this 15th day of February, 1989.

Elizabeth L. Gandy
Notary Public

Attachments

cc w/atch: J. B. Martin, NRC, Walnut Creek
A. D'Angelo, NRC, Rancho Seco

I. REVIEW OF NUREG-1275, Vol. 2

The District has reviewed NUREG-1275, Vol. 2 and is aware of the potential impact of a poor quality Instrument Air System (IAS) on the proper function of the facility. As noted in the NUREG, Rancho Seco had three reportable occurrences involving instrument air quality problems. Since 1981 (date of last occurrence), the District implemented a number of hardware and procedural improvements. These improvements include: installation of a new, high capacity desiccant air dryer, installation of a continuous readout dewpoint monitor with Control Room annunciation, complete revisions to the normal and casualty operating procedures, and an aggressive Preventive Maintenance (PM) program. Recently, two additions were made to the IAS to improve overall system reliability and control of critical valves upon a loss of air supply. These additions include (1). An auto-start (on low system pressure), diesel-driven air compressor with a complete instrument grade air filtration and dryer package, and (2) Compressed air bottle back-up system that passively supplies two hours of instrument grade air to several critical valves upon a loss of the normal air supply.

In support of providing a consistent supply of instrument grade air, Rancho Seco employs a thorough PM program on all the IAS supply components. The PM program includes compressor inspections, dryer lubrication and inspection, dryer desiccant inspection, and after-filter inspection and change out. Additionally, system walkdowns are performed to check for air leakage at components and system connections.

II. AIR QUALITY REVIEW

--The District reviewed Quality Class I air-operated components with regard to vendor recommendations on the air quality for each component. The review verified that each component's operating pressure requirements were satisfied. If the supply pressure requirement was less than the normal IAS header pressure, then the use of an upstream filter/regulator set to the correct supply pressure was verified.

The air quality recommendations of the manufacturers are summarized in Attachment II.

The IAS at Rancho Seco is designed and operated to maintain air quality that meets or exceeds the requirements of ANSI/ISA S-7.3, Quality Standard for Instrument Air.

<u>Moisture Contamination</u>

The IAS dewpoint is monitored continuously at the output of the air dryers and filters via a digital readout meter. The dewpoint is recorded at least once per shift by the plant operators, and the unit provides an input to a Control Room annunciator on high dewpoint. The dewpoint monitor is calibrated on an annual basis. The instrument air dryers maintain the dewpoint at -60 to -80°F at atmospheric pressure (-20 to -30°F at 100 psig). Further information on the air dryers is contained in Section IV.

A monthly blowdown of the IAS at various locations throughout the plant checks for moisture or other abnormal conditions. A portable dewpoint meter is being purchased to verify air moisture content at the points of use of the IAS.

Particulate Contamination

At present, SMUD is investigating a method to accurately sample for particulate contamination at various points of use to insure that the IAS filters are functioning as designed. The IAS filters are high temperature, 0.9 micron rated units. Further information on the filters is contained in Section IV.

Oil Contamination

Rancho Seco uses Teflon-ringed, reciprocal air compressors, which prevent condensed hydrocarbon contamination of the system. The diesel driven back-up air compressor uses a carbon bed adsorber to prevent oil contamination. Further information on the air compressors is contained in Section IV.

A quarterly check of the Service Air System (same compressors as the IAS) for hydrocarbons is performed as a part of a breathing air sampling and analysis test.

III. VERIFICATION OF MAINTENANCE, PROCEDURES, AND TRAINING – LOSS OF INSTRUMENT AIR

Preventive Maintenance - Air Operated Components

The present PM program lubricates and strokes the air-operated components to ensure smooth operation. The PM program is being enhanced to include a systematic inspection and, when required, replacement of air-operated actuator internals.

Emergency Procedures

Many Rancho Seco procedures were revised during the outage which began December 26, 1985. Operations Casualty Procedure C.23 "Loss of Plant Air System" was extensively rewritten to reflect the modifications made to the IAS during the outage.

The purpose of Casualty Procedure C.23 is to ". . . provide the operators with the necessary response and recovery actions to mitigate the consequences of a partial or total loss of plant air." C.23's adequacy to perform its intended function was verified by an "Operations Procedure Validation." This process involved a walk-through of the affected sections of the procedure. The walk-through addressed various areas of concern, such as:

- Sufficient information to perform specified actions
- Proper sequence of steps for operation
- Equipment line-ups correct
- Abbreviations and nomenclature clear
- Communication difficulties
- Instrument values correct -- Proper units.

Training

Rancho Seco operators receive training on air-operated valves by both classroom instruction and on-the-job training. They receive classroom instruction through various lesson plans dealing with both system operation and specific components (pneumatic valves).

One example of classroom training is a general course on valves which covers the design, construction, manual operation, and normal operation of various types of valves, including pneumatic (diaphragm). This is a basic course that addresses all valves, both safety-related and non-safety-related.

A second course addresses the Auxiliary Feedwater (AFW) Flow Control Valves, Turbine Bypass Valves (TBVs), and Atmospheric Dump Valves (ADVs). This course familiarizes the operators with the proper means of local operation of valves that are normally remotely operated. It also covers the basic components of local valve controls and local operation of the AFW Flow Control Valves, TBVs, and ADVs.

During the on-shift, on-the-job training each license candidate receives, the candidate completes a training checksheet documenting that he has locally operated major motor/air-operated valves. These valves include the AFW Flow Control Valves, TBVs, and ADVs, as well as other air-operated valves (e.g., Letdown Isolation Valve).

Additionally, Operations personnel receive training on air-operated valves associated with specific systems. This is given as part of system training and includes purpose, function, and normal/abnormal operation of the respective system and components.

Rancho Seco requalification training also covers Casualty Procedures. Casualty Procedure C.23 "Loss of Plant Air System" is covered extensively on the annual operating exam.

IV. DESIGN VERIFICATION OF THE INSTRUMENTATION AIR SYSTEM AND AIR-OPERATED COMPONENTS

Supply System Components

The three plant air compressors employed at Rancho Seco are single stage, dual-acting reciprocal compressors with Teflon rings (oil free). The normal operating pressure range is 100 to 110 psig. The nominal output from each unit is 275 cfm. Normal operation has two units running, one fully loaded and one cycling with demand with the third unit in auto-start standby. Downstream of each air compressor is an aftercooler and moisture separator prior to air receivers.

The plant air receivers supply both the IAS and Service Air System (SAS). At the initiation point of the Service Air header, a pneumatic, spring-to-close, priority valve closes upon a decrease in the Service Air header pressure. This feature ensures the Plant Air Compressors supply the IAS header in the event of a failure of the SAS header.

The IAS has two dual-tower desiccant dryers piped in parallel, with one unit normally in service. The main dryer has a design capacity of 900 cfm and a rated outlet dewpoint of -40°F at 100 psig. The standby dryer has a capacity of 340 cfm and a -40°F dewpoint rating at 100 psig.

Downstream of the dryers are three parallel-piped afterfilters, each rated for a maximum flow of 360 scfm. Each filter is rated for a particulate size of 0.9 micron absolute at 90 scfm (100 psig).

Distribution Piping

The IAS distribution piping uses both loop and single run header designs. Copper pipe is used for the main headers, with copper tubing used for small branch headers and local component supplies. The distribution system is not considered safety related, therefore, it is not seismically supported.

Back-up Systems

In addition to the main IAS supplies, two back-up systems are installed in the IAS:

(1) The diesel driven air compressor is a self-contained Instrument Air unit which auto-starts on low IAS pressure or upon a loss of 120V AC to its battery charger and heaters. The unit consists of a 600 cfm rotary screw air compressor, air-to-air aftercooler, and a filtration and dryer package. (This package includes a coalescing pre-filter, a heatless desiccant air dryer, a carbon bed oil adsorber, and a 0.9 micron afterfilter.) The unit is tied into the IAS header downstream of the IAS filters, using an in-line check valve to prevent flow back into the normal IAS supply components. This air compressor package supports the plant's requirements for Instrument Air in the event of failure of a supply component (i.e., filters, dryer), or a loss of power to the plant air compressors.

(2) The compressed air bottle back-up systems consist of high pressure cylinders, pressure reducing stations, low pressure alarms, and spring-loaded, soft-seat check valves. These systems are passive supplies of instrument grade air to various valves upon a loss of normal IAS header pressure. The back-up air systems are designed to initiate and supply the valves for a minimum of two hours without operation action. Those back-up air systems supplying valves controlled by the Emergency Feedwater Initiation and Control (EFIC) system are seismically designed.

Accumulators

Two Safety Features Valves (the Letdown Isolation and Reactor Coolant Pump Seal Return Isolation) are backed up by accumulators for a loss of air event. The accumulators and tubing are seismically mounted and sized to provide an adequate quantity of air for closure of the valves. In addition, the interface check valves used for the accumulators are a soft-seat, spring-loaded design.

Quality Class I Air Operated Components

A list of all Quality Class I air-operated components was compiled to determine and verify their failure modes and Instrument Air requirements.

All the components that perform a safety related function fail in their designed fail-safe position upon a loss of Instrument Air. These failure positions are verified by surveillance testing. The components backed up by either accumulators or high pressure cylinders all have interfacing check valves and have been tested to ensure the check valves function to isolate the normal air supply when the component is being supplied from the back-up air source.

The design of the IAS supply components, maintained in accordance with the PM program, permit the IAS to be operated within the guidelines prescribed by ANSI/ISA-S7.3, thus meeting the air quality recommendations of the manufacturers, as listed on Attachment II.

No other testing is planned with regard to air-operated components.

System Reviews

Deterministic Failure Consequence (DFC) Analysis Report on Loss of Instrument Air:

This report analyzed the failure of the IAS supply components and the failure mode of air-operated components upon a loss of air and their affect on the plant during power operation and following a transient. Actions resulting from this report included improvements in the operating procedures, training of operators and staff, revisions to the piping and instrumentation drawings, and the addition of the back-up air systems noted earlier.

System Status Report (SSR) on the IAS/SAS:

This report summarized all problems, concerns and ongoing activities on the IAS and the SAS. Some of the sources drawn upon to develop the report were plant interviews, DFC reports, Owner's Group recommendations, and investigations by the assigned System Engineer. The SSR was used to prioritize activities on the system during the Restart program, including modifications and testing. Improvements continue to be made to the IAS and its associated procedures and documentation as a result of the SSR on the IAS/SAS.

Expanded Augmented System Review and Test Program (EASRTP):

EASRTP, a Safety System Functional Inspection type program, evaluated the adequacy of various activities and systems (the IAS was a selected system) in support of the Restart program. The review team used the same fundamental evaluation techniques as the NRC in their Augmented System Review and Test Program (ASRTP) inspection. The report brought up specific concerns in the areas of modification designs, operating procedures, and testing, which resulted in either changes to the appropriate area of concern or resolution of the item via an engineering review.

System Design Bases - IAS:

A System Design Bases document has been drafted which summarizes the entire design of the IAS and its ability to support operation of the plant.

V. TESTING SUMMARY - SPECIAL TESTING

The following is a summary of the special testing performed on the IAS during the Restart program.

STP.1107 Plant Air System Functional Test

This test performed an actual verification of the control logic of the Plant Air Compressors to ensure the trip and low pressure auto-start controls function as designed.

STP.1043 Diesel Driven Air Compressor (DDAC) Acceptance Test

This test evaluated all aspects of the new back-up IAS prior to tie-in to the IAS header. The test included verification of the control features (auto-starts, trips, etc.), aftercooler, and the dryer and filtration package.

STP.1071 Gradual Loss of the IAS With DDAC Auto-start and Header Recovery

This test tripped all three Plant Air Compressors, allowing the IAS header pressure to degrade. Upon reaching the designated setpoint, the DDAC auto-started, recovered the header pressure, and maintained it.

STP.784 IAS/SAS Priority Valve Functional Test

This test verified that upon a degradation of the SAS header pressure, the priority valve closed to supply only the IAS from the air receivers.

STP.774 Compressed Air Bottle Back-up System Functional Test

This test verified the function of the new bottle back-up systems, including air supply duration (time and valve strokes), alarms, and the ability to isolate the normal air supply upon initiation.

STP.1058A Sudden Loss of IAS to an ADV

This test verified that upon a sudden loss of air to an ADV (with main steam header pressure) the back-up air system initiated and the valve remained in its initially closed position.

STP.782 Gradual Loss of IAS to an ADV

This test was a verification of the acoustic monitors for the ADVs, but included a verification that upon a gradual loss of IAS to an ADV (with main steam header pressure) the bottle back-up air system initiated and provided motive and control air to stroke the valve.

STP.1058B Gradual and Sudden Loss of Air to the TBVs

This test performed both a gradual and sudden loss of air to the TBVs (with main steam header pressure) to verify that the bottle back-up air system initiated and maintained operability of the valves; the TBVs maintained the main steam header pressure during the test.

STP.1058C Gradual Loss of Air to an AFW Control Valve

This test verified that upon a gradual loss of air to an AFW Control Valve, the bottle back-up air system initiated to maintain the valve in its initially closed position; the subject valve fails open upon a total loss of air.

STP.667 Sudden Loss of Air to an AFW Control Valve

This test was a verification of the EFIC system, but included a verification that upon a sudden loss of air to an AFW Control Valve, with the AFW system operating, the back-up air system initiated and maintained control of the valve.

STP.1058D Gradual Loss of Air to MFW Regulating Valves

This test performed a gradual loss of air to a set of Main Feedwater (MFW) Regulating Valves, with feedwater flow through the valves. The test verified that the bottle back-up air system initiated, and in conjunction with a MFW isolate signal, supplied air to close the MFW valves.

AIR ACTUATORS

Manufacturer	Air Quality Recommendations
BETTIS	Clean, dry air
FISHER	Clean, dry air
CONTROMATIC	Clean, dry air
BORG-WARNER	Clean, dry air
CCI	Clean, dry air
GRINNELL	Clean, dry air
KIELEY & MUELLER	No data
COWAN	No data

CONTROL COMPONENTS

Manufacturer	Air Quality Recommendations
BAILEY	Clean, dry air
CONOFLOW	5 micron particulate size, supplied with upstream filter/regulator, dry air
ASCO	Clean, dry air