2. DESIGN ANALYSIS TITLE
COMPRESSED AIR SYSTEM FAILURE MODE AND EFFECTS ANALYSIS (FMEA) - DESIGN PACKAGE 1C

3. DOCUMENT IDENTIFIER (Including Rev. No.)
BABBDF000-01717-0200-00026 REV 00

4. REV. NO.
00

5. TOTAL PAGES
8

6. TOTAL ATTACHMENTS
1

7. ATTACHMENT NUMBERS - NO. OF PAGES IN EACH
1-14

8. SYSTEM ELEMENT
MGDS

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<td>9. Originator</td>
<td>Tze-Yuen Chen</td>
<td>9/8/95</td>
</tr>
<tr>
<td>10. Checker</td>
<td>Siddique Anwar</td>
<td>9/8/95</td>
</tr>
<tr>
<td>11. Lead Design Engineer</td>
<td>Russel E. Flye</td>
<td>9/8/95</td>
</tr>
<tr>
<td>12. QA Manager</td>
<td>O. J. Gilstrap</td>
<td>9/5/95</td>
</tr>
<tr>
<td>13. Department Manager</td>
<td>Gene N. Kimura</td>
<td>9/8/95</td>
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14. REMARKS
## Design Analysis Revision Record

Complete only applicable items.

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### 2. DESIGN ANALYSIS TITLE

COMPRESSED AIR SYSTEM FAILURE MODE AND EFFECTS ANALYSIS (FMEA) - DESIGN PACKAGE 1C

### 3. DOCUMENT IDENTIFIER (Including Rev. No.)

BABBDF000-01717-0200-00026 REV 00

### 4. REVISION NO.

00

### 5. Revision No.

| 00 |

### 6. Total Pages

| 8 |

### 7. Description of Revision

Initial Issue
1. PURPOSE

This Failure Mode Effect Analysis (FMEA) was prepared to determine the adequacy of system design and the reliability of the Compressed Air System (CAS) and its failures, which have a potential to impact Exploratory Studies Facility (ESF) construction, testing, operations, and life support for Refuge Chambers. This FMEA is required by Section 5.9 of Yucca Mountain Site Characterization Project (YMP) Reliability, Availability, and Maintainability Plan (Reference 5.1). The CAS FMEA identifies the failure mode of various components that could detract the CAS from normal operation.

2. QUALITY ASSURANCE

The CAS is designed to supply compressed air for ESF construction, testing, operation and life support for the Refuge Chambers. The CAS is a temporary utility. The quality assurance (QA) control requirements as listed in the Determination of Importance Evaluation (Reference 5.4) do not apply to this analysis. The QA classification of this analysis is QA: NONE.

3. METHOD

The FMEA is a systematic process for identifying how a component or an instrument fail, how the failure is detected, what the effects are on the system, and how to prevent or mitigate the impacts.

The output of the analysis will be used to ensure the adequacy of the system design and to increase system reliability and enhance plant safety by detecting, preventing, or mitigating the failure effects. The FMEA for the CAS was performed for normal operation.

The essential function of this FMEA is to consider each part of the system, how it may fail (for all modes of failure), and what effect each failure has on safety due to the loss of the system and on ESF operations. Design Package 1C System Safety Analysis (Reference 5.19) was used to identify modes of failure and the effect on safety of operating personnel. This analysis was developed in accordance with MIL-STD-1629A (Reference 5.6).

4. DESIGN INPUTS

4.1 DESIGN PARAMETERS

4.1.1 Design pressure = 150 psig (References 5.3 and 5.7)

4.1.2 Compressed air flowrate/compressor = 1365 scfm (References 5.3 and 5.7)

4.1.3 Duration of compressed air supplied to Refuge Chambers = 48 hours (References 5.2 and 5.5)
4.1.4 Sequence of operation (References 5.2 and 5.3)

4.1.5 Maximum compressed air temperatures = 111° F (References 5.3 and 5.7).

4.2 CRITERIA

4.2.1 Criteria from the Exploratory Studies Facility Design Requirements (ESFDR) Document (Reference 5.17)

This analysis will evaluate the major components of the CAS, whose failure could result in personnel injury or illness (ESFDR Section 3.2.1.9.2 A2 [Reference 5.17]). This analysis will propose mitigating features and recommendations to ensure reliability and minimize safety hazards to the extent practical. The MIL-STD-882C, "System Safety Program Requirements," was determined not to be applicable to this analysis because MIL-STD-882C was considered in the Design Package 1C System Safety Analysis (Reference 5.19).

4.2.2 Criteria from the Basis for Design (BFD) Document (Reference 5.18)

This analysis will evaluate CAS components and subsystems whose failure could result in personnel injury. (BFD Section 7.2.4.6 IV.D.2)

4.3 ASSUMPTIONS

The sources of the following assumptions were obtained from accepted project sources. No verification is required since the system is not Q-listed.

4.3.1 FMEA was performed assuming single equipment failure. Random combinations of equipment failures were not considered (Reference 5.6).

4.3.2 Single failure applies to failure of a single component, which loses the capability to perform its intended function (Reference 5.1).

4.3.3 Multiple failures caused by a single initiating event are considered a single failure (Reference 5.1).

4.3.4 Structural failures are not included in the analysis (Reference 5.1).

4.3.5 CAS is not a sole source for life support for the Refuge Chambers (Reference 5.20).

4.3.6 Analysis of Personal Injury other than loss of the CAS is addressed in Design Package 1C System Safety Analysis (Reference 5.19).

4.4 CODES AND STANDARDS

None.
5. REFERENCES

5.1 Yucca Mountain Site Characterization Project Reliability, Availability, and Maintainability Plan, YMP/93-15 Rev 0.

5.2 North Portal Surface-Based Compressed Air System Analysis, BABBDF000-01717-0200-00023 Rev 01.

5.3 Compressed Air System Specification, BABBDF000-01717-6300-15480 Rev 03.

5.4 Determination of Importance Evaluation for ESF Surface Compressed Air System BABBD0000-01717-2200-00022 Rev 01.

5.5 Layout and Sizing of ESF Alcoves and Refuge Chambers BABEA0000-01717-0200-00001 Rev. 00.


5.7 Compressed Air System Equipment Schedules, BABBDF000-01717-2100-29020 Rev 01.

5.8 Compressed Air System Pad Location Plan, BABBDF000-01717-2100-29021 Rev 01.

5.9 Compressed Air System Enlarged Pad Plan, BABBDF000-01717-2100-29022 Rev 01.

5.10 Compressed Air System Elevations, Sections and Details, BABBDF000-01717-2100-29023 Rev 01.

5.11 Compressed Air System Piping and Instrumentation Diagram (P&ID), Sheet 1, BABBDF000-01717-2100-29024 Rev 01.

5.12 Compressed Air System P&ID, Sheet 2, BABBDF000-01717-2100-29025 Rev 01.

5.13 Compressed Air System P&ID, Sheet 3, BABBDF000-01717-2100-29026 Rev 01.

5.14 Compressed Air System P&ID, Sheet 4, BABBDF000-01717-2100-29027 Rev 01.

5.15 Compressed Air System P&ID, Sheet 5, BABBDF000-01717-2100-29028 Rev 01.

5.16 Compressed Air System P&ID, Sheet 6, BABBDF000-01717-2100-29029 Rev 01.

5.17 ESFDR, YMP/CM-0019 Rev 01, ICN 2.


5.20 Refuge Chamber Specification, BABFAE000-01717-6300-13046 Rev 01.

5.21 Site Design and Test Requirements Documents & Technical Requirements Documents Availability To Be Determined Resolution Analysis BAO000000-01717-0200-00001 Rev 01.

5.22 DOE Order 6430.1A, April 1989, General Design Criteria.

5.23 Mechanical Piping Specification, BABBA0000-01717-6300-15060 REV 01.

6. USE OF COMPUTER SOFTWARE

This analysis uses Lotus 1-2-3 Rev. 4 and WordPerfect Rev. 5.2 computational support software as defined by Quality Administrative Procedure, QAP-SI-0 Rev 0 and is not subject to the software controls of Supplement I of the Quality Assurance Requirement Document (QARD) and associated implementing procedures.

7. DESIGN ANALYSIS

The three 50 percent capacity air compressors with accessories in the existing design (References 5.3 and 5.7 through 5.16) allow the CAS to operate continuously without interruption. The standby air compressor will be energized to replace an operating compressor if the system does not perform its intended function. However, the changeover of air compressors is not entirely an automatic function. The analysis revealed that some of the malfunction signals or alarms only draw the attention of the operating personnel who need to investigate the incident and conduct the changeover manually. As such, a short interruption of operation is anticipated. The addition of some interlocks that would provide an automatic changeover to the standby compressor and the addition of some status alarms is recommended. (See Attachment I - FMEA Worksheets). Below are features of the analysis.

7.1 BOUNDARY OF ANALYSIS

The CAS consists of three identical assemblies, each consisting of an air compressor, aftercooler, moisture separator, receiver, coalescing filter, interconnected piping, and control instrumentation.

Although the CAS consists of three compressors, this analysis focuses only on one assembly because the performance of each air compressor and its associated accessories are identical. The CAS Programmable Control System, which links electronic communicating signals with the computer, was included in this analysis.
The piping are not analyzed because piping failure and their impact to personnel are addressed in Design Package 1C System Safety Analysis (Reference 5.19, Scenarios Nos. SI0080 and SI0100) and the mitigating/control features are included in the CAS design.

Each active component listed in the FMEA worksheet was discussed as a part of the system and does not include detailed analysis of the component itself.

### 7.2 INTERFACING COMPONENTS

The air compressor interfaces directly with the following components:

- **7.2.1 Aftercooler for maintaining compressed air temperature** (References 5.3, 5.7, and 5.11 through 5.16)
- **7.2.2 Moisture separator for moisture removal** (References 5.3, 5.7, and 5.11 through 5.16)
- **7.2.3 Receiver for storage of compressed air** (References 5.3, 5.7, and 5.11 through 5.16)
- **7.2.4 Coalescing filter for oil/water removal from compressed airstream** (References 5.3, 5.7, and 5.11 through 5.16)
- **7.2.5 Control instrumentation for controlling, monitoring, and annunciating on abnormal conditions** (References 5.3 and 5.7 through 5.16).

### 7.3 FAILURE MODES AND CAUSES

**7.3.1** To meet compressed air design requirements under plant normal operation mode, two of the three air compressors will be selected to provide compressed air for equipment and tools during construction and operation, and also to provide emergency life support for the Refuge Chambers for 48 hours. The standby air compressor starts automatically when one of the two selected air compressors fails to start or on failure of the operating air compressor system. The failure modes listed below apply to the CAS performance unable to meet design requirements.

- **7.3.1.1** Fails to maintain nominal 150 psig pressure.
- **7.3.1.2** Fails to maintain 2,730 scfm flow rate (with 2 compressors in operation).
- **7.3.1.3** Fails to maintain compressed air temperature within 3°F above maximum ambient temperature.
- **7.3.1.4** Oil content in airstream greater than 10 ppm.
7.3.2 The changeover to a standby air compressor from an operating air compressor may be initiated manually following an alarm from a component which does not provide a signal for automatic switchover. The CAS is not an engineering safeguard system and does not operate under Design Basis Accident conditions.

8. CONCLUSIONS

The CAS design, in general, is adequate for its intended purpose. The failure of the system does not have a significant safety impact or an impact on ESF operation. Since the CAS operates 24 hours a day, scheduled maintenance is of utmost importance to ensure proper function of components and instrumentations. If the standby air compressor is logged out for maintenance and a failure of one of the operating compressors occurs simultaneously, the CAS service is interrupted until the compressor in maintenance is brought back on line. This may cause a disruption of the construction, testing, and operation activities. However, this disruption will not cause operations activities to be below 85 percent availability requirements (Reference 5.21).

9. ATTACHMENTS

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<td>I</td>
<td>CAS - Failure Mode and Effects Analysis</td>
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</table>
ATTACHMENT I

CAS - FAILURE MODE AND EFFECTS ANALYSIS

(This Attachment Contains a 14-Page Table)
### CAS - Failure Mode and Effects Analysis (FMEA)

**System:** Compressed Air System (CAS)  
**Dwg No:** BABBDF000-01717-2100-29024, Rev. 01, (Ref 5.11)  
**Di No:** BABBDF000-01717-0200-00026  
**Rev:** 00  
**Date:** 09/06/95

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Function</th>
<th>Failure Mode</th>
<th>Failure Cause</th>
<th>Local/Plant Effects</th>
<th>Method of Detection</th>
<th>Prevent/Mitigate Features</th>
<th>Action Recommended</th>
</tr>
</thead>
</table>
| 1   | Air compressor CM-001     | Two of three compressors provide compressed air for Plant use during normal mode. | No or low compressed air pressure. | Failure of one operating compressor. | No Local/Plant effect, if standby air compressor energizes automatically. | 1. Low pressure alarm at PI-1010.  
2. Low flow alarm at FI-1009. | 1. Scheduled maintenance.  
2. Standby compressor start automatically. |                      |
| 2   | Compressor motor (part of CM-001) | Air compressor driver                                                   | Motor fails to run. | 1. Loss of power.  
2. Overload protection trip off.  
3. Control signal fails. | No Local/Plant effect, if standby air compressor energizes automatically. | Announcing at UA-1002, local and PCS | 1. Scheduled maintenance.  
2. Standby compressor start automatically. |                      |
| 3   | Flow control valve FCV-1003 | Open to allow air intake to air compressor.                              | Valve closes while compressor is operating. | 1. Signal failure.  
2. Operator failure.  
2. Standby compressor start automatically.  
3. Replace FCV-1003 |                      |
| 4   | Pressure relief valve PSV-1004 | Relief excessive air pressure above set point.                          | Valve failure. | 1. Fail to open.  
Valve failure. | No Local/Plant effect.  
If PSV-1017 at Receiver VE-001 opens for pressure relief. | PI-1016 high pressure alarms. | 1. Scheduled maintenance.  
2. Manually start standby compressor.  
3. Replace PSV-1004 |                      |
|     |                           |                                                                          |              | 2. Fail to close after open.  
Valve failure. | CAS requirement not met due to low compressed air flow and pressure. | 1. FI-1009 alarms on low flow.  
2. PI-1010 alarms on low pressure. | 1. Scheduled maintenance.  
2. Manually start standby compressor.  
3. Replace PSV-1004 |                      |
# CAS - Failure Mode and Effects Analysis (FMEA)

**Title:** Compressed Air System Failure Mode and Effects Analysis - Design Package 1C

<table>
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<tr>
<th>No.</th>
<th>Function</th>
<th>Failure Mode</th>
<th>Local Plant Effect</th>
<th>Method of Detection</th>
<th>Preventive/Mitigation Measures</th>
<th>Action Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pressure indicating switch</td>
<td>1. Fail to send signal on low pressure</td>
<td>1. Standby compressor will not start on failure of operating compressor</td>
<td>1. FI-100G alarms on low flow</td>
<td>1. Replace FE-1009.</td>
<td>None.</td>
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<tr>
<td>2</td>
<td>Pressure indicating switch</td>
<td>2. Sends incorrect signal on normal pressure</td>
<td>2. No Plant effect and standby compressor will start</td>
<td>2. Replace FE-1009.</td>
<td>2. Replace FE-1009.</td>
<td>None.</td>
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**Notes:**
- **DI:** BABBF000-01717-0200-00026 REV 00
- **Date:** 08/08/95

**System:** Compressed Air System (CAS)

**Dwg No.:** BABBF000-01717-0200-00026

**Originator:** T.Y. Chen

**Checker:** Seeleke Anwar
# CAS - Failure Mode and Effects Analysis (FMEA)

**System:** Compressed Air System (CAS)

**Dwg No.:** BABBD000-01717-2100-29024, Rev. 01, (Ref 5.11)

**Originator:** T.Y. Chen  
**Checker:** Siddique Anwar

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<th>Failure Cause</th>
<th>Local/Plant Effects</th>
<th>Method of Detection</th>
<th>Prevent/Mitigate Features</th>
<th>Action Recommended</th>
</tr>
</thead>
</table>
| 8   | Flow indicator FI-1009 | Flow indication and Alarms on low flow signal. | 1. Fails to alarm on low flow. | Indicator failure. | CAS requirement not met due to low compressed air flow. | 1. FS-1012 alarms on low flow.  
2. PI-1010 alarms on low pressure. | 1. Scheduled maintenance.  
2. Manually start standby compressor.  
3. Replace FI-1009 | |
2. Replace FI-1009 | |
| 9   | Pressure indicating transmitter PIT-1010 | Monitoring flow pressure. Transmits pressure signal to PI-1010 | 1. No output signal to PI-1010 on low pressure. | Transmitter failure. | CAS requirement not met due to low compressed air pressure. | FI-1009 alarms on low flow. | 1. Scheduled maintenance.  
2. Manually start standby compressor.  
3. Replace PIT-1010 | |
2. Replace PIT-1010 | |
**Title:** Compressed Air System Failure Mode and Effects Analysis - Design Package 1C

**System:** Compressed Air System (CAS)

**Dwg No:** BABBDF000-01717-0200-00026, Rev. 01 (Ref 5.11)

**Originator:** T.Y. Chen

**Checker:** Siddique Anwar

### Table: CAS - Failure Mode and Effects Analysis (FMEA)

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<th>Method of Detection</th>
<th>Prevent/Mitigate Features</th>
<th>Action Recommended</th>
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<tr>
<td>10</td>
<td>Pressure indicator</td>
<td>Indicates compressed air pressure and alarms on low pressure</td>
<td>1. Fail to alarm on low pressure.</td>
<td>Indicator failure.</td>
<td>CAS requirement not met due to low compressed air pressure.</td>
<td>None.</td>
<td>1. Scheduled maintenance. 2. Manually start standby compressor. 3. Replace PI-1010</td>
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<tr>
<td>11</td>
<td>Temperature indicating transmitter TIT-1011</td>
<td>Monitoring flow temperature and transmits signal to TI-1011.</td>
<td>1. No output signal to TI-1011 on high or low temp.</td>
<td>Transmitter failure.</td>
<td>No effect on low temp. Temp higher than design is harmful for life support service.</td>
<td>None.</td>
<td>1. Scheduled maintenance. 2. Manually start standby compressor on high temp. 3. Replace TIT-1011.</td>
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</tr>
</tbody>
</table>
# CAS - Failure Mode and Effects Analysis (FMEA)

**System:** Compressed Air System (CAS)  
**Dwg No:** BABBDF000-01717-2100-29024, Rev. 01, (Ref 5.11)  
**Originator:** T.Y. Chen  
**Checker:** Siddique Anvar

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<th>No.</th>
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<th>Function</th>
<th>Failure Mode</th>
<th>Failure Cause</th>
<th>Local/Plant Effects</th>
<th>Method of Detection</th>
<th>Prevent/Mitigate Features</th>
<th>Action Recommended</th>
</tr>
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<tr>
<td>12</td>
<td>Temperature indicator Ti-1011</td>
<td>Indicates compressed air temp. and alarms on high and low temperatures.</td>
<td>1. Fail to alarm on temp. higher or lower than normal.</td>
<td>Indicator failure.</td>
<td>No effect on low temp. Temp. higher than design is harmful for life support service.</td>
<td>None.</td>
<td>1. Scheduled maintenance.</td>
<td>At high temp. Ti-1011 should initiate the start of the standby compressor.</td>
</tr>
<tr>
<td>13</td>
<td>Temperature indicating transmitter TIT-1007</td>
<td>Transmitting signal to open valve TCV-1008 and stop Aftercooler fan AX-001 if temp. below 40°F. Reverse action at temp. above 60°F.</td>
<td>1. Fail to transmit signal on higher or lower than set-points.</td>
<td>Transmitter failure.</td>
<td>No effect on temp. below 40°F. Temp. above 60°F is harmful for life support service.</td>
<td>Ti-1013 alarms on high or low temp.</td>
<td>1. Scheduled maintenance.</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td>2. Transmitting incorrect signal.</td>
<td>Transmitter failure.</td>
<td>Open or close TCV-1008 and stop or start Aftercooler fan AX-001 off set points. No effect on temp. below 40°F. Temp. above 60°F is harmful for life support service.</td>
<td>Ti-1013 alarms on high or low temp.</td>
<td>1. Scheduled maintenance.</td>
<td></td>
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</table>
### CAS - Failure Mode and Effects Analysis (FMEA)

**System:** Compressed Air System (CAS)  
**Dwg No:** BABBD000-01717-2000-20024, Rev. 01, (Ref 5.11)

**Originator:** T.Y. Chen  
**Checker:** Siddique Aminwala

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<th>Failure Mode</th>
<th>Failure Cause</th>
<th>Local/Plant Effects</th>
<th>Method of Detection</th>
<th>Prevent/Mitigate Features</th>
<th>Action Recommended</th>
</tr>
</thead>
</table>
| 14  | Temp. control valve YCV-1008 | Drainage of condensate to receiver when compressor is off and ambient temp. is below 40°F. | 1. Fails to open. | Valve failure. | None. Condensate could be drained through KCV-1014. | None. | 1. Scheduled maintenance.  
2. Open valve with hand wheel.  
3. Replace YCV-1008 | |
|     |                         |                                      | 2. Fails to close after open. | Valve failure. | Compressed air leaks to atmosphere through open drain valve.  
CAS requirement not met due to low compressed air pressure. | FS-1012 alarms on low flow. | 1. Scheduled maintenance.  
2. Close valve with hand wheel.  
3. Replace YCV-1008 | |
2. Manually start standby compressor on low flow  
3. Replace FS-1012 | |
2. Replace FS-1012 | |
| 16  | Aftercooler fan motor AX-001 | Maintaining compressed air temp. 3°F above ambient. | Motor fails to run. | 1. Loss of power.  
2. Overload protection trip off.  
3. Control signal fails. | Compressed air temp. can not be maintained.  
Temp. higher than design is harmful for life support service. | Local Indicating light and “fault” signal at UA-1006. | 1. Scheduled maintenance.  
2. Standby compressor start automatically |
### CAS - Failure Mode and Effects Analysis (FMEA)

**System:** Compressed Air System (CAS)

**Dwg No:** BABBDF000-01717-2100-29024, Rev. 01. (Ref 5.11)

**Originator:** T.Y. Chen

**Checker:** Siddique Anwar

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<th>Method of Detection</th>
<th>Prevent/Mitigate Features</th>
<th>Action Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>Temp. indicating transmitter.</td>
<td>Monitoring flow temperature and transmits signal to Ti-1013</td>
<td>1. No output signal to Ti-1013 on high or low temp.</td>
<td>Transmitter failure.</td>
<td>No effect on low temp. Temp. higher than design is harmful for life support service.</td>
<td>None.</td>
<td>1. Scheduled maintenance. 2. Replace TiT-1013.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TiT-1013</td>
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<td></td>
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</tr>
<tr>
<td>18</td>
<td>Temp. indicator Ti-1013</td>
<td>Indicates compressed air temp. and alarms on high and low temperatures.</td>
<td>1. Fails to alarm on temp. higher or lower than normal.</td>
<td>Indicator failure.</td>
<td>No effect on low temp. Temp. higher than design is harmful for life support service.</td>
<td>None.</td>
<td>1. Scheduled maintenance. 2. Replace Ti-1013.</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>At high temp. Ti-1013 should initiate the start of the standby compressor.</td>
</tr>
<tr>
<td>19</td>
<td>Moisture Separator MS-001</td>
<td>Removing moisture from compressed airstream.</td>
<td>Moisture remains in airstream.</td>
<td>Battle broken.</td>
<td>No Local/Plant effect because Coalescing filter FL-001 removes moisture in airstream.</td>
<td>AI-1015 alarms on high moisture.</td>
<td>1. Scheduled maintenance. 2. Manually start standby compressor. 3. Replace MS-001</td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Name</td>
<td>Function</td>
<td>Failure Mode</td>
<td>Failure Cause</td>
<td>Method of Detection</td>
<td>Feature</td>
<td>Prevent/Mitigate Features</td>
<td>Recommended Action</td>
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</table>

**Title:** Compressed Air System Failure Mode and Effects Analysis - Design Package 1C
# CAS - Failure Mode and Effects Analysis (FMEA)

**System:** Compressed Air System (CAS)  
**Dwg No:** BABD000-01717-2100-20024, Rev. 01 (Ref 5.11)

**Originator:** T.Y. Chen  
**Checker:** Siddique Anwar

<table>
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<tr>
<th>No.</th>
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<th>Method of Detection</th>
<th>Prevent/Ameliorate Features</th>
<th>Action Recommended</th>
</tr>
</thead>
</table>
| 23  | Analyzer indicating transmitter AIT-1015 | Transmitting signal to AIT-1015 on high moisture content. | 1. Fails to transmit signal on high moisture content. | Transmitter failure. | No Plant effect. High moisture content will be filtered through Coalescing filter FL-001. | None. | 1. Scheduled maintenance.  
2. Replace AIT-1015. | |
2. Replace AIT-1015. | |
| 24  | Analyzer Indicator AI-1015 | Indicating and alarms on high moisture content in airstream. | 1. Fails to alarm on high moisture content. | Indicator failure. | No Plant effect. High moisture content will be filtered through Coalescing filter FL-001. | None. | 1. Scheduled maintenance.  
2. Replace AI-1015. | |
2. Replace AI-1015. | |
| 24  | Pressure Indicating Transmitter PIT-1016 | Monitoring flow pressure. Transmits pressure signal to PI-1016 | 1. No output signal to PI-1016 on high pressure. | Transmitter failure. | No local/Plant effect. PSV-1017 will open to relief pressure. | None. | 1. Scheduled maintenance.  
2. Replace PIT-1016. | |
2. Replace PIT-1016. | |
# CAS - Failure Mode and Effects Analysis (FMEA)

System: Compressed Air System (CAS)
Dwg No: BABBDF000-01717-2100-00024, Rev. 01. (Ref 5.11)

**Originator:** T.Y. Chen
**Checker:** Siddique Anwar

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<tr>
<td>25</td>
<td>Pressure indicator</td>
<td>Alarms on high pressure.</td>
<td>1. Fail to alarm on high pressure.</td>
<td>Indicator failure.</td>
<td>No local/Plant effect.</td>
<td>PSV-1017 will open to relief pressure.</td>
<td>None.</td>
<td>1. Scheduled maintenance. 2. Replace PI-1016.</td>
</tr>
<tr>
<td></td>
<td>PI-1016</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Pressure relief valve</td>
<td>Relief excessive air pressure above set point.</td>
<td>1. Fail to open.</td>
<td>Valve failure.</td>
<td>No Local/Plant effect.</td>
<td>If PSV-1004 at compressor CM-001 opens for pressure relief.</td>
<td>PI-1016 high pressure alarms.</td>
<td>1. Scheduled maintenance. 2. Replace PSV-1017.</td>
</tr>
<tr>
<td></td>
<td>PSV-1017</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Fail to close after open.</td>
<td>Valve defective.</td>
<td>CAS requirement not met due to low compressed air flow and pressure.</td>
<td>None.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DI No:** BABBDF000-01717-0200-00026
**Rev.:** 00
**Date:** 09/08/95
### CAS - Failure Mode and Effects Analysis (FMEA)

**System:** Compressed Air System (CAS)  
**Dwg No:** BABBDF000-01717-2100-29024, Rev. 01 (Ref 5.11)

**DI No:** BABBDF000-01717-0200-00026  
**Rev:** 00  
**Date:** 09/06/95

**Originator:** T.Y. Chen  
**Checker:** Sudique Anwar

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<tr>
<td></td>
<td></td>
<td></td>
<td>2. Filter overloaded.</td>
<td>CAS requirement not met due to low compressed air flow.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
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# CAS - Failure Mode and Effects Analysis (FMEA)

**System:** Compressed Air System (CAS)  
**Dwg No:** BABBDF000-01717-2100-29024, Rev. 01, (Ref 5.11)  
**DI No:** BABBDF000-01717-0200-00026  
**Rev:** 00  
**Date:** 09/08/95  
**Originator:** T.Y. Chen  
**Checker:** Siddique Anwar

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</table>
2. Manually start standby compressor.  
3. Replace PDIT-1019. |
|     |      |          |              |               |                     |                      |                         |                   |
|     |      |          |              |               |                     |                      |                         |                   |
| 30  | Pressure differential indicator PDIT-1019 | Indicating pressure differential across Coalescing filter FL-001 | 1. Fail to alarm on high/low pressure. | Indicator failure. | CAS requirement not met due to low compressed air flow caused by high pressure differential across filter. On low pressure differential, equipment and tools on compressed air can not operate properly. | None. | 1. Scheduled maintenance.  
2. Manually start standby compressor.  
3. Replace PDIT-1019. |
|     |      |          |              |               |                     |                      |                         |                   |
|     |      |          |              |               |                     |                      |                         |                   |
|     |      |          |              |               |                     |                      |                         |                   |
### Title: Compressed Air System Failure Mode and Effects Analysis - Design Package 1C

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<tr>
<td>31</td>
<td>Automatic drain valve</td>
<td>Valve failure, Coalescing filter FI-501 will be saturated with condensate.</td>
<td>Receiver drain valve operates with lever control.</td>
<td>PIC-019 alarms on high pressure.</td>
<td>Replace KCV-010B.</td>
<td>1. Scheduled maintenance. 2. Standby compressor start automatically on high pressure. 3. Replace KCV-010B.</td>
</tr>
<tr>
<td>32</td>
<td>Hand switch</td>
<td>Valve failure</td>
<td>HS-1001B to start/stop locally.</td>
<td>None.</td>
<td>None.</td>
<td>2. Replace HS-1001A.</td>
</tr>
<tr>
<td>33</td>
<td>Select switch for local or remote start/stop compressor.</td>
<td>None.</td>
<td>HS-1001B</td>
<td>None.</td>
<td>None.</td>
<td>2. Replace HS-1001B.</td>
</tr>
<tr>
<td>34</td>
<td>Hand switch for local or remote start/stop compressor.</td>
<td>None.</td>
<td>HS-1006B to start/stop locally.</td>
<td>None.</td>
<td>None.</td>
<td>2. Replace HS-1006A.</td>
</tr>
<tr>
<td>35</td>
<td>Hand switch for local or remote start/stop compressor.</td>
<td>None.</td>
<td>HS-1009A</td>
<td>None.</td>
<td>None.</td>
<td>2. Replace HS-1009A.</td>
</tr>
</tbody>
</table>
# CAS - Failure Mode and Effects Analysis (FMEA)

System: Compressed Air System (CAS)  
Dwg No: BABDF000-01717-2000-29024, Rev. 01, (Ref 5.11)  
Originator: T.Y. Chen  
Checker: Siddique Anwar  

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- Design Package 1C  

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<td>35</td>
<td>Hand switch</td>
<td>Selector switch for local or</td>
<td>Switch fails to change from</td>
<td>Switch failure.</td>
<td>No Local/Plant effect.</td>
<td>None.</td>
<td></td>
<td>1. Schedded mainten-</td>
</tr>
<tr>
<td></td>
<td>HS-1006B</td>
<td>remote start/stop Aftercooler.</td>
<td>&quot;Remote&quot; to &quot;local&quot;.</td>
<td></td>
<td>Aftercooler is not operating.</td>
<td></td>
<td></td>
<td>ence. 2. Replace HS-1006B.</td>
</tr>
</tbody>
</table>