COMPRESSED AIR SYSTEM REFURBISHMENT AND MODERNIZATION

BY

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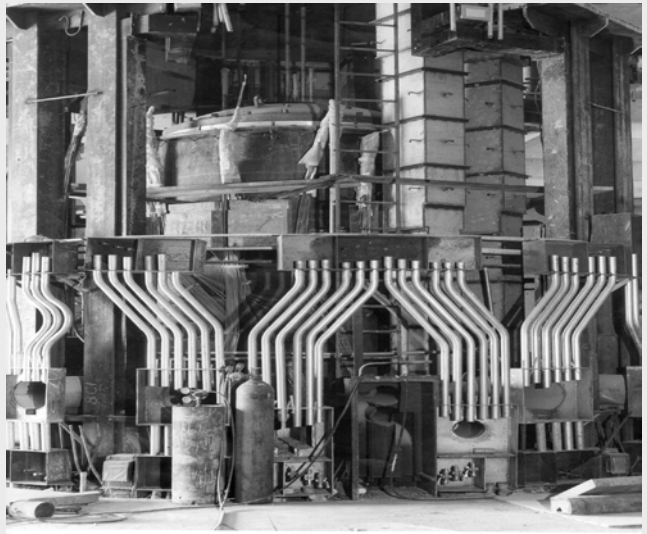
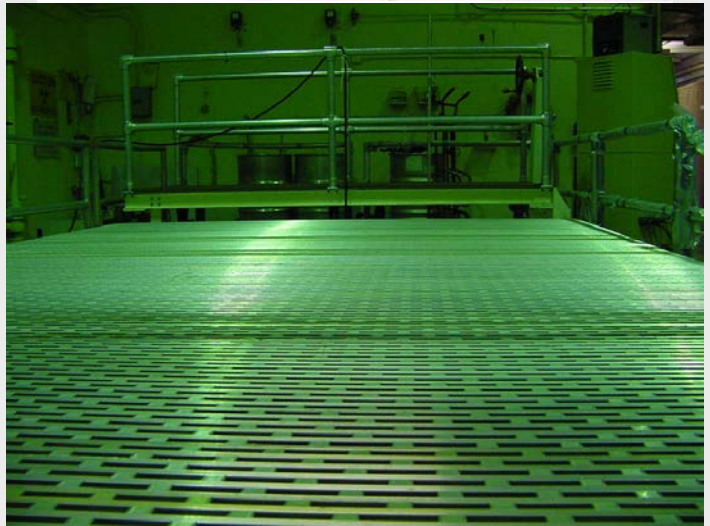
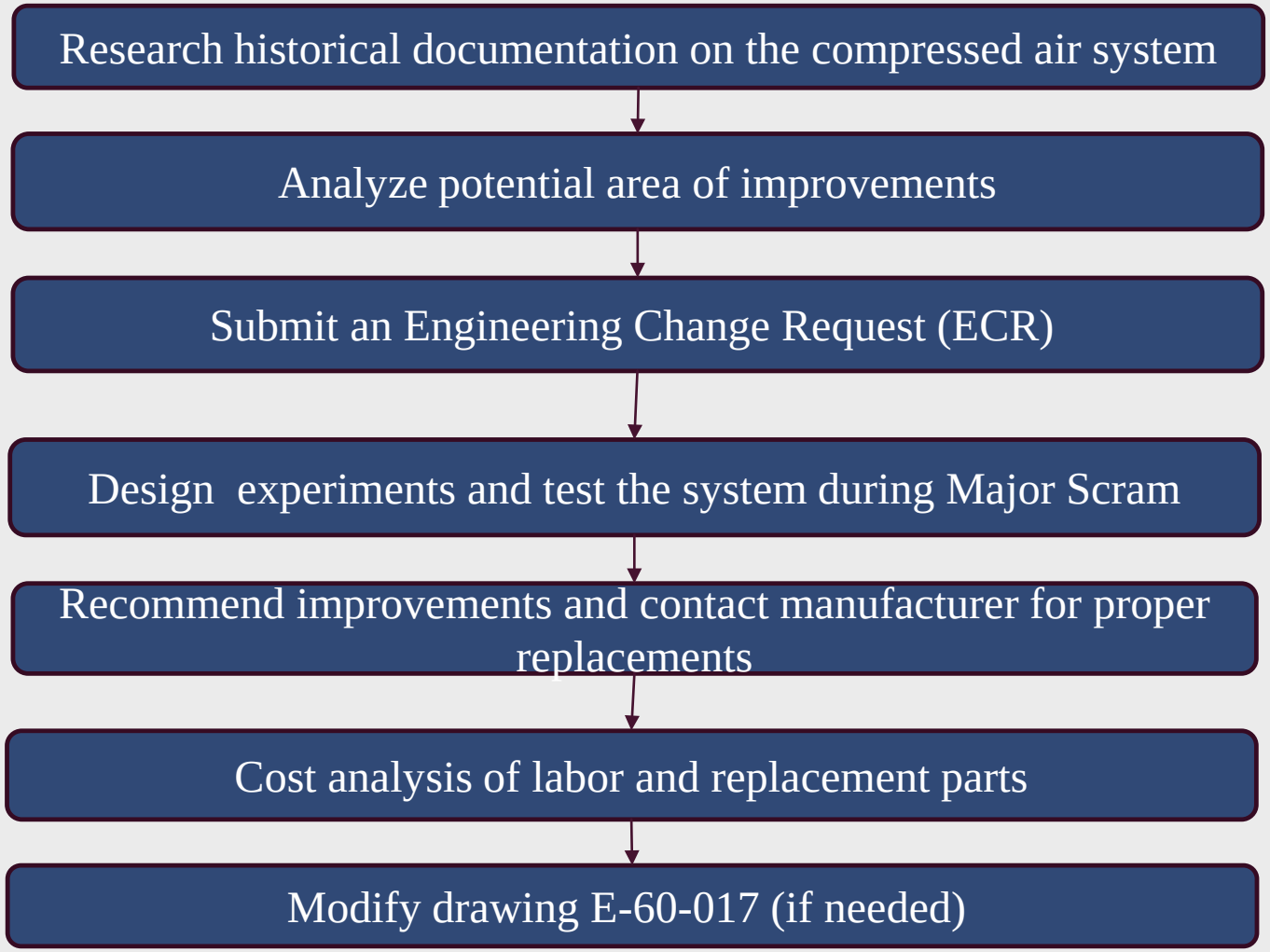
BACKGROUND

- The compressed air system is used for a variety of safety and control functions within NCNR, and as such, its reliability is critical to the safe continued operation of the National Bureau of Standards Reactor(NBSR).
- Critical reactor control and support systems include components of ventilation, confinement doors, storage pool, fuel transfer system, and other integral systems.



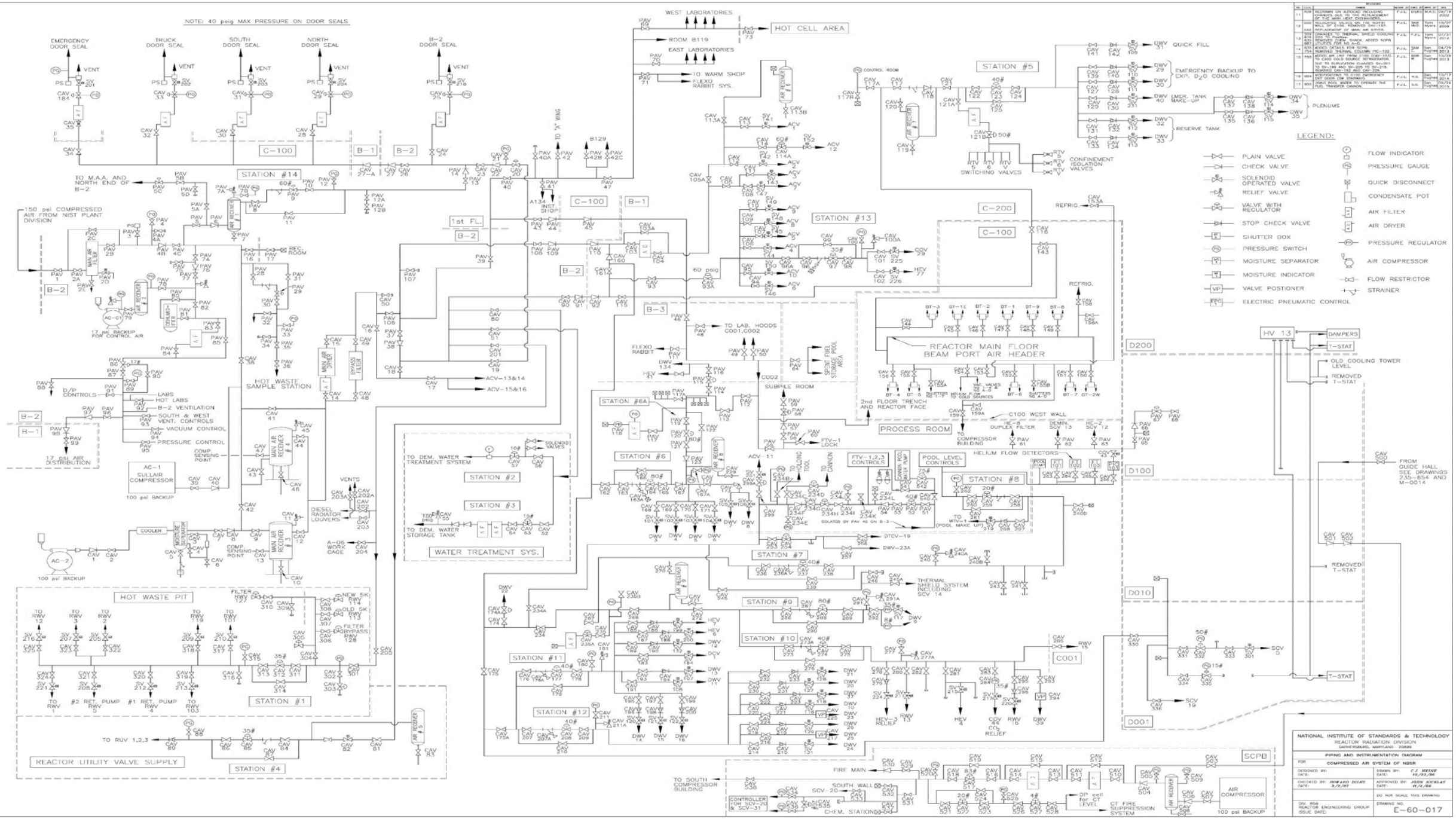


PROJECT APPROACH



PURPOSE

- To test the reliability of the compressed air system given the aging equipment and plant modifications.
- A compressed air system study is required to determine how the system is functioning and what modifications, if needed, are required to return the system to design specifications.
- Identification of changes that are required for the system to be up to industry standard.
- System Documentation.


NOTE: 40 psig MAX PRESSURE ON DOOR SEALS
EMERGENCY DOOR SEAL
TRUCK DOOR SEAL
SOUTH DOOR SEAL
NORTH DOOR SEAL
B-2 DOOR SEAL
VENT
C-100
B-1
B-2
STATION #14
TO M.A.A. AND NORTH END OF B-2
150 psi COMPRESSED AIR FROM NIST PLANT DIVISION
MAIN AIR FILTER
AIR RECEIVER #1
AC-C1
17 psi BACKUP FOR CONTROL AIR
DEHUMIDIFIER
REC. ROOM
HOT WASTE SAMPLE STATION
17 psi AIR DISTRIBUTION
D/P CONTROLS
LABS
HOT LABS
B-2 VENTILATION
SOUTH & WEST VENT. CONTROLS
VACUUM CONTROL
PRESSURE CONTROL
COMP. SENSING POINT
AC-1
SULLAIR COMPRESSOR
100 psi BACKUP
MAIN AIR RECEIVER #4
MAIN AIR RECEIVER #5
MAIN AIR JUMPER
BYPASS FILTER
DIESEL RADIATOR LOUVERS
VENTS
A-06 WORK CAGE
COOLER
MOISTURE SEPARATOR
AC-2
100 psi BACKUP
HOT WASTE PIT
FILTER RWV 107
NEW 5K RWV 114
OLD 5K RWV 113
FILTER BYPASS RWV 112
TO RWV 1
TO RWV 2
TO RWV 3
TO RWV 101
TO RWV 102
TO RWV 103
#2 RET. PUMP RWV 5
#1 RET. PUMP RWV 4
STATION #1
TO RUV 1,2,3
REACTOR UTILITY VALVE SUPPLY
STATION #4
AIR RECEIVER #5
1st FL.
B-3
TO "A" WING
A134 INST. SHOP
B129
TO LAB. HOODS C001,C002
FLEXO RABBIT
DWV 134
SPENT FUEL POOL STORAGE AREA
SUBPILE ROOM
C002
ACV-13&14
ACV-15&16
60 psig
WEST LABORATORIES
ROOM B119
EAST LABORATORIES
TO WARM SHOP
FLEXO RABBIT SYS.
HOT CELL AREA
AIR RECEIVER #6
CONTROL ROOM
STATION #5
40#
RTV 5 SWITCHING VALVES
RTV 6 SWITCHING VALVES
CONFINEMENT ISOLATION VALVES
D2O 50#
DWV 31 QUICK FILL
EMERGENCY BACKUP TO EXP. D2O COOLING
DWV 40 EMER. TANK MAKE-UP
RESERVE TANK
PLENUMS
DWV 34
DWV 35
STATION #13
C-200
C-100
REFRIG.
REACTOR MAIN FLOOR BEAM PORT AIR HEADER
BT-3
BT-2
BT-1
BT-9
BT-8
BT-4
BT-5
SHUTTERS BT-1-9
BT-6
SHUTTERS BT-A-D
BT-7 GT-2W
2nd FLOOR TRENCH AND REACTOR FACE
C100 WEST WALL
PROCESS ROOM
TO COMPRESSOR BUILDING
HE-1 DUPLEX FILTER
DEMIN SCV 13
HE-2 SCV 12
HELIUM FLOW DETECTORS
STATION #6A
STATION #6
FTV-1 LOCK
FTV-1,2,3 CONTROLS
TO CANNON
POOL LEVEL CONTROLS
STATION #8
TO W-1 (POOL MAKE UP)
STATION #7
THERMAL SHIELD SYSTEM INCLUDING SCV 14
STATION #9
STATION #10
STATION #11
STATION #12
C001
HEV-3 RELIEF
HEV 4
CO2 RELIEF
TO DEM. WATER TREATMENT SYSTEM
STATION #2
STATION #3
TO DEM. WATER STORAGE TANK
SOLENOID VALVES
WATER TREATMENT SYS.
D200
D100
D010
D001
HV 13
DAMPERS
T-STAT
OLD COOLING TOWER LEVEL
REMOVED T-STAT
FROM GUIDE HALL SEE DRAWINGS 2.55-654 AND M-0014
SCV 5
SCV 19
FIRE MAIN
TO SOUTH COMPRESSOR BUILDING
SOUTH WALL
SCV-20
CONTROLLER FOR SCV-20 & SCV-31
CHEM. STATION
DP cell for CT LEVEL
CT FIRE SUPPRESSION SYSTEM
SCPB
AIR COMPRESSOR
100 psi BACKUP
LEGEND:
PLAIN VALVE
CHECK VALVE
SOLENOID OPERATED VALVE
RELIEF VALVE
VALVE WITH REGULATOR
STOP CHECK VALVE
SHUTTER BOX
PRESSURE SWITCH
MOISTURE SEPARATOR
MOISTURE INDICATOR
VALVE POSITIONER
ELECTRIC PNEUMATIC CONTROL
FLOW INDICATOR
PRESSURE GAUGE
QUICK DISCONNECT
CONDENSATE POT
AIR FILTER
AIR DRYER
PRESSURE REGULATOR
AIR COMPRESSOR
FLOW RESTRICTOR
STRAINER
NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGY
REACTOR RADIATION DIVISION
GAITHERSBURG, MARYLAND 20899
PIPING AND INSTRUMENTATION DIAGRAM
FOR COMPRESSED AIR SYSTEM OF NBSR
DESIGNED BY: C.J. MEINE DATE: 11/22/96
CHECKED BY: HOWARD DILES DATE: 3/2/97
APPROVED BY: JOHN NICKLAS DATE: 11/4/96
DO NOT SCALE THIS DRAWING
DIV. 856 REACTOR ENGINEERING GROUP ISSUE DATE:
DRAWING NO. E-60-017

EXAMPLE

June 12th - The confinement back door was found deflated.

Possible causes:

- Regulator
- Solenoid valve
- Clogged airline

Concluded:

The door will inflate but very slowly. Not allowed to use the door unless there is an emergency.

PRESSURE DROP

- Allow measurement of the change in pressure in undesirable locations, identify leaks, and observe any changes that affect the system.
- Is the change in pressure significant?
- **Experiment setup**
  - Prior to Major Scram isolate PAV12, CAV 21 and install transducers, close valve CAV 103 and 104 then relieve the pressure in the air dryer, install the transducers in place on the air dryer relief then isolate CAV 93 and install the transducer in CAV 93A. Apply snoop to check for air leaks when installing and resetting the equipment.
- Program monitors.

MATERIALS

- Pressure gauge: Identify the pressure in the regulator.
- Wire: To carry the electrical signal converted from the transducer to the recorders.
- Yokogawa monitors: Used to record the signal, time of the operation, and chart the data received from the transducers.
- 8v-30v Power Source: Supply power to the transducers.
- Snoop: Leak detector for connections.
- Pressure transducers: Seven transducers will be used to change difference in pressure across the system into an electrical signal.

Standard pressure gauge

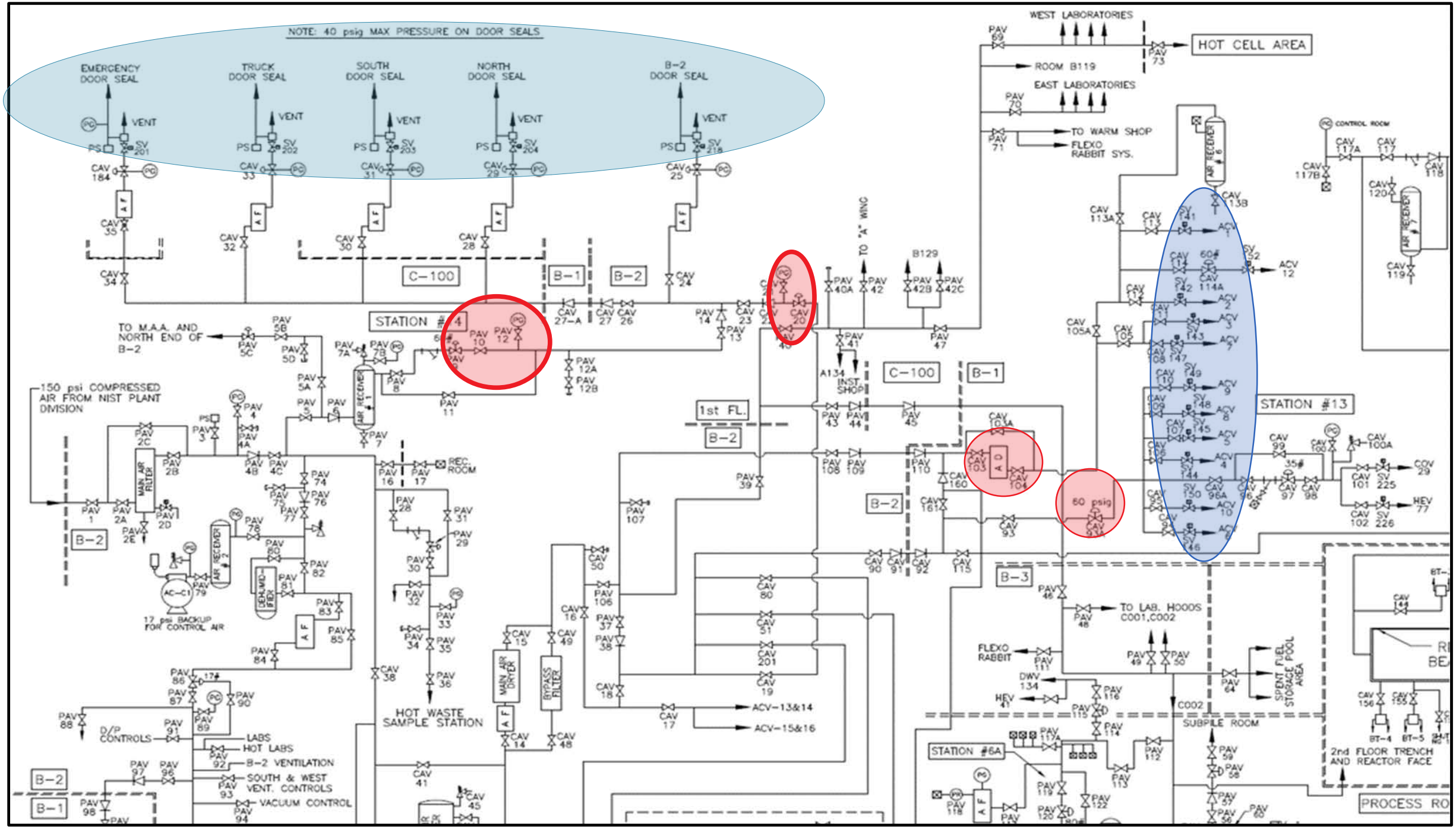

2 core 22awg wire, 500'

DX1006N

Power supply

Leak detector

150 psi, 8V-30V, sealed gauge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ACV-13&14
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60 psig
TO LAB. HOODS C001,C002
FLEXO RABBIT
SUBPILE ROOM
SPENT FUEL STORAGE POOL AREA
2nd FLOOR TRENCH AND REACTOR FACE
PROCESS RO

EXPECTED RESULTS

- Expected to see some loss but not significant amount to affect the system due to leakage or pressure drop in undesirable location.
- Possible reasons for pressure drop:

  a) Incorrectly connected pressure transducer

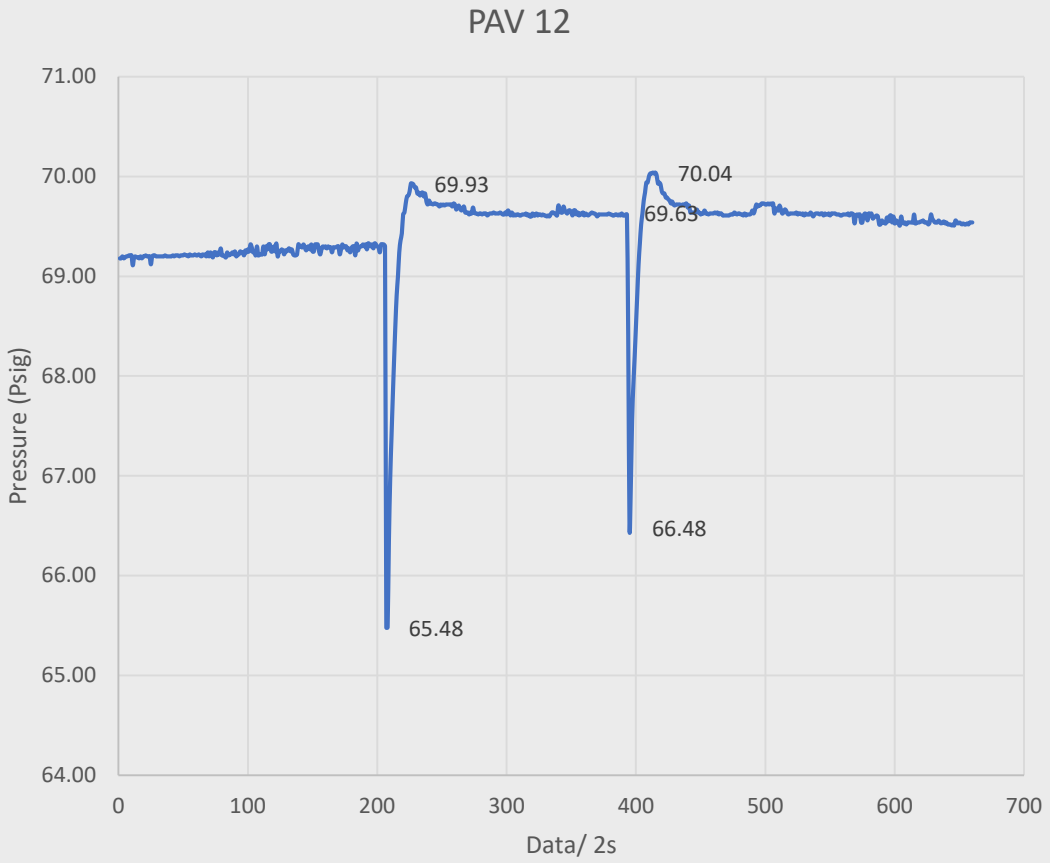
  b) Clogged filters and pipes

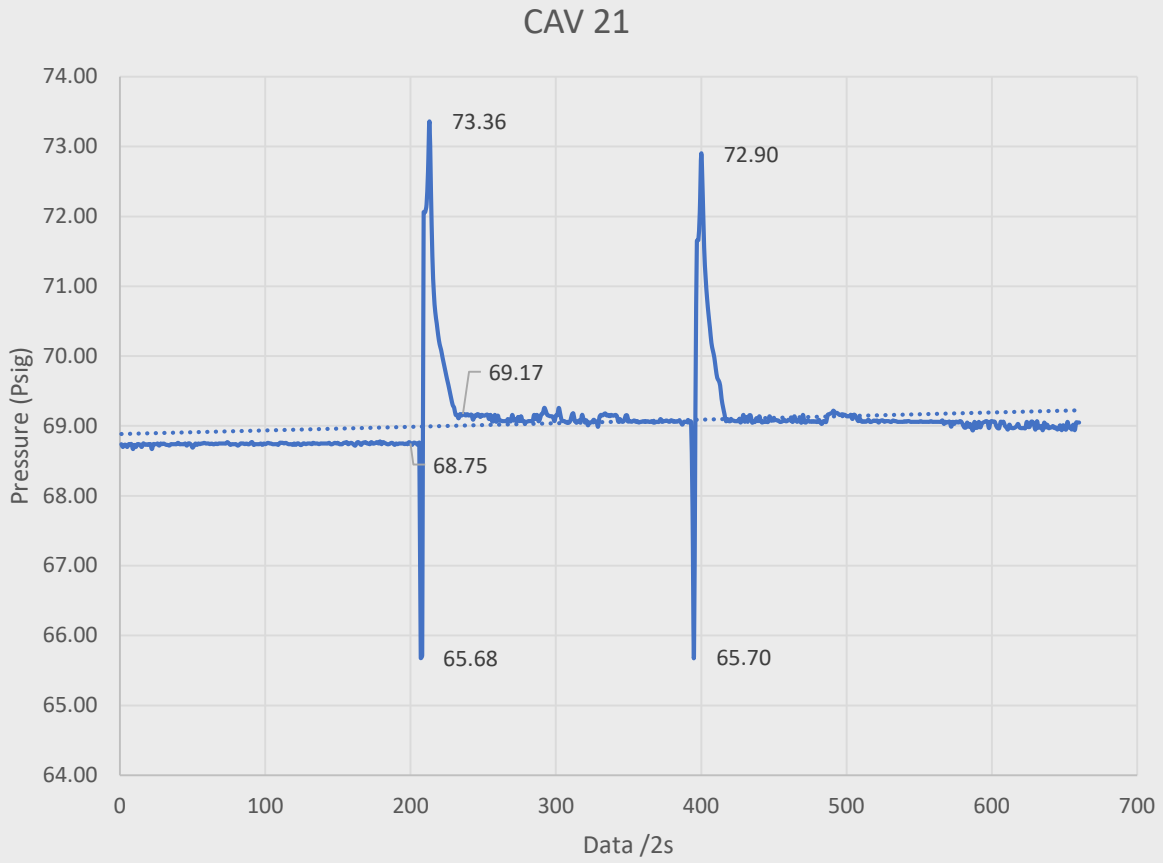
  c) Not enough pressure in the receivers

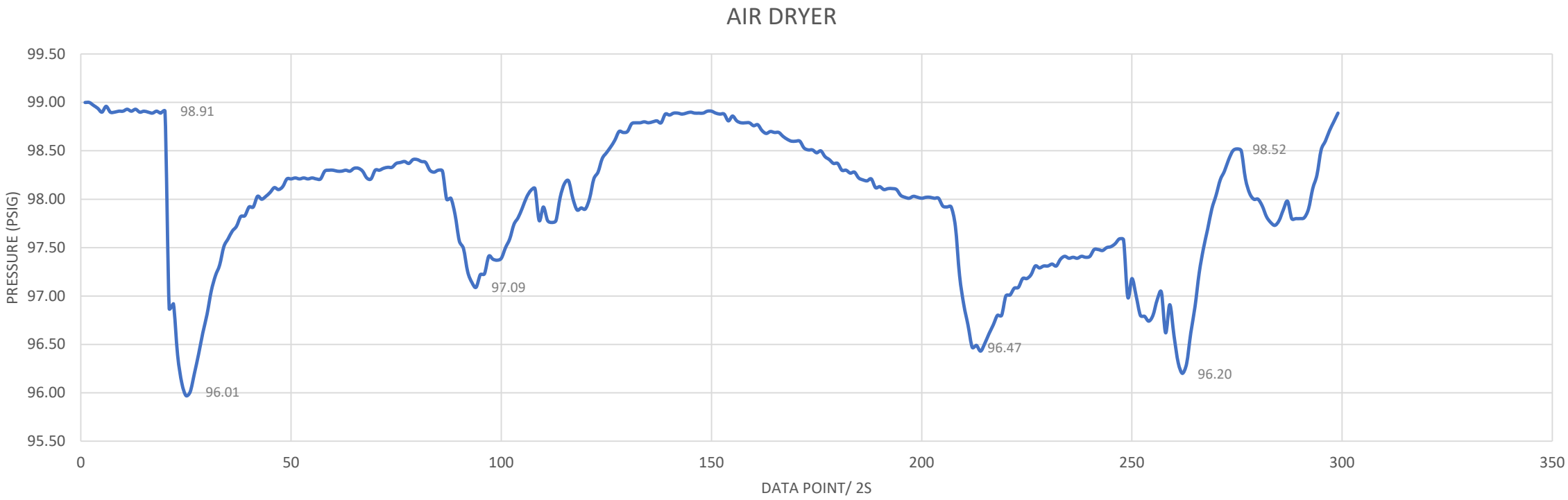
  d) Regulator malfunction

  e) Leaks in pipes

RESULTS


PAV 12
71.00
70.00
69.00
68.00
67.00
66.00
65.00
64.00
Pressure (Psig)
0
100
200
300
400
500
600
700
Data/ 2s
69.93
70.04
69.63
66.48
65.48

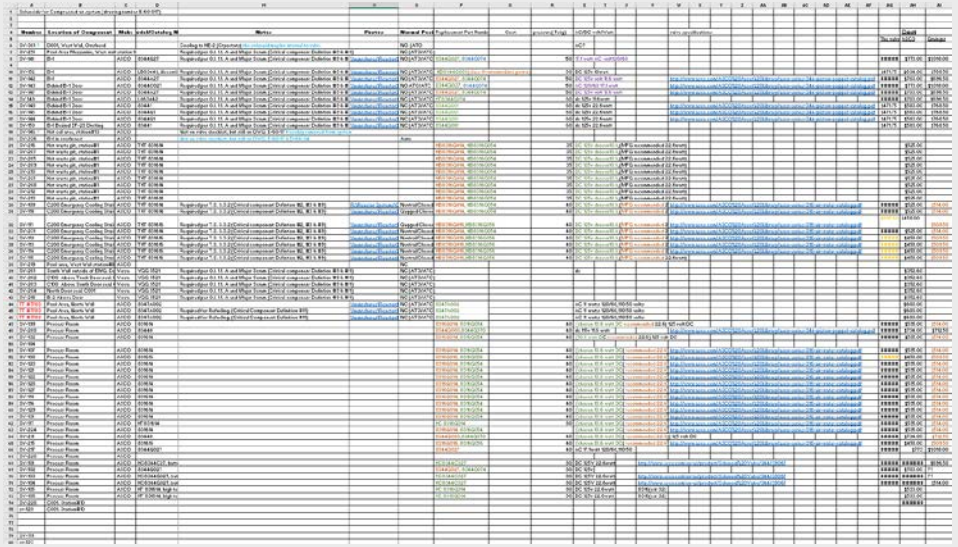

CAV 21
74.00
73.00
72.00
71.00
70.00
69.00
68.00
67.00
66.00
65.00
64.00
Pressure (Psig)
0
100
200
300
400
500
600
700
Data /2s
73.36
72.90
69.17
68.75
65.68
65.70


AIR DRYER
99.50
99.00
98.50
98.00
97.50
97.00
96.50
96.00
95.50
PRESSURE (PSIG)
98.91
96.01
97.09
96.47
98.52
96.20
0
50
100
150
200
250
300
350
DATA POINT/ 2S

ENGINEERING CHANGE REQUEST (ECR)

The purpose is to remove and replace old, discontinued, obsolete, broken, and faulty valves and replace them with modern components.

- Estimated cost of replacement solenoid valves: $37,575.00
- Engineering Effort: 440 hours
- Operating Effort: 600 hours



CONCLUSIONS

- Reproducible Test
- No air leakage
- Negligible amount of pressure drop
- Achieved confinement in 12s
- Valve activation in 1.5s
- Replace critical components for preventative maintenance

FUTURE TESTS

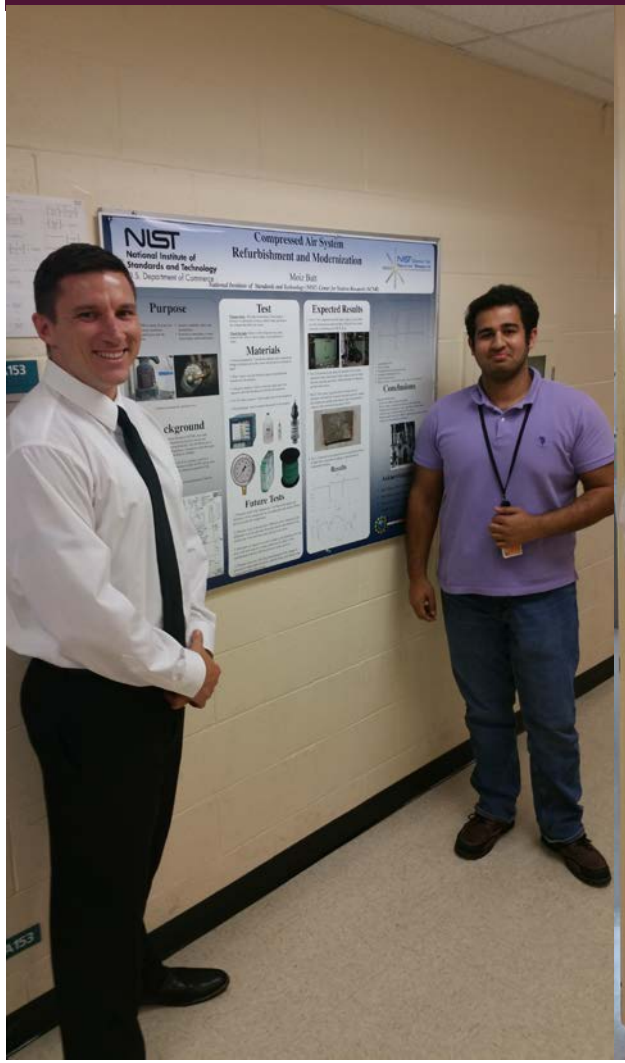
- **1. Pressure relief with compressor-** To observe the speed and efficiency of the compressor by recording the time used to fill the receivers with the compressor.
- **2. Pressure relief with receivers-** Observe valves response to the difference in air for pressure drop and observe the amount of air used by the valve and how long until an issue arises.
- **Speed requirement test-** Since there is no specified time requirement for the solenoid valve closure (generally assumed to close in 5 seconds) **(optional).**
- **3. Minimum air required for use in single cycle-** Enabling us to see how well/ how long the system works and the status of the confinement with just half the pressure in the receivers.
- **4. Pressure drop test -**Allowing measurement of the change in pressure in undesirable locations, identify leaks, and observe any changes that effect the system.

ACKNOWLEDGEMENTS

- Thanks to the Reactor Operations and Engineering group
- Special thanks to:
- Julie Borchers
- Joe Dura
- Dan Hughes, Chief of Reactor Operations
- Paul Brand, Chief of Reactor Engineering
- Oscar Wiygul
- Scott Arneson
- Sam McDavid
- Ricky Sprow
- Dan Mattes

NSF CHRNS CENTER FOR HIGH RESOLUTION NEUTRON SCATTERING NIST

MENTOR- MARCUS SCHWADERER



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