WCRRF TA050-69 Ventilation System Software Post Maintenance Testing Procedure

Rev 1

4-19-2007

PREREQUISITES:

All building physical modifications have been completed to the satisfaction of the Cognizant System Engineer (CSE).

Data Mining test has been completed and any necessary software changes made.

PLC and HMI are powered up

Revised PLC and HMI programs are load IAW SCP and running.

Electrical System is powered up.

WCRRF meets requirements for TSR defined COLD STANDBY Mode

A Laptop is connected to PLC and monitoring real time data.

Ventilation system shall be OFF.

Inform LAN ESS desk that testing is underway and to disregard alarms.

Notify of Facility Coordinator and Operations prior to starting test.

A RCT to perform radiological survey of PLC cabinet and ventilation control cabinet.

PERSONNEL:

Sufficient personnel shall be available to perform this procedure and shall be briefed prior to starting this procedure.

Required Personnel	Record Name
Test Specialist	MARC ROBBINS
Cognizant SE	Allen Hayward
Electrician or Controls Technician	Roger Salazar
HMI Operator	Ricky Baros
Radiation Control Technician	Claude Gallegos

HMI Operator:

A dedicated person shall be assigned to operate the HMI, report and acknowledge alarms, and shutdown the Ventilation system via the HMI if conditions warrant. This person should have no other duties. Is expected that all alarms are acknowledged by this operator. Alarms that are not expected should be noted in comments.

To VERIFY an alarm in the procedure, the HMI Operator will acknowledge the alarm screen *and* verify the alarm on the active alarms screen or the Alarm History screen.

NOTE: Depending on later programming, the screens may have been changed.

PRECAUTIONS: At all times during the test, all personnel shall have the authority to stop the test if a potentially unsafe condition is discovered or observed. Reminders are placed throughout this procedure to alert personnel to possible problems.

If any test step does not appear to perform as expected, stop the test, place the system in a safe and stable condition. The Test Specialist will determine what actions to take and if the test can continue. Note all exceptions in the comments at the end of the procedure.

Electrical Connections for testing may be made at electrically equivalent locations, such as terminal boards or at the field device.

LIMITATIONS: During the testing of the software function the Test Specialist in conjunction with approval from the CSE may make minor modifications to the software to produce the desired results. All changes to the software must be documented for a formal review. Prior to releasing the ventilation control system to normal operations, other than COLD STANDBY, the changes must be approved through a Field Change Request (FCR) which must have the appropriate level of formal review and be evaluated through the USQ process. Any major software revisions will require the testing to stop until further evaluation is completed. The Test Specialist or the CSE make the decision if a modification is considered a major change. All revisions to the software must be retuned to the institutional software configuration management program for archiving purposes.

The tests listed in this procedure can preformed in any order, with the permission of the CSE. The only exception is the "System Start/Stop Test" which must be preformed first, and "Post Testing Restoration Test" which must be preformed last.

TEST EQUIPMENT:

3- DMM, capable of reading 4-20ma, 120 VAC, and 24 VDC.
With leads and alligator clips. (Calibration not required, these will only be used for nominal voltage readings to verify on/off commands from the PLC)

2- Transmitter simulator, capable of controlling a powered 4-20 ma loop. (Calibration not required, these will only be used for simulation, not calibration. Current signals generated by these test tools will always be considered to be approximate values in this test plan.)

1- Stopwatch (calibration not required)

Electrical Tape.

Screwdriver.

KSL Lifted and Landed Leads sheet

TEST REQUIREMENTS:

Each step in the following test plan has a check box location on the left side of the procedure. When the test step is completed the CSE or Test Specialist shall place a check in this location to indicate the step has been completed satisfactorily. Any test step that was not completed satisfactorily shall be marked with an "X" and shall be noted in the comment section at the end of the test plan.

Where the test plan requires a value to be recorded, the person recording the value shall initial next to the value. Where an independent check of a value is required, the independent reviewer shall record the value they have verified and initial next to the value. When alarm timers are to be verified, the laptop computer may be used to monitor the timer values in the PLC. It is allowable to use the PLC internal timing as

verification of the delay (ie, a delay timer of 30 seconds can be verified by watching the PLC timer count in one second intervals for 30 counts without the use of an external stopwatch).

Where the test plan indicates a value is to be monitored at the HMI, the equivalent (linked) point in the PLC may be monitored using the laptop computer. This may be necessary when short alarm delays cause the "pop up" alarm screen on the HMI to cover the HMI values at the time the value is to be recorded.

Acceptance criterion marked with a $ indicate that the value is directly related to a TSR specified value.

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System Start/Stop Test

1.0 System Start/Stop Test. The ventilation system PLC shall sequentially start-up and Shutdown the ventilation system.

FR 1.1, 1.2, 1.3, 2.0, 3.1, 3.2, 3.3, 3.4, 4.1, 4.2, 5.1, 5.2, 5.3, 6.1, 7.1, and 8.1.

✓ 1.1 Connect DMM on VDC scale across coil of CR1 (FE-001), Slot 3, Out 0. 24 VDC signal.

✓✓✓ 1.1.1. Verify initial reading is 0 VDC nominal.

✓✓ 1.2 At the HMI, Select OPERATIONS SCREEN.

✓✓ 1.3 Depress F9, System Start button.
Expected Results:
Fans Start-up Sequence.
FE-003 Start with FLOW indication on FE-003 and Possibly on HVA-001 delay
FE-002 Start with FLOW indication
delay
HVA-001 Start.

✓ 1.4 Verify DMM changes state after HVA-001 starts. Time delay required. This verified enabling of FE-001.

✓ 1.5 Verify Fans is started in correct sequence.

✓ 1.6 After Fans are stable, record data in Table 1.

✓ 1.6.1. Verify all HMI reading are consistent with direct indications.

✓ 1.7 Verify no alarms during start-up or normal operations.

NOTE: For the next step, It is required that negative pressure is maintained in the GBE, WCG, and Room 102 during fan coast down. It is expected that all DP indications will decay to about zero.

✓ 1.8 Monitor PLC readings for GBE, WCG, and Room 102 DP's during shut down. It is required that negative pressure is maintained in the GBE, WCG, and Room 102 during fan coast down.

Depress F10, System Stop AND F10 again to confirm System Stop.

Expected results:

DMM read goes to 0 VDC nominal

HVA-001 Stop

FE-002 and FE-003 *may* reduce speed due to Min-Max Mode.

delay

FE-002 Stop

delay

FE-003 Stop.

✓ 1.9 Verify DMM reads 0 VDC nominal.

✓ 1.10 Remove DMM

✓ 1.11 Verify Negative Pressure maintained during fan coast down.

Fan Failure Test

2.0 Fan Failure Test FR 1.4.

✓ 2.1 Install 3- DMM in the PLC cabinet as follows:

✓ 2.1.1. Connect DMM on VDC scale across coil of CR2 (FE-002) , Slot 3, Out 1. 24 VDC signal

✓ 2.1.2. Connect DMM on VDC scale across coil of CR3 (FE-003) , Slot 3, Out 2. 24 VDC signal

✓ 2.1.3. Connect DMM on VDC scale across coil of CR4 (HVA-001) , Slot 3, Out 3 24 VDC signal

✓ 2.1.4. Verify initial readings are 0 VDC nominal

✓ 2.2 Open the following Electrical Power Supply Breakers:

✓ 2.2.1. FE-003, PP-A/10

✓ 2.2.2. FE-002, PP-B/3

✓ 2.2.3. HVA-001, PP-B/22

✓ 2.3 At HMI, attempt to start the system by depressing F9, System Start.
Expected results
No Fan Start

✓ 2.4 Verify DMM across CR3 indicates 24 VDC nominal.

✓ 2.5 Verify DMM across CR2 indicates 0 VDC nominal.

✓ 2.6 Verify DMM across CR4 indicates 0 VDC nominal.

✓ 2.7 Verify "FAN STARTUP FAILURE" alarm on HMI.

✓ 2.8 Acknowledge Alarm.

✓ 2.9 Depress F10, System Stop AND F10 again to confirm System Stop.
Expected results:
System Shutdown sequence will reset after about one minute.

✓ 2.10 Verify DMM across CR3 indicates 0 VDC nominal.

✓ 2.11 Close breaker for FE-003, PP-A/10

✓ 2.12 At HMI, attempt to start the system by depressing F9, System Start.
Expected results:
FE-003 Starts

✓ 2.13 Verify DMM across CR3 indicates 24 VDC nominal.

✓ 2.14 Verify DMM across CR2 indicates 24 VDC nominal.

✓ 2.15 Verify DMM across CR4 indicates 0 VDC nominal.

✓ 2.16 Verify "FAN STARTUP FAILURE" alarm on HMI.

✓ 2.17 Depress F10, System Stop AND F10 again to confirm System Stop.
Expected results:
System will Shutdown sequence reset after about one minute.
FE-003 Stop

✓ 2.18 Verify DMM across CR3 indicates VDC nominal.

✓ 2.19 Verify DMM across CR2 indicates 0 VDC nominal.

✓ 2.20 Close breaker for FE-002, PP-B/3

✓ 2.21 At HMI, attempt to start the system by depressing F9, System Start.
Expected results
FE-003 Starts
delay
FE-002 Starts

✓ 2.22 Verify DMM across CR3 indicates 24 VDC nominal.

✓ 2.23 Verify DMM across CR2 indicates 24 VDC nominal.

✓ 2.24 Verify DMM across CR4 indicates 24 VDC nominal.

✓ 2.25 Verify "FAN STARTUP FAILURE" alarm on HMI.

✓ 2.26 Acknowledge Alarm.

✓ 2.27 Depress F10, System Stop AND F10 again to confirm System Stop.
Expected results:

System will Shutdown sequence reset after about one minute.

FE-003 Stop

✓ 2.28 Verify DMM across CR3 indicates 0 VDC nominal.

✓ 2.29 Verify DMM across CR2 indicates 0 VDC nominal.

✓ 2.30 Verify DMM across CR4 indicates 0 VDC nominal.

✓ 2.31 Close Breaker to HVA-001, PP-B/22

Loss Of Electric Power Test

3.0 Loss Of Electric Power (LOEP) Test. FR 1.5.

___√___ 3.1 Locate leads for Under Voltage Relay YS-602. One of YS-602 leads land on Input board Slot 2, terminal 0. This lead will be lifted and re-landed to induce a LOEP.

___√___ 3.2 On HMI, Start ventilation system by depressing F9.
Expected Results. Normal Startup.

___√√___ 3.3 When system is Stable and running, initiate a LOEP by simultaneously lifting the lead located in above step and starting stopwatch.

___√___ 3.4 Stop Stopwatch when FE-003 run command output indicates stop.
Record Time: 3 ADH
Acceptance Criterion: 3 Seconds +/-1

X √ 3.5 Verify "LOSS OF ELECTRICAL POWER" alarm on HMI. (Emulation OK ADH)

___√___ 3.6 Verify all fans have shutdown.

___√___ 3.7 Simultaneously Re-land lifted lead and Start Stopwatch.

___√___ 3.8 Stop Stopwatch when FE-003 Starts.
Record Time: 60 ADH
Acceptance Criterion: 60 Seconds +/-1

___√___ 3.9 Verify all fans restart.

___√___ 3.10 Verify no alarms.

NOTE: Leave system running for next test.

FE-002 HEPA DP Test

4.0 FE-002 HEPA DP Test. FR 6.3, 6.5, and 6.6

INFO TABLE 4 to -20 ma equivalent 0-to 10 " H2O

4	0
8	2.5
9.6	3.5
11.2	4.5
11.6	4.8
19.2	9.5
20	10

✓ 4.1 In Ventilation Control Cabinet , locate leads for PT-203, FE-002 HEPA DP. Transmitter terminals are preferred.
Note designation: Wire I4.2 on Left Hand Terminal Block ADH

✓ 4.2 Lift both field side leads and cover exposed leads with tape.

✓ 4.3 Verify Transmitter Simulator output is zeroed and de-energized.

✓ 4.4 Land leads from Transmitter Simulator.

NOTE: 4-20 ma will correspond to 0 to 10" H2O Scaling.

✓ 4.5 Energize and slowly increase Transmitter Simulator output to 8 ma.

✓ 4.6 Verify HMI indication for FE-002 HEPA DP is 2.5" H2O nominal.

✓ 4.7 Adjust Transmitter Simulator output upward while monitoring the T11:13 timer enable and the FE-002 HEPA pressure on the HMI

✓ 4.7.1. When the timer is enabled record the FE-002 HEPA pressure value indicated on the HMI
Record Value: 3.50 ADH 4-20-07
Verify Value: 3.50 ma 4/20/07
$Acceptance Criterion: 3.5 +/- 0.1

✓ 4.7.2. Verify the "FE-002 HEPA HIGH DP (LCO)" Alarm is received 1 second later. Record the time delay.

Record Value: 1 Second ADH

Acceptance Criterion: 1 Second +/-1

NOTE: The testers should read and understand the following before proceeding.

During these steps the Control mode of the FE-002 will change from controlling on Room 102 DP to controlling HEPA DP, including tripping HVA-001. Since the HEPA DP is an artificial signal, the Transmitter Simulator will directly control FE-002. The tester must monitor Room 102 DP, HEPA DP, and FE-002 CFM during this section. Do not exceed Room 102 DP of -0.50" H2O.

The tester will maintain a signal at about 11.6 ma. This is the controlling point of the HEPA control mode.

The follow control action is expected

If Transmitter Simulator current is decreased, fan speed will increase in an attempt to increase HEPA DP.

If Transmitter Simulator current is increased, fan speed will decrease in an attempt to decrease HEPA DP.

When FE-002 HEPA HIGH-HIGH DP Alarm is received, FE-002 speed will be limited by to the MIN and MAX setpoints. This will limit FE-002 VFD to the Min Max mode limits, as read on HMI.

This mode is locked and requires system restart to reset.

As soon as the FE-002 HIGH-HIGH HEPA alarm is received, adjust the Transmitter Simulator output to 11.6 ma.

✓ 4.8 Adjust Transmitter Simulator output upward while monitoring the T11:14 timer enable and the FE-002 HEPA pressure on the HMI

✓ 4.8.1. When the timer is enabled record the FE-002 HEPA pressure value indicated on the HMI

Record Value: 4.5 ADH

Acceptance Criterion: 4.5 +/- 0.1

✓ 4.8.2. Verify the "FE-002 HEPA HIGH HIGH DP" Alarm is received 1 second later. Record the delay.
Record Value: 1 Sec ADH
Acceptance Criterion: 1 Second +/-1

✓ 4.9 Increase Transmitter Simulator output to 11.6 ma AND maintain fan control.

✓ 4.10 Verify DMM across CR4 indicates 0 VDC. This indicates HVA-001 has shutdown.

✓ 4.11 Adjust Transmitter Simulator output upward while monitoring the FE-002 HEPA pressure on the HMI

✓ 4.11.1. When the "FE-002 HEPA VERY HIGH DP" Alarm is received record the FE-002 HEPA pressure value indicated on the HMI
Record Value: 9.5 ADH
Acceptance Criterion: 9.5 +/- 0.1

✓ 4.12 Verify all fans have shut down.

✓ 4.13 Adjust Transmitter Simulator to zero and de-energize.

✓ 4.14 Remove Transmitter Simulator from PLC and restore transmitter leads.

FE-003 HEPA DP Tests

5.0 FE-003 HEPA DP Tests. FR 4.3, 4.4, and 4.5

INFO TABLE 4 to -20 ma equivalent 0 to 10" H2O

4	0
8	2.5
9.6	3.5
11.2	4.5
11.6	4.8
19.2	9
20	10

ADH 4-21 Test ✓

✓ 5.1 In Ventilation Control Cabinet , locate leads for PY-301, FE-003 HEPA Prefilter and #2 DP. Transmitter terminals are preferred.
Note designation: Terminal IA, 5 at Left Hand Terminal Block ADH

✓ ✓ 5.2 Lift both field side leads and cover exposed leads with tape.

✓ ✓ 5.3 Verify Transmitter Simulator #2 output is zeroed and de-energized.

✓ ✓ 5.4 Land leads from Transmitter Simulator #2. Mark as #2.

NOTE: 4-20 ma will correspond to 0 to 10" H2O Scaling.

✓ ✓ 5.5 In Ventilation Control Cabinet , locate leads for PY-302, FE-003 HEPA #1 DP. Transmitter terminals are preferred.
Note designation: Terminal IA 6 at Left Hand Terminal Block ADH

✓ ✓ 5.6 Lift both field side leads and cover exposed leads with tape.

✓ ✓ 5.7 Verify Transmitter Simulator #1 output is zeroed and de-energized.

✓ ✓ 5.8 Land leads from Transmitter simulator #1. Mark as #1

NOTE: 4-20 ma will correspond to 0 to 10" H2O Scaling.

✓ ✓ 5.9 Start ventilation system by depressing F9, System Start at HMI.

✓ ✓ 5.10 Verify Normal Startup.

✓ ✓ 5.11 Energize and slowly increase Transmitter Simulator #1 output to 8 ma.

ADH 4/21 Test ✓ ✓ 5.12 Verify HMI indication of FE-003 HEPA #1 DP is 2.5" H2O Nominal.

✓ ✓ 5.13 Energize and slowly increase Transmitter Simulator #2 output to 8 ma.

✓ ✓ 5.14 Verify HMI indication of FE-003 HEPA #2 DP is 2.5" H2O Nominal.

✓ ✓ 5.15 Adjust Transmitter Simulator #1 output upward while monitoring the T11:7 timer enable and the FE-003 HEPA #1 pressure on the HMI

✓ ✓ 5.15.1. When the timer is enabled record the FE-003 HEPA #1 pressure value indicated on the HMI

3.5 recorded ADH 4/20/07

Record Value: 3.5 MR 4/20/07

Verify Value: 3.5 Reb 4-20-07

$Acceptance Criterion: 3.5 +/- 0.1

✓ ✓ 5.15.2. Verify the "FE-003 HEPA #1 HIGH DP (LCO)" Alarm is received 1 second later. Record the delay.

Record Value: 1 Sec ADH

Acceptance Criterion: 1 Second +/-1

✓ ✓ 5.16 Adjust Transmitter Simulator output #2 upward while monitoring the T11:10 timer enable and the FE-003 HEPA #2 pressure on the HMI

✓ ✓ 5.16.1. When the timer is enabled record the FE-003 HEPA #2 pressure value indicated on the HMI

3.5 recorded ADH 4/20/07

Record Value: 3.5 MR 4/20/07

Verify Value: 3.5 Reb 4-20-07

$Acceptance Criterion: 3.5 +/- 0.1

✓ ✓ 5.16.2. Verify the "FE-003 HEPA #2 HIGH DP (LCO)" Alarm is received 1 second later. Record the delay.

Record Value: 1 ADH

Acceptance Criterion: 1 Second +/-1

NOTE: The testers should read and understand the following before proceeding. During these steps the Control mode of the FE-003 will change from controlling on GBE DP to controlling HEPA DP, including tripping HVA-001. Since the HEPA DP is an artificial signal, the Transmitter Simulators will directly control FE-003. The tester must monitor GBE DP, both HEPA DP's, and FE-003 CFM during this section. Do not drop below GBE or WCG DP of -0.75" H2O.

Because FE-003 has two HEPA filters, the controls selects the greater of the two values when in HEPA Control Mode

The tester will maintain the higher signal at about 11.6ma. This is the controlling point of the HEPA control mode.

The follow control action is expected:

If Transmitter Simulator current is decreased, fan speed will increase in an attempt to increase HEPA DP.

If Transmitter Simulator current is increased, fan speed will decrease in an attempt to decrease HEPA DP.

When either FE-003 HEPA HIGH-HIGH DP Alarm is received, FE-003 speed will be limited by the MIN and MAX setpoints. This will limit FE-003 VFD to min/max mode setpoints, as read on HMI.

This mode is locked and requires system restart to reset.

ADH 4/21/07 Test

As soon as the first "FE-003 HIGH-HIGH HEPA DP" alarm is received, adjust the Transmitter Simulator output to 11.6 ma.

✓ ✓ 5.17 Adjust Transmitter Simulator output #1 upward while monitoring the T11:8 timer enable and the FE-003 HEPA #1 pressure on the HMI

✓ ✓ 5.17.1. When the timer is enabled record the FE-003 HEPA #1 pressure value indicated on the HMI

Record Value: 4.5 ADH

Acceptance Criterion: 4.5 +/-0.1

✓ ✓ 5.17.2. Verify the "FE-003 HEPA #1 HIGH HIGH DP" Alarm is received 1 second later. Record the delay.

ADH 4/20/07 Test

Record Value: 1 ADH

Acceptance Criterion: 1 Second +/-1

✓ ✓ 5.18 Increase Transmitter Simulator #1 output to 11.6 ma AND maintain fan control.

✓ ✓ 5.19 Adjust Transmitter Simulator #1 output to verify control of FE-003 speed Control.

✓ ✓ 5.20 Adjust Transmitter Simulator output #2 upward while monitoring the T11:11 timer enable and the FE-003 HEPA #2 pressure on the HMI

✓ ✓ 5.20.1. When the timer is enabled record the FE-003 HEPA #2 pressure value indicated on the HMI

Record Value: 4.5 ADH

Acceptance Criterion: 4.5 +/-0.1

✓ ✓ 5.21 Verify the "FE-003 HEPA #2 HIGH HIGH DP" Alarm is received 1 second later. Record the delay.

Record Value: 1 ADH

Acceptance Criterion: 1 Second +/-1

✓ ____ 5.22 Increase Transmitter Simulator #2 output to 11.6 ma AND maintain fan control

✓ ____ 5.23 Decrease Transmitter Simulator #1 output to 8 ma (~2.5in wc).

✓ ____ 5.24 Verify "FE-003 HEPA #1 HIGH DP" Alarm clears.

✓ ____ 5.25 Adjust Transmitter Simulator #2 output to verify control of FE-003 speed.

✓ ____ 5.26 Adjust Transmitter Simulator #2 output upward while monitoring the FE-003 HEPA #2 pressure on the HMI

✓ ____ 5.26.1. When the "FE-003 HEPA #2 VERY HIGH DP" Alarm is received record the FE-003 HEPA #2 pressure value indicated on the HMI

Record Value: 9.5 ADH

Acceptance Criterion: 9.5 +/- 0.1

✓ ____ 5.27 Verify all fans have shut down.

ADH
4/21/07
Test

✓ 5.28 Decrease Transmitter Simulator #2 output to 8 ma (~2.5in wc).

✓ 5.29 Start ventilation system by depressing F9, System Start at HMI.

✓ 5.30 Verify Normal Startup.

✓ 5.31 Increase Transmitter Simulator #1 output to 11.6 ma AND maintain fan control. "FE-003 HEPA #1 HIGH HIGH DP" alarm is expected

✓ 5.32 Adjust Transmitter Simulator #1 output upward while monitoring the FE-003 HEPA #1 pressure on the HMI

✓ 5.32.1. When the "FE-003 HEPA #1 VERY HIGH DP" Alarm is received record the FE-003 HEPA #1 pressure value indicated on the HMI

Record Value: 9.5 ADH

Acceptance Criterion: 9.5 +/- 0.1

✓ 5.33 Verify all fans have shut down.

✓ 5.34 Adjust Transmitter Simulators to zero and de-energize.

✓ 5.35 Remove Transmitter Simulator #1 and #2 from PLC and restore transmitter leads.

WCG and GBE Pressure Alarms and Test

6.0 WCG and GBE Alarms. FR 3.4, 3.5, 3.6, 3.7, and 3.8.

INFO TABLE 4 to -20 ma equivalent 0 to -1.0" H2O

4	0
8	-0.25
12	-0.5
16	-0.75
20	-1.0

✓ 6.1 In Ventilation Control Cabinet , locate leads for PC-501 GBE DP. Transmitter terminals are preferred.
Note designation: Left Hand Terminal Strip Terminal I:4/4 ADH

✓ 6.2 Lift both field side leads and cover exposed leads with tape.

✓ 6.3 Verify Transmitter Simulator #1 output is zeroed and de-energized.

✓ 6.4 Land leads from Transmitter Simulator #1. Mark as #1.

NOTE: 4-20 ma will correspond to 0 to -1.0" H2O Scaling.

✓ 6.5 Energize transmitter and set Transmitter Simulator #1 to 12 ma.

✓ 6.6 Verify PC-501 HMI indication is about -0.5" H2O.

✓ 6.7 Adjust Transmitter Simulator #1 to 4 ma.

✓ 6.8 In Ventilation Control Cabinet, locate leads for P-502, WCG DP. Transmitter terminals are preferred.
Note designation: Left Hand Terminal Strip, Terminal I:3/0 ADH

✓ 6.9 Lift both field side leads and cover exposed leads with tape.

✓ 6.10 Verify Transmitter Simulator #2 output is zeroed and de-energized.

✓ 6.11 Land leads from Transmitter Simulator #2. Mark as #2

NOTE: 4-20 ma will correspond to 0 to -1.0" H2O Scaling.

✓ 6.12 Energize transmitter and set Transmitter Simulator #2 to 12 ma.

✓ 6.13 Verify PC-502 HMI indication is about -0.5" H2O.

✓ 6.14 Perform one of the following to defeat FE-003 VFD Manual Mode signal.

✓ 6.14.1. Use Laptop to force FE-003 VFD Manual Mode bit to OFF
Ladder bit designation: I:1/1 "FE-003 Manual Mode" ADH

OR

NA ADH 6.14.2. In PLC Cabinet, locate leads for FE-003 Manual Mode, Slot 2, In 1.
Note designation: NA ADH
Lift one lead and cover exposed leads with tape.

NOTE: The testers should read and understand the following before proceeding.
Forcing the PLC point OR lifting the FE-003 Manual Mode lead will enable the system to be started and operated without alarms.
Control note:
During the start-up, the error signal produced by the DP signal (Transmitter Simulator) influences the start up of the fan. It will be necessary to adjust the Transmitter Simulator during system start-up to simulate the normal start up sequence. The best method should be to control the Transmitter Simulator between the OFF value and Normal operating value as the system start's up. Observe and compare DP gauge and HMI DP indication (OPERATION Screen). The normal operating value is about 12 ma.
During startup the Signal produced by Transmitter Simulator #1 will control FE-003 speed.
Since the GBE DP is an artificial signal, the Transmitter Simulator will directly control FE-003. The tester must monitor GBE DP, WCG DP, and FE-003 CFM during this section. Do not exceed GBE or WCG DP of -0.75" H2O.
The tester will maintain a signal at about 12ma. This is the controlling point of the normal control mode.
The follow control action is expected:
If Transmitter Simulator current is decreased, fan speed will increase in an attempt to decrease GBE DP.

If Transmitter Simulator current is increased, fan speed will decrease in an attempt to increase GBE DP.

When the GBE HIGH-HIGH Press Alarm is received, FE-003 speed will be limited by the MIN and MAX setpoints. This will limit FE-003 VFD to the min/max mode setpoints, as read on HMI.

This mode is locked and requires system restart to reset.

✓ 6.15 While monitoring GBE DP and FE-003 Flowrate, Start Ventilation system by depressing F9 on the HMI Display.

✓ 6.16 Control and stabilize FE-003 Flow and GBE DP with Transmitter Simulator #1. Target is GBE DP equal to -0.5" H2O as read at PDI-031.

✓ 6.17 Adjust Transmitter Simulator #1 to demonstrate control of FE-003 Flow, GBE DP, and WCG DP.

✓ 6.18 Adjust Transmitter Simulator output #2 downward while monitoring the T11:5 timer enable and the WCG DP on the HMI

✓ 6.18.1. When the timer is enabled record the WCG DP value indicated on the HMI

Record Value: -.3 ADH

Acceptance Criterion: -0.30 +/- 0.05

✓ 6.18.2. Verify the "WCG HIGH PRESSURE" Alarm is received 30 Seconds later. Record the delay.

Record Value: 30 ADH

Acceptance Criterion: 30 Seconds +/-1

✓ 6.19 Adjust Transmitter Simulator output #2 downward while monitoring the T11:6 timer enable and the WCG DP on the HMI

✓ 6.19.1. When the timer is enabled record the WCG DP value indicated on the HMI

Record Value: -0.10" ADH 4/21/07

Verify Value: -.10" MR 4/21/07

$Acceptance Criterion: -0.10 +/- 0.02

✓ 6.20 Verify the "WCG HIGH HIGH PRESSURE" Alarm is received 5 seconds later. Record the delay.
Record Value: 5 Sec ADH
Acceptance Criterion: 5 Seconds +/-1
Expected results:
FE-002 Shutdown
HVA-001 Shutdown

✓ 6.21 Stabilize FE-003 Flow and GBE DP with Transmitter Simulator #1. Target is GBE DP equal to -0.5" H2O.

✓ 6.22 Record FE-003 VFD Percent on HMI: 24.5 Hz ADH
Acceptance Criterion: None, value for reference only

✓ 6.23 Verify DMM across CR4 indicates 0 VDC. This indicates HVA-001 has shutdown.

ADH Final Test 11:21
X ✓ 6.24 Verify DMM across CR2 indicates 0 VDC. This indicates FE-002 has shutdown.

✓ 6.25 Stop ventilation system by depressing F10 on HMI Display.

✓ 6.26 Set Transmitter Simulator #2 to 12 ma.

✓ 6.27 Verify PC-502 HMI indication is about -0.5" H2O.

✓ 6.28 While monitoring GBE DP and FE-003 Flowrate, Start Ventilation system by depressing F9 on the HMI Display.

✓ 6.29 Control and stabilize FE-003 Flow and GBE DP with Transmitter Simulator #1. Target is GBE DP equal to -0.5" H2O as read at PDI-031.

NOTE: The testers should read and understand the following before proceeding.
Control of FE-003 will be controlled directly with the VFD in manual mode.
Establish communication with VFD operator, Gauge Monitor, and HMI Operator to insure control of ventilation system.
Control mode will change when FE-003 HIGH-HIGH alarm is received.
Use VFD percent record above as target to control the system.

✓ 6.30 At FE-003 VFD, select manual control. Control system using VFD controls. Target is GBE DP on local indication (PDI-031) equal to -0.5" H2O.

✓ 6.31 Adjust Transmitter Simulator output #1 downward while monitoring the T11:3 timer enable and the GBE DP on the HMI

✓ 6.31.1. When the timer is enabled record the GBE DP value indicated on the HMI

Record Value: -0.3" ADH

Acceptance Criterion: -0.30 +/- 0.05

✓ 6.31.2. Verify the "GBE HIGH PRESSURE" Alarm is received 30 seconds later. Record the delay.

Record Value: 30 Sec ADH

Acceptance Criterion: 30 Seconds +/-1

✓ 6.32 Adjust Transmitter Simulator output #1 downward while monitoring the T11:4 timer enable and the GBE DP on the HMI

✓ 6.32.1. When the timer is enabled record the GBE DP value indicated on the HMI

Record Value: -0.10" ADH 4/21/07

Verify Value: -0.10" MA 4/21/07

$Acceptance Criterion: -0.10 +/- 0.02

✓ 6.33 Verify the "GBE HIGH HIGH PRESSURE" Alarm is received 5 seconds later. Record the delay.

Record Value: 5 ADH

Acceptance Criterion: 5 Seconds +/-1

Expected results:

FE-002 Shutdown

HVA-001 Shutdown

✓ 6.34 Stabilize FE-003 Flow and GBE DP with FE-003 VFD controls. Target is GBE DP on local indication (PDI-031) equal to -0.5" H2O.

✓ 6.35 Verify DMM across CR4 indicates 0 VDC. This indicates HVA-001 has shutdown.

✓ 6.36 Verify DMM across CR2 indicates 0 VDC. This indicates FE-002 has shutdown.

✓ 6.37 Stop ventilation system by depressing F10 on HMI Display.

✓ 6.38 De-energize Transmitter Simulator #1 and #2.

✓ 6.39 Remove Transmitter Simulator #1 and restore wiring.

✓ 6.40 Remove Transmitter Simulator #2 and restore wiring.

✓ 6.41 Place FE-003 in Automatic Mode.

FE-003 Flow Verification Test

7.0 FE-003 Flow Verification. FR 3.9, 3.10

✓ 7.1 In Ventilation Control Cabinet , locate leads for FY-301, FE-003 Flow DP. Transmitter terminals are preferred.
Note designation: I: 4/3 on Left hand terminal Block ADH

✓ 7.2 Lift both field side leads and cover exposed leads with tape.

✓ 7.3 Verify Transmitter Simulator #1 output is zeroed and de-energized.

✓ 7.4 Land leads from Transmitter Simulator #1. Mark as #1.

NOTE: 4-20 ma will correspond to 0 to 0.5" H2O or 0 to 2673 CFM

✓ 7.5 Energize transmitter and set Transmitter Simulator #1 to 4 ma.

NOTE: The testers should read and understand the following before proceeding. During the start-up, the error signal produced by the flow signal (Transmitter Simulator) influences the start-up of the fan. It will be necessary to adjust the Transmitter Simulator during system start-up to simulate the normal start up sequence. The best method should be to control the Transmitter Simulator between the OFF value and Normal operating value as the system start's up. Observe and compare DP gauge and HMI DP indication (STATUS Screen). The normal operating value is about 8 ma.

✓ 7.6 Start Ventilation system by depressing F9 on the HMI Display.

✓ 7.7 Control and stabilize FE-~~002~~ 003 Flow and GBE DP with Transmitter Simulator #1. Target is GBE DP on HMI Indication of -0.50" H2O. ADH 4-21-07

✓ 7.8 Verify system starts normally.

NOTE: Following Step verifies restoration from previous steps.

✓ 7.9 Verify normal indication for GBE and WCG DP on HMI.
Record GBE DP Value: -.49 ADH
Acceptance Criterion: -0.50" +/-0.20

Record WCG DPValue: -0.46 ADH

Acceptance Criterion: -0.50" +/-0.20

✓ 7.10 Verify normal readings on FE-003 HEPA Filters.

Record Value: .33 / .31 ADH

Acceptance Criterion: Greater than Zero

✓ 7.11 Verify normal reading on FE-002 HEPA Filter.

Record Value: .01 ADH

Acceptance Criterion: Greater than Zero

✓ 7.12 Adjust Transmitter Simulator #1 to demonstrate control of FE-003 Flow, GBE DP, and WCG DP.

NOTE: The testers should read and understand the following before proceeding. Control of FE-003 will be controlled directly with the VFD in manual mode. Establish communication with VFD operator, Gauge Monitor, and HMI Operator to insure control of ventilation system.
Control mode will change when FE-003 LOW LOW FLOW alarm is received. Use VFD setpoint record in section 6 above as target to control the system.

✓ 7.13 At FE-003 VFD, select manual control. Control system using VFD controls. Target is GBE DP on HMI Indication of -0.50" H2O.

✓ 7.14 Adjust Transmitter Simulator #1 to display about 1000 CFM on FE-003 Flow

✓ 7.15 Adjust Transmitter Simulator output #1 downward while monitoring the T11:16 timer enable and the FE-003 flow on the HMI

✓ 7.15.1. When the timer is enabled record the FE-003 flow value indicated on the HMI ADH 4-21-07

Record Value: ~~750~~ 749 ADH

Acceptance Criterion: 750 +/-50

✓ 7.15.2. Verify the "FE-003 LOW FLOW" Alarm is received 1 second later. Record the delay.

Record Value: 1 Sec ADH

Acceptance Criterion: 1 Second +/-1

✓ 7.16 Adjust Transmitter Simulator output #1 downward while monitoring the T11:17 timer enable and the FE-003 flow on the HMI

✓ 7.16.1. When the timer is enabled record the FE-003 flow value indicated on the HMI

Record Value: 499 ADH

Acceptance Criterion: 500 +/-50

✓ 7.17 Verify the "FE-003 LOW LOW FLOW" Alarm is received 1 second later. Record the delay.

Record Value: 1 Sec ADH

Acceptance Criterion: 1 Second +/-1

✓ 7.18 Stop ventilation system by depressing F10 on HMI Display.

✓ 7.19 Remove Transmitter Simulator #1 and restore Transmitter wiring.

✓ 7.20 On FE-003 VFD, select Automatic Mode.

Room 102 Pressure Test

8.0 Room 102 Pressure Alarms. FR 5.3, 5.4, 5.5.

INFO TABLE 4 to -20 ma equivalent +0.50 to -0.50" H2O

4	-0.50
8	-0.25
12	0.0
16	0.25
20	0.5

✓ 8.1 In Ventilation Control Cabinet , locate leads for PC-601 Room 102 DP. Slot 5, In 1. Transmitter terminals are preferred.
Note designation: I:4/1 at Left hand Terminals ADH

✓ 8.2 Lift both field side leads and cover exposed leads with tape.

✓ 8.3 Verify Transmitter Simulator #1 output is zeroed and de-energized.

✓ 8.4 Land leads from Transmitter Simulator #1. Mark as #1.

NOTE: 4-20 ma will correspond to -0.5 to -0.5 " H2O Scaling.

✓ 8.5 Energize transmitter and set Transmitter Simulator #1 to 8 ma.

✓ 8.6 Verify PC-601 HMI indication is -0.25" H2O nominal.

NOTE: The testers should read and understand the following before proceeding. During the start-up, the error signal produced by the DP signal (Transmitter Simulator) influences the start-up of the fan. It will be necessary to adjust the Transmitter Simulator during system start-up to simulate the normal start-up sequence. The best method should be to control the Transmitter Simulator between the zero building pressure value and Normal operating value as the system start's up. Observe and compare DP gauge and HMI DP indication (STATUS Screen). The normal operating value is about 8ma.

During startup, the signal produced by Transmitter Simulator #1 will control FE-002 speed.

Since the Room 102 DP is an artificial signal, the Transmitter Simulator will directly control FE-002. The tester must monitor Room 102 DP, GBE DP, FE-002 HEPA DP, and FE-002 CFM during this section. Do not exceed Room 102 DP of -0.5" H2O.

The following control action is expected: This is contrary to the previous test section.

If Transmitter Simulator current is increased, fan speed will increase in an attempt to decrease room 102 DP.

If Transmitter Simulator current is decreased, fan speed will decrease in an attempt to increase Room 102 DP.

When the Room 102 HIGH-HIGH Press Alarm is received, FE-002 speed will be limited by the MIN and MAX setpoints. This will limit FE-002 VFD to the min/max mode setpoints, as read on HMI.

This mode is locked and requires system restart to reset.

✓ 8.7 While monitoring Room 102 DP, GBE DP, FE-002 HEPA DP, and FE-002 Flowrate, Start Ventilation system by depressing F9 on the HMI Display.

✓ 8.8 Control and stabilize FE-002 Flow and Room 102 DP with Transmitter Simulator #1. Target is Room 102 DP of -0.25" H2O as read on local indicator (PDI-022).

✓ 8.9 Adjust Transmitter Simulator #1 to demonstrate control of FE-002 Flow and Room 102 DP.

NOTE: The testers should read and understand the following before proceeding. Control of FE-002 will be controlled directly with the FE-002 VFD in manual mode. Establish communication with VFD operator, Gauge Monitor, and HMI Operator to insure control of ventilation system. Control mode will change when "ROOM 102 HIGH-HIGH PRESSURE" alarm is received.

✓ 8.10 At FE-002 VFD, select manual control. Control system using FE-002 VFD controls. Target is Room 102 DP of -0.25" H2O as read on local indicator (PDI-022).

✓ 8.11 Adjust Transmitter Simulator output #1 upward while monitoring the T11:1 timer enable and the Room 102 Static Pressure on the HMI

✓ 8.11.1. When the timer is enabled record the Room 102 Static Pressure value indicated on the HMI

Record Value: -0.25" ADH

Acceptance Criterion: 0.1 +/- 0.02

✓ 8.11.2. Verify the "ROOM 102 HIGH PRESSURE" Alarm is received 60 seconds later. Record the delay.

Record Value: 60 ADH

Acceptance Criterion: 60 Seconds +/-1

✓ 8.12 Adjust Transmitter Simulator output #1 upward while monitoring the T11:2 timer enable and the Room 102 Static Pressure on the HMI

✓ 8.12.1. When the timer is enabled record the Room 102 Static Pressure value indicated on the HMI

Record Value: -0.05" ADH 4/21/07

Verify Value: -.05" MR 4/21/07

$Acceptance Criterion: -0.05 +/- 0.02

ADH 4/4/07

Room 102 HIGH HIGH PRESSURE

✓ 8.13 Verify the "~~GBE HIGH PRESSURE~~" Alarm is received 30 seconds later. Record the delay.

Record Value: 30 ADH

Acceptance Criterion: 30 Seconds +/-1

Expected results:

HVA-001 Shutdown

✓ 8.14 Verify DMM across CR4 indicates 0 VDC. This indicates HVA-001 has shutdown.

✓ 8.15 Stop ventilation system by depressing F10 on HMI Display.

✓ 8.16 De-energize Transmitter Simulator #1.

✓ 8.17 Remove Transmitter Simulator #1 and restore wiring.

✓ 8.18 Place FE-002 in Automatic Mode.

FE-002 Flow Verification Test

9.0 FE-002 Flow Verification. FR 5.6, 5.7

✓ 9.1 In Ventilation Control Cabinet , locate leads for FY-201, Flow DP. Slot 5, Input 0. Transmitter terminals are preferred.
Note designation: I:4/0 on Left hand Terminals AD4

✓ 9.2 Lift both field side leads and cover exposed leads with tape.

✓ 9.3 Verify Transmitter Simulator #1 output is zeroed and de-energized.

✓ 9.4 Land leads from Transmitter Simulator #1. Mark as #1.

NOTE: 4-20 ma will correspond to 0 to 0.5" H2O or 0 to 2659 CFM

✓ 9.5 Energize transmitter and set Transmitter Simulator #1 to 4 ma.

NOTE: The testers should read and understand the following before proceeding. During the start-up, the error signal produced by the flow signal (Transmitter Simulator) influences the start-up of the fan. It will be necessary to adjust the Transmitter Simulator during system start-up to simulate the normal start up sequence. The best method should be to control the Transmitter Simulator between the OFF value and Normal operating value as the system start's up. The normal operating value is about 8 ma.

✓ 9.6 Start Ventilation system by depressing F9 on the HMI Display.

✓ 9.7 Control and stabilize Room 102 DP with Transmitter Simulator #1. Target is Room 102 DP of -0.25" H2O as read on PDI-022.

✓ 9.8 Verify system starts normally.

✓ 9.9 Adjust Transmitter Simulator #1 to demonstrate control of FE-002 Flow and Room 102 DP.

NOTE: The testers should read and understand the following before proceeding. Control of FE-002 will be controlled directly with the VFD in manual mode. Establish communication with VFD operator, Gauge Monitor, and HMI

Operator to insure control of ventilation system.
Control mode will change when "FE-002 LOW LOW FLOW" alarm is received.

✓ 9.10 At FE-002 VFD, select manual control. Control system using VFD controls. Target is Room 102 DP of -0.25" H2O as read on PDI-022.

✓ 9.11 Adjust Transmitter Simulator #1 to display about 3500 CFM on FE-002 Flow.

✓ 9.12 Adjust Transmitter Simulator output #1 downward while monitoring the T11:18 timer enable and the FE-002 flow on the HMI

✓ 9.12.1. When the timer is enabled record the FE-002 flow value indicated on the HMI
Record Value: 2999 ADH
Acceptance Criterion: 3000 +/-150

✓ 9.12.2. Verify the "FE-002 LOW FLOW" Alarm is received 1 second later. Record the delay.
Record Value: 1 ADH
Acceptance Criterion: 1 Second +/-1

✓ 9.13 Adjust Transmitter Simulator output #1 downward while monitoring the T11:19 timer enable and the FE-002 flow on the HMI

✓ 9.13.1. When the timer is enabled record the FE-002 flow value indicated on the HMI
Record Value: 1999 ADH
Acceptance Criterion: 2000 +/-100

✓ 9.14 Verify the "FE-002 LOW LOW FLOW" Alarm is received 1 second later. Record the delay.
Record Value: 1 ADH
Acceptance Criterion: 1 Second +/-1

✓ 9.15 Stop ventilation system by depressing F10 on HMI Display.

✓ 9.16 Remove Transmitter Simulator #1 and restore Transmitter wiring.

✓ 9.17 On FE-002 VFD, select Automatic Mode.

HVA-001 Flow Test

10.0 HVA-001 Flow Tests. 7.2, 7.3

✓ 10.1 In Ventilation Control Cabinet , locate leads for FY-101, Flow DP.
Slot 5, Input 7. Transmitter terminals are preferred. ADH 4-21-07
Note designation: Left Hand Terminal Block, Terminal I:4/~~7~~ 7 A-DH

✓ 10.2 Lift both field side leads and cover exposed leads with tape.

✓ 10.3 Verify Transmitter Simulator #1 output is zeroed and de-energized.

✓ 10.4 Land leads from Transmitter Simulator #1. Mark as #1.

NOTE: 4-20 ma will correspond to 0 to 0.5" H2O or 0 to 5,070 CFM

✓ 10.5 Energize transmitter and set Transmitter Simulator #1 to 10 ma.

✓ 10.6 Start Ventilation system by depressing F1 on the HMI Display.

✓ 10.7 Verify system starts normally.

✓ 10.8 Adjust Transmitter Simulator #1 for about 3500 CFM indication on HMI.

X ✓ 2nd Time 10.9 Adjust Transmitter Simulator output #1 downward while monitoring the T11:20 timer enable and the HVA-001 flow on the HMI

✓ 10.9.1. When the timer is enabled record the HVA-001 flow value indicated on the HMI
Record Value: 2000 ADH
Acceptance Criterion: 2000 +/-100

✓ 10.9.2. Verify the "HVA-001 LOW FLOW" Alarm is received 1 second later. Record the delay.
Record Value: 1 ADH
Acceptance Criterion: 1 Second +/-1

✓ 10.10 Adjust Transmitter Simulator output #1 downward while monitoring the T11:21 timer enable and the HVA-001 flow on the HMI

✓ 10.10.1. When the timer is enabled record the HVA-001 flow value indicated on the HMI

Record Value: 1000 ADH

Acceptance Criterion: 1000 +/-75

✓ 10.11 Verify the "HVA-001 LOW LOW FLOW" Alarm is received 1 second later.

Record the delay.

Record Value: 1 ADH

Acceptance Criterion: 1 Second +/-1

✓ 10.12 Stop ventilation system by depressing F10 on HMI Display.

✓ 10.13 Remove Transmitter Simulator #1 and restore Transmitter wiring.

Freeze Protection Test

11.0 Freeze Protection. FR 9.1

INFO TABLE 4 to -20 ma equivalent 0 to 135 °F

4	0°F
8.74	40°F
12	67.5°F
20	135

NOTE: Low Temperature alarms are expected during Transmitter Simulator setup.

✓ 11.1 In Ventilation Control Cabinet , locate leads for TE/TT-001, Room Temperature Transmitter.
Slot 4, Input 1.
Note designation: Input Modul 3, Input #1 ADH

✓ 11.2 Lift both field side leads and cover exposed leads with tape.

✓ 11.3 Verify Transmitter Simulator #1 output is set to 12mA.

✓ 11.4 Land leads from Transmitter Simulator #1. Mark as #1.

NOTE: 4-20 ma will correspond to 0 to 135°F

✓ 11.5 In Ventilation Control Cabinet , locate leads for TE/TT-002, Attic Temperature Transmitter.
Slot 4, Input 2.
Note designation: Input Modul 3, Input #2 ADH

✓ 11.6 Lift both field side leads and cover exposed leads with tape.

✓ 11.7 Verify Transmitter Simulator #2 output is 12mA.

✓ 11.8 Land leads from Transmitter Simulator #2. Mark as #2.

NOTE: 4-20 ma will correspond to 0 to 135°F.

✓ 11.9 Verify all arms clear.

✓ 11.10 Start Ventilation system by depressing F9 on the HMI Display.

✓ 11.11 Verify Normal Startup.

✓ 11.12 Adjust Transmitter Simulator #1 output downward while monitoring the TE-001 ~~pressure~~ Temperature on the HMI ADH 4-20-07

✓ 11.13 When the "TE-001 LOW TEMP" Alarm is received record the TE-001 temperature value indicated on the HMI

Record Value: 40 ADH

Acceptance Criterion: 40 +/-1

✓ 11.14 Expected Results:

Alarm

HVA-001 Shutdown

FE-002 Shutdown.

✓ 11.15 Verify Freeze Protection Alarm.

✓ 11.16 Increase Transmitter Simulator #1 until Freeze Protection Alarm Clears.

✓ 11.17 Verify Fans FE-002 and HVA-001 DO NOT RESTART.

✓ 11.18 Stop ventilation system by depressing F10 on HMI Display.

✓ 11.19 Start Ventilation system by depressing F9 on the HMI Display.

✓ 11.20 Verify Normal Startup

✓ 11.21 Adjust Transmitter Simulator #2 output downward while monitoring the TE-002 ~~pressure~~ Temperature ADH 4-20-07 on the HMI

✓ 11.22 When the "TE-002 LOW TEMP" Alarm is received record the TE-002 temperature value indicated on the HMI

Record Value: 40 ADH

Acceptance Criterion: 40 +/-1

✓ 11.23 Expected Results:

Alarm

HVA-001 Shutdown

FE-002 Shutdown.

✓ 11.24 Verify Freeze Protection Alarm.

✓ 11.25 Increase Transmitter Simulator #2 until Freeze Protection Alarm Clears.

✓ 11.26 Verify Fans FE-002 and HVA-001 DO NOT RESTART.

✓ 11.27 Stop ventilation system by depressing F10 on HMI Display.

✓ 11.28 Adjust Transmitter Simulator #2 output downward until TE-002 reads 20°F and the "TE-002 LOW TEMP" alarm is received,

✓ 11.29 On HMI, Depress Freeze Protection Override AND start stopwatch.

✓ 11.30 Start Ventilation system by depressing F9 on the HMI Display.

Note: Status can be monitored with Laptop by monitoring T12:10.

✓ 11.31 (About 30 minutes later) When Ventilation system shuts down, stop stopwatch and record time: 1800 Seconds = 30min ADH
Acceptance Criterion: 30 Minutes +/-

✓ 11.32 Stop ventilation system by depressing F10 on HMI Display.

NOTE: Low Temperature alarms are expected during channel restoration.

✓ 11.33 Remove Transmitter Simulator #1 and restore wiring.

✓ 11.34 Remove Transmitter Simulator #2 and restore wiring.

✓ 11.35 Remove all DMM from PLC cabinet.

✓ 11.36 Start Ventilation system by depressing F9 on the HMI Display.

✓ 11.37 Verify System Starts normally.

Maintenance Mode Tests

12.0 Maintenance Mode Test. FR 10.1, 10.2, 10.3, 10.4

✓ 12.1 Perform one of the following:

✓ 12.1.1. Remove PLC Force from section 6.

OR

NA ADH 12.1.2. Restore Transmitter leads for FE-003 Manual Mode, Slot 2, In 1.

✓ 12.2 On HMI, depress and hold TEST ALARM.

✓ 12.3 Verify ALARM TEST Alarm.

✓ 12.4 On HMI, release TEST ALARM.

NOTE: Window Replacement mode changes control mode of FE-003. FE-003 will attempt to control on the FE-003 HEPA filter with the greatest DP with a setpoint of 4.5" H2O.
It is not required to let FE-003 obtain maximum speed.

✓ 12.5 On the HMI MAINTENANCE Screen, depress Window Replacement Mode.

✓ 12.6 Verify Maintenance Mode Alarm.

✓ 12.7 Verify FE-003 speed increase, as indicated by an decrease in GBE DP, WCG DP, or an increase in FE-003 Flow indication.

✓ 12.8 Depress NORMAL OPERATIONS

✓ 12.9 Verify Maintenance Mode Alarm Clears.

✓ 12.10 Verify FE-003 returns to normal operations, as indicated on GBE DP, WCG DP, and FE-003 Flow indication

✓ 12.11 Set the "CUTTING CHAMBER SETPOINT" to -0.50

✓ 12.12 On the HMI MAINTENANCE Screen, depress Large Bag-Out Mode.

✓ 12.13 Verify Maintenance Mode Alarm.

✓ 12.14 Verify that FE-003 modulates to maintain a GBE pressure of -0.50in wc nominal

✓ 12.15 Set the "CUTTING CHAMBER SETPOINT" to -0.40

✓ 12.16 Verify that FE-003 modulates to maintain a GBE pressure of -0.40in wc nominal

NA AOH 12.17 ~~Verify Maintenance Mode Alarm:~~ AOH 4-21-07

✓ 12.18 Depress NORMAL OPERATIONS

✓ 12.19 Verify Maintenance Mode Alarm Clears.

NOTE: The testers should read and understand the following before proceeding. Control of FE-003 will be controlled directly with the VFD in manual mode. Establish communication with VFD operator, Gauge Monitor, and HMI Operator to insure control of ventilation system.

✓ 12.20 At FE-003, Select Manual Control

✓ 12.21 Verify Maintenance Mode Alarm.

✓ 12.22 At FE-003, Select Auto Control

✓ 12.23 Verify Maintenance Mode Alarm Clears.

VFD Fault Test for FE-002 and FE-003

13.0 VFD Fault alarm testing. FR 12.0, 12.1, 12.2

✓ 13.1 Start the ventilation system in normal mode.

✓ 13.2 Once system has stabilized:

✓ 13.2.1. Using the FE-002 VFD display, change Parameter 1403 from 4 (Fault) to 3 (Fault (-1)) AND start stop watch

✓ 13.2.2. (About 30 seconds later) The PLC will generate a FE-002 VFD Fault alarm.

✓ 13.2.3. Record the time 30 ADH

Acceptance Criterion: 30 Seconds +/- 1

✓ 13.2.4. Using the FE-002 VFD display, change Parameter 1403 from 3 (Fault (-1)) to 4 (Fault)

✓ 13.3 Reset the FE-002 alarm and allow system to return to normal operations

X See Log Entry 4/20/07 19:36 ADH 13.3.1. Using the FE-003 VFD display, change the VFD Parameter for the VFD Run Relay from "Fault" to "Fault(-1)" AND start stop watch.

✓ 13.3.2. (About 30 seconds later) The PLC will generate a FE-003 VFD Fault alarm.

✓ 13.3.3. Record the time 30 ADH

Acceptance Criterion: 30 Seconds +/- 1

X See Log Entry 4/20/07 19:40 ADH 13.3.4. Using the FE-003 VFD display, change the VFD Parameter for the VFD Run Relay from "Fault(-1) to "Run"

✓ 13.4 Reset the FE-002 alarm and allow system to return to normal operations.

Loop Stability Test for FE-002 and FE-003

14.0 Loop stability and tuning test. FR Good Engineering Practice.

✓ 14.1 Start the ventilation system in normal mode.

✓ 14.2 Verify that the system starts and operates normally

✓ 14.3 When FE-002 has stabilized perform a stability test as follows:

✓ 14.3.1. Adjust the building pressure setpoint to -0.30 in w.c.

✓ 14.3.2. Monitor the FE-002 fan speed and building pressure as the system re-stabilizes.

✓ 14.3.3. If needed, based on the response of the system, adjust FE-002 PID loop tuning parameters.
Acceptance Criterion: Subject to Test Specialist best engineering judgment but in no case should the oscillation of the system leave the -0.15" to -0.50" range.

✓ 14.3.4. Adjust the building pressure setpoint to -0.25" in w.c.

✓ 14.3.5. Monitor the FE-002 fan speed and building pressure as the system re-stabilizes.

✓ 14.3.6. If PID loop tuning parameters were adjusted in step 13.3.3 then return to step 13.3.2 and repeat until no adjustments are required.

✓ 14.3.7. Record the changes (if any) to the tuning parameters.

✓ 14.4 When FE-003 has stabilized perform a stability test as follows:

✓ 14.4.1. Adjust the GBE pressure setpoint to -0.55 in w.c.

✓ 14.4.2. Monitor the EF-003 fan speed and GBE pressure as the system re-stabilizes.

✓ 14.4.3. If needed, based on the response of the system, adjust the FE-003 PID loop tuning parameters.
Acceptance Criterion: Subject to Test Specialist best engineering

judgment but in no case should the oscillation of the system leave the -0.30" to -1.00" range.

✓ 14.4.4. Adjust the GBE pressure setpoint to -0.50" in w.c.

✓ 14.4.5. Monitor the FE-003 fan speed and GBE pressure as the system re-stabilizes.

✓ 14.4.6. If PID loop tuning parameters were adjusted in step 13.4.3 then return to step 13.3.2 and repeat until no adjustments are required.

✓ 14.5 Record the changes (if any) to the tuning parameters.

✓ 14.6 Tests complete.

✓ 14.7 On Laptop, Verify all PLC forces removed.

✓ 14.8 Remove laptop.

Post Testing Restoration Test

15.0 Post Testing Verifications

✓ 15.1 Record all the following data in the following table:

✓ 15.1.1. Verify normal indication for GBE and WCG DP on HMI.

✓ 15.1.2. Verify normal indication for Room 102 DP on HMI.

✓ 15.1.3. Verify normal readings for FE-003 HEPA Filters (Greater than zero).

✓ 15.1.4. Verify normal reading for FE-002 HEPA Filter (Greater than zero).

✓ 15.1.5. Verify normal indication for FE-003 Flow on HMI

✓ 15.1.6. Verify normal indication for FE-002 Flow on HMI

✓ 15.1.7. Verify normal indication for HEPA-001 Flow on HMI

✓ 15.1.8. Verify normal indication for Both Room Temperature indicators on HMI

✓ 15.2 Tests complete.

Full System Flow Determination

Record the following Data:

Reading	Instrument	Section 1	Section 15
FE-003 VFD percent Speed	At VFD	23.2 Hz	23.4 Hz
FE-003 VFD percent Speed	VFD Speed @ HMI	23%	23%
FE-002 VFD percent Speed	At VFD	44.2 Hz	43.8 Hz
FE-002 VFD percent Speed	VFD Speed @ HMI	74%	74%
HEPA #2 DP	PDI-012	0.3	0.3
PRE FILTER	PDI-014	0.03	0.05
HEPA #2 DP PDT-301	PY-301 @ HMI	0.33	0.33
HEPA #1 DP	PDI-013	0.3	.3
HEPA #1 DP PDT-302	PY-302 @ HMI	.3	0.30
FE-002 HEPA	PDI-020	0	0
FE-002 HEPA PDT-203	PY-203 @ HMI	0.0	0.00
FE-003 Flow	FI-002	1100 CFM	1100 CFM
FE-003 Flow	FY-301 @ HMI	950 CFM	970 CFM
FE-002 Flow FT-201	FY-201 @ HMI	7000 CFM	6800 CFM
HVA-001 FT-101	FY-101 @ HMI	~~5500~~ 5500 CFM ADH 4-20-07	5580 CFM
Room DP	PDI-02[illegible]	-.23	-.25
Room DP PDT-601	PC-6[illegible]1 @ HMI	-.24	-.25
GBE Pressure	PDI-03[illegible]	-.50	-.50
GBE Pressure	PDI-[illegible]	-.50	-.50
GBE Pressure PDT-501	PC-501 @ HMI	-.50	-.50
WCG Pressure	PDI-033	-.45	-.45
WCG Pressure	PDI-034	-0.45	-.45
WCG Pressure PDT-502	PC-502 @ HMI	-0.47	-.46
Data Recorder Initial and Date		9DH 4-20-07	9DH 4-21-07

Comments:

4-20-07 08:50 Preformed Prebrief, Verified Central Alarm Notified

09:30 CSE Preformed System Walkdown
Disconnects on, Damper Locked open on FE-002
HVA-01 BDP in +OK, HVA-01 Inlet damper Removed,
OSA Pressure Pickup Installed + Connected. VFD Connections Checked

10:08 Red Smears of Cabinets where clean

10:10 System Shutdown - Programs Loaded into PLC/HMI

10:21 PLC Placed in Run Mode, Verified Communication
between PLC and HMI - Values are updating

10:23 Start "System Start/Stop 1-.+"

10:35 at step 1.1.1 error Fa..d in the alarm
display HMI - Co..ted HMI

10:42 Returned processor to Run, Returned to Step 1.1.1

10:54 Unexpected Alar.. Step 1.3 - "Fan Startup Failure"

10:59 Stoped S..stem

11:01 Returned to Step 1.1.1

11:06 Started Startup - Determined room pressure
re..ppr.. below -0.15 when HVA-001 starts
& Stoped System, Returned to step 1.1.1
Set FE-002 Room Pressuer setpoint to -0.05" for
F. Failure detect - Alarm "Fan Startup Failure"

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11:11 Restarted System - Lowest building pressure
recorded at HVA-001 was -0.04" - Alarm

11:13 Stoped System, Reset FE-002 Accell/Decel
(2202+2203) from 30 Sec. to 15 Sec. Returned to 1.1.1

11:18 Restarted System - Lowest building pressure
recorded was -0.05". Noted that Building pressure
was at about -0.20" at HVA-001 Startup. Changed
delay on HVA-001 from 30 Sec. to 60 Sec. To allow
FE-002 to Stabilize at Setpoint of -0.25. Stoped
system. Returned to 1.1.1

4-07 11:24 Restarted System

11:27 FE-002 Stabilized at ≈ -0.29. FE-002 Building pressure droped -0.06" when HVA-001 started. Noted FE-002 PID output was immediate on HVA-001 starting No Alarm

11:32 Stoped System and added debounce timer to Fan Fail, Low Building Pressure, startup alarm. Set delay to 5 Seconds to prevent nusance trips at startup. Retured to step 1.1.1

11:37 Restarted System

11:39 System restored normaly - No Alarms. Min pressure at HVA-001 Startup was -0.06" It was noted that the delay timer was not activated - Continued with test plan.

12:01 "System start/stop Test" Completed - Break for Lunch

13:38 Resume Testing with start of "Fan Failue Test" ADH 4-20-07

13:44 Fan Failure Alarm was recieved and ~~VFD~~ VFD FE-003 VFD Fault Alarm ADH was also recieved due to FE-003 VFD Power being Turned off - This is an appropriate alarm. Test Continued.

13:51 Similar results as Event at 13:44 except it was FE-001 VFD Fault - This is an appropriate alarm

13:59 Fan Failure Test Completed

13:59 Started "Loss of Electrical Power Test"

14:08 At step 3.5 an alarm for Loss of electical Power was recieved and displayed on the active alarms screen, but no entry in the History was found. Located Problem in HMI Program and reloaded Stoped system and returned to step 3.2.

14:19 Pressed start. FE-003 Started then stoped. Checked Progran to check for sequence errors. Tried starting System again - Normal Startup retured to step 3.3

14:35 Prior to restarting the system it was noted that the Fan Failure bit in the PLC was set. Further investigation showed that the fault was registered

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14:35 Cont. Modified Logic to prevent fan fail on Power fail ADH 4/20/07 ~~Logic~~ Alarm. This modification only effects System Shutdown. Shutdown will be retested. Return to Step 3.2

14:49 It was noted that the system could not restart after power was restored. Ricky noted that after power outages they always needed to restart the System manually. Changed program to allow auto restart as required for ~~operational~~ requirements. Returned to Step 3.

15:00 Returned to Steps 1.8 to 1.11 to recheck Shutdown Sequence. Results OK
Loss of Electrical Power Complete
Restarted the System Procedure on Step 3.10

15:10 Started "FE-002 HEPA DP Test"

15:36 In step 4.81 when the FE-002 HEPA High pressure alarm tripped the following alarms also reported
HVA-001 Low Flow
HVA-001 Low Low Flow
Room 102 High Pressure
These alarms where acceptable based on system status at shutdown

15:39 Completed "FE-002 HEPA DP Test"

15:41 Started "FE-003 HEPA DP Test"

16:02 At Step 5.17 "FE-003 HIGH HEPA DP" alarm was recived due to drift in mA Source

16:31 Noted that while in HEPA DP Limit the DP Limit mode was acting in reverse of what was expected. Stoped System to evaluate

17:31 Made corrections to program to chage PID sign during HEPA DP Limit mode. Restarted Test at Step 5.0

17:43 Test was normal until Step 5.18 at which point FE-003 Ramped to max Speed based on min/max settings Resulting in a OBE Pressure of -1.0". Stoped Test and Tabled issue for Later. Reloaded Wires for HEPA DPs

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18:00 Started test 11.0 "Freeze Protection Test"

18:12 Noted that at 12.0mA TE-001 & TE-002 Read 67.5°

18:16 Low Temp Alarm reported as expected and the Following
HVA-001 LOW FLOW
HVA-001 LOW LOW FLOW
FE-002 LOW FLOW
FE-002 LOW LOW FLOW
Room 102 HIGH PRESSURE
Room 102 HIGH HIGH PRESSURE
These are acceptable alarms for this mode

18:25 Low Temp Alarm for TE-002 reported as expected as well as alarms Listed in 18:16 Log entry

18:31 Noted in Step 11.29 that when the Freeze Protection Override was pressed the button turned Yellow as expected but the Time remains disapeared. Correct display and reloaded HMI Only.

18:38 After HMI was Reloaded it was noted that the number count up to 1800 when activated Resumed at Step 11.29 with 546 seconds acumulated in the override Timer

18:46 Reviewed program during timer count and Found a rung that would not let the system Restart if it had been ~~Logo~~ running at the time of the freeze Alarm. Agreed test should be rerun the test From Step 11.28 with System running

19:02 System Shutdown when Freeze Protection Override Timed out. Alarms as noted in Log entry 18:16 reported
Reset TE-002 to 50°
Stoped the System

19:06 At System Restart, Fan Startup Failure Alarm was noted at start of HVA-001. Reason unknown
Resumed test at Step 11.28

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19:10 Alarms Reported in Log entry 18:16 Reported at freeze stat

19:15 Noted that System must be stoped before it can be restarted in Freeze protection mode override

19:17 Noted that outside conditions have changed to very windy. This may explain the false alarm recorded at 19:06 Log entry.

19:22 Did not procede through steps 11.33 to 11.37 as Dmms are needed for other Tests
Low Temp Alarm Test Completed

19:23 Started VFD Fault Test For FE-002 and FE-003

19:29 Noted the VFD Parameter 1403 needed to be switched from 3 to 4, Not 4 to 3

19:36 In Step 13.3.3 it was found that the drive would not allow the relay output to be reprogramed while in Run mode. To create a simulated Loss of Run signal the Lead at Left hand Terminal strip, Terminal I:1/2

19:40 Lead I:1/2 was restored inplace of step 13.3.4

19:42 Completed test 13, Ended Testing For Today Shut System down before Leaving.

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7:52 Resumed Testing. Started "LIVA-001 Flow Test" 10.0

8:05 In Step 10.9 No Alarm was recived at 2000 cfm. Found bug in Program and corrected. Resumed Test at 10.9

8:10 Step 10.9 functioned normally. Test Completed

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8:13 Noted that min Value for FE-003 min/max mode was set at 30% not the required 13% this was causing a bump in GBE Pressure at startup when HVA-001 started. Restarted System in normal mode. System response at start of HVA-001, minimal bump in FE-003 speed was noted at transision

8:19 Made modifications to High HEPA DP programing To reverse the sign of the PID Control when in this mode.

8:26 Restarted "FE-003 HEPA DP Test at Step 5.0

8:48 At Step 5.18 Noted that fan action was still incorrect. It was believed that the problem encountered earlier was due to entering/exiting the High HEPA DP mode rather than actually enrolling to HEPA DP. Restored original programy and restarted Step 5.9 with mA Transmitters reset to 3.0

9:03 At Step 5.17.1 Low flow alarm for HVA-001 was also received when HVA-001 shutdown - Alarm acceptable

9:12 At Step 5.27.1 A Fan Startup Failure Alarm was Recieved. This is based on HVA-001 (or Any Fan) being off (Failed) when the system Shutsdown

9:20 Recived "FE-003 HEPA #1 HIGH DP" Alarm at 3.5"

9:23 Several Alarms associated with the shutdown of the System where recived at step 5.32.1. All where appriate.

9:25 Test "FE-003 HEPA DP Tests" Completed

9:42 Started Test "WCG and GBE Pressure Alarms and Tests"

10:05 Noted in step 6.24 FE-002 did Not Shutdown as expected. Reviewed Progam and added bits to Turn off FE-002 in this mode.

10:19 Resumed Test at Step 6.15

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10:50 At Step 6.20 HVA-001 & FE-002 Started to Short Cycle. Shut System down and evaluated. Made corrections to program to Latch Condition and resumed Testing at Step 6.15

10:58 Similar Result. Found Change Should have had Paralled contacts for High-High Shutdown. Series was found in program. Corrected and Restarted Test at Step 6.15

11:08 Similar Result - Stoped test. We will Return to test once solution is determined.

11:13 Found editing error in High-High Shutdown and Corrected it (Double Runs were removed on accident). Resumed test at Step 6.15

11:19 On startup "Fan Start-up Fail" Alarm and "FE-003 "VFD Fault" Alarm noted. Found FE-003 VFD in Overcurrent Alarm. Reset and Restarted System Normal Operation

11:21 Test Resumed. Both HVA-001 & HVA FF-002 Stoping as expected

11:35 stoped System. MA controller operator was confused and glovebox pressure when Too Low. Reviewed the operation requirements and Resumed in step 6.28

11:47 Step 6.41 Completed before Step 6.38

11:48 Test "WCG and GBE Pressure Alarms & Test" Completed

12:52 Started "FE-003 Flow Verification Test"

13:14 At Step 7.16 a "HVA-001 Low Flow" Alarm Reported after the "FE-003 Low Low Flow" This was expected because HVA-001 stops on this Alarm Completed step 7.20 before 7.19

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13:15 Started "Room 102 Pressure Test"

13:25 Noted that HVA-001 stoped on Low-Low Alarm

13:39 It was noted in step 8.15 that FE-002 would Continue to run after FIO was pressed and FE-003 had stoped. Prior to preforming 8.15 stop Comand FE-002 VFD was stoped.

13:41 Test "Room 102 Pressure Test Completed"
Started "FE-002 Flow Verfication Test"

13:50 Noted that HVA-001 Stoped on Low-Low Alarm

13:54 Noted Same problem in step 9.5 as 8.15
Followed same shutdown steps as noted in 13:39 Log entry

13:59 Test "Room 102 Pressure Test" Completed
~~DM~~ 4-21-07
Resumed Test 11 at Step 11.34 to Remove DMMs from Cabinet

14:06 Completed the removal to Test 11.
Started "Maintenance Mode Tests"

14:15 When Purge bypass Mode was Selected in Step 12.12 the HMI Entered the correct mode, but the HMI indicate HEPA Change mode. Corrected and reloaded HMI with fixes

14:28 Resumed test at 12.11

14:31 Step 12.17 - No Alarm noted on Setpoint Chang. This is a Problem with the test Procedure. Was Still Pressent on Active Alarms

14:36 Test "MaintenanceMode Test" Completed
Started "Loop Stability Test for FE-002 and FE-003"
Note: Outside wind conditions are very high gusts Building pressure is chaging between -.25 +/- .02

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14:51 Preformed "Bump Test" on FE-002. System overshoot was ≤ 0.01" and System Stabilized at near setpoint in Less than 60 Seconds. Note wind gusts caused fluctuations of ±0.02" during Test. No Changes made to PID Settings

14:56 Preformed "Bump Test" on FE-003. System overshoot was Zero and System Stabilized in approximately 16 Seconds. No Changes made to PID

14:58 Test "Loop stability for FE-002 and FE-003" Complete Started "Post Testing Restoration Test"

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14:

15:07 Completed "Post Testing Restoration Test" Completed Note FE-002 HEPA reading Zero. This is a known problem with the tubing.

All Tests Completed.