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| TITLE: FDC/CDC GAS SYSTEM OXYGEN PURGE | DATE: 04/22/2014 |
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| BY: DAVE BUTLER | APP: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
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**References:**

Hall D – GlueX Utilities Gas Systems – Detector Gas Assembly D00000-10-02-0000

Hall D – GlueX Utilities Gas Systems – Detector Blend Tank Sub-Assembly D00000-10-02-1002

Gas System P&I Diagram (Preliminary)

**NOTE: FAILURE TO FOLLOW THIS PROCEDURE IN THE ORDER THAT IT IS WRITTEN** WITHOUT INPUT FROM SUBJECT MATTER EXPERTS MAY CAUSE DAMAGE TO THE FORWARD AND OR CENTRAL DRIFT CHAMBERS.

**Abbreviations:**

Manual Valve – MV

Check Valve – CV

Pressure Regulator – PR

Pressure Transmitter – PT

Pressure Gauge – PG

Bubbler Never – BN

Bubbler Always – BA

Normally Open – NO

Normally Closed – NC

PLC – Programmable Logic Controller

**Gas System Purge (~2 Days) -** The purpose of this procedure is the purge the gas lines with Argon/CO2 mixtures and purge it from Oxygen contamination.

 **Gas Room Purge (~1 Day)**

1. **VERIFY** that all Manual Valves (MV) are in the **CLOSED** state.
2. **ENSURE** PR201 and PR202 read 0 psi and **OPEN** MV133 (NO) and MV134 (NO).

NOTE: MV133 and MV 134 are for maintenance only.

1. Inside the Gas Room **ENSURE** Manual Valves MV135 (NO), MV136 (NO), MV137 (NC), MV138 (NC), MV139 (NO) and MV140 (NO) are **CLOSED**.
2. **SET** Pressure Regulators (PR) PR201 and PR202 to 50 +/- 2psi.
3. **OPEN** the following Manual Valves (MV) in the following order: MV117 (NO), MV118 (NO), MV119 (NO), MV120 (NO), MV121 (NO) and MV122 (NO).
4. **VERIFY** Pressure Gauge (PG) PG401 and PG402 / Pressure Transmitter PT501 and PT502 read 50 +/- 2psi.
5. **OPEN** the following valves in the following order: MV127 (NO), MV128 (NO), MV129 (NO) and MV130 (NO).
6. **VERIFY** Brooks Controller 1 & 2 settings per *Table 1* but do not start the blend process.

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|  |  | **Measure Units** | **Blend** | **Time Base** | **PV Signal Type** | **PV Full Scale** | **SP Signal Type** | **SP Full Scale** | **SP Function** | **Gas Factor** | **SP (Blend)** |
| **CDC Brooks Controller 1** | **Master** | bar | master | n/a | 4-20mA | 1 bar | 4-20mA | 1 bar | blending | n/a | 1 bar |
| **MFC1** | litre | n/a | min | 4-20mA | l/m | 4-20mA | 4 l/m | blending | 0.74 | (50%) |
| **MFC3** | litre | n/a | min | 4-20mA | l/m | 4-20mA | 2 l/m | blending | 1.395 | (50%) |
| **FDC Brooks Controller 2** | **Master** | bar | master | n/a | 4-20mA | 1 bar | 4-20mA | 1 bar | blending | n/a | 1 bar |
| **MFC2** | litre | n/a | min | 4-20mA | l/m | 4-20mA | 1.4 l/m | blending | 0.74 | (24%) |
| **MFC4** | litre | n/a | min | 4-20mA | l/m | 4-20mA | 1.4 l/m | blending | 1.395 | (36%) |

*Table 1 Flow Settings for Nitrogen Calibrated MFCs*

NOTE: ENSURE THERE IS NO ALCOHOL IS PRESENT IN THE SYSTEM

1. **REMOVE** plug at the alcohol fill port.
2. In the Gas Room **OPEN** the following valves in the following order MV135 (NO), MV136 (NO) and MV162 (NC), MV163 (NC).
3. Start the blend process on Brooks Controllers 1 and 2.
4. After ~1 hour **OPEN** Bypass Valves MV137 (NC) and MV138 (NC)

**PURGE** lines for ~1 hour.

1. **CLOSE** MV137 (NC) and MV138 (NC).
2. **OPEN** VENT Valves MV158 (NC) and MV159 (NC) **PURGE** lines for ~1 hour.
3. **OPEN** MV139(NO) and MV 140 (NO) **PURGE** lines for ~1 hour.
4. **CLOSE** MV162 (NC) and MV163 (NC) and reinstall the plug in the alcohol fill port.

**Gas Room Purge (~1 Day)**

1. In Hall D at the Gas Panel **VERIFY** that MV141 (NC) is closed.
2. **OPEN** the following valves in the following order: MV147 (NC), MV148 (NC), MV149 (NC), MV150 (NC) and MV151 (NC).
3. **VERIFY** the following valves are **CLOSED** MV142(NO), MV152(NO), MV143(NO), MV153(NO), MV144(NO), MV154(NO), MV145(NO), MV155(NO), MV146(NO) and MV156(NO).
4. **SET** Brooks Controller 3 & 4 settings per *Table 2*.

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|  |  | **Measure Units** | **Time Base** | **PV Signal Type** | **PV Full Scale** | **SP Signal Type** | **SP Full Scale** | **SP Function** | **Gas Factor** | **SP Rate** |
| **FDC Brooks Controller 3** | **MFC6** | sccm | min | 4-20mA | 500 sccm | 4-20mA | 500 sccm | rate | 1.002 | 100 sccm |
| **MFC7** | sccm | min | 4-20mA | 500 sccm | 4-20mA | 500 sccm | rate | 1.002 | 100 sccm |
| **MFC8** | sccm | min | 4-20mA | 500 sccm | 4-20mA | 500 sccm | rate | 1.002 | 100 sccm |
| **MFC9** | sccm | min | 4-20mA | 500 sccm | 4-20mA | 500 sccm | rate | 1.002 | 100 sccm |
| **CDC Brooks Controller 4** | **MFC5** | sccm | min | 4-20mA | 6 l/m | 4-20mA | 6 l/m | rate | 1.0675 | 200 sccm |

*Table 2 Flow Settings for Nitrogen Calibrated MFCs*

1. **VERIFY** that Bubbler Always (BA) BA901, BA902, BA903, BA904 and BA905 start to bubble within 5 minutes.
2. **VERIFY** Bubblers Never (BN) BN801, BN802, BN803, BN804 and BN805 are **NOT** bubbling.
3. **RUN** the gas system in this configuration for ~1 day.

**Purge Pressure Taps (~30 Minutes) -** The purpose of this procedure is the purge the input and output pressure tap-lines of the FDC and CDC and the output tab-lines to the Oxygen analyzer system.

**NOTE:** The system should be in the same configuration as step 23 of the Gas System Flush procedure.

1. To flush the gas system **OPEN** Solenoid Valves (SV) groups SV601 and SV603, SV636 thru SV640, SV628 thru SV631 and SV632 thru SV635.
2. **DISCONNECT** the input gas line to Pressure Transmitter (PT) PT505 and PT507 to create a vent for the gas.
3. After approximately ½ hour **RECONNECT** the gas lines to PT505 and PT507.
4. **CLOSE** SV601 and SV603, SV636 thru SV640, SV628 thru SV631 and SV632 thru SV635.
5. **VERIFY** that BA901, BA902, BA903, BA904 and BA905 start to bubble within a 5 minutes.
6. **VERIFY** BN801, BN802, BN803, BN804 and BN805 are **NOT** bubbling.
7. **OPEN** SV636 thru SV640 and **INSTALL** a quick disconnect fitting with a vent hose at Check Valve (CV) CV313.
8. **FLUSH** for **~**30 minutes. Bubblers BA901, BA902, BA903, BA904 and BA905 may not bubble at this time.
9. **CLOSE** SV636 thru SV640.

**Detector Purge (~3 Days) -** The purpose of this procedure is to switch from bypass to Detector operations.

  **NOTE:** The system should be in the same configuration as step 9 of the Flush Pressure Taps procedure.

1. **OPEN** the following valves in the following order MV152 (NO), MV153 (NO), MV154 (NO), MV155 (NO), MV156 (NO).
2. **OPEN** the following valves in the following order MV142 (NO), MV143 (NO), MV144 (NO), MV145 (NO), MV146 (NO).
3. **CLOSE** the following valves in the following order MV147 (NC), MV148 (NC), MV149 (NC), MV150 (NC) and MV151 (NC).
4. **VERIFY** that BA901, BA902, BA903, BA904 and BA905 start to bubble within a 5 minutes.
5. **VERIFY** BN801, BN802, BN803, BN804 and BN805 are **NOT** bubbling.

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|  |  | **Measure Units** | **Time Base** | **PV Signal Type** | **PV Full Scale** | **SP Signal Type** | **SP Full Scale** | **SP Function** | **Gas Factor** | **SP Rate** |
| **FDC Brooks Controller 3** | **MFC6** | sccm | min | 4-20mA | 500 sccm | 4-20mA | 500 sccm | rate | 1.002 | 50 sccm |
| **MFC7** | sccm | min | 4-20mA | 500 sccm | 4-20mA | 500 sccm | rate | 1.002 | 50 sccm |
| **MFC8** | sccm | min | 4-20mA | 500 sccm | 4-20mA | 500 sccm | rate | 1.002 | 50 sccm |
| **MFC9** | sccm | min | 4-20mA | 500 sccm | 4-20mA | 500 sccm | rate | 1.002 | 50 sccm |
| **CDC Brooks Controller 4** | **MFC5** | sccm | min | 4-20mA | 6 l/m | 4-20mA | 6 l/m | rate | 1.0675 | 200 sccm |

 *Table 3 Flow Settings for Nitrogen Calibrated MFCs*

1. **SET** flow rates of MFC’s per *Table 3* above.
2. **RUN** for ~3 days.

**Detector Pressure Tap Purge (~30 Minutes) -** The purpose of this procedure is to purge the pressure-tap lines from both FDC and CDC.

**NOTE:** The system should be in the same configuration as step 7 of the Purge Pressure Taps procedure.

1. To flush the detector pressure taps **OPEN** Solenoid Valves (SV) groups SV604 thru SV609, SV610 thru SV615, SV616 thru SV621 and SV622 thru SV621.
2. **DISCONNECT** the input gas line to Pressure Transmitter (PT) PT506 to create a vent for the gas.
3. Bubbler Always BA901, BA902, BA903, BA904 and BA905 may stop bubbling during this operation.
4. After approximately ~3 Minutes **CLOSE** Solenoid Valves (SV) groups SV604 thru SV609, SV610 thru SV615, SV616 thru SV621 and SV622 thru SV621 and wait ~5 Minutes for pressure to build.
5. **OPEN** Solenoid Valves (SV) groups SV604 thru SV609, SV610 thru SV615, SV616 thru SV621 and SV622 thru SV621.
6. Repeat Steps 4 and 5 several times to ensure pressure taps are flushed then proceed to Step 7.
7. **RECONNECT** the gas line to PT506.
8. **CLOSE** SV601 and SV603, SV636 thru SV640, SV628 thru SV631 and SV632 thru SV635.
9. **VERIFY** that BA901, BA902, BA903, BA904 and BA905 start to bubble within a 5 minutes.
10. **INITIATE** Gas System PLC pressure scanning sequence.
11. At this point the alcohol MAY be filled with alcohol. The gas system will now be in normal operation configuration.