**Appendix 9E Software Factory Acceptance Testing (FAT)**

**General Information**

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| --- | --- |
| PLC Name |  |
| Plant |  |
| Review Date DD/MM/YY |  |
| Checked by: |  |
| Halton Staff |  |
| Consultant |  |
| Contactor |  |

The following tests are required for all Factory Acceptance Tests. The FAT must also incorporate testing of devices using the driver check sheets included elsewhere in these appendices.

**Deficiencies**

| Check | Pass/Fail |
| --- | --- |
| All Pre-FAT Deficiencies Closed |  |
| Verify Historian Trend Configuration |  |
| Verify Tag Event Logging |  |

*This is a sample list of screens. It is the consultant’s responsibility to make sure that the list is accurate for their project. The screens only need to have the graphics completed at this stage. Tags and scripting do not need to be completed until submission #2*

**Screen Verification**

| Check | Pass/Fail |
| --- | --- |
| Plant Overview |  |
| Process and Town Overview |  |
| Report Screens |  |
| Chemical Screens |  |
| Security |  |
| Setpoint Screens |  |
| Options Screens |  |
| Duty Rotation Screens |  |
| Dialer Screens |  |
| Communications Map |  |
| PLC Status Screen |  |
| Alarm/History Menu |  |
| SQL Event Log |  |
| Server and Workstation Screen |  |
| Work Alone System |  |
| All Screens Visually Inspected |  |
| InTouch Trending Button Configurations |  |
| Historian Trending Button Configurations |  |

**Screen Verification Deficiencies**

| Deficiency | Noted BY Initials (Print) | Approved BY (ROH Employee) | Date Fixed |
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**Interlocks**

**Software Interlocks Testing Procedure**

1. Activate software interlock in the PLC.
2. Confirm when active that they device cannot be activated in PLT\_AUTO and PLT\_MAN as applicable.
3. Confirm nuisance software alarms are not active in the PLC.
4. Confirm that when the alarm is reset (typically manually) the device can again be activated.
5. Document time delay settings as set in the PLC upon completion.

*Below is a sample check list. Update this check list to make it appropriate for the project being tested.*

Software Interlocks

| **Software Interlock Test Point** | **Device Interlocked** | **Pass/Fail** | **Time Delay Setting** |
| --- | --- | --- | --- |
| Well Pump 1 VFD Fault | Well Pump 1 |  |  |
| Well Pump 1 Emergency Stop | Well Pump 1 |  |  |
| Well Pump 1 Sliding Average Flow HIHI Alarm | Well Pump 1 |  |  |
| Well Pump 1 Flow LOLO Alarm | Well Pump 1 |  |  |
| Well Pump 1 Flow HIHI Alarm | Well Pump 1 |  |  |
| Well Pump 1 Flow Signal Error | Well Pump 1 |  |  |
| Well Pump 1 Pressure HIHI | Well Pump 1 |  |  |
| Well Pump 1 Pressure and Station Pressure Signal Error | Well Pump 1 |  |  |
| Well Pump 2 VFD Fault | Well Pump 2 |  |  |
| Well Pump 2 Emergency Stop | Well Pump 2 |  |  |
| Well Pump 2 Sliding Average Flow HIHI Alarm | Well Pump 2 |  |  |
| Well Pump 2 Flow LOLO Alarm | Well Pump 2 |  |  |
| Well Pump 2 Flow HIHI Alarm | Well Pump 2 |  |  |
| Well Pump 2 Flow Signal Error | Well Pump 2 |  |  |
| Well Pump 2 Pressure HIHI | Well Pump 2 |  |  |
| Well Pump 2 Pressure and Station Pressure Signal Error | Well Pump 2 |  |  |
| Pre-Filters Differential Pressure Signal Error Alarm | Well Pump 1,2 |  |  |
| Pre-Filters Differential Pressure HIHI Alarm | Well Pump 1,2 |  |  |
| Final Filters Differential Pressure Signal Error Alarm | Well Pump 1,2 |  |  |
| Final Filters Differential Pressure HIHI Alarm | Well Pump 1,2 |  |  |
| No UV Units Active Alarm | Well Pump 1,2 |  |  |
| Duty UV Unit Major Alarm | Well Pump 1,2 |  |  |
| Duty UV Unit Critical Alarm | Well Pump 1,2 |  |  |
| Duty UV Unit Communication Alarm | Well Pump 1,2 |  |  |
| Turbidity Signal Error Alarm | Well Pump 1,2 |  |  |
| Turbidity HIHI Alarm | Well Pump 1,2 |  |  |
| Station Discharge Pressure HIHI Alarm | Well Pump 1,2 |  |  |
| Low Booster pressure | Well Pump 1,2 |  |  |
| Chlorine System 1 Low Vacuum | Well Pump 1,2 |  |  |
| Chlorine System 2 Low Vacuum | Well Pump 1,2 |  |  |
| Chlorine System High Vacuum | Well Pump 1,2 |  |  |
| Chlorine Stopped Alarm | Well Pump 1,2 |  |  |
| Chlorine Residual Signal Error Alarm | Well Pump 1,2 |  |  |
| Chlorine Residual HIHI Alarm | Well Pump 1,2 |  |  |
| Chlorine Residual LOLO Alarm | Well Pump 1,2 |  |  |
| Chlorine Tank Weight 1 & 2 Signal Error or LOLO Alarm | Well Pump 1,2  Chlorine Pumps |  |  |
| Fluoride Residual Signal Error Alarm | Well Pump 1,2  Fluoride Pumps |  |  |
| Fluoride Residual HIHI Alarm | Well Pump 1,2  Fluoride Pumps |  |  |
| Fluoride Residual LOLO Alarm | Well Pump 1,2  Fluoride Pumps |  |  |
| Fluoride Stopped Alarm | Well Pump 1,2 |  |  |
| Common Well Sliding Average Flow HIHI Alarm | Well Pump 1,2 |  |  |
| Common Well Daily Flow Total HIHI Alarm | Well Pump 1,2 |  |  |
| No Valid Flow Path | Well Pump 1,2 |  |  |
| Chlorine Virus Log Inactivation | Well Pump 1,2 |  |  |
| Fluoride Pump Motor Fault | Well Pump 1,2  Fluoride Pumps |  |  |
| No Station Flow (No Well Pumps Running) | Well Pump 1,2 |  |  |

**Software Interlock Deficiencies**

| Deficiency | Noted BY Initials (Print) | Approved BY (ROH Employee) | Date Fixed |
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**Logix Processor Status Check Procedure**

|  |  |
| --- | --- |
| **Test** | **Result** |
| Check the time synch script works |  |
| Time sink button |  |
| PLC to PLC Comm Status |  |
| PLC Key Status |  |
| Controller Status |  |
| Battery Status |  |
| Major Fault |  |
| Forces Present |  |
| Forces Enabled |  |
| Start up Protection Fault |  |
| Program Fault Watchdog |  |
| Major Fault Type |  |
| Major Fault Code |  |
| Major Fault Info |  |
| PLC Minor Fault |  |
| IO Fault |  |

Logix Processor Status Deficiencies

| Deficiency | Noted BY Initials (Print) | Approved BY (ROH Employee) | Date Fixed |
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**Sample Dialer Alarms Check Procedure**

1. Enable all Raw Alarms and Dialer Alarms that are to be tested.
2. Make sure that no alarms are active.
3. Generate one alarm per channel at a time and verify that the appropriate message bit for the Dialer PLC is set.
4. Disable the Dialer Alarm and Verify the Message Bit Turns Off.
5. Disable the Raw Alarm and Verify the Alarm Returns to Normal.
6. Disable each Dialer Alarm Channel on the Dialer Channel Page .
7. Generate one alarm per channel and verify that the Dialer PLC does not receive the alarms.
8. Disable all Raw Alarms and Dialer alarms.

**Sample Dialer Alarms Check Procedure**

1. Enable all Virtual and Dialer Alarms that are to be tested.
2. Make sure that no alarms are active.
3. Disable Individual Virtual Alarm.
4. Generate Fail to Start or Fail to Open (where applicable) Dial-out Alarm in PLC.
5. Verify that the Alarm is not generated on HMI and is not received at Dialer PLC.
6. Re-enable the Virtual Alarm.
7. Verify that the Alarm being generated is in the correct group (Equipment).
8. Verify the Dialer PLC receives Alarm.
9. Disable Operator Control Dialer Alarm and verify that the Dialer Alarm Clears.
10. Re-enable Operator Control Dialer Alarm and verify that the Dialer Alarm re-generates.
11. Disable Supervisor Control Dialer Alarm and verify that the background colour turns yellow, and that the Dialer Alarm clears.
12. Re-enable Supervisor Control Dialer Alarm and verify that the background colour returns to white, and that the Dialer Alarm is re-generated.
13. Repeat Steps 5 to 12 for Fail to Stop, Uncommanded Start, and Uncommanded Stop Alarms or Fail to Close, Uncommanded Open, and Uncommanded Close (where applicable).
14. Verify that the “Alarm Disable Reason” box is functioning properly.
15. Disable all Virtual Alarms and Dialer alarms.

*Below is a sample check list. Update this check list to make it appropriate for the project being tested.*

Dialer Alarms

| **Alarm Description** | **Raw Enable** | **Alarm Status** | **Dialer Enable** |
| --- | --- | --- | --- |
| Zone 2 Chlorine Residual HIHI Alarm |  |  |  |
| Zone 2 Chlorine Residual LOLO Alarm |  |  |  |
| Zone 2 Chlorine Residual Signal Error |  |  |  |
| Zone 2 Flow HIHI Alarm |  |  |  |
| Zone 2 Flow LOLO Alarm |  |  |  |
| Zone 2 Flow Signal Error |  |  |  |
| Zone 2 Discharge Pressure HIHI Alarm |  |  |  |
| Zone 2 Discharge Pressure LOLO Alarm |  |  |  |
| Zone 2 Discharge Pressure Signal Error |  |  |  |
| Zone 2 Discharge Pressure HHH Alarm |  |  |  |
| Zone 2 Discharge Pressure LLL Alarm |  |  |  |
| Zone 3 Chlorine Residual HIHI Alarm |  |  |  |
| Zone 3 Chlorine Residual LOLO Alarm |  |  |  |
| Zone 3 Chlorine Residual Signal Error |  |  |  |
| Zone 3 Flow HIHI Alarm |  |  |  |
| Zone 3 Flow LOLO Alarm |  |  |  |
| Zone 3 Flow Signal Error |  |  |  |
| Zone 3 Discharge Pressure HIHI Alarm |  |  |  |
| Zone 3 Discharge Pressure LOLO Alarm |  |  |  |
| Zone 3 Discharge Pressure Signal Error |  |  |  |
| Zone 3 Discharge Pressure HHH Alarm |  |  |  |
| CC Outlet CL2 Residual LO LO Alarm |  |  |  |

Dialer Alarms Deficiencies

| Deficiency | Noted BY Initials (Print) | Approved BY (ROH Employee) | Date Fixed |
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**Auto Control**

*This is a sample of the type of test procedure that is required. Test Protocols should be written according to the control narrative and ACP functions in the PLC.*

**Level Control**

| Function | Pass/Fail |
| --- | --- |
| When the Acton Reservoir level falls to the Duty Well Pump Level Start Setpoint, the Duty UV Unit is requested and begins a warm up cycle. |  |
| When the Duty UV Unit Ready status is active, the Duty UV Inlet Valve is commanded to open. |  |
| When the Duty UV Valve is open, the Duty Well Pump, the Duty Chlorine Booster Pump and Duty Fluoride Pump are commanded to start. |  |
| While the system is running the Duty Well Pump speed is modulated to maintain its corresponding Well Pump Flow Setpoint. |  |
| While the system is running, the Duty Chlorinator Position is modulated using the instantaneous combined well flow and the Chlorine Dose Adjustment Factor Setpoint. |  |
| While the system is running, the Duty Fluoride Pump speed is modulated using the instantaneous combined well flow and the Fluoride Dose Adjustment Factor Setpoint. |  |
| If communication to the Acton Reservoir PLC fails, the station operates using the last known Acton Reservoir Level value. |  |
| If an Acton Reservoir Level value outside the window of 0% to 105% is received, the station operates using the last known Acton Reservoir Level value. |  |
| When the Actor Reservoir level rises to the Duty Well Pump Level Stop Setpoint, the Duty Well Pump is commanded to stop. |  |
| Once stopped the Duty UV Unit begins a cool down cycle, the Chlorine Booster Pumps and Duty Fluoride Pump are commanded to stop. |  |
| The Standby Well Pump is always commanded to stop. |  |

**Pressure Control**

| Function | Pass/Fail |
| --- | --- |
| When the Station Discharge Pressure falls to the Duty Well Pump Pressure Start Setpoint, the Duty UV Unit is requested and begins a warm up cycle. |  |
| When the Duty UV Unit Ready status is active, Duty Well Pump, the Chlorine Booster Pumps and Duty Fluoride Pump are commanded to start. |  |
| While the system is running the Duty Well Pump speed is modulated to maintain its corresponding Well Pump Flow Setpoint. |  |
| While the system is running, the Duty Chlorinator Position is modulated using the instantaneous combined well flow and the Chlorine Dose Adjustment Factor Setpoint. |  |
| While the system is running, the Duty Fluoride Pump speed is modulated using the instantaneous combined well flow and the Fluoride Dose Adjustment Factor Setpoint. |  |
| When the Station Discharge Pressure rises to the Duty Well Pump Pressure Stop Setpoint, the Duty Well Pump is commanded to stop. |  |

**Auto-Control Deficiencies**

| Deficiency | Noted BY Initials (Print) | Approved BY (ROH Employee) | Date Fixed |
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**Removal of I/O Check List**

| Address | Description (New) | Pass / Fail |
| --- | --- | --- |
| I:01/00 | Hydro Power Failure |  |
| I:01/01 | UPS Fault |  |
| I:01/02 | Phase Fail Alarm |  |
| I:01/03 | TVSS Alarm |  |
| I:01/04 | Building Illegal Entry Alarm |  |
| I:01/05 | Building Security System Armed |  |
| I:01/06 | Well 9a Pump Room Fire Alarm Status |  |
| I:01/07 | Generator Room Fire Alarm Status |  |
| I:01/08 | Well 9b Pump Room Fire Alarm Status |  |

**Deficiencies**

*Insert Appendix 9k – Standard Deficiency Sheet here.*

Hand written notes are not to be replaced with typed notes later nor are these sheets to be removed or replaced in the binder at any time.