SEQUENCE OF OPERATION FOR PUMP AND HVAC SYSTEMS

PLC WITH HMI SYSTEM

- 1.1. THE HMI WILL PROVIDE GRAPHIC SCREENS DEPICTING THE PUMPING AND HVAC PROCESSES AND STATUS.
- THE HMI WILL DISPLAY ALL ALARMS AND PROVIDE AN INTERFACE TO ALLOW FOR TESTING AND BLOCKING OF EACH INDIVIDUAL ALARM IN THE PLC. A "BLOCKED" INDICATION WILL BE SHOWN ON THE HMI NEXT TO EACH LISTED ALARM POINT WHEN IT IS BLOCKED. IF ANY ALARM POINTS ARE BLOCKED, AN "ALARM BLOCKED" POINT WILL BE SET IN THE PLC AND TRANSMITTED BACK TO THE SCADA SYSTEM.

FLOOD PUMPING OPERATION

2.1. DEVICES:

- PUMP 1 (P-F01) 100HP 2.1.1.
- PUMP 2 (P-F02) 100HP 2.1.2.
- 2.1.3. PUMP 3 (P-F03) - 225HP
- 2.1.4. PUMP 1 STARTER (MS-F01) IN MCC (MCC-F70)
- 2.1.5. PUMP 2 STARTER (MS-F02) IN MCC (MCC-F70)
- 2.1.6. PUMP 3 STARTER (MS-F03) IN MCC (MCC-F70)
- 2.1.7. ULTRASONIC LEVEL SYSTEM (LE-F201)
- BUBBLER LEVEL SYSTEM (LTS-F211) 2.1.8. 2.1.9. BUBBLER LOW AIR PRESSURE SWITCH (PS-F211)
- 2.1.10. BUBBLER SYSTEM ON-OFF SWITCH (HS-F21)

LEVEL SENSING

- THE EXISTING BUBBLER LEVEL SYSTEM (LTS-F211) AND THE NEW ULTRASONIC LEVEL SYSTEM (LE-F201) WILL PROVIDE REDUNDANCY FOR THE WET WELL LEVEL MEASUREMENT. THE BUBBLER LEVEL SYSTEM (LTS-F211) WILL BE THE PRIMARY LEVEL INDICATION SYSTEM WITH THE ULTRASONIC LEVEL SYSTEM (LE-F201) OPERATING AS BACKUP.
- THE TWO SYSTEMS SHALL BE CALIBRATED TO PROVIDE SUFFICIENTLY SIMILAR MEASUREMENT SO AS TO NOT CAUSE A "LEVEL MEASUREMENT ERROR" THROUGH THE FULL RANGE OF OPERATION. IF THERE IS A DISAGREEMENT BETWEEN THE LEVEL VALUES PROVIDED BY BOTH SYSTEMS GREATER THAN 0.5 METERS A "LEVEL MEASUREMENT ERROR" ALARM WILL BE ISSUED. IF THE BUBBLER SYSTEM AIR PRESSURE SWITCH (PS-F211) IS ENERGIZED, A
- "BUBBLER SYSTEM LOW AIR" ALARM WILL BE ISSUED. THIS ALARM WILL FORCE THE ULTRASONIC LEVEL SYSTEM (LTS-F211) TO BECOME THE PRIMARY LEVEL SENSOR FOR CONTROL. THE BUBBLER SYSTEM DEACTIVATED-ACTIVATED SWITCH (HS-F211) WILL BLOCK THE
- "LEVEL MEASUREMENT ERROR" AND "BUBBLER SYSTEM LOW AIR" ALARMS WHEN IN THE DEACTIVATED POSITION. IF THE ULTRASONIC LEVEL SYSTEM (LTS-F211) FAULT CONTACT IS ENERGIZED, A "ULTRASONIC SYSTEM FAULT" ALARM WILL BE ISSUED. THIS ALARM WILL BLOCK THE
- "LEVEL MEASUREMENT ERROR" ALARM. THE EXISTING FLYGT FLOAT LEVEL SWITCH, THE BUBBLER LEVEL SYSTEM AND THE ULTRASONIC LEVEL SENSOR WILL PROVIDE A "HI WET WELL" ALARM TO THE PLC. COORDINATE WITH THE CITY OF WINNIPEG FOR THE HIGH WATER LEVEL OF THE
- THE FOLLOWING LEVELS ARE TO BE SET VIA THE HMI AND STORED IN THE PLC: 3.7.
- 3.7.1. FIRST PUMP START LEVEL (LOW WATER LEVEL)
- 3.7.2. FIRST PUMP STOP LEVEL (LOW WATER LEVEL)
- 3.7.3. SECOND PUMP START LEVEL
- 3.7.4. SECOND PUMP STOP LEVEL 3.7.5. THIRD PUMP START AND FIRST PUMP STOP LEVEL
- 3.7.6. THIRD PUMP STOP LEVEL
- 3.7.7. FIRST PUMP RESTART LEVEL (HI WATER LEVEL) FIRST PUMP STOP LEVEL (HI WATER LEVEL) 3.7.8.
- HIGH WET WELL LEVEL ALARM

AUTOMATIC PUMP OPERATION

- THE HAND-OFF-AUTO (HOA) SWITCH, IN THE MCC, POSITION FOR EACH PUMP WILL BE MONITORED AND AFFECT THE ASSIGNMENT OF WHICH PUMP WILL BE FIRST AND SECOND PUMPS. ALL PUMPS WILL HAVE THEIR RUNNING HOURS RECORDED WITHIN THE PLC. PUMP 1 (P-F01) AND PUMP 2 (P-F02) WILL SWITCH BEING THE FIRST AND SECOND PUMPS BASED ON OPERATING HOURS AND THEIR RESPECTIVE AVAILABILITY. A PUMP WILL BE AVAILABLE IF THE PUMP'S HOA SWITCH IS IN THE AUTO POSITION AND THERE IS NO FAULT ALARM FOR THE PUMP COMING FROM THE MCC. THE ASSIGNMENT OF FIRST AND SECOND PUMPS WILL NOT CHANGE WHILE ANY PUMPS ARE OPERATING. THE LOWER OPERATING HOURS PUMP WILL BE THE FIRST PUMP. IF ONE OR TWO OF PUMPS 1 (P-F01) AND 2 (P-F02) ARE UNAVAILABLE THEN PUMP 3 (P-F03) WILL MOVE UP IN ORDER AS REQUIRED.
- THE FIRST PUMP WILL START WHEN THE WET WELL LEVEL IS EQUAL TO THE FIRST PUMP START LEVEL. THE FIRST PUMP WILL STOP WHEN THE WET WELL LEVEL IS EQUAL TO THE FIRST PUMP STOP LEVEL.
- IF TWO OR MORE PUMPS ARE AVAILABLE, THE SECOND PUMP WILL START WHEN THE WET WELL LEVEL IS EQUAL TO THE SECOND PUMP START LEVEL. THE SECOND PUMP WILL STOP WHEN THE WET WELL LEVEL IS EQUAL TO THE SECOND PUMP STOP
- IF ALL THREE PUMPS ARE AVAILABLE, THE FIRST PUMP WILL STOP AND PUMP 3 4.4. (P-F03) WILL START WHEN THE WET WELL LEVEL IS EQUAL TO THE THIRD PUMP START LEVEL. THE FIRST PUMP WILL START AND PUMP 3 (P-F03) WILL STOP WHEN THE WET WELL LEVEL IS EQUAL TO THE THIRD PUMP STOP LEVEL.
- IF ALL THREE PUMPS ARE AVAILABLE, THE FIRST PUMP WILL START WHEN THE WET WELL LEVEL IS EQUAL TO THE FIRST PUMP RESTART HIGH WATER LEVEL. THE FIRST PUMP WILL STOP WHEN THE WET WELL LEVEL IS EQUAL TO THE FIRST PUMP HIGH WATER LEVEL STOP LEVEL.
- THIS PROPOSED ORDER WILL ELIMINATE THE HIGH STARTING CURRENT OF THE 225HP PUMP WHILE THE OTHER PUMPS ARE RUNNING, THEREBY REDUCING THE MAXIMUM CURRENT DRAW FOR THE STATION.

5. <u>HVAC OPERATION</u>

- 5.1. MAJOR DEVICES:
- HEATING/CIRCULATION SYSTEM CONTROL PANEL (HCCP-F60) 5.1.1. 5.1.2. ON/OFF HAND SWITCH (HS-F600)
- 5.1.3. EXHAUST FAN 1 (EF-F60)
- 5.1.4. EXHAUST AIR DAMPER (ED-F60)
- 5.1.5. VARI-GREEN CONTROLLER (CTRL-F60-1)
- 5.1.6. SUPPLY FAN 1 (SF-F60) 5.1.7. SUPPLY FAN 1 VFD (VFD-F60)
- 5.1.8. HEATER COIL (HC-F60)
- 5.1.9. HEATER COIL CONTROLLER (CTRL-F60-2) 5.1.10. DUCT TEMPERATURE SENSOR (TE-F601)
- 5.1.11. SIGNAL CONVERTER (EY-F601) 5.1.12. DEFAULT/AUTO HAND SWITCH (HS-F601)
- 5.1.13. OUTSIDE TEMPERATURE SENSOR (TE-F821) 5.1.14.
- LOW AIR FLOW SWITCH (FSL-F601) 5.1.15. DIFFERENTIAL PRESSURE - WET WELL (PDT-F601-1)
- 5.1.16. DIFFERENTIAL PRESSURE - DRY WELL (PDT-F601-2)
- 5.1.17. DRY WELL SUPPLY AIR DAMPER (SD-F60-2)
- 5.1.18. RECIRCULATION AIR DAMPER (RD-F60) 5.1.19. INTAKE SUPPLY AIR DAMPER (SD-F60-1)
- 5.1.20. OCCUPIED HAND SWITCH (MAIN FLOOR LIGHT SWITCH) (SW-F71)
- 5.1.21. EXHAUST/COOLING SYSTEM CONTROL PANEL (ECCP-F61) HAND/OFF/AUTO HAND SWITCH (HS-F611-1) 5.1.22.
- 5.1.23. HIGH/LOW SPEED HAND SWITCH (HS-F611-2)
- 5.1.24.
- SUPPLY FAN (SF-F61) 5.1.25.
- SUPPLY FAN MOTOR STARTER (MS-F61) 5.1.26. ROOM TEMPERATURE SENSOR (TE-F610)
- 5.1.27. EXHAUST DAMPER (ED-F61)
- 5.1.28. FRONT DOOR CONTACT (ZS-601)
- 5.1.29. DRY WELL RECEPTACLE (RCPT-F71-16) 5.1.30. DRY WELL RECEPTACLE (RCPT-F71-18)

HEATING/CIRCULATION SYSTEM OPERATION

- THE HEATING/CIRCULATION SYSTEM HAS FOUR STATES OF OPERATION,
- CONTROLLED BY THREE MODES: 6.1.1. SUMMER/WINTER MODE
- 6.1.2. OCCUPIED/UNOCCUPIED MODE
- 6.1.3. DEFAULT/AUTO MODE
- SUMMER MODE IS WHEN THE OUTSIDE TEMPERATURE SENSOR (TE-F821) IS ABOVE 7C. WINTER MODE IS ENABLED WHEN THE OUTSIDE TEMPERATURE SENSOR (TE-F821) IS 7C OR LOWER.
- OCCUPIED MODE IS ENABLED WHEN THE MAIN FLOOR LIGHT SWITCH CONTACT (SW-F71) IS ON. UNOCCUPIED MODE IS WHEN THE MAIN FLOOR LIGHT SWITCH CONTACT (SW-F71) IS OFF.
- DEFAULT/ AUTO MODE IS CONTROLLED BY THE DEFAULT/AUTO MODE HAND SWITCH (HS-F601) MOUNTED ON THE HEATING/CIRCULATION SYSTEM CONTROL PANEL
- IN AUTO AND SUMMER MODE, THE FOLLOWING CONDITIONS ARE TO BE FOLLOWED: 6.5.1. OCCUPIED

100% FRESH AIR WILL BE SUPPLIED

- 6.5.1.1. 6.5.1.2. INTAKE SUPPLY AIR DAMPER (SD-F60-1) IS OPEN OR ON.
- 6.5.1.3. EXHAUST FAN 1 (EF-F60) OPERATES ON HIGH SPEED VIA VARI-GREEN CONTROLLER (CTRL-F60-1) AND THE EXHAUST AIR DAMPER (ED-F60) IS OPERATED INTO THE OPEN POSITION BY THE VARI-GREEN CONTROLLER
- (CTRL-F60-1). 6.5.1.4. RECIRCULATION AIR DAMPER (RD-F60) IS OFF.
- 6.5.2. UNOCCUPIED
- 6.5.2.1. 25% FRESH AIR, 75% OF AIR RECIRCULATED 6.5.2.2.
 - EXHAUST FAN 1 (EF-F60) OPERATES ON LOW SPEED VIA VARI-GREEN CONTROLLER (CTRL-F60-1) AND THE EXHAUST AIR DAMPER (ED-F60) IS OPERATED INTO THE OPEN POSITION BY THE VARI-GREEN CONTROLLER (CTRL-F60-1).
- RECIRCULATION AIR DAMPER (RD-F60) IS ON. 6.5.2.3.
- IN AUTO AND WINTER MODE, THE FOLLOWING CONDITIONS ARE TO BE FOLLOWED: 6.6.1. OCCUPIED
- 6.6.1.1. MINIMUM 15°C TEMPERATURE
- 100% FRESH AIR 6.6.1.2. 6.6.1.3. EXHAUST FAN 1 (EF-F60) OPERATES ON HIGH SPEED VIA VARI-GREEN
- CONTROLLER (CTRL-F60-1) AND THE EXHAUST AIR DAMPER (ED-F60) IS OPERATED INTO THE OPEN POSITION BY THE VARI-GREEN CONTROLLER (CTRL-F60-1).
- 6.6.1.4. THE PLC OUTPUT A CONDITIONED VOLTAGE, INCREASING THE VOLTAGE TO MAKE THE SIGNAL APPEAR AS THE DUCT TEMPERATURE SENSOR (TE-F601) IS SET AT 15C, THROUGH AN ANALOGUE OUTPUT TO THE HEATER COIL CONTROLLER (CTRL-F60-2) TO OPERATE THE HEAT COIL

(HC-F60). 6.6.2. UNOCCUPIED

- 6.6.2.1. MINIMUM 7°C TEMPERATURE
- 6.6.2.2. 25% FRESH AIR, 75% OF AIR RECIRCULATED
- 6.6.2.3. RECIRCULATION AIR DAMPER (RD-F60) IS OPEN OR ON. 6.6.2.4.
 - EXHAUST FAN 1 (EF-F60) OPERATES ON LOW SPEED VIA VARI-GREEN CONTROLLER (CTRL-F60-1) AND THE EXHAUST AIR DAMPER (ED-F60) IS OPERATED INTO THE OPEN POSITION BY THE VARI-GREEN CONTROLLER

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(CTRL-F60-1). 6.6.2.5. THE PLC PASSES THE SAME VOLTAGE SIGNAL FROM THE HEAT COIL DUCT TEMPERATURE SENSOR SIGNAL CONVERTER THROUGH AN ANALOGUE OUTPUT SIGNAL TO THE HEATER COIL CONTROLLER (CTRL-F60-2) TO OPERATE THE HEAT COIL (HC-F60).

- IN DEFAULT MODE, THE FOLLOWING CONDITIONS ARE TO BE FORCED:
- 6.7.1. SUPPLY FAN 1 (SF-F60) VIA SUPPLY FAN 1 VFD (VFD-F60) IS SET AT A DEFAULT
- 6.7.2. INTAKE SUPPLY AIR DAMPER (SD-F60-1) IS OPEN OR ON.
- EXHAUST FAN 1 (EF-F60) OPERATES ON HIGH SPEED VIA VARI-GREEN 6.7.4. CONTROLLER (CTRL-F60-1) AND THE EXHAUST AIR DAMPER (ED-F60) IS OPERATED INTO THE OPEN POSITION BY THE VARI-GREEN CONTROLLER (CTRL-F60-1)..

RECIRCULATION AIR DAMPER (RD-F60) IS CLOSED OR OFF

- 6.7.5. DRY WELL SUPPLY AIR DAMPER (SD-F60-2) IS FULLY OPEN.
- 6.7.6. DUCT TEMPERATURE SENSOR (TE-F601) VIA THE SIGNAL CONVERTER
- (EY-F601) CONTROLS THE HEATER COIL CONTROLLER (CTRL-F60-2) DIRECTLY. THE 0-10V SIGNAL FROM THE SIGNAL CONVERTER (EY-F601) WILL BE INPUT TO THE HEATER COIL CONTROLLER (CTRL-F60-2) VIA THE CONTACT OF THE DEFAULT/AUTO HAND SWITCH (HS-F601) IN DEFAULT POSITION.

ROOM TEMPERATURE MONITORING

6.7.3.

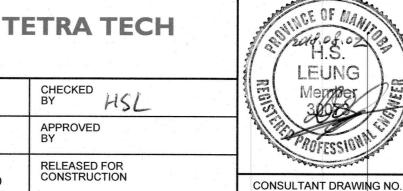
- ROOM TEMPERATURE SENSOR (TE-F610) MONITORS THE BUILDING MAIN FLOOR TEMPERATURE. THE FOLLOWING CONDITIONS ARE PRODUCED BASED ON THE
- TEMPERATURE: AT 45C INITIATES A "HIGH BUILDING TEMPERATURE" ALARM
- 7.1.2. AT 35C OPENS OR TURNS ON EXHAUST DAMPER (ED-F61) AND TURNS OPERATES SUPPLY FAN (SF-F61) ON HIGH SPEED VIA SUPPLY FAN SF-F61
- STARTER (MS-F61) AT 25C OPENS OR TURNS ON EXHAUST DAMPER (ED-F61) AND TURNS OPERATES SUPPLY FAN (SF-F61) ON LOW SPEED VIA SUPPLY FAN SF-F61 STARTER (MS-F61)
- AT 5C INITIATES A "LOW BUILDING TEMPERATURE" ALARM

8. DIFFERENTIAL PRESSURE MONITORING

- DIFFERENTIAL PRESSURE TRANSMITTER WET WELL (PDT-F601-1) CONTROLS THE FOLLOWING:
- VARIES THE SPEED OF SUPPLY FAN 1 (SF-F60) VIA SUPPLY FAN 1 VFD (VFD-F60) TO KEEP THE MAIN FLOOR POSITIVELY PRESSURIZED RELATIVE TO THE WET
- WELL DRY WHEN THE DEFAULT/AUTO HAND SWITCH (HS-F601) IS IN AUTO. INITIATES A "BUILDING PRESSURE" ALARM WHEN THE MAIN FLOOR IS NOT POSITIVELY PRESSURIZED RELATIVE TO THE WET WELL FOR TWO MINUTES CONTINUOUS. THE FRONT DOOR CONTACT (ZS-F601) BLOCKS THIS ALARM
- WHEN THE FRONT DOOR IS OPEN. DIFFERENTIAL PRESSURE - DRY WELL (PDT-F601-2) CONTROL THE FOLLOWING: 8.2.
- MODULATES THE DRY WELL SUPPLY AIR DAMPER (SD-F60-2) WHEN IN "UNOCCUPIED" MODE TO KEEP THE MAIN FLOOR OF THE BUILDING POSITIVELY
- PRESSURIZED RELATIVE TO THE DRY WELL. DRY WELL SUPPLY AIR DAMPER (SD-F60-2) WILL FULLY OPEN WHEN IN "OCCUPIED" MODE AND IS IN "DEFAULT" MODE. WHEN THE DEFAULT/AUTO HAND SWITCH (HS-F601) IS IN DEFAULT THE DRY WELL SUPPLY AIR DAMPER (SD-F60-2) WILL BE FULLY OPEN.

HEATER COIL (HC-F60)

- HEAT COIL (HC-F60) IS CONTROLLED VIA THE HEATER COIL CONTROLLER
- (CTRL-F60-2). A 0-10V SIGNAL IS USED TO CONTROL THE REQUIRED OUTPUT OF THE HEATER COIL
- CONTROLLER (CTRL-F60-2). THE DUCT TEMPERATURE SENSOR (TE-F601), WITH THE MANUAL TEMPERATURE SETTING AT 7°C, PROVIDES A SIGNAL (RTD) INTO THE SIGNAL CONVERTER (EY-F601) WHICH CONVERTS THE SIGNAL TO A 0-10V SIGNAL WHICH IS THEN SUPPLIED AS AN INPUT TO THE PLC AND HEATER COIL CONTROLLER (CTRL-F60-2) DIRECTLY VIA THE
- CONTACT OF THE DEFAULT/AUTO HAND SWITCH (HS-F601) IN THE DEFAULT POSITION. THE PLC PASSES THE SAME VOLTAGE THROUGH AN ANALOGUE OUTPUT TO THE HEATER COIL CONTROLLER (CTRL-F60-2) WHEN IN "WINTER MODE" AND
- "UNOCCUPIED" MODES AND THE DEFAULT/AUTO HAND SWITCH (HS-F601) IS IN AUTO. THE PLC OUTPUT A CONDITIONED VOLTAGE, INCREASING THE VOLTAGE TO MAKE THE SIGNAL APPEAR AS THE DUCT TEMPERATURE SENSOR (TE-F601) IS SET AT 15C, THROUGH AN ANALOGUE OUTPUT TO THE HEATER COIL CONTROLLER (CTRL-F60-2) WHEN IN "WINTER MODE" AND "OCCUPIED" MODES AND THE DEFAULT/AUTO HAND
- SWITCH (HS-F601) IS IN AUTO. THE 0-10V SIGNAL FROM THE SIGNAL CONVERTER (EY-F601) WILL BE SUPPLIED TO THE HEATER COIL CONTROLLER (CTRL-F60-2) THE DEFAULT/AUTO HAND SWITCH
- THE LOW FLOW SWITCH (FSL-F601) INITIATES A "PLUGGED FILTER" ALARM WHEN A LOW AIRFLOW IS DETECTED



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SPECIFICATION

SHEET 2 OF 2

THE CITY OF WINNIPEG WATER AND WASTE DEPARTMENT

BALTIMORE FLOOD PUMPING STATION UPGRADES **ELECTRICAL**

SHEET OF 23 19 E0007

CITY DRAWING NUMBER

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LOCATION APPROVED

UNDERGROUND STRUCTURES

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