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1. GENERAL

1.1 Migration Overview

The City of Winnipeg is upgrading the Process Control System (PCS) at the North Sewage Treatment Plant (aka NEWPCC) to a Schneider Programmable Logic Controller (PLC) based PCS. The existing PCS at NEWPCC is a Distributed Control System (DCS) based PCS that was first introduced by ABB in 1980 as Network 90. Since that time, the City has continued to expand and upgrade the original system as new process areas were brought on line.

Over the years the City has upgraded the Human Machine Interface (HMI) software from ABB Process Control View (PCV) to ABB's Symphony Plus S+ Operations Software (which presently has issues working with the City's Hyperview application), and upgrading of HMI workstation hardware and original process controller modules.

In this document, the existing ABB control system will be referred to as the DCS, and the new PLC based control system will be referred to as the PCS.

NEWPCC consists of various process areas, each with dedicated DCS cabinets. The NEWPCC DCS Migration will switch over the control of each area from DCS cabinets to a dedicated Hot-Standby PLC controller. The migration will occur area-by-area to reduce the disruption to the NEWPCC Operators.

The NEWPCC DCS Migration will have two contractors to complete the work, the Integrator (76-2023) and the General Contractor (385-2023). The Integrator and the General Contractor will work together to perform the migration from the DCS to Programmable Logic Controller (PLC) based PCS while maintaining plant operation.

The Integrator will be responsible for, including but not limited to:

- Set up and configuration of the PCS servers
- Network configuration
- Provide, install, and configure new PCS workstations
- Panel fabrication
- Development of new standardized logic blocks
- Development of new standardized HMI graphics
- Review of existing DCS logic and developed control narratives
- Generation of new PLC programs for each area
- PLC panel Factory Acceptance Testing (FAT) and System Integration Functional Test (SIFT)
- Set up, configure, and maintain DCS and PCS interim communication
- Switch over, testing, and commissioning Inputs and Outputs (IO) from DCS to PCS
- Commissioning of devices, equipment, and control loops on PCS
- Produce as-built drawing set to the City's Standards – including all field wiring from the General Contractor
- On-Call assistance for PCS related issues

The General Contractor will be responsible for, including but not limited to:

- Safety
- Install new PLC panels
- Wire power from the local panelboards to the PLC panels
- Wire cables from Field Device Panels (FDP), Termination Panels (TP), and Marshalling Panels (MP) to new PLC panels

- De-energize and disconnect IO from DCS during switch over
- Terminate and connect IO to PCS duration switch over
- Assist the integrator with any field wiring required during the switch over, testing, and commissioning
- Demolition, decommissioning, de-energizing, and salvaging of migrated DCS cabinets
- Assistance with installing and re-installing temporary panels
- Install PLC backboards into enclosures
- Produce loop wiring red lines with information required by City Standards

The General Contractor will act as the Prime Contractor for Safety on site for both the Integrator and the General Contractor.

Please note that this is a generalization of the responsibilities of each contractor for ease of understanding of the migration and does not limit responsibility or liability. The Contract Documents for each contract define the terms and conditions between the City and the contractors.

1.2 Migration Approach

The typical automation configuration at NEWPCC consists of the area DCS cabinets wired to FDPs, TPs, or MPs. The DCS cabinets, FDPs, TPs, and MPs are all located within the area control rooms. These panels are wired to the field devices.

From a circuit perspective, to switch an IO from the DCS to the PLC, the input or output wires from the FDP/TP/MP to the DCS cabinet will be replaced with equivalent wires to the PLC. To achieve this the General Contractor will pre-install and label multi-conductor cables from the FDP/TP/MPs to the PLCs and terminate each conductor in the PLC at the associated labelled terminal block.

The area migration will happen in stages of switchovers. A switchover is a period of time when a device is run in manual by the NEWPCC operations staff while the Integrator and General Contractor rewire and switch Remote control of the device from the DCS to the PCS.

When the prerequisites have been met for switching over a device and the City has been coordinated with, the device will be removed from DCS service by the City Operations and Automation and Industrial Control Group (AICG) teams. The general contractor will disconnect the conductor from the FDP/TP/MP to the DCS cabinet and will terminate the pre-installed conductor to the new PLC. The Integrator and the General Contractor will test and verify the new equipment IO and proceed to commission the device and automation logic on the PLC.

Once a device or set of common devices are switched over and commissioned to the PCS, communication between the DCS and PCS will be set up by the Integrator as required to facilitate the operation of the plant while some areas of the plant are still operating on the DCS system.

1.3 Migration Stages

The migration will be complete in stages, unless explicitly stated or permission is given by the City, work on future stages shall not be commenced by the Integrator or General Contractor until the previous migration stage’s completion milestone has been achieved with notice of achievement from the Contract Administrator.

.1 PCS Configuration Stage

The migration will start with the PCS Configuration Stage. In the PCS Configuration Stage the Integrator will set up and configure the servers, configure the network, and set up the PCS operator workstations in each control room.

In certain area control rooms there is a lack of space to accommodate a PCS operator workstation alongside the existing DCS workstation. In these space-constrained area control rooms the Integrator will install KVM switches on the existing workstations until the DCS operator workstations can be removed. Training for the AICG and Operators on the KVM switches will be provided by the Integrator. Integrator to schedule training with AICG and Operators ahead of time to ensure all shifts receive training and training is accurately priced.

Communication between the DCS and PCS will be established by the Integrator to facilitate data exchange as required throughout the migration.

Included with the PCS Configuration Stage is the template setup for the standardized logic blocks and the standardized HMI graphics. Separate review meetings for the logic blocks and HMI graphics will be held following the City's review to demonstrate the functionality.

.2 Migration Stages

Once the PCS Configuration tasks are completed the area migration stages will begin. Each area migration will follow a typical procedure but will have specific requirements as called out in the migration plan.

The areas will be migrated in the following sequence:

1. Area G: Grit
2. Area P: Primary Clarifiers
3. Area D: Digesters
4. Area W: Dewatering
5. Area C: Centrate
6. Area B: Boilers:
7. Area U: Ultraviolet (UV) Disinfection
8. Area S: Secondary Clarifiers
9. Area R: High Purity Oxygen Reactors
10. Area M: Main Building

This sequence may be changed by written direction from the City at the City's discretion.

Space for the PLCs is unavailable in most area control rooms. Where denoted on drawings, the PLC cabinet back plane will be installed on temporary stands built by the integrator. This will allow the PLC to take up less space until the DCS cabinet can be removed. When temporary stands are used, the cables must be routed with enough slack and through the final installation location penetrations such that the PLC backplane can be installed in the final location without removing the wire terminations. Provide protection for temporary stands to ensure the PLC cabinet backplane, wiring, and components are not damaged from foot traffic. The loops will have to be tested twice, once in the temporary installation and again in the permanent placement.

Commissioning, production of operation and maintenance manuals, training, and development of as-builts are required to be completed before work in other stages may begin. This will allow the City to operate the migrated areas with a full understanding of what has been installed.

During the future migration stages, the Integrator and General Contractor will be on-call to respond to any issues that require resolving with the PCS system.

.3 PLC Integrations

Newer areas at NEWPCC are already on PLC controllers. These PLCs and associated HMI screens do not need full scale migrations but will be integrated by the Integrator to the PCS as an “Included Project” for seamless control across the Plant PLCs from the PCS.

The PLCs to be integrated include:

- Power Supply Upgrade PLCs and networked devices;
- Headworks Upgrade PLCs and networked devices;
- Interim Phosphorus Upgrade PLCs and networked devices.
- Lab HVAC PLC;
- Fan House PLC
- Main Building HVAC PLCs (total 3);
- RSP Sump Pit PLC;
- Boiler PLCs (1-4);
- Digester #11 PLC;
- Primary Clarifier Bridge PLCSs (4 & 5);
- Secondary Clarifier Bridge PLCs (1-8);
- Dewatering Centrifuge PLCs (1-6);
- Dewatering Centrifuge Backdrive ATV (1-6);
- Dewatering Autoloading PLC;
- Dewatering Sludge PLC;
- Dewatering PLCs (12, 34, 56);
- UV PLC;
- UV Pump Control Panels (1-5);
- Leachate PLC;
- Hauled Liquid Waste (HLW) PLC; and
- HLW 2 PLC.

Integrator will develop new HMI screens for integrated PLCs to the PCS, existing HMI screens will be used to replicate and develop new screens. Integrator to implement all necessary changes as required to new developed HMI screen to include any modifications in the PLC logic.

The PLC Integrations shall include Preliminary work, pre-integration inspections, system integration functional testing, and commissioning.

During the preliminary work of integrating a PLC and associated HMI screens, the system documentation will be reviewed by the Integrator to understand the functionality and begin the basis for designing the new HMI screens and any PLC data links.

The Integrator will perform Pre-Integration inspections will occur before the finalization of the integration development to confirm the documentation in the field and at the existing workstations

HMI graphics will be submitted by the Integrator to the Contract Administrator for the City’s review. The PLC logic and HMI graphics should be based around the standardized blocks and graphics. Work in the

area will not commence until the PLC logic and HMI graphics have been reviewed with no comment or reviewed as noted.
The Integrator will complete work request forms, SIFT, and commissioning for all PLC integrations following the same requirements as for the area migrations detailed in Section 2 of the migration plan and the specifications.

.4 Headworks PLC and HMI Integrations

Headworks Facilities project at NEWPCC is already started and the construction is in progress. It is the Headworks system integrator's responsibility to complete the Headworks PLC and HMI programing and the successfully test Headworks system and Headworks temporary servers. Upon completion, the Headworks system integrator will work in conjunction with the DCS system integrator to tie the Headworks facility to the NEWPCC PCS. Both integrators will communicate to exchange the interface signal between NEWPCC PCS and Headworks. The integrators will include City's AICG group in all communications.

Headworks PLC and HMI program will be handed over to the DCS integrator to integrate Headworks to the NEWPCC PCS. The Headworks integrator will disconnect and remove the temporary server upon successful integration of the headworks to PCS.

Once the Headworks is tied to the NEWPCC PCS, the DCS system integrator will move the new two servers (CS-A8100, CS-A8300) from the main building to the Headworks new server room and complete all necessary testing. The timing of the servers' move will be discussed with the City.

.5 Interim Phosphorus project PLC and HMI Integrations

Interim Phosphorus project at NEWPCC is already started and the construction is in progress. It is the Interim Phosphorus project system integrator's responsibility to complete the PLC and HMI programing and the successfully test of the system on a temporary server. Upon completion, the Interim Phosphorus system integrator will work in conjunction with the DCS system integrator to integrate Interim Phosphorus project to the NEWPCC PCS. Both integrators will communicate to exchange the interface signal and integrate Primary PLCs and HMI screens to NEWPCC PCS. The integrators will include City's AICG group in all communications.

.6 DCS Final Decommissioning Stage

Once all of the area migration stages have all been completed the DCS Servers will be decommissioned by the Integrator. The City will salvage the DCS Servers, Workstations, and the KVM switches.

2. GENERAL AREA MIGRATION STAGE REQUIREMENTS

2.1 Switchover plans

The Integrator will produce a plan for each switchover that documents the associated equipment, loops, and IO being switched from the DCS to PCS and the order these will occur in. This will be reviewed by the General Contractor for any Safety and submitted to the Contract Administrator as an attachment to the Work Request Form.

The switchover plan will include the required assistance from operations and/or maintenance for testing and commissioning.

Any signals that will need to be communicated back to the DCS for maintained operation of the DCS control loops will be included in the switchover plan.

The switchover plan must state the duration of the switchover attempt period, and both a time and plan to revert the controls back to the DCS if the switchover is unsuccessful. The Contract Administrator, Integrator, and General Contractor must agree to the switchover start time and duration. The General Contractor must agree to the time available to revert back to DCS controls and that they will be able to wire all of the IO back to the DCS within the allotted time.

The General Contractor shall be in the control room and available for the entire switchover duration.

2.2 Preliminary Work

.1 Site Condition Verification

When beginning the migration stage of a process area, the General Contractor must review the existing wiring between the DCS and the FDPs/TPs/MPs to against the IO lists and document their findings. These findings are to be given to the Contract Administrator and the Integrator. The Integrator will review the findings and visit the area control room as required to understand the wiring and any deviations from the plant standard installations.

The General Contractor and Integrator must inform the Contract Administrator of any identified issues relating to the condition of the existing instruments, equipment, panels, or controllers prior to beginning any work. The Contract Administrator will advise of any necessary corrective action required by the Contractor prior to initiation of migration work.

The Contractor shall provide written checklists to document all site condition pre-installation checks.

.2 Detailed Drawings

Based upon the findings of the Site Condition Verification, the Integrator is required to produce the following detailed drawings:

- Loop Drawings
- IO Module Wiring Diagrams

The detailed loop drawings shall be based upon the template drawings included in the Contract Documents and adhere to the City Drawing Standards.

.3 FAT and SIFT

Factory Acceptance Tests (FATs) and System Integration Functional Tests (SIFTs) shall be performed on all PLC processor and remote I/O panels before they are delivered to site. Perform the FAT and SIFT as specified.

.4 City Review

The PLC logic and HMI graphics will be submitted by the Integrator to the Contract Administrator for the City's review. The PLC logic and HMI graphics should be based around the standardized blocks and graphics. Work in the area will not commence until the PLC logic and HMI graphics have been reviewed with no comment or reviewed as noted.

If the Integrator determines additional standardized blocks or graphics are required while developing the PLC program of HMI screens for an area, the Integrator will inform the Contract Administrator of the additional blocks or logic and submit the new standardized components to the City for review.

2.3 Pre-Migration Inspections

.1 Panel and Equipment Inspection

The General Contractor and Integrator will each be responsible for visually inspecting all materials and assemblies brought on site prior to the commencement of the area migration. Provide a checklist to the Contract Administrator of the materials or assembly sub-components verifying they have been they have been inspected. The Contract Administrator will review the checklists against the materials and assemblies for completeness.

.2 Identification

The General Contractor will identify and label any wires or terminals without labels to facilitate the migration once underway. This is to prevent incorrect wires from being disconnected from the existing system. The General Contractor shall submit RFI's as required when assistance is need from the City's maintenance staff for identifying conductors.

.3 Loop Check Methods

The cables from the PLC cabinets to the FDPs/TPs/MPs will be installed and terminated at the PLC cabinet or temporary rack by the General Contractor prior to the migration. These connections will all be checked by Loop Checks to verify the correct wiring installation. Produce loop check documents of each IO loop prior to the migration and submit for review. The loop checks require generating, simulating, or reading a signal at the FDP/TP/MP and generating, simulating, or reading on the PLC based on the type of loop being checked. The General Contractor is to perform all activities required to perform the loop check outside of the PLC panel, the Integrator is to perform all activities on the PLC.

Discrete inputs to the PCS will be verified by generating the appropriate voltage level signal at the FDP/TP/MP and will be correctly read by the PLC. Both high and low states need to be verified.

Analog inputs to the PCS will be injected by a signal generator or multimeter at the correct voltage level at the FDP/TP/MP and correctly read and scaled by the PLC. At a minimum the loop check must check for signal under-range and three (3) evenly spaced values across the full signal span. Analog inputs are to be scaled to the same range as the DCS scaling.

Discrete outputs from the PCS will be generated by the PLC and the verified voltage level will be read at the FDP/TP/MP. Both high and low states need to be verified.

Analog outputs from the PCS will be generated by the PLC and the signal level will be verified at the FDP/TP/MP. At a minimum the loop check must check the signal at three (3) evenly spaced values across the full signal span. Analog outputs are to be scaled to the same range as the DCS scaling.

.4 Networking

The Control Network, the Supervisory Network, the Server Network (if applicable), and Device Networks (if applicable) in area the area being migrated shall be fully set up, configured, and commissioned by the Integrator.

Interim communication for the area will be established with the DCS to communicate any required signals between the DCS and PCS. The Integrator will identify any interim signals required to or from the DCS to facilitate correct operation during the migration as identified in the process control narratives and the DCS logic.

For example, if a pump is being migrated from the DCS to the PCS and this pump is part of a control loop regulating the pump speed based off of a discharge flowmeter signal, the flowmeter signal required for automatic operation will be identified and communicated to the PCS to allow for automatic operation. When able, the flowmeter and pump should be migrated together, however this may not always be feasible.

.5 SAT and SIT

Perform SAT and SIT tests as defined in spec section 40 99 92 to complete the requirements of SAT and SIT tests, submit test results for review and acceptance.

.6 Work Request Forms

Prior to commencing work in a new area, a Work Request Form must be submitted by both the Integrator and the General Contractor. This is to allow the City to prepare for the Work being performed. A general work request form must be submitted for the area control room access, however each switchover of signals between the DCS and PCS requires a Work Request Form to be submitted by the Integrator.

Please note that each type of process equipment has varying demands on the Operators and therefore requires different lead times for the Work Request Form. Similarly, each type of process equipment has a maximum amount of time it can be run in manual or be offline for.

Each switchover Work Request Form shall document the equipment tags, loops, and IO being switched over to the PCS and the equipment tags, loops, and IO losing DCS control temporarily during the switchover.

.7 Draft O&M Manual

The draft copy of the O&M Manuals for the area will be submitted by the integrator for review and approval. The O&M Manual will be completed with all required information as specified in 01 78 23 and as required throughout the specifications. This version of the O&M Manual is only referred to as a draft copy as the system has not been switched over and will not have changes required to be made during the switch over

2.4 Switchover

The Integrator will plan and lead the switchovers. The General Contractor will still be responsible for safety and has the authority to stop or revert any work in the interest of safety. The General Contractor will be in the control room and ready to assist as required and directed by the integrator.

.1 City Coordination

The switchover period will begin at the documented date and time on the Work Request Form that has been approved by the City. The Integrator and General Contractor must receive positive confirmation

from the City Operations that the alternate control strategy is being employed and they are able to take the identified equipment off of control from the DCS.

.2 PLC State

To begin the switchover of IO, the Integrator will ensure all of the associated outputs are forced to off and the associated control loops are disabled.

.3 De-energization

Once directed by the Integrator, the General Contractor will de-energize the DCS IO cards associated with the switchover according to the approved Work Request Form. If the General Contractor identifies that additional loops must be de-energized, the City Operations and AICG staff must be coordinated with to determine if the additional loops can be de-energized.

.4 IO switchover

The Integrator will direct the General Contractor which loops to switch over as defined in the switchover plan. The Integrator will perform tests throughout the switchover to verify the IO switchovers are successful.

.5 Testing

Each individual IO must be tested during the switchover prior to commissioning. An IO Test checklist will be filled out by the Integrator as the testing progresses throughout the switchover.

Testing may require the support of operators or maintenance staff to create the correct condition to verify an input or output.

Discrete inputs are to be tested in both the high and low state from the field device.

Analog inputs are to be tested at three (3) evenly spaced values across the full signal span generated from the Field device. Where this is not be feasible due to process conditions, maximize the span between each of the three (3) readings.

Discrete outputs are to be tested in both the high and low state from the PLC to the field device. The Integrator must coordinate with the operations staff that it is safe to perform any discrete output testing.

Analog outputs are to be tested at three (3) evenly spaced values across the full signal span generated from the PLC to the field device. Where this is not be feasible due to process conditions, maximize the span between each of the three (3) readings. The Integrator must coordinate with the operations staff that it is safe to perform any discrete output testing.

Any untested control loops will be documented on the switchover checklist and will be identified to the Contract Administrator.

.6 DCS feedback signals

Any signals that are needed for the continued DCS operation for the controls remaining on the DCS will be set up and communicated back to the DCS. The Integrator will coordinate with the City’s AICG to communicate these signals to the DCS.

.7 Re-energization

The DCS cards will be re-energized once the control loops have been verified and the DCS feedback signals have been configured.

The General Contractor will notify the operator and AICG that they are ready to re-energize the DCS cards. Once the operator and AICG staff have confirmed the re-energization of the DCS cards the General Contractor will reconnect the DCS cards that were taken out of service during the switchover.

Operations will test and verify that the DCS controls that were taken down during the switchover but remain on the DCS are still functional.

.8 Commissioning and Demonstration

Once the Integrator has tested and tuned the control loops and the DCS cards are re-energized, they will commission and demonstrate the complete PLC, HMI, and PCS system for the associated switched over IO to the Contract Administrator and senior operator or representative. During commissioning the Integrator will demonstrate all aspects of the process control narrative.

In general commissioning will occur in the following sequence:

- Test of motor start / stop / speed control, valves open / close, dampers open / close, device functionality in Remote Manual mode
- Test subsystem interlocks
- Test control functions
- Test each subsystem in Remote Automatic
- Test each complete system with all subsystem controls in Remote Automatic
- Test communication with other controllers and any associated logic
- Configure HMI and PLC to PLC communication to allow for remote monitoring and control throughout the plant

.9 Untested Control Loops

In certain circumstances, the appropriate conditions might not allow for the testing, tuning, or commissioning of control loops. This will be determined by a NEWPCC senior operator. When this occurs notify the Contract Administrator. The Contract Administrator will work with the senior operator to determine the risk level associated for the given untested control loops.

If the risk is determined to be too great, the controls will remain on the DCS until the conditions allow for proper testing and tuning. Operations will monitor conditions and notify the Contract Administrator once conditions allow for testing and tuning. The Integrator and General Contractor will then perform a switchover for the untested control loops.

If the risk is considered acceptable, the controls will be migrated to the PCS. Operations will monitor conditions and notify the Contract Administrator once conditions allow for testing and tuning. The Integrator will perform testing and tuning on the untested control loops.

.10 Red lines

Throughout the switchover procedure redlines will be marked up by the General Contractor for any wiring outside of the PLC panel and the Integrator for any changes within the PLC panel. PLC set points, logic variations, or any in-situ changes should be documented by the Integrator.

A copy of the red-lines is to remain in the control room and accessible to City operations and maintenance staff. This will facilitate City troubleshooting in case of emergency.

.11 Handover

Once the commissioning has successfully been completed and the remaining DCS controls have been verified to be in working condition, the General Contractor and the Integrator will restore the PLC and control room to operating condition. Any wireway and panel covers will be replaced, any forced values from testing in the PLC will be removed to allow for operation in the normal operating state.

HMI screens should be marked to clearly indicate which controls are on the DCS and which controls are on the PCS.

The hand over will occur once the area PLC is installed in the final location and the commissioning and verification test is complete, all deficiencies are addressed and accepted by the contract administrator.

2.5 On Call Support

The contractor and the Integrator will be required to provide on-call support for all the areas previously migrated throughout the project and during the construction and the warranty period. The Contractor with Integrator shall provide the City with a phone number and email contact for the on-call support. There are four levels of call out support based on required response time. The City has the right to determine what level of support is required.

For the On Call Support Business Days are defined as the days Monday, Tuesday, Wednesday, Thursday, or Friday excluding Canadian Federal Statutory Holidays. Business Hours are defined as the hours from 7AM to 4PM CDT on Business Days.

.1 Emergency Call Support

An Emergency Call Support request will be communicated via phone call. A follow up documentation email will be sent within 48 hours or when conditions allow.

The Emergency Call Support acknowledgment time is 1 hour from the initial call.

The Emergency Call Support response time to begin resolving an Emergency Call Support request is 2 hours from the initial call. Remote support is acceptable if available to resolve it issue.

.2 Urgent Call Support

An Urgent Call Support request will be communicated via phone call. A follow up documentation email will be sent within 48 hours or when conditions allow.

The Urgent Call Support acknowledgment time is 2 Business Hours from the initial call.

The Urgent Call Support response time to begin resolving an Urgent Call Support request is 4 Business Hours from the initial call. Remote support is acceptable if available to resolve it issue.

.3 Standard Call Support

A Standard Call Support request will be communicated via email.

The Standard Call Support acknowledgment time is 1 Business Day from the initial email.

The Standard Call Support response time to begin resolving a Standard Call Support request is 5 Business Days from the initial call. Support must be provided in person.

.4 Maintenance Call Support

A Maintenance Call Support request will be communicated via email.

The Maintenance Call Support acknowledgment time is 5 Business Day from the initial email.

The Maintenance Call Support response time to begin resolving a Maintenance Call Support request is 10 Business Days from the initial call. Support must be provided in person.

2.6 Area Migration Completion

Once all of the switchovers for an area have occurred the process area will be completely running on the PCS. To compete the migration of the process area the DCS must be decommissioned, the PLC installation must be finalized, and the as-builts must be produced.

.1 Decommission DCS Controllers

The Integrator will request that the DCS be de-commissioned to the Contract Administrator once the switchovers have been completed and the PCS is completely controlling the process area. The City's AICG team will then verify the DCS can be decommissioned, decommission the DCS Controllers, and take the controllers offline. Allow for one (1) week for the AICG to decommission a DCS Controller Logic.

.2 DCS Communication Ring

The ABB Infi90 system runs on a communication ring through each area terminating in the DCS cabinets. As such, before the DCS cabinet can be removed, the communication ring must be temporarily bridged until the DCS is fully decommissioned across the plant. The integrator will install this communication bridge prior to the salvaging of DCS components.

.3 Salvage DCS Components

Upon notice that the DCS is set to be decommissioned, the City will compile a list of cards and module to be salvaged. The Integrator will remove these cards, package them in anti-static, weather-resistant packaging and provide them to the City at storage location determined by the City.

.4 Demolish DCS cabinets

Once the salvaging is complete the General Contractor will contact the Contract Administrator to request permission to proceed with the demolition/salvage of the DCS cabinet.

Demolition of the cabinet involves de-energizing the cabinet and removing the power feeder cables, removing any decommissioned cables between the DCS and the FDP/TP/MPs, and removing the remaining panel internals and enclosure. The General Contractor will repair the floor, wall or ceilings associated with the demolition.

.5 PLC Final Location Installation

If the area had a temporary PLC structure to facilitate the migration, the General Contractor will install the PLC enclosure in the final location. The General Contractor will then remove the backplane from the temporary PLC structure and install in PLC enclosure.

To perform the re-location of the PLC backplane, the General Contractor will put in a Work Request Form for the Operators to manually run the area. The area will then be taken offline and placed in manual to the General Contractor to install the backplane in the enclosure. The maximum time a process can be run in manual mode is defined in the tables in section 3 as the Maximum Down Time for each area.

During the PLC backplane relocation, the Integrator will be in the area control room to monitor for any damage to the PLC backplane.

.6 As-builts

As-builts must be produced for the area prior to the completion of the area migration stage. This is required to allow the operations and maintenance staff to respond to issues. At a minimum, as-builts at this stage include:

- Loop Drawings
- IO Module Wiring Diagrams
- Panel Elevations
- Panel Power Distribution Schematics
- Control Narratives
- Location Plans
- O&M Manuals

As well as the as-builts, the working programming files must be provided to the City's AICG.

.7 Demonstration Period

Once the DCS systems are demolished and the PLC is installed in the final location a two (2) week demonstration period will commence. The demonstration period must complete with no major process interruptions before Work may begin on the subsequent areas.

The area Senior Operator can define any incident during the demonstration period as a major process interruption at their discretion. Examples of a major process interruption include when the plant area is unable to function in manual or automatic mode in a similar capacity as the existing DCS control system.

If a major process interruption occurs within the demonstration period, the Integrator will resolve the issue and restart the Demonstration Period The Integrator will notify the Contract Administrator if the General Contractor is required to resolve the issue.

3. MIGRATION SEQUENCE

This sequence has been developed to facilitate the NEWPCC DCS Migration. Many reasons may require the City to adjust the schedule, such as annual flow patterns, equipment maintenance, etc. This sequence may be changed by written direction from the City at the City's discretion.

Once a stage has begun migration, work should continue in that area until the migration is complete to minimize disruption to the plant staff.

3.1 PCS Configuration Stage

Three servers have been pre-purchased by the City. The Integrator will supply and install two racks to mount the servers in, NP-A8100 and NP-A8200. NP-A8100 will be installed in the main building and will house two servers (CS-A8100, CS-A8300). NP-A8200 in the Secondary Clarifiers area to house one server (CS-A8200). The Integrator will then feed the racks with power, install the servers in the racks, and configure the servers for the PCS. The integrator will provide network connections from the network panels to the servers.

CS-A8100 will have three (3) virtual machines running on it. The first virtual machine will run HMI Server A, the second virtual machine will run the Tier 1 Historian, and the third machine will run a domain controller.

CS-A8200 will similarly have two (2) virtual machines. The first virtual Machine will run the HMI Server B, the second will run a domain controller.

CS-A8300 will have two (2) virtual machines running on it. The first virtual machine will run the DMZ server, and the second virtual machine will run the Tier 2 Historian, the third will run a domain controller. Additional virtual machines to be set up as needed as test development servers for projects.

The Integrator will configure the PCS networks. The PCS has the following networks:

- Demilitarized Zone (DMZ)
- Supervisory Network
- Server Network
- Control Network
- Device Network (Local to process areas)

Perform server and network handover once all FAT, SAT, SIFT, SIT, and performance tests are complete and in conjunction with the handover of the first area in the migration sequence. All the general PCS components and systems will be tested, commissioned, and handed over to the City upon the completion of the first area.

Prior to migrating any areas, PCS workstations will be set up and configured in each area control room to allow for remote monitoring and control as equipment is switched over to the PCS. In areas with limited space, the Integrator will install KVM switches for the workstations to share peripherals. The integrator will provide network connections from the network panel to the workstations. The Integrator will train the operators on use of the KVM switches.

A communication link will be established during the PCS Configuration Stage to allow for data communication between the DCS and PCS. The AICG will provide the programming on the DCS to facilitate the communication upon receiving a request from the Integrator.

Standard PLC logic blocks will be configured for use throughout the project. The standardization will assist with the maintenance of the PCS after the migration. The Integrator will develop the standardized block for use in the PCS and submit the blocks for review. A meeting will be held to review the standardized blocks. The standardized blocks will be revised and resubmitted based on City comments.

Standard HMI graphics will be configured for use throughout the project. The standardization will assist with the maintenance of the PCS after the migration. The Integrator will develop the standardized graphics for use in the PCS and submit the graphics for review. A meeting will be held to demonstrate and review the standardized graphics. The standardized graphics will be revised and resubmitted based on City comments.

3.2 Stage: Grit Migration

.1 Preliminary Work

- Site Condition Verification
- Detailed Drawings
- FAT and SIFT
- City Review

.2 Pre-Migration Inspections

- Panel and Equipment Inspections
- Identification
- Loop Checks
- Networking
- Switchover Plans
- Work Request Forms
- Draft O&M Manual

.3 Area Control Groups

Control Group	Operational Bypass	Work Request Form Lead Time (days)	Maximum Down Time	Prerequisites
Influent Sluice Gates	Manual	3		
Bar Screens	Manual	3		
Grit Tanks	Manual	3		
Grit Conveyors and Hoppers	Manual	3		
Grit Blowers	Manual	3		
Tank Fans	Manual	3		
Tank Area Exhaust Fans	Manual	3		
Sump Pumps	Manual	3		
Flushing Water Pumps	Redundant Train	3		
H2S Monitor	Manual	3		

Refer to the Process Control Narrative for details on the control and automation.

.4 Switchover

- City Coordination
- De-Energization
- IO Switchover
- Testing
- DCS Feedback Signals
- Re-Energization
- Commissioning and Demonstration

.5 Decommissioning

- Decommission DCS Controllers
- DCS Communication Ring
- Salvage DCS Components
- Demolish DCS cabinets
- Demonstration Period

.6 Handover

- PLC Final Location
- Verification test and address deficiencies
- Redline drawings submission
- As Builts

.7 Decommissioning

- Decommission DCS Controllers
- DCS Communication Ring
- Salvage DCS Components

3.3 Stage: Primary Clarifiers Migration

.1 Preliminary Work

- Site Condition Verification
- Detailed Drawings
- FAT and SIFT
- City Review

.2 Pre-Migration Inspections

- Panel and Equipment Inspections
- Identification
- Loop Checks
- Networking
- Switchover Plans
- Work Request Forms
- Draft O&M Manual

.3 Area Control Groups

Control Group	Operational Bypass	Work Request Form Lead Time (days)	Maximum Down Time	Prerequisites
Primary Clarifiers 1,2 & 3	Manual	3	4 hours	
Primary Clarifiers 4 & 5	Manual	3	4 hours	
Sludge System – Clarifiers 1, 2, & 3	Redundant Train	3		
Sludge System – Clarifiers 4 & 5	Redundant Train	3		
Primary Clarifier Batch System	Manual	10	8 hours	Sludge System – Clarifiers 1, 2, & 3; Sludge System – Clarifiers 4 & 5
Scum Removal System – Clarifiers 1, 2, & 3	Manual	5	8 hours	
Scum Removal System – Clarifiers 4 & 5	Manual	5	8 hours	

Refer to the Process Control Narrative for details on the control and automation.

.4 Switchover

- City Coordination
- De-Energization
- IO Switchover
- Testing
- DCS Feedback Signals
- Re-Energization
- Commissioning and Demonstration
- Red Lines
- Handover

.5 Decommissioning

- Decommission DCS Controllers
- DCS Communication Ring
- Salvage DCS Components
- Demolish DCS cabinets
- PLC Final Location
- As-builts
- Demonstration Period

3.4 Stage: Digesters Migration

.1 Preliminary Work

- Site Condition Verification
- Detailed Drawings
- FAT and SIFT
- City Review

.2 Pre-Migration Inspections

- Panel and Equipment Inspections
- Identification
- Loop Checks
- Networking
- Switchover Plans
- Work Request Forms
- Draft O&M Manual

.3 Area Control Groups

Control Group	Operational Bypass	Work Request Form Lead Time (days)	Maximum Down Time	Prerequisites
Digester Batch Feed System	Manual	5	8 hours	
Primary Sludge Receiving	Manual	3		
Sludge Recirculation System	Off	3	8 hours	
Digested Sludge Transfer Pumps	Manual	3	8 hours	
Emergency Overflow Tank – Tank 1	Manual	3		
Sludge Mixing	Off	3	8 hours	
Gas Booster Compressors and Sphere	Redundant Train	5		
Gas Piping	Off	5	4 hours	Gas Booster Compressors and Sphere
Waste Gas Burners	Local Automatic	3		
Gas Detection and Alarming	Manual	3	8 hours	
Sump Pumps	Local Automatic	3		
Miscellaneous	As Required	3		
Integration of Digester Gallery M340 PLC				

Refer to the Process Control Narrative for details on the control and automation.

.4 Switchover

- City Coordination
- De-Energization
- IO Switchover
- Testing
- DCS Feedback Signals
- Re-Energization
- Commissioning and Demonstration
- Red Lines
- Handover

.5 Decommissioning

- Decommission DCS Controllers
- DCS Communication Ring
- Salvage DCS Components
- Demolish DCS cabinets
- PLC Final Location
- As-builts
- Demonstration Period

3.5 Stage: Dewatering Migration

.1 Preliminary Work

- Site Condition Verification
- Detailed Drawings
- FAT and SIFT
- City Review

.2 Pre-Migration Inspections

- Panel and Equipment Inspections
- Identification
- Loop Checks
- Networking
- Switchover Plans
- Work Request Forms
- Draft O&M Manual

.3 Area Control Groups

Control Group	Operational Bypass	Work Request Form Lead Time (days)	Maximum Down Time	Prerequisites
Digest Sludge Holding Tanks 6 and 8	Manual	3		
Holding Tank Circulation Pumps	Redundant Train	3		
Digested Sludge Transfer Pumps	Redundant Train	3		
Sludge Feed Pump System	Redundant Train	3		
Dry Polymer Batch System	Redundant Train	3		
Polymer Feed Pumps	Redundant Train	3		
Centrifuge System	Redundant Train	3		
Sludge Cake System	Redundant Train	3		
Sludge Cake Storage	Local Automatic	3		
Sludge Cake Loadout	Local Automatic	3		
Centrifuge Building Exhaust Fans	Manual	3		
Ferric Chloride Unloading	Manual	3		
Ferric Chloride Dosing Pumps	Manual	5		
Miscellaneous Systems	Local Automatic	3		

Refer to the Process Control Narrative for details on the control and automation.

.4 Switchover

- City Coordination
- De-Energization
- IO Switchover
- Testing
- DCS Feedback Signals
- Re-Energization
- Commissioning and Demonstration
- Red Lines
- Handover

.5 Decommissioning

- Decommission DCS Controllers
- DCS Communication Ring
- Salvage DCS Components
- Demolish DCS cabinets
- PLC Final Location
- As-builts
- Demonstration Period

3.6 Stage: Centrate Migration

.1 Preliminary Work

- Site Condition Verification
- Detailed Drawings
- FAT and SIFT
- City Review

.2 Pre-Migration Inspections

- Panel and Equipment Inspections
- Identification
- Loop Checks
- Networking
- Switchover Plans
- Work Request Forms
- Draft O&M Manual

.3 Area Control Groups

Note that the Centrate automated control is prohibitive to manually control. The two redundant Centrate tanks are rotated between in-service and out-of-service approximately every 18 months. The out of service Centrate tank will be migrated to the PCS, and commissioned when its is put into service. Then when the alternate Centrate tank is taken out of service for maintenance, it will be migrated.

Control Group	Operational Bypass	Work Request Form Lead Time (days)	Maximum Down Time	Prerequisites
Centrate Transfer	Manual	5	8 hours	
SBR Systems	Off	3		
ChemScan Systems	Local Automatic	3		
Equalization Tank	Manual	5	8 hours	
Exhaust Fan	Manual	3		
Soda Ash Unloading	Off	3	3 days	
Soda Ash Dosing	Redundant Train	3		
Soda Ash Ancillary Systems	Redundant Train	3		Soda Ash Dosing
Methanol System	Redundant Train	3		

Refer to the Process Control Narrative for details on the control and automation.

.4 Switchover

- City Coordination
- De-Energization
- IO Switchover
- Testing
- DCS Feedback Signals
- Re-Energization

- Commissioning and Demonstration
- Red Lines
- Handover

.5 Decommissioning

- Decommission DCS Controllers
- DCS Communication Ring
- Salvage DCS Components
- Demolish DCS cabinets
- PLC Final Location
- As-builts
- Demonstration Period

3.7 Stage: Boilers Migration

.1 Preliminary Work

- Site Condition Verification
- Detailed Drawings
- FAT and SIFT
- City Review

.2 Pre-Migration Inspections

- Panel and Equipment Inspections
- Identification
- Loop Checks
- Networking
- Switchover Plans
- Work Request Forms
- Draft O&M Manual

.3 Area Control Groups

Control Group	Operational Bypass	Work Request Form Lead Time (days)	Maximum Down Time	Prerequisites
Make-Up Water System and expansion and blowdown tanks	Manual	5	4 hours	
Boiler Circulation Pumps	Manual	3	8 hours	
Boilers 1 and 2	Off	3		
Boilers 3 and 4	Off	3		
Boiler 5	Off	3		
Hot Water Mixing Tank	N/A	3		
Hot Water Distribution Pumps	Local Automatic	3		
Sump Pump	Local Automatic	3		

Refer to the Process Control Narrative for details on the control and automation.

.4 Switchover

- City Coordination
- De-Energization
- IO Switchover
- Testing
- DCS Feedback Signals
- Re-Energization
- Commissioning and Demonstration
- Red Lines

- Handover

.5 Decommissioning

- Decommission DCS Controllers
- DCS Communication Ring
- Salvage DCS Components
- Demolish DCS cabinets
- PLC Final Location
- As-builts
- Demonstration Period

3.8 Stage: UV Disinfection Migration

.1 Preliminary Work

- Site Condition Verification
- Detailed Drawings
- FAT and SIFT
- City Review

.2 Pre-Migration Inspections

- Panel and Equipment Inspections
- Identification
- Loop Checks
- Networking
- Switchover Plans
- Work Request Forms
- Draft O&M Manual

.3 Area Control Groups

Control Group	Operational Bypass	Work Request Form Lead Time (days)	Maximum Down Time	Prerequisites
UV Pumps	Redundant Train	3		
UV Banks	Redundant Train	3		
UV Bypass	Manual	3		
UV Final Effluent Sampler	Local Automatic	3		

Refer to the Process Control Narrative for details on the control and automation.

.4 Switchover

- City Coordination
- De-Energization
- IO Switchover
- Testing
- DCS Feedback Signals
- Re-Energization
- Commissioning and Demonstration
- Red Lines
- Handover

.5 Decommissioning

- Decommission DCS Controllers
- DCS Communication Ring
- Salvage DCS Components

- Demolish DCS cabinets
- PLC Final Location
- As-builts
- Demonstration Period

3.9 Stage: Secondary Clarifiers Migration

.1 Preliminary Work

- Site Condition Verification
- Detailed Drawings
- FAT and SIFT
- City Review

.2 Pre-Migration Inspections

- Panel and Equipment Inspections
- Identification
- Loop Checks
- Networking
- Switchover Plans
- Work Request Forms
- Draft O&M Manual

.3 Area Control Groups

Control Group	Operational Bypass	Work Request Form Lead Time (days)	Maximum Down Time	Prerequisites
Secondary Clarifiers Train 1 Collectors	Manual	3		
Secondary Clarifiers Trains 2 and 3 Collectors	Manual	3		
Secondary Clarifiers RAS Train 1	Redundant Train	5	8 hours	
Secondary Clarifiers RAS Trains 2 and 3	Redundant Train	5	8 hours	
Secondary Clarifiers WAS System	Manual	5	8 hours	
Scum Removal System	Manual	5	8 hours	
Air Blowers and Instrument Air	Manual Control	3		
Fan House	Local Automatic	3		
Secondary WAS and Final Effluent Samples	Manual	5	8 hours	
Sump Pumps	Local Automatic	3		

Refer to the Process Control Narrative for details on the control and automation.

.4 Switchover

- City Coordination
- De-Energization

- IO Switchover
- Testing
- DCS Feedback Signals
- Re-Energization
- Commissioning and Demonstration
- Red Lines
- Handover

.5 Decommissioning

- Decommission DCS Controllers
- DCS Communication Ring
- Salvage DCS Components
- Demolish DCS cabinets
- PLC Final Location
- As-builts
- Demonstration Period

3.10 Stage: HPO Reactors Migration

.1 Preliminary Work

- Site Condition Verification
- Detailed Drawings
- FAT and SIFT
- City Review

.2 Pre-Migration Inspections

- Panel and Equipment Inspections
- Identification
- Loop Checks
- Networking
- Switchover Plans
- Work Request Forms
- Draft O&M Manual

.3 Area Control Groups

Control Group	Operational Bypass	Work Request Form Lead Time (days)	Maximum Down Time	Prerequisites
Reactor Primary Effluent Flow	Manual	5	8 hours	
Reactor RAS Flow	Local Automatic	3		
Reactors	Local Automatic	3		
Hydrocarbon Gas Detection and Alarming	Manual	3		
Oxygen Gas Detection and Alarming	Manual	5	8 hours	

Refer to the Process Control Narrative for details on the control and automation.

.4 Switchover

- City Coordination
- De-Energization
- IO Switchover
- Testing
- DCS Feedback Signals
- Re-Energization
- Commissioning and Demonstration
- Red Lines
- Handover

.5 Decommissioning

- Decommission DCS Controllers
- DCS Communication Ring
- Salvage DCS Components
- Demolish DCS cabinets
- PLC Final Location
- As-builts
- Demonstration Period

3.11 Stage: Main Building Migration

.1 Preliminary Work

- Site Condition Verification
- Detailed Drawings
- FAT and SIFT
- City Review

.2 Pre-Migration Inspections

- Panel and Equipment Inspections
- Identification
- Loop Checks
- Networking
- Switchover Plans
- Work Request Forms
- Draft O&M Manual

.3 Switchover

- City Coordination
- De-Energization
- IO Switchover
- Testing
- DCS Feedback Signals
- Re-Energization
- Commissioning and Demonstration
- Red Lines
- Handover

.4 Decommissioning

- Decommission DCS Controllers
- DCS Communication Ring
- Salvage DCS Components
- Demolish DCS cabinets
- PLC Final Location
- As-builts
- Demonstration Period

3.12 Stage: PLC Integration

The existing PLCs at NEWPCC will be integrated in the PCS as sub-projects to the DCS Migration. Configure links in the new and existing PLC and new HMI screens to facilitate coherent navigation between the different projects and areas within the DCS Migration.

The PLCs to be integrated are as follows:

.1 Power Supply Upgrade PLCs and networked devices;

.2 Headworks Upgrade PLCs and networked devices;

.3 Interim Phosphorus Upgrade PLCs and networked devices.

.4 Lab HVAC PLC;

.5 Main Building HVAC PLCs (total 3);

.6 RSP Sump Pit PLC;

.7 Boiler PLCs (1-4);

.8 Digester #11 PLC;

.9 Primary Clarifier Bridge PLCSs (4 & 5);

.10 Secondary Clarifier Bridge PLCs (1-8);

.11 Dewatering Centrifuge PLCs (1-6);

.12 Dewatering Centrifuge Backdrive ATV (1-6);

.13 Dewatering Autoloading PLC;

.14 Dewatering Sludge PLC;

.15 Dewatering PLCs (12, 34, 56);

.16 UV PLC;

.17 UV Pump Control Panels (1-5);

.18 Leachate PLC;

.19 Hauled Liquid Waste (HLW) PLC; and

.20 HLW 2 PLC.

3.13 Stage: Headworks Facilities Integration

The occurrence of Headworks Facilities integration to the PCS will be dependent on the completion of the Headworks system integrator's Work. The integration will require a combined effort between Headworks

and DCS Migration integrators. DCS Migration integrator will configure PCS servers and the network to integrate Headworks PLC and HMI programs into the new servers. Interface signals will be configured between area PLCs programs withing the PCS for headworks process integration.

.1 Preliminary Work

- Site Condition Verification
- Detailed Drawings
- Integration plan
- City Review

.2 Pre-Migration Inspections

- Networking verification
- Communication check
- Signals exchange test
- PLC and HMI programs installation and configuration on PCS servers
- Work Request Forms

.3 Post-Migration Work

- Servers (CS-A8100, CS-A8300) move to Headwork
- Communication check
- Functional test and verification
- Handover

3.14 Stage: Interim Phosphorus Project Integration

The occurrence of Interim Phosphorus Project integration to the PCS will be dependent on the completion of the Interim Phosphorus Project system integrator's Work. The integration will require a combined effort between Interim Phosphorus Project and DCS Migration integrators. DCS Migration integrator will configure PCS servers and the network to integrate Interim Phosphorus Project PLC and HMI programs into the new servers. Interface signals will be configured between area PLCs programs withing the PCS for the process integration.

.1 Preliminary Work

- Site Condition Verification
- Detailed Drawings
- Integration plan
- City Review

.2 Pre-Migration Inspections

- Networking verification
- Communication check
- Signals exchange test
- PLC and HMI programs installation and configuration on PCS servers
- Work Request Forms

.3 Post-Migration Work

- Communication check
- Functional test and verification
- Handover

3.15 Stage: Final DCS Decommissioning

Once all of the area migration stages have all been completed the DCS Servers will be decommissioned by the Integrator. The City will salvage the DCS Servers, Workstations, and the KVM switches.