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2.A. SCADA STANDARDS

2.A.1. GENERAL

The intent of this section of the document is to provide design and construction standards for implementing selected control and monitoring points in the City water pump houses and sewage lift stations based on the SCADA Feasibility Report and Conceptual Design dated April 2000. This document applies only to Water and Waste SCADA and Alarming Systems that are common among many of the City facilities, and is not intended to serve as a comprehensive tag list for all points within any given facility. It is essential that the designer of any new facility or alterations to a facility exercises sound engineering practice to determine all monitoring, control and SCADA points or alarms that may be required for the facility and its process. See also the *City of Whitehorse 1999 Pumphouse and Lift Station Audit* report dated November 2000.

The common systems within the facilities that are considered in this document include:

- Generators
- Building Systems
- Pumps and all applicable additional instrumentation

Throughout this document, input and output points for control and monitoring are referenced with respect to the local PLC in any given facility.

2.A.2 GENERATORS

When determining the control and monitoring points for a particular generator at any given site, what must first be determined is whether or not the generator is to be considered an emergency power supply. In general, if a pumping facility is a sewage lift station or is providing water for firefighting purposes or includes valves, controls or other equipment used for firefighting and is supplied by a generator, the generator is to be considered an emergency power supply. If a sewage facility is at risk of overflowing into a water body or compromising human safety the generator is to be considered an emergency power supply. Nonetheless, this should be evaluated and confirmed by the engineer at the time of design

Depending on whether or not an emergency power supply system is needed, the points that are to be connected to the station PLC and SCADA system will vary. If the generator is part of an emergency power system, it must conform to the national standard *CAN/CSA C282-00 Emergency Power Supply for Buildings.* Among the various requirements of this standard is a set of remote monitoring and alarm points that must be included in the system. The expectation is that these remotely annunciated points would be sent to the SCADA system.

Peak shaving should be considered for all facilities and implemented where beneficial. Should peak shaving be pursued, the logic for determining the requirements for the peak shaving cycle is to be resident in the local PLC rather than the SCADA system. The ability to cause a transfer switch to change to the emergency position, and confirm the transfer, when utility power is available must be included as part of any transfer switch used for peak shaving. See the *City of Whitehorse 1999 Pumphouse and Lift Station Audit* report dated November 2000, and located in the City of Whitehorse Engineering Services Library[BS1], for additional information on peak shaving. A summary of the points required for generators is provided below:

CITY OF WHITEHORSE SCADA STANDARDS
GENERATOR INPUT/OUTPUT LIST

Tag Description	I/O Type	Purpose	Notes	Comments/Intent
GENERATOR RUNNING	DI	STATUS		Provide running status to SCADA and can also be used as feedback for SCADA-generated alarm.
GENERATOR START SIGNAL	DO	CONTROL		Used to start generator for sites where peak shaving is implemented.
GENERATOR RUN TIME	N/A	STATUS		PLC internal timer used to accumulate total generator run time. To be read by SCADA system. A pop-up banner is to be implemented in the SCADA system to display after a preset elapsed time to assist with maintenance.
GENERATOR RUN TIME TODAY	N/A	STATUS		PLC internal timer used to accumulate run time for current 24-hour period only. To be read by SCADA system.
GENERATOR RUN TIME YESTERDAY	N/A	STATUS		PLC internal timer used to accumulate run time for previous 24-hour period only. To be read by SCADA system.
TRANSFER SWITCH IN NORMAL POSITION	DI	STATUS		Info to SCADA system. Can be used to detect problem with back-up/emergency power system and generate alarm in SCADA system.
TRANSFER SWITCH IN EMERGENCY POSITION	DI	STATUS		Info to SCADA system. Can be used to detect problem with transfer switch and generate alarm in SCADA system. This point is to also be used to provide feedback to the PLC for determining when a peak shaved load can be started.
TRANSFER SWITCH IN PEAK SHAVING MODE	DO	CONTROL		Force transfer switch to emergency mode and start generator at facilities where peak shaving has been implemented.

TRANSFER SWITCH IN BYPASS MODE	DI	STATUS	1,3	Provides status to SCADA system to advise staff that the automatic features of the transfer switch have been bypassed. Transfer switches with manual bypass systems are recommended for critical liftstations and pumphouses.
GENERATOR COMMON FAULT	DI	ALARM	1	Alarms any generator fault that causes generator failure. Specific cause of problem to be determined on site.
GENERATOR NOT IN AUTO	DI	ALARM		Alarms when generator is not useable due to not being in automatic start mode.
GENERATOR LOW BATTERY VOLTAGE/STARTING CAPACITY COMPROMISED	DI	ALARM	1	Alarm to be received from battery chargers or, with newer generators, a signal indicating that the battery starting capacity is compromised can be obtained from the genset-mounted control panel.
GENERATOR DAY TANK LEAK	DI	ALARM	1	Alarm from day tanks with containment and primary leak detection. Can be integral to tank, or from a float switch in containment dikes.
GENERATOR LOW FUEL	DI	ALARM	1	To trip when less than 2-hours of fuel are available to generator. Discrete measurement has been selected over analog due to the high cost of suitable analog level measuring devices.
GENERATOR REMOTE EMERGENCY STOP	DI	ALARM		Included to notify SCADA system and staff that generator is not operational.
GENERATOR OVERCRANK	DI	ALARM	1,2	To report generator starting failure.
GENERATOR LOW ENGINE TEMPERATURE	DI	ALARM	1,2	To report a temperature condition that may prevent the generator from starting. Also could be used to indicate a block heater failure.
GENERATOR HIGH ENGINE TEMPERATURE	DI	ALARM	1,2	To alarm on an engine overheating problem based on factory settings.
GENERATOR LOW LUBE OIL PRESSURE	DI	ALARM	1,2	To alarm on a low oil pressure condition based on factory settings.
GENERATOR OVERSPEED	DI	ALARM	1,2	To alarm when engine exceeds acceptable range of speed based on factory settings.

GENERATOR S/A DAMPER NOT OPEN	DI	ALARM	1,2	To alarm when supply air damper does not open to minimum positions while generator is running.
GENERATOR E/A DAMPER NOT OPEN	DI	ALARM	1,2	To alarm when exhaust air damper does not open to minimum positions while generator is running.
GENERATOR LOW COOLANT LEVEL	DI	ALARM	1,2	To alarm on coolant level below factory set point.

DI - DENOTES DISCRETE INPUT

DO - DENOTES DISCRETE OUPUT

AI - DENOTES ANALOG INPUT

AO - DENOTES ANALOG OUTPUT

N/A - NOT APPLICABLE

1. Required for remote annunciation by CAN/CSA C282-00.

2. To be implemented where generator is deemed an "Emergency Power Supply."

3. Used only where applicable to particular site.

2.A.3 BUILDING SYSTEMS

Within the buildings at each pump house and lift station are a set of systems that are generally common among the facilities that require connection to the local PLC and are to be read by the central SCADA system. These systems include:

- Facility Power Supplies (Utility and Generator)
- Intrusion Alarms
- Fire Alarms
- Building Temperatures and Sump Levels/Building flood alarm in case of well houses or other buildings where deemed applicable.[BS2]

The availability of power and, in some cases, the parameters associated with a power supply need to be monitored in most City pump houses and lift stations. This is of particular importance in critical facilities including most lift stations and all pump houses that affect the supply of water for fire fighting purposes, with the intent that should all power fail at such a facility a critical situation exists that needs to be addressed quickly.

The availability of power can be monitored by local relay devices or by reading parameters from customer meters, where installed. Where customer meters are to be included in the project, the meter communication format is to be compatible directly with the PLC used in that facility without the need for any translators or interfacing devices.

Other systems such as intrusion alarms, fire alarms and building temperatures are to be monitored and appropriately alarmed as a property protection measure and to reduce any potential compromise of the processes taking place within the facility.

A summary of the points required for the building systems is provided below:

CITY OF WHITEHORSE SCADA STANDARDS BUILDING SYSTEMS INPUT/OUTPUT LIST				
Tag Description	**I/O Type**	**Purpose**	**Notes**	**Comments/Intent**
UTILITY POWER FAILURE	DI	ALARM	1,3	Provide notice to SCADA system/personnel that the regular utility power has failed. Sensed downstream of utility metering transformers and upstream of any transfer switch.
TOTAL STATION POWER FAILURE	DI	ALARM	2,3	Provide high priority alarm to SCADA system indicating complete power failure at facility. Sensed downstream of any applicable transfer switch (or switches). The alarm should be generated in the PLC logic after a suitable time delay (operator adjustable).
ILLEGAL ENTRY	DI	ALARM		Notify SCADA system of unauthorized entry with signal received from local intrusion alarm system.
BUILDING LOW TEMPERATURE	DI	ALARM		Provide alarm signal to SCADA system when temperature is significantly below normal heating system set points. Alarm temperature will vary among the facilities.
BUILDING HIGH TEMPERATURE	DI	ALARM		To provide alarm signal to SCADA system when temperature is significantly above normal heating system set point or operating temperature (in the case of facilities with generators and boilers). Alarm temperature will vary among the facilities.
BUILDING SUMP HIGH LEVEL	DI	ALARM		Where applicable, provide alarm signal to SCADA system to indicate potential sump pump failure and possible flood condition.
BUILDING (STATION) FLOOD	DI	ALARM		Where applicable, provide alarm signal to SCADA system to indicate potential possible flood condition. Signal to SCADA and DSC to be triggered by applicable float controller, mounted in stations or drywell.
FIRE ALARM	DI	ALARM		Provide signal from facililty fire alarm panel to SCADA system indicating alarm condition.

FIRE TROUBLE	DI	ALARM		Provide signal from facililty fire alarm panel to SCADA system indicating trouble condition.
FIRE ALARM SUPERVISORY	DI	ALARM		Where the facility has a sprinkler system, provide signal from facililty fire alarm panel to SCADA system indicating supervisory condition.
PLC COMMUNICATION STATUS	COMM	ALARM		To generate an alarm sent to the SCADA system should the communication status of the facility PLC not be in the normal state.
PLC HALTED FROM DATA CONCENTRATOR OR SCADA NETWORK	COMM	ALARM		To generate an alarm sent to the SCADA system that the facility PLC has halted (tested by noting no change in PLC timer between communications with PLC).
Where customer meter(s) are included in project (merit should be evaluated by design engineer):				
PHASE A-TO-NEUTRAL VOLTS	COMM	STATUS	4	Parameter to be obtained from customer meter, communicated to PLC on comm link and read by SCADA system.
PHASE B-TO-NEUTRAL VOLTS	COMM	STATUS	4	"
PHASE C-TO-NEUTRAL VOLTS	COMM	STATUS	4	"
LINE A CURRENT	COMM	STATUS	4	"
LINE B CURRENT	COMM	STATUS	4	"
LINE C CURRENT	COMM	STATUS	4	"
NEUTRAL CURRENT	COMM	STATUS	4	"
GROUND CURRENT	COMM	STATUS	4	"
LINE AB VOLTS	COMM	STATUS	4	"
LINE BC VOLTS	COMM	STATUS	4	"
LINE CA VOLTS	COMM	STATUS	4	"
REAL 3-PHASE POWER	COMM	STATUS	4	"
LINE FREQUENCY	COMM	STATUS	4	"

POWER FACTOR	COMM	STATUS	4	"
APPARENT POWER DEMAND	COMM	STATUS	4	"
PEAK REAL POWER DEMAND	COMM	STATUS	4	"
TOTAL HARMONIC DISTORTION	COMM	STATUS	4,5	"
POWER QUALITY METER (PQM)	COMM	STATUS	4	"

DI - DENOTES DISCRETE INPUT

DO - DENOTES DISCRETE OUPUT

AI - DENOTES ANALOG INPUT

AO - DENOTES ANALOG OUTPUT

COMM - COMMUNICATIONS PORT
CONNECTION TO PLC

N/A - NOT APPLICABLE

1. Located in distribution system after main breaker and upstream of any transfer switch. To monitor undervoltage and phase loss as a minimum.

2. To be located in the distribution system downstream of any transfer switch(es) and to monitor undervoltage and phase loss.

3. Where facilities have customer meters monitoring the power supplies, information can be obtained from the meters directly to provide these alarm parameters without providing additional relays.

4 The measured parameters indicated should be repeated for any point in the distribution system where a customer meter is installed.

5. Design engineer to determine if THD has value and if individual harmonics need to be measured.

2.A.4 PUMPS

Most facilities within the City water and wastewater system include one or more pumps. In general, these pumps are controlled and monitored by the local PLC with relevant information read by the SCADA system. While it is necessary to monitor and control these pumps with the PLC logic, in some cases it is necessary to control the pumps manually from the SCADA workstation.

Below is a list of basic control and monitoring points that need to be included for each process pump in the system. This list does not necessarily represent a comprehensive list of the monitoring and control points, or all alarms that should be generated, for all pumps in the system but lists the typical minimum points and alarms required for all process pumps. The list below does include for the situation where manual control of the pumps is deemed necessary.

CITY OF WHITEHORSE SCADA STANDARDS PUMPS				
Tag Description	**I/O Type**	**Purpose**	**Notes**	**Comments/Intent**
PUMP START OVERRIDE	DO	CONTROL	1	Control point to allow SCADA operators to start a pump outside of when the control logic would do so.
PUMP STOP OVERRIDE	DO	CONTROL	1	Control point to allow SCADA operators to stop a pump outside of when the control logic would do so.
OVERRIDE ENABLE	DO	CONTROL	1	Enables the ability to allow a pump to be manually started or stopped from the SCADA workstation.
PUMP RUN	DI	STATUS/ ALARM		Status that reports to the SCADA system when the pump is running. Can also be used to generate an alarm when a start command is given, but no confirmation of pump run status is received.
PUMP IN AUTO	DI	STATUS/ ALARM		Status indicating that pump is in the automatic mode where it can be controlled by the PLC. Alarm is to be sent to the SCADA system when all the pumps in a station are not in the 'auto' state.
PUMP OVERLOAD	DI	ALARM		Alarm condition sent to the SCADA system that indicates that a pump has tripped off on overload or by the breaker opening.
FLOW CONTROL VALVE OPEN or PUMP DISCHARGE VALVE OPEN	DI	STATUS/ ALARM		To provide status to the SCADA system of the position of the control valve. In some facilities, this point may be replaced by a flow pump discharge valve which operates in the reverse of a flow control valve. This information is to be used to generate an alarm when the valve is not in the expected position.
PUMP RUN TIME - TOTAL	N/A	STATUS		To be a register in the PLC and communicated to the SCADA system that stores the total elapsed pump run time.

PUMP RUN TIME TODAY	N/A	STATUS		To be a register in the PLC and communicated to the SCADA system that stores the total elapsed pump run time for the current 24 hours period.
PUMP RUN TIME YESTERDAY	N/A	STATUS		To be a register in the PLC and communicated to the SCADA system that stores the total elapsed pump run time for the previous 24 hours period.
MOTOR OR PUMP VIBRATION	DI	STATUS/ ALARM		Alarm condition sent to the SCADA system that indicates that a pump has tripped off on high vibration. To provide analog input of pump vibration to SCADA for trending and alarming.
HIGH-FLOAT LEVEL ALARM	DI	ALARM & CONTROL	2	To be provided by a Flygt bulb that is located above the high level point in the level controller, and connected to the PCL. Normally also used to start lift station pumps and stop reservoir pumps.
HIGH-HIGH LEVEL ALARM	N/A	ALARM	2	To be provided by a Flygt bulb that is located above the high-float level Flygt bulb. This device is to be directly connected to the building security system to allow reporting when the PLC or SCADA (DCS) system have failed.
LOW-FLOAT ALARM	DI	ALARM & CONTROL	2	To be provided by a Flygt bulb located at the level below the low level alarm generated by the level controller, and directly connected to the PLC for pump shut-down. Normally also used to stop lift station pumps and start reservoir pumps.
LOW - LOW LEVEL ALARM	N/A	ALARM		To be provided by a Flygt bulb that is located below the low-float level Flygt bulb. This device is to be directly connected to the building security system to allow reporting when the PLC or SCADA system have failed.
FLOW RATE & VOLUME	AI	STATUS		Use analog input from each flow meter to display to the SCADA system the instantaneous flow rate as well as a calculated volume per day. Calculations for instantaneous rate and daily volume are done in the PLC. Once the volume is calculated, at midnight each day the value is to be stored in a register identified as "yesterday". This value is to be retrieved by the SCADA system, trend logged and displayed on the SCADA flow totals screen.

DI - DENOTES DISCRETE INPUT

DO - DENOTES DISCRETE OUPUT

AI - DENOTES ANALOG INPUT

AO - DENOTES ANALOG OUTPUT

COMM - COMMUNICATIONS PORT
CONNECTION TO PLC

N/A - NOT APPLICABLE

1. To be used where City has a requirement to control pumps outside of the normal operation parameters.

2. To be used for wetwells in lift stations with reversed logic applied to reservoirs. These points represent alarms outside the normal operating range of wetwell pumps.