Assets Delivery Group
Engineering

DESIGN STANDARD DS 70-20

Small Chlorination Systems (Water) –Functional Control Description

VERSION 4
REVISION 13

OCTOBER 2018

FOREWORD

The intent of Design Standards is to specify requirements that assure effective design and delivery of fit for purpose Water Corporation infrastructure assets for best whole-of-life value with least risk to Corporation service standards and safety. Design standards are also intended to promote uniformity of approach by asset designers, drafters and constructors to the design, construction, commissioning and delivery of water infrastructure and to the compatibility of new infrastructure with existing like infrastructure.

Design Standards draw on the asset design, management and field operational experience gained and documented by the Corporation and by the water industry generally over time. They are intended for application by Corporation staff, designers, constructors and land developers to the planning, design, construction and commissioning of Corporation infrastructure including water services provided by land developers for takeover by the Corporation.

Nothing in this Design Standard diminishes the responsibility of designers and constructors for applying the requirements of WA OSH Regulations 1996 (Division 12, Construction Industry – consultation on hazards and safety management) to the Information on these statutory requirements may be viewed at the following website location

https://www.legislation.wa.gov.au/legislation/statutes.nsf/law_s4665.html

Enquiries relating to the technical content of a Design Standard should be directed to the Senior Principal Engineer, Water Treatment, Engineering. Future Design Standard changes, if any, will be issued to registered Design Standard users as and when published.

Head of Engineering

This document is prepared without the assumption of a duty of care by the Water Corporation. The document is not intended to be nor should it be relied on as a substitute for professional engineering design expertise or any other professional advice.

Users should use and reference the current version of this document.

DISCLAIMER

Water Corporation accepts no liability for any loss or damage that arises from anything in the Standards/Specifications including any loss or damage that may arise due to the errors and omissions of any person. Any person or entity which relies upon the Standards/Specifications from the Water Corporation website does so that their own risk and without any right of recourse to the Water Corporation, including, but not limited to, using the Standards/Specification for works other than for or on behalf of the Water Corporation.

The Water Corporation shall not be responsible, nor liable, to any person or entity for any loss or damage suffered as a consequence of the unlawful use of, or reference to, the Standards/Specifications, including but not limited to the use of any part of the Standards/Specification without first obtaining prior express written permission from the CEO of the Water Corporation.

Any interpretation of anything in the Standards/Specifications that deviates from specific Water Corporation Project requirements must be referred to, and resolved by, reference to and for determination by the Water Corporation's project manager and/or designer for that particular Project.

PREVIOUS REVISION HISTORY

The previous revision history of this standard is shown section by section below:

Revision Number	Section Number	Page Numbers	Description	Submitting Officer	Approving Officer	Date of Issue
0.1			Initial Draft	T Block	W Goode	17/10/03
0.2			Revised After Water Corporation Meetings 22/10/03 and 24/10/03	R. Susanto-Lee	W Goode	27/10/03
0.3			Moved DirectNET interface to separate document	R. Susanto-Lee	W Goode	17/11/03
0.4			Revised after Water Corp requested modifications	R. Susanto-Lee	W Goode	23/01/04
0.5			Added minimum and maximum ranges to section 6	R. Susanto-Lee	W Goode	02/04/04
0.6			Added BG040209 changes	R. Susanto-Lee	W Goode	13/04/04
0.7			General modifications for SCADA interface	R. Myles		26/10/05
0.8			Added Dual Range function	R. Myles		26/10/06
0.9			Revised to include requested modifications and updated standards	R. Myles		23/07/09
0.10			Equipment Tags revised	R. Myles		23/02/10
0.11			Integration of New Design Features	S.Patel	N.Herbert	20/10/11

REVISION STATUS

The revision status of this standard is shown section by section below:

REVISION STATUS						
SECT.	**VER./ REV.**	**DATE**	**PAGES REVISED**	**REVISION DESCRIPTION (Section, Clause, Sub-Clause)**	**RVWD.**	**APRV.**
1	**4/12**	**28.08.17**	**9**	**DirectNET removed**	**NH**	**DH**
2	**4/12**	**28.08.17**	**9**	**Removed reference to italics**	**NH**	**DH**
4	**4/12**	**28.08.17**	**9**	**"Communications Interface" changed to "SCADA Interface". Removed reference to DirectNET.**	**NH**	**DH**
5	**4/12**	**28.08.17**	**10**	**Minor changes. Additional inputs added.**	**NH**	**DH**
6	**4/12**	**28.08.17**	**11-21**	**Heading changed. Major revision to all sections.**	**NH**	**DH**
	4/13	**19.10.18**	**12**	**Sec6.1 Minor formatting change**		
7	**4/12**	**28.08.17**	**22-24**	**Sec7, 7.1, 7.2, 7.4, 7.5 minor updates**	**NH**	**DH**
8	**4/12**	**28.08.17**	**25-26**	**Sec 8.1 updated**	**NH**	**DH**
9	**4/12**	**28.08.17**	**26**	**Sec 9.1 updated**	**NH**	**DH**
10	**4/12**	**28.08.17**	**27-30**	**Major revision of all sections**	**NH**	**DH**
11	**4/12**	**28.08.17**	**31**	**Major revision of table**	**NH**	**DH**
12	**4/12**	**28.08.17**	**32**	**Major revision of table**	**NH**	**DH**

13	**4/12**	**28.08.17**	**32-33**	**Major revision of table**	**NH**	**DH**

14	**4/12**	**28.08.17**	**34**	**Major revision of table**	**NH**	**DH**

15	**4/12**	**28.08.17**	**35-43**	**Major revision of table**	**NH**	**DH**

DESIGN STANDARD DS 70-20
Small Chlorination Systems – Functional Control Description

CONTENTS

Section *Page*

1 Definitions

PLC	Programmable Logic Controller
OIP	Operator Interface Panel
SCADA	Supervisory Control and Data Acquisition (system)
RTU	Remote Terminal Unit
PID	Proportional, Integral and Derivative (controller)
Modbus	Generic communications protocol
ESD	Emergency Shutdown Device

2 Introduction

The standard small chlorination package reflects the current design of many chlorination modules (and their PLC programs) already in use by the Water Corporation for disinfecting potable water. The standard package enables the majority of package chlorination plants to use the same PLC program and OIP interface.

Configurable options accessed using the OIP enable the standard chlorination package to be customized to individual situations by including or excluding equipment, indications, and control functionality.

3 Scope

The scope of this document is to outline the functionality of the standard chlorination package. This document is not intended as a user manual but describes how the control of each piece of equipment should operate.

The document also indicates which parts of the package can be configured, enabled, and disabled from the OIP.

4 SCADA Interface

The standard chlorination package has a communications interface to provide indication and control to eNet and SCADA RTU devices. For Ethernet connected devices Modbus protocol is used.

The SCADA interface provides a consecutive series of registers to facilitate block communications reads and writes.

All indications are always available at the SCADA interface but control of the chlorination package can either be from local or remote controlled. A selection on the OIP toggles between local and remote. When in local mode all setpoints and control operations are changed or initiated from the OIP. In local mode the system will ignore commands from the SCADA interface. When in remote mode all setpoints and control operations are changed or initiated from the SCADA interface. In remote mode the system will ignore commands from the OIP.

5 Analogue Values

The following analogue inputs will be read from the PLC inputs and scaled internally. The PLC analogue input is configured for 0 to 20 milliamps; the raw values are between 0-4095 bits for Koyo PLCs and 0-32000 for GE PLCs. Should the analogue signal drop below 3.5ma an analogue failure alarm is generated. Should the main water flow rate signal fail; a "water quality poor" alarm is generated. The analogue input signal is also damped using a first order filter. The analogue ranges are also configured via the OIP. The scaled analogue values will be made available on the OIP and SCADA interfaces.

- AT80101: Cell 1 leak detector;
- AT80101: Cell 2 leak detector;
- AT80101: Cell 3 leak detector;
- WI 80102A: Cylinder 1 weight;
- WI 80102B: Cylinder 2 weight;
- WI 80102C: Cylinder 3 weight (optional)
- WI 80102D: Cylinder 4 weight (optional)
- AT81202: Sample water chlorine residual;
- MFT03005: Mains water flow rate;
- pH (optional);
- Water temperature;
- Turbidity (optional);
- Tank level "A" (optional) – this transmitter must fail low (0% / 4mA);
- Tank level "B" (optional)
- FT002: Tank Outlet water flow rate

6 Chlorination Module

The chlorination module consists of a number of sub-modules that provide various functions in monitoring and controlling the chlorine levels in the process water. The chlorination module is normally enabled, and the following sub-sections describe operations of the module.

When the chlorination module is disabled, the chlorinator will not be initiated under any conditions, and all chlorination alarms will be deactivated. The following alarms will, however, remain active:

- Power Failure
- 5ppm Chlorine Leak
- 20ppm Chlorine Leak
- Intruder Alarm
- Chlorine Leak Detector Cell Failure
- Tank Faults (if selected)
- Communications Fail

6.1 Chlorination Function/Operation

Chlorination is initiated once the mains water flow rate is above the 'Initiate Chlorinators Flow' setpoint. If the chlorinator has been running within the previous two minutes, it will not re-initiate until the two minute delay has expired. The chlorination system has a minimum run time of two minutes following initiation to prevent flow instability from unnecessarily starting and stopping the system. If the mains water flow rate falls below the initiate chlorinators flow setpoint once the minimum run time has expired, the chlorination system will shut down.

To flag problems with the mains flow meter, the "Flow Verification" function can be used to determine a "Mains Flow Discrepancy" alarm. To implement this, the "Flow Verification" needs to be set to enabled via the OIP and a "Main Flow Established" signal is required. A "Mains Flow Discrepancy" alarm will be set and annunciated on the OIP and on SCADA for the following scenarios:

- If "Main Flow Established" is on and the flow meter has not detected a flow greater than the "System On" setpoint for a configurable time a "Mains Flow Discrepancy" alarm is set and annunciated on the OIP and on SCADA. After a further two minutes 'Water Quality Poor' alarm is generated which subsequently inhibits the source water.

- If "Main Flow Established" is off (Not "Main Flow Established") and the flow meter has detected a flow greater than the "System On" set point for a configurable time, a "Mains Flow Discrepancy" alarm is set. The chlorinator will operate normally using the measured flow rate. If, however, the flow meter is not

indicating correctly the chlorinator should fault out on “Dosing Fault” after a given time.

The ‘Main Flow Established’ signal could be from a call for water or pump station run with a flow switch used as last resort. If the ‘Main Flow Established’ signal source is faulty (e.g. faulty flow switch) the “Flow Verification” function can be disabled from the OIP to prevent flow discrepancy alarms.

The chlorinator’s dose rate is normally controlled by a flow pacing calculation and is adjusted by a PID loop monitoring the chlorine residual. The PID loop gain and integral time control parameters can be set from the local OIP.

The PID loop can be in auto or manual mode. Auto mode allows for flow paced with residual trim dosing. In auto mode the PID loop adjusts the chlorinator output continuously to achieve the desired chlorine residual based on a defined setpoint (password protected). The chlorinator output is also subject to varying flow conditions in this mode. To implement flow paced dosing only, the residual trim can be disabled which sets the PID in manual mode. In manual mode chlorine residual feedback is ignored and the chlorinator output adjusts to varying flow conditions only.

The PID loop is halted (i.e. the output is locked) under the following conditions:

- The chlorination system is not initiated (to prevent the PID loop from adjusting the output when the chlorinator is not running);
- Neither of the chlorinators are called to run;
- The chlorine residual analyser sample water flow is low (the chlorine residual analyser sample water flow low alarm is produced by the flow switch not detecting a flow). The system continues dosing chlorine at last known dose rate;
- Operator initiated PID manual mode. In this mode the operator is able to set a fixed chlorine dosing rate with flow pacing;
- If 3-way sampling valve is enabled and the valve toggles from the inlet to the outlet as described in section 8.1.

If none of these conditions are present then the PID loop is started after a configurable delay (in minutes). The delay period is to allow the chlorination system to stabilize.

For flow pacing the chlorine gas flow rate that is sent to the chlorinators is calculated using the formula:

Gas Flow = Mains Water Flow Rate (m^3/h) * Dose Rate (mg/l)

If the calculated gas flow is above 100% it is limited to 100%.If the required dose rate is greater than the upper dose rate limit continuously for a period of *five* minutes then a dose rate high warning alarm is activated. The chlorine gas flow rate upper limit is calculated per the formula:

Gas Flow = Mains Water Flow Rate (m^3/h) * Upper Dose Rate Limit (mg/l)

Conversely if the required dose rate is less than the lower dose rate limit

continuously for a period of thirty minutes then a dose rate low warning alarm is activated. The chlorine gas flow rate lower limit is calculated per the formula:

Gas Flow = Mains Water Flow Rate (m^3/h) * Lower Dose Rate Limit (mg/l)

Both upper and lower dose rate limits are settable locally from the OIP and remotely from SCADA.

Note: On SCADA the flow rates are indicated as litres per second (L/s) whereas the PLC requires m^3/h to calculate the gas flow. The conversion factor from L/s to m^3/h is 3.6. If a low range chlorinator is fitted, the high and low range max gas flow rates should be entered from the OIP. If a low range chlorinator is not fitted only the high range needs to be entered and the low range should be set to zero. With these two settings the PLC will select the high or low range chlorinator and control the dosing based on the gas flow rate required.

The low range chlorinator is selected when the required gas flow rate drops below 85% of the range of the low range chlorinator. The high range chlorinator is selected when the required gas flow rate goes above 95% of the low range chlorinator. The changeover points are calculated per the formula:

Low Range Select = ((Low Range/High Range)* 0.85 * Gas Flow Required) /High Range

High Range Select = ((Low Range/High Range)* 0.95 * Gas Flow Required) /High Range

The low range chlorinator is controlled using the follow formula:

Low Range Gas Control = ((High Range/Low Range)* Gas Flow Required) / High Range

If the gas flow rate required is less than the turndown ratio of the chlorinator the chlorinator can be made to pulse to maintain linearity of the gas flow rather than installing a low range chlorinator. The “V” notch pulsing initiate setpoint is configured locally from the OIP. If a low range chlorinator is fitted; pulsing should be configured for the non-linear region of the low range chlorinator.

“V” notch pulsing occurs cyclically when the required chlorine gas flow is less than the minimum configured gas flow.

If “V” notch pulsing is enabled, the solenoid on time is calculated using the following formula:

Pulse on time = gas flow (%) / min gas flow (%) * cycle time

Cycle time is set at 60 seconds

Note that “V” notch pulsing can be disabled by setting the minimum gas flow to 0%.

If the required chlorine gas flow is above the minimum configured gas flow then “V” notch pulsing is not required and the required gas flow is output directly to the chlorinator.

Duty/Standby Operation

Initially chlorinator 1 is the duty unit. The associated ejector pump starts running once chlorination is initiated. Duty can be set manually locally or remotely. The following modes of operation are possible:

Auto alternating

Chlorinator 1 on duty

Chlorinator 2 on duty

When set to Auto alternating, the chlorinators toggle automatically each time the Chlorinator stops or when they reach the maximum run-time. The maximum run-time is configurable through the OIP (e.g. weekly or daily). Change over occurs at 8am daily or at 8am Tuesdays if weekly is selected.

If the running chlorinator or ejector pump faults out or is not selected to PLC control, the standby chlorinator and ejector pump starts automatically if selected to PLC control. The duty/standby changeover occurs in all three modes. For example, if "Chlorinator 2 on duty" is selected and chlorinator 2 faults, chlorinator 1 and the associated ejector pump will start automatically.

6.2 Duty/Standby Changeover Faults

The duty chlorinator is called to run when chlorination is initiated. This involves calling the chlorinator's associated ejector pump and ejector valve to run and open respectively. If a fault condition occurs on the duty chlorinator, the fault is displayed on the OIP and sent to the SCADA and the standby chlorinator is called to run. The possible chlorinator fault conditions include:

- Ejector Pump Hydraulic Fault;
- Ejector Pump Incomplete Start;
- Dosing Fault (Chlorine Residual low or High)
- Ejector Pump Motor Overload;
- Ejector Isolation Valve Fault (Opening or Closing);
- Loss of Chlorine;
- Loss of Vacuum

Incomplete Start and Hydraulic Faults occur when the required system state is not achieved within a set time period. To allow time for the ejector pumps to start and the ejector isolation valves to open, the timers for Incomplete Start and Hydraulic Fault cannot start until 20 seconds after the chlorinator is called to run. These faults are flagged:

- If the ejector pump run contactor is not on following a chlorinator call to run and

the incomplete start timer elapses, the Incomplete Start fault is activated. The incomplete start time delay is set by the PLC. If an ejector pump is employed the incomplete start delay is a further 10 seconds (30 seconds overall). If an ejector valve is employed the delay is a further 60 seconds (70 seconds overall).

- If the flow switch does not detect a flow following a chlorinator call to run and the hydraulic timer elapses, the Hydraulic Fault is activated. The Hydraulic fault time delay is settable from the OIP (default is 10 seconds).

If an opening or closing fault occurs on the duty ejector isolation valve the standby chlorinator will be called. An opening fault occurs when a valve open/vacuum not high signal is not received within 30 seconds from when the chlorinator is called to run. This fault is displayed on the OIP and SCADA interfaces. The same happens for a closing fault except this is when a valve close/vacuum not low signal is not received within 30 seconds from when the chlorinator run signal turns off.

If Chlorinator high vacuum (Loss of Chlorine) or Chlorinator low vacuum alarm is activated, it generates an alarm and causes the standby chlorination system to start automatically. Both the high and low alarm delays are configurable from the OIP (Default is 20 seconds)

6.3 Digital Leak Detection

There are four digital inputs for chlorine leak detection:

- 5ppm Chlorine room leak;
- 5ppm Chlorinator room leak;
- 1ppm Chlorine room leak;
- Chlorine leak detector cell fail.

6.4 5ppm Chlorine Leak (Chlorine Room or Chlorinator Room)

If either the 5ppm chlorine room leak or the 5ppm chlorinator room leak inputs are activated the 5ppm flashing light is activated on the chlorine building. A separate alarm for the chlorine room and chlorinator room leak is displayed on the OIP and sent to the SCADA interface.

If either the 5ppm chlorine room leak or the 5ppm chlorinator room leak inputs are activated for at least one second the chlorine leak audible alarm siren is sounded. The siren sounds for 2 minutes continuously before silencing. It is also possible to silence the siren immediately by pressing an alarm acknowledge button on the OIP. The alarm cannot be silenced from the SCADA interface.

6.5 1ppm Chlorine Leak

The 1ppm chlorine leak alarm is a local alarm only and provides indication on OIP immediately when the input is activated. The alarm activates the general audible alarm but does not sound the alarm siren or activate the flashing light.

6.6 Chlorine Leak Detector Cell Fail

The chlorine leak detector cell fail alarm provides immediate indication on the OIP. The alarm is common for all leak detectors. If the security system is on the alarm is sent to the SCADA interface immediately. If the security system is off then the chlorine leak detector cell fail alarm is sent to the SCADA interface after fifteen minutes

6.7 Analogue Leak Detection

The standard chlorination package supports up to three chlorine leak detector cells. Two leak detector cells are placed in the chlorine room, while one is placed in the chlorinator room.

If any of the leak detector cells detect a leak above 20ppm an alarm is displayed and sent to the SCADA interface separately for chlorine and chlorinator rooms. Once the 20 ppm leak is activated it will latch and will remain latched until the chlorine has dissipated to below 5 ppm.

6.8 General Alarm

A general chlorination alarm is displayed on the OIP if any of the following alarms are activated:

- PLC/RTU communication fail;
- Chlorine cylinder no.1 low weight;
- Chlorine cylinder no.2 low weight;
- Chlorine cylinder no.1 empty;
- Chlorine cylinder no.2 empty;
- Chlorine cylinder change required;
- Turbidity high;
- Service tank level high;
- Service tank level low;
- Inlet chlorine residual high;
- Inlet chlorine residual low;
- Inlet chlorine residual high high;
- Inlet chlorine residual low low
- Sample valve failed to reach inlet position;

- Sample valve failed to reach outlet position;
- Chlorine dose rate high
- Chlorine dose rate low
- Chlorine store 5ppm chlorine leak detected;
- Chlorination room 5ppm Chlorine leak detected;
- Chlorine leak detector cell no.1: 20ppm leak chlorine store;
- Chlorine leak detector cell no.2: 20ppm leak chlorine store;
- Chlorine leak detector cell no.3: 20ppm leak chlorinator room;
- Common 1ppm leak detected;
- Chlorine leak cell; cell fail;
- Security breached;
- Power fail;
- Fire alarm;
- Safety Shower Activated alarm;
- Ejector pump no.1 hydraulic fault;
- Ejector pump no.1 incomplete start;
- Ejector pump no.1 overload;
- Chlorinator no.1 loss of chlorine (high vacuum);
- Chlorinator no.1 loss of vacuum;
- Chlorinator no.1 dosing fault;
- Ejector pump no.2 hydraulic fault;
- Ejector pump no.2 incomplete start;
- Ejector pump no.2 overload;
- Chlorinator no.2 loss of chlorine (high vacuum);
- Chlorinator no.2 loss of vacuum;
- Chlorinator no.2 dosing fault;

- Water quality poor;
- Analyser sample water flow low;
- Chlorine store door open for 55 minutes;
- Chlorine store door open for 60 minutes;
- Chlorination system disabled
- ESD battery volts low;
- ESD Activated;
- CO2 cylinder no.1 empty;
- CO2 cylinder no.2 empty;
- CO2 ejector pump hydraulic fault;
- CO2 ejector pump incomplete start;
- CO2 ejector pump overload;
- CO2 leak detected;
- Soda ash batch not prepared
- Soda ash transfer pump fault
- Soda ash solution tank level low
- Soda ash solution tank level high
- Soda ash dosing pump fault
- Soda ash mixer fault
- Isolation valve no.1 failed to open;
- Isolation valve no.2 failed to open;
- Isolation valve no.1 failed to close;
- Isolation valve no.2 failed to close;
- Chlorine leak cell no.1 transmitter fault;
- Chlorine leak cell no.2 transmitter fault;
- Chlorine leak cell no.3 transmitter fault;

- Chlorine cylinder no.1 transmitter fault;
- Chlorine cylinder no.2 transmitter fault;
- Chlorine residual analyser transmitter fault;
- Inlet flow meter transmitter fault;
- pH transmitter fault;
- Temperature transmitter fault;
- Turbidity transmitter fault;
- Service tank level A transmitter fault
- Service tank level B transmitter fault
- Outlet flow meter transmitter fault
- Mains flow discrepancy

6.9 Cylinder Empty Indication

When any of the chlorine cylinders empties an off-line indication is sent to the OIP and to the SCADA interface. There are separate indications for each cylinder.

6.10 Cylinder Weights

Each of the cylinder weights provides a configurable low weight alarm. The alarms are displayed on the OIP and sent to the SCADA interface.

6.11 Vacuum Alarms

Each chlorinator provides loss of chlorine (high vacuum) and loss of vacuum (low vacuum) alarms. If a high vacuum stays on for a configurable period (0-999 seconds), it will produce a high vacuum alarm on the OIP and to the Communications interface.

A low vacuum for a configurable period (0-999 seconds), produces a loss of vacuum alarm on the OIP and to the Communications interface. The low vacuum alarm is only activated when the process water flow switch indicates that sufficient process water is flowing past the injectors.

Vacuum alarms are derived from the manifold vacuum pressure transmitter. If the chlorination site has the facility to operate more than one chlorinator at any one time; each chlorinator will require a dedicated vacuum pressure transmitter.

6.12 Power Failure

Loss of power, indicated by the phase failure relay, produces a power failure alarm on the OIP and to the SCADA interface if the condition remains for a configurable time

with a default setting of 60 seconds (Maximum 15 minutes). When the power is restored the chlorinator delays resumption of normal operation for a configurable time with a default setting of 60 seconds.

6.13 Security System

The security system provides a security system enabled (on) input and a security system alarm input. If the security system is enabled and the security system alarm is on a security system alarm is displayed on the OIP and sent to the SCADA interface.

If the security system is not enabled for 8 hours, then a “Security System Disabled for 8 hours” warning is activated.

6.14 General Audible Alarm

The general audible alarm is separate from the chlorine leak audible alarm. The general audible alarm is sounded if the security system is off, and any of the general alarms above becomes active for at least 1 second.

The general audible alarm is automatically silenced after 5 minutes but can be silenced immediately from the OIP. The audible alarm cannot be silenced using the SCADA interface.

6.15 Chlorine Residual Monitoring

The chlorine residual monitoring is based on the position of the three way valve. The same chlorine residual analyser is used to monitor both inlet and outlet chlorine residual. If a three way valve is not installed the inlet chlorine residual only is monitored. A three way valve will be installed where there is tank storage after chlorination.

The inlet chlorine residual only is monitored for *High High*, High, Low and *Low Low* chlorine residual alarm. High and Low Chlorine residual are entered as offset values from chlorine set point. The inlet chlorine residual high and low alarms have a configurable delay time (Default is 15 minutes). All the inlet chlorine residual alarms are displayed on the OIP and sent to the SCADA interface. The inlet chlorine residual alarms are generated only when the chlorinator is running. Set point value and High and Low Chlorine residual offset values can be entered from OIP and remotely. More explanation can be found in PM-#4500905-Chlorination Portfolio - SCADA Alarms

High High and Low Low Chlorine residual limits are entered as absolute values as per the Water Safety Plans. The Low Low value has been specified as 0.2 mg/L for all sites in Western Australia (Unless this value is insufficient to achieve required Ct). Both alarm limits are only configurable from the SCADA interface.

If the chlorine residual approaches the High/Low chlorine residual limits and stays above/below the limits for 15 (default) minutes, the High/Low chlorine residual alarm will shut down the duty chlorination system and start the standby system. If the chlorine residual again reaches the high/low chlorine residual limit the High/Low alarm will activate, however, the “standby chlorination system” will continue as the duty system, however should the faulty chlorination system be reset it will re-commence as the duty system.

If the chlorine residual breaches the High High or Low Low limit and stay there for 60 seconds, it will activate the High High or Low Low alarm; if one of the chlorination systems is not available the High High/Low Low alarm will also latch. The High High and Low Low chlorine residual alarms are displayed on OIP and sent to the SCADA interface. The "water quality poor" alarm will set after thirty seconds. The "water quality poor" alarm will shut down the water source and hence the chlorination system.

When analyser low flow is detected, the control system PID switches to manual immediately (flow paced only) and all chlorine residual alarms are disabled. When flow is restored, a ten minute delay is required to allow the analyser signal to stabilise after which the PID reverts back to auto mode (flow paced and residual trim). If flow has not been restored after fifteen minutes - an "analyser sample water flow low" alarm is set and sent to the communications interface.

6.16 Water Quality Poor

"Water quality poor" is activated under any of the following conditions:

- Chlorination System is initiated and:
    - neither chlorination system is on
    - both chlorination systems have faulted
    - turbidity high alarm
    - turbidity analyser failure
    - inlet chlorine residual high high
    - inlet chlorine residual low low
    - chlorine residual analyser failure
- Emergency Shutdown Device activated
- Flowmeter failure

If chlorination is initiated and if neither of the ejector pumps are running or if a turbidity high alarm is active (if enabled) or flow discrepancy alarm comes on, a "water quality poor" alarm is generated after thirty seconds.

Water Safety Plans may require, the "water quality poor" alarm to initiate shutdown of pump station, tank inlet control valve, bore field, or whatever sources of water requiring treatment.

If the "water quality poor" alarm is set by the "turbidity high" or the chlorination system will continue to run until the flow of water has stopped.

If the "water quality poor" alarm was set due to a power failure, i.e. sites where "water quality poor" has no control of the source (chlorination initiate is still active); the alarm will be reset automatically on restoration of power.

The "water quality poor" alarm must be manually reset either locally or remotely (unless reset on power restore) before the system can be returned to operation.

7 Chlorine Risk Mitigation Measures (optional)

Risk mitigation measures need to be included at some chlorine facility's because of their offsite risk profile. Chlorine Store Risk Mitigation Options include:

- Containment
- Emergency Shutdown Device

7.1 Enabled Containment Operation

When the chlorine store door is open, after fifty five minutes a warning audible alarm is generated locally, and after sixty minutes a door open alarm is generated. Alarms are reset when the door is closed.

Under normal operation, the chlorine room fan will switch on when the security door is disarmed. This provides a safer environment for any personnel working in the chlorine store. In case of containment operation the fan is inhibited to contain any leaks 5ppm or above. The fan inhibit system can be overridden using the OIP by selecting the Fan Inhibit Override function on the OIP. If the Fan Inhibit Override function is activated the fan will run for a set time and then turn off. This fan run time is configurable through the OIP. During this period it can be turned off on the OIP if required. Each time the Fan Inhibit function is used the special password must be re-entered before the fans will operate.

7.2 Enabled Emergency Shutdown Device Operation

The emergency shutdown device (ESD) consists of a control unit and a number of ratchet devices which attach to the cylinder valves. These devices close the chlorine cylinder valves on detection of a five part per million chlorine gas concentration or on local or remote operator initiation.

The ESD if operated will send a digital signal to the PLC: ESD Activated. The ESD control unit also monitors the battery voltage and provides an alarm to the PLC/SCADA on low battery voltage.

7.3 pH Correction System (optional)

The pH Correction system consists of a pH meter, a CO2 injection or a Soda Ash injection module, and an optional booster pump for CO2 if required.

If pH is high Co2 is introduced to reduce the pH.

If pH is low soda ash is introduced to raise the pH.

7.3.1 Enabled Operation

The pH meter provides an analogue indication. Alarms for pH are no longer generated

from the PLC. Soft alarms should be configured using the "tune alarm limits" from SCADA.

7.3.2 Disabled Operation

The pH meter is not displayed on the OIP. (This is done only when there is no pH meter in the system)

7.4 CO2 Injection (optional)

7.4.1 Enabled Operation

The CO2 injection is initially initiated when the pH reaches a configurable high level initiate setpoint and chlorination has been initiated. The CO2 system is turned off if the pH reaches a configurable low level setpoint. Under normal conditions the CO2 system will start and stop with the initiate chlorination signal.

The CO2 injection is flow paced to the mains water flow. The output to the CO2 flow controller is calculated using the following formula:

CO2 flow controller output (%) = Mains water flow rate (%) * pH Control calibration factor/100

The pH Control calibration factor is a setpoint entered from the OIP or from the communications interface and is a value between zero and five, where output is above 100% it is limited to 100%. If the CO2 injection is not initiated it outputs 0% to the CO2 flow controller.

7.5 Soda Ash Injection (optional)

7.5.1 Enabled Operation

The Soda Ash injection is initially initiated when the pH reaches a configurable low level initiate setpoint and chlorination has been initiated. The Soda Ash system is turned off if the pH reaches a configurable high level setpoint. Under normal conditions the Soda Ash system will start and stop with the initiate chlorination signal.

Triggered by a "soda ash batch not prepared" warning alarm from SCADA or OIP the operator is required to initiate the Soda Ash batching sequence as follows:

- Batch tank requires water – operator presses "add water" button next to batch tank
- Batch tank fill solenoid will open to allow water to flow. The solenoid will shut when the water level reaches the high level switch.
- The operator will manually pour bags of soda ash into the batch tank filled with water.
- The operator will then initiate mixing by pressing the "initiate mixing" button next to the batch tank.

From here the soda ash batching and decanting is automatic:

Initial mixing is for 20 minutes. If after this time the soda ash storage tank level is less than 40%, a soda ash transfer from the batch tank to the storage tank is initiated using the soda ash transfer pump. However, if the soda ash tank level is greater than forty percent, the batch tank waits for sixty minutes before invoking the mixer again for a further ten minutes, before checking the soda ash storage tank level again.

The soda ash is pumped from the storage tank by a dosing pump into the mains water supply using a flow controller.

The output to the soda ash flow controller is calculated using the following formula:

Soda ash flow controller output (%) = Mains water flow rate (%) * pH Control calibration factor/100

The pH Control calibration factor is a setpoint entered from the OIP or from the communications interface and is a value between zero and five.

If the calculated soda ash flow controller output is above 100% it is limited to 100%.

If the soda ash injection is not initiated it outputs 0% to the soda ash flow controller.

The following indications are displayed on the OIP:

- Transfer pump on or off
- Batch tank is empty (batch required), filling or full
- Soda ash storage tank is low, less than 40%, greater than 40% or high
- Mixer is on or off

The following alarms are displayed on the OIP and are sent to the communications interface:

- Transfer pump fault
- Solution tank level low
- Batch not prepared

7.6 Soda Ash Dosing Pump

The soda ash dosing pump is started based on soda ash injection being initiated, and the pump control selector switched to PLC.

A target pH of 7 is required (chloramination sites require a target pH of 8.3)

The pump remains on until soda ash injection is uninitiated, or if the pump control CSS is switched to off.

8 Three Way Valve (optional)

The three way valve enables sample and process water to be taken from either the storage tank inlet or outlet.

8.1 Enabled Operation

The three way valve control provides five setpoints:

- Inlet on time (default 480 minutes)
- Outlet on time (default 20 minutes)
- Inlet Monitoring delay (default 6 minutes)
- Outlet Monitoring delay (default 6 minutes)
- Inlet Position delay (default 0 seconds)

The valve will initially be in the outlet position. The valve will move to the inlet position when the chlorination system is initiated for the inlet on time. After the inlet on time expires the valve will move to the outlet position for the outlet on time. Once the outlet on time expires the valve moves back the inlet position and the sequence starts again. When the three way valve toggles from inlet to outlet monitoring, the chlorination PID loop will lock its current output value - flow pacing still occurs. When the three way valve is toggled back to inlet monitoring the PID loop is re-enabled. The valve defaults to the outlet position when the chlorination system is off.

The operator can request the valve to go to the opposite position if required to do sample tests. The valve will automatically return to the original position after a given time. For inlet to outlet position operation the delay before returning to the inlet position is settable on the OIP (default is twenty minutes), for outlet to inlet operation the delay is fifteen minutes before the valve returns to the outlet position.

The inlet on time and outlet on time can have configurable times in the range zero to one thousand minutes with technician's access level (default time is 480 minutes for inlet and 20 minutes for outlet). Both setpoints can be set from the OIP.

The sample water three way valve has limit switches installed to provide indication when the valve is in the inlet and outlet positions. The valve will provide position discrepancy faults if the valve does not reach the required positions within one minute.

If the valve fails to reach the required position it will generate an alarm on the OIP and send the alarm to the SCADA interface.

The position of the three way valve is determined by limit switch inputs from the field. The status of the valve is represented on the OIP as either in inlet monitoring or outlet monitoring. This status is also sent to the SCADA interface.

When the three way valve changes position from inlet to outlet there is an amount of inlet water still in the pipework that must be purged before the chlorine residual analyser will start 'seeing' the outlet water. The same is true when the three way valve changes from the outlet position to the inlet position.

The three way valve control provides an inlet monitoring delay time setpoint and an outlet monitoring delay time setpoint to overcome this problem. The inlet delay time provides a configurable delay time from when the three way valve moves to the inlet

position to when the chlorine analyser can expect to see inlet water instead of outlet water. A similar setpoint exists for when the three way valve moves from the inlet position to the outlet position. Both the inlet delay time and outlet delay time setpoints are configurable from the OIP only.

The three way valve control will automatically switch to outlet monitoring when the chlorinator is not running. On initiate chlorination the three way valve will move to the inlet position after a configurable delay time, the default delay is zero seconds. At sites where a lot of air/turbulence occurs at start up this delay time should be increased. When the valve is switched from inlet monitoring to outlet monitoring, the last value of the inlet chlorine residual is displayed on the OIP. Similarly, when the valve is switched from outlet monitoring to inlet monitoring, the last value of the outlet chlorine residual will be displayed.

8.2 Disabled Operation

If the three way valve operation is disabled the system will operate as if no three way valve is installed. The three way valve and its setpoints will not appear on the OIP screen.

9 Turbidity (optional)

The turbidity meter monitoring is an optional module.

9.1 Enabled Operation

The turbidity meter provides an analogue indication and a local high turbidity alarm. It provides no input to the control of the chlorination system. It does, however, if configured, provide a high turbidity alarm, which is interlocked to the “water quality poor” alarm.

The high turbidity setpoint and delay time is configurable from the OIP (Default is 3 NTU and is *technician level access*). The high alarm is displayed on the OIP when the alarm limit is exceeded. Soft alarms for high turbidity are no longer generated from the PLC for SCADA. Soft alarms should be configured using the “tune alarm limits” from SCADA.

9.2 Disabled Operation

The turbidity meter is not displayed on the OIP. The turbidity high alarm is disabled. (This is done only when there is no turbidity meter in the system).

10 Service Tank (options)

The service tank options include:

- Tank Level Monitoring
    - Tank Level A indication
    - Tank Level B indication

- Equipment 1 Control
- Equipment 2 Control
- High level float switch
- Low level float switch

10.1 Tank Level Monitoring

The tank level monitoring is implemented using either a single level transmitter or dual level transmitters. If tank monitoring is enabled, equipment control is available based on the Duty Tank Level.

To implement single level transmitter monitoring, Tank Level A needs to be enabled via the OIP. For dual level transmitter monitoring, both Tank Level A and Tank Level B need to be enabled via the OIP.

When dual level transmitters are enabled, both level values are visible on OIP and SCADA. To flag failures on either or both of the dual level transmitters, a level discrepancy alarm will be generated when the following conditions occur:

- Both analogue inputs are under ranged (channel 9 & 11); or
- Difference of more than 2.5% between the two tank levels.

Note that Tank Level B and temperature indication share the same analogue input (channel 9). If Tank Level B is enabled, the temperature analog input is wired to the RTU and the value is communicated serially to the PLC.

10.1.1 Duty Tank Level

The duty tank level is used for equipment control and visual tank level indication on the HMI interfaces. If dual level transmitters are not available (Tank Level B not enabled), the default Duty Tank Level is Tank Level A. Where dual level transmitters are available, either Tank Level A or Tank Level B is selected as the Duty Tank Level via SCADA.

Tank Level A is used as the Duty Tank Level when Tank Level A is enabled, Tank Level A analogue input (channel 11) is not under ranged and:

- Tank Level B is not enabled (single level transmitter): or
- Tank Level B is not the selected as the Duty Tank Level; or
- Tank Level B is enabled but the analogue input (channel 9) is under ranged.

Tank Level B is selected as the Duty Tank Level when the analogue input (channel 9) is not under ranged and:

- Tank Level B is selected as the Duty Tank Level; or

- Tank Level A analogue input (channel 11) is under ranged.

10.2 Equipment Control

If tank level monitoring is enabled, the equipment control functionality can be enabled which provides the ability to control peripheral equipment based on the duty tank level or manual intervention. Although the equipment control was originally intended to control an altitude control valve (ACV); it can be used to control any equipment be it a pump station, tank inlet control valve, or bore. All of these will ideally fill the tank up.

Up to two different items of equipment (Equipment 1 and Equipment 2) can be controlled using the duty tank level or manual control. When control for both items of equipment is enabled, a duty assist setup exists where Equipment 2 is not enabled to start until Equipment 1 has been requested to start.

The start and stop level setpoints for the equipment are set via the OIP or SCADA. If only one level transmitter (Tank Level B disabled) is installed and this fails, the high and low alarm float switches, if fitted, will be used for control. The high and low level alarms will still occur with each operation.

The equipment can be operated manually locally from the OIP or remotely from SCADA. To manually operate the equipment, the operator is required to put the equipment control in “Manual” before they can toggle the manual control to “On/Off”. When switching from auto to manual; the change of operation is bumpless, meaning that if the equipment start request is active, it will remain so until the operator changes the state. When switching from manual to auto; the change of operation is also bumpless however if the tank level is above the equipment stop setpoint (or the high level float switch is active where the sole level transmitter has failed), the equipment start request will deactivate. Conversely if the tank level is below the equipment start setpoint (or the low level float switch is active where the sole level transmitter has failed) and the equipment start request is not active, the equipment start request will activate.

Note: The manual control bypasses all other interlocks

10.2.1 Equipment Control Time Period Permissive

The Permissive function allows the PLC to control the hours the Water Treatment Plant can run:

- Permissive: If the Permissive is Off the “Call for Water” is inhibited. If the Permissive is On the WTP will run if required.

- Start Time: The start time is set on a twenty four hour clock basis. The operator can set the Permissive start time between 00 hours (midnight) and 23:00 hours (11pm).

- Duration: the duration is the length of time the site is allowed to run. For sites that are not restricted to run the duration should be set to 24 hours.

For example; If the WTP is to operate between the hours of 6am and 8pm the settings are as follows:

- Start Time: 6:00am
- Duration: 14 Hours.

If the time is permissive the operator can “Force On” the Permissive by pressing Force On button on the OIP, or if required the operator can “Force OFF” the Permissive by pressing the Force Off button on the OIP.

10.2.2 Equipment 1 Control

Equipment 1 start request will be unable to activate, unless in manual control, while the following conditions are not present:

- Equipment 1 is not in manual mode; and
- Tank Level is not high; and
- Water quality is not poor ; or Equipment 2 is enabled and has been requested to start;

If the above conditions are met, Equipment 1 is requested to start when the start time is permissive and the Duty Tank Level is below the Equipment 1 start level setpoint (or low level float switch where sole level transmitter has failed) for at least 30 seconds. This start request is maintained (latched) if Equipment 2 has been requested to start or while the following conditions are met:

- Level transmitter control is active; and
- Duty tank level is less than stop setpoint (or high level float switch not active where the sole level transmitter has failed); and
- Permissive start is active; and
- Equipment 2 is not enabled or is enabled but is off (start request off for 2 minutes).

The duty tank level must be above the stop equipment setpoint (or the high level float switch is active where the sole level transmitter has failed) for 10 seconds.

The operator can “Force Start” Equipment 1 by pressing Force Start button on the OIP or SCADA interface. This bypasses the requirement for the tank level to be below the start level setpoint for the equipment start.

10.2.3 Equipment 2 Control

Equipment 2 start request will be unable to activate while the following conditions are not present:

- Equipment 1 start request is active; and
- Chlorination has been initiated for the minimum required time (2 minutes); and
- Level Control is available.

If the above conditions are met, Equipment 2 is requested to start when the start time is permissive and the Duty Tank Level is below the Equipment 2 start level setpoint (or low level float switch where sole level transmitter has failed) for at least 2 minutes. This start request is maintained (latched) while the following conditions are met:

- Equipment start time is permissive; and
- Duty tank level is less than the stop level.

The start request will no longer be active if either of the above two conditions are not met for at least 10 seconds.

The operator can "Force Start" Equipment 2 by pressing Force Start button on the OIP or SCADA interface. This bypasses the requirement for the tank level to be below the start level setpoint for the equipment start.

Note that restrictions are placed on the start and stop setpoints based on Equipment 1 start and stop setpoints.

10.3 Level Float Switches

There is provision for a high level switch and a low level switch on the service tank. These switches can be enabled or disabled independently via the OIP configuration. When using level switches, the service tank level alarm is generated based on the digital input into the PLC from these physical level switches. The inputs have a debounce time of 10 seconds. When triggered, the associated high or low level alarm is displayed on the OIP and sent to the SCADA interface.

The low and high alarm float switches can be used for equipment control as start and stop points should the sole level transmitter fail. The high and low level alarms will still occur with each operation.

10.4 Disabled Operation

The level alarms will remain off at all times and the associated indications on the OIP will not be visible.

11 Configurable Set-points and Settings Default Values

11.1 Control Setpoints

Setpoint Group	Setpoint Item	Units	Range	Default Value (*)	Access Level
PID Controls	Chlorine Residual Setpoint	mg/l	0.00 – 5.00	1	Supervisor
	System On Flow	l/s	0.0 – 100.0	10	Technician
	Gain Setpoint	k	0.00 – 20.00	0.33	Technician
	Integral	min	0.0 – 100.0	Variable	
	Scaling Factor K1	k	0 - 5	1.2	Technician
	Fixed Dead Time K2	min	0 - 100	6	Technician
	Main Line Pipe Diameter	mm	0 - 2000	250	Technician
	Main Line Pipe Length	m	0 - 100	3	Technician
	PID Auto Delay	min	0 - 15	10	Technician
	Max Gas Flow High Range	gm/hr	0 - 5000	500	Technician
	Max Gas Flow Low Range	gm/hr	0 - 5000	0	Technician
	Manual Dose Rate	mg/l	0.00 – 20.00	2.5	Operator
	Maximum Dose Rate	mg/l	0 - 20	5	Operator
	Upper Dose Rate Limit	mg/l	0 - 20	4	Operator
	Lower Dose Rate Limit	mg/l	0 - 20	1	Operator
Pulse Settings (V-Notch)	Minimum Gas Flow	%	0.0 – 100.0	10	Technician
Chlorinator Duty	Auto Alternate Select	N/A	N/A	Y	Operator
	Weekly Select	N/A	N/A	Y	Operator
	Daily Select	N/A	N/A	N	Operator
	Chlorinator 1 Select	N/A	N/A	N	Operator
	Chlorinator 2 Select	N/A	N/A	N	Operator
Sample Water Valve (3 Way Valve)	Inlet On-Time	min	0 - 1000	480	Technician
	Outlet On-Time	min	0 - 1000	20	Technician
	Inlet Delay Time	min	0 - 15	6	Technician
	Outlet Delay Time	min	0 - 15	6	Technician
	Delay to Inlet	min	0 - 15	0	Technician
pH Setpoints	Calibration Factor	k	0.00 – 5.00	1	Technician
	pH Correction On Setpoint	pH	0.0 – 10.0	8	Technician
	pH Correction Off Setpoint	pH	0.0 – 10.0	6.5	Technician
Containment	Fan Runtime Setpoint	min	0 - 60	5	Technician
Ejector Pump	Hydraulic Fault Delay	sec	0 - 999	10	Technician

Setpoint Group	Setpoint Item	Units	Range	Default Value (*)	Access Level
Power Relay	Power Fail Delay	sec	0 - 999	60	Technician
	Power Restored Delay	sec	0 - 999	60	Technician

(*) Values provided here are for guidance only and may change from site to site. Setpoint values for each sites needs to be documented during the commissioning phase.

12 Alarm Setpoints

Setpoint Group	Setpoint Item	Units	Range	Default Value	Access Level
Chlorine Inlet Residual	High High Setpoint	mg/l	0.00 – 5.00	4.95	SCADA
	High Setpoint	mg/l	0.00 – 5.00	+0.5 Above SP	Operator
	Low Setpoint	mg/l	0.00 – 5.00	-0.5 Below SP	Operator
	Low Low Setpoint	mg/l	0.00 – 5.00	0.2	SCADA
	Alarms Timeout	min	0 - 60	15	Technician
Chlorine Cylinder Alarms	High/Low Vacuum Timeouts	Seconds	0 - 999	20 sec	Technician
Turbidity	High Setpoint	NTU	0.0 – 20.0	3	Technician
	Turbidity Alarm Delay	min	0 - 60	15	Technician
Vacuum Pressure	High Setpoint	kPa	0.0 – 50.0	10	Technician
	Low Setpoint	kPa	0.0 – 50.0	2	Technician

13 Module Enables and Disables

Module	1	0	Default Value
Chlorination	Enable	Disable	1
Residual Trim	Enable	Disable	1
Three Way Valve	Enable	Disable	0
Ejector Valve	Enable	Disable	0
Dual Range	Enable	Disable	0
CO2 Pump	Enable	Disable	0
Cl2 Isolation Valve	Enable	Disable	0
Leak Cell 2	Enable	Disable	0
Flow Verification	Enable	Disable	0
Containment	Enable	Disable	0
Spare	Enable	Disable	0
ESD Remote Activate	Enable	Disable	0
Four Cl2 Cylinders	Enable	Disable	0

Module	1	0	Default Value
Cylinder Bank	Enable	Disable	0
Inlet Flow (Serial)	Enable	Disable	0
Spare	Enable	Disable	0
Turbidity	Enable	Disable	0
Turbidity High Inhibit	Enable	Disable	0
Temperature	Enable	Disable	0
Manifold Vacuum Indication	Enable	Disable	0
Vacuum Invert Signal	Enable	Disable	0
Outlet Flow	Enable	Disable	0
Outlet Flow (Serial)	Enable	Disable	0
Tank Level A	Enable	Disable	0
Equipment 1	Enable	Disable	0
Equipment 2	Enable	Disable	0
Tank Level High Switch	Enable	Disable	0
Tank Level Low Switch	Enable	Disable	0
3 Way Valve	Enable	Disable	0
Tank Level B	Enable	Disable	0
pH Indication	Enable	Disable	0
Soda Ash	Enable	Disable	0
Co2	Enable	Disable	0
Co2 Booster Pump	Enable	Disable	0
Co2 Leak Detector	Enable	Disable	0
Ammonia	Enable	Disable	0
Monochloramine-Cl	Enable	Disable	0

14 Analogue Ranges

Analogue Input	Units	Range	Low	High
Leak Detector Cell 1	ppm	20	0	20
Leak Detector Cell 2	ppm	20 - 100	0	100
Leak Detector Cell 3	ppm	20	0	20
Cylinder Scale 1	kg	0 - 1000	0	70
Cylinder Scale 2	kg	0 - 1000	0	70
Chlorine Residual	mg/L	0 - 10	0	5
Flow Rate	l/s	0 - 5000	0	200
pH	-	0 - 14	0	14
Water Temperature	degC	0 - 100	0	50
Turbidity	NTU	0 - 50	0	10
Service Tank Level	m	0.00 – 50.00	0	5
Outlet Flow Rate	l/s	0 - 5000	0	200

15 Appendix A SCADA Map

Description	Input/Output Type	Tag	Unit	Point No.
Clearwater Tank Level Transmitter Selection	IED 1 Digital Input (TCPIP)	TA00010_SEL3E		42049.00
Chlorine ESD Shutdown Activated	IED 1 Digital Input (TCPIP)	PL00001_ACT1E		42049.01
Cl2 Cylinder Change Required	IED 1 Digital Input (TCPIP)	CD00104_REQ1AE		42049.02
Cl2 Store Door Open for 60 minutes	IED 1 Digital Input (TCPIP)	CL00002_CLS1AE		42049.03
	IED 1 Digital Input (TCPIP)			42049.04
Chlorine ESD Battery Voltage Low	IED 1 Digital Input (TCPIP)	BT00002_L1ALE		42049.05
Inlet Chlorine Residual High	IED 1 Digital Input (TCPIP)	AT00884_RES1AHE		42049.06
Inlet Chlorine Residual Low	IED 1 Digital Input (TCPIP)	AT00884_RES1ALE		42049.07
Chlorinator No.1 Loss of Vacuum	IED 1 Digital Input (TCPIP)	CL00809_P1ALE		42049.08
Chlorinator No.1 Loss of Chlorine	IED 1 Digital Input (TCPIP)	CL00809_P1AHE		42049.09
Chlorinator No.1 Dosing Fault	IED 1 Digital Input (TCPIP)	PU01201_FLT2AE		42049.10
Chlorinator No.1 Flow Range	IED 1 Digital Input (TCPIP)	CL00809_RGE1E		42049.11
Chlorinator No.1 On	IED 1 Digital Input (TCPIP)	CL00809_RNG1E		42049.12
Chlorinator No.1 Hydraulic Fault	IED 1 Digital Input (TCPIP)	PU01201_FLT1AE		42049.13
Chlorinator No.1 Pump Overload	IED 1 Digital Input (TCPIP)	PU01201_OVL1AE		42049.14
Chlorinator No.1 Incomplete Start	IED 1 Digital Input (TCPIP)	PU01201_FLT3AE		42049.15
Chlorinator No.1 On Normal	IED 1 Digital Input (TCPIP)	PU01201_ENA1E		42050.00
Chlorinator No.2 Loss of Vacuum	IED 1 Digital Input (TCPIP)	CL00809_P2ALE		42050.01
Chlorinator No.2 Loss of Chlorine	IED 1 Digital Input (TCPIP)	CL00809_P2AHE		42050.02
Chlorinator No.2 Dosing Fault	IED 1 Digital Input (TCPIP)	PU01202_FLT2AE		42050.03
Chlorinator No.2 Flow Range	IED 1 Digital Input (TCPIP)	CL00809_RGE2E		42050.04
Chlorinator No.2 On	IED 1 Digital Input (TCPIP)	CL00809_RNG2E		42050.05
Chlorinator No.2 Hydraulic Fault	IED 1 Digital Input (TCPIP)	PU01202_FLT1AE		42050.06
Chlorinator No.2 Pump Overload	IED 1 Digital Input (TCPIP)	PU01202_OVL1AE		42050.07
Chlorinator No.2 Incomplete Start	IED 1 Digital Input (TCPIP)	PU01202_FLT3AE		42050.08
Chlorinator No.2 On Normal	IED 1 Digital Input (TCPIP)	PU01202_ENA1E		42050.09
Analyser Flow Low	IED 1 Digital Input (TCPIP)	AT00884_F1ALE		42050.10
Water Quality Poor	IED 1 Digital Input (TCPIP)	PU01202_ENA1E		42050.11
Duty Chlorinator 1 Selected	IED 1 Digital Input (TCPIP)	PU01202_ENA1E		42050.12
Duty Chlorinator 2 Selected	IED 1 Digital Input (TCPIP)	PL00001_FLT1AE		42050.13
Outlet Flow Rate Underrange	IED 1 Digital Input (TCPIP)	FT00002_F1AE		42050.14
Duty Daily Selected	IED 1 Digital Input (TCPIP)	PG00010_DTY2E		42050.15
Duty Auto Alternate Selected	IED 1 Digital Input (TCPIP)	PG00010_AUT1E		42051.00
Dose Rate High	IED 1 Digital Input (TCPIP)	CL00000_RTE1AHE		42051.01
PID in Auto	IED 1 Digital Input (TCPIP)	LP00001_AUT1E		42051.02
Dose Rate Low	IED 1 Digital Input (TCPIP)	CL00000_RTE1ALE		42051.03
Sample Valve in Inlet Position	IED 1 Digital Input (TCPIP)	VA00003_INL1E		42051.04
Sample Valve in Outlet Position	IED 1 Digital Input (TCPIP)	VA00003_OTL1E		42051.05
Sample Valve Failed to reach Inlet Position	IED 1 Digital Input (TCPIP)	VA00003_FLT1AE		42051.06
Sample Valve Failed to reach Outlet Position	IED 1 Digital Input (TCPIP)	VA00003_FLT2AE		42051.07
Zone Control Equipment 1 Requested	IED 1 Digital Input (TCPIP)	ZM00010_RTR1E		42051.08
Flow Discrepancy	IED 1 Digital Input (TCPIP)	PL00001_DSC1AE		42051.09

Zone Control Equipment Mode Manual	IED 1 Digital Input (TCPIP)	ZM00010_MAN1E		42051.10
1ppm Chlorine Leak Detected	IED 1 Digital Input (TCPIP)	CL00000_LDT3AE		42051.11
5ppm Chlorine Leak	IED 1 Digital Input (TCPIP)	CL00000_LDT1AE		42051.12
20ppm Chlorine Leak	IED 1 Digital Input (TCPIP)	CL00000_LDT2AE		42051.13
Chlorine leak detector cell failure	IED 1 Digital Input (TCPIP)	AT00140_FLT1AE		42051.14
Chlorinator manually disabled	IED 1 Digital Input (TCPIP)	CL00000_DIS1E		42051.15
Intruder alarm	IED 1 Digital Input (TCPIP)	PL00001_SEC2AE		42052.00
AC Power Failure	IED 1 Digital Input (TCPIP)	CC00010_E1AE		42052.01
Security System Armed	IED 1 Digital Input (TCPIP)	PL00001_SEC2E		42052.02
Fire Alarm	IED 1 Digital Input (TCPIP)	PL00001_WRN1AE		42052.03
Remote Selected	IED 1 Digital Input (TCPIP)	PL00001_REM1E		42052.04
CO2 Cylinder No.1 Empty	IED 1 Digital Input (TCPIP)	CD00104_L1ALE		42052.05
CO2 Cylinder No.2 Empty	IED 1 Digital Input (TCPIP)	CD00105_L1ALE		42052.06
Soda Ash batch Tank full	IED 1 Digital Input (TCPIP)	TA96001_L1HE		42052.07
Soda Ash batch Tank decanting/filling	IED 1 Digital Input (TCPIP)	TA96001_FLS1E		42052.08
Soda Ash batch Tank empty	IED 1 Digital Input (TCPIP)	TA96001_L1ALE		42052.09
Soda Ash Mixer on	IED 1 Digital Input (TCPIP)	MX96003_RNG1E		42052.10
Soda Ash Mixer Overload	IED 1 Digital Input (TCPIP)	MX96003_TOL1AE		42052.11
Soda Ash pH dosing Pump On	IED 1 Digital Input (TCPIP)	PU96002_RNG1E		42052.12
Soda Ash Storage Tank low	IED 1 Digital Input (TCPIP)	TA96002_L1ALE		42052.13
Soda Ash Storage Tank < 40%	IED 1 Digital Input (TCPIP)	TA96002_L1LE		42052.14
Soda Ash Storage Tank > 40%	IED 1 Digital Input (TCPIP)	TA96002_L1HE		42052.15
Soda Ash Storage Tank high	IED 1 Digital Input (TCPIP)	TA96002_L1AHHE		42053.00
Soda Ash transfer Pump on	IED 1 Digital Input (TCPIP)	PU96001_RNG1E		42053.01
Soda Ash transfer Pump Fault	IED 1 Digital Input (TCPIP)	PU96001_FLT1AE		42053.02
Soda Ash transfer Pump Overload	IED 1 Digital Input (TCPIP)	PU96001_OVL1AE		42053.03
Inlet Turbidity High	IED 1 Digital Input (TCPIP)	AT00010_TUR1AHE		42053.04
Clearwater Tank Level High Alarm	IED 1 Digital Input (TCPIP)	TA00010_L1AHE		42053.05
Clearwater Tank Level Low Alarm	IED 1 Digital Input (TCPIP)	TA00010_L1ALE		42053.06
Clearwater Tank Level Discrepancy Alarm	IED 1 Digital Input (TCPIP)	TA00010_L1DSCAE		42053.07
Sodium Hypochlorite Bund -Tank Leak Alarm	IED 1 Digital Input (TCPIP)	TA81040_L1AHE		42053.08
Sodium Hypo Solution Tank Volume Low	IED 1 Digital Input (TCPIP)	TA81030_VOL1ALE		42053.09
Sample Water Reclaim Tank High	IED 1 Digital Input (TCPIP)	TA00020_L1AHE		42053.10
Sodium Hypo Dosing Pump No.1 Dosing Fault	IED 1 Digital Input (TCPIP)	PU81001_FLT2AE		42053.11
Sodium Hypo Dosing Pump No.1 On	IED 1 Digital Input (TCPIP)	PU81001_RNG1E		42053.12
Soda Ash batch Tank Feeder Incomplete Start	IED 1 Digital Input (TCPIP)	PU96010_STR1AE		42053.13
Soda Ash Hopper Level Low	IED 1 Digital Input (TCPIP)	TA96003_L1ALE		42053.14
Soda Ash Water Pressure Low	IED 1 Digital Input (TCPIP)	PT96003_P1ALE		42053.15
Sodium Hypo Dosing Pump No.1 On Normal (IED Control Enabled)	IED 1 Digital Input (TCPIP)	PU81001_ENA1E		42054.00
Sodium Hypo Dosing Pump No.2 Dosing Fault	IED 1 Digital Input (TCPIP)	PU81002_FLT2AE		42054.01
Sodium Hypo Dosing Pump No.2 On	IED 1 Digital Input (TCPIP)	PU81002_RNG1E		42054.02
Chlorine PID Manual Mode Selected	IED 1 Digital Input (TCPIP)	LP00001_MAN1E		42054.03
Ammonia PID Manual Mode Selected	IED 1 Digital Input (TCPIP)	LP88001_MAN1E		42054.04

Security System Arming Required	IED 1 Digital Input (TCPIP)	PL00001_SEC3AE		42054.05
Sodium Hypo Dosing Pump No.2 On Normal (IED Control Enabled)	IED 1 Digital Input (TCPIP)	PU81002_ENA1E		42054.06
Sodium Hypo Dosing Pump No.1 Flow Underrange	IED 1 Digital Input (TCPIP)	PU81001_F1AE		42054.07
Sodium Hypo Dosing Pump No.2 Flow Underrange	IED 1 Digital Input (TCPIP)	PU81002_F1AE		42054.08
Hypochlorite Storage Tank Volume Underrange	IED 1 Digital Input (TCPIP)	TA81030_VOL1AE		42054.09
Ammonia Analyser System Fault	IED 1 Digital Input (TCPIP)	AT00003_FLT1AE		42054.10
Total Ammonia Quality Poor	IED 1 Digital Input (TCPIP)	LP00001_FLT1AE		42054.11
Monochloramine Quality Poor	IED 1 Digital Input (TCPIP)	LP00001_FLT2AE		42054.12
Chlorine Cylinder No.1 Weight Underrange	IED 1 Digital Input (TCPIP)	CD00101_W1AE		42054.13
Chlorine Cylinder No.2 Weight Underrange	IED 1 Digital Input (TCPIP)	CD00102_W1AE		42054.14
Cell No.1 Chlorine Leak Underrange	IED 1 Digital Input (TCPIP)	AT00140_RES1AE		42054.15
Cell No.2 Chlorine Leak Underrange	IED 1 Digital Input (TCPIP)	AT00140_RES2AE		42055.00
Cell No.3 Chlorine Leak Underrange	IED 1 Digital Input (TCPIP)	AT00140_RES3AE		42055.01
Chlorine Residual Underrange	IED 1 Digital Input (TCPIP)	AT00884_RES1AE		42055.02
Turbidity Underrange	IED 1 Digital Input (TCPIP)	AT00010_TUR1AE		42055.03
Inflow Rate Underrange	IED 1 Digital Input (TCPIP)	FT00001_F1AE		42055.04
pH Underrange	IED 1 Digital Input (TCPIP)	AT00886_A1AE		42055.05
Clearwater Tank Level A Underrange	IED 1 Digital Input (TCPIP)	TA00010_L1AE		42055.06
Water Temperature Underrange	IED 1 Digital Input (TCPIP)	AT00002_T1AE		42055.07
Clearwater Tank Level B Underrange	IED 1 Digital Input (TCPIP)	TA00010_L2AE		42055.08
Total Ammonia Residual Underrange	IED 1 Digital Input (TCPIP)	AT00003_A1AE		42055.09
Monochloramine Residual Underrange	IED 1 Digital Input (TCPIP)	AT00003_A3AE		42055.10
Outlet Flow Comms Failed	IED 1 Digital Input (TCPIP)	FT00002_COM1AE		42055.11
Inlet Chlorine Residual High High	IED 1 Digital Input (TCPIP)	AT00884_RES1AHHE		42055.12
Inlet Chlorine Residual Low Low	IED 1 Digital Input (TCPIP)	AT00884_RES1ALLE		42055.13
Inlet Flow Comms Failed	IED 1 Digital Input (TCPIP)	FT00001_COM1AE		42055.14
100ppm Chlorine Leak	IED 1 Digital Input (TCPIP)	CL00000_LDT4AE		42055.15
	IED 1 Digital Input (TCPIP)			
Inlet pH High	IED 1 Digital Input (TCPIP)	AT00886_A1AHE		42057.00
Inlet pH Low	IED 1 Digital Input (TCPIP)	AT00886_A1ALE		42057.01
Ammonia Cylinder Change Required	IED 1 Digital Input (TCPIP)	CD88104_REQ1AE		42057.02
Ammonia Store Door Open for 60 minutes	IED 1 Digital Input (TCPIP)	PL88002_CLS1AE		42057.03
25ppm Ammonia Leak Detected	IED 1 Digital Input (TCPIP)	AT88000_LDT3AE		42057.04
35ppm Ammonia Leak Detected	IED 1 Digital Input (TCPIP)	AT88000_LDT1AE		42057.05
100ppm Ammonia Leak Detected	IED 1 Digital Input (TCPIP)	AT88000_LDT2AE		42057.06
Ammonia Leak Detector Cell Failure	IED 1 Digital Input (TCPIP)	AT88000_FLT1AE		42057.07
Ammoniator Manually Disabled	IED 1 Digital Input (TCPIP)	AT88000_DIS1E		42057.08
Ammonia Intruder alarm	IED 1 Digital Input (TCPIP)	PL88001_SEC2AE		42057.09
Ammoniator No.1 Loss of Vacuum	IED 1 Digital Input (TCPIP)	AT88809_P1ALE		42057.10
Ammoniator No.1 Loss of Ammonia	IED 1 Digital Input (TCPIP)	AT88809_P1AHE		42057.11
Ammoniator No.1 Dosing Fault	IED 1 Digital Input (TCPIP)	PU88201_FLT2AE		42057.12
Ammoniator No. 1 Flow Range	IED 1 Digital Input (TCPIP)	AT88809_RGE1E		42057.13
Ammoniator No.1 On	IED 1 Digital Input (TCPIP)	AT88809_RNG1E		42057.14
Ammoniator No.1 Hydraulic Fault	IED 1 Digital Input (TCPIP)	PU88201_FLT1AE		42057.15

Ammoniator No.1 Pump Overload	IED 1 Digital Input (TCPIP)	PU88201_OVL1AE		42058.00
Ammoniator No.1 Incomplete Start	IED 1 Digital Input (TCPIP)	PU88201_FLT3AE		42058.01
Ammoniator No.1 On Normal (IED Control Enabled)	IED 1 Digital Input (TCPIP)	PU88201_ENA1E		42058.02
Ammoniator No.2 Loss of Vacuum	IED 1 Digital Input (TCPIP)	AT88809_P2ALE		42058.03
Ammoniator No.2 Loss of Ammonia	IED 1 Digital Input (TCPIP)	AT88809_P2AHE		42058.04
Ammoniator No.2 Dosing Fault	IED 1 Digital Input (TCPIP)	PU88202_FLT2AE		42058.05
Ammoniator No. 2 Flow Range	IED 1 Digital Input (TCPIP)	AT88809_RGE2E		42058.06
Ammoniator No.2 On	IED 1 Digital Input (TCPIP)	AT88809_RNG2E		42058.07
Ammoniator No.2 Hydraulic Fault	IED 1 Digital Input (TCPIP)	PU88202_FLT1AE		42058.08
Ammoniator No.2 Pump Overload	IED 1 Digital Input (TCPIP)	PU88202_OVL2AE		42058.09
Ammoniator No.2 Incomplete Start	IED 1 Digital Input (TCPIP)	PU88202_FLT3AE		42058.10
Ammoniator No.2 On Normal (IED Control Enabled)	IED 1 Digital Input (TCPIP)	PU88202_ENA1E		42058.11
Ammonia Dose Rate High	IED 1 Digital Input (TCPIP)	AT88000_RTE1AHE		42058.12
Ammonia PID in Auto	IED 1 Digital Input (TCPIP)	LP88001_AUT1E		42058.13
Ammonia Dose Rate Low	IED 1 Digital Input (TCPIP)	AT88000_RTE1ALE		42058.14
Duty Ammoniator 1 Selected	IED 1 Digital Input (TCPIP)	PU88201_DTY1E		42058.15
Duty Ammoniator 2 Selected	IED 1 Digital Input (TCPIP)	PU88202_DTY1E		42059.00
Content Control Mode Monochloramine Selected	IED 1 Digital Input (TCPIP)	LP00001_SEL3E		42059.01
Ammonia Duty Daily Selected	IED 1 Digital Input (TCPIP)	PG88010_DTY2E		42059.02
Ammonia Duty Auto Alternate Selected	IED 1 Digital Input (TCPIP)	PG88010_AUT1E		42059.03
	IED 1 Digital Input (TCPIP)	PU88202_DTY1E		42059.04
Ammonia ESD Battery Voltage Low	IED 1 Digital Input (TCPIP)	BT88002_L1ALE		42059.05
Inlet Ammonia Residual Total High	IED 1 Digital Input (TCPIP)	AT00003_RES1AHE		42059.06
Inlet Ammonia Residual Total Low	IED 1 Digital Input (TCPIP)	AT00003_RES1ALE		42059.07
Ammonia Cylinder No.1 Weight Underrange	IED 1 Digital Input (TCPIP)	CD88101_W1AE		42059.08
Ammonia Cylinder No.2 Weight Underrange	IED 1 Digital Input (TCPIP)	CD88102_W1AE		42059.09
Cell No.1 Ammonia Leak Underrange	IED 1 Digital Input (TCPIP)	AT88000_RES1AE		42059.10
Cell No.2 Ammonia Leak Underrange	IED 1 Digital Input (TCPIP)	AT88000_RES2AE		42059.11
Inlet Ammonia Residual Total High High	IED 1 Digital Input (TCPIP)	AT88000_RES1AHHE		42059.12
Inlet Ammonia Residual Total Low Low	IED 1 Digital Input (TCPIP)	AT88000_RES1ALLE		42059.13
Safety Shower in Operation	IED 1 Digital Input (TCPIP)	PL00001_STA1AE		42059.14
Chlorine Cylinder Manifold Vacuum Pressure Underrange	IED 1 Digital Input (TCPIP)	PT80001_P1AE		42059.15
CO2 Dosing Pump Running	IED 1 Digital Input (TCPIP)	PU00104_RNG1E		42060.00
CO2 Dosing Pump Hydraulic Fault	IED 1 Digital Input (TCPIP)	PU00104_FLT1AE		42060.01
CO2 Dosing Pump Overload	IED 1 Digital Input (TCPIP)	PU00104_OVL1AE		42060.02
CO2 Dosing Pump Incomplete Start	IED 1 Digital Input (TCPIP)	PU00104_FLT3AE		42060.03
Chlorine Cylinder No.3 Weight Underrange	IED 1 Digital Input (TCPIP)	CD00103_W1AE		42060.04
Chlorine Cylinder No.4 Weight Underrange	IED 1 Digital Input (TCPIP)	CD00104_W1AE		42060.05
CO2 Dosing Pump On Normal (IED Control Enabled)	IED 1 Digital Input (TCPIP)	PU00104_ENA1E		42060.06
Zone Control Equipment 2 Start Requested	IED 1 Digital Input (TCPIP)	ZM00010_RTR2E		42060.07
Bank No.1 Valve Opened	IED 1 Digital Input (TCPIP)	VA80013_OPN1E		42060.08

Bank No.1 Valve Closed	IED 1 Digital Input (TCPIP)	VA80013_CLS1E		42060.09
Bank No.1 Valve Fault	IED 1 Digital Input (TCPIP)	VA80013_FLT1AE		42060.10
Bank No.2 Valve Opened	IED 1 Digital Input (TCPIP)	VA80014_OPN1E		42060.11
Bank No.2 Valve Closed	IED 1 Digital Input (TCPIP)	VA80014_CLS1E		42060.12
Bank No.2 Valve Fault	IED 1 Digital Input (TCPIP)	VA80014_FLT1AE		42060.13
PID Auto Setpoint Enabled	IED 1 Digital Input (TCPIP)	LP00001_ENA1E		42060.14
PID Setpoint Control Mode	IED 1 Digital Input (TCPIP)	LP00001_AUT2E		42060.15
Chlorinator No.1 Isolation Valve Opened	IED 1 Digital Input (TCPIP)	VA81111_OPN1E		42061.00
Chlorinator No.1 Isolation Valve Closed	IED 1 Digital Input (TCPIP)	VA81111_CLS1E		42061.01
Chlorinator No.1 Isolation Valve Fault	IED 1 Digital Input (TCPIP)	VA81111_FLT1E		42061.02
Chlorinator No.2 Isolation Valve Opened	IED 1 Digital Input (TCPIP)	VA81106_OPN1E		42061.03
Chlorinator No.2 Isolation Valve Closed	IED 1 Digital Input (TCPIP)	VA81106_CLS1E		42061.04
Chlorinator No.2 Isolation Valve Fault	IED 1 Digital Input (TCPIP)	VA81106_FLT1E		42061.05
	IED 1 Digital Input (TCPIP)			42061.06
	IED 1 Digital Input (TCPIP)			42061.07
Ammoniator No.1 Isolation Valve Opened	IED 1 Digital Input (TCPIP)	VA88111_OPN1E		42061.08
Ammoniator No.1 Isolation Valve Closed	IED 1 Digital Input (TCPIP)	VA88111_CLS1E		42061.09
Ammoniator No.1 Isolation Valve Fault	IED 1 Digital Input (TCPIP)	VA88111_FLT1E		42061.10
Ammoniator No.2 Isolation Valve Opened	IED 1 Digital Input (TCPIP)	VA88106_OPN1E		42061.11
Ammoniator No.2 Isolation Valve Closed	IED 1 Digital Input (TCPIP)	VA88106_CLS1E		42061.12
Ammoniator No.2 Isolation Valve Fault	IED 1 Digital Input (TCPIP)	VA88106_FLT1E		42061.13
Ammonia ESD Shut Down Activated	IED 1 Digital Input (TCPIP)	PL00001_ACT2E		42061.14
Clear Water Tank Zone Control Inhibit	IED 1 Digital Input (TCPIP)	ZM00010_INH1E		42061.15
RTU Midnight Pulse	IED 1 Digital Output (TCPIP)	RT00001_K1CE		42113.00
	IED 1 Digital Output (TCPIP)			42113.01
Chlorine Gas System Misc Fault Reset	IED 1 Digital Output (TCPIP)	CD00103_RST1CE		42113.02
System 1 Chlorinator Fault Reset	IED 1 Digital Output (TCPIP)	CL00809_RST1CE		42113.03
Chlorine System 1 Ejector Boost Fault Reset	IED 1 Digital Output (TCPIP)	PU01201_RST1CE		42113.04
System 2 Chlorinator Fault Reset	IED 1 Digital Output (TCPIP)	CL00809_RST2CE		42113.05
Chlorine System 2 Ejector Boost Fault Reset	IED 1 Digital Output (TCPIP)	PU01202_RST1CE		42113.06
Sodium Hypo Dosing Unit 1 Fault Reset	IED 1 Digital Output (TCPIP)	PU81001_RST1CE		42113.07
Sodium Hypo Dosing Unit 2 Fault Reset	IED 1 Digital Output (TCPIP)	PU81002_RST1CE		42113.08
Sodium Hypo Storage Fault Reset	IED 1 Digital Output (TCPIP)	TA81030_RST1CE		42113.09
Inlet Chlorine Residual Fault Reset	IED 1 Digital Output (TCPIP)	AT00884_RST1CE		42113.10
Auto Alternate Duty Select	IED 1 Digital Output (TCPIP)	PG00010_AUT1CE		42113.11
Chlorinator 1 Duty Select	IED 1 Digital Output (TCPIP)	PU01201_DTY1CE		42113.12
Chlorinator 2 Duty Select	IED 1 Digital Output (TCPIP)	PU01202_DTY1CE		42113.13

Daily or Weekly Duty Select	IED 1 Digital Output (TCPIP)	PG00010_AUT2CE		42113.14
PID Remote Manual	IED 1 Digital Output (TCPIP)	LP00001_MAN1CE		42113.15
Dosing Room PID Fault Reset	IED 1 Digital Output (TCPIP)	CL00000_RST1CE		42114.00
Dosing Room Sample Valve Fault Reset	IED 1 Digital Output (TCPIP)	VA00003_RST1CE		42114.01
Zone Control Equipment Manual Start/Open Request Select	IED 1 Digital Output (TCPIP)	ZM00010_RTR1CE		42114.02
Zone Control Equipment Manual Mode Select	IED 1 Digital Output (TCPIP)	ZM00010_MAN1CE		42114.03
Remote Select	IED 1 Digital Output (TCPIP)	PL00001_REM1CE		42114.04
Local Select	IED 1 Digital Output (TCPIP)	PL00001_LOC1CE		42114.05
Miscellaneous Fault Reset	IED 1 Digital Output (TCPIP)	PL00001_RST1CE		42114.06
Chlorine ESD Shutdown Activate Select	IED 1 Digital Output (TCPIP)	PL00001_ACT1CE		42114.07
Content Control Mode - Chlorine Select	IED 1 Digital Output (TCPIP)	LP00001_SEL1CE		42114.08
Water Treatment Inhibit (Optional)	IED 1 Digital Output (TCPIP)	PL00001_INH1CE		42114.09
Content Control Mode - Monochloramine Select	IED 1 Digital Output (TCPIP)	LP00001_SEL2CE		42114.10
PID Automatic Setpoint Enable Select	IED 1 Digital Output (TCPIP)	LP00001_ENA1CE		42114.11
PID Automatic Setpoint Disable Select	IED 1 Digital Output (TCPIP)	LP00001_NENA1CE		42114.12
Zone Control Equipment 2 Force Start	IED 1 Digital Output (TCPIP)	ZM00010_FRC2CE		42114.13
Temperature Underrange (Used when it connects to RTU)	IED 1 Digital Output (TCPIP)	AT00002_T1ACE		42114.14
CO2 Dosing Fault Reset	IED 1 Digital Output (TCPIP)	PU00104_RST1CE		42113.15
	IED 1 Digital Output (TCPIP)			
Clearwater Tank Level A Select	IED 1 Digital Output (TCPIP)	TA00010_SEL1CE		42121.00
Clearwater Tank Level B Select	IED 1 Digital Output (TCPIP)	TA00010_SEL2CE		42121.01
Ammonia Gas System Misc Fault Reset	IED 1 Digital Output (TCPIP)	CD88103_RST1CE		42121.02
System 1 Ammoniator Fault Reset	IED 1 Digital Output (TCPIP)	AT88809_RST1CE		42121.03
Ammonia System 1 Ejector Boost Fault Reset	IED 1 Digital Output (TCPIP)	PU88201_RST1CE		42121.04
System 2 Ammoniator Fault Reset	IED 1 Digital Output (TCPIP)	AT88809_RST2CE		42121.05
Ammonia System 2 Ejector Boost Fault Reset	IED 1 Digital Output (TCPIP)	PU88202_RST1CE		42121.06
Ammonia PID Remote Manual	IED 1 Digital Output (TCPIP)	LP88001_MAN1CE		42121.07
Ammonia PID Fault Reset	IED 1 Digital Output (TCPIP)	AT88000_RST1CE		42121.08
Ammonia Auto Alternate Duty Select	IED 1 Digital Output (TCPIP)	PG88010_AUT1CE		42121.09
Ammoniator 1 Duty Select	IED 1 Digital Output (TCPIP)	PU88201_DTY1CE		42121.10
Ammoniator 2 Duty Select	IED 1 Digital Output (TCPIP)	PU88202_DTY1CE		42121.11
Ammonia Daily or Weekly Duty Select	IED 1 Digital Output (TCPIP)	PG88010_AUT2CE		42121.12
	IED 1 Digital Output (TCPIP)			42121.13
	IED 1 Digital Output (TCPIP)			42121.14
	IED 1 Digital Output (TCPIP)			42141.15
Chlorine Cylinder No.1 Weight	IED 1 Analog Input (TCPIP)	CD00101_W1E	kg	42177
Chlorine Cylinder No.2 Weight	IED 1 Analog Input (TCPIP)	CD00102_W1E	kg	42178
Cell No.1 Chlorine Leak	IED 1 Analog Input (TCPIP)	AT00140_RES1E	ppm	42179
Cell No.2 Chlorine Leak	IED 1 Analog Input (TCPIP)	AT00140_RES2E	ppm	42180
Inlet Chlorine Residual High Deviation SP Feedback	IED 1 Analog Input (TCPIP)	AT00884_RES1SHE	mg/l	42181
Inlet Chlorine Residual Low	IED 1 Analog Input (TCPIP)	AT00884_RES1SLE	mg/l	42182
Inlet Chlorine Residual	IED 1 Analog Input (TCPIP)	AT00884_RES1E	mg/l	42183
Outlet Chlorine Residual	IED 1 Analog Input (TCPIP)	AT00884_RES2E	mg/l	42184

Cell No.3 Chlorine Leak	IED 1 Analog Input (TCPIP)	AT00140_RES3E	ppm	42185
Chlorine Residual SP	IED 1 Analog Input (TCPIP)	CL00809_RES1SE	mg/l	42186
Inlet Chlorine Residual High High SP Feedback	IED 1 Analog Input (TCPIP)	AT00884_RESSHHE	mg/l	42187
Chlorine Remote Manual Dose Rate	IED 1 Analog Input (TCPIP)	CD00000_MAN1E	mg/l	42188
Chlorine Gas Flow Rate	IED 1 Analog Input (TCPIP)	CL00809_F1E	gm/h	42189
Chlorine PID Maximum Dose Rate Limit	IED 1 Analog Input (TCPIP)	LP00001_RTE1SXE	mg/l	42190
Chlorine PID Minimum Dose Rate Limit	IED 1 Analog Input (TCPIP)	LP00001_RTE1SIE	mg/l	42191
Chlorine Maximum Dose Rate	IED 1 Analog Input (TCPIP)	CD00000_RTE1SXE	mg/l	42192
Inlet Turbidity	IED 1 Analog Input (TCPIP)	AT00010_TUR1E	NTU	42193
Inlet Chlorine Residual Low Low SP Feedback	IED 1 Analog Input (TCPIP)	AT00884_RESSLLE	mg/l	42194
Zone Control Equipment Start Setpoint	IED 1 Analog Input (TCPIP)	ZM00010_STR1SE	m	42195
Zone Control Equipment Stop Setpoint	IED 1 Analog Input (TCPIP)	ZM00010_STP1SE	m	42196
pH Calibration factor	IED 1 Analog Input (TCPIP)	AT00886_PVL1SE	k	42197
Inlet pH	IED 1 Analog Input (TCPIP)	AT00886_A1E		42198
Clear Water Tank Level A	IED 1 Analog Input (TCPIP)	TA00010_L1E	m	42199
Inlet Water Temperature	IED 1 Analog Input (TCPIP)	AT00002_T1E	ºC	42200
Inlet Total Ammonia Residual	IED 1 Analog Input (TCPIP)	AT00003_A1E	mg/l	42201
Chlorine Cylinder Manifold Vacuum Pressure	IED 1 Analog Input (TCPIP)	PT80001_P1E	kPa	42202
Inlet Flow Meter Oldest Error Pending	IED 1 Analog Input (TCPIP)	FT00001_STA1E		42203
Outlet Flow Meter Oldest Error Pending	IED 1 Analog Input (TCPIP)	FT00002_STA1E		42204
Dosing Unit 1 Hypochlorite Flow Rate	IED 1 Analog Input (TCPIP)	PU81001_F1E	ml/h	42205
Dosing Unit 2 Hypochlorite Flow Rate	IED 1 Analog Input (TCPIP)	PU81002_F1E	ml/h	42206
	IED 1 Analog Input (TCPIP)			42207
Hypochlorite Storage Tank Volume	IED 1 Analog Input (TCPIP)	TA81030_VOL1E	l	42208
Clear Water Tank Volume	IED 1 Analog Input (TCPIP)	TA00010_VOL1E	kl	42209
Clear Water Tank Level B	IED 1 Analog Input (TCPIP)	TA00010_L2E	kl	42210
Chlorine PID Output	IED 1 Analog Input (TCPIP)	LP00001_RTE1E	%	42211
PLC to RTU Comms Check	IED 1 Analog Input (TCPIP)	PC00001_CNT1		42212
Outlet Turbidity	IED 1 Analog Input (TCPIP)	AT00010_TUR2E	NTU	42213
Outlet pH	IED 1 Analog Input (TCPIP)	AT00886_A2E		42214
Outlet Water Temperature	IED 1 Analog Input (TCPIP)	AT00002_T2E	ºC	42215
Outlet Total Ammonia Residual	IED 1 Analog Input (TCPIP)	AT00003_A2E	mg/l	42216
	IED 1 Analog Input (TCPIP)			42217
Chlorine PID Process Variable	IED 1 Analog Input (TCPIP)	CL00809_PVL1E	mg/l	42218
Inlet Monochloramine as Nitrogen	IED 1 Analog Input (TCPIP)	AT00003_A3E	mg/l	42219
Outlet Monochloramine Residual	IED 1 Analog Input (TCPIP)	AT00003_A4E	mg/l	42220
Inlet Free Ammonia Residual	IED 1 Analog Input (TCPIP)	AT00003_A5E	mg/l	42221
Outlet Free Ammonia Residual	IED 1 Analog Input (TCPIP)	AT00003_A6E	mg/l	42222
Chlorine Cylinder No.3 Weight	IED 1 Analog Input (TCPIP)	CD00103_W1E	kg	42223
Chlorine Cylinder No.4 Weight	IED 1 Analog Input (TCPIP)	CD00104_W1E	kg	42224
Clearwater Tank Level High SP FB	IED 1 Analog Input (TCPIP)	TA00010_L1SHE	m	42225
Clearwater Tank Level Low SP FB	IED 1 Analog Input (TCPIP)	TA00010_L1SLE	m	42226
Zone Control Equipment 2 Start SP FB	IED 1 Analog Input (TCPIP)	ZM00010_STR2SE	m	42227
Zone Control Equipment 2 Stop SP FB	IED 1 Analog Input (TCPIP)	ZM00010_STP2SE	m	42228
Cell 3 Ammonia Leak	IED 1 Analog Input (TCPIP)	AT88000_RES3E	ppm	42229

	IED 1 Analog Input (TCPIP)			42230
	IED 1 Analog Input (TCPIP)			
Ammonia Cylinder No.1 Weight	IED 1 Analog Input (TCPIP)	CD88101_W1E	kg	42305
Ammonia Cylinder No.2 Weight	IED 1 Analog Input (TCPIP)	CD88102_W1E	kg	42306
Cell No.1 Ammonia Leak	IED 1 Analog Input (TCPIP)	AT88000_RES1E	ppm	42307
Cell No.2 Ammonia Leak	IED 1 Analog Input (TCPIP)	AT88000_RES2E	ppm	42308
Inlet Ammonia Residual High High SP Feedback	IED 1 Analog Input (TCPIP)	AT88000_RESSHHE	mg/l	42309
Ammonia PID Output	IED 1 Analog Input (TCPIP)	LP88001_RTE1E	%	42310
Ammonia Residual SP	IED 1 Analog Input (TCPIP)	AT88809_RES1SE	mg/l	42311
Inlet Ammonia Residual Low Low SP Feedback	IED 1 Analog Input (TCPIP)	AT88000_RESSLLE	mg/l	42312
Ammonia Remote Manual Dose Rate	IED 1 Analog Input (TCPIP)	CD88000_MAN1E	mg/l	42313
Ammonia Gas Flow Rate	IED 1 Analog Input (TCPIP)	AT88809_F1E	g/h	42314
Ammonia PID Process Variable	IED 1 Analog Input (TCPIP)	AT88809_PVL1E	mg/l	42315
Ammonia PID Upper Dose Rate Limit	IED 1 Analog Input (TCPIP)	LP88001_RTE1SXE	mg/l	42316
Ammonia PID Lower Dose Rate Limit	IED 1 Analog Input (TCPIP)	LP88001_RTE1SIE	mg/l	42317
Ammonia Maximum Dose Rate	IED 1 Analog Input (TCPIP)	CD88000_RTE1SXE	mg/l	42318
Inlet Ammonia Residual Total High Deviation SP Feedback	IED 1 Analog Input (TCPIP)	AT88000_RES1SHE	mg/l	42319
Inlet Ammonia Residual Total Low Deviation SP Feedback	IED 1 Analog Input (TCPIP)	AT88000_RES1SLE	mg/l	42320
	IED 1 Analog Input (TCPIP)			
Inlet Forward Flow Rate	IED 1 Analog Input (TCPIP)	FT00001_F1E	l/s	42465
Inlet Forward Flow Total	IED 1 Analog Input (TCPIP)	FT00001_F1QE	kl	42466
Inlet Reverse Flow Rate	IED 1 Analog Input (TCPIP)	FT00001_F2E	l/s	42467
Inlet Reverse Flow Total	IED 1 Analog Input (TCPIP)	FT00001_F2QE	kl	42468
Outlet Forward Flow Rate	IED 1 Analog Input (TCPIP)	FT00002_F1E	l/s	42469
Outlet Forward Flow Total	IED 1 Analog Input (TCPIP)	FT00002_F1QE	kl	42470
Outlet Reverse Flow Rate	IED 1 Analog Input (TCPIP)	FT00002_F2E	l/s	42471
Outlet Reverse Flow Total	IED 1 Analog Input (TCPIP)	FT00002_F2QE	kl	42472
	IED 1 Analog Input (TCPIP)			42473
	IED 1 Analog Input (TCPIP)			42474
Inlet Chlorine Residual High Deviation Setpoint	IED 1 Analog Output (TCPIP)	AT00884_RES1SHCE	mg/l	42369
Inlet Chlorine Residual Low Deviation Setpoint	IED 1 Analog Output (TCPIP)	AT00884_RES1SLCE	mg/l	42370
Chlorine Remote Residual SP	IED 1 Analog Output (TCPIP)	CL00809_RES1SCE	mg/l	42371
Chlorine Remote Manual Dose Rate	IED 1 Analog Output (TCPIP)	CD00000_MAN1CE	mg/l	42372
Chlorine PID Maximum Dose Rate Limit	IED 1 Analog Output (TCPIP)	LP00001_RTE1SXCE	mg/l	42373
Chlorine PID Minimum Dose Rate Limit	IED 1 Analog Output (TCPIP)	LP00001_RTE1SICE	mg/l	42374
Chlorine Maximum Dose Rate	IED 1 Analog Output (TCPIP)	CD00000_RTE1SXCE	mg/l	42375
pH Calibration factor	IED 1 Analog Output (TCPIP)	AT00886_PVL1SCE	k	42376
Zone Control Equipment 1 Start SP	IED 1 Analog Output (TCPIP)	ZM00010_STR1SCE	m	42377
Zone Control Equipment 1 Stop SP	IED 1 Analog Output (TCPIP)	ZM00010_STP1SCE	m	42378
Zone Control Equipment 2 Start SP	IED 1 Analog Output (TCPIP)	ZM00010_STR2SCE	m	42379
Zone Control Equipment 2 Stop SP	IED 1 Analog Output (TCPIP)	ZM00010_STP2SCE	m	42380
	IED 1 Analog Output (TCPIP)			42381
	IED 1 Analog Output (TCPIP)			42382

RTU to PLC Comms Check	IED 1 Analog Output (TCPIP)	RT00001_CNT1		42383
Clearwater Tank Level High SP	IED 1 Analog Output (TCPIP)	TA00010_L1SHCE	m	42384
	IED 1 Analog Output (TCPIP)			
Ammonia Remote Residual SP	IED 1 Analog Output (TCPIP)	AT88809_RES1SCE	mg/l	42409
Ammonia Remote Manual Dose Rate	IED 1 Analog Output (TCPIP)	CD88000_MAN1CE	mg/l	42410
Ammonia PID Upper Dose Rate Limit	IED 1 Analog Output (TCPIP)	LP88001_RTE1SXCE	mg/l	42411
Ammonia PID Lower Dose Rate Limit	IED 1 Analog Output (TCPIP)	LP88001_RTE1SICE	mg/l	42412
Ammonia Maximum Dose Rate	IED 1 Analog Output (TCPIP)	CD88000_RTE1SXCE	mg/l	42413
Inlet Chlorine Residual High High SP	IED 1 Analog Output (TCPIP)	AT00884_RESSHHCE	mg/l	42414
Inlet Chlorine Residual Low Low SP	IED 1 Analog Output (TCPIP)	AT00884_RESSLLCE	mg/l	42415
Clearwater Tank Level Low SP	IED 1 Analog Output (TCPIP)	TA00010_L1SLCE	m	42416
Inlet Ammonia Residual High High SP	IED 1 Analog Output (TCPIP)	AT88000_RESSHHCE	mg/l	42417
Inlet Ammonia Residual Low Low SP	IED 1 Analog Output (TCPIP)	AT88000_RESSLLCE	mg/l	42418
Inlet Ammonia Residual Total High Deviation SP	IED 1 Analog Output (TCPIP)	AT88000_RES1SHCE	mg/l	42419
Inlet Ammonia Residual Total Low Deviation SP	IED 1 Analog Output (TCPIP)	AT88000_RES1SLCE	mg/l	42420
Temperature (Reserve - used when it connects to RTU)	IED 1 Analog Output (TCPIP)	AT00002_T1CE	ºC	42421
RTU Time - Date	IED 1 Analog Output (TCPIP)	RT00001_K2CE		42422
RTU Time - Month	IED 1 Analog Output (TCPIP)	RT00001_K3CE		42423
RTU Time - Year	IED 1 Analog Output (TCPIP)	RT00001_K4CE		42424
RTU Time - Day of Week	IED 1 Analog Output (TCPIP)	RT00001_K5CE		42425
	IED 1 Analog Output (TCPIP)			42426
	IED 1 Analog Output (TCPIP)			42427
	IED 1 Analog Output (TCPIP)			42428
	IED 1 Analog Output (TCPIP)			42429
	IED 1 Analog Output (TCPIP)			42430

END OF DOCUMENT