Operation & Maintenance Manuals Volume 5 Engineering Lists & Reports

Wacol WRP

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Wacol Water Reclamation Plant

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Functional Specification

Rev.4

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Glossary

ADWF	Average Dry Weather Flow
AWTP	Advanced Water Treatment Plant
CV	Controlled Variable (PID)
FCV	Flow Control Valve
HMI	Human-Machine Interface
IDC	Internet Display Client
IO	Inputs and Outputs (to/from PLC)
LCP	Local Control Panel
MCC	Motor Control Centre
MLSS	Mixed Liquor Suspended Solids
PID	Proportional Integral Derivative
P+ID	Process & Instrumentation Diagram
PLC	Programmable Logic Controller
PV	Process Variable (PID)
RDS	Rotary Drum Screen
SCADA	Supervisory Control and Data Acquisition
SP	Set point (PID)
VFD	Variable Frequency Drive
VSD	Variable Speed Drive
WAS	Waste Activated Sludge
WRP	Water Reclamation Plant

Revision Record

Rev	Date	Description	Author	Approval
1.0	**23 Dec**	**Original Issue provided by QUU**	**Z. Tomlins, W. Khan, M. Greene**	
2.0	**25/01/13**	**Wacol Project Update as part of 80% submission to QUU**	**Pieter Bonker**	**Mike Leske**
3.0	**23/04/13**	**100% submission to QUU for review**	**Pieter Bonker**	**Mike Leske**
4.0	**08/05/13**	**100% design revision as per QUU comments email 06/05/13**	**Jean-Marc Laurillard**	**Pieter Bonker**

1. Introduction

Wacol Water Reclamation Plant (WRP) is located at 176a Grindle Rd, Wacol. This project consists of the installation of a third Rotary Drum Screen and associated equipment.

This existing PLC controls or monitors the following equipment:

- Drum Screen #1
- Inlet Valve #1
- Foul Air Fan #1
- Drum Screen #2
- Inlet Valve #2
- Foul Air Fan #2
- Screenings Wash Press(3 off)
- Wash Water Pumps (2 off)
- Grit Recovery Drive #1
- Grit Pump #1
- Grit Recovery Drive #2
- Grit Pump #2

Wacol Water Reclamation Plant

The site PLC's are linked by an ethernet network to the plant SCADA system which provides the operator with an interface to the control of the plant. This interface provides status and alarm indication, remote command functions, and historical trend collection of various data points. Remote dial-out of certain critical alarms is carried out to provide off-site alarm monitoring, and the on-call operator is able to remotely connect to the plant SCADA system to view the current status and perform remote control functions.

The Wacol WRP was originally commissioned in 1990, and in 2006 the Brisbane Water Enviro Alliance, (BWEA), modified the existing Bioreactor Tanks to improve the removal of nitrogen. This work included an upgrade to the Blower control system in which two new Siemens S7-300 PLC's were installed. In 2013 Tenix designed and installed the third Rotary Drum Screen (RDS) and associated equipment under the Collaborative Delivery Agreement (CDI)

1.1 Process Description

Wacol WRP receives wastewater from the S6 sewer catchment. Flows are delivered to the WRP through three rising mains. Beanland St and Brumby Circuit pump stations pump into the WRP via a 600mm Hobas rising main. Sewage from Birkin Rd and Weekes Rd pump stations enter the WRP via a 375mm GRP rising main. All three rising mains connect into the inlet 910mm pipework at the base of the surge tower and each rising main has its own isolation valve prior to the interconnection manifold.

The private pump station from the adjacent Wolston Correctional Facility enters Wacol WRP via a 200mm rising main manifold outside the plant. The WRP's internal sewage pump station also connects into the 910mm pipe at the base of the surge tower. As the land area around Wacol is flat, the surge tower was constructed to keep the rising mains full and prevent surges of flow entering the plant. Raw sewage enters the base of the surge tower, travels up the 755mm standpipe and flows into the screening complex. An overflow pipe connection at the top of the surge tower bypasses flow directly to the grit removal system when there is excessive flow for the screenings complex to handle.

The screenings complex comprises of three (3) Rotary Drum Screens (RDS) to remove large non-biodegradable solids, grit material, rags, paper etc… present in the raw sewage stream. The screened material is deposited onto the screenings disposal chute dedicated to each RDS. It falls into a screening wash press where service water cleans off faecal material from the screenings before they are compressed and dewatered. Thereafter, the 'dry' screenings are discharged into an endless bag as a relatively dry screenings product. The endless bag is usually replaced with another empty bag when it is ½ to ¾ full.

A diverter flap located at high level in each chute, allows the screenings to be directed into the screw wash press or be diverted to a wheelie bin. The latter destination is only used during maintenance of wash press or power failure, as it does not provide any dewatering.

Screened sewage from each rotary drum screen enters the de-aeration chamber through its own dedicated pipe. The de-aeration chamber is designed to remove entrained air which could affect the grit removal process. Air is released in the chamber and sewage then flows over a weir which splits the chamber in half. The flow leaves the de-aeration chamber to enter the grit removal system. One foul air fan is located on each RDS and operates to exhaust foul air to atmosphere when the RDS is online and in auto mode.

In the grit removal system, there are two inlet channels with manual screens. Each inlet channel has its own grit chamber and the system operates via gravity by settling out and collecting heavy grit material from the influent sewage stream. The inlet and outlet flow rate is controlled by manual penstocks at the entry and exit points of each grit chamber. The manual penstocks when closed isolate the relevant grit chamber. The penstocks can also be used to balance the flow rate to each grit chamber.

The grit that settles out in each chamber is collected in the chamber's central hopper. Each grit chamber has a dedicated grit pump to pump the grit material to a single cyclone where the grit stream is concentrated. This concentrated grit stream is then passed over a wedge wire screen which further separates the grit and sewage. The grit collected on the wedge wire screen is disposed into a grit hopper. This hopper has a drain attached to remove excess water. The water from the hopper then gravitates to a drain sump which flows into the internal sewage pump station. This pump station is adjacent to the grit chambers and receives flow from the drain sumps on the grit removal system, plus drain water from the screenings area and wastewater from the workshop and amenities building area.

From the grit chambers, the screened sewage then flows into the Contact Tank where it is mixed with the Return Activated Sludge (RAS) stream. There is also an automated valve (i.e. Plant Bypass Valve) to allow bypass of flow in excess of > 3 x ADWF from the Inlet Works to

the plant outfall connection leading to the outfall UV disinfection system. Disinfection of the excess influent stream is then carried out prior to discharging into the outfall structure leading to the Brisbane River. For further details of the plant bypass valve and UV disinfection system control, refer to the functional specifications for PLC03FST and PLC04BFP respectively.

1.2 New Rotary Drum Screen Project

This project aim to add a third Rotary Drum Screen located next to the existing Rotary Drum Screen. The third RDS will operate in a similar way to the two existing RDS's.

The Screening Handling System for RDS #1 and #2 had two Chute Diverters, a Common Conveyor, and a single Wash Press. The Common Conveyor has been removed and new Wash Presses have been installed below the Chutes for RDS #1, RDS #2 and RDS #3.

1.3 PLC Control

The existing Siemens S7-300 PLC covered in this specification is to be kept and modify to provide the functionality described in this document.

The existing PLC is designated PLC01INL. A remote IO rack connected to this PLC will be located in the new Phosphorus Removal switchboard located between the access roadway and Bioreactor 1.

1.4 Network Connection

PLC01INL is connected via a Cat.6 Ethernet cable to a new network switch mounted in Fibre-optic Termination Panel #1(FOTP#1), located on the eastern wall of the inlet screens Switch room adjacent to the high voltage Switch room door. This new switch has dual fibre-optic connections to the plant SCADA network which is configured as a "redundant ring" and runs at 1Gb/sec.

1.5 Controlled Equipment

PLC01INL controls or monitors the following equipment (or motors associated with the stated equipment):

Equipment associated with the Surge Tower:

- FIT-0210-001 Surge Tower Flow meter
- FS_-0210-001 High Flow Sensor (For overflow pipe)

Equipment associated with the Rotary Drum Screens:

- SC_-0210-001 Rotary Drum Screen 1 Drive
- FCV-0210-101 Rotary Drum Screen 1 Inlet Valve
- SC_-0210-002 Rotary Drum Screen 2 Drive
- FCV-0210-201 Rotary Drum Screen 2 Inlet Valve
- SC_-0210-003 Rotary Drum Screen 3 Drive (new)
- FCV-0210-301 Rotary Drum Screen 3 Inlet Valve (new)

Equipment associated with the Foul Air Exhaust:

- FAN-0210-001 Foul Air Exhaust Fan 1
- FAN-0210-002 Foul Air Exhaust Fan 2
- FAN-0210-003 Foul Air Exhaust Fan 3 (new)

Equipment associated with the Screenings Handling (Option 2):

- CV_-0210-001 Screenings Press 1 (new)
- CV_-0210-002 Screenings Press 2 (new)
- CV_-0210-003 Screenings Press 3 (new)

Equipment associated with the Wash Water Pumps:

- PU_-0210-101 Wash Water Pump 1
- SC_-1030-301 Wash Water Pump 1 VSD
- PU_-0210-102 Wash Water Pump 2
- SC_-1030-302 Wash Water Pump 2 VSD
- SV_-0210-101 Screen 1 Internal Spray Solenoid Valve
- SV_-0210-102 Screen 1 External Spray Solenoid Valve
- SV_-0210-201 Screen 2 Internal Spray Solenoid Valve
- SV_-0210-202 Screen 2 External Spray Solenoid Valve
- SV_-0210-301 Screen 3 Internal Spray Solenoid Valve (new)
- SV_-0210-302 Screen 3 External Spray Solenoid Valve (new)
- SV_-0220-101 Screw Wash Press 1 Solenoid Valve (new)
- SV_-0220-102 Screw Wash Press 1 Solenoid Valve (new)
- SV_-0220-201 Screw Wash Press 2 Solenoid Valve (new)
- SV_-0220-202 Screw Wash Press 2 Solenoid Valve (new)
- SV_-0220-301 Screw Wash Press 3 Solenoid Valve (new)
- SV_-0220-302 Screw Wash Press 3 Solenoid Valve (new)
- FIT_-1030-303 Wash water discharge Flow meter
- PIT_-1030-301 Pressure transmitter

Equipment associated with the Grit Chambers:

- GT_-0230-001 Grit Recovery Chamber 1 Drive
- GT_-0230-002 Grit Recovery Chamber 2 Drive
- AT_-0230-001 pH Analyser
- PU_-0230-001 Grit Recovery Pump 1
- PU_-0230-002 Grit Recovery Pump 2

Equipment associated with the Internal Sewage Pump Station:

- PU_-1150-001 Internal Sewage Pump 1
- PU_-1150-002 Internal Sewage Pump 2

Equipment associated with the Site Weather Station:

- AT_-1300-001 Solar Radiation
- AT_-1300-002 Wind Direction
- AT_-1300-002 Wind Speed
- AT_-1300-002 Ambient Temperature

1.6 SCADA and PLC Functionality

The PLC is directly connected to the plant SCADA network, and all standard QUU Citect and PLC functionality are available. This will include all of the functions described in the separate documents:

- NCS PLC & RTU Software Guidelines v2.5.pdf
- Citect HMI Standards v2.5.pdf

1.7 Modes of Operation

Up to three modes of operation will be available for all drives and valves controlled by PLC01INL as listed below:

Equip Num Description A/M	Description	A/M Sel	PLC Ctrl	Loc/ Man	Rem/ Man	Rem/ Auto
SC_-0210-001 SC_-0210-002 SC_-0210-003	Rotary Drum Screens 1, 2, and 3	Y	Y	Y	Y	Y
FCV-0210-101 FCV-0210-201 FCV-0210-301	Screen Inlet Valves 1, 2, and 3	Y	Y	Y	Y	Y
FAN-0210-001 FAN-0210-002 FAN-0210-003	Foul Air Fans 1, 2, and 3	Y	Y	Y	Y	Y
CV_-0210-001 CV_-0210-002 CV_-0210-003	Screenings Press 1, 2, and 3	Y	Y	Y	Y	Y
PU_-0210-101 PU_-0210-102	Wash Water Pumps 1 and 2	Y	Y	Y	Y	Y
SV_-0210-101 SV_-0210-102 SV_-0210-201 SV_-0210-202 SV_-0210-301 SV_-0210-302	Screens 1, 2, and 3 Internal and External Wash Solenoid Valves	N	Y	Y	Y	Y
GT_-0230-001 GT_-0230-002	Grit Recovery Chamber Drives 1 and 2	Y	Y	Y	Y	Y
PU_-0230-001 PU_-0230-002	Grit Recovery Pumps 1 and 2	Y	Y	Y	Y	Y
SP_-1150-001 SP_-1150-002	Internal Sewage Pumps 1 and 2	N	N	L OC/ Auto	N	N
SV_-0220-101	Screw Wash Press 1 Solenoid Valve (new)	N	Y	Y	Y	Y
SV_-0220-102	Screw Wash Press 1					

	Solenoid Valve (new)	
SV_-0220-201	Screw Wash Press 2 Solenoid Valve (new)	
SV_-0220-202	Screw Wash Press 2 Solenoid Valve (new)	
SV_-0220-301	Screw Wash Press 3 Solenoid Valve (new)	
SV_-0220-302	Screw Wash Press 3 Solenoid Valve (new)	
Ventilation System	(Independent control system)	N/A

For drives that have a two-position Manual/Auto selector switch located on the front of the starter cubicle, the term “Manual” is synonymous with the term “Local”, and the term “Auto” is synonymous with the term “Remote”.

Local/Manual Mode will be active when the selector switch is set to Manual. In this mode the drive may be started and stopped via pushbuttons located either on the main switchboard or in some cases located adjacent to the pump or motor.

When the selector switch is set to Auto, either Remote/Manual or Remote/Auto will be active. In this mode, the operator can select either Remote/Manual or Remote/Auto via buttons on the drive popup at any one of the following locations:

- Control Room SCADA Computers (primary and secondary)
- Advantech Touch Panel located in the blower instrument room
- Advantech Touch Panel located in the belt filter press switchroom
- Via remote Citect IDC

In some cases only Remote/Manual is available and this will be because there are no automatic control functions required for that drive or valve, so Remote/Auto mode is not available.

In Remote/Manual mode, the drive can be manually started and stopped, or the valve opened and closed, via buttons on the SCADA drive/valve popup.

In Remote/Auto mode, the drive will start under automatic PLC control when requested to by the control sequence.

1.8 Out-of-Service Mode

In addition to the three normal operating modes described above, the drives may be taken completely out of operation. This is carried out by clicking on the “spanner” on the SCADA drive popup. Placing a drive in Out-of-Service Mode can be carried out at any of the HMI’s listed above. When in Remote/Manual or Remote/Auto modes, and placed in Out-of-Service mode the drive will not start under any circumstances. Out-of- Service has no affect when the mode is set to Local/Manual and the drive is still able to be started via the local pushbuttons.

If a drive is required as part of a sequence of drives, it is in Remote/Auto mode and is running, and then it is placed in Out-of-Service Mode, the sequence will perform either a controlled shutdown sequence or an Emergency Stop sequence, (depending on how critical the drive is to the sequence).

2. Surge Tower

2.1 Process Description

The Surge Tower is located near the entrance gate at the eastern end of the plant. It receives raw sewage from three rising mains and distributes the load currently to three(3) Rotary Drum Screens via a 750mm outlet pipe from the Surge Tower. The manual penstock at this outlet pipe is in the fully open position; further downstream of this pipe is the Surge Tower Flow meter which measures the daily incoming flow (i.e. ADWF) into the plant.

Future: Future planning may include converting the manual penstock to an automatic system. This will assist in future automatic operation with improved system monitoring and performance of the downstream equipment.

An overflow pipe connection at the top of the Surge Tower allows for bypass of flow directly to two (2) grit chambers during wet weather events where incoming flow could go beyond 3 x ADWF and exceed the capacity of the rotary drum screens' operation.

The overflow pipe has an overflow probe installed to indicate when the Surge Tower is bypassing and a portion of the flow is not passing through the rotary drum screens. An alarm will be sent to the SCADA screen to alert the plant operators. This is important as the bypass flow that goes through this overflow pipe will pass through manual screens prior to entering the grit chambers. If the overflow pipe is operational for an extended period of time (i.e. greater than 4 hours with no RDS operating, greater than 8 hours with at least one RDS operating), the manual grit screens will need to be cleaned, otherwise they will clog up and unscreened sewage will flow through the top of the manual screens and downstream to the rest of the treatment processes in the plant.

2.2 Monitored Equipment

- FIT-0210-001 Surge Tower Flow meter (range 0-450 L/s)
- FS_-0210-001 High Flow Sensor (In overflow pipe)

2.3 SCADA Controls

The following controls are available on the SCADA screen:

FIT-0210-001 Flow meter

Out-of-Service Toggle	Normal / Out-of-Service
High Flow Set point	150 min, 450 max
High/High Flow Set point	150 min, 450 max

2.4 Fault Conditions

The following fault conditions are able to be displayed on the SCADA:

Fault Description	**Latched**
1. Inlet Flow meter Signal Invalid	No
2. Inlet Flow rate High Alarm	No

3. Inlet Flow rate High/High Alarm	No
4. Screens Bypass in Progress Alarm	No

3 Rotary Drum Screens

3.1 Process Description

The Rotary Drum Screens (RDS) are located on the rooftop of the screenings complex. Three (3) RDS are operating in a duty/duty assist /standby.

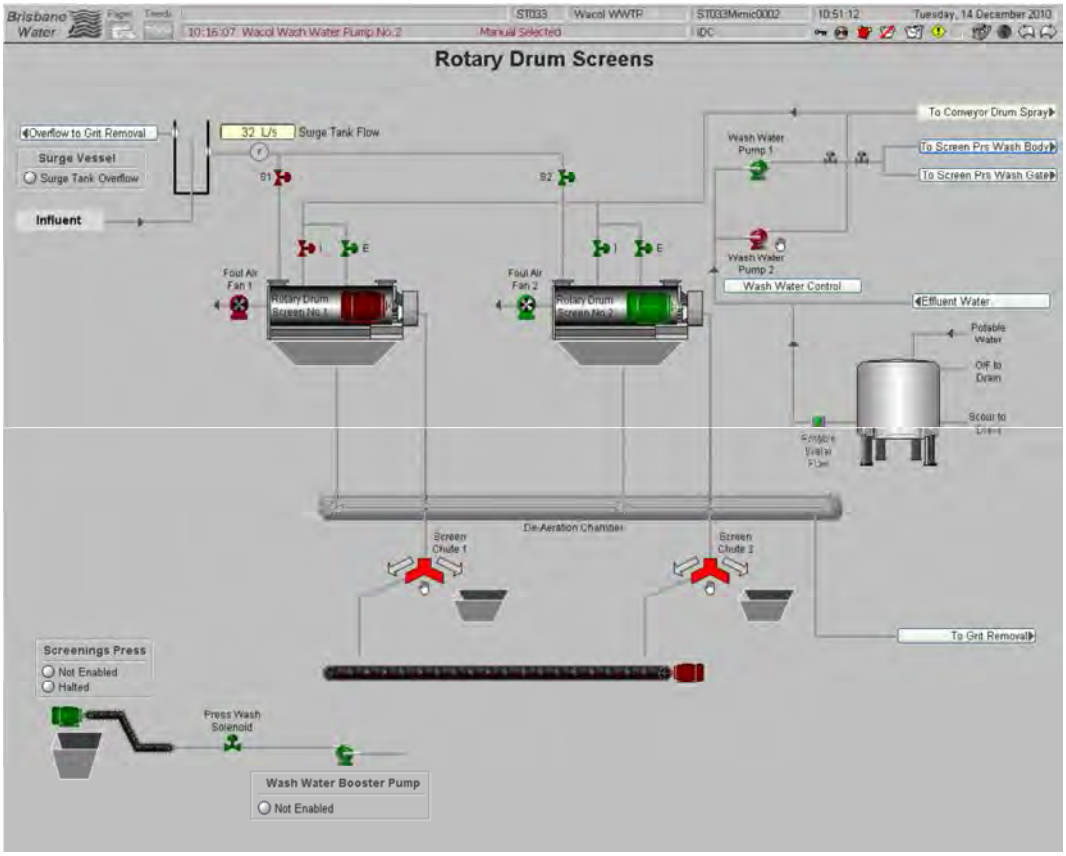
The screens are always 'Available' in Auto. One screen is always on-line (the duty screen) but as the flow to the works increases a second screen will be brought on-line (the duty assist screen). The 3rd screen is the standby. To bring a screen on-line, the DN600 inlet knife gate valve is opened automatically via the Rotork electric actuator. When a screen is taken off-line, the inlet valve is closed.

The capacity for each RDS is estimated at a maximum of 400L/s. Each RDS has an actuated valve to control the amount of influent flow into the screens. The PLC is programmed to start the second RDS if the inflow exceeds 300L/s; and shutting it down when the inflow drops to 200L/s. If the duty screen fails, the standby screen will be called into operation. The duty and standby screens rotate duty based on a run cycle. The current duty rotation time is around 14 hours. The control allows two screens to run together and the third screen will be a standby. There will never be three screens operating at the same time, (unless operated in Local/Manual or Remote/Manual mode and started by an operator).

Raw sewage enters the duty screen and overflows the inlet trough to contact the rotating screen. Large particles are captured and moved along the screen area via a combination of collection vanes and the rotating motion of the screen before being transferred to the screenings collection area for dewatering and disposal.

The screened sewage passes through the screen apertures, is captured by the collection trough and flows via a 1040NB pipe to the de-aeration chamber. This chamber is designed to remove entrained air within the screened sewage. In the de-aeration chamber, air is released and sewage passes over a weir then piped to the grit chambers. A foul air fan is located on each RDS to exhaust foul air to atmosphere.

The duty rotary drum screen is periodically cleaned using internal and external sprays from service water delivered by the duty wash water pump. Cleaning is performed at a pressure of at least 400kPa (Duty 500 kPa). If the RDS is not properly washed, material may accumulate in the screen. Failure of the washing system may occur if the solenoid valves on the internal and external sprays fail. All solenoids valves are fail open type to ensure continuous operation of the screens. Any malfunction can be rectified by manually opening the bypass valves provided.



Existing SCADA Page "ST033Mimic0002" (RDS #3 yet to be added)

The following description is for RDS #1. RDS #2 and #3 operate in the same way as RDS #1.

3.2 Controlled Equipment

- SC_-0210-001 Rotary Drum Screen 1 Drive

- SC_-0210-002 Rotary Drum Screen 2 Drive
- SC_-0210-003 Rotary Drum Screen 3 Drive (new)

3.3 Switchboards and Controls

3.3.1 Essential Services Supply Connection

The main switchboard for the Inlet Screens is called SDSB. It has two 3-phase feeds, one from the incoming Energex supply via Transformer T3, and the second a feed from the Essential Services Switchboard (ESSB) which is connected to the site emergency generator. Although there is an Auto-changeover Circuit in SDSB, the sensing circuits have not been connected between ESSB and SDSB, so Auto Mode is not operable. The supply is always left connected to ESSB (called “Standby Supply” on the panel), meaning that the normal supply transformer (T3) is virtually unused.

3.3.2 Switchboard SDSB

This switchboard contains starter cubicles for the three drives associated with each Rotary Drum Screens 1, 2, and 3. Each RDS has two cubicles, one for the control circuits and the second containing the soft starter drive. The soft starter cubicle has no front door controls or indicators and simply contains the open soft starter circuit board. The control cubicle has the following controls and indications:

- Main Isolator
- Motor Ammeter
- Mode Selector: Man / Auto
- “Drive Running” Indicator
- “Control Available” Indicator
- Fault Rest Pushbutton
- Motor Hours Run Counter

The RDS starts rotating via its Soft Starter Drive output which slowly ramps up the speed of the drum. When the Soft Starter has reached its full speed it energises a Bypass Contactor which bypasses the 3-phase power around the Soft Starter directly to the motor.

3.3.3 Supply to Internal Pump Station

The soft starter cubicle for the future RDS #3 is vacant, however the control cubicle for RDS #3 has been used as a 3-phase supply to the Internal Pump Station. This is the small in-ground sewage pump station located to the south of Grit Recovery Structure #1. This Pump Station was originally fed from Distribution Switchboard #2 (DS2) which is located at the right-hand end of switchboard SDSB. DS2 is fed from Transformer T3 (located in the south/east of the Inlet Screens building) but does not have a separate feed from the Essential Services Switchboard (ESSB) located in the Blower Switch room.

Since SDSB does have a feed from ESSB and the Internal Pump Station must run during a power outage, this feed was moved over to SDSB. As part of the new RDS #3 contracts, this feed will be moved to the Screens Complex Essential Supply Distribution Board (located on the eastern wall of the Inlet Screens Switch room).

Normal Supply DB **Essential Services Supply DB**

3.3.4 Local Control Station

There is a local control station for each RDS located on the rooftop at the west end of the RDS structure. It contains the following local controls and indications:

- ~~Local Isolator~~
- Emergency Stop Pushbutton
- Local Start Pushbutton
- Local Stop Pushbutton
- “Drive Running” Indicator
- “Auto Selected” Indicator
- “Extra High Liquid Level” Indicator (Blocked Screen)
- “Liquid Discharge to Solids Chute” Indicator (High Trough Level)
- External Screen Wash Valve Selector: Open / Auto
- Internal Screen Wash Valve Selector: Open / Auto
- External Screen Wash Valve “Open” Indicator
- External Screen Wash Valve “Closed” Indicator
- Internal Screen Wash Valve “Open” Indicator
- Internal Screen Wash Valve “Closed” Indicator

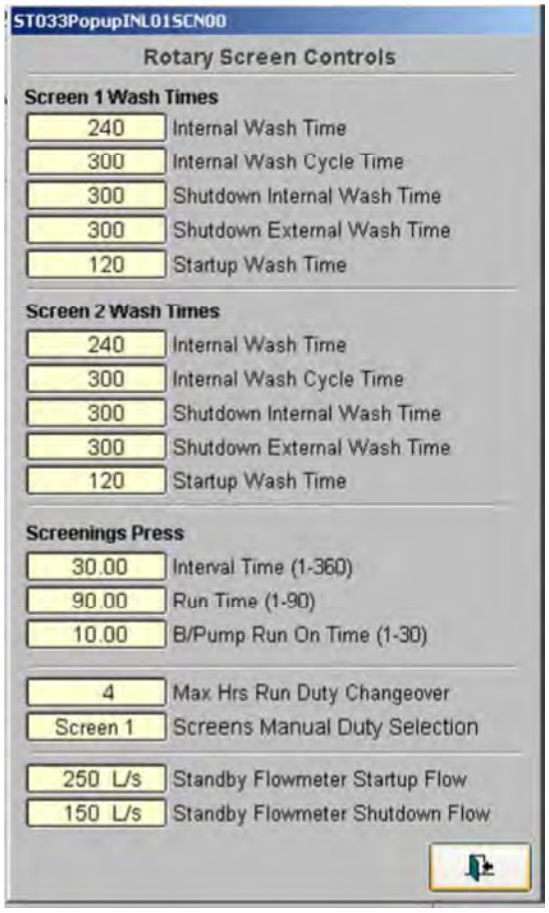
3.4 Set points

The following set points are available on the SCADA for adjustment by the plant operator:

- Follow Screen Start-up Flow rate 250 L/s (Min 200 L/s, Max 400 L/s)
- Follow Screen Shutdown Flow rate 150 L/s (Min 100 L/s, Max 200 L/s)
- Duty Screen Selection Auto, or one of the following fixed orders: 1-2-3 / 2-3-1 / 3-1-2 / 2-1-3 / 3-2-1
- Auto Duty Changeover Time 4 hrs (Min 2 hrs, Max 24 hrs – operator input)

Rotary Drum Screen Wash Times (separate set points for each screen)

- Start-up Wash Time 2 min (Min1 min, Max 10 min)
- Internal Wash Time ON 4 min (Min 1 min, Max 10 min)
- Internal Wash Time OFF 5 min (Min 1 min, Max 10 min)
- External Wash Time ON Min 1 min, Max 10 min
- External Wash Time OFF Min 1 min, Max 10 min
- Shutdown Wash Time 5 min (Min 1 min, Max 10 min)



The existing popup “ST033PopupINL01SCN00” is to be adjusted to suit the above list of set points. In addition, the current “hot spot” for opening the above set point popup is by clicking

on the trough below each RDS on Mimic0002. This is to be changed to the QUU standard of a set points button  added to Mimic0002.
The New Rotary Drum screen, new wash presses and wash water pumps will be added to the Scada popups

3.5 Operating Modes

The Rotary Drum Screens can be operated either via the Local Control Station (LCS), or remotely via the PLC in Remote/Manual or Remote/Auto modes.

3.5.1 Local/Manual Control

When the selector on the MCC is placed in Manual mode, the RDS can be started or stopped using the Start and Stop pushbuttons on the LCS. In this mode all fault conditions including chain breakage detection are active and will stop the drive, except the following conditions:

- Drive Failed to Start (PLC-generated off Running feedback)
- Drive Failed to Stop (PLC-generated off Running feedback)
- Blocked Screen alarm
- High Trough Level alarm

3.5.2 Remote/Manual Mode

Remote/Manual mode is set by placing the MCC mode selector to “Auto” (i.e.; “Remote”), and selecting “Manual” on the SCADA drive popup (the Motor icon inside the Screen graphic). This allows the plant operator to remotely control the starting and stopping of the RDS using the buttons on the SCADA drive popup.

NOTE: When operating the RDS in Local/Manual and Remote/Manual modes, the Foul Air Fan will also operate automatically, but only if it’s mode has been set to Remote/Auto on the SCADA. The Internal and External Screen Wash Water Solenoids will also operate automatically on timers if their mode has been set to Remote/Auto.

3.5.3 Remote/Auto Mode

Remote/Auto mode is set by placing the MCC mode selector in “Auto” (i.e.; “Remote”), and selecting “Auto” on the SCADA drive popup. In this mode, PLC01INL will control the starting and stopping of the three Rotary Drum Screens, plus their associated drives.

Each RDS has two ancillary drives and three valves associated with it, and in Remote/Auto mode all of this equipment operates as a “Process Stream”. Each stream operates independently of the other two streams, but their starting and stopping is controlled by an overall scheme determined by the current flow rate into the plant.

3.5.4 Remote/Auto Duty Selection

The three RDS's are able to set up as a fixed duty order or as an automatically changing duty cycle. The operator can select one of the following selections from a drop-down pick list:

Auto
1 – 2 – 3
2 – 1 – 3
3 – 1 – 2
1 – 3 – 2
2 – 3 – 1
3 – 2 – 1

Auto Duty Changeover

If "Auto" is selected, the duty/follow/standby roles will be automatically changed by the control system based on the run hours of the duty RDS. The value entered for:

- Auto Duty Changeover Time Hrs (Min 2 hrs, Max 24 hrs)

It will be used by the system to trigger a change in duty roles. The "follow" will become the "duty", the "standby" will become the "follow", and the "duty" will become the "standby".

Fixed Duty Order

If any one of the fixed duty orders is selected, the roles will stay in the order selected. The three positions are aligned as: Duty – Follow – Standby in Fixed Mode, there will be no automatic change to the duty order.

In either Auto or Fixed Duty, if any RDS stream is not available, (i.e.; a fault condition is active, or not all drives are available), the next stream in the duty order will take up its role.

3.5.5 Remote/Auto – Duty Start

At least one RDS must be running at all times. When the first RDS stream is available, it will be automatically started, even if the plant inflow has stopped, (e.g.; night-time low flow period).

3.5.6 Remote/Auto – Follow Start/Stop

When in more than one RDS stream is available, the control system will continuously check the rate of inflow to the plant. When the flow increases above the set point for:

- Follow Screen Start-up Flow rate 250 L/s (Min 200 L/s, Max 400 L/s) for a continuous 30 seconds, the "follow" RDS stream will start-up.

When the flow decreases below the set point for:

- Follow Screen Shutdown Flow rate 150 L/s (Min 100 L/s, Max 200 L/s) for a continuous 5 minutes, the “follow” RDS stream will shut down.

3.5.7 Remote/Auto “Start Interlocks”

The “Start Interlocks” for each process stream are displayed on a popup that shows each item of equipment in the associated stream along with a grey button. This button will change to blue when the associated drive is “Available”, i.e.; has no active fault conditions, has been selected to Auto at the MCC, and is in Auto via its SCADA drive popup. When at least one process stream has all of its drives available and all common equipment is also available the lowest button “Start Interlocks Healthy” will be blue. This indicates that the Screening Sequence is able to run.

An example of a “Start Interlocks” popup is shown below. (Editor’s note: this popup graphic is to be replaced when the new SCADA work has been completed).

The two options for Screenings Handling will determine which one of the following sets of Start Interlocks will be used:

Start Interlocks

Rotary Drum Screens Start Interlocks

MCC Power Okay
Inlet Flow meter Signal Valid

Screen 1 Available / Screen 2 Available / Screen 3 Available
Foul Air Fan 1 Avail / Foul Air Fan 2 Avail / Foul Air Fan 3 Avail
Inlet Valve 1 Avail / Inlet Valve 2 Avail / Inlet Valve 3 Avail
Wash Press 1 Avail / Wash Press 2 Avail / Wash Press 3 Avail

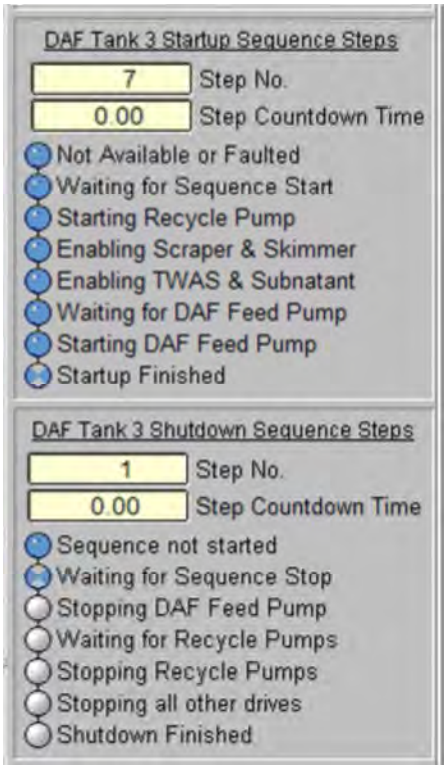
Wash Pump 1 Available / Wash Pump 2 Available

Start Interlocks Healthy

3.5.8 Remote/Auto "Start-up Sequence Steps"

Each RDS process stream has the same start-up sequence, the status of which is displayed on the "Start-up Sequence Steps" popup. Each RDS process stream also has the same shutdown sequence, the status of which is displayed on the "Shutdown Sequence Steps" popup. (Note: the "Start Interlocks", "Start-up Sequence Steps", and the "Shutdown Sequence Steps" can all be displayed on the same popup).

An example of a "Start-up Sequence Steps" and a "Shutdown Sequence Steps" popup is shown below. (Editor's note: this popup graphic is to be replaced when the new SCADA work has been completed).



There is no overall control enable button on the SCADA for the Screening System, it

will simply start up automatically when all of the "Start Interlocks" are healthy. The following start-up sequence will be carried out when the "Start Interlocks" are healthy for the first process stream.

Start-up Sequence

Step 1: Start RDS Drive, and Foul Air Fan. Initiate start-up of the Screenings Handling System, (this will start the Screw Wash Press, Screw Wash Press Flush and Wash Valves, the sequence for which is explained in Section 4). Wait 20 seconds for Drum Screen to reach full speed.

Step 2: Open both the Internal and External Screen Wash Valves (it will start the duty Wash Water Pump) Wait for the time period set by "Start-up Wash Time".

Step 3: Open the Screen Inlet Valve. The Internal and External Screen Wash Valve will now cycle ON and OFF based on the time periods set via the SCADA.

3.5.9 Remote/Auto "Start-up Sequence Steps"

The duty RDS will not shut down under normal conditions because one RDS must operate at all times. It would only shutdown under fault conditions or via operator intervention. The Follow RDS will shut down when the Plant Inlet Flow rate drops below the following set point:

- Follow Screen Shutdown Flow rate 150 L/s (Min 100 L/s, Max 200 L/s) for a continuous 30 seconds.

3.6 Fault Conditions

The following fault conditions will cause the actions shown in the table:

Fault Description	Active in Loc/ Man	Active in Rem/ Man	Close Valve	Latched
Valve Unavailable	Yes	Yes	Yes	No
Valve Failed to Open	Yes	Yes	Yes	Yes
Valve Failed to Close	Yes	Yes	Yes	Yes
Plant Bypass Active (if valve position>5%)	Yes	Yes		No

NOTE: The "Valve Unavailable or Faulted" is a single PLC input and it turns off when the valve either has an internal fault or the Actuator Mode Selector is placed in Local (Hand). Since the PLC cannot differentiate between the two conditions, an alarm will be posted on the SCADA and the valve icon will flash red, even if the valve is not faulted but has simply been selected to local mode.

3.7 Controlled Equipment

- SC_-0210-001 Rotary Drum Screen 1 Drive
- FCV-0210-101 Rotary Drum Screen 1 Inlet Valve
- FAN-0210-001 Foul Air Exhaust Fan 1
- SV_-0210-101 Screen 1 Internal Spray Solenoid Valve
- SV_-0210-102 Screen 1 External Spray Solenoid Valve
- SC_-0210-002 Rotary Drum Screen 2 Drive
- FCV-0210-201 Rotary Drum Screen 2 Inlet Valve
- FAN-0210-002 Foul Air Exhaust Fan 2
- SV_-0210-201 Screen 2 Internal Spray Solenoid Valve
- SV_-0210-202 Screen 2 External Spray Solenoid Valve
- SC_-0210-003 Rotary Drum Screen 3 Drive (new)
- FCV-0210-301 Rotary Drum Screen 3 Inlet Valve (new)
- FAN-0210-003 Foul Air Exhaust Fan 3 (new)
- SV_-0210-301 Screen 3 Internal Spray Solenoid Valve (new)
- SV_-0210-302 Screen 3 External Spray Solenoid Valve (new)

4 Screenings Wash Press

4.1 Process Description

The screenings collected from each rotary drum screen are normally deposited to the Screenings Wash Press via a dedicated Screen Chute. The screen chutes guide the screenings to the Wash Press and have an bypass pipe to discharge to screening and effluent to the floor during overflow.

During normal operating conditions, screenings are transported to the Screenings Wash Press. This screen wash press has a screw action to move and clean the screenings. At the beginning of the screen press cycle, spray nozzles using service water wash off faecal material from the screenings. Excess water drains through a perforated collection trough and flows to the internal sewage pump station. After washing is completed, the pitch of the screw is reduced and the pipe is then inclined to compress and dewater the screenings. The screenings are then deposited into an endless bag as a relatively dry screenings product. The endless bag is replaced with another empty one when it is ½ to ¾ full.

The control of the Screenings Press involves the following:

- Rotary Drum Screen starts
- Screw wash press starts, wash water solenoid valve opens;
- Rotary Drum Screen starts
- Screw stops after a time period;
- After the run-on time, and the solenoid valve closes
- There is a time delay between the start of the next screen press cycle.

4.2 Controlled Equipment

- SV_-0220-101 Screen Wash Press 1 Spray Solenoid Valve 1(new)
- SV_-0220-102 Screen Wash Press 1 Spray Solenoid Valve 2 (new)
- SV_-0220-201 Screen Wash Press 2 Spray Solenoid Valve 1(new)
- SV_-0220-202 Screen Wash Press 2 Spray Solenoid Valve 2 (new)
- SV_-0220-301 Screen Wash Press 3 Spray Solenoid Valve 1(new)
- SV_-0220-302 Screen Wash Press 3 Spray Solenoid Valve 2 (new)
- CV_-0210-001 Screw Wash Press 1 (new)
- CV_-0210-002 Screw Wash Press 2 (new)
- CV_-0210-003 Screw Wash Press 3 (new)

4.3 Switchboards and Controls

4.3.1 Screens Complex Essential Supply Distribution Board (SCESDB)

The three new Screw Wash Presses will have power supplied to their local control panels from the Screens Complex Essential Supply Distribution Board (located on the eastern wall of the Inlet Screens Switch room). All indicators and operator local/ manual controls will be at the local control panels LCP.

4.3.2 Local Control Panels

There are three Local Control Panels, one for each Screw Wash Press, located next to each Screw Wash Press.

The LCP's have the following controls and indication for Screw Wash Press functions:

- Three phase Isolator
- "Running" Indicator Lamp
- "Fault" Indicator Lamp
- Emergency Stop Pushbutton
- Auto/Off/Manual Selector switch
- Run Forward Pushbutton
- Run Reverse Pushbutton
- Spray Solenoid Valves On Pushbutton

4.4 Operating Modes

Each Rotary Drum Screen has its own dedicated Screw Wash Press. When a screen wash is initiated by the PLC, a simultaneous signal shall be sent from the PLC to the Screen Wash Press which is dedicated to that screen, upon which that Screen Wash Press shall start to operate and process the screenings.
The Screw Wash Press can be operated either via local control at the LCP's, or remotely via the PLC in Remote/Manual or Remote/Auto modes.

4.4.1 Local/Manual Control

In local mode (at the Screw Wash Press) the Screw Wash Press shall be able to be started and stopped via the local control panels located adjacent to each Screw Wash Press. In local mode the Screw Wash Press will start via hard-wired circuits.

4.4.2 Remote/Manual Mode

In remote mode, the Screw Wash Press will start and stop via PLC control. The operator may select either Remote/Manual or Remote/Auto mode via SCADA.

4.4.3 Remote/Auto Mode

In remote mode, the Screw Wash Press will start and stop via PLC control; this will be the mode that will normally be used. The operator may select either Remote/Manual or Remote/Auto mode via SCADA.

Remote/Auto mode is set by placing the wash press selector on the LCS in “Auto”, and then clicking on the Auto button on the SCADA drive popup. When placed in this mode the Screw Wash Press will immediately start and run continuously if its respective drum screen is operating. This is the normal mode of operation.

All Screw Wash Presses operate independently of each other.

4.5 SCADA Controls

The following controls are available on the SCADA screen:

Local/Manual Mode

All remote functions via the SCADA are disabled.

Remote/Manual Mode

Out-of-Service Toggle Normal / Out-of-Service
Start / Stop

Remote/Auto Mode

Out-of-Service Toggle Normal / Out-of-Service
Automatic Control

4.6 Fault Conditions

The following fault conditions will cause the actions shown in the table:

Fault Description	Active Loc/ Man	Active Rem/ Man	Active in Rem/ Auto	Stop Drive	Latched
1. Thermal Overload	Yes	Yes	Yes	Yes	Yes (reqs SB reset)

2. Shaft Monitor Overload	Yes	Yes	Yes	Yes	Yes (reqs SB reset) See Note :1
3. Emergency Stop Activated	Yes	Yes	Yes	Yes	Yes (reqs SB reset)
4. Drive Isolated	Yes	Yes	Yes	Yes	No
5. Drive Failed to Start	No	Yes	Yes	Yes	Yes
6. Drive Failed to Stop	No	Yes	Yes	Yes	Yes

Note 1: When a shaft monitor overload is triggered the Plc program is to automatically auto reverse the screw wash press for two revolutions. Following this an attempt to drive the press forward under normal operating conditions is again instigated. Should the overload fault occur again the auto reverse function needs to be attempted again. This process can occur a maximum of three times thereafter if the overload is still triggered on forward rotation, a fault is triggered on the scada and the screw wash press is locked out by the Plc until operator / maintenance intervention. There is to be no remote reset of this fault on the Scada

5 Wash Water pumps

5.1 Process Description

The wash water pumps system has its own control panel and independent control system. Seven user configurable alarms/feedback signals operate between the wash water pumps control panel and the plant Plc.

The pump set is complete with pressure monitoring instrumentation. Upon a drop in pressure, caused by a demand in the system, the pump set responds by starting the duty pump through the inbuilt frequency converter. The shutdown procedure is a reversal of the start up procedure as water demand decreases.

To ensure equal number of hours run by each pump and to reduce the number of starts per hour on each pump, the independent control system alternates the duty pumps each time the system starts.

5.2 Controlled Equipment

- PU_-0210-101 Wash water Pump 1 (new)
- PU_-0210-102 Wash water Pump 2 (new)
- PIT_-1030-301 Pressure Transmitter
- FIT-1030-303 Wash Water Discharge Flow meter
- TK_-1030-311 Pressurised tank
- SC_-1030-301 Wash Water Pump 1 VSD (new)
- SC_-1030-302 Wash Water Pump 2 VSD (new)

5.3 Switchboards and Controls

5.3.1 Screens Complex Essential Supply Distribution Board (SCESDB)

The Wash Pumps will have power supplied to their local control panels from the Screens Complex Essential Supply Distribution Board (located on the eastern wall of the Inlet Screens Switch room). All indicators and operator local/ manual controls will be at the local control panels LCP.

5.3.2 Local Control Panels

Local control panel is available which allows manual start /stop of the wash water pumps. Hardwired feedback of high pressure and low flow floats from the discharge pipe automatically cuts pump operation.

5.4 Operating Modes

The wash water pump set is able to be operated in two modes: Local/Manual, and Remote/Auto.

5.4.1 Local/Manual Mode

When the wash water pump has been placed in Manual mode via the menu option on its pump control panel, (details to be confirmed), it will be able to be started and stopped locally at the pump. The flow rate will also be manually adjusted via the pump panel keys.

5.4.3 Remote/Auto Mode

When the wash water Pump has been placed in Automatic mode via the menu option on its pump control panel, it will be considered to be in “Remote” mode. In this mode, when the SCADA pump popup mode has been set to “Auto”, the pump will be in Remote/Auto mode.

In Remote/Auto mode, the pump start/stop and speed control will be carried out by the Pump local PLC based on pressure feedback from the discharge pressure transmitter

5.4.6 Pump Speed Control

In Remote/Auto mode, the pump speed will be automatically controlled via a closed-loop PID calculation using the pressure transmitter signal as the Process Variable, and the Pump Speed as the Controlled Variable. The PID algorithm will try to match the Instantaneous discharge manifold pressure to the required pressure Set point.

5.5 SCADA Controls

Remote/Auto Mode
Wash Water Pump 1 / 2 Mode Selection Manual / Auto

Wash Water Pump 1 / 2 Out-of-Service Toggle	Normal / Out-of-Service
Auto Start on Power Outage	Enabled / Disabled
Force Auto Start	Off / Force
Dosing Rate Mode Fixed / Flow-paced	
Fixed Pressure Set point	500 kPa (min 400, max 600)
Pump 1 Minimum Speed 15% (min 10, max 50)	
Pump 2 Minimum Speed 15% (min 10, max 50)	

5.6 Fault Conditions

6 Load Shedding

6.1 Background

Wacol WRP has an existing 182kW diesel-powered generator that is planned to be replaced in 2010/11 by a larger unit. Most of the site switchboards have dual feeds from both Energex-supplied transformers and from the Essential Services Switchboard (ESSB), which is fed from the generator. Currently none of the boards have auto-changeover capability enabled.

During an Energex outage, the ability to provide load shedding is currently only available in the BWEA-installed PLC, however it was never enabled. None of the existing Siemens S5 PLC's has load shedding logic.

The new replacement PLC's will all have load shedding facilities as described in this section.

6.2 Existing Transformers

Designation	Voltage Rating		Location				Feeds Equipment					
T1	11kV/415V	750kVA	Blower	Building	NW	corner	DS1,ESSB,	SDSB,	AESB,	ASB1,	BSB1	
T2	11kV/415V	750kVA	Blower	Building	NW	corner	DS1,ESSB,	SDSB,	AESB,	ASB1,	BSB1	
T3	11kV/415V	300kVA	Screening	Building	SE	corner	DS2,	SDSB				
T4	11kV/415V	300kVA	Belt	Filter	Press	Building	NE	corner	DS3,	SPSB,	EPSB,	BPSB

6.3 Existing Switchboards

6.4 Load Shedding Functionality

QUU standard PLC Drive Blocks include a “Load Shed Counter” that PLC03FST writes out to all of the other PLC’s via the Ethernet network. In each PLC, every drive block has a “Load Shed Number” which determines how critical the drive is. “9” is most critical, “0” is least.
It is expected the system will operate similar to the following description. Final functionality will be determined by the Generator Replacement Project Design Team.

This project is expected to occur in 2011. PLC03FST will be the PLC that writes the Load Shed Counter value because it also gets signals from the Emergency Generator. It will write “0” when there is normal Energex power available, (which will be read via the supply from Transformers T1/T2). When it detects loss of power it immediately writes the number “10” out on the network.

All drives will immediately stop (plant wide) due to the loss of 415v, but the site PLC’s will also remove all Request to Run Signals and go to an idle state. The Generator will automatically start, (via hard-wired circuits), and when it is up to speed and ready to take load, the auto changeover circuits will open the ESSB bus-tie (ACB3) and close the generator supply (ACB4). The Distribution Boards that are connected to the Essential Services Bus will be the first to apply load. PLC03FST will wait for 60 seconds after it senses power is available from the Generator and then it will send out the value “9” onto the plant network. All PLC’s will now stage-start their critical drives that have the value 9 as their Load Shed Value. This will include:

- Inlet Drum Screens and associated equipment,
- One Supernatant Pump,
- One service water pump, and;
- the Plant Bypass Valve.

After a wait period, the PLC will check how many kW is being used off the generator circuit, and then it will drop the number to “8” if there is sufficient capacity to bring the next group of drives online. This process will continue until all the generator capacity is used up, and if for some reason the generator load increases and it is overloading, the number can be increased again to bring it back under its overloaded condition.

When the Normal Energex Supply returns, PLC03FST will wait for 10 mins to be sure that it is a reliable return to the normal supply, (this period is SCADA-adjustable), and it will then step through a staged shutdown of all drives to progressively unload the generator. This will be done by increasing the Load Shed Counter at 20 second intervals until it reads 10 when all drives will be stopped.

The ESSB ACB’s will then changeover placing the switchboards back on Energex supply and the generator will stop. The Load Shed Value for each of the more critical drives will be made available on the site SCADA so that it will be possible for adjustments to be made by the operators without requiring any PLC code changes. Also available will be functions like: a tick box for each Priority so the operator can limit how far down the value can go when running on the generator, plus set points can be adjusted for the kilowatt rating of the generator.

The intention would be to provide all of the functionality available in the PLC and SCADA software so that when the PLC Replacement Project is completed, (June 2011), the control scheme will be able to be easily adjusted for any existing or future generator capacity.

Load Shed Priorities

These items priorities will be confirmed as part of Generator Replacement Project in 2011. An example is shown below for programming purposes.

6.5 SCADA Status Values & Set points

The following status information is provided on the SCADA:

- Instantaneous Voltage and Power values for each of the following switchboards:
  - ASB1 (Auxiliary Services) Normal Supply
  - Wacol WRP - PLC Replacement Project Functional Specification
  - PLC01INL Inlet Works
  - Printed at 4:16 PM on 7/12/12 Page 35 of 35
  - Wacol PLC01 Inlet Works FuncSpec Rev0-1
  - ASB1 (Auxiliary Services) Essential Supply
  - BSB1 Normal Supply
  - BSB1 Blower 1 Power
  - BSB1 Blower 2 Power
  - BSB1 Blower 3 Power
  - AESB (Aeration) Normal or Essential Supply
  - BPSB (Belt Filter Press) Normal Supply
  - SDSB (Inlet Works) Normal Supply
  - SDSB (Inlet Works) Essential Supply

- Instantaneous Voltage and Power values for the Generator output
- Energex Power Online/Offline
- Energex Power Returned
- Generator Online/Offline
- Current Load Shed Counter 0 to 10

The following set points and commands are available on the SCADA:

- Load Shed Functions Enable/Disable