RAND WATER

ENGINEERING STANDARD

FOR THE

CONTROL OF PLANT AND EQUIPMENT

RW/00320/AS/488

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Record of Revisions

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CONTENTS Page

1. SCOPE

This standard covers the requirements of Rand Water for control systems and man machine interfaces (MMI) for the control and operation of process functional units.

It also defines the requirements for the application of programmable logic controllers (PLCs) and supervisory, control and data acquisition systems (SCADA).

2. STANDARDS AND REGULATIONS

2.1 Mandatory Standards and Regulations

All installations shall comply fully with the requirements of the Occupational Health and Safety (OHS) Act and Regulations - Act 85 of 1993.

This standard is compiled to meet the requirements of the OHS Act and Regulations and is not intended to supercede any of the provisions of the afore-mentioned Act and Regulations.

2.2 Reference national and international standards, codes of practice and procedures.

The supply, installation and engineering of control systems shall be carried out strictly in accordance with the requirements of the following Acts and Regulations, Standards and Procedures. In all cases the latest revision shall apply.

SABS 0142	Code of Practise for the Wiring of Premises
SABS-IEC 439	Factory Built Assemblies (Low voltage switchgear)
IEC 529	Degrees of Protection Provided by Enclosures
SABS-ISO 9000-1991 (Part 3)	Guide lines for the application of ISO 9001 to the development, supply and maintenance of software

2.3 Rand Water reference documentation

RW/00320/S/001	Standard for Low Voltage Electrical Installations
RW/00320/S/015	Design and Implementation of PLC Software
RW/00320/S/041	Standard for PLC and SCADA Hardware

3. PERFORMANCE REQUIREMENTS

3.1 General

All system hardware shall be selected to operate under the conditions defined in Standard RW/00320/S/001.

3.2 Power supplies

Power supply parameters are covered in RW/00320/S/001. However all SCADA and PLCs shall be powered from uninterruptible power supplies that shall provide voltage regulation of better than +/- 5% for all load conditions.

It should be recognised that a UPS can go into bypass mode in which case voltage regulation can deteriorate to the normal fluctuations experienced on the pump stations.

3.3 Environmental Conditions

Equipment shall be selected for continuous operation under the following environmental conditions.

3.3.1

Altitude	:	1 800 m above mean sea level
Maximum air temperature	:	40 degrees Celsius
Minimum air temperature	:	-10 degrees Celsius
Vibration	:	-,5g operating 4g non-operating
Maximum humidity	:	95% non-condensing

Location	:	Generally indoors unless specifically stated otherwise
Depredations	:	Subject to insect and vermin depredations

All equipment shall be required to operate in areas experiencing a high incidence of lightning activity. Careful attention shall be applied to the correct earthing of equipment.

4. GENERAL SAFETY REQUIREMENTS

All motor control circuits shall have the stop buttons hardwired into the stop or trip circuits. The information may be duplicated into the respective plants PLC control regime but the primary trip or stop function shall be hardwired.

The **requirement applies to all plant without exception.**

5. DEFINITIONS

"Proven" shall mean a design or system that has been in frequent or common use in the market place for some time or for which the vendor can give references that may be contacted to discuss the relative merits of the equipment.

"Field Mounted Equipment" is defined as equipment located in plant areas outside of control rooms. For the purpose of this definition it includes equipment mounted outdoors, equipment mounted in process plant buildings and equipment mounted in switchgear and engine rooms.

"Automatic" shall mean capable of full operation without intervention in any way by persons, other than to start or stop the process. All safety and protection functions are taken care of as well as normal process operations.

"Manual" shall mean the process is controlled at all stages of operation by an operator but all safety functions are taken care of by the control systems and do not require any operator intervention. Safety functions that are taken care of without operator intervention will be those that protect persons and machinery from injury.

"Maintenance" in the control sense shall mean a mode whereby the plant or equipment is not available for process operation or service and is only available for maintenance, repair, calibration or set up functions. In maintenance mode a plant will not be sequenced with any other plant. However all essential safety interlocks and protection circuits necessary for the protection of persons and plant from injury shall be fully operational at all times.

"Jog" shall mean to run a motor for very short periods only when the start push button is held depressed. In jog mode the motor starter contactor shall not latch and immediately the start button is released the drive will stop.

"Dual redundant" systems being defined as 2 systems operating in parallel with each system fully up to date on data and system status so that if one system fails the second system can pick up plant control in a smooth ("bumpless") manner with no change being apparent to the plant or operator that the failure of a system has occurred.

6. GENERAL REQUIREMENTS FOR THE SELECTION OF EQUIPMENT FOR THE CONTROL OF PROCESS PLANT

6.1 General

Equipment selected shall meet the following criteria:

(i) It shall be of a proven design.
(ii) It shall have a proven reliability.
(iii) It shall be robust and generally of a "heavy duty" construction.

It may be expected that all equipment will be subjected to arduous usage in its life and therefore no compromise will be accepted in the selection of equipment.

6.2 Field Mounted Equipment

Equipment shall be IP 55 or better and generally selected to comply with the requirements of Rand Water's Engineering Standard RW/00320/S/001.

Control devices shall generally be conventional industrial push buttons and indication lamps.

6.3 Industrial Terminals - Field Mounted

Where required such terminals shall have enclosures rated IP 55, or better and shall comprise equipment specifically designed for this purpose. Adaptation of "soft" equipment normally designed for office application is not permitted and this equipment shall not be installed in field locations.

"Factorymate" or "Panelmate" terminals are considered suitable for field installation, together with "ruggardised" computers that comply with the requirements of RW/00320/S/041.

6.4 Equipment Installed in Control Rooms

Equipment to be installed in control room environments may be selected to meet less onerous requirements. Control rooms housing computer equipment should however be suitably pressurised and/or air conditioned and equipment power supplies shall be derived from uninterruptible power supplies.

Conventional personal computers, monitors and printers may be used in control rooms.

Computer key boards, for process control computers and SCADA systems shall have conventional 101 key boards with the "click" type key to permit positive indication of a key stroke and where a pointer device is required a roller ball shall be provided. The use of the conventional "mouse" is not permitted.

Terminals installed for engineering programming may be provided with conventional 101 key boards with the "click" type key to permit positive indication of a key stroke.

7. GENERAL REQUIREMENTS FOR THE CONTROL OF PROCESS PLANTS

7.1 General

Process plants include all plant necessary for the operation of the Rand Water treatment and pumping facilities and all ancillary equipment.

Hardware selected for the control of process plant shall meet the basic requirements of Section 6.

This section describes the specific requirements for the control regimes for process plant. It defines for each plant category the type of hardware to be used and the man/machine interfaces (MMI) to be employed.

7.2 Main Pump Units

Main pump units are defined as pumps with medium voltage motors or pump sets with a capacity of more than 80 MP/day.

Low voltage motor driven pump sets should however be considered on merit and the decision as to the form of the MMI for pump sets of capacity less than 80 MP/day should be referred to the Chief Electrical Engineer.

7.2.1 Hardware Configuration - Unit Basis

Hardware shall be configured on a "unit" basis, that is each pump set shall be configured in a module with equipment dedicated to that pump set only on a unit by unit basis so that the failure of any one item will affect only a single pump set at any instant.

It will however be necessary to serve a pump set with common services such as uninterruptible power supplies. If any device serves more than 1 pump set it shall be duplicated and be required to operate in "dual redundant" mode.

Equipment operating in this mode shall be provided with adequate alarm recording and monitoring to enable component failure to be detected in order to permit quick repairs and restoration of the full service.

For this purpose each pump set shall be provided with the following:

(a) A control console located on the operating floor in a position where the operator is able to overlook the pump sets.

(b) A PLC per pump set.

(c) A Panelmate terminal to display process and fault information. The normal start and stop functions shall be executed by way of soft keys on the Panelmate terminal.

(d) An "Emergency Stop" push button mounted on the control console. The emergency stop push button shall have a red mushroom operator and shall be of the latching, twist to release type.

The pump set PLC shall be housed in the pump set control console for ease of maintenance and fault finding.

Stop circuits shall be hardwired in the main circuit breaker control circuit as the primary trip route and shall also be wired into the PLC control circuit.

Emergency trip push buttons shall activate both the trip coil and no volt release coil of the main circuit breaker or contactor where used.

7.2.2 Hardwired Control Devices - Alarms and Indication

The control console shall be fitted with a stroboscopic light to indicate that a fault trip has occurred. The lamp shall be positioned so that it is clearly visible.

7.2.3 MMI Terminal - Process Information

Each pump set shall be provided with a Panelmate terminal to provide a man/machine interface.

The device shall be programmed with soft keys configured such that each pump set in Rand Water is the same. To ensure that this requirement is maintained a standard software package shall be applied to each pump set. Variable speed pump sets shall have the facility for speed adjustment added.

The following basic process information shall be displayed for each pump set or pump stage as applicable.

(a) Operating Parameters

- Suction
- Running hours - accumulated total and since last start
- Accumulated pressure
- Intermediate stage pressure
- Delivery pressure
- Delivery flow rate
- Pump set efficiency (calculated value)
- System efficiency kWh

(b) Valve Parameters

- Suction valve per cent open
- Delivery valve per cent open

(c) Pump Parameters

- DE and NDE bearing temperatures
- Thrust bearing temperature
- Vibration level
- Volute temperature

(d) Motor Parameters

- DE and NDE bearing temperatures
- Highest phase stator temperature
- Cooling air temperature (before and after cooler)
- Cooling water temperature (cooler inlet and outlet temperature)
- Motor power
- Motor current
- Motor speed (variable speed drives only)
- Power factor (variable speed drives)

(e) Auxiliary Devices

- Device run and stop indication
- Device fault indication

The following basic information screen shall be provided:

(i) Process indication of the pump set
(ii) An alarm screen
(iii) Status indication of interlocks to facilitate evaluation of the start up sequence
(iv) Status indication of the interlocks that are in “Bypass” condition

7.2.4 SCADA Interface

To facilitate an interface with a SCADA system the PLC shall have a Modbus Plus port.

The intention is that all main potable water pump sets be controlled from the local control panel. However process data will be collected via the Modbus Plus port for reporting and trending on the SCADA system. It should also be possible to “sequence” the pump set from either the control console or the SCADA terminal up to the point that the pump set is ready to start. The actual starting shall only be possible form the local control console.

However provision shall be made for future control of the pump sets via the SCADA system. For this purpose a selector switch shall be provided on the motor starter panel located in the substation which shall have the functions “Automatic/Off/Maintenance”.

7.2.5 Main Circuit Breaker Control

The operation of the pump set starter (circuit breaker or contactor) shall in each of the 4 positions be as follows:

(a) “Maintenance” Position

Shall mean local to the circuit breaker with the intention of testing the circuit breaker in the racked out only position. As soon as the breaker is switched to the “Maintenance” position the breaker shall be caused to trip immediately.

Information reflected on the SCADA shall indicate the breaker is “Out of Service”.

(b) “Off” Position

Closing of the breaker from any position will not be possible with the circuit breaker selector switch in the off position.

Switching to the off position shall cause the breaker to trip immediately. Information reflected on the SCADA shall indicate the breaker is "Out of Service".

(c) "Automatic" Position

Opening of the breaker or contactor will be possible via the PLC and SCADA systems. However it shall only be possible to start the pump set from the control console. Operation will only be possible with the circuit breaker racked in and the latching switch positioned for safe operation. It shall be possible to trip the circuit breaker from any location. AS soon as the selector switch is moved off "Automatic" to "Off" or "Maintenance" the circuit breaker or contactor shall be opened.

7.3 Pump Auxiliary Devices

This includes the auxiliary devices associated with water pumps as described in Section 7.2 above and will include devices such as cooling water and lubrication oil pumps.

7.3.1 Hardwired Equipment Configuration

Each motor shall be provided with a local control station located within 2 m of the device and an "Auto/Off/Maintenance" selector switch on the local control station with control in the following manner:

(a) "Auto/Off/Maintenance" selector switch.

In "Maintenance" mode the control of the pump shall be from the stop and start stations with the logic that when maintenance is selected the device is not available to the PLC for automatic control and is available for maintenance "jog" purposes only.

In "Off" position the device is out of service all together.

In "Auto" mode the device is fully controlled from the PLC as part of the potable pump set. Stopping and starting shall be part of the automatic start up sequence and should not need any operator interference.

(b) Stop Push Button (local to the drive). The stop push button shall be operational for all modes of operation. The stop push button shall have a red mushroom head operator with the latching, twist to release operation.

(c) Start Push Button (local to the drive). The start push button shall be only operational when the selector switch is in "Maintenance" and shall provide a "jog" function. The run contactor serving the device shall not be permitted to latch on when the start button is pressed. This function shall be executed via the PLC.

The software shall be designed so as to permit automatic selection of device with the minimum running hours and designed to have the running hours accumulate equally across the run and standby devices. A trip of an auxiliary device while a main pump set is running shall cause the standby unit to be started immediately to prevent an unnecessary trip of the main pump.

The flow and pressure detection circuits on cooling water and lubrication flow shall have short time delays built into the tripping function to override any flutter caused by the transfer to the standby device. Override delays should not exceed a few seconds, for example 3 seconds, the optimum time should be determined on site at commissioning.

7.4 Key Process Pumping Installations

This section will apply to main process pumping installations such as raw water pump sets, wash water pump sets, sludge pumps and any other pump sets associated with water treatment plants that are normally supplied at low voltage or of less than 80 MP/day capacity.

7.4.1 Pump Sets

The pump sets shall be equipped with a local control console mounted on the walk way/access platform. The console shall contain the stop/start push buttons, ammeter and a colour Panelmate unit to permit annunciation of key alarms only. There is no requirement for a mimic and sequence status indication as required for main potable water pump sets.

The functions of the start and stop push buttons shall be as defined below in Section 7.4.2 except that the controls are located on the control console.

The Panelmate display shall indicate the following process variables in table format:

Motor current and power
Pump set flow rate if applicable
Motor and pump set bearing temperatures (if applicable)

Control of the pump sets shall be on a unit basis as per main potable water pumps and the PLC shall be provided with a Modbus Plus port for interfacing with a SCADA system.

7.4.2 Major process pumps and drives

This section refers to major process pumps such as wash water pumps, recovered water pumps and sludge pump sets.

(a) PLC Requirements

The allocation of PLCs shall be on a motor control centre (MCC) by motor control centre.

All control functions shall be carried out via the PLC including the local “jog” facility. No provision shall be made for hardwired control with the following exception:

All stop push buttons shall be hardwired in addition to being incorporated into the PLC control regime.

(b) SCADA Requirements

Each control room serving the respective pump house shall be provided with 2 (two) SCADA terminals that are fully standby for each other, i e the failure of a single terminal shall not cause the control point to the operator to loose control over the plant.

From the SCADA terminals it shall be possible for full operator control of the section of the plant covered by the respective control room.

In addition to the SCADA controls additional hardware shall be provided as detailed below to enable maintenance to be carried on the respective equipment.

(c) “Auto/Off/Maintenance” selector switch.

The selector switch shall be mounted on the respective starter’s door in the motor control centre.

In “Maintenance” mode the control of he pump shall be from the stop and start stations with the logic that when local is selected the device is not available to the PLC for control and is available for maintenance purposes.

In “Off” position the device is out of service all together.

In “Auto” mode the device is fully controlled from the PLC as part of the process pump set.

Stopping and starting shall be part of the automatic start up sequence and should not need any operator interference.

(d) Stop Push Button. The stop push button shall be operational at all times. The stop push button shall have a red mushroom head operator with the latching, twist to release operation.

(e) Start Push Button. The start push button shall only be operational when the selector switch is in "Maintenance" and the control circuit shall be designed to allow the motor to only run while the button is pressed. The run contactor serving the device shall not be permitted to latch on when the start button is pressed.

These control devices listed in Paragraphs (a), (b) and (c) above shall be incorporated into a single control station that shall be located within 2 m of the motor.

The software shall be designed to permit automatic selection of the device with the minimum running hours and designed to have the running hours accumulate equally across the run and standby devices. A trip of a device during the running of the pump set shall cause the standby unit to be started immediately to prevent interruption of the process function unless such high speed start up will cause water hammer problems or excessive starts.

Reference shall be made to the Mechanical Engineers for any special requirements.

Pumps requiring gland seal water shall have the gland water pressure switches wired into the PLC logic. Gland pressure switch tripping should have a small time delay built into the logic to prevent spurious tripping.

7.5 Chemical Process Plants

For the purpose of this definition chemical process plants shall include all plants that are designed for the production of process chemicals such as lime burning plants, CO_2 plants, boilers and chemical dosing plants such as chlorine, ferric salts and similar process units.

The different process control requirements are as follows:

7.5.1 Main process plants (Lime and CO_2)

(a) PLC and SCADA Requirements

These plants shall be fully PLC controlled and the allocation of PLCs shall be on a stream basis. If a plant has 2 streams it shall have 2 PLCs, and if it has only 1 process stream there shall be only 1 PLC installed.

A "stream" is defined as a full process line that is complete in its function and does not share common process devices with other plant. It can operate totally independently of other lines.

The PLC shall communicate with a SCADA system installed at the plant control room. Two SCADA terminals shall be provided and shall be fully dual redundant. It shall be possible to effect full process control and monitoring from the SCADA system without having to refer to field instrumentation.

Where the plant is located on a station that has a plant wide SCADA system the system shall be integrated into the plant wide system for management information systems (MIS) reporting and control.

(b) "Auto/Off/Maintenance" Selection

Each plant drive shall be provided with an auto/off/maintenance selector switch, stop and start push buttons installed in a single control station located within 2 m of the motor being controlled.

Auto: Full PLC control - local stop switch fully functional at all times as it will be hardwired into the drive control circuit.

Off: Drive out of service - PLC or local starting not possible and the selection of off position shall cause the drive to be stopped immediately.

Maintenance: The starting of the drive will be possible from the local push button station. The operation of the manual control shall be via the PLC control circuit but shall only permit the drive to run while the start push button is pressed.

In this mode of operation sequence interlocks will be bypassed unless there are essential safety interlocks required for the safe operation of the drive in which case they shall be included. For example some drives may require that an associate lubrication pump runs, in which case the requirement for that device to run shall be included in the interlocking sequence.

7.5.2 Chemical Dosing Plants

(a) PLC Requirements

Chemical dosing plants shall be fully PLC controlled with device control generally as above for main chemical plants.

(b) SCADA Requirements

If the chemical dosing plant is a fully stand alone plant located at a station that does not have a plant wide SCADA system installed or planned with a 1 year time frame the dosing plant shall have a Panelmate terminal installed to permit local operator control.

Where a Panelmate is installed it shall be configured using P & I type symbols and shall be configured to permit entry of process variables, such as set points for control purposes.

Where the dosing plant is situated on a station that has a fully integrated SCADA system the PLCs shall be integrated into the SCADA system for control and monitoring by the Scientists and/or operators responsible for that plant's performance.

7.5.3 Minor Chemical Plants

This would include standby plants that are not normally in operation and are required for emergency back up use. It does not include standby equipment that forms part of main chemical or dosing plants.

It would include for example standby flocculant dosing plants.

The requirement is that these plants are normally provided with hardwired controls with only the facility to incorporate a "run" contact into a convenient PLC system to provide basic operator information if the station has a plant wide SCADA system. There is no requirement for any further control, the requirement is for indication only.

7.5.4 Minor Plant Control

Minor plant will include, by definition, plant that is incidental to the processing and pumping water and will include plant such as roof extraction fans and similar plant for which there is no water quality implications if that plant is not operational.

The requirement for these plants is that they be hardwire controlled i e there is no requirement for PLC control and no requirement for indication on a SCADA system if the plant is operational at all.

Control will be limited to a local stop/start station, or if the control panel is located within close proximity of the plant or normal control point then the stops/starts may be incorporated on the control panel.

Simple conveyor systems could also be considered to fall into this definition, particularly if associated plant is not PLC controlled.

7.6 Specific Requirements for Conveyors

Conveyor belts shall be provided with the following safety devices without exception:

(a) Emergency stop push button at the head and tail pulleys of the conveyor.

(b) Emergency stop pull wire switches with easily accessible pull wires along the full length of the conveyor where normal personnel access is possible.

(c) Start up warning siren that shall sound for at least 10 (ten) seconds before the conveyor is started.

(d) Conveyor under speed switch detecting the motion of a non-driven pulley, preferably the drive snubbing pulley or alternatively the tail pulley.

Items (a) and (b) shall be hardwired into the contactor control circuit. If the plant PLC controlled the signal may be repeated into the PLC for additional control and indication purposes.

8. CONTROL OF ELECTRICAL SWITCHGEAR

8.1 General

This section covers the control of medium voltage and low voltage switchgear and the requirements for incorporation into PLC and SCADA systems.

8.2 Protection Schemes

Protection schemes shall be hardwired and shall not be incorporated into PLCs or any other programmable device for fault tripping and control purposes. Indication and alarm functions may however be incorporated into PLC systems.

8.2.1 Distribution Switchgear

All functions including but not limited to the following shall be executed using discrete devices in hardwired protection circuits at all times:

(a) Over current and earth fault protection

(b) Cable differential protection

(c) Back up and restricted earth fault protection

(d) Transformer temperature, Buchholz and tank pressure protection

(e) Inter tripping with supply authorities

(f) Synchronisation of alternators with mains supplies

(g) Reverse power flow protection

(h) Under voltage or over voltage protection

The above list is not exhaustive and if additional protection is indicated reference should be made to the Chief Electrical Engineer for a ruling.

8.2.2 Motor Protection

As for distribution switchgear all electrical protection functions shall be executed using discreet components in hardwired protection circuits, for example:

(a) Motor over load and earth fault protection

(b) Motor differential protection (if applicable)

(c) Motor bearing and winding temperature protection

(d) Motor under voltage protection

(e) Low power factor (pumps only)

8.2.3 Fault Lockout Relay

Each distribution switchgear circuit breaker shall be equipped with a fault lock out relay (FLO relay) which, in the event of a fault trip shall cause the circuit breaker to be electrically locked out and it shall not be possible to reclose the circuit breaker until the FLO relay has been manually reset. The FLO relay shall be the GEC VAJ series (or of direct equivalent) relay with flag.

Under no circumstances is the closing of a circuit breaker permitted from a remote location or device until such time as the panel has been visited to determine the cause of the circuit trip.

8.3 PLCs used for Interlocking for Switching Control Purposes

8.3.1 Power Supply for PLCs

Interlocking of switchgear for safety purposes may be carried out using PLCs. The source of power supply for the PLC shall however be taken from the same power source as the protection tripping supplies i e usually from a DC tripping battery and charger.

8.3.2 Selection of Switching Devices

It should be remembered that 100 V DC is used as a control voltage in the switching of distribution breakers and that trip and close coils are highly inductive circuits. The operation of trip and closing coils shall always be effected using suitably rated interposing relays and that reed relay output cards used by PLCs are not suitable for this duty.

The use of the 8 and 11 pin plug in relays for switching 110 V DC is not permitted under any circumstances as the contacts are prone to welding in the closed position.

8.3.3 Function of PLCs in the control of distribution switchgear

PLCs shall be used for the control of the switching function of medium and low voltage switchgear to ensure correct switching sequences and safety to operators. The PLCs shall also provide an interface to SCADA systems if installed to permit indication, control and alarming functions.

To permit PLC control each circuit breaker shall be equipped with a “Service/Off/Maintenance” selector switch with the following functionality:

“Maintenance” shall mean control of the switchgear form the actual switchgear and the PLC shall be active to provide the full safety requirements. If the breaker is racked out and operated on jumper leads there shall be no safety protection circuitry active.

“Off” shall mean the breaker may not be closed from any location and the switching into the off position shall cause the breaker to be tripped.

“Service” shall mean remote closing from the SCADA system or mimic panel is permitted.

Note: It shall be possible to trip the circuit breaker(s) when the selector switch is in any position.

The design of the PLC hardware and software shall be such that the operation of the switchgear from the hardwired mimic shall be possible. This operation shall be limited to essential safety supplies only and the failure of a PLC shall not cause essential safety features to be overridden, for example paralleling of Eskom in feeds etc.

The PLC shall also log all reasons for circuit trips which shall be made available to the associated SCADA systems for interpretation by maintenance personnel.

Metering information shall where provided be incorporated into the PLC and SCADA system by way of a Modbus or Modbus Plus communication link as provided by the Rand Water's H2pOwer or equivalent device. In all incoming circuits from the local supply authority a separate and discrete set of metering shall be installed that shall provide maximum demand and energy consumption data for comparison with the Eskom meters. The demand and energy consumption functions shall be selected to match the applicable tariff structure.

8.4 Hardwired mimic panels

Hardwired mimic panels using painted tiles shall be provided in each switchgear location to enable the operator to control the distribution switchgear applicable to that location in the event of a PLC failure.

The selection of mimic components shall be determined by their ability to switch 110 V DC.

The information on the mimic shall be limited to the following basic parameters:

(a) Breaker open lamp

(b) Breaker closed lamp

(c) Breaker racked out lamp

The mimic shall also include the breakers associated with the main potable pumps and it shall be possible to trip the main pumps' breakers from the mimic but it shall not be possible to close them from this mimic.

For low voltage distribution the extent of control shall be limited to distribution board incomer and bus section switch closing and opening.

8.5 SCADA requirements

Where plant wide SCADA systems have been installed the control, indication and alarming functions associated with the switchgear shall be incorporated.

It shall be possible, with suitable password protection, to carry out switching from the SCADA system.

9. SOFTWARE QUALITY CONTROL

Software for PLC and SCADA systems shall be executed and quality assured in accordance with Rand Water procedure RW/00320/S/015 (procedure in draft format).