

JOHANNESBURG WATER (SOC) Ltd.
BULK WASTEWATER

PARTICULAR SPECIFICATION
VOLUME 7 : NETWORKING



Johannesburg Water (SOC) Ltd.
PO Box 61542
Marshalltown
2107

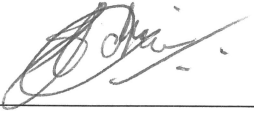


DOCUMENT CONTROL SHEET

Document Title: Particular Specification – VOLUME 7 : Networking

JW Reference: BWW523C

Document Ref. No: VOLUME 7

DOCUMENT APPROVAL

ACTION	FUNCTION	NAME	DATE	SIGNATURE
Prepared	HOD	C. Du Toit	2019-08-26	
Reviewed	Engineer	L. Gobinca	2019-08-26	
Approved	Manager	T. Thabeng	09/09/2019	

RECORD OF REVISIONS

Date	Revision	Author	Comments
2019-08-26	15	C. Du Toit	Cover page updated
2019-06-25	14	C. Du Toit	Revision approved by JW.
2018-11-30	13	C. Du Toit	Added reference to Labelling specification.
2014-04-17	12	C. Du Toit	Added use of blown fibre.
2013-10-07	11	C. Du Toit	Updated footer.
2012-07-27	10	C. Du Toit	Updated headers & footers.
2012-03-08	9	C. Du Toit	Changed (Pty) to (SOC), updated core switch port requirements, core switch power supply requirements,
2011-07-11	8	C. Du Toit	Removed 2010 logo.
2010-07-27	7	C. Du Toit	Area and core switch requirements clarified, data irrelevant to tenderers deleted and data sheets
2010-03-12	6	C. Du Toit	Fibre core switch requirements updated to specify Gigabit uplinks and to include a data sheet.

2009-08-18	5	C. Du Toit	New logos added.
2009-03-25	4	C. Du Toit	JW Wastewater Partnership deleted & logos altered as per client's requirements.
2009-02-24	3	C. Du Toit	Switch requirements from specialist added plus "Joburg" & "JW" Logos added to top & partnership
2007-06-05	2	C. Du Toit	Revision block updated and "Joburg" logo added
2007-03-28	1	C. Du Toit	Final copy issued for approval and sign-off

INDEX

7	NETWORKING	4
7.1	Scope	4
7.2	Abbreviations	4
7.3	Standards	5
7.4	Communication Protocol	5
7.5	Network Topology	6
7.6	Switches	7
7.7	Compliance With Standards.....	9
7.8	Network Switch Data Sheets.....	9
7.9	Redundancy Testing	9
7.10	Labelling	10

7 NETWORKING

7.1 Scope

- 7.1.1 This specification covers the supply and installation of equipment, the network topologies, the communication methods and the security for data communication systems, typically between Programmable Logic Controllers and Supervisory systems, used in process monitoring and control applications at Johannesburg Water wastewater sites.

7.2 Abbreviations

- 7.2.1 In this specification the following abbreviations will apply :-

CD	:	Compact Disk
CLI	:	Command Line Interface
DiffServ	:	Differentiated Services
EMC	:	Electro-Magnetic Compatibility
GARP	:	Generic Attribute Registration Protocol
GMRP	:	GARP Multicast Registration Protocol
GUI	:	Graphical User Interface
GVRP	:	GARP VLAN Registration Protocol
HTTPS	:	Hyper Text Transfer Protocol Secure switches
IEC	:	International Electrotechnical Commission
IEEE	:	Institute of Electrical and Electronic Engineers
IGMP	:	Internet Group Management Protocol
LACP	:	Link Aggregation Control Protocol
LAN	:	Local Area Network
LED	:	Light Emitting Diode
MAC	:	Media Access Control
Mbit	:	Mega bits
Mbps	:	Mega bits per second
MDI/MDI-X	:	Medium Dependent Interface/ Medium Dependent Interface (crossed)
OS	:	Operating system
PC	:	Personal Computer
PLC	:	Programmable Logic Controller
QoS	:	Quality Of Service
RD	:	Read
RSTP	:	Rapid Spanning Tree Protocol
SANS	:	South African National Standards
SCADA	:	Supervisory Control And Data Acquisition

SNMP	:	Simple Network Management Protocol
SSH	:	Secure Shell
SSL	:	Secure Sockets Layer
TCP/IP	:	Transmission Collision Protocol/Internet Protocol
TOS	:	Type Of Service
TX	:	Transmit
USB	:	Universal Serial Bus
VLAN	:	Virtual Local Area Network

7.3 Standards

7.3.1 All design standards shall be subject to the latest amendments and editions of the following standard specifications:-

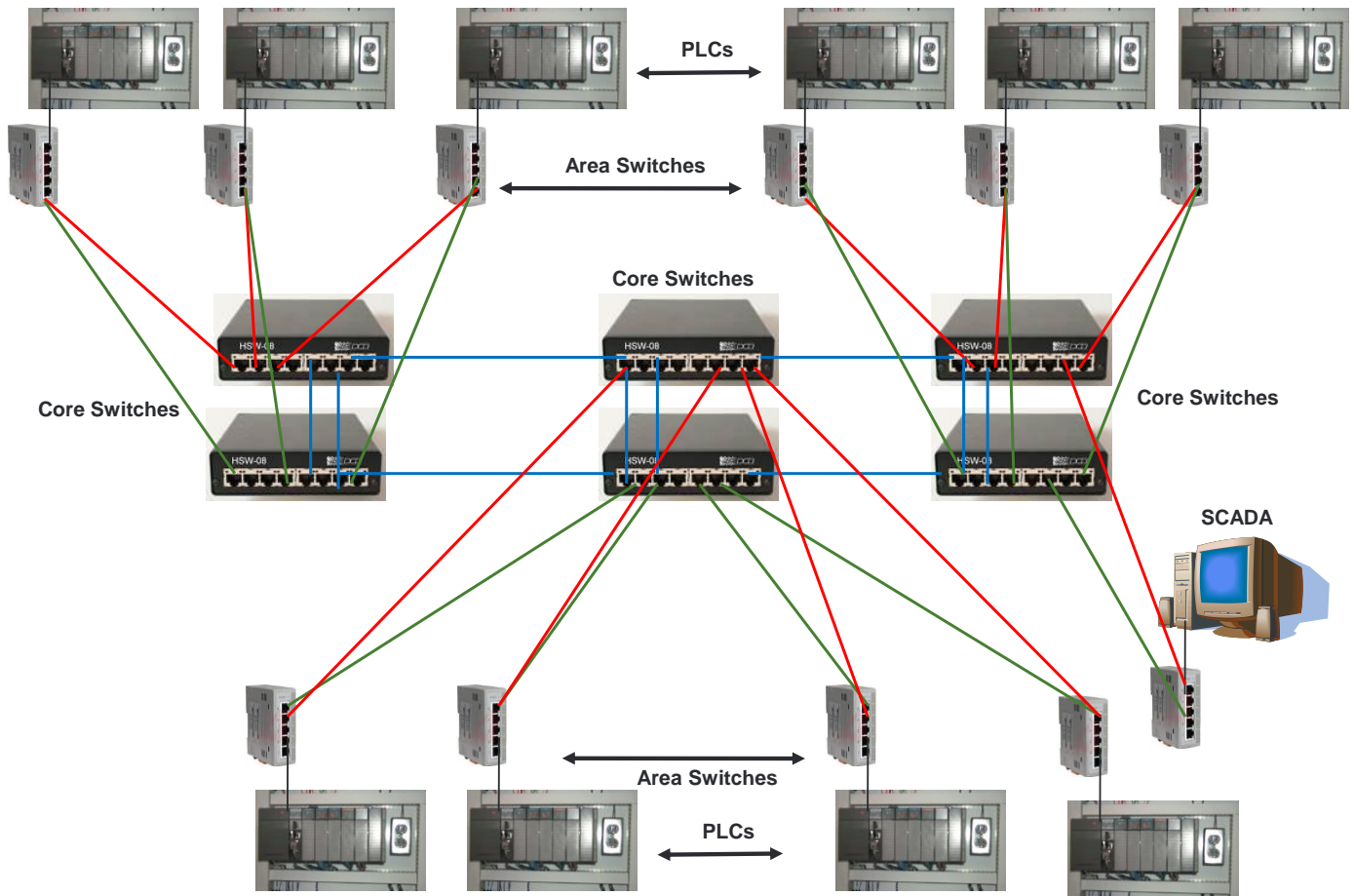
SANS 10142-1	:	National Standards for the wiring of premises
IEEE 802.3-2005	:	Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method and physical layer specifications
IEEE 802.3ad (Now IEEE 802.1AX):	:	Link Aggregation
IEEE 802.1d	:	MAC Bridges
IEEE 802.1p	:	Quality of service
IEEE 802.1Q	:	VLAN Tagging
IEEE 802.1w	:	Rapid Spanning Tree Protocol
IEEE 802.1X	:	Port Based Network Access Control
IEC 60068-2-6	:	Environmental Testing - Vibration
IEC 60068-2-27	:	Environmental Testing – Test Ea and guidance: Shock
SANS 61000-4/IEC 61000-4	:	Electromagnetic compatibility – testing and measurement techniques

7.4 Communication Protocol

7.4.1 The preferred method of communication between PLC's or between PLC's and SCADA systems is Ethernet TCP/IP.

7.4.2 Systems must be designed and equipment selected with the view of communicating via TCP/IP over Ethernet.

7.5 Network Topology



- 7.5.1 The preferred topology is an Ethernet star/mesh topology as indicated in the diagram above.
- 7.5.2 Where existing installations make the use of a star/mesh topology impractical, contractors must link into the existing system in such a way that future conversion to a star/mesh topology will not be hampered by the current installation.
- 7.5.3 All systems must be designed and equipment selected with the view of converting to a star/mesh topology when possible.
- 7.5.4 Network redundancy must be such that if one core switch fails, there must be a second one that can maintain communication (as shown in the diagram above).
- 7.5.5 Data communication between core switches and from core switches to the area switch patch panels must be done via 9/125µm, single mode, PVC, CST (Corrugated Steel Tape) cable or single mode blown fibre microduct assemblies (see the Cabling Specification (Volume 6 of the Automation And Control Standards)). The number of cores must be as specified in the project scope of work and the tender bill of quantities.

- 7.5.6 Each core switch pair (i.e. the two core switches which form a dual redundant system at a particular location) must be equipped with two UPSs (Uninterruptable Power Supplies) as specified in the “Automation And Control Design Standards, Volume 5, Clean Power And Surge Protection”. The two power supplies must be connected to both switches (i.e. each UPS supplies both core switches) to provide redundancy. These supplies must also be equipped with proper surge protection as detailed in the same specification - “Automation And Control Design Standards, Volume 5, Clean Power And Surge Protection”.

7.6 Switches

7.6.1 Minimum Requirements For Area Switches

- 7.6.1.1 Only industrial type switches will be accepted. No standard “commercial” or “Office” switches will be accepted. These switches must have at least an IP 20 rating, must have a rugged high-strength metal case and must have DIN-rail or panel mounting ability. They must have an operating temperature of at least 0 to 55°C, without the use of cooling fans and must be able to work in relative humidity up to 95% without condensation.
- 7.6.1.2 Redundancy and fault recovery:
- Must comply with IEEE 802.1w for Rapid Spanning Tree Protocol
- 7.6.1.3 Remote management and monitoring:
- Must support SNMP V1/V2/V3 for different levels of network management security
- 7.6.1.4 Area switches must have at least two SFP uplink ports which are 1000Base-LX Gigabit Ethernet standard compatible. These ports must be compatible with Duplex LC-type connectors for single-mode fibre.
- 7.6.1.5 Area switches must have the number of copper ports as specified in the project scope of work and the tender bill of quantities. The copper ports must be 10BASE-T/100BASE-TX compatible in order to communicate with the PLCs. These ports must be capable of accepting RJ45 connectors on CAT-6 cable.
- 7.6.1.6 In terms of configuration, maintenance, management and monitoring features required, all area switches must:
- Have support for loading or saving configurations to a remote host
 - Have port monitoring for debugging
 - Have line-swap fast recovery to normal operation (within milliseconds) after devices are unplugged and then re-plugged into different ports
 - Be configurable by Operating System (OS) independent web browser, using secure HTTPS

7.6.2 Minimum Requirements For Core Switches

- 7.6.2.1 Only industrial type switches will be accepted. No standard “commercial” or “Office” switches will be accepted. These switches

must have redundant, dual DC power units, must have at least an IP 30 rating, must have a rugged high-strength metal case and must be 19" rack-mounted switches. They must have an operating temperature of at least 0 to 55°C, without the use of cooling fans and must be able to work in relative humidity up to 95% without condensation.

- 7.6.2.2 Redundancy and fault recovery:
- Must comply with IEEE 802.1w for Rapid Spanning Tree Protocol
 - Must comply with IEEE 802.3ad (now 802.1AX) for link aggregation or port trunking and must have at least 4 trunks.
- 7.6.2.3 Broadcast isolation and network segmentation:
- Must comply with IEEE 802.1Q in terms of support for VLAN Registration Protocol (GVRP) to ease network planning
- 7.6.2.4 Quality of service:
- Must comply with IEEE 802.1p/1Q in terms of support for TOS/DiffServ in order to increase determinism
- 7.6.2.5 Multicasting:
- Must have IGMP Snooping and GMRP for filtering multicast traffic from industrial Ethernet protocols
- 7.6.2.6 Security and authentication:
- Must comply with IEEE 802.1X in terms of support for SSL to enhance network security
- 7.6.2.7 Remote management and monitoring:
- Must support SNMP V1/V2/V3 for different levels of network management security
- 7.6.2.8 Core switches must be managed, Layer 3 switches with the number of ports as specified in the project scope of work and the tender bill of quantities.
- 7.6.2.9 Core switches must provide support for a minimum of four trunked Gigabit SFP ports with 1000Base-LC, LC connectors.
- 7.6.2.10 Core switches must provide support for a minimum of eight SFP ports that will support a combination of Fast Ethernet ports (10/100Base-TX,) and Gigabit Ethernet ports (1000Base-T, 1000Base-LX).
- 7.6.2.11 In terms of configuration, maintenance, management and monitoring features required, all core switches must:
- Have support for loading or saving configurations to a remote host
 - Have port monitoring for debugging
 - Have line-swap fast recovery to normal operation (within milliseconds) after devices are unplugged and then re-plugged into different ports
 - Be configurable by Operating System (OS) independent web browser, using secure HTTPS
 - Be configurable by CLI by Local Serial console and remote SSH network connection
 - Support ping commands to identify network segment integrity

7.7 Compliance With Standards

- 7.7.1 It is important that all equipment is selected and installations are done to industrial standards. These are usually harsh environments in terms of dirt, industrial activities such as welding, grinding, etc. and electrical interference such as lightning, capacitor switching, large drives starting and stopping, etc.
- 7.7.2 The complete installation and networking system must comply with IEEE 802.3-2005.
- 7.7.3 The equipment installed must comply with SANS 61000-4/IEC 61000-4 for EMC.
- 7.7.4 The equipment installed must comply with IEC 60068-2-6 for vibration (10 to 57 Hz – amplitude 0.15mm, 57 to 150 Hz – acceleration 2g).
- 7.7.5 The equipment installed must comply with IEC 60068-2-27 for shock (12 shocks semi-sinusoidal, 15g, 11ms).
- 7.7.6 All installations must comply with the requirements of SANS 10142-1.

7.8 Network Switch Data Sheets

- 7.8.1 For network switches supplied, the tenderer must supply the data sheets shown in Appendix A with his tender.
- 7.8.2 All installations must comply with the requirements of SANS 10142-1.

7.9 Redundancy Testing

- 7.9.1 All the core network switches and area switches that have been installed in a redundant configuration must to be tested by a network specialist and the results documented. The contractor must make the following equipment available to complete these tests:
- Two portable area switches as specified in 7.6.1
 - Two portable computers, running from a CD ROM-booted operating system (e.g. Linux LiveCD)
- 7.9.2 The following ping test procedures must be followed using ICMP (Internet Control Message Protocol).
- Continuous ping messages will be sent from a portable test computer located at the core switch to a remote portable test computer that will be moved around all the network points (i.e. the area switches) to confirm the data throughput, latency (ping time) and network failover time.
 - Confirm that the round-trip ping times with a packet size of 10kb does not exceed 2 milliseconds.
 - Confirm that the continuous ping messages recovers within 3 seconds after either one of the redundant core switches has been powered down or powered up and after either one of the fly leads to the area switch has been disconnected from a core switch.
 - Capture the result as indicated in the following example:

Port No	PING Time	SW0-A Switch Down	SW0-B Switch Down	SW0-A Link Down	SW0-B Link Down	Comments
1	<1ms	✓	✓	✓	✓	Location L2

7.10 Labelling

7.10.1 All labelling must comply with the requirements as specified in the Labelling Specification (Volume 25 of the Automation And Control Standards).

APPENDIX 1

DATA SHEET - FIBRE “CORE” GIGABIT ETHERNET SWITCHES

DESCRIPTION	DATA
Manufacturer	
Model or Type	
Part or Order Number	
19” Rack-mount switch?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Comply with IEEE 802.1w for Rapid Spanning Tree Protocol?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Comply with IEEE 802.3ad (now 802.1AX) for link aggregation or port trunking?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Switch has at least 4 trunks?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Comply with IEEE 802.1Q i.t.o. support for VLAN Registration Protocol (GVRP)?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Comply with IEEE 802.1p/1Q i.t.o. support for TOS/DiffServ?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Comply with IEEE 802.1X i.t.o. support for SSL?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Support SNMP V1/V2/V3 for different levels of network management security?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Is it a managed, Layer 3 switch?	<input type="checkbox"/> Yes <input type="checkbox"/> No
At least 8 SFP ports that will support a combination of Fast Ethernet ports (10/100Base-TX) and Gigabit Ethernet ports (1000Base-T, 1000Base-LX)?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Support for loading or saving configuration to a remote host?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Port monitoring for debugging?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Has line-swap fast recovery to normal operation (within milliseconds) after swapping devices?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Configurable by Operating System (OS) independent web browser, using secure HTTPS?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Configurable by CLI by Local Serial console and remote SSH?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Support ping commands to identify network segment integrity?	<input type="checkbox"/> Yes <input type="checkbox"/> No

Local Agent?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Local agent contact details	
Guarantee period	

DATA SHEET – “AREA” ETHERNET SWITCHES

DESCRIPTION	DATA
Manufacturer	
Model or Type	
Part or Order Number	
Comply with IEEE 802.1w for Rapid Spanning Tree Protocol?	<input type="checkbox"/> Yes <input type="checkbox"/> No
SFP Uplink ports which are 1000BASE-LX Gigabit Ethernet standard compatible?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Uplink ports compatible with Duplex LC-type connectors for single-mode fibre?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Support for loading or saving configuration to a remote host?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Port monitoring for debugging?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Has line-swap fast recovery to normal operation (within milliseconds) after swapping devices?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Configurable by Operating System (OS) independent web browser, using secure HTTPS?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Local Agent?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Local agent contact details	
Guarantee period	