Process Control Network Standard
PL703

DOCUMENT APPROVAL PROCESS

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The owner of this document is responsible for the revision and control of the document, including updating of the table below, which contains the history of the document with details of each revision.

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03/02/06	-	1.0	Document Approved
21/04/17	1.0	1.1	Document Updated. Format updated to new TPL standard.
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18/09/20	2.0	3.0	Document updated to include OASyS PCS Network details

This table summarises what has been changed in the document so that it is easy to keep track of the effected changes.

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1 INTRODUCTION

1.1 Purpose

The purpose of this standard is to define the design, installation, performance and operational requirements of the Transnet Pipelines Process Control Network (PCN).

The PCN is used to support the transfer of data between remote stations and a central master control centre, for the purposes of remote control, monitoring and protection of the pipeline and its equipment from the Master Control Centre. The PCN spans over various geographical regions within South Africa and comprises of fibre, microwave and frame relay technologies.

This standard is independent of network topology (e.g. point-point, bus, star, ring), media (e.g. fibre, microwave) and service provider.

This document details all high-level user requirements. Detailed requirements will be developed in conjunction with the Contractor. Site specific configurations of the PCN are included in the Site-specific documentation.

The document is intended to be read by users, designers and engineers, designing, configuring, installing and maintaining the PCN WAN and individual PCN LAN's per site.

1.2 SCOPE

1.2.1 General

This document defines as a minimum, the general responsibilities and requirements for the provision and maintenance of the Process Control Network, by the service provider / contractor, for and on behalf of Transnet Pipelines. This standard should be read in conjunction with all other specifications and drawings issued for a specific contract and as referenced in Section 2.

Contractors are required to familiarise themselves with all applicable Standards, Specifications and Codes of Practice listed herein, and to ensure compliance in the execution of any work in terms of this document. Failure to comply may render the contractor liable for corrections at his own cost. Where discrepancies occur, these must be brought to the attention of Transnet Pipelines in writing before commencement of work.

This document defines the Process Control Network standards with applicable specifications in terms of the following requirements where applicable:

- Type of network
- Network Layers and Protocols
- Network Performance and Availability
- Quality of Service (QoS)
- Network Management

1.2.2 Requirements Excluded

This document does not address standards, specifications or requirements relating to the following systems,

- Process Control Systems (PCS)

- Custody Metering Systems (CMS)
- Pipeline Monitoring Systems (PLMS)
- Central Archive Systems (CAS)
- Manufacturing Execution Systems (MES)
- Management Information System (MIS)
- Machine Monitoring Systems (MMS)
- Electrical SCADA Systems (ESS)
- Electrical VSD Monitoring Systems (EVS)
- Motorised Block Valve Control Systems (MOBV's)
- Tank Gauging Systems (TGS)
- Security Systems

1.3 Document Usage

This document is intended to convey core requirements for the RPS.

All requirements included here in should be traceable to lower level documents to ensure compliance.

In this specification,

- the word **shall** is to be understood as a mandatory requirement,
- the word **should** as a preference,
- the word **may** as a permissive (i.e. neither mandatory nor necessarily recommended),
- and the word **will** as a declaration on behalf of something/ someone else.

The word **should** shall be treated as a requirement, although it is acknowledged that it may be negotiated based on appropriate justification.

Text indicated as **'Note'** does not form part of this specification. Notes aid the reader's understanding of the associated requirements.

1.4 Abbreviations

ACDB	Alarm Configuration Database
API	American Petroleum Institute
AS	PL723 Automation Standard
ASCII	American Standard Code for Information Interchange
CAS	Central Archive Server
CMS	Custody Metering System
CO	Co-ordinating Officer
DDS	Detailed Design Specification

EDS	Engineering Design Specification
ES	Engineering System
ESS	Electrical SCADA System, previously known as EMS
EVS	Electrical VSD Monitoring System (ABB)
F&G	Fire and Gas System
FDS	Functional Design Specification
FC	Flow Computer
HIS	Historian
I/O	Input/output
ISO	International Standards Organisation
LAN	Local Area Network
MAC (1)	Media Access Control address
MOBV	Motorised Block Valve
MCC	Master Control Centre
MES	Manufacturing Execution System
MIS	Manufacturing Information System
MMS	Machine Monitoring System
NAS	Network Attached Storage
NOC	National Operations Centre
NTP	Network Time Protocol
OPC	OLE for Process Control
OS	Operating System
OSI	Open Systems Interconnection Model (OSI Model0
OASYS	Aveva OASyS SCADA PCS
P&ID	Piping and Instrumentation Drawing
PCS	Process Control System
PCN	Process Control Network
PLC	Programmable Logic Controller
PLMS	Pipeline Monitoring System
PN	Pipeline Network
RPS	Process Control Replay System
RTU	Remote Termination Unit
SCADA	Supervisory Control and Data Acquisition
SCC	Secondary Control Centre

SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
SO	Station Operator
SOP	Standard Operating Procedure
STM	Synchronous Transport Module
TBA	To be Advised
TBC	To be Confirmed
TBD	To be Defined
TCP/IP	Transmission Control Protocol/Internet Protocol
TGS	Tank Gauging System
VLAN	Virtual LAN
WAN	Wide Area Network
WI	Work Instructions

1.5 Station Abbreviation and Numbers

STATION-NAME	STATION-ABBREVIATION	STATION-NUMBER
Fynnland	FYN	1
Durban	DNR	2
Hillcrest (DJP, DWP)	HLR	3,4
Howick (DJP, DWP)	HWR	7,8
Ladysmith (DJP, DWP)	LAY	9,10
Van Reenen	VRN	11
Bethlehem (TOP)	BHT	12
Bethlehem	BEM	13
Kroonstad	KRO	14
Magdala	MGA	15
Sasolburg	SBG	16
Coalbrook	CBK	17
Alrode	ALR	18
Potchefstroom	PCM	19
Klerksdorp	KRP	20
Airport	APT	21

Waltloo	WAO	22
Pretoria West	PWT	23
Langlaagte	LLA	24
Tarlton	TLR	25
Rustenburg	RTR	26
Witbank	WIR	27
Newcastle	NCS	28
Volksrust	VRR	29
Standerton	SNR	30
Secunda	SEC	31
Vrede	VDE	-
Empangeni	EMG	32
Mahlabatini	MAT	33
Scheepersnek	SCN	34
Quagga	QGA	35
Kendal	KEN	36
Meyerton	MTN	37
Mngeni	MGN	38
Duzi	DUZ	39
Mooi River	MRR	40
Fort Mistake	FTM	41
Wilge	WIL	42
Refractionator	IRP	43
Jameson Park	JMP	44
Elardus Park	EDP	45
Island View (TM1)	IVW	50
Twini (PS1)	TNI	51
Umbumbulu (PS2)	UBB	52
Hilltop (PS3)	HTP	53
Lions River (PS4)	LRV	54

Mnambithi (PS5)	MBT	55
Van Reenen (PS6)	VNN	56
Warden (PS7)	WDN	57
Villiers (PS8)	VLR	58
Jameson Park (TM2)	JMP	59
JHB Railway Station	NSB	96
Durban Railway Station	DRS	97
Secondary Control Centre	SCC	98
Master Control Centre	MCC	99

2 APPLICABLE DOCUMENTS

Documents of the revision cited in this Applicable Documents section form part of this standard to the extent specified. In the event of conflict between the text of this standard and the documents invoked herein, the text of this standard shall take precedence.

However, nothing in this standard shall supersede applicable laws and regulations.

2.1 TPL Applicable Standards and Specifications

No. and Title		Doc. No.	Rev.
[1]	Pipeline SCADA Security	API 1164 2nd Edition	June 2009
[2]	NMPP MAC WAN Macro Network Specification	2684358-J-A00-CS-DC-001 Shts 1-6	Latest
[3]	Framework for Minimum Controls for Security in the Process Control Environment	TPL-TECH-I-PCE-006	02
[4]	Specification for Equipment Cabinets to house Electronic Equipment Safety Regulations for Contractors	PL711	10
[5]	Cable, Racking, Trenching, Earthing Installation Codes of Practise	PL727	11
[6]	Transnet Group Legal: Intellectual Property Policy	TG/GL 4/14/4 P	01

2.2 Other Applicable Standard and Specifications

The following national and international standards are required to be complied with and shall be read in conjunction with this Specification.

No. and Title		Doc. No.	Rev.
[7]	The Classification of hazardous locations and the selection of electrical apparatus for use in such locations	SANS 10108	2014
[8]	The wiring of premises – Part 1: Low-voltage installations	SANS 10142-1	2012
[9]	Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test	IEC 61000-4-2	2008
[10]	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	IEC 61000-4-3	2006
[11]	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast	IEC 61000-4-4	2012

	transient/burst immunity test		
[12]	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	IEC 61000-4-5	2014

2.3 Reference Documentation

The documents included in this section do not form part of the specification, but are included for background and context.

	No.	**Doc. No.**	**Rev.**
[13]	Standard for Information Technology – Software Lifecycle Processes	IEEE 12207.0	1996
[14]	Drawing Standards	PL100	03
[15]	Plant & Equipment Tag Numbering Standards	PL101	03
[16]	Equipment, Instrument & Electrical Symbology Standards	PL102	01
[17]	General Drawing Standards	PL103	03
[18]	Control System Policy	TPL-TECH-I-POL-001	03
[19]	Explosive atmospheres: Part 14: Electrical installations design, selection and erection; Part 17: Electrical installations inspection and maintenance; Part 25: Intrinsically safe electrical systems	SANS 60079	2007
[20]	The installation, inspection and maintenance of equipment used in explosive atmospheres	SANS 10086-1	2003
[21]	The Petroleum Industry Part 2: Electrical and other installations in the distribution and marketing sector	SANS 10089-2	2007

3 PIPELINE NETWORK OVERVIEW

Transnet Pipelines operates and maintains petroleum product pipeline infrastructure in South Africa. Pipelines traverse KwaZulu Natal, Free State, Gauteng, North West and Mpumalanga provinces. (Refer to Appendix 5 for a map of the pipeline network).

Intake/Delivery stations and Pump Stations are distributed along the pipeline network. Each of these stations is controlled either from the control room on site or from the Master Control Centre (MCC) situated in Durban. The purpose of the communication network is to link the MCC to each of the stations in order to facilitate monitoring and control from the MCC.

The communications network also provides networking infrastructure to engineering systems for the monitoring and control of plant equipment and power reticulation.

3.1 Site Conditions

All equipment shall be suitable for use in an industrial environment containing microscopic metallic and liquid particles and dusty materials. Equipment shall operate reliably under the following ambient conditions:

- Temperature: -15 to +50 Deg C
- Humidity: 5 to 99% relative humidity
- Elevation: Up to 2000 m above mean sea level
- Power Supply: 230 VAC, 10A, single phase, 50 Hz

Voltage	90-110% of rated voltage
Frequency	+/- 2% of rated frequency
Impulse Voltage	200% peak voltage up to 1ms duration with rise time of 500 nano second to 500 miro second.
Voltage Drop	Reduction of 50% of peak voltage for ½ cycle or 20% for 1cycle
Micro-interruption	Supply disconnection or a zero voltage for 3ms at any random time in the cycle. More than 1 second between successive reductions.
UPS Back-up	UPS power is supplied on all sites

4 PROCESS CONTROL NETWORK REQUIREMENTS

The pipeline network will provide infrastructure for the following systems and/or sub-systems:

- Process Control Systems (PCS)
- Custody Metering Systems (CMS)
- Pipeline Monitoring Systems (PLMS)
- Central Archive Systems (CAS)
- Manufacturing Execution Systems (MES)
- Management Information System (MIS)
- Machine Monitoring Systems (MMS)
- Electrical SCADA Systems (ESS)
- Electrical VSD Monitoring Systems (EVS)
- Motorised Block Valve Control Systems (MOBV's)
- Tank Gauging Systems (TGS)
- DMZ
- Network Management
- Security

The Process Control Network comprises of two components; namely the Local Area Network (LAN) which connects all systems installed on a station together to facilitate local control and monitoring; and a Wide Area Network (WAN) which connects all systems installed on the respective stations back to the Master Control Centre and/or Secondary Control Centre for remote control and monitoring.

Both LAN and WAN Networks are required to support the following communication busses:

Process Control & Metering Systems:

- PCS SCADA Communication busses between PCS SCADA servers and clients which might be locally on site or at the MCC/SCC, and between the PCS SCADA and CMS, PLMS, CAS, MES, MIS and TGS where installed.
- PCS PLC Communications busses, between redundant PLCs, between sets of redundant PLCs, and between PLCs and remote controllers and CMS Systems and Flow Computers locally on site.
- Field communication bus. (Profibus networks etc.)
- CAS Bus – Transfer of historical data from sites to the archive servers at the MCC/SCC.
- PLC to PLC communication such as to remote Motorised Block Valves.
- PLMS Bus – Communication between PCS and PLMS servers at the MCC.

Electrical Switchgear SCADA Systems:

- ESS – Communication of electrical switchgear monitoring, configuration and control data from sites to the MCC/SCC.

- EVS – Communication of electrical VSD monitoring, configuration and control data from sites to the MCC/SCC.

Machine Monitoring Systems:

- MMS – Communication of condition monitoring data from sites to the MCC/SCC.

Network Monitoring and Configuration:

- CISCO LMS – Network equipment monitoring and configuration for network equipment not forming part of the Dense Wavelength-division Multiplexing (DWDM) section of the network.
- CISCO Transport Management – Monitoring and configuration network, internal to the network equipment of Dense Wavelength-division Multiplexing section of the network. (CTM is also referred to as CISCO Prime)
- CISCO ACS – User management and access control to all CISCO DWDM equipment.

Security Monitoring and Configuration:

- Security - Communication of security system monitoring, configuration of WAN from sites to the MCC.

4.1 Overview of the WAN

The WAN for the Process Control network will span from the MCC in Durban, to all remotely located Stations. The WAN will consist of fibre, microwave and frame relay infrastructure.

The WAN will be used to communicate data between the MCC/SCC and the Pump Stations, Terminals and Depots, as well as to provide a reciprocal service to Transnet Freight Rail's SABRE network. Transnet Freight Rail's fibre optic SABRE network provides a physical redundant route between North Station Building (NSB) located in Johannesburg railway station and Durban railway station (DRs) with automatic failover and recovery.

Two transmission standards are used on the WAN, Dense Wavelength-division Multiplexing (DWDM) and Synchronous Digital Hierarchy (SDH) with Synchronous Transport Module level 1 interfaces (STM1). Each site will have it's own Ethernet LAN connecting into the WAN. The DWDM section will have two Head end's, one in Durban and another in Johannesburg.

Table 1 below indicates which sites form part of the WAN and indicates current infrastructure and WAN transmission protocols per site.

Table 1: Current Infrastructure per Site (Station Bandwidth)

Site Name	WAN Infrastructure Provided	WAN Infrastructure Provided	Bandwidth Available for all Systems
MCC	Fibre	Redundant	10 Gbps (DWDM)
SCC	Fibre	Redundant	10 Gbps (DWDM)
iMCC	Fibre	Redundant	Each is 10 Gbps (DWDM)
DNR	Fibre	Redundant	Each is 10 Gbps (DWDM)
IVW (TM1)	Fibre	Redundant	Each is 10 Gbps

Site Name	WAN Infrastructure Provided	WAN Infrastructure Provided	Bandwidth Available for all Systems
			(DWDM)
TNI (PS1)	Fibre	Redundant	Each is 10 Gbps (DWDM)
HTP (PS3)	Fibre	Redundant	Each is 10 Gbps (DWDM)
MBT (PS5)	Fibre	Redundant	Each is 10 Gbps (DWDM)
WDN (PS7)	Fibre	Redundant	Each is 10 Gbps (DWDM)
VLR (PS8)	Fibre	Redundant	Each is 10 Gbps (DWDM)
JMP (TM2)	Fibre	Redundant	Each is 10 Gbps (DWDM)
Kendal	Fibre	Redundant	10 Gbps (DWDM)
Waltloo	Fibre	Redundant	10 Gbps (DWDM)
Alrode	Fibre	Redundant	10 Gbps (DWDM)
Langlaagte	Fibre	Redundant	10 Gbps (DWDM)
Durban Railway Station	Fibre	Redundant	3 x 10 Gbps (DWDM)
NSB	Fibre	Redundant	3 x 10 Gbps (DWDM)
PL1 MBV 5	Fibre	Redundant	1 Gbps
PL1 MBV 12	Fibre	Redundant	1 Gbps
PL1 MBV 16	Fibre	Redundant	1 Gbps
PL1 MBV 19	Fibre	Redundant	1 Gbps
PL1 MBV 23	Fibre	Redundant	1 Gbps
PL1 MBV 28	Fibre	Redundant	1 Gbps
PL1 MBV 32	Fibre	Redundant	1 Gbps
PL1 MBV 37	Fibre	Redundant	1 Gbps
PL1 MBV 47	Fibre	Redundant	1 Gbps
PL1 MBV 54	Fibre	Redundant	1 Gbps
PL1 MBV 62	Fibre	Redundant	1 Gbps
PL1 MBV 68	Fibre	Redundant	1 Gbps
PL1 MBV 70	Fibre	Redundant	1 Gbps
PL1 MBV 72	Fibre	Redundant	1 Gbps
PL2 MBV 2	Fibre	Redundant	1 Gbps
PL2 MBV 3	Fibre	Redundant	1 Gbps
PL2 MBV 6	Fibre	Redundant	1 Gbps
PL3 MBV 2	Fibre	Redundant	1 Gbps
PL4 MBV 7	Fibre	Redundant	1 Gbps
PL4 MBV 15	Fibre	Redundant	1 Gbps
Airport	Fibre	Non Redundant	130 Mbps (STM1)

Site Name	WAN Infrastructure Provided	WAN Infrastructure Provided	Bandwidth Available for all Systems
Coalbrook	Fibre	Non Redundant	130 Mbps (STM1)
Klerksdorp	Microwave	Non Redundant	130 Mbps (STM1)
Highgate MBV	Fibre	Non Redundant	1 Ggps
Kroonstad	Fibre	Non Redundant	130 Mbps (STM1)
Meyerton	Microwave	Non Redundant	130 Mbps (STM1)
Rustenburg	Fibre	Non Redundant	130 Mbps (STM1)
Sasolburg	Fibre	Non Redundant	130 Mbps (STM1)
Secunda	Microwave	Non Redundant	130 Mbps (STM1)
Tarlton	Microwave	Non Redundant	130 Mbps (STM1)
Witbank	Microwave	Non Redundant	130 Mbps (STM1)
Howick	DWDM	Non Redundant	10Gbps (DWDM)
Mgeni	Microwave	Non Redundant	100 Mbps (STM1)
Duzi	DWDM	Non Redundant	10Gbps (DWDM)
Mooiriver	DWDM	Non Redundant	10DGbps (DWDM)
Ladysmith	Fibre	Non Redundant	100 Mbps (STM1)
Van Reenen	Microwave	Non Redundant	100 Mbps (STM1)
Quagga	Microwave	Non Redundant	100 Mbps (STM1)
Wilge	Microwave	Non Redundant	100 Mbps (STM1)
Magdala	Fibre	Non Redundant	100 Mbps (STM1)
Betlehem	Fibre	Non Redundant	100 Mbps (STM1)
Hilcrest	Microwave	Non Redundant	100 Mbps (STM1)
Fortmistake	Microwave	Non Redundant	100 Mbps (STM1)
Newcastle	Microwave	Non-Redundant	100Mbps (STM1)

Note: (Current Specifications)

1. The dedicated fibre connecting the MBV's to the sites host both the H1 Bus and the CISCO LMS as VLAN's. These VLAN's will be connected to their respective VLANs mentioned above.
2. The total bandwidth available on the STM section of the network is 135 Mbps (155 Mbps – 12 % overhead). The assigned bandwidth as per the above may be re-assigned/optimised.
3. The total bandwidth available on the DJP STM1 section of the network is 100 Mbps (155 Mbps -12% overhead). The balance of the 135 Mbps is reserved for other services for the respective sites.
4. There SABRE backup link of STM16 (2.56 GB) between North Station Building (NSB) and Durban Railway Station, this provides a temporary failover link in the event there is break on DWDM backbone.

4.2 WAN design requirements

4.2.1 Network Separation

Network separation shall be done to achieve:

- Functional separation of data
- Prioritise data

- Data security
- Performance

The following separation of networks has been identified:

- Security and PCN will be separate networks and will utilise separate Lambda's of the DWDM system, within the transmission equipment.
- Separation of the PCS networks will be as follows, each as a VLAN service on the WAN:
    - PCS SCADA
    - CMS
    - PCS PLC
    - CAS Bus
    - PLC to PLC – For communicating with the remote motorised block valves
    - Machine Monitoring System Network
    - Electrical SCADA and Electrical VSD System Network
    - CISCO LMS – Network Monitoring
    - PLMS Bus

The above mentioned networks will have no connectivity to, and should not be accessible from, unless intentionality connected via a demilitarised zone.

- Each Other
- The Internet
- Any Other TPL Network (including TPL Enterprise Network)

4.2.2 Network Routing

To minimise network complexity, no routing will be required for stations, terminals and depots that exist on the DWDM infrastructure. To minimise network traffic on the STM1 networks routing will be done on stations, terminals and depots that exist on the STM1 section. The routing of data for stations on the STM1 section will be done by the layer 3 equipment installed at NSB.

Routing will be done to allow for connectivity of each of the STM1 sites to JMP (TM2) and also for each of the STM1 sites to the MCC/SCC. There is no requirement for routing data between STM1 sites or STM1 sites to DWDM sites, other than above mentioned.

The services provided should include the routing of network management (SNMTP, DNS, Domain, etc.) and SNTP/NTP data.

4.2.3 Sub-netting

To achieve the routing requirements there will be no sub-netting on the DWDM, but the subnet mask on STM1 will be set up to separate each station onto its own subnet. The network numbers on the STM1 section is different for the same network on the DWDM section.

4.2.4 VLAN properties

The following tables indicate the Lambda that the LAN will be connected to achieve physical transmission separation, the bandwidth, the requirement for LAN connectivity into the WAN and also the priority of data on the WAN. The highest priority VLAN should not be interrupted by lower priority VLAN's of which the bandwidth is exceeded.

Table 2: Network Properties including Sabre failover

VLAN Service	VLAN Name	DWDM Minimum Bandwidth Mbps	STM1 Minimum Bandwidth Mbps	SABRE Combined (DWDM & STM1) Minimum Bandwidth Mbps	Port Number				Priority (5 = Highest, 0 = Best Effort)	Conn. Type	Protocol
					STM1	Lambda 1	Lambda 1	Lambda 2			
						XP A	XP B				
Terminal Bus	101 – CVLAN	600	0	680	1	1	1	-	1	RJ45	TCP/IP
System Bus A	102 – CVLAN	200	0	110	2	2	2	-	2	RJ45	TCP/IP[3]
System Bus B	103 – CVLAN	200	0	110	3	3	3	-	2	RJ45	TCP/IP[3]
CAS Bus	104 – CVLAN	300	0	340	4	4	4	-	1	RJ45	TCP/IP
H1 Bus	105 – CVLAN	100		100		5	5	-	3	RJ45	TCP/IP
H1 Bus - Local Fibre to MBV's	105 – CVLAN	1 000		0		20	20	-	N/A	LC	TCP/IP
Machine Monitoring Network	110 – CVLAN	100		0		6	6	-	0	RJ45	TCP/IP
Electrical SCADA System Network	109 – CVLAN	100		0		7	7[1]	-	0	LC	TCP/IP
CISCO LMS (DWDM Sites)	111 – CVLAN	5	5	10	8	8	8	-	0	RJ45	TCP/IP
PLMS Bus	120 – CVLAN	1 000		500		9	9		0	RJ45	TCP/IP
PCS7 OS Sync Bus	130 – CVLAN	100		50		10	10		0	RJ45	TCP/IP
LSX Bus	140 – CVLAN	100	95	110	11	11	11[1]		4	RJ45	OSI
OASyS Bus	150 – CVLAN	1 000	100	180	12	12	12[1]		1	RJ45	TCP/IP
Security	170 – CVLAN	10 000		0				1	5	-	TCP/IP

Notes:

1. Configured but disabled and not connected
2. For STM1 sites where routing is required it will be necessary to use IP protocol. For this the Siemens "ISO on TCP/IP" could be used.
3. TCP/IP configured but not used for communications on DWDM section.

4.3 PCN Performance Criteria

4.3.1 WAN Availability

The point of interface from the LAN to the WAN is defined as the point where the LAN plugs into the WAN equipment.

4.3.1.1 DWDM

Availability for network equipment hosting PCN Networks will be no less than 99.9%.

Availability of PCN communication from the MCC/SCC to the furthest point on the pipeline will be no less than 99.9%.

Availability of other communication, excluding PCN from the MCC/SCC to each station along the pipeline will be no less than 99.4%.

4.3.1.2 STM1

Availability for network equipment hosting PCN Networks will be no less than 99.9%.

Availability of PCN communication from the MCC to the furthest point on the pipeline will be no less than 99.4%.

4.3.2 LAN Availability

The following section indicates availability for LAN's at each site for PCN networks only.

Availability for network equipment hosting PCN Networks will be no less than 99.9%.

Availability of PCN communication from the Controllers (PLC, Flow Computers, etc.) to the SCADA will be no less than 99.4%.

4.3.3 WAN Latencies

The network latency response time's excluding microwave links shall be less than 50 milliseconds, also excluding Cisco Router and Switch alarm detection and switching latency. The total latency including router and switch alarm detection shall not exceed 150ms per end-to-end link.

4.3.4 Quality of Service (QoS)

Network traffic prioritisation and bandwidth reservation with alarming thresholds must be configured in terms of: data throughput, dropped packets, errors and latency.

4.3.5 WAN Redundancy

4.3.5.1 DWDM

The following networks will be connected in ring topology. The ring will be established by routing these networks at the Durban Head end and Johannesburg Head end onto existing Transnet STM 16 Infrastructure.

- PCS SCADA
- PCS PLC
- CAS Bus
- PLC to PLC – For communicating with the remote motorised block valves
- Machine Monitoring System Network
- Electrical SCADA System Network
- CISCO LMS – Network Monitoring
- PLMS Bus

The current total available bandwidth on the STM 16 (SABRE) link is 2.4 Gbps. VLAN minimum bandwidth is indicated in Table 2 and priorities will be the same as indicated for the DWDM.

4.3.5.2 STM1

No network redundant ring topology will be provided on any of the sites with microwave infrastructure.

The router at Johannesburg Head end of the DWDM section for routing data from the DWDM section to the STM1 section will be in backed up by the similar router installed at the Durban Head end of the DWDM section, in hot standby configuration.

4.4 LAN Design Requirements

4.4.1 Network Separation

Each of the VLAN's on the WAN will be a physical LAN. Each LAN will have separate infrastructure (switches, fibre, etc.) however no hubs are allowed on the network.

The LAN's will have no connectivity to, and should never be accessible from, unless intentionality connected via a central demilitarised zone.

- Each Other
- The Internet
- Any Other TPL Network (including TPL Enterprise Network)

4.4.2 Network Colouring

For easy identification of networks the following colouring will be used for networking cables, connecting PC's and servers to wall sockets and switches, connecting switches or networked equipment/devices to each other and documentation:

Table 3: Network Colouring

Network	Colour
Reserved for normal IT	Grey
PCS SCADA Bus (currently assigned to Terminal / Metering Bus - DWDM)	Green
PCS PLC Bus A (currently assigned to System Bus A - DWDM)	Blue
PCS PLC Bus B (currently assigned to System Bus B - DWDM)	Yellow
CAS Bus (DWDM)	Red
PLC to PLC Bus (currently assigned to H1 Bus – MOBVs - DWDM)	Orange
PLMS (DWDM)	Black
Machine Monitoring Network (DWDM)	Purple
Electrical SCADA System Network (DWDM)	Black
CISCO (DWDM)	White cable with Red sleeve (1)
LSX and legacy PCS's (STM1)	White
OASYS	Magenta
Security(DWDM)	Grey
Internet DMZ (DWDM)	Black
MCC DMZ (DWDM)	Black
Extenders/KVM	Black
PCS7 OS Synch Bus (DWDM)	Black
NAS Network (DWDM)	Black cable with Red sleeve

Where sleeves are used in combination with cable colouring for identification the following apply:

- For cables shorter than 5m, sleeves are heat-shrinked onto cable for the last meter at either end of the cable, 30mm long, 200mm apart, and starting 200mm from the end of the cable.
- For cables longer than 5m, sleeves are applied as per above at either end, or in-between a 30mm sleeve is applied every 1m.
- Cable to be terminated with the same colour RJ45 boots as the colour of the sleeves.

Notes: Based on deviation request nr NMPP-DVR-010 (17 May 2013).

4.5 WAN Connectivity

4.5.1 DWDM Section

Connectivity of the LAN into the WAN equipment will be as indicated in Table 2.

Where the connection table indicates that there is two connections to a Lambda, those connections will be from different sources (switches) on the LAN.

Design, equipment and cabling for LAN connectivity into WAN to be supplied by LAN provider.

4.5.2 STM1 Section

Connectivity of the LAN into the WAN equipment will be as indicated in Table 2.

4.6 IP Addressing

Addressing will be static IP's. There will be no dynamic IP addressing server available on the network. The following structure will be followed on networks:

10.X.Y.Z, where:

X = Bus Number (Network Number)
Y = Station Number
Z = Device ID (Host)

4.6.1 Bus Numbering

The following table indicates the network numbering to be used:

Table 4: Bus Numbers

Network Name	Bus Number - DWDM	Bus Number - STM1
PCS SCADA Bus (currently assigned to Terminal / Metering Bus)	1	101
PCS PLC Bus A (currently assigned to System Bus A)	2	102
PCS PLC us B (currently assigned to System Bus B)	3	103
CAS Bus	4	104
PLC to PLC Bus (currently assigned to H1 Bus - MOBVs)	5	N/R
CMS	6	106
Security	7	N/R
ESS	9	N/R
MMS	10	N/R
CICSO LMS/CTM	11	111
Internet DMZ	12	N/R
MCC DMZ	13	N/R
PLMS Bus	14	N/R
PSC7 OS Synch Bus	15	N/R
LSX Bus	16	116
NAS Network	17	N/R
OASYS Bus	18	118

4.6.2 Station Numbering

Refer to Section 1.5 for Station Numbering details.

Note:

MBV's for PL1 will form part of the IVW (TM1) control system, IVW's (TM1) station number shall be used in conjunction with the PL1 MBV numbers.

MBV's for the inland network will form part of the JMP (TM2) control system, JMP's (TM2) station number shall be used in conjunction with the PL2, PL3,PL4 and Highgate MBV's.

4.6.3 Device ID (Host Address Ranging)

For easy identification of equipment types connected to the network, the host portion (Z) of the IP address will comply with the following ranges as indicated in the following table:

Table 5: Device Ranges

Host Type		Range		Available Hosts
		Start	End	
Network Equipment	Routers, Firewalls & Gateways	1	15	15
	Switches	16	39	24
PC's and Servers	Engineering Functions	40	44	5
	HMI Server Functions	45	54	10
	Historian Functions	55	59	5
	Replay Functions	60	64	5
	Connectivity Functions	65	69	5
	WEB Functions	70	74	5
	HMI Client Functions	75	94	20
	Special Functions (Video Wall Servers, PLMS, etc.)	95	109	15
	IT Functions (Domain Controller, Anti-Virus, etc.)	110	119	10
Controllers	PLC's, Protection Relay's, Flow Computers, etc.	120	199	80
Clock's		200	204	5
UPS's		205	219	15
Printers		220	229	10
Other		230	254	25

Note: Additional requirements to be ratified on a site basis with the LAN providers.

4.6.4 Subnet Masks

Two subnet mask will be used on the LAN's. A 16 bit subnet will be used for the sites on the DWDM section (255.255.0.0) and a 24 bit subnet shall be used on the STM1 section (255.255.255.0)

4.7 Network Security Requirements

Network Security is required to comply with API 1164 [1] and TPL FRAMEWORK FOR MINIMUM CONTROLS FOR SECURITY IN THE PROCESS CONTROL ENVIRONMENT [3] specifications.

4.7.1 Physical Security

Network equipment shall be secured with an access control system that will only allow access to authorised personnel. Where access control via an access control system cannot be achieved, the installation of network equipment shall be in a lockable cabinet with the keys to the cabinet held and controlled by the owner of the network.

Network ports shall be secured such that it will not allow any access from any unauthorised device. Unused ports shall be de-activated.

4.7.2 Intrusion Prevention IPS

An Intrusion Prevention System (IPS) shall be configured as a network security/threat prevention system that examines network traffic flows to detect and prevent vulnerability exploitation.

4.7.3 System Access Control

System access to the WAN equipment for monitoring shall be password protected. A minimum of two levels of access may be granted:

- Monitoring – For monitoring of the network on a daily basis. The users will only require the minimum access for navigating through the system monitoring tool and identifying abnormal conditions.

4.7.4 Remote Access

A remote access procedure for access to the WAN infrastructure will be controlled as determied by the Framework for Minimum Controls for Security in the Process Control Environment.

4.7.5 Interfaces to the PCN Network

The different networks specified in section 4 each have different requirements; therefore there will be no direct interface between any of the networks at WAN or LAN level.

Interfaces from other networks to the PCN networks will be via a centralized Demilitarized Zone in the MCC with a backup interface in the SCC in accordance with API 1164.

5 APPENDIX 1: TRANSNET PIPELINE NETWORK DIAGRAM