

 Eskom	Standard	Technology
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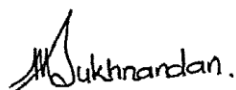
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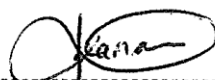


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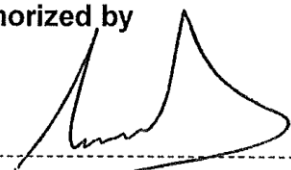


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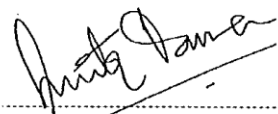


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1. Introduction

IEC61850 is an international, open standard for substation automation systems. It defines what to communicate and how to communicate it. It defines abstract data models i.e logical nodes (PTOC, XCBR etc), communication services and also specifies how these can be mapped to existing protocols. The IEC61850 standard was published by the Technical Committee 57 of the IEC in 2002. This IEC61850 standard provides numerous implementation options and hence this document specifies Eskom Transmission and Distribution exact IEC61850 requirements for the following:

- a) ACSI Basic Conformance
 - b) ACSI Model Conformance
 - c) ACSI Service Conformance
 - d) Extra Protocol Information Conformance (PIXIT)
 - e) Technical Issue Conformance (TIC).
- } PICS

2. Supporting clauses

2.1 Scope

This document presents the IEC61850 Protocol Information Conformance Statement(PICS), Extra Protocol Information for Testing (PIXIT) and Technical Issues Conformance Statement (TICS) requirements of the Eskom Transmission and Distribution business.

IEC61850 requirements for PICS, ACSI and TICs

2.1.1 Purpose

This standard will firstly be used to inform the Eskom Transmission and Distribution businesses on which parts of the IEC61850 standard relating to the PICS, TICS and PIXIT shall be supported by external vendors. It will also be used in the tender evaluation process of all products that are IEC61850 compliant.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

- [1] IEC 61850-7-1: Basic Communication Structure for Substation and Feeder: Principles and models
- [2] IEC 61850-7-2: Abstract communication service interface (ACSI)
- [3] IEC 61850-7-3: Common Data Classes
- [4] IEC 61850-7-4: Compatible logical node classes and data classes
- [5] IEC 61850-8: Specific communication service mapping (SCSM)
- [6] IEC 61850-8-1: Mappings to MMS (ISO/IEC9506-1 and ISO/IEC 9506-2)
- [7] IEC 61850-9: Specific communication service mapping (SCSM)
- [8] IEC 61850-9-2: Sampled values over ISO/IEC 8802-3
- [9] IEC 61850-10-: Conformance testing

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2.2.2 Informative

None

2.3 Definitions

2.3.1 General

None

2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

Abbreviation	Description
ACSI	Abstract Communication Service Interface
BRCB	Buffered Report Control Block
GOOSE	Generic Object Oriented Substation Event
GSE	Generic Substation Event
GSSE	Generic Substation State Event
HMI	Human Machine Interface
MMS	Machine Manufacturing Specification
PICS	Protocol Information Conformance Statement
PIXIT	Extra Protocol Information Conformance for Testing
SCSM	Specific Communication Service Mapping
TICS	Technical Issue Conformance Statement

2.5 Roles and responsibilities

This document forms a standard for the adoption of IEC61850 standard.

2.6 Process for monitoring

PTM&C shall be responsible for revising the document as required.

2.7 Related/supporting documents

Not applicable.

3. Requirements

3.1 Protocol Implementation Conformance (PIC) Requirements

3.1.1 Basic Conformance Requirements

Eskom Transmission and Distribution requirements for ACSI Basic Conformance are presented in Table 1.

Table 1: ACSI Basic Conformance Requirements

ACSI BASIC CONFORMANCE STATEMENT				
		Client / Subscriber	Server / Publisher	Value / Comments
Client Server Roles				
B11	Server Side (of two party application association)	-	Y	NA
B12	Client Side (of two party application association)	Y	-	NA
What is Two Party Application Association The application association model consists of provisions on how the communication between various types of devices is achieved. It defines services provided for managing associations between Client and Server (Two Party Associations) It defines services provided for managing associations for Multicast Messaging (GOOSE, Sampled Values)				
Specific Communication Service Mapping (SCSM) Supported				
B21	SCSM: IEC61850-8-1 used (MMS)	Y	Y	
B22	SCSM: IEC61850-9-1 used (Sampled values over serial link)	N/A	N/A	
B23	SCSM: IEC61850-9-2 used (Sampled Values over LAN)	Preferable	Preferable	
B24	SCSM: Other	N/A	N	
Generic Substation Event (GSE)				
B31	Publisher side	-	Y	
B32	Subscriber side	Y	-	

3.1.2 Model Conformance Requirements

Eskom Transmission and Distribution requirements for ACSI Model Conformance are presented in Table 2, 3 and 4.

Table 2: ACSI Model Conformance Requirements – Part 1

ACSI MODEL CONFORMANCE STATEMENT				
	Models	Client / Subscriber	Server / Publisher	Value / Comments
If Server or Client Side is supported				
M1	Logical Device	Y	Y	
M2	Logical Node	Y	Y	
M3	Data	Y	Y	
M4	Dataset	Y	Y	
M5	Substitution	Y	Y	Eskom Use: Substitutes MX and ST values for Commissioning
M6	Setting Group Control	Y	Y	Preferred

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Table 3: ACSI Model Conformance Requirements – Part 2

ACSI MODEL CONFORMANCE STATEMENT				
	Models	Client / Subscriber	Server / Publisher	Value / Comments
Reporting				
M7	Buffered Report Control	Y	Y	
M7-1	sequence number	Y	Y	Seq Number shall be included in report
M7-2	report time stamp	Y	Y	Time of entry shall be included in report
M7-3	reason for inclusion	Y	Y	ReasonCode shall be included in report
M7-4	data set name	Y	Y	Dataset name to be included in report
M7-5	data reference	Y	Y	Data or Data Attribute Red to be included in report
M7-6	buffer overflow	Y	Y	Buffer Overflow to be included in report
M7-7	entry ID	Y	Y	Shall represent an Arbitrary OCTET STRING used to identify an entry in a sequence of events in a Buffered report. BRCB to start sending the next report which follows the value in the Entry ID parameter in the BRCB.
M7-8	BufTm	Y	Y	Shall specify the time in (ms) for buffering of internal notifications caused by dchg, qchg, dupd by the BRCB for inclusion into a single report
M7-9	IntgPd	Y	Y	(Period in (ms) used for generating an integrity report)
M7-10	GI (General Interrogation)	Y	Y	Shall indicate the request for the BRCB to start the interrogation process
M7-11	conf rev	Y	Y	Configuration Revision
M8	Unbuffered Report Control	Y	Y	
M8-1	sequence number	Y	Y	Seq Number shall be included in report
M8-2	report time stamp	Y	Y	Time of entry shall be included in report
M8-3	reason for inclusion	Y	Y	ReasonCode shall be included in report
M8-4	data set name	Y	Y	Dataset name to be included in report
M8-5	data reference	Y	Y	Data or Data Attribute Red to be included in report
M8-6	BufTm	Y	Y	Shall specify the time in (ms) for buffering of internal notifications caused by dchg, qchg, dupd by the BRCB for inclusion into a single report
M8-7	IntgPd	Y	Y	(Period in ms used for generating an integrity report)
M8-8	GI (General Interrogation)	Y	Y	Shall indicate the request for the BRCB to start the interrogation process
M8-9	conf rev	Y	Y	Configuration Revision

Table 4: ACSI Model Conformance Requirements – Part 3

ACSI MODEL CONFORMANCE STATEMENT				
	Models	Client / Subscriber	Server / Publisher	Value / Comments
	Logging			
	Many IEDS have an internal storage of historical data (metering type periodic data as well as SOE). The LOG is a circular buffer that overwrites the oldest values in the LOG. LOG Entries are identified by Entry ID and Time of Entry			
M9	Log Control	Y	P	
M9-1	IntgPd	Y	P	
M10	Log	Y	P	Log shall be filled on a FIFO basis. Log shall have a structure as defined in Table 27 of 7-2.
	Control			
M11	Control	Y	Y	Data related to external devices, control outputs may require to be controlled by a client. The control model allows data with a FC of CO or SP to be operated.
	GSE			
M12	GOOSE	Y	Y	
M13	GSSE	N	N	
	SVC			
M14	Multicast SVC	P	P	
M15	Unicast SVC	P	P	
M16	Time	Y	Y	Subscribe and Publish time .
M17	File Transfer	Y	Y	

3.1.3 Service Conformance Requirements

Eskom Transmission and Distribution requirements for ACSI Service Conformance are presented in Table 5, 6 and 7.

Table 5: ACSI Service Conformance Requirements – Part 1

ACSI SERVICE CONFORMANCE STATEMENT					
	Services	AA: TP/MC	Client / Subscriber	Server / Publisher	Value / Comments
	Server				
S1	ServerDirectory	TP		Y	To support self description the GetXXDirectory and GetXXDefinition are specified . Client shall use the GetServerDirectory to retrieve a list of the names of all LD or Files made visible and thus accessible to the client. <i>Client shall support the GetServerDirectory</i>
	Application Association				
S2	Associate		Y	Y	Establish an association. A client shall use the Associate service to establish a two party association with a specific server.
S3	Abort		Y	Y	Abort an association. Abort shall be used to abruptly disconnect a specific application association between a client and server.
S4	Release		Y	Y	Release an association. Release shall be used to gracefully disconnect a specific application association between a client and server. Graceful means that all service requests shall be completed before termination.

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Table 6: ACSI Service Conformance Requirements – Part 2

ACSI SERVICE CONFORMANCE STATEMENT					
	Services	AA: TP/MC	Client / Subscriber	Server / Publisher	Value / Comments
Logical Device					
S5	Logical DeviceDirectory	TP	Y	Y	
Logical Node					
S6	LogicalNodeDirectory	TP	Y	Y	
S7	GetAllDataValues	TP	P	Y	A client shall use GetAllDataValues service to retrieve all Data Attribute values having the same functional constraint of all DATA made visible thus making it accessible to the client.
Data					
S8	GetDataValues	TP	Y	Y	
S9	SetDataValues	TP	Y	Y	Client shall use this service to set values of DATA ATTRIBUTES
S10	GetDataDirectory	TP	Y	Y	Client shall use this service to retrieve all Data Attributes
S11	GetDataDefinition	TP	Y	Y	Client shall use this service to retrieve the complete list of all the DATA ATTRIBUTE definitions.
Data set					
S12	GetDataSetValues	TP	Y	Y	
S13	SetDataSetValues	TP	P	P	Client shall use this service to set values of DATA ATTRIBUTES in the DATA SET.
S14	Create DataSet	TP	Y	Y	
S15	Delete DataSet	TP	Y	Y	
S16	GetDataSetDirectory	TP	Y	Y	Client shall use this service to retrieve the complete list of all the OBJECT REFERENCES of the data set members
Substitution					
S17	SetDataValues	TP	Y	Y	
Setting Group Control					
S18	SelectActiveSG	TP	Y	Y	Select which SG shall become the active SG
S19	SelectEditSG	TP	P	P	Select which SG shall become the SG that can be edited after selecting
S20	SetSGValues	TP	P	P	Write values to the SG which has been selected for editing
S21	ConfirmEditSGValues	TP	P	P	Confirm the new values to the SG
S22	GetSGValues	TP	Y	Y	Read values from SG
S23	GetSGCBValues	TP	Y	Y	Read all attributes of the SG CB
Buffered Reporting					
S24	Report	TP	Y	Y	Send a report
S24-1	data-change (dchg)		Y	Y	
S24-2	quality-change (qchg)		Y	Y	
S24-3	data-update (dupd)		Y	Y	
S25	GetBRCBValues	TP	Y	Y	
S26	SetBRCBValues	TP	Y	Y	
Unbuffered Reporting					
S27	Report	TP	Y	Y	Send a report
S27-1	data-change (dchg)		Y	Y	If the server has enough buffered reports then there is no need to support unbuffered reporting - 8 buffered reports
S27-2	quality-change (qchg)		Y	Y	
S27-3	data-update (dupd)		Y	Y	
S28	GetURCBValues	TP	Y	Y	
S29	SetURCBValues	TP	Y	Y	

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Table 7: ACSI Service Conformance Requirements – Part 3

ACSI SERVICE CONFORMANCE STATEMENT					
	Services	AA: TP/MC	Client / Subscriber	Server / Publisher	Value / Comments
	Logging				
	Log Control Block				
S30	GetLCBValues	TP	Y	Y	
S31	SetLCBValues	TP	P	P	
	Log				
S32	QueryLogByTime	TP	Y	Y	
S33	QueryLogAfter	TP	P	Y	
S34	GetLogStatusValues	TP	Y	Y	
	Generic Substation Event (GSE)				
	GOOSE				
S35	SendGOOSEMessage	TP	Y	Y	
S36	GetGoReference	TP	Y	Y	
S37	GetGOOSEElementNumber	TP	Y	Y	
S38	GetGoCBValues	TP	Y	Y	
S39	SetGoCBValues	TP	Y	Y	
	Generic Substation Event (GSE)				
	GSSE				
S40	SendGSSEMessage	TP			
S41	GetReference	TP			
S42	GetGSSEElementNumber	TP			
S43	GetGsCBValues	TP			
S44	SetGSCBValues	TP			
	Transmission of Sampled Values				
	Multicast				
S45	SendMSVMessage	MC		P	
S46	GetMSVCBValues	TP	P	P	
S47	SetMSVCBValues	TP	P	P	
	Unicast				
S48	SendUSVMessage	TP			
S49	GetUSVCBValues	TP			
S50	SetUSVCBValues	TP			
	Control				
S51	Select	TP	Y	Y	
S52	SelectWithValue	TP	Y	Y	
S53	Cancel	TP	Y	Y	
S54	Operate	TP	Y	Y	
S55	Command-Termination	TP	Y	Y	
S56	TimeActivated-Operate	TP	Y	Y	
	File Transfer				
S57	GetFile	TP	Y	Y	
S58	SetFile	TP	P	P	
S59	DeleteFile	TP	Y	Y	
S60	GetFileAttributeValues	TP	Y	Y	
	Time				
T1	Time Resolution of Internal Clock (nearest to neg power of 2 in secs)	TP	-10	-10	
T2	Time Accuracy of internal clock (T0, T1, T2, T3, T4, T5)	TP	T1	T1	T1 or better
T3	Supported TimeStamp Resolution	TP	1ms	1ms	

3.2 Protocol Implementation Extra Information Requirements

Eskom Transmission and Distribution requirements for Protocol Implementation Extra Information Conformance Requirements are presented in Tables 8 – 15.

Table 8: PIXIT Conformance Requirements – Association Model

PIXIT - ASSOCIATION MODEL		
No	Description	Eskom Requirements/Comments
1	Max no of clients that can setup an association simultaneously	10
2	TCP_KEEPALIVE Value	Configurable preferable bet 1 - 20 Mandatory: 5s
3	Lost Connection Detection Time	As long as products provide an indication that connection is lost within 15s but it is preferable if it is configurable.
4	Is authentication supported	Not Required / Preferred
5	What association parameters are necessary for successful association	Transport Selector: Y Session Selector: Y Presentation Selector: Y AP Title: N AE Qualifier: N
6	If Association parameters are necessary, describe the correct values	Transport Selector: 0001 (default) Session Selector: 0001 (default) Presentation Selector: 00000001 (default) AP Title: N/A AE Qualifier: N/A
7	What is the maximum and minimum MMS PDU size	128 to 32000 bytes
8	What is the maximum startup time after a power supply interrupt	2mins Max

Table 9: PIXIT Conformance Requirements – Settings Group Control Model

PIXIT - SETTING GROUP CONTROL MODEL		
No	Description	Eskom Requirements / Comments
1	What is the supported number of Setting Groups for each Logical Device	Min 2
2	What is the effect of when and how non volatile storage is updated	1. Settings group change shall not affect operation of a commissioned IED. 2. Shall only update non volatile storage once all settings have been received and fully committed.
3	Can multiple clients edit the same settings group	No
4	What happens if the association is lost while editing a settings group	Shall discard all settings
5	Is EditSG value 0 allowed	Preferred

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Table 10: PIXIT Conformance Requirements – Server, Dataset and Substitution Model

PIXIT - SERVER MODEL		
No	Description	Eskom Requirements/Comments
1	Quality Bits - Analogue / measurements: Which quality bits are supported (can be set by the server)?	Validity: Good - Y Invalid - Y Reserved - N Questionable - Y Overflow - Y Out of Range - N Bad Reference - N Oscillatory - N Failure - N OldData - Y Inconsistent - N Inaccurate - N Source: Process: Y Substituted: Y Test: Y OperatorBlocked: Y
2	Quality Bits - Status: Which quality bits are supported (can be set by the server)?	Validity: Good - Y Invalid - Y Reserved - N Questionable - Y Bad Reference - N Oscillatory - N Failure - N OldData - Y Inconsistent - N Inaccurate - N Source: Process: Y Substituted: Y Test: Y OperatorBlocked: Y
3	What is the maximum number of data values in one "GetDataValues" request?	MMS PDU is the limit.
4	What is the maximum number of data values in one "SetDataValues" request?	MMS PDU is the limit.
5	Measurement Deadbands	Configurable on steps of 0.1%
PIXIT - DATA SET MODEL		
No	Description	Eskom Requirements/Comments
1	What is the maximum number of data elements in one data set?	100
2	How many persistent datasets can be created by one or more clients?	Preferred
3	How many non- persistent datasets can be created by one or more clients?	Preferred
PIXIT - SUBSTITUTION MODEL		
No	Description	Eskom Requirements
1	Substitution	Substitution of a value is supported. Quality shall be substituted.

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Table 11: PIXIT Conformance Requirements – Reporting Model

PIXIT - REPORTING MODEL		
No	Description	Eskom Requirements/Comments
1	The supported trigger conditions are:	Integrity: Y, Y Data Change: Y, Y Quality Change: Y Data Update: Y General Interrogation: Y, Y
2	The supported optional fields are:	sequence-number: Y, Y report-time-stamp: Y, Y reason for inclusion: Y, Y data-set-name: Y, Y data-reference: Y, Y buffer-overflow: Y entry ID: Y conf-rev: Y, Y segmentation: Y
3	Can the server send segmented reports? Reports will be segmented and sent with sub-sequence numbers if the data is too big to fit into a single MMS frame.	Yes
4	Mechanism on the second internal data change notification of the same analogue data value within the buffer period	Send report immediately
5	Multi client URCB approach	Min Requirement: 1 report control block per client
6	What is the buffer size for each BRCB or how many reports can be buffered?	Fully populated report control blocks. Min 20 BRCB instances
7	Dataset Assignment: May the reported dataset contain: a) Structured data objects b) Data Attributes c) Timestamp data attributes	a) Y, b) Y, c) Y,
8	What is the scan cycle for binary events? Is this fixed or configurable?	Configurable Min: 1ms
9	Supported FC	Only FC MX and ST can be included in datasets for reporting.
10	Does the Client support IEDs with indexed and non-indexed report control blocks (RCB)?	Support for Both Indexed and Non-Indexed RCB

Table 12: PIXIT Conformance Requirements – Logging Model

PIXIT - LOGGING MODEL		
No	Description	Eskom Requirements/Comments
1	General	Preferred - Supported

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Table 13: PIXIT Conformance Requirements – GSE Model

PIXIT - GSE MODEL		
No	Description	Eskom Requirements
1	Message Validation What elements of a subscribed GOOSE header are checked to decide the message is valid and AllData values are accepted? If Y, describe the conditions. Note: VLAN tag is removed by an Ethernet switch and should not be checked	Dest MAC Address: Y Frame EtherType: 0x88B8 Appl ID: GoCB Ref Time Allowed to Live: Y DataSet: Y GoID: Y t: P stNum: Y sqNum: Y test: Y confRev: Y numDatSetEntries: Y
2	Can the test flag in the published GOOSE be turned on/off?	N
3	When is a subscribed GOOSE lost? (TAL = time allowed to live value from the last received GOOSE message)	If GOOSE message is not received within the TAL from the last received
4	What is the behaviour when one or more subscribed GOOSE messages isn't received or syntactically incorrect (Missing GOOSE)?	Internal data change its status to "unhealthy" if TAL times out.
5	What is the behaviour when one or more subscribed GOOSE messages is out of order?	Alarm option for this behaviour. GOOSE message should not be processed
6	What is the behaviour when one or more subscribed GOOSE messages is duplicated?	Alarm option for this behaviour. GOOSE message should not be processed
7	Does the device subscribe to GOOSE messages with/without the VLAN tag?	with VLAN: Y
8	May the GOOSE dataset contain: a) Structured data objects b) Data Attributes c) Timestamp data attributes	a) Y b) Y c) Y
9	What is the slow retransmission time? Is it fixed or configurable?	Configurable Shouldn't be less than 100ms
10	What is the fast retransmission scheme? Is it fixed or configurable?	Configurable
11	Can the GOOSE Publish be turned on/off by using SetGoCBValues (GoEna)?	N
12	How does the receiving IED treat GOOSE messages with T = true and NdsCom = Y?	The GOOSE message should not be acted upon

Table 14: PIXIT Conformance Requirements – Time Synch Model

PIXIT - TIME SYNCH MODEL		
No	Description	Eskom Requirements
1	What quality bits are supported?	Clock Failure: Y Clock Not Synchronised: Y LeapSecondsKnown: Y
2	Describe the behaviour when the time synchronisation signal/messages are lost	Supplier to describe behaviour. Shall send a clock failure alarm.
3	Time quality bit "clock failure" shall be set when?	Estimated deviation exceeds a certain value.
4	Time quality bit "clock not synchronised" shall be set when?	Loss of time synchronisation
5	Does the device support time zone and daylight saving?	Time Zone and Daylight saving
6	Which attributes of SNTP response packet are validated?	Leap Indicator not equal to 3: Y Model is equal to SERVER: Y Originate Time Stamp is equal to value sent by the SNTP client as Transmit Timestamp: Y Rx/Tx timestamp fields are checked reasonableness: Y SNTP version 4: Y
7	Time accuracy of the IED	T1, T2, T3, T4

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Table 15: PIXIT Conformance Requirements – File Transfer Model

PIXIT - FILE TRANSFER MODEL		
No	Description	Eskom Requirements
1	What is the structure of files?	Comtrade files
2	Is the Internet Engineering Task Force FTP Protocol also implemented?	Y
3	Directory names are separated from the file by?	/
4	The maximum file name size including path (recommended 64 chars)	64
5	Are directory / file name case sensitive?	N
6	Is the wild char supported MMS fileDirectory request?	preferable
7	Is it allowed that 2 Clients get a file at the same time?	preferable Y
8	FTP Authentication	Y

3.3 Technical Issues Conformance Requirements

It shall be mandatory for all tissues listed on the IEC61850 Tissues website (tissues.iec61850.com) that relates to interoperability of the supported IEC61850 edition to be implemented.

4. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Sham Dhrampal	Group IT: Corporate Specialist
Prince Moyo	General Manager: Power Delivery Engineering
Mervin Mottian	Dx SCADA Managers Forum Convenor
Prudence Madiba	Senior Manager: Electrical and C&I Engineering
Isabel Fick	Senior Manager: Telecommunications
Comfort Masike	Senior Manager: System Operator
Danie Conradie	Senior Manager: Distribution
Lenah Mothata	Senior Manager: Transmission

5. Revisions

Date	Rev	Compiler	Remarks
Feb 2019	2	M Sukhnandan	Document template has been changed. No technical content changes.
Nov 2013	1	M Sukhnandan	First issue

6. Development team

The following persons were involved in the development of this document:

- Tertius Hyman - Western Cape Operating Unit
- Marlini Sukhnandan - PTM&C – Control and Automation

7. Acknowledgements

Not applicable.