Eskom	Standard	Transmission

Title: **STANDARD FOR ASSIGNING PHYSICAL DEVICE TECHNICAL KEYS IN TRANSMISSION**

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Compiled by	Approved by	Authorized by
Indresen Chetty	**Rishi Hariram**	**Nelson Luthuli**
Senior Technologist - Control & Automation Technology and Support	**Manager - Control and Automation Technology and Support**	**Acting Senior Manager - PTM&C**
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Supported by SCOT/SC

Anita Oommen

PASC Chairperson

Date: 24th November 2021

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SCOT Study Committee Number/Name: **Protection and Automation Study Committee**

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Executive Summary

Technical keys are issued to intelligent electronic devices (IEDs) deployed in substations that adopt the IEC 61850 standard for substation automation. Technical keys are a combination of alphanumeric characters that form a unique name for the device. This document lays out the standard for creating a technical key by following a standard naming structure.

1. Introduction

Eskom Transmission has adopted the IEC 61850 standard for substation automation. To take advantage of the technology and fully utilize the high speed messaging services of GOOSE and MMS, each intelligent electronic device must have a unique name called the technical key assigned to it. This technical key is different from the unique MAC address and the assigned IP address.

This document provides a structured breakdown approach to assigning a technical key from substation voltage level down to the IED.

2. Supporting clauses

2.1 Scope

This standard shall apply to all IEDs that require a technical key in Eskom Transmission substations and covers all substation arrangements and control room network topologies.

2.1.1 Purpose

This document will provide a standard naming convention and prevent duplicate technical keys from being issued on two or more IEDs across Transmission substations and on the same substation LAN.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings SOC Limited's Transmission Division.

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] ISO 9001, Quality Management Systems.

[2] IEC 61850 Communication Networks and Systems in Substations

[3] IEC 81436 Industrial installations and Equipment and Industrial products-structuring principles and references.

2.2.2 Informative

None

2.3 Definitions

2.3.1 General

Definition	Description
BAY 1	In a Breaker and a Half substation layout this is the Bay in a Diameter connected to Bus bar 1 and consists of a Breaker with Isolators on both sides of the Breaker.
BAY 2	In a Breaker and a Half substation layout this is the Bay in a Diameter connected to bus bar 2 and consists of a Breaker with Isolators on both sides of the Breaker.
Bay Identifier	A number allocated to a bay to differentiate it from other bays of the same type

Definition	Description
Breaker and a Half operating system	There will be more than one diameter (connections) between the two Bus bars, and it will consist of three breakers with isolators to complete the circuit in one diameter. The system provides for circuit breaker maintenance, since any breaker can be removed from service and isolated without interrupting any circuit.
Diameter	Means the Breaker and a Half circuit consisting of one or two connectors to complete the connection to the two Bus bars and may include the Tie Breaker.
GOOSE	Messaging between peer to peer devices.
IED	A microprocessor-based device that encompasses all or some of the following functionalities: protection, control and automation, metering, telecontrol, substation DC and auxiliary supply systems, quality of supply monitoring, and disturbance and event recording.
Object	Means the primary plant being protected e.g. feeder, transformer etc.
Object Identifier	The object number being protected by the IED. E.g. Feeder 2
Panel or bay	Means all the apparatus in the same circuit situated in live chambers, prohibited or restricted areas, from and including the bus bar isolators and / or connectors.
Process Interface Unit	Also referred to as a ‘digital merging unit’ or ‘binary input/output device’; an Intelligent Electronic Device (IED) that collects binary data from process devices, typically electrical primary plant equipment, by way of status contacts, and processes and publishes this data to other IEDs in a digital format (e.g. IEC 61580-based communication). The device similarly converts digital commands from other IEDs into electrical control signals to the primary equipment. PIUs are typically installed on or near the primary equipment with which they exchange data.
Scheme	A set of components that work together to execute a specific behaviour under predefined power system conditions sensed through the scheme interface. ‘Scheme’ is most commonly applied in the context of power system protection equipment, although tele-control items such as gateways and associated hardware and software may also be defined as a ‘scheme’.
Tie Bay	Serves as the connection between one or two Connectors within a diameter consisting of its own circuit breaker with isolators on both sides of the circuit breaker.

2.3.2 Disclosure classification

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

2.4 Abbreviations

Abbreviation	Description
COE	Centre of Excellence
DC	Direct Current
DCD	Diameter Control Device
DFR	Disturbance Fault Recorder
GOOSE	Generic Object Orientated Substation Event
GPS	Global Positioning System

Abbreviation	Description
HMI	Human Machine Interface
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device
IP	Internet Protocol
LAN	Local Area Network.
MMS	Manufacture Messaging Service
PIU	Process Interface Unit
PTM&C	Protection Telecommunication Metering and Control
SCOT	Steering Committee of Technology
SDS	Serial Device Server

2.5 Roles and responsibilities

The PTM&C - Project Planning and Support Department is responsible for creating technical keys and distributing to the various stakeholders who require the technical keys.

2.6 Process for Monitoring

Not applicable.

2.7 Related/supporting documents

Not applicable.

3. Breakdown of Naming Structure

This standard covers the method to assign technical keys to IEDs used in four broadly classified groups of schemes. Namely

- Double Bus Bar schemes
- Breaker and a Half schemes
- Common Equipment schemes
- Control and Automation schemes

The naming structure allocates alphanumeric characters to a substation identifier, switch gear voltage level identifier, object identifier(if possible), scheme/bay identifier and IED identifier.

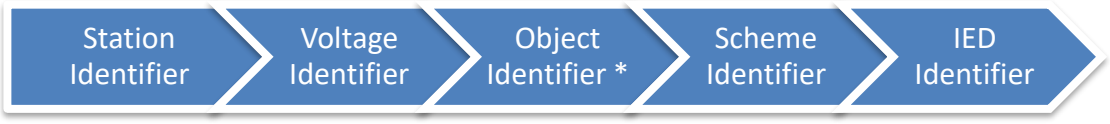

Figure 1: Breakdown of structure to assign a Technical Key

*The Object Identifier may not be allocated on some schemes.

3.1 Double Busbar Substation Arrangement Schemes

3.1.1 Substation Identifier

The first three characters of the technical key are uniquely allocated to identify the substation. The PTM&C Control Applications department are responsible to allocate and update the station indentifier. A comphrensive list of existing Transmission substations can be requested from the PTM&C Control Applications department.

Table 1: Substation Identifier

1. Substation Designation (Central Control System)	**Characters**							**Comments**
Unique designation for each substation (AA1, AA2,... etc)	**AA1**							As per IEC 81346

3.1.2 Switchgear Voltage level

The next set of characters describes the voltage class of the switchgear at the substation. IEC 81346 Table 4 provides alphanumeric coding within voltage ranges denoted by an alphabet and *n.* Table 2 covers the Eskom operating voltage of 0,4kV to 765kV. If only one Eskom operating voltage falls within a voltage range the number 1 is placed as a suffix to the alphabet allocated. When two or more operating voltages fall within an allocated voltage range. E.g. The Substation operating voltage of 275kV is denoted as D1 since it lies within the 220 ≤ U_n < 380 kV range. Substation operating voltage of 220kV is denoted as D2 since it also lies within the 220 ≤ U_n < 380 kV range together with 275kV. Schemes without switchgear interface adopts the substations highest operating voltage.

Table 2: Switchgear Voltage Level

2. Switchgear Voltage Level									
Voltage Class	**Operating Voltage (kV)**	**Characters**							**Comments**
Switchgear U_n > 420kV (Bn)	**765**		**B**	**1**					As per IEC 81346 The green column denotes Switchgear Voltage Level.
Switchgear 380 ≤ U_n ≤ 420 kV (Cn)	**400**		**C**	**1**					
Switchgear 220 ≤ U_n < 380 kV (Dn)	**275**		**D**	**1**					
Switchgear 220 ≤ U_n < 380 kV (Dn)	**220**		**D**	**2**					
Switchgear 110 ≤ U_n < 220 kV (En)	**132**		**E**	**1**					
Switchgear 60 ≤ U_n < 110 kV (Fn)	**88**		**F**	**1**					
Switchgear 60 ≤ U_n < 110 kV (Fn)	**66**		**F**	**2**					
Switchgear 45 ≤ U_n < 60 kV (Gn)	**50**		**G**	**1**					
Switchgear 30 ≤ U_n < 45 kV (Hn)	**44**		**H**	**1**					
Switchgear 30 ≤ U_n < 45 kV (Hn)	**33**		**H**	**2**					
Switchgear 20 ≤ U_n < 30 kV (Jn)	**22**		**J**	**1**					
Switchgear 10 ≤ U_n < 20 kV (Kn)	**11**		**K**	**1**					
Switchgear 6 ≤ U_n < 10 kV (Ln)	**6,6**		**L**	**1**					
Switchgear 1 ≤ U_n < 6 kV (Mn)	**3,3**		**M**	**1**					
Switchgear U_n < 1 kV (Nn)	**0,4**		**N**	**1**					

3.1.3 Object Identifier - Double Busbar Schemes

The Object Identifier allocates an alphabet to the object being protected by the IED. E.g. A feeder will be allocated an alphabet F.

Table 3: Object Identifiers - Double Busbar Schemes

3. Object Indentifier									
Description of the Object	**Characters**							**Comments**
Feeder				**F**				Object Identifiers
Transformer				**T**				
Line Reactor				**L**				
Busbar Reactor				**R**				
Series Reactor				**X**				
Generator bay				**G**				
Bus Coupler				**C**				
Bus Section				**S**				
Capacitor bank				**B**				

3.1.4 Bay Identifier - Double Busbar Schemes

The Bay Identifier allocates 2 characters to distinguish between multiple bays of the same type. E.g. Feeder 2 will be allocated 02. Feeder 10 will be allocated 10.

Table 4: Bay Identifiers - Double Busbar Schemes

4. Bay Identifier								
Description of the Bay	**Characters**							**Comments**
Feeder 1					**0**	**1**		Numbers/letters associated with a particular bay
Feeder 2					**0**	**2**		
Feeder 3					**0**	**3**		
Feeder 4					**0**	**4**		
Feeder 5					**0**	**5**		
Feeder 6					**0**	**6**		
Feeder 10					**1**	**0**		
Transformer 31					**3**	**1**		
Bus Coupler A					**0**	**A**		0B' for the next Bus Coupler
Bus Section					**#**	**#**		1st # = Busbar No, 2nd # = Bus Section No
Transfer Coupler					**T**	**#**		# = A, B, C, …
Reactor					**#**	**#**		Reactor on Feeder/Busbar No ##,
Capacitor Bank 01					**0**	**1**		According to the Capacitor bank number 01, 31, etc.

3.1.5 IED Identifier - Double Busbar Schemes

The IED identifier provides an alphanumeric code to describe the IEDs. A list of IEDs used in the double busbar station is provided in the below. E.g. IED Main 1 / Main is allocated A3 as its IED identifier.

Table 5: IED identifier - Double Busbar Schemes

Description of the IED	Characters							Comments
Breaker PIU - Main 1 / Main							**A1**	Letter and number associated with the IED type
Breaker PIU - Main 2 / Backup							**A2**	
IED - Main 1 / Main							**A3**	
IED - Main 2 / Backup							**A4**	
Transformer / Reactor PIU - Main 1							**A5**	
Transformer / Reactor PIU - Main 2							**A6**	
Tap Change PIU							**A7**	
3rd Party C/Diff - Main 1							**A8**	
3rd Party C/Diff - Main 2							**A9**	
Bay Ethernet Switch - Main 1 / Main							**Y1**	
Bay Ethernet Switch - Main 2 / Backup							**Y2**	
D25 IED - Main (Bus Coupler/Bus section)							**E1**	
Bay Processor IED (Legacy)							**E2**	
Test Set 1 - Main 1 / Main							**B1**	
Test Set 1 - Main 2 / Backup							**B2**	
Test Set 2 - Main 1 / Main							**B3**	
Test Set 2 - Main 2 / Backup							**B4**	
Measurements Device 1							**M1**	
Measurements Device 2							**M2**	
Measurements Device 3							**M3**	

3.1.6 Practical Examples- Double Busbar Schemes

The examples below make use of the breakdown and allocation structure mentioned above.

Step 1. Allocate the substation identifier characters from Table 1.

Step 2. Allocate the switchgear voltage level characters from Table 2.

Step 3. Allocate the object identifier characters from Table 3.

Step 4. Allocate the bay identifier from Table 4.

Step 5. Allocate the IED identifier from Table 5.

Table 6: Examples of Double Busbar Schemes Technical Keys

Bay Description	Technical Key Name						
Substation AA1, 765kV Feeder 01, Main 1 Breaker PIU	**AA1**	**B**	**1**	**F**	**0**	**1**	**A1**
Substation AA4, 400/132/22kV Transformer 31, Main 2 IED	**AA4**	**C**	**1**	**T**	**3**	**1**	**A4**

3.2 Breaker and a Half Substation Arrangement Schemes

3.2.1 Substation Designation

The first three characters of the technical key are uniquely allocated to identify the substation. The PTM&C Control Applications department are responsible allocate and update the station identifier. A comprehensive list of existing Transmission substations can be requested from the PTM&C Control Applications department.

Table 7: Substation Identifier

1. Substation Designation (Central Control System)	**Characters**							**Comments**
Unique designation for each substation (AA1, AA2,... etc)	**AA1**							As per IEC 81346

3.2.2 Switch Gear Voltage Level Breaker and a Half

The next set of characters describes the voltage class of the switch gear at the substation. IEC 81346 Table 4 provides alphanumeric coding within voltage ranges denoted by an alphabet and *n.* Table 8 covers the Eskom operating voltage of 0,4kV to 765kV. If only one Eskom operating voltage falls within a voltage range the number 1 is placed as a suffix to the alphabet allocated. When two or more operating voltages fall within Aan allocated voltage range. E.g. Substation operating voltage of 275kV is denoted as D1 since it lies within the A220 ≤ U_n < 380 kV range. Schemes without switchgear interface adopts the substations highest operating voltage.

Table 8: Switchgear Voltage Level

2. Switchgear Voltage Level									
Voltage Class	**Operating Voltage (kV)**	**Characters**							**Comments**
Switchgear U_n > 420kV (Bn)	**765**		**B**	**1**					As per IEC 81346 The green column denotes Switchgear Voltage Level.
Switchgear 380 ≤ U_n ≤ 420 kV (Cn)	**400**		**C**	**1**					
Switchgear 220 ≤ U_n < 380 kV (Dn)	**275**		**D**	**1**					
Switchgear 220 ≤ U_n < 380 kV (Dn)	**220**		**D**	**2**					
Switchgear 110 ≤ U_n < 220 kV (En)	**132**		**E**	**1**					
Switchgear 60 ≤ U_n < 110 kV (Fn)	**88**		**F**	**1**					
Switchgear 60 ≤ U_n < 110 kV (Fn)	**66**		**F**	**2**					
Switchgear 45 ≤ U_n < 60 kV (Gn)	**50**		**G**	**1**					
Switchgear 30 ≤ U_n < 45 kV (Hn)	**44**		**H**	**1**					
Switchgear 30 ≤ U_n < 45 kV (Hn)	**33**		**H**	**2**					
Switchgear 20 ≤ U_n < 30 kV (Jn)	**22**		**J**	**1**					
Switchgear 10 ≤ U_n < 20 kV (Kn)	**11**		**K**	**1**					
Switchgear 6 ≤ U_n < 10 kV (Ln)	**6,6**		**L**	**1**					
Switchgear 1 ≤ U_n < 6 kV (Mn)	**3,3**		**M**	**1**					
Switchgear U_n < 1 kV (Nn)	**0,4**		**N**	**1**					

3.2.3 Diameter Identifier - Breaker and a Half Schemes

The diameter identifier allocates two alphabet characters. The first alphabet denotes the voltage level and the second alphabet identifies the Diameter. Noting that the operating voltage has been denoted previously.

Table 9: Diameter Identifier - Breaker and a Half Schemes

3. Diameter Identifier (Colour of the associated with Diameter Voltage, the Diameter identifiers)										
Diameter Description	**Operating Voltage**	**Characters**								**Comments**
Diameter A	**765**				**M**	**A**				M - Magenta, A - Diameter A
Diameter B	**765**				**M**	**B**				M - Magenta, B - Diameter B
Diameter C	**765**				**M**	**C**				M - Magenta, C - Diameter C
Diameter A	**400**				**G**	**A**				G - Verdigris Green, A - Diameter A
Diameter A	**275**				**O**	**A**				O - Orange, A - Diameter A
Diameter A	**220**				**T**	**A**				T - Tangerine, A - Diameter A
Diameter A	**132**				**B**	**A**				B - Arctic Blue, A - Diameter A
Diameter N (nth Diameter)	**765**				**M**	**N**				M - Magenta, N –Diameter N

3.2.4 Bay Identifier - Breaker and a Half Schemes

The Bay Identifier provides a number to describe the bay and differentiate it from other bays of the same type. A list of bays used in the Breaker and a Half station is provided inTable 10 below. E.g. Object 2 is allocated 5 as its Bay identifier.

Table 10: Bay Identifier - Breaker and a Half Schemes

4. Bay Identifier								
Bay Description	**Characters**							**Comments**
Bay 1						**1**		The number associated with a particular bay, 0 for the entire Diameter
Bay 2						**2**		
Tie Bay (Diameter Control Device (DCD))						**3**		
Object 1						**4**		
Object 2						**5**		
Reactor or Auxiliary Transformer - Object 1 Side						**6**		
Reactor or Auxiliary Transformer - Object 2 Side						**7**		
Diameter						**0**		

3.2.5 IED Identifier - Breaker and a Half Schemes

The IED identifier provides an alphanumeric code to describe the IEDs. A list of IEDs used in the Breaker and a Half station is provided inTable 11 below. E.g. IED / DCD Main 1 is allocated A3 as its IED identifier.

Table 11: IED Identifier - Breaker and a Half Schemes

5. IED Identifier								
IED Description	**Characters**							**Comments**
BAY PIU - Main 1							**A1**	Alphabets and numbers associated with the IED Type
BAY PIU - Main 2							**A2**	
IED / DCD - Main 1							**A3**	
IED / DCD - Main 2							**A4**	
Transformer PIU - Main 1							**A5**	
Transformer PIU - Main 2							**A6**	
3rd Party C/Diff - Main 1							**A8**	
3rd Party C/Diff - Main 2							**A9**	
Bay Ethernet Switch - Main 1							**Y1**	
Bay Ethernet Switch - Main 2							**Y2**	
Bay Ethernet Switch - Common							**Y3**	
D25 IED - Main (Bus Coupler/Bus section)							**E1**	
Bay Processor IED (Legacy)							**E2**	
Test Set 1 - Main 1							**B1**	
Test Set 1 - Main 2							**B2**	
Test Set 2 - Main 1							**B3**	
Test Set 2 - Main 2							**B4**	
Monitoring Device 1							**C1**	
Monitoring Device 2							**C2**	
Modem							**D1**	

3.2.6 Practical Examples- Breaker and a Half Schemes

The examples below make use of the break down and allocation structure mentioned above.

Step 1. Allocate the substation identifier from Table 7.

Step 2. Allocate the switchgear voltage level characters from Table 8.

Step 3. Allocate the diameter identifier from Table 9.

Step 4. Allocate the bay identifier from Table 10.

Step 5. Allocate the IED identifier from Table 11.

Table 12: Examples of Breaker and a Half Scheme Technical Keys

Bay Description	**Technical Key**						
Substation AA1, 765kV Diameter MA, Bay 1, Main 1 PIU	**AA1**	**B**	**1**	**M**	**A**	**1**	**A1**
Substation AA3, 400kV Diameter GB, Tie Bay, Main 2 DCD	**AA3**	**C**	**1**	**G**	**B**	**3**	**A4**

3.3 Common Equipment Schemes

3.3.1 Substation Designation

The first three characters of the technical key are uniquely allocated to identify the substation. The PTM&C Control Applications department are responsible allocate and update the station identifier. A comprehensive list of existing transmission substations can be requested from the PTM&C Control Applications department.

Table 13: Substation Identifier

1. Substation Designation (Central Control System)	**Characters**							**Comments**
Unique designation for each substation (AA1, AA2,... etc)	**AA1**							As per IEC 81346

3.3.2 Switchgear Voltage Level

The next set of characters describes the voltage class of the switch gear at the substation. IEC 81346 Table 4 provides alphanumeric coding within voltages ranges denoted by an alphabet and *n.* Table 14 covers the Eskom operating voltage of 0,4kV to 765kV. If only one Eskom operating voltage falls within a voltage range the number 1 is placed as a suffix to the alphabet allocated. When two or more operating voltages fall within an allocated voltage range. E.g. Substation operating voltage of 275kV is denoted as D1 since it lies within the 220 ≤ U_n < 380 kV range. Substation operating voltage of 220kV is denoted as D2 since it also lies within the 220 ≤ U_n < 380 kV range. Schemes without switchgear interface adopts the substations highest operating voltage.

Table 14: Switchgear Voltage Level

2. Switchgear Voltage Level									
Voltage Class	**Operating Voltage (kV)**	**Characters**							**Comments**
Switchgear U_n > 420kV (Bn)	**765**		**B**	**1**					As per IEC 81346 The green column denotes Switchgear Voltage Level.
Switchgear 380 ≤ U_n ≤ 420 kV (Cn)	**400**		**C**	**1**					
Switchgear 220 ≤ U_n < 380 kV (Dn)	**275**		**D**	**1**					
Switchgear 220 ≤ U_n < 380 kV (Dn)	**220**		**D**	**2**					
Switchgear 110 ≤ U_n < 220 kV (En)	**132**		**E**	**1**					
Switchgear 60 ≤ U_n < 110 kV (Fn)	**88**		**F**	**1**					
Switchgear 60 ≤ U_n < 110 kV (Fn)	**66**		**F**	**2**					
Switchgear 45 ≤ U_n < 60 kV (Gn)	**50**		**G**	**1**					
Switchgear 30 ≤ U_n < 45 kV (Hn)	**44**		**H**	**1**					
Switchgear 30 ≤ U_n < 45 kV (Hn)	**33**		**H**	**2**					
Switchgear 20 ≤ U_n < 30 kV (Jn)	**22**		**J**	**1**					
Switchgear 10 ≤ U_n < 20 kV (Kn)	**11**		**K**	**1**					
Switchgear 6 ≤ U_n < 10 kV (Ln)	**6,6**		**L**	**1**					
Switchgear 1 ≤ U_n < 6 kV (Mn)	**3,3**		**M**	**1**					
Switchgear U_n < 1 kV (Nn)	**0,4**		**N**	**1**					

3.3.3 Scheme Identifier - Common Equipment Schemes

The next set of alphanumeric's for the common equipment denotes the scheme identifier. Table 15 provides a list of common equipment. The alphabets will be assigned from the scheme type and the number will distinguish between different schemes of the same type.

Table 15: Scheme Identifier - Common Equipment Schemes

3. Scheme Identifier								
Scheme Description	**Characters**							**Comments**
Bus zone				**B**	**Z**	**#**		Letters identifying a particular scheme type. # denotes the scheme number 1, 2 etc. for the particular voltage level or for multiple voltage levels
Measurements				**M**	**E**	**#**		
Disturbance Fault Recorder (DFR)				**D**	**R**	**#**		
Tap Change				**T**	**C**	**#**		
Metering				**M**	**T**	**#**		
Under Frequency Load Shedding				**U**	**F**	**#**		

3.3.4 IED Identifier - Common Equipment Schemes

The IED identifier provides an alphanumeric code to describe the IEDs. A list of IEDs used in the Common Equipment are provided in Table 16 below. E.g. Metering IED 1 is allocated W1 as its IED identifier.

Table 16: IED Identifier - Common Equipment Schemes

4. IED Identifier								
IED Description	**Characters**							**Comments**
Bus zone Central Unit							**A1**	Letter and number associated with the IED Type
Measurements IED 1							**M1**	
Measurements IED 2							**M2**	
Measurements IED 3							**M3**	
Measurements IED 4							**M4**	
Disturbance Fault Recorder IED 1							**R1**	
Disturbance Fault Recorder IED 2							**R2**	
Disturbance Fault Recorder IED 3							**R3**	
Disturbance Fault Recorder IED 4							**R4**	
Disturbance Fault Recorder IED 5							**R5**	
Disturbance Fault Recorder IED 6							**R6**	
Tap Change IED 1							**T1**	
Tap Change IED 2							**T2**	
Tap Change PIU 1							**T3**	
Tap Change PIU 2							**T4**	
Scheme Ethernet Switch							**Y1**	
Serial Port Server							**D1**	
Test Set 1							**B1**	

IED Description	Characters							Comments
Metering IED 1							**W1**	
Metering IED 2							**W2**	
Metering IED 3							**W3**	
Metering IED 4							**W4**	
Under Frequency Load Shedding IED 1							**U1**	
Under Frequency Load Shedding IED 2							**U2**	

3.3.5 Practical Examples of Common Equipment Scheme Technical Keys

The examples below make use of the break down and allocation structure mentioned above.

Step 1. Allocate the substation identifier from Table 13.

Step 2. Allocate the switchgear voltage level characters from Table 14.

Step 3. Allocate the scheme identifier from Table 15.

Step 4. Allocate the IED identifier from Table 16.

Table 17: Examples of Common Equipment Scheme Technical Keys

Bay Description	Technical Key						
Substation AA1, 765kV Bus Zone Scheme 1, Bus Zone Central Unit	**AA1**	**B**	**1**	**B**	**Z**	**1**	**A1**
Substation AA3, 275kV DFR Scheme 2, DFR IED 2	**AA3**	**D**	**1**	**D**	**R**	**2**	**R2**

3.4 Control and Automation Equipment Schemes

3.4.1 Substation Identifier

The first three characters of the technical key are uniquely allocated to identify the substation. The PTM&C Control Applications department are responsible to allocate and update the station identifier. A comprehensive list of existing Transmission substations can be requested from the PTM&C Control Applications department.

Table 18: Substation Identifier

1. Substation Designation (Central Control System)	Characters								Comments
Unique designation for each substation (AA1, AA2,... etc)	**AA1**								As per IEC 81346

3.4.2 Switchgear Voltage level

The next set of characters describes the voltage class of the switch gear at the substation. IEC 81346 Table 4 provides alphanumeric coding within voltages ranges denoted by an alphabet and *n.* Table 19: Switchgear Voltage Level covers the Eskom operating voltage of 0,4kV to 765kV. If only one Eskom operating voltage falls within a voltage range the number 1 is placed as a suffix to the alphabet allocated. When two or more operating voltages fall within an allocated voltage range. E.g. Substation operating voltage of 275kV is denoted as D1 since it lies within the $220 \leq U_n < 380$ kV range. Substation operating voltage of 220kV is denoted as D2 since it also lies within the $220 \leq U_n < 380$ kV range. Schemes without switchgear interface adopts the substations highest operating voltage.

Table 19: Switchgear Voltage Level

2. Switchgear Voltage Level											
Voltage Class	**Operating Voltage (kV)**	**Characters**									**Comments**
Switchgear U_n > 420kV (Bn)	**765**		**B**	**1**							As per IEC 81346 The green column denotes Switchgear Voltage Level.
Switchgear 380 ≤ U_n ≤ 420 kV (Cn)	**400**		**C**	**1**							
Switchgear 220 ≤ U_n < 380 kV (Dn)	**275**		**D**	**1**							
Switchgear 220 ≤ U_n < 380 kV (Dn)	**220**		**D**	**2**							
Switchgear 110 ≤ U_n < 220 kV (En)	**132**		**E**	**1**							
Switchgear 60 ≤ U_n < 110 kV (Fn)	**88**		**F**	**1**							
Switchgear 60 ≤ U_n < 110 kV (Fn)	**66**		**F**	**2**							
Switchgear 45 ≤ U_n < 60 kV (Gn)	**50**		**G**	**1**							
Switchgear 30 ≤ U_n < 45 kV (Hn)	**44**		**H**	**1**							
Switchgear 30 ≤ U_n < 45 kV (Hn)	**33**		**H**	**2**							
Switchgear 20 ≤ U_n < 30 kV (Jn)	**22**		**J**	**1**							
Switchgear 10 ≤ U_n < 20 kV (Kn)	**11**		**K**	**1**							
Switchgear 6 ≤ U_n < 10 kV (Ln)	**6,6**		**L**	**1**							
Switchgear 1 ≤ U_n < 6 kV (Mn)	**3,3**		**M**	**1**							
Switchgear U_n < 1 kV (Nn)	**0,4**		**N**	**1**							

3.4.3 Scheme Identifier - Control and Automation Equipment

The Scheme identifier provides an alphanumeric code to describe the scheme. A list of schemes used in the Common Equipment are provided in Table 20 below. E.g. D20 Panel 1 is allocated E1 as its scheme identifier.

Table 20: Scheme Identifier - Control and Automation Equipment Schemes

3. Scheme Identifier									
Scheme Description	**Characters**								**Comments**
Common Equipment Panel				**C**	**#**				Letters associated with a scheme type except for DC. # is the Panel instance number or DC Voltage
D20 Panel				**E**	**#**				
Data Concentrator Panel				**D**	**#**				
Fibre Switching Panel #				**F**	**#**				
Gateway Panel				**G**	**#**				
HMI Server Module				**H**	**#**				
SDS Panel				**S**	**#**				
Station Panel #				**R**	**#**				
ITM Panel #				**I**	**#**				
DC Charger Panel				**J**	**#**				#: A = 220VDC, B = 110VDC, C = 50VDC
DC Board Panel				**B**	**#**				#: A = 220VDC, B = 110VDC, C = 50VDC

3.4.4 IED Identifier - Control and Automation Equipment Schemes

The IED identifier provides an alphanumeric code to describe the IEDs. A list of IEDs used in the Automation schemes are provided in Table 21 below. E.g. Gateway Ethernet Switch is allocated GS as its IED identifier.

Table 21: IED Identifier - Control and Automation Equipment Schemes

4. IED Identifier									
IED Description	**Characters**								**Comments**
Backbone Ethernet Switch						B	#		Letter/s associated with the IED type. # = IED Instance Number
Station Ethernet Switch						S	#		
Gateway Ethernet Switch						G	S		
Station Router						R	R		
Gateway						G	W		
GPS						T	S		
HMI						H	M		
Station IED						I	#		
Data Concentrator						C	#		
Engineering Workstation						E	#		
Serial Device Server						D	#		
Station RTU (D20)						U	#		
SDS Ethernet Switch						F	#		
SDS Media Converter						M	#		
DC Charger IED						J	#		
DC Board IED						K	#		

3.4.5 IED Redundancy / Virtual Machine Identifier - Control and Automation Equipment Schemes

The IED Redundancy / Virtual Machine Identifier denotes the functional position of the IED that is either Main 1 or Main 2 and allocates either a 0, 1 or 2 as the final characters in Table 22 .

Table 22: IED Redundancy / Virtual Machine Identifier - Control and Automation Equipment

5. IED Redundancy / Virtual Machine Identifier								
IED Description	**Characters**							**Comments**
Not applicable							0	Identifies the Main 1, Main 2 and 0 where not applicable
Main 1							1	
Main 2							2	
Virtual Machines							$	For Data Concentrator (Host Device) $ = A for DTC Virtual Machine For Engineering Server (Host Device) $ = A for SSC Virtual Machine $ = B for RODC Virtual Machine $ = C for Legacy SSC Virtual Machine

3.4.6 Practical Examples – Control and Automation Schemes

Step 1. Allocate the substation identifier from Table 18.

Step 2. Allocate the switchgear voltage level characters from Table 19.

Step 3. Allocate the scheme identifier characters from Table 20.

Step 4. Allocate the IED identifier characters from Table 21.

Step 5. Allocate the IED Redundancy/Virtual Machine identifier characters from Table 22.

Table 23: Examples of Control and Automation Schemes Technical Keys

Bay Description	Technical Key							
Substation AA1, 765kV, Fibre Switching Panel 1, Backbone Switch 1 - Main 1	**AA1**	**B**	**1**	**F**	**1**	**B**	**1**	**1**
Substation AA1, 765kV, Fibre Switching Panel 1, Backbone Switch 1 - Main 2	**AA1**	**B**	**1**	**F**	**1**	**B**	**1**	**2**
Substation AA2, 400kV, Gateway Panel 1, Gateway - Main 1	**AA2**	**C**	**1**	**G**	**1**	**G**	**W**	**1**
Substation AA2, 400kV, Gateway Panel 1, Gateway - Main 2	**AA2**	**C**	**1**	**G**	**1**	**G**	**W**	**2**
Substation AA1, 765kV, Data Concentrator Panel 1, Engineering Server 1 - SSC Virtual Machine	**AA1**	**B**	**1**	**D**	**1**	**E**	**1**	**A**

4. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Tony Sheerin	Manager Project Planning and Support
Quinton Labuschagne	Manager Control Applications
Nombuso Msibi	Manager Engineering Applications

5. Revisions

Date	Rev	Compiler	Remarks
Nov 2021	1	I Chetty	First issue of document

6. Development team

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

- Ian Naicker
- Indresen Chetty

7. Acknowledgements

- Ronny Lehutso
- Deepak Rampersad