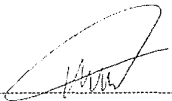
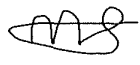





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1. Introduction

This document presents the requirements for the Reliability Services Data Collector and Reliability Services Installations as part of the Reliability Services Aggregator System solution. The Data Collector and Reliability Services Installation solution will provide the necessary infrastructure and functionality to enable the Reliability Services Aggregator System to provide the Instantaneous Demand Response (IDR), Supplemental Demand Response (SDR), Fast Frequency Response (FFR), Ten-minute Fast Response (TFR) and Supplemental Fast Response (SFR) initiatives to the business.

2. Supporting clauses

2.1 Scope

The scope of this document is to document all the requirements applicable to the Data Collector and the Reliability Services Installations. The applications, systems or services to run on the Data Collector and Reliability Services Installations are not defined in this document. This document rather provides a foundation hardware platform set of requirements which specific applications can leverage to realise the required functionality.

Additionally, this document outlines the requirements to ensure correct operation and successful integration with supporting sub-systems in the RSAP solution. These include, but are not limited to, the following:

- Reliability Services Aggregator System
- The Reliability Services Data Collector
- The System Operator
- Reliability Services Installations
- The Participants
- Eskom substations

The IDR, SDR, FFR, TFR and SFR services provided by the RSAP solution transverse multiple sub-systems. This document only covers the requirements for FFR, IDR, TFR, SFR and SDR applicable to the Data Collector and SR Installations.

2.1.1 Purpose

The purpose of this document is to specify Eskom Transmission's requirements for a Data Collector and Reliability Services Installations towards establishing a RSAP solution. This specification ensures that the required services and features provided by the current solution are obtained from the open market while also ensuring movement towards Eskom's desired future requirements.

2.1.2 Applicability

This document shall apply to Power System Reliability Services department, Transmission.

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] 240-79669677, Demilitarised Zone (DMZ) Designs for Operational Technology, Eskom, latest
- [2] DPL 240-55410927, Cyber security policy for operational technology, Eskom, latest

- [3] IEC 60255-22-5, Measuring relays and protection equipment – Part 22-5: Electrical disturbance tests - Surge immunity test, IEC, latest
- [4] 240-76625087 Cellular Modem Standard, Eskom, latest
- [5] IEC 60870-2-1, Telecontrol equipment and systems Part 2: Operating conditions - Section 1: Power supply and electromagnetic compatibility, IEC, latest
- [6] IEEE-1613, Communication networking devices in electrical power substations, IEEE, latest
- [7] SANS 60529, Degrees of protection provided by enclosures, IP codes, SANS, latest.
- [8] IEC 62053-22, Electricity metering equipment - Particular requirements - Part 22: Static meters for AC active energy (classes 0,1S, 0,2S and 0,5S)
- [9] 240-76624509 Control of new metering product and version changes in technical, software, firmware and hardware.
- [10] 32-373: Information Security - IT/OT Remote Access Standard.
- [11] 240-91479924 Cyber Security Configuration Guidelines of Networking Equipment for Operational Technology.

2.2.2 Informative

- [12] 240-64636794, Standard for wiring and cable marking in substations, Eskom, latest.
- [13] 240-62629353, Specification for panel labelling standard, Eskom, latest.
- [14] 240-64100247, Specification for earthing of secondary plant equipment in substations, Eskom, latest
- [15] 240-62773019, Specification for low voltage electrical auxiliary components, Eskom, latest
- [16] 240-70413291, Specification for electrical terminal blocks, Eskom, latest
- [17] 240-70975231, Specification for current and voltage transformer test blocks, Eskom, latest
- [18] 240-60725641 - Spec for Standard 19inch Equipment Cabinet, Eskom, latest
- [19] The South African Grid Code – System Operation Code.
- [20] Grid Connection Code for Battery Energy Storage Facilities (BESF) connected to the Electricity Transmission System (TS) or the Distribution System in South Africa.
- [21] SANS 474 Electricity metering - Standards requirements / NRS 057, Code of practice for electricity metering.
- [22] 32-85: Information Security Policy.
- [23] 240-16706821 Certification and Performance Monitoring for Battery Energy Storage Facility Reserves

2.3 Definitions

2.3.1 General

Definition	Description
Ancillary Service	Services supplied to the National Transmission Company by generators, Network Service Providers (NSP) or end-user customers, necessary for the reliable and secure transport of power from generators to NSPs and other customers, as defined in the System Operation Code [19].
Battery Energy Storage Facility (BESF)	A Battery Energy Storage Facility comprises batteries, chargers, power converters and related equipment connected to a single point of connection (POC) on the power system for the purpose of storing electrical energy in the batteries during the charging process and discharging the stored electrical energy when required.

Definition	Description
BESF Certified Capacity	The capacity (in MW) that the Battery Energy Storage Facility service providers are contracted to deliver. The certified capacity for BESF 100% of their capacity.
IDR/SDR Certified Capacity	Is the capacity in megawatt (MW), that the LOAD PROVIDER has proved to ESKOM on 2 (two) or more occasions that it can reduce, and which has subsequently been accepted and certified by ESKOM.
Contract	Each Participant is contracted a day ahead to provide their full certified capacity. This contract indicates an agreement between the System Operator and Participant that the Participant will be able to provide load curtailment in accordance with the contracted amount.
Contract Schedule	A schedule sent to the Participant by ESKOM, specifying the capacity (in MW per hour) to be available for Load Reduction during each hour of the next Day.
Data	Information stored in electronic format
Data Collector	Equipment at a central location which will poll all the Demand Response Installations to gather the required measurements and operational information and push it to the Demand Response Aggregator System.
Dead band	Region between 49.85 and 50.15Hz (as defined in Grid Code) within which no MW response to provide primary frequency control is expected from contracted facilities.
Demand Response (DR)	An ESKOM initiative through which a Load Provider contracts with ESKOM to make capacity available for reduction on instruction from ESKOM.
Reliability Services Aggregator System	A centralised system, through which dispatchable loads will be managed and offered to the ESKOM System Operator as part of reserves.
Reliability Services Installation	Any equipment, belonging to ESKOM, on the Participant's premises or in an ESKOM substation that enables the Participant to participate in Instantaneous Demand Response as part of Operating Reserves.
Event	Used in this document, refers to a low or high frequency system condition to which Participant sites are required to respond by providing a mandatory autonomous active power response to support the frequency in accordance with SO's requirements.
Fast Frequency Response	The capacity (MW) used to arrest a rapid change in frequency i.e., arrest frequency rise for load trips and arrest frequency decline for generator trips. The activation of the response is automatic and responds in accordance with droop characteristics prescribed in the Grid Connection Code for BESF. The contracted capacity (MW) shall be fully activated within 400 milliseconds and shall be sustained for up to 10 minutes.
Frequency control	Automatic active power regulation in response to a measured deviation of system frequency beyond pre-set thresholds, to maintain system frequency stability.
Instantaneous DR (IDR)	The mechanism created by ESKOM to ensure stability of the ESKOM transmission system/grid whereby demand is reduced within 6 (six) seconds on a Trip Frequency signal and such reduction will be sustained for a minimum of 1 (one) minute up to 10 (ten) minutes at a time.
Instantaneous Reserve	Reserve capacity that is fully activated within 10 seconds and sustained for 10 minutes or until the system frequency recovers.

Definition	Description
Participant	Used in this document to refer to a participant of a specific type of reserve and who is certified and contracted to participate in Instantaneous Demand Response.
Load Reduction	A reduction in the Participant's consumption relative to the level of consumption before the instruction, measured in four-second intervals.
Normal Operating Conditions	An operating condition where the system frequency, voltage and equipment loading are within their statutory, contractual and/or design limits and no network component on the relevant part of the Distribution System or Transmission System is out of service due to an outage.
Service Provider	This refers to the DR aggregator who aggregates IDR data by managing systems that enable participation and collection of relevant data used to monitor performance and facilitate payments to participants.
Shed Schedule	A schedule sent to the Participant by ESKOM, specifying the capacity (in MW per hour) of Load Reduction during each hour of the current Day.
Supplemental Frequency Response	Supplemental Fast Response– Participants contracted to provide SFR must respond to the dispatch instruction/notification by fully activating the required capacity (up to 100%) within 10 minutes of acknowledging the request. the resource's response must be sustainable for at least 120 minutes.
System Operator (SO)	The legal entity licensed to be responsible for short-term reliability of the Interconnected Power System (IPS), which is in charge of controlling and operating the Transmission System and dispatching generation (or balancing the supply and demand) in real time.
Ten-minute Fast Response	Participants contracted to provide TFR must respond to the dispatch instruction/notification by fully activating the required capacity (up to 100%) within 1 minute of acknowledging the request.
Trip Frequency	The frequency as determined by the ESKOM System Operator from time to time as the level at which the Participant's load has to be reduced to ensure system stability.
Low Frequency Threshold	The frequency between 49.0 and 50.0 Hz as determined by the ESKOM System Operator from time to time as the level at which the Participant's has to respond to ensure system stability.
High Frequency Threshold	The frequency between 50.0 and 51.0 Hz as determined by the ESKOM System Operator from time to time as the level at which the Participant's has to respond to ensure system stability.

2.3.2 Disclosure classification

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

2.4 Abbreviations

Abbreviation	Description
AC	Alternating current
APN	Access Point Name
API	Application Programming Interface

Abbreviation	Description
AS	Ancillary Services
BESF	Battery Energy Storage Facility
CPU	Central Processing Unit
CSD	Circuit Switched Data
CT	Current Transformer
DC	Direct Current
DMZ	Demilitarised Zone
DR	Demand Response
RSAS	Reliability Services Aggregator System
DVI	Digital Visual Interface
Dx	Distribution
EMS	Energy Management System
ET	Eskom Telecommunications
FFR	Fast Frequency Response
GPRS	General Packet Radio Service
GPS	Global Positioning System
HDD	Hard Disk Drive
IDM	Integrated Demand Response
IDR	Instantaneous Demand Response
IED	Intellectual Electronic Device
IP	Internet Protocol
IP (rating)	Ingress Protection
IT	Information Technology
LED	Light-Emitting Diode
MB	Megabytes
MCB	Miniature Circuit Breaker
NC	National Control
NSP	Network Service Provider
NTP	Network Time Protocol
OS	Operating System
PPA	Power Purchase Agreement
PSRS	Power System Reliability Services
PTMC	Protection, Telecoms, Metering and Control
PTP	Precision Time Protocol
RAM	Random Access Memory

Abbreviation	Description
SATA	Serial Advanced Technology Attachment
SFR	Supplemental Fast Response
SO	System Operator
TB	Terabytes
TFR	Ten-minute Fast Response
Tx	Transmission
UPS	Uninterrupted Power Supply
USB	Universal Serial Bus
VGA	Video Graphics Array
VT	Voltage Transformer
WAN	Wireless Area Network

2.5 Roles and responsibilities

Not applicable.

2.6 Process for monitoring

Not applicable.

2.7 Related/supporting documents

Not applicable.

3. Solution Architecture Requirements

The solution for the Data Collector and SR Installations shall be such that the Participants shall be able to participate in the Instantaneous Demand response and/or Supplemental demand response operating reserves or Fast Frequency Response, Supplemental and Ten-minute Reserve. The location and Information Technology (IT) interface requirements of the RSAS are not covered in this standard. The architecture requirements specified in this document only covers the Operational Technology portion of the interface between the RSAS and Data Collector.

- 3.1) The intended architecture for the Data Collector and Reliability Services Installations is depicted in Figure 1 and shall apply to the RSAP solution.
- 3.2) The Data Collector shall be fully hosted (virtualised) on Employer premises and managed by Supplier.
- 3.3) The Data Collector shall be able to reside between two firewalls within a Demilitarized Zone (DMZ).
- 3.4) The Data Collector shall adhere to the Eskom Demilitarised Zone (DMZ) Designs for Operational Technology [1].
- 3.5) The solution shall adhere to the Eskom Operational Technology (OT) Cyber Security Policy [2].
- 3.6) The Data Collector shall interface with the following sub-systems:
 - a) Reliability Services Aggregator System
 - b) The System Operator (SO)
 - c) Reliability Services Installations

- 3.7) The Reliability Services Installation shall interface with the Participant.
- 3.8) The Data Collector - RSAS interface shall make use of international protocols and avoid using a proprietary protocol for any reason whatsoever.
- 3.9) The Data Collector-SR Installation interfaces shall support the following communication protocols:
 - a) IEC 61850
 - b) DNP/IP or DNP3
 - c) OpenADR 2.0
- 3.10) Communications between the Data Collector and various Reliability Services Installations shall be over one or two of the Eskom Access Point Name (APN) networks. Eskom shall provide the Subscriber Identity Module (SIM) cards.

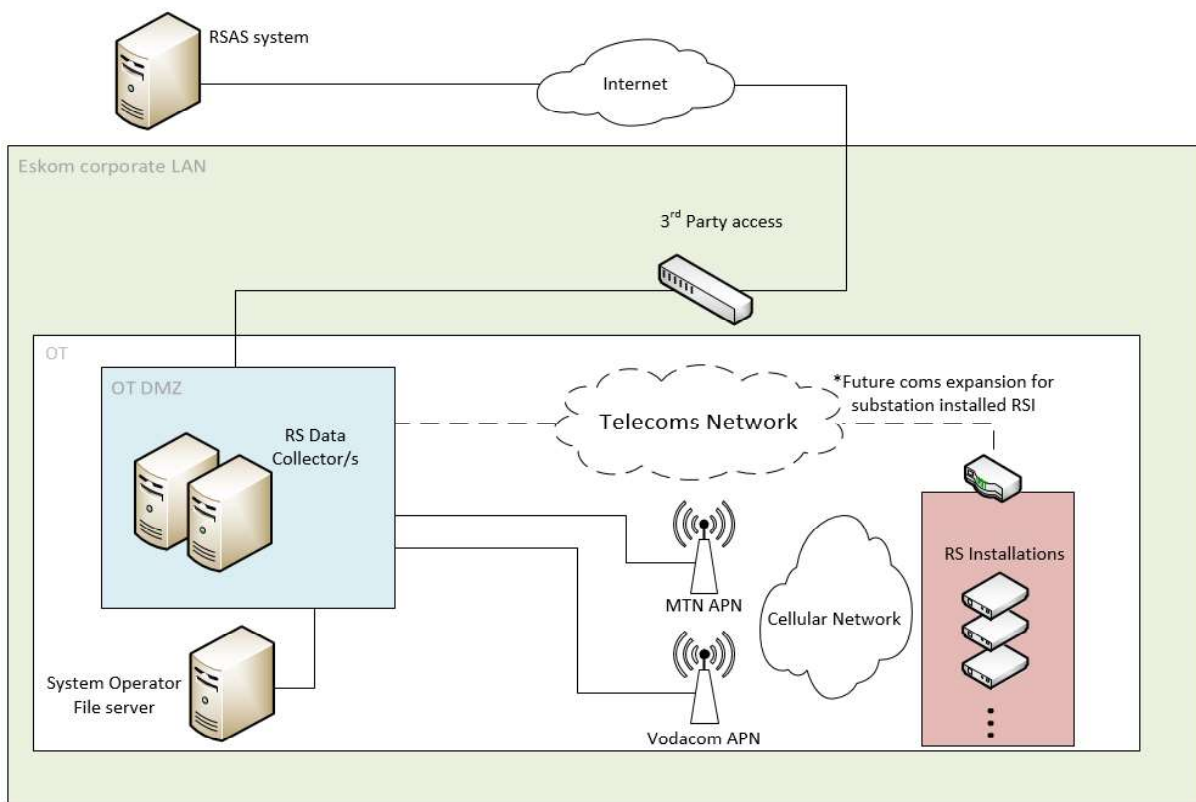


Figure 1: Data Collector and Reliability Services Installations architecture within the RSAP solution

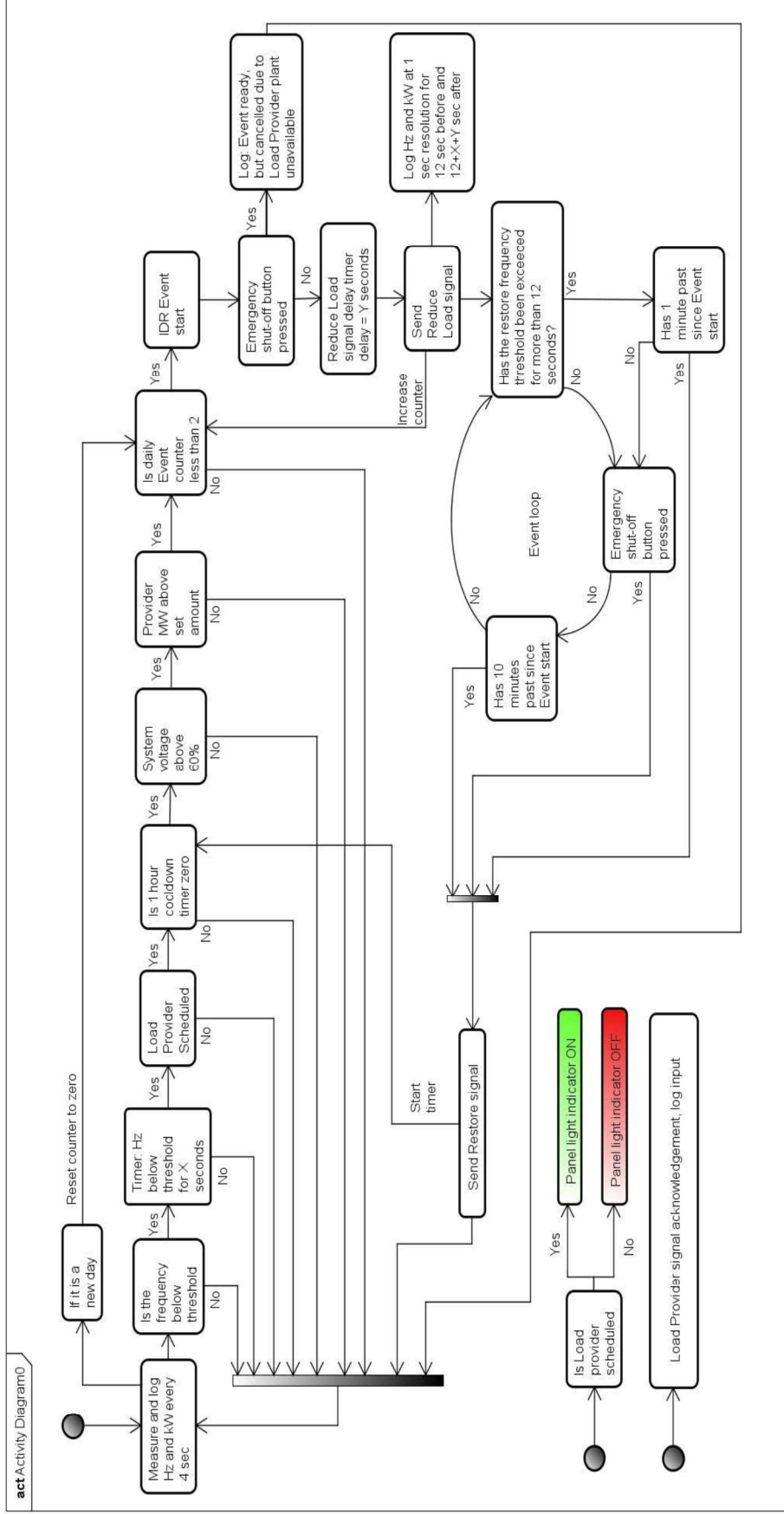
- 3.11) The solution shall not limit the location of the Reliability Services Installation at the Participant sites. As a minimum, the communications system shall support the following Reliability Services Installation locations: an Eskom substation or a Participant substation.
- 3.12) The Reliability Services Installation shall be able to reside in an Eskom substation or a Participant substation.
- 3.13) Provision shall be made for a suitable method of time synchronisation for all the relevant components of the Reliability Services Installation system. As a minimum, the Reliability Services Installation shall use GSM network time synchronisation for time stamping of the signals, events and system parameters.

4. Reliability Services Installation Solution Requirements for IDR

- 4.1) Measure and record the national system frequency every 4 seconds.
- 4.2) Measure and record the Participant's kW value every 4 seconds.
- 4.3) Determine whether the frequency drops below the Trip Frequency. The Trip Frequency shall be adjustable between 49.0Hz and 50.0Hz.
- 4.4) The IDR solution shall allow for setting the trip frequency to an accuracy of 0.01 Hz.
- 4.5) The Reliability Services Installation shall have the provision to receive the daily IDR Contract Schedule settings sent from the RSAS via the Data Collector.
- 4.6) If the frequency remains below the Trip Frequency for the predetermined delay period (configurable between 0 – 60 seconds) and the Participant is scheduled to participate in IDR as per the Contract Schedule settings received for that day, an IDR shed signal shall be indicated to the Participant.
- 4.7) The IDR solution shall have an input to record an IDR shed acknowledgement signal sent from the Participant to indicate that they have successfully received the IDR shed signal from the RS Installation.
- 4.8) The Participants are contracted to reduce their Scheduled Capacity within 6 seconds after the IDR shed signal is sent and sustain the load reduction for a minimum of 1 minute to a maximum of 10 minutes.
- 4.9) After the contracted 1 minute, if the frequency recovers to the predetermined restore frequency threshold value (currently 49.85Hz), and remains above this frequency for at least 12 seconds, the system shall send an IDR restore signal to the Participant.
- 4.10) The IDR solution shall have an input to record an IDR restore acknowledgement signal sent from the Participant to indicate that they have successfully received the IDR restore signal from the RS Installation.
- 4.11) If the frequency stays below the restore frequency threshold during an IDR shed Event, an IDR restore signal shall be sent to the Participant after reaching the 10 minutes maximum as outlined in point number 8 above.
- 4.12) The solution shall ensure that Eskom is able to calculate the load reduced by the Participant using the following formula:
 - Performance is equal to the average of (A + B), where A and B is defined as:
 - The reference point "X" will be the first complete 4 second interval prior to the trip signal
 - A: Maximum load reduced within the first 12 seconds (Three 4 second integration periods) of being dispatched with reference to "X"
 - B: Average load reduced during the remainder of the event with reference to "X"
- 4.13) The Participant is obligated to react to a maximum of two events per day (00h00 to 23h59) if the Participant is participating in the Contract Schedule for that day. The RS Installation shall have a mechanism to track and regulate this requirement.
- 4.14) The system shall have a rest period of a minimum of 1 hour between the end of the 1st event and the beginning of the 2nd event whereby the system will not issue any trip signals to the Participant. The rest period will be applicable even if the 1st event has ended in the 23rd hour of the previous day.
- 4.15) The Reliability Services installation shall have a backup battery or Uninterrupted Power Supply (UPS) system able to sustain the Reliability Services Installation for 8 hours during normal operation.

To summarize the intent of the functionality required by the Reliability Services Installation in order to allow the Participant to participate in the Instantaneous Demand Response reserve, an activity flow diagram is presented in Figure 2. The IDR functionality should not be limited to what is shown in Figure 1. This figure excludes the semantics of interfacing to the RSAS.

Note: Plant availability is only applicable to new installations.



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Figure 2: Reliability Services Installation activity flow diagram

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5. Reliability Services Installation Solution Requirements for SDR

- 5.1) Measure and record the Participant's kW value every 15 minutes.
- 5.2) The Reliability Services Installation shall have the provision to receive the daily SDR Contract Schedule settings sent from the RSAS via the Data Collector. These SDR Contract Schedule settings will indicate to the Reliability Services Installation what hours of the day the Participant's plant will be scheduled to participate in SDR.
- 5.3) Additionally, the Reliability Services Installation shall have the provision to receive SDR Shed Schedule settings sent from the RSAS via the Data Collector. These SDR Shed settings will indicate to the Reliability Services Installation what hours of the day Eskom wants the Participant to participate in the SDR reserve.
- 5.4) The Reliability Services Installation shall be able to receive and immediately implement the SDR Shed Schedule at any time of the day and even multiple times during a day.
- 5.5) If the Participant's plant is scheduled as indicated by the SDR Contract Schedule settings and Eskom requested that the Participant participate in SDR as indicated in the SDR Shed Schedule settings, a SDR shed signal shall be sent to the Participant.
- 5.6) The SDR solution shall have a user configurable timer (settable between 0 to 360 minutes at 1 minute steps) to advance the SDR Shed signal prior to the SDR Shed condition being met in requirement 5.5.
- 5.7) The SDR solution shall have an input to record a SDR shed acknowledgement signal sent from the Participant to indicate that they have successfully received the SDR shed signal from the RS Installation.
- 5.8) If either the Participant's plant is unscheduled as indicated by the SDR Contract Schedule settings or Eskom does not require the Participant to participate in SDR as indicated in the SDR Shed Schedule settings, the system shall send a SDR restore signal to the Participant.
- 5.9) The SDR solution shall have an input to record a SDR restore acknowledgement signal sent from the Participant to indicate that they have successfully received the SDR restore signal from the RS Installation.
- 5.10) Additionally, the Reliability Services Installation shall have a mechanism through which Eskom can trigger that a SDR restore signal be sent to the Participant even though the Participant's plant is available as per the SDR Contract Schedule settings and the SDR Shed Schedule settings as indicated by the SDR Shed Schedule settings.
- 5.11) This trigger (5.10) shall be sent to the Reliability Services Installation via the Data Collector by the RSAS.
- 5.12) The system shall have a rest period of 0 to 6 hours (user settable with 1 minute steps) from the end of the 1st event and the beginning of the 2nd event whereby the system will not issue any SDR trip signals to the Participant. The rest period will be applicable even if the 1st event has ended in the 23rd hour of the previous day.

6. Reliability Services Installation Solution Requirements for FFR

- 6.1) Measure and monitor the system frequency at minimum sampling rate of 20ms.
- 6.2) Determine whether the frequency drops below the low threshold frequency or rises above the high threshold frequency or remains within the dead-band. The low and high threshold frequencies shall be determined by SO and must be adjustable.
- 6.3) The FFR solution shall allow for setting the low and high threshold frequencies to an accuracy of 0.01 Hz.

- 6.4) Measure and record the Active Power (MW), Reactive Power (MVar), Voltage (kV), Current (A), Frequency (Hz) and ROCOF (Hz/s) every 1s during normal operation and every 20ms during an event.
- 6.5) The Reliability Services Installation shall have the provision to receive the daily FFR Contract Schedule settings sent from the RSAS via the Data Collector.
- 6.6) If the frequency remains below the Lower Frequency Threshold or above High Frequency Threshold for the predetermined configurable delay period and the Participant is scheduled to participate in FFR as per the Contract Schedule settings received for that day, an FFR shed signal shall be indicated to the SO via the Data Collector.
- 6.7) The Participants are contracted to respond to the FFR events by absorbing / discharging the contracted MW within 400ms and sustain the response until the frequency is recovered to the dead-band or for a minimum of 10 minutes, whichever occurs first.
- 6.8) If the frequency recovers to the dead-band and remains within the dead-band for at least 12 seconds, the system shall send an FFR restore signal to the SO via the Data Collector.

7. Reliability Services Installation Solution Requirements for TFR and SFR

- 7.1) Measure and record the Active Power (MW), Reactive Power (Mvar), Voltage (kV), Current (A) every 4s during normal operation.
- 7.2) The Reliability Services Installation shall have the provision to receive the daily MW Contract and Duration Schedule settings sent from the RSAS via the Data Collector.
- 7.3) The Participants contract to provide TFR shall respond and fully activate required capacity within 1 minute of acknowledging the request when called upon and must be sustained for two hours or as instructed by SO.
- 7.4) The Participants contract to provide SFR shall respond and fully activate required capacity within 10 minutes of acknowledging the request and must be sustained for two hours or as instructed by SO.

8. Data Collector Solution Requirements for IDR

- 8.1) All data shall be date and time stamped with the following format: yyyy-MM-dd HH:mm:ss.

Example: 2016-01-17 14:15:00

The IDR data from the Reliability Services Installations shall be polled by the Data Collector as per the tabled requirements below:

Table 1: Reliability Services Installation IDR data poll requirements

No	Situation	Data Group	Data resolution	Data time rage	Report time (seconds)	Solicited/ Unsolicited
8.2)	Non Event	All	4 seconds	24 hours per Day	60	Unsolicited
8.3)	Event	Metering	4 seconds or less	5 minute before the Event to 10 minutes after the Event	4	Solicited
8.4)	Event	Contract and system	4 seconds	Duration of the event	4	Unsolicited
8.5)	Start of the Event. (once the Event gets triggered)	Metering	1 second	12 seconds before to 12 seconds + trip delay after the Event inception	4	Solicited

As a minimum requirement, the following parameters shall be polled from the Reliability Services Installations for IDR:

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Table 2: Minimum required IDR data which the Data Collector shall poll from the Reliability Services Installation

No	Field Name	Description	Data type	Data Group	Allowed/Default values or Example values
8.6)	siteld	Site ID	Int	IDR Contract	
8.7)	freqThreshold	The frequency threshold in Hz for instantaneous Participant	float	IDR System	49.0 to 50.0
8.8)	freqRestore	The restore frequency in Hz	Float	IDR System	49.0 to 50.0
8.9)	delayTime	The delay time in seconds, before response is expected for an instantaneous Participant	Float	IDR System	0 to 60
8.10)	custPowerSupply	Participant power supply ON/OFF	boolean	IDR System	0 – power supply off 1 - power supply on
8.11)	custEmerStop	Participant emergency stop button status	boolean	IDR System	0 – emergency stop not activated 1 - emergency stop activated
8.12)	custkW	Participant power usage in kW	Float	IDR Metering	
8.13)	tripSignal	Trip signal status	boolean	IDR System	0 – restore/don't trip 1 – Trip/shed
8.14)	Freq	network frequency in Hz measured at site	Float	IDR Metering	45.0 to 55.0
8.15)	custParticipation	Participant participation status. This shall be applicable to the hour of the Day in which this parameter is reported.	boolean	IDR Contract	0 – Participant is not scheduled 1 – Participant is scheduled

Reliability Services Installation IDR Settings Requirements for IDR:

8.16) The Data Collector shall be able to receive new IDR settings from the RSAS.

8.17) The Data Collector shall be able to push new IDR settings to any or all Reliability Services Installations.

These IDR settings include, but are not limited to, the following:

Table 3: Minimum Reliability Services Installation IDR settings

No	Field Name	Description	Data type	Allowed/Default values or Example values
8.18)	siteld	Site ID	Int	
8.19)	freqThreshold	The frequency threshold in Hz for instantaneous Participant	Float	49.0 to 50.0
8.20)	delayTime	The delay time in seconds, before response is expected for an instantaneous Participant	Float	0 to 60
8.21)	freqRestore	The restore frequency in Hz	Float	49.0 to 50.0
8.22)	custSchedule	The schedule shall consist of 24 Boolean values whereby each value will indicate if the Participant is scheduled to participate in the IDR service for that specific hour period. The 24 Boolean parameters will correlate with the 24 hours in a day.	Array of boolean	Example: [0,0,1, ..., 0]

9. Data Collector Solution Requirements for SDR

9.1) All data shall be date and time stamped with the following format: yyyy-MM-dd HH:mm:ss.

Example: 2016-01-17 14:15:00

The SDR data from the Reliability Services Installations shall be polled by the Data Collector as per the tabled requirements below:

Table 4: Reliability Services Installation SDR data poll requirements

No	Situation	Data resolution	Data time rage	Report time (seconds)	Solicited/ Unsolicited
9.2)	Non Event	30 minutes	24 hours per Day	30 minutes	Solicited
9.3)	Event	15 minutes	24 hours per Day	15 minutes	Solicited

As a minimum requirement, the following parameters shall be polled from the Reliability Services Installations for SDR:

Table 5: Minimum required SDR data which the Data Collector shall poll from the Reliability Services Installation

No	Field Name	Description	Data type	Data Group	Allowed/Default values or Example values
9.4)	SDRsiteld	Site ID	Int	SDR General	
9.5)	SDRcustkW	Participant power usage in kW	Float	SDR General	
9.6)	SDRtripSignal	Trip signal status	boolean	SDR General	0 – restore/don't trip 1 – Trip/shed

No	Field Name	Description	Data type	Data Group	Allowed/Default values or Example values
9.7)	SDRcustParticipation	Participant participation status. This shall be applicable to the hour of the Day in which this parameter is reported.	boolean	SDR General	0 – Participant is not scheduled 1 – Participant is scheduled

RS Installation SDR Settings Requirements for SDR:

9.8) The Data Collector shall be able to receive new SDR settings from the RSAS.

9.9) The Data Collector shall be able to push new SDR settings to any or all Reliability Services Installations.

These SDR settings include, but are not limited to, the following:

Table 6: Minimum Reliability Services Installation SDR settings

No	Field Name	Description	Data type	Allowed/Default values or Example values
9.10)	siteld	Site ID	Int	
9.11)	custSchedule	The schedule shall consist of 24 Boolean values whereby each value will indicate if the Participant is scheduled to participate in the SDR service for that specific hour period. The 24 Boolean parameters will correlate with the 24 hours in a day.	Array of Boolean	Example: [0,0,1, ..., 0]
9.12)	custShedSchedule	The schedule shall consist of 24 Boolean values whereby each value will indicate if the Participant will be requested to participate in the SDR service for that specific hour period. The 24 Boolean parameters will correlate with the 24 hours in a day.	Array of Boolean	Example: [0,0,1, ..., 0]

10. Data Collector Solution Requirements for FFR

10.1) All data shall be date and time stamped with the following format: yyyy-MM-dd HH:mm:ss.000

Example: 2016-01-17 14:15:00.020

The FFR data from the Reliability Service Installations shall be polled by the Data Collector as per the tabled requirements below:

Table 7: Reliability Service Installation FFR data poll requirements

No	Situation	Data Group	Data resolution	Data time range	Report time (seconds)	Solicited/ Unsolicited
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10.2)	Non Event	All	1 seconds	24 hours per Day	4	Unsolicited
10.3)	Event	Metering	20 milliseconds or less	5 minute before the Event Start to 10 minutes after the Event Completion	4	Solicited
10.4)	Event	Contract and system	1 seconds	Duration of the event	4	Unsolicited

As a minimum requirement, the following parameters shall be polled from the Reliability Services Installations for FFR:

Table 8: Minimum required FFR data which the Data Collector shall poll from the Reliability Services Installation

No	Field Name	Description	Data type	Data Group	Allowed/Default values or Example values
10.5)	siteld	Site ID	Int	FFR Contract	
10.6)	freqThresholdLow	The low frequency threshold in Hz for FFR Participant	Float	FFR System	49.0 to 50.0
10.7)	freqThresholdHigh	The high frequency threshold in Hz for FFR Participant	Float	FFR System	50.0 to 51.0
10.8)	freqRestoreLow	The low restore frequency in Hz	Float	FFR System	49.0 to 50.0
10.9)	freqRestoreHigh	The high restore frequency in Hz	Float	FFR System	50.0 to 51.0
10.10)	delayTime	The delay time in seconds, before response is expected for an FFR Participant	Float	FFR System	0 to 60
10.11)	custPowerSupply	Participant power supply ON/OFF	boolean	FFR System	0 – power supply off 1 - power supply on
10.12)	ActivePower	Participant delivered or absorbed active power in MW	Float	FFR Metering	
10.13)	ReactivePower	Participant dispatched or absorbed reactive power in MVar	Float	FFR Metering	
10.14)	Current	Currents measured at the POC to the Grid in kA	Float	FFR Metering	
10.15)	Voltage	Voltages measured at the POC to the Grid in kV	Float	FFR Metering	
10.16)	HighFreqResponse	Trip signal Signal status	Boolean	FFR System	0 – Restore

No	Field Name	Description	Data type	Data Group	Allowed/Default values or Example values
					1 – Response
10.17)	LowFreqResponse	Trip signal Signal status	Boolean	FFR System	0 – Restore 1 – Response
10.18)	Freq	network frequency in Hz measured at site	Float	FFR Metering	45.0 to 55.0
10.19)	Participation	Participant participation status. This shall be applicable to the hour of the Day in which this parameter is reported.	Boolean	FFR Contract	Participant is not scheduled 1 – Participant is scheduled
10.20)	ROCOF	Rate of change of frequency measured at site in (Hz/s)			

Reliability Services Installation Settings Requirements for FFR:

- 10.21) The Data Collector shall be able to receive new FFR settings from the RSAS.
- 10.22) The Data Collector shall be able to push new FFR settings to one or multiple Reliability Services Installations.
- 10.23) These FFR settings include, but are not limited to, the following:

Table 9: Minimum Reliability Services Installation FFR settings

No	Field Name	Description	Data type	Allowed/Default values or Example values
10.24)	siteld	Site ID	Int	
10.25)	delayTime	The delay time in seconds, before response is expected for an instantaneous Participant	Float	0 to 60
10.26)	freqThresholdLow	The low frequency threshold in Hz for instantaneous Participant	Float	49.0 to 50.0
10.27)	freqThresholdHigh	The high frequency threshold in Hz for instantaneous Participant	Float	50.0 to 51.0
10.28)	freqRestoreHigh	The restore frequency in Hz	Float	49.0 to 50.0
10.29)	freqRestoreLow	The restore frequency in Hz	Float	50.0 to 51.0
10.30)	ROCOF	Rate of change of frequency in (Hz/s)		

No	Field Name	Description	Data type	Allowed/Default values or Example values
10.31)	custSchedule	The schedule shall consist of 24 Boolean values whereby each value will indicate if the Participant is scheduled to participate in the FFR service for that specific hour period. The 24 Boolean parameters will correlate with the 24 hours in a day.	Array of boolean	Example: [0,0,1, ..., 0]

11. Data Collector Requirements for TFR and SFR

Table 10: Reliability Services Installation TFR and SFR data poll requirements

No	Situation	Data Group	Data resolution	Data time range	Report time (seconds)	Solicited/ Unsolicited
11.1)	Non-event	All	4 seconds	24 hours per Day	60	Unsolicited
11.2)	Event	Metering	4 second	5 minute before the Event Start to 10 minutes after the Event Completion	4	Solicited

Table 11: Minimum required TFR and SFR data which the Data Collector shall poll from the Reliability Services Installation

No	Field Name	Description	Data type	Data Group	Allowed/Default values or Example values
11.3)	siteld	Site ID	Int	TFR and SFR Contract	
11.4)	refPowerSupply	Participant 220V power supply ON/OFF	boolean	TFR and SFR System	0 – power supply off 1 - power supply on
11.5)	ActivePower	Participant delivered or absorbed active power in MW	Float	TFR and SFR Metering	
11.6)	ReactivePower	Participant dispatched or absorbed reactive power in MVar	Float	TFR and SFR Metering	
11.7)	Current	Currents measured at the POC to the Grid in kA	Float	TFR and SFR Metering	
11.8)	Voltage	Voltages measured at the POC to the Grid in kV	float	TFR and SFR Metering	

12. Data Collector Requirements for the System Operator interface

The SO requires different data groups of information at different time intervals to be shared via their web service. In this section each one of these data groups applicable to the Data Collector are listed with the requirements thereof followed by the when and how the SO requires this data.

12.1 Data – IDR Contract information:

The SO requires the RSAS system to generate and share contract information with them. This is needed by the SO in order to see the amount of reserve available. The requirements related to the Contract data sharing are not covered in this standard, but rather in the RSAS documentation. It is merely mentioned here so that it can be taken into account during the development of the solution and the developer can be cognisant of the option for the solution to combine the Contract data sharing with the Response and Metering data sharing web service/Application Program Interface (API). The overview of the System Operator API can be found on Appendix A

To summarise for information sharing purposes:

Contract information should be provided by the solution to the SO before 16:00 on the day prior to the contracted day. This is required 365 days per year. Contracted information required for each site shall as a minimum contain the following:

Event Type	0 – Instantaneous Reserve 1 – Supplemental Reserve 2 – Standby Generation 3 – Fast Frequency Response Currently only instantaneous reserve is implemented
Contract start day	The day at which the contract starts
Contract values	Hourly (24) values indicating contracted values in MW
Bid Curve Name	The SO provided name of the RSAS unit to which the Participant is allocated.
Bid Curve Station Id	The SO provided station id of the RSAS to which the Participant is allocated
Bid Curve Unit Id	The SO provided unit id of the RSAS unit to which the Participant is allocated
Site Id	The SP provided id for the site
Site Name	The SP provided name for the site

In the context of the currently available web service, these values can be mapped as follows (indicated in bold below)

Field Name	Description	Data type	Allowed/Default values or Example values
EventId	Event identification	long	
eventType	Event Type	int	0 – Instantaneous Reserve 1 – Supplemental Reserve 2 – Standby Generation
eventTime	Contract Start Date In the format yyyy-MM-dd HH:mm:ss.	string	Example: 2016-01-17 00:00:00
notificationId		long	

Field Name	Description	Data type	Allowed/Default values or Example values
notificationType	The type of notification	int	0 – Shed 1 – Restore 2 – Dispatch Load 3 – Available 4 – Unavailable 5 – Scheduled
notificationTime	In the format yyyy-MM-dd HH:mm:ss. The same as eventTime	string	Example: 2016-01-17 00:00:00
notificationData	Contracted Values Comma delimited list of 24 scheduled values for the next day	string	Example : 64,64,64,64,64,64,64,64,64,64,64,0,0,0,64,64,64,64,64,64,64,64,64
bidCurveId		int	
bidCurveName	Bid Curve Name Name of the bid curve (Virtual Power Station) that the Participant belongs too	string	Example: VPNCN01
bidCurveStationId	Bid Curve Station Id Station id for the virtual power station as determined by SO	string	Example: 3004
bidCurveUnitId	Bid Curve Unit Id Unit id for the virtual power station as determined by SO	string	Example: 01
siteId	Site Id	int	
siteName	Site Name	string	Example: Samancor Tubatse
supplierId		int	
unitId		int	
certifiedCapacity	The capacity for which the Participant is certified in MW	int	
freqThreshold	The frequency threshold in Hz for instantaneous Participant	float	
delayTime	The delay time in seconds, before response is expected for an instantaneous Participant	float	
loadBlock	The load block identifier for the Participant	string	

12.2 Data – IDR Response information

12.2.1) The response information takes the form of a single message sent to the SO for each Participant changing status. This could mean that a Participant has responded to an Event (Shed) or recovered from an Event (Restore). It is also necessary to get information when a Participant becomes unavailable (Unavailable) or available (Available).

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The following response information is required by the SO per site:

12.2.2)	Event Type	0 – Instantaneous Reserve 1 – Supplemental Reserve 2 – Standby Generation Currently only instantaneous reserve is implemented
12.2.3)	Event Time	The time at which the Participant changes status
12.2.4)	Notification Time	The time at which the notification was sent from the Participant
12.2.5)	Notification Type	0 – Shed 1 – Restore 2 – Dispatch Load 3 – Available 4 – Unavailable 5 – Schedule
12.2.6)	Bid Curve Name	The SO provided name of the RSAS unit to which the Participant is allocated.
12.2.7)	Bid Curve Station Id	The SO provided station Id of the RSAS to which the Participant is allocated
12.2.8)	Bid Curve Unit Id	The SO provided unit Id of the RSAS unit to which the Participant is allocated
12.2.9)	Site Id	The Participant provided id for the site
12.2.10)	Site Name	The Participant provided name for the site

In the context of the currently available web service, these values can be mapped as follows (indicated in bold below)

Field Name	Description	Data type	Allowed/Default values or Example values
Eventide		Long	
eventType	Event Type	Int	0 – Instantaneous Reserve 1 – Supplemental Reserve 2 – Standby Generation
eventTime	Event Time In the format yyyy-MM-dd HH:mm:ss.	String	Example: 2016-01-17 14:15:00
notificationId		Long	
notificationType	Notification Type	Int	0 – Shed 1 – Restore 2 – Dispatch Load 3 – Available 4 – Unavailable 5 – Schedule
notificationTime	Notification Time	String	Example: 2016-01-17 14:15:00

Field Name	Description	Data type	Allowed/Default values or Example values
	In the format yyyy-MM-dd HH:mm:ss. The time that the notification was sent to SO.		
notificationData	Field to provide additional information about the notification. Typically empty	String	
bidCurveId		Int	
bidCurveName	Bid Curve Name	String	Example: VPNCN01
bidCurveStationId	Bid Curve Station Id	String	Example: 3004
bidCurveUnitId	Bid Curve Unit Id	String	Example: 01
siteId	Site Id	Int	
siteName	Site Name	String	Example: Eskom Simmerpan
supplierId		Int	
unitId		Int	
certifiedCapacity	The capacity for which the Participant is certified in MW	Int	
freqThreshold	The frequency threshold in Hz for instantaneous Participant	Float	
delayTime	The delay time in seconds, before response is expected for an instantaneous Participant	Float	
loadBlock	The load block identifier for the Participant	String	

12.3 Data – IDR Metering information

12.3.1) SO requires participant metering information as close to real time as can be provided. The purposes of this data will be to enable SO to determine as accurate as possible the real capacity that responded to the Event.

The data requirement is as follows:

12.3.2)	Data Range	From 5 minutes before the event to 10 minutes after the event
12.3.3)	Data Resolution	The highest available from service provider, minimum requirement is 4 seconds resolution
12.3.4)	Time provided	As close as possible to the actual event, minimum requirement is within 4 seconds after the event
12.3.5)	Participant range	All Participants that responded to the event that has a valid contract

It is possible that SO can retrieve this information from the Data Collector if an Application Program Interface (API) exists to do so. This retrieval can be initiated when shed signal is received for the Participant in question. It is also possible that a "data ready" signal be sent to SO, which would trigger the retrieval.

12.3.6) The Data Collector shall have a mechanism/API through which it will share the metering data with the SO upon receiving shed signals from the participating Participants.

12.4 Data – Performance Requirements

The response and metering information as listed above for each Participant site shall be sent to the SO with the following performance requirements:

No	Situation or notification trigger	Data Group	Data resolution	Data time rage	Report time (seconds)	Solicited/ Unsolicited
12.4.1)	Non Event	All	4 seconds	24 hours per Day	60	Solicited
12.4.2)	Event	Metering	4 seconds or less	Duration of the event	Within 4 seconds following an Event	Solicited
12.4.3)	Event	Contract information	4 seconds	Duration of the event	60	Solicited
12.4.4)	-Shed -Restore -Dispatch Load -Available -Unavailable -Schedule	Response Information	4 seconds	Duration of the event	Within 4 seconds following an Event	Solicited
12.4.5)	Start of the Event. (once the Event gets triggered)	Metering Information	1 second	12 seconds before to 12 seconds + trip delay after the Event inception	Within 4 seconds following a trip signal being sent to the Participant	Solicited
12.4.6)	Not Event related	Contract Schedule	Hourly	24 hours of the next day	Before 16:00 on the day prior to the Contract date	Not applicable

12.5 Data – FFR, SFR and TFR Metering information

The SO requires participant metering data as close to real time as can be provided to enable SO to monitor the Participant and also to determine the real capacity that responded to the Event.

The data requirement is as follows:

12.5.1)	Data Range	24/7
12.5.2)	Data Resolution	The highest available from service provider, minimum requirement is 1 seconds resolution
12.5.3)	Participant range	All Participants

It is possible that SO can retrieve this information from the Data Collector if an Application Program Interface (API) exists to do so. The Data Collector shall have a mechanism/API through which it will share the metering data with the SO upon receiving shed signals from the participating Participants.

12.6 Data – FFR, SFR and TFR Response Information

The response information takes the form of a single message sent to the SO for each Participant changing status. This could mean that a Participant has responded to an Event (Shed) or recovered from an Event (Restore). It is also necessary to get information when a Participant becomes unavailable (Unavailable) or available (Available).

The following response information is required by the SO per site:

12.6.1)	Event Type	0 – Instantaneous Reserve 1 – Supplemental Reserve 2 – Standby Generation 3 – FFR 4 – TFR 5 – SFR
12.6.2)	Event Time	The time at which the Participant changes status
12.6.3)	Notification Time	The time at which the notification was sent from the Participant
12.6.4)	Notification Type	0 – Shed 1 – Restore 2 – Dispatch Load 3 – Available 4 – Unavailable 5 – Schedule 6 - Acknowledge
12.6.5)	Bid Curve Name	The SO provided name of the RSAS unit to which the Participant is allocated.
12.6.6)	Bid Curve Station Id	The SO provided station Id of the RSAS to which the Participant is allocated
12.6.7)	Bid Curve Unit Id	The SO provided unit Id of the RSAS unit to which the Participant is allocated
12.6.8)	Site Id	The Participant provided id for the site
12.6.9)	Site Name	The Participant provided name for the site

13. Data Collector - Hardware Requirements**13.1 General Data Collector requirements**

Eskom Transmission has an on-premise Data Collector which is currently operational and a life expectancy of 10 years. With the new Request For Proposal, where a different Supplier might be awarded the RSAP contract, the existing Data Collector will be incorporated into the solution. The exact methodology to be finalised during contract negotiations. The decision will be limited to the following implementaions:

- 13.1.1) The new data collector shall be hosted fully hosted on a virtual machine with a host standby on the Employers's premises and managed by the suppliers.
- 13.1.2) The supplier shall operate and maintain the existing data collector located at Eskom Megawatt Park until the new data collector is fully commissioned.

13.1.3) The existing data collector will be decommissioned once the new data collector is fully commissioned.

13.2 Data Collector hardware specifications

The current operational Data Collector has the following specifications:

Hardware:

Dell PowerEdge R440 with 4 x 3.5 chassis:

- 1 x Intel Xeon Silver 4208 2.1 GHz
- 2 x 550 W Hot-plug Power Supply
- 2 x Dell 8 GB DDR4 Memory
- 4 x 4 TB 7.2K RPM SATA 6Gbps 512n 3.5in Hot-plug Hard Drive
- 1 x Dell Broadcom 5719 Quad Port 1 Gb Network Interface Card Low Profile

Software:

- Windows Server 2019 Standard (16-core and 5 CAL licence)
- MS SQL Server 2019 Standard (Server and 20 CAL Licence)
- Schneider EcoStructure® Power Monitoring Expert
- Data Collector Communication Module

14. Data Collector - Software Requirements

14.1 OS Support

14.1.1) The Data Collector shall have the ability to install any 32 bit or 64 bit OS.

14.1.2) The Data Collector will be pre-loaded with one of the following OS:

- Linux Debian 6 or newer
- Linux Ubuntu 12 or newer
- Linux Mint 14 or newer
- Linux openSUSE 12 or newer
- Windows 10
- Windows 11
- Windows Server 2016 R2
- Windows Server 2019
- Windows Server 2021

For the above list of OS the vendor shall indicate which OS are supported, certified and tested. Windows Server 2021 is preferred.

14.2 Data Management

14.2.1) The retrieved data from the RS Installation shall be stored in a database guise for long term use and reference. The retention period for different types of data shall as a minimum be 60 months.

14.2.2) The Data Collector shall grant Ethernet connected sub-systems access to the database.

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14.2.3) The database shall have configurable user authentication and privileges.

15. Reliability Services Installation - Hardware Requirements

15.1 General Requirements – Existing Reliability Services Installation

- 15.1.1) The supplier shall operate and maintain the existing Reliability Services installations.
- 15.1.2) The existing Reliability Services installations will be moved from the existing data collector to the new data collector.

15.2 General Requirements - Hardware Requirements

The hardware to be used for the Reliability Services Installation shall make provision for the following requirements:

- 15.2.1) Participant emergency shut-off button – to be used when the Participant has a Technical Reason to stop participation before or during an Event
- 15.2.2) The panel shall have a light/LED indicator to indicate if the panel is activated and participating in that point in time. The status of this indicator will be linked to that of the “custParticipation” parameter.
- 15.2.3) A three phase Current Transformer (CT) input (nominal Amps of 1/5 A). Each CT input shall have a dedicated four-way current transformer test block.
- 15.2.4) A three phase Voltage Transformer (VT) input (nominal Volts of 110 V VT or 400 V). Each VT input shall have a dedicated four-way voltage transformer test block.
- 15.2.5) The trip output contacts shall be supplied directly from the frequency measurement/relay device.
- 15.2.6) The Reliability Services Installation shall cater for four freely programmable tripping contacts. It shall be possible to marshal the contacts to follow operation of any of the frequency protection elements.
- 15.2.7) The trip/restore signal generated by the Reliability Services Installation shall consist of one of these tripping contacts. The tripping contact shall be used to sink or source current in order to provide a latching signal to the Participant. The relay shall have a minimum rating of 100 mA.
- 15.2.8) The frequency measurement/relay device shall comply with the following criteria:
 - a) The pick-up (trip) setting range shall be between 49Hz and 50Hz in steps of 0,01Hz
 - b) The device shall have a settable definite time delay with a range of 0s to 60s in steps of 0.1s
 - c) The minimum trip time shall be less than 300ms
 - d) The accuracy of the frequency measurement shall be better than ± 10 mHz. The protection elements shall have a reset difference (i.e. hysteresis) of between 30 mHz and 50 mHz and/or shall accommodate frequency averaging. Protection relays or metering devices specifically designed for under frequency load shedding typically include an averaging process in their frequency measurement algorithm. Where provided as a setting, the device shall be set to perform frequency averaging over 6 cycles. Where 6 cycles is not available as a setting option, the next lowest setting shall be chosen.
 - e) The device must include settable under voltage blocking of the Trip Frequency signal.

15.3 Power Supply

- 15.3.1) Power supply input voltage requirements.
 - a) The standard supply voltage options shall be:
 - UDC = 48 V. (Positive pole earthed.)
 - UDC = 110 V. (Floating input.)
 - UDC = 220 V. (Floating input.)
 - UAC = 220 V at 50 Hz.
 - b) The DC voltage tolerances shall be as per Table 1: DC supply tolerances.

Table 12: DC supply tolerances

Nominal voltage supply	48 V	110 V	220 V
Normal supply voltage	52.8 V	117 V	234 V
Equipment terminal voltage limits	43 V to 55 V	88 V to 132 V	176 V to 264 V
Connection to earth	Fully floating supply symmetrically balanced about earth with earth fault detection set to detect 10 mA current from either pole to earth. For the 48 V telecommunications supply, the positive is earthed.		

- c) The Reliability Services Installation shall preferably have universal power supplies capable of being supplied by any of the voltages listed in 11.2.1.1

15.3.2) Power supply voltage transient requirements

There shall be no equipment malfunction, damage or spurious under any of the following conditions:

- a) As a result of a supply interruption for five seconds and consequent restoration of supply.
- b) Short interruptions on the power supply voltage for not longer than 20 ms, occurring in a random sequence for a period of no longer than 20 s.
- c) AC ripple: the device shall function correctly with a 12 % 100 Hz AC signal superimposed on the DC supply.
- d) The Reliability Services Installation shall have passed the Surge Immunity test of [3] IEC 60255-22-5: 1.2/50 µs voltage and 8/20 µs current surges. 0.5, 1 and 2 kV line-to-earth and 0.5 and 1 kV line-to-line applied to the power supply, inputs and outputs. 0.5 and 1 kV line-to-earth applied to communication ports.

15.3.3) Power supply general requirements

- a) The power supplies shall be equipped with terminals for connecting the primary power cable (per power supply) and capable of accepting a 6 mm² cable
- b) The power supplies should preferably have independent current overload cutouts and overvoltage limiting, with automatic reset on removal of the fault.
- c) An LED indication, with a check facility, should preferably be provided to indicate a supply healthy condition for all internal supply voltages.
- d) A contact should preferably also be available to sense the power supply health remotely.
- e) The design shall support a floating power supply input, regardless of any earthing which may exist on the DC supply rails.
- f) The power supply unit shall provide galvanic isolation between the primary supplies and the electronic circuitry.

15.4 Ethernet

15.4.1) All Ethernet ports shall operate independently

15.4.2) The Reliability Services Installation should preferably support network teaming on the Ethernet ports.

15.4.3) For the copper interface, the requirements are as follows:

- a) Shall support both 10Base-Tx and 100Base-Tx.
- b) Should preferably support 1000Base-Tx.
- c) Shall support RJ45 connectors.

15.4.4) The Reliability Services Installation shall as a minimum support two (2) Ethernet ports.

15.5 General Packet Radio Service [GPRS] Modem

- 15.5.1) The Reliability Services Installation shall support the addition of a GPRS modem.
- 15.5.2) The Reliability Services Installation shall have the option to be supplied with a GPRS modem.
- 15.5.3) The GPRS modem supported or supplied shall comply with the Cellular Modem Standard [4]

15.6 Environmental, Electrical and Mechanical

- 15.6.1) Environmental:
 - a) The Reliability Services Installation shall comply with Class C3, as per IEC 60870-2 part 1[5], Table 1; except for temperature.
 - b) The Reliability Services Installation shall operate within a temperature range of -25°C to 55°C, with passive cooling.
- 15.6.2) Altitude
 - a) The Reliability Services Installation shall operate within an altitude range between 0 – 2000m.
- 15.6.3) EMI Immunity
 - a) The Reliability Services Installation shall provide error-free operation when exposed to EMI stress and electrical surges, as per Class 2 requirements of IEEE 1613 [6].
- 15.6.4) Electrical
 - a) The Reliability Services Installation shall operate within an electrical interference environment, where equipment is sited within high voltage switching compounds (132 kV or above) such that it is subject to high levels of radiated electrical interference, due to its physical placement or its direct connection to electrical plant.
 - b) The Reliability Services Installation shall not be affected by other device frequencies.
 - c) The Reliability Services Installation shall not generate any interference, which could hinder its own performance or the performance of the other equipment in its vicinity.
- 15.6.5) Mechanical Shock and Vibration
 - a) The Reliability Services Installation shall comply with Class Bm, as per IEC 60870-2 part 1[5], section 4.2.2.

15.7 Physical

- 15.7.1) The Intellectual Electronic Device/s (IED/s) used for the Reliability Services Installation shall be substation hardened or ruggedized, without the performance being out of limits, reliability being compromised or the life cycle being shortened.
- 15.7.2) The IED/s shall not have any rotating disk drives.
- 15.7.3) The IED/s shall not have any moving parts.
- 15.7.4) The IED/s shall not have any fans.
- 15.7.5) The IED/s should not have any vent holes
- 15.7.6) The IED/s cooling mechanism shall not include any moving parts.
- 15.7.7) The Reliability Services Installation enclosure should satisfy the IP3x rating [7], which dictates protection from objects larger than 2.5mm such as tools and thick wires.
- 15.7.8) The Reliability Services Installation shall be supplied with a standard 19' rack panel with all associated accessories.
- 15.7.9) The Reliability Services Installation shall be supplied with the option to be retrofitted on a standard 19' rack panel with all associated accessories.

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15.8 Voltage Transformer Circuits

- 15.8.1) Voltage acquisition by the Reliability Services Installation shall be via one of the following configurations:
- a) [Most preferred] The IED shall include one three phase voltage transformer input and shall be capable of frequency tracking from any one phase-to-phase or phase-to-neutral supply, determined by suitable phase selection logic. In addition, the IED shall include a separate single phase voltage transformer input that will be used for frequency tracking should none of the three phase inputs be available.
 - b) The IED shall include one three phase voltage transformer input and shall be capable of frequency tracking from any one phase-to-neutral supply, determined by suitable phase selection logic. It shall be possible to supply the individual phases from separate VT supplies.
- 15.8.2) Each of the two sets of VT inputs shall be protected by a MCB (curve C) with a 2 A rating.
- 15.8.3) The terminals on which the VT cabling is terminated shall provide a means of isolation using sliding link type terminals with test plugs.

15.9 Trip Outputs from the Scheme

- 15.9.1) The Reliability Services Installation shall cater for eight or sixteen freely programmable tripping contacts. It shall be possible to marshal the contacts to follow operation of any of the frequency protection elements, or of the automatic load restoration function.
- 15.9.2) The trip output contacts shall be supplied directly from the IED. Trip repeat relays shall not be used.
- 15.9.3) The trip output contacts shall be sealed-in for the duration that the associated UF protection element is asserted, with a minimum duration of 500ms.

15.10 Alarm and Indication Circuits

The following shall be minimum requirements for alarm circuit outputs:

- 15.10.1) The following local alarms shall be provided using cluster LEDs that are external to the IED:
- a) IDR Trip (Red LED)
 - b) SDR Trip (Red LED)
 - c) Panel Not Healthy (Amber LED).
- 15.10.2) The trip LED in (a) and (b) above shall be activated upon operation of the associated trip output contacts.

15.11 General Requirements of the Reliability Services Installation

The Reliability Services Installation shall comply with the following requirements:

- 15.11.1) The accuracy of all timers shall be better than $\pm 5\%$ or $\pm 10\text{ms}$ throughout the setting range.
- 15.11.2) The settings shall be easy to apply by personal computer and any software required for this shall be free issued.
- 15.11.3) A password shall be required before the user is able to change any setting on the IED. Provision shall be made for the password to be changed by the user upon successful entry of the original password.

15.12 Frequency Level Function

The frequency functions shall comply with the following criteria:

- 15.12.1) the setting range shall be between 45Hz and 55Hz in steps of 0,05Hz;
- 15.12.2) each stage shall have a separately settable definite time delay with a range of 0s to 300s in steps of 0,01s;
- 15.12.3) the minimum trip time shall be less than 100ms;
- 15.12.4) the accuracy of the frequency measurement shall be better than ± 10 Hz;
- 15.12.5) the elements shall have a reset difference (i.e. hysteresis) of between 30mHz and 50mHz. This is to cater for the 20mHz of noise band that is encountered on the frequency in Southern Africa (see Chown & Wigdorowitz reference in Section 3.3.2).

15.13 Rate of change of frequency function – Future expansion

The df/dt function shall have two stages each with its own df/dt setting and Definite Time timer. As the power system frequency drops at an exponential rate, which is greater than the df/dt setting, the timer shall start timing. If at the expiry of the time delay, the measured df/dt is still greater than the setting, the relay shall issue a trip.

On an interconnected power system, typical frequency curves measured do not follow the theoretical exponential curves as shown in textbooks, but they oscillate at the natural frequency of the power system. This natural frequency is also the frequency at which a power swing will oscillate. If the df/dt function resets instantaneously, it may happen that the df/dt function may never operate because it resets every time that the frequency starts to increase as part of the oscillation process. This problem shall be solved by using an appropriate measuring technique.

The time constant of a digital filter must typically be at least half that of the fundamental frequency. The natural frequency of the Eskom power system is of such a nature that the time constant required for a filter to remove the frequency oscillation described above is of the same magnitude as the required operating time of the df/dt function. This presents a reliability and security problem with measured data. It is therefore not allowed for the Reliability Services Installation to filter out the oscillation described in the previous paragraph.

The df/dt function shall comply with the following criteria:

- 15.13.1) the setting range shall be between 0,2Hz/s and 10Hz/s in steps of 0,05Hz/s;
- 15.13.2) each stage shall have a separate settable definite time delay with a range of 0s to 10s in steps of 0,02s;
- 15.13.3) the df/dt function pick-up time shall be better than 150ms
- 15.13.4) the accuracy of the df/dt measurement shall be better than $\pm 0,2$ Hz/s
- 15.13.5) the reset time of the df/dt function shall less than 200ms
- 15.13.6) the minimum trip time shall be less than 150ms

15.14 Under voltage inhibit / Loss of VT supply

- 15.14.1) The Reliability Services Installation shall have an under voltage inhibit function, the operating level of which shall be settable between 30% and 90% of rated voltage. All frequency functions shall be instantaneously blocked in the event that the VT supply to the Reliability Services Installation falls below the set threshold.
- 15.14.2) Voltage thresholds shall be accurate to $\pm 1\%$ or ± 1 V, and timers shall be accurate to $\pm 5\%$.
- 15.14.3) The under voltage inhibit/loss of VT supply functions shall have reset ratios (i.e. hysteresis) of 1.05: the voltage must recover to 105% of the setting before the functions reset.

15.15 Time Synchronisation

- 15.15.1) The Reliability Services Installation shall be time synchronised.
- 15.15.2) As a minimum, the IED/relay shall allow for GSM network time synchronisation.

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15.15.3) The Reliability Services Installation shall be time synchronised with a Global Positioning System (GPS)

16. Reliability Services Installation – Software Requirements

16.1 Data Management

16.1.1) Parameters selected to be shared with the Data Collector shall have a mechanism to be buffered, for a reasonable time, until it can be successfully polled by the Data Collector.

16.1.2) Data logging. In the case of communications to the Data Collector not being operational, all the logged values that need to be reported shall be buffered until such time that the Reliability Services Installation can synchronise all the buffered data with the Data Collector. The size of the buffer shall as a minimum sustain normal parameter logging for a period of 48 hours. In the event that the buffer is full, the system will start to overwrite the oldest records first.

17. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Ferdi Becker	Demand Response
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18. Revisions

Date	Rev	Compiler	Remarks
Mar 2024	Draft 1.2	D Gojela	Standard updated with as built information TFR, SFR and FFR requirements.
Aug 2018	1	TC Visser	First issue 240-138187960 superseded

19. Development team

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

- T Visser
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20. Acknowledgements

- Rishi Hariram.
- Kenneth Brown

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21. APPENDIX A – RSAS API

21.1 System Operator API Overview

The System Operator (SO) Application Programming Interface (API) provides methods for getting and updating data on various SO systems. The API is implemented using HTTP(s) GET and POST requests. A GET request is combined with a Provider that returns the requested data. A POST request is combined with an Updater that updates data on the systems and returns a success status. All message formats and return values are JSON, except where specifically indicated otherwise.

21.2 Authentication

In order to use the SO API it is necessary to have an administrator provided username and password. This will allow the user to obtain an authentication token using a HTTP(s) authentication URL. This token needs to be provided in the HTTP(s) request header of subsequent API calls in order to authenticate the caller.

An authentication token is valid for 30 days, and needs to be renewed before expiry. It is strongly discouraged to obtain a new token before every request as this is resource expensive and unnecessary.

21.3 Making Requests

21.3.1 Provider Requests (GET)

A GET request is made by providing the following parameters as a query string to the request:

provider	This is the name of the data provider and is the same as the Python class that implements it.
method	This is the data retrieval function and corresponds to a method within the Python class.
parameters	This is a JSON string of a dictionary object that contains the parameters for the above method. For some methods this is optional

21.3.2 Example

An example is given below with some valid parameters. The parameters need to be converted to a HTTP query string.

```
{  
  "provider": "Schedules" ,  
  "method": "detail",  
  "parameters": "{ 'detail_type': 'unit', 'active_schedule': 'CON',  
  'active_day': '2024-02-01' }"  
}
```

21.3.3 Updater Requests (POST)

A POST request is made by providing the following parameters as the body of the request:

updater	This is the name of the data updater and is the same as the Python class that implements it.
method	This is the data update function and corresponds to a method within the Python class.
parameters	This is a JSON string of a dictionary object that contains the parameters for the above method. For some methods this is optional

The example would look the same as for GET requests, but the “provider” parameters is replaced with “updater”, and the payload is passed in the request body, instead of as a query string.

21.4 Required Interfaces

Please note that the interfaces below are supplied as an example only. The successful tenderer will be able to influence the final design of the API, and the messages required will differ based on the requirements of the tenderer’s design.

GET/ POST	Provider/ Updater	Method	Parameters
GET	Schedules	detail	detail_type (str, mandatory): One of ('unit','region', 'storage','reserve') active_schedule (string): One of ('UC', 'CS', 'CON', 'ID') active_day (date/str): The date for which to retrieve the schedule data day_count (number): number of days to return
GET	Frequency	data	start_time (datetime/str,optional): The start time of the frequency data. Default is the start of the previous hour. (Included) end_time (datetime/str,optional): The end time of the frequency data. Default is start_time + 1 hour. (Not included) device (str, optional): One of CLOCK1 or CLOCK2. Default is CLOCK1
POST	Offer	load_offer_xml	Data (str(XML), mandatory): The XML offer/bid file

			formatted according to the XSD in Appendix A
POST	Dmp	notification	<p>event_id (int): The id of the event that this message is linked to</p> <p>notification_id (int): The id of this particular message</p> <p>notification_type (int): One of (Schedule/Load/Shed/Available/Unavailable)</p> <p>notification_time (datetime): The time of this notification</p> <p>notification_data (str): The data for this notification</p> <p>bid_curve_id (int): The id of the associated bid curve</p> <p>bid_curve_name (str): The name of the associated bid curve</p> <p>bid_curve_station_id (int): The station id of the associated bid curve</p> <p>bid_curve_unit_id (str): The unit id of the associated bid curve</p> <p>site_id (int): The id of the associated site</p> <p>site_name (int): The name of the associated site</p> <p>supplier_id (int): The supplier id</p> <p>unit_id (str): The supplier unit id</p> <p>certified_capacity (float): The certified capacity</p> <p>freq_threshold (float): The</p>

			<p>frequency threshold for the site in Hz</p> <p>delay_time (int): The delay time for the site in seconds</p> <p>load_block (int): The number of the load block that the site belongs to</p> <p>event_time (datetime): The time of the associated event</p> <p>event_type (str): The type of the associated event</p>
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