Government of
Democratic Socialist Republic of Sri Lanka

Ministry of Power

CEYLON ELECTRICITY BOARD

Request for Proposals
Development of 100 MW_{AC} Solar PV Power Plant on Build, Own and Operate (BOO) Basis and Construction of 132 kV Transmission Facility on Turnkey Basis

REQUEST FOR PROPOSALS
(APPENDIX 4-B)
SCOPE OF WORK (GRID SUBSTATION)

APPENDIX 4-B

SCOPE OF WORK
GRID SUBSTAION

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1 SCOPE OF WORKS

1.1 GENERAL DESCRIPTION OF THE PROJECT

1.1.1 SIYABALANDUWA SOLAR COLLECTOR SUBSTATION CONSTRUCTION

Siyabalanduwa solar collector substation construction shall consist of following main features.

1. 145kV Outdoor air insulated switchgear with feeder transformer arrangement comprising of

   02 Nos. 145kV Line bays.

   02 Nos. 145kV Transformer bays.
2. 02 Nos. 132/33 kV, 63MVA Power Transformers.
3. 02 Nos. 33kV, 800A Earthing Transformers.
4. 02 Nos. 33/0.4kV, 160kVA Auxiliary Transformers.
5. 36kV SF_6 gas insulated indoor switchgear with Single Bus bar arrangement comprising of

   02 Nos. 36kV Transformer bays

   08 Nos. 36kV Generator feeder bays

   01 No. 36kV Bus Section bay
6. 08 Nos. of 36kV Outdoor line gantries/ cable termination structures including 36kV cable terminations.
7. Control, Metering, Monitoring and Protection equipment.
8. Batteries, Battery Chargers, DC equipment, LVAC and Inverter equipment etc.
9. 30kW Roof-Top Solar Power System
10. SCADA & Communication equipment.
11. Substation Automation System.
12. Digital disturbance recorder and power quality analyser.
13. Energy Metering System.
14. Power and Control cables including terminations.
15. Substation grounding system and shield earth wire system.
16. 50kVA Diesel Generator.
17. Electrical, Civil and Mechanical works required for substation including control and other buildings.
18. CCTV Camera System.
19. Spare parts.

1.1.2 MONARAGALA GRID SUBSTATION AUGMENTATION

Monaragala Grid Substation augmentation shall consist of following main features.

1. 145kV Outdoor air insulated switchgear with Single Bus bar arrangement comprising of

   02 Nos. 145kV Line bays.

2. Control, Metering, Monitoring and Protection equipment for two new 145kV line bays.
3. Modifications to DC and LVAC distribution boards.
4. SCADA & Communication equipment.
5. Extension of existing Substation Automation System.
6. Power and Control cables including terminations.
7. Extension/ Modification of Substation grounding system and shield earth wire system.
8. Electrical, Civil and Mechanical works required for substation including control and other buildings.
9. Spare parts.

1.1.3 MISCELLANEOUS WORKS IN OTHER GRID SUBSTATIONS

Monaragala (Remote end of Siyabalanduwa)

Reference shall be made to Clause 0. Main 1 and Main 2, matching control and protection IEDs shall be supplied for Monaragala substation.

Required modifications/ extensions to the existing Substation Automation System at Monaragala GSS. (Note: existing Monaragala GSS is remotely controlled & monitored at the Badulla GSS)

Reference shall be made to Clause 1.2.1.6 (remote end of Siyabalanduwa) for Required Communication System modifications at remote ends.

1.1.4 TERMINAL POINTS

A. Siyabalanduwa Grid Substation

The following shall be the contract terminal points: -

(a) 145kV Overhead Line/ Switchgear interfaces.

145kV Overhead Transmission lines terminate at the line bay gantries, which shall be provided under Grid Substation Contract. This contract includes the connections and connectors from the 145kV switchgear to the 145kV overhead line down droppers, which terminate at the line bay gantries.

(b) 36kV Overhead Lines/ Switchgear interfaces.

36kV overhead distribution lines terminate at the line bay gantries (or cable termination structures), which shall be provided at Grid Substation. This includes the connections and connectors from 36kV outdoor terminations to the 36kV line down droppers, which terminate at the line bay gantries.

B. Monaragala Grid Substation

The following shall be the contract terminal points: -

(a) 145kV Overhead Line/ Switchgear interfaces.

145kV Overhead Transmission lines terminate at the line bay gantries, which shall be provided under Grid Substation Contract. This contract includes the connections and connectors from the 145kV switchgear to the 145kV overhead line down droppers, which terminate at the line bay gantries.

1.1.5 SITE ENVIRONMENTAL CONDITIONS

Siyabalanduwa/ Monaragala

Altitude of site above sea level not exceeding	m	1000
Maximum ambient air temperature	^{0}C	38.5
Minimum ambient air temperature	^{0}C	14.7
Average yearly temperature	^{0}C	22.3
Relative humidity (24 hours)	%	72.3
Average annual rainfall	mm	1754.6
Maximum recorded rainfall for 24 hours	mm	145.7
Storms		Frequency of thunderstorms high
Average isokeraunic level		50 days per annum
Atmospheric Corrosivity Category		C4 (ISO 12944-2)
Pollution level for bushings and insulators		43.3mm/kV (USCD)

1.1.6 ELECTRICITY, WATER, GAS AND OTHER SERVICES

The Contractor shall at his expense, provide all electricity, water, gas and other services necessary to execute and complete the Works on site. Prevailing tariff and service connection procedure shall be applicable.

1.1.7 ADHERENCE TO THE ENVIRONMENTAL MITIGATION MEASURES

Bidders are requested to comply with the requirements stated in the Chapter 1, Clause 1.8 of Section 6 Part B -Technical Specifications.

1.2 PLANT & EQUIPMENT INCLUDING MANDATORY SPARE PARTS

1.2.1 SIYABALANDUWA GRID SUBSTATION CONSTRUCTION

1.2.1.1 OUTDOOR SWITCHGEAR

1.2.1.1.1 02 Nos. 145kV Line feeder bays for Monaragala each comprising: -

3 Nos. - 145kV, 31.5kA Single Phase Current Transformers with cores as follows:

Class 5P20, ratio 1600-800/1A for Line Main 1 protection and control IED.

Class 5P20, ratio 1600-800/1A for Line Main 2 protection and control IED and connection to DDR.

Class 0.2, ratio 1600-800/1A.

Class 5P20, ratio 2000/1A for busbar differential protection and breaker failure protection.

Class 5P20, ratio 800-400//1A for Transformer Main 1 protection and control IED.

Class 5P20, ratio 800-400/1A for Transformer Main 2 protection and control IED.

1 No. - 1250A, 145kV, 31.5kA three phase line disconnector with hand and motor operating mechanism and integral with hand and motor operated earthing switch.

3 Nos. - Single-phase Capacitor type voltage transformers with cores,

Class 3P, ratio 132,000/√3V:110/√3V for Main 1 protection and control IED.

Class 3P, ratio 132,000/√3V:110/√3V for Main 2 protection and control IED and connection to DFR.

Class 0.5, ratio 132,000/√3V:110/√3V.

3 Nos. - 120kV, 10kA, Class 2 Surge arresters with counters.

1 Lot - Set of bay connections, connectors, clamps, etc.

1.2.1.1.2 02 Nos. 145kV Transformer bays each comprising: -

3 Nos. - 120kV, 10kA Class 2 Surge arrestors with counters.

1No. - Neutral Current Transformer with core as follows: -
Class 5P20 ratio 400/1A for Main 1 protection and control IED

Class 5P20 ratio 400/1A for Main 2 protection and control IED.

1 Lot - Set of connections, connectors, clamps, access ladders etc. including connections to transformer 132kV and neutral bushings.

1.2.1.1.3 02 Nos. 36kV Transformer Bays each comprising: -

3 Nos. - 36kV, 10kA, Class 2 Single phase Surge arresters with counters.

1 Lot - Set of cable connection between indoor switchgear and outdoor equipment including set of connections, connectors, clamps, structures, access ladders, Cable sealing end or terminal arrangement suitable for incoming 36kV cables etc. to terminate the 36kV cable and connect to the Transformer.

1 Lot - Connections, connectors, clamps, and access ladders etc. including connections to transformer 36kV bushings.

1.2.1.1.4 08 Nos. of 36kV Generator Feeder bays each comprising: -

3 Nos. - 36kV, 10kA, Class 2 Surge arresters with counters.

1 No. - 1250A, 36kV, 25kA, 3 phase line disconnector with hand and motor operating mechanism.

1 Lot - Set of bay connections, connectors, and clamps, etc.

1 Lot - Set of cable connection between indoor switchgear and outdoor equipment including set of connections, connectors, clamps, structures, access ladders, Cable terminating structure, sealing end or terminal arrangement suitable for incoming 36kV cables etc. to terminate the 36kV cable and connected to the 36kV take-off structure.

Note: The current rating of generator feeders is 800A, and hence all connections, connectors and clamps shall be selected accordingly.

1.2.1.1.5 02 Nos. of 36kV Auxiliary Transformer bays each comprising: -

1 Lot - Set of cable connection between indoor LVAC switchgear and LV Cable box including set of connections, connectors, clamps, structures.

1 No. - Set of bay connections, connectors, and clamps, etc for 33kV connection.

1.2.1.1.6 02 Nos. of 36kV, 800A/30s Earthing Transformer bays each comprising: -

1 No. - Neutral Current Transformer with cores as follows: -
Class 5P20, ratio 800/1A for HV Main 1 protection and control IED

Class 5P20, ratio 800/1A for HV Main 2 protection and control IED, and DDR.

1 Lot - Outdoor equipment including set of connections, connectors, clamps, structures, access ladders etc. to connect 36kV outdoor busbars and neutral current transformers.

1.2.1.2 SF_6 INSULATED INDOOR SWITCHGEAR

Panel design which allows removal of panel with lowest disturbance to adjacent panels is preferred.

1.2.1.2.1 02 Nos. 36kV Transformer bays each comprising: -

1 Set	-	36kV, 2500A, 25kA, three phase bus bars.
1 No	-	2000A, 36kV, 25kA, 3-phase busbar disconnector with earth switch and motor operating mechanism.
1 No	-	2000A, 36kV, 25kA, 3-phase circuit breaker complete with operating mechanism.
3 Nos.	-	36kV Current Transformers with cores as follows: - Class 5P20, ratio 1600/1A for HV Main 1 protection and control IED Class 5P20, ratio 1600/1A for HV Main 2 protection and control IED, DDR, AVR and LV protection and control IED. Class 0.2 ratio 1600/1 for metering.
3 Nos.	-	Single phase voltage transformers with cores Class 3P ratio 33,000/√3V:110/√3V for HV Main 1 protection and control IED Class 3P ratio 33,000/√3V:110/√3V for HV Main 2 protection and control IED, DDR AVR, and LV protection and control IED Class 0.2 ratio 33,000/√3V:110/√3V for Energy metering system
1 Lot	-	Cable terminating chamber, complete with cable box, sealing end or terminal arrangement suitable for incoming 36kV cables.
1 Lot	-	Complete set of miscellaneous items required for the safe and efficient operation of the switch gear, including cables, independently lockable shutters over busbar, cable and voltage transformer spouts (as appropriate), facility to enable busbar or cable to be earthed through circuit breakers, terminal boxes for multi-core cables, busbar end covers or link to adjacent switch panel as appropriate etc.

1.2.1.2.2 08 Nos. of 36kV Feeder bay for incoming generations each comprising: -

1 Set	-	36kV, 2500A, 25kA three phase bus bars.
1 No.	-	1250A, 36kV, 25kA three phase busbar disconnector with earth switch and motor operating mechanism.
1 No.	-	1250A, 36kV, 25kA three phase circuit breaker complete with operating mechanism.
3 Nos.	-	36kV current transformers with cores as follows: Class 5P20, 800/400/1A for directional over current, directional earth

fault, over current and earth fault protection.
Class 0.2, 800/400/1A for Energy metering system.

3 Nos. - Single phase voltage transformers, ratio 33,000/√3V:110/√3V:110/√3V Class 0.2 for energy metering of incoming generation and Class 3P for protection.

1 Lot - Set of cable terminating chamber, complete with cable box, sealing ends or terminal arrangement suitable for incoming 36 kV cables including all terminating accessories, cable lugs etc.

1 Lot - Complete set of miscellaneous items required for the safe and efficient operation of the switch gear, including cables, independently lockable shutters over busbar, cable and voltage transformer spouts (as appropriate), facility to enable busbar or cable to be earthed through circuit breakers, terminal boxes for multi-core cables, busbar end covers or link to adjacent switch panel as appropriate etc.

1.2.1.2.3 36kV Bus Section bay consists of: -

1 Set - 36kV, 2500A, 25kA three phase bus bars.

1 No - 2500A, 36kV, 25kA, three phase circuit breaker complete with operating mechanism.

2 Nos - 2500A, 36kV, 25kA three phase disconnector with earth switch and motor operating mechanism.

3 Nos. - Current transformers with core as follows: -
Class 5P20, ratio 2500/1A for over current and earth fault protection and for metering with interposing current transformer.

6 Nos. - Single phase voltage transformers with cores

Class 3P ratio 33,000/√3V:110/√3V for Protection and control IED

Class 0.2 ratio 33,000/√3V:110/√3V for Energy metering system

1 Lot - Complete set of miscellaneous items required for the safe and efficient operation of the switch gear, including cables, independently lockable shutters over busbar, cable and voltage transformer spouts (as appropriate), facility to enable busbar or cable to be earthed through circuit breakers, terminal boxes for multi-core cables, busbar end covers or link to adjacent switch panel as appropriate etc.

1.2.1.3 LVAC SWITCH BOARDS

400V switchboards, for supplies to substation services, free standing and for indoor installation, are to be supplied and installed.
The incoming supplies to each switchboard are to be interlocked to automatically establish supply to the busbar in the event of failure of the incoming supply and not to

parallel any supplies. In case of failure of incoming, Diesel Generator shall be automatically switched on for emergency supplies.

1.2.1.3.1 400V Main switchboard comprising:

Auto changeover logic for Bus-section breakers, Incoming Breakers & Generator Breaker initiated by:

Incomer No. 1 from No. 1, 160kVA, 33/0.4kV Auxiliary transformer.

Incomer No. 2 from No. 2, 160kVA, 33/0.4kV Auxiliary transformer.

Incomer No. 3 - 50kVA Diesel Generator for emergency supply.

Incomer No. 4 - Solar PV system

1 Set	-	Busbars (3Phases, Neutral and Earth).
9 Nos	-	4pole MCCBs for two incoming, one solar PV system, one bus section, one Generator and four outgoing (rating shall be according to the load required).
1 Set	-	Equipment required for interlocking and automatic switch over between incomer 1 & 2 and diesel generator including auto changeovers.
3 Sets	-	Indicator lamps for each distribution board.
3 Nos	-	Ammeters.
3 Nos	-	Voltmeters.

1.2.1.3.2 400V Distribution panel comprising:

MCB for following distribution Circuits (Number of Phases and rating shall be according to the load required.)

Essential loads

Storage Battery Charger No.1 for 110V

Main transformer No. 1 OLTC & cooling fans

Main transformer No. 2 OLTC & cooling fans

Outdoor & Perimeter lighting

Indoor lighting

Guard House

Inverter Supply

Others as necessary

Spares

Panel No.1

Storage Battery Charger No.2 for 110V

145kV Switchgear Auxiliary Power

36kV Switchgear Auxiliary Power

Cubicle lighting & space heater

Distribution Panel No. 1 for small power supply

Air Conditioning and Ventilation

Outdoor Lighting panel

Power outlet

Water Supply Pump

Others as necessary

Spares

Panel No.2

145kV Switchgear Auxiliary Power

36kV Switchgear Auxiliary Power

Cubicle lighting & space heater

Distribution Panel No. 2 for small power supply

Air Conditioning and Ventilation

Power outlet

Pumps

Others as necessary

Spares

A separate circuit shall be provided for Oil Filtering as shown in the LVAC drawing.

1.2.1.4 BATTERIES, CHARGERS, DISTRIBUTION BOARDS & INVERTER EQUIPMENT

Substation battery systems complete with chargers and distribution switchboards, as shown on drawings are to be supplied and installed in the substation building. The 110V DC system shall supply the following loads: -

(i) 145kV and 36kV switchgear standing loads of control, protection and alarms as dictated by the equipment offered on other Chapters.

(ii) SAS/CCTV Inverter supply.

(iii) Emergency building lighting of 1kW loading for 8 hours.

(iv) SCADA and Communication system.

(v) After supply of the above coincident loads for a period of 8 hours, the battery shall be capable of two closing and two tripping operations of each circuit breaker within the substation.

(vi) 20% Design margin shall be kept for future loads

1.2.1.4.1 110V Battery System comprising: -

2 Nos.	-	110V Ni-Cd battery banks with the minimum capacity of 400Ah (Actual capacity shall be calculated at detail design stage and if the actual capacity exceeds 400Ah, battery banks that satisfy actual capacity requirement shall be supplied) in each.
2 Sets	-	Charging equipment with automatic switch-over function.
1 No.	-	Selector switch for Chargers 1 and 2.
1 Set	-	DC distribution board.
1 Lot	-	Set of miscellaneous items.

Other circuits as may be required for the equipment.

1.2.1.4.2 Inverter System for Substation Automation System and CCTV System

2 Sets	-	Inverters with automatic load transfer facility by means of automatic transfer system, instrument and alarms described in Technical Specification. (20% of spare capacity shall be provided in each inverter system)

1.2.1.4.3 Positive Grounded 48V DC System for SCADA and Communication System Comprising

2 Nos	-	Galvanically Isolated DC - DC converters (110V DC to 48V DC, 20A each)
1 Set	-	48V DC distribution board

1.2.1.4.4 Roof-Top Solar PV System

1 30kW solar PV system shall be installed on top of the roof of control building as per clause 3.11 of Technical Specification.

2 Supply and installation of inverter as per clause 3.11.3 of Technical Specification.

3 Supply and installation of combine boxes as per clause 3.11.4 of Technical Specification.

4 Supply and installation of monitoring and data acquisition system as per clause 3.11.7 of Technical Specification.

5 All required cables, accessories and earthing works.

Note:

- The requested SCADA signals of the Solar PV system as per the NSCC SCADA Signal List (Annex A1) shall be made available to the NSCC and shall be commissioned up to the NSCC.

1.2.1.5 PROTECTION, METERING, MONITORING AND CONTROL

1.2.1.5.1 Substation Automation System: -

Substation Automation system must be provided by the SAS manufacturer as per Clause: 5.24 of Technical Specification - Grid Substation and typical architecture drawing provided in Volume 06 of bidding document.

All facilities and requirements including necessary hardware and software shall be provided as specified in all the relevant clauses in Chapter 5 of Technical Specification - Grid Substation.

It shall be possible to operate Siyabalanduwa GS remotely from Badulla GS. Remote Web HMI Workstation shall be provided by the Contractor.

Note:

- Separate SCADA control authority level shall be defined for National System Control Center (NSCC) Operation, if there are regional control centers and it should not allow same operation from several control centers at same time.
- Tripping of the Circuit Breaker of each bay shall be provided as an Alarm according to the NSCC Signal List. This Circuit Breaker Tripping Indication shall be made available up to the Gateway to be integrated to the NSCC.

1.2.1.5.2 Digital Disturbance Recorder with Analysis Computers and Power Quality Analyzer: -

Digital Disturbance Recorder with Analysis Computers

1 No - Digital Disturbance Recorder (DDR) with a minimum of 55 Analog Channels and 66 Digital Channels shall be provided as per clause 5.21 of Technical Specifications

1 No. - Remote analysis computer, a data modem with dedicated telephone line with all necessary connections from remote communication and DDR analysis software, as per Clause 5.21 of Technical Specification

1 No - Local analysis computer with DDR analysis software, as per Clause 5.21 of Technical Specification.

Power Quality Analyzer

1 No. - Power Quality Analyzing Equipment as per Clause 2.3.

1 Lot - Accessories to connect Current and Voltage Circuit of selected bay.

1 No. - Local analysis computer with analysis software.

1.2.1.5.3 145kV Protection & Control facilities: -

All the control metering and protection panels shall be complied with requirements of Chapter 5 of the Technical Specifications.

The trip circuit supervision scheme shall provide continuous supervision of all the trip coils and trip circuits with the circuit breaker in either the open or closed position for each 145kV bay as per clause 5.19.

1.2.1.5.3.1 For 02 Nos. 145kV Line Bays Each Comprising with Following Functions: -

Control IEDs with panel shall be provided as per Chapter 5 of Technical Specifications.

Controls shall be provided for disconnecting and earthing of overhead line with interlocks.

1.2.1.5.3.2 For 02 Nos. 145kV Transformer comprising with: -

Protection and control panel and Mechanical protection and control panel shall be provided as per clause 5.12 of Technical Specifications.

(a) Protection and Control panel with IEDs

Protection and control panel with HV main 1 and main 2 IEDs with functions listed in 5.12.1 of Technical Specifications and other required accessories as per Chapter 5 of Technical Specifications shall be provided.

(b) Mechanical Protection and Control Panel

Mechanical protection and control panel with relays, AVRs and accessories as per clause 5.12 of technical specifications shall be provided.

1.2.1.5.4 36kV Protection & Control facilities: -

(Relays may be installed in 36kV switchgear compartment).

1.2.1.5.4.1 For 08 Nos. 36kV feeders for incoming generations each comprising with:-

IEDs shall be provided as per the requirements given in Chapter 5 of Technical Specification -Grid Substation for following functions.

Clause 5.11.1	-	General Requirements
Clause 5.11.4	-	Protection/Control Functions Required in 11kV/33kV Feeder Protection (All the clauses under shall be complied for TCS, BB protection etc.)
Clause 5.11.5	-	Trip Matrix
Clause 5.11.6	-	Interlocking
Clause 5.19	-	Trip Circuit Supervision.

1.2.1.5.4.2 For 02 Nos. 36kV Transformer bays each comprising with:-

IEDs shall be provided as per the requirements given in Chapter 5 of Technical Specification -Grid Substation for following functions.

Clause 5.12.2
- Directional and Non-directional Over current protection for LV side
- Directional and Non-directional Residual Earth fault protection for LV side
- BCU function for LV side
- Synchronism Check function for the LV side
- Monitoring of Lockout relay

Clause 5.19 - Trip circuit supervision

Clause 5.9.5.2 - Synchrocheck & Synchronizing

Clause 5.8.1 and clause 5.8.2 - Control IED'S on 36kV level

Operation counter auto-trip for circuit breaker.

Operation counter hand-trip for circuit breaker.

1.2.1.5.4.3 For 01 No. 36kV Bus Section bay each comprising with: -

IEDs shall be provided as per the requirements given in Chapter 5 of Technical Specification -Grid Substation for following functions.

Clause 5.16 - Bus Section Bay General requirements

Clause 5.16.4 - General Requirements for 33kV Bus Section Protection.

Clause 5.19 - Trip Circuit Supervision.

1.2.1.5.4.4 Station Alarm and Annunciation

Input modules and annunciator shall be provided as per Clause 5.20 of the Technical Specification - Grid Substation.

1.2.1.5.5 Energy Metering panels comprising with: -

Two separate sets of meter panels named as Transco and Disco are required where each set includes Energy meters for Transformers and feeders

Transco Energy Metering panel set:
Energy meters with modems as specified in chapter 9 of the Technical Specification-Grid Substation for Transformers and 36 kV feeders.

Disco Energy Metering panel set:
Energy meters with modems as specified in chapter 9 of the Technical Specification-Grid Substation for Transformers and 36 kV feeders.

Ethernet Network Switch:

Ethernet switches for each set of Transco and Disco panels as specified in chapter 9 of the Technical Specification-Grid Substation

1.2.1.6 COMMUNICATION EQUIPMENT AND SCADA GATEWAYS/RTUs

1.2.1.6.1 Fiber Optic Multiplexer at Siyabalanduwa Grid Substation

01 number of STM-1/STM-4 SDH multiplexer (Utility grade) with following interfaces with redundant CPU and power supply interfaces shall be provided. This shall be possible to connect with the existing SDH optical multiplexers (in STM-1) at Monaragala GSS for communication of voice, data, Tele-protection signals and integration with the existing Network Management System.

01 number of Power supply Main

01 number of Power supply Standby

01 number of main CPU

01 number of Standby CPU

01 number of Optical interface module having interfaces for Monaragala GSS and one extra interface for future.

08 numbers of FXS ports with standard external surge protection circuitry

04 numbers of Data ports for SCADA (V.24, V.28) for IEC 101 SCADA

01 no. of module with minimum 04 numbers of Ethernet ports with L2- switching, also configurable for VLAN and L3- routing facility (10/100 Mbps) for IEC 104 SCADA application. This router/switch should be able to link to existing other such routers/switches on other multiplexer nodes internally through the same transport STM-N by using PPP (point to point protocol) or MLPPP (Multi level PPP) encapsulated tunnels over VC12 containers.

1.2.1.6.1.1 Tele protection Modules

For 132 kV (Monaragala GS direction)

Distance protection Interface: 01 command for Direct Tripping **per each circuit.**

Differential Protection Interface : 02 nos. digital channel (Optical/complying to IEEE C37.94) per each circuit (Optical Interface)

1.2.1.6.1.2 Accessories:

01 Lot cable with accessories

04 Nos. Optical patch cords with suitable connectors to connect the patch panel to Multiplexer

03 Nos. Small Form-factor Pluggable (SFP) optical transceiver modules (with DDM support) of 1.25Gbit/s and 03 nos. Optical patch cords

05 Nos. 2 wire analog telephone sets with Display.
(All telephones shall be wired to the control desk and other required places of the Substation from the fiber optic multiplexer.)

1.2.1.6.2 Required SCADA for Siyabalanduwa Substation

SCADA Gateway

Gateway System Comprising:
02 Nos. Gateway Computers with 1+1 redundancy and Gateway to be independent from SAS and shall be installed inside a server rack
01 No. Separate Software Access Keys (Separate Dongle/License key) shall be provided

01 No Laptop/Software tool to access the Gateway computer, for maintenance purposes.

01 Lot 20% of the total Gateway Datapoints as spare Datapoints
04 Nos. of 10/100Mbps Ethernet Ports (electrical) with redundancy for each Gateway.

All these ports should not be built in a single interface module. There should be separate interface modules for these ports to provide 1+1 redundancy. All the ports shall be surge protected.
Final configuration of Database, Project file and Gateway image (Acronis true image) backup files shall be submitted in the form of Portable external hard disk.

Required SCADA Signals and Commissioning of Siyabalanduwa GS

"All the signals related to 132/33 kV Siyambalanduwa Solar Collector GS as per Signal List given in "Annex A1-Siyambalanduwa GS" shall be configured in the Gateway as per the IEC 60870 – 5 – 104 protocol. Gateway configuration parameters are given in "Annex B". The communication interfaces shall be configured as in Annex C1. Finalized Signal List shall be submitted at least 02 weeks prior to the commissioning as per the format given in Annex D. Configuration of National System Control Center (NSCC) SCADA Master Station for integration of the signals shall be done by the CEB. The integrated signals shall be tested up to the NSCC by the contractor. The separate remote control level for NSCC operations and interlocking operations shall be activated for the NSCC operations. Simulations of any signals shall not be accepted.

1.2.1.6.3 Required SCADA for Siyabalanduwa Solar Power Station

All the signals related to Solar Plants and controllers in Siyambalanduwa Solar PS as per Typical Signal List given in "Annex A2- Siyambalanduwa Solar PS" shall be configured in the Gateway as per the IEC 60870 – 5 – 104 protocol. Gateway configuration parameters are

given in “Annex B”. The communication interfaces shall be configured as in Annex C2. Finalized Signal List shall be submitted at least 02 weeks prior to the commissioning as per the format given in Annex D. Configuration of National System Control Center (NSCC) SCADA Master Station for integration of the signals shall be done by the CEB. The integrated signals shall be tested up to the NSCC by the contractor. The separate remote control level for NSCC operations and interlocking operations shall be activated for the NSCC operations. Simulations of any signals shall not be accepted.

Final configuration of Database, Project file and Gateway image (Acronis true image) backup files shall be submitted in the form of Portable external hard disk).

If the separate gateway facility not available through Solar Plant Automation System, the relevant SCADA monitoring and controlling facility of Solar Plant shall be available through Siyambalanduwa GS for the NSCC operations. Controlling functions shall be separately arranged for NSCC operation from Solar Plant via Siyambalanduwa GS.
The architecture of NSCC operations of Solar Power Plant, Single Line diagram of Solar Power Plant and storage design if available shall be submitted at the design stage to finalize the NSCC SCADA requirement.

1.2.1.6.4 Modifications required at Monaragala GSS

1.2.1.6.4.1 Fiber Optic Multiplexer

The existing Fiber Optic Multiplexer (FOX**615** by ABB) shall be extended with following interfaces.
01 no Optical interface module with minimum 4 nos. of STM-1/STM-4 ports (with 2 nos. Patch cords and SFPs)

Tele protection Modules
For Siyambalanduwa Grid Substation (132kV) direction

Distance protection Interface: 01 command for Direct Tripping per each circuit

Differential Protection Interface: 02 nos digital channel (Optical/complying to IEEE C37.94) per each circuit (Optical Interface)

1.2.1.6.4.2 SCADA Gateway

CEB will be undertaken integration work of new control and protection IEDs to existing Gateway at Monaragala Grid Substation.
Bidder shall provide required license to upgrade the data points of the Gateway.
Control & Protection IEDs which will be supplied for Monaragala GS shall be compatible with IEC 61850 Revision (Edition) 01 protocol. The bidder shall submit IEC 61850 conformance certificate issued by an independent laboratory empowered by UCA International Users Group tested according to the IEC 61850-10 for the Control & Protection IEDs.
New control & protection IEDs should be connected to existing IEC 61850 SAS communication network to get the data to the Gateway using fiber optic cables and

Ethernet Switches. Existing redundant protocol such as RSTP shall be maintained on the added IEC 61850 SAS communication network.

Bidder should provide high quality ICD and CID files of new control & protection IEDs and the relevant IED software with license to CEB in order to carry out Gateway modification work.

Required SCADA signals and Commissioning of Monaragala GS

All the signals related Siyambalanduwa line bays as per Signal List given in “Annex A3-Monaragala GS” shall be configured in the Gateway as per the IEC 60870 – 5 – 104 protocol. Gateway configuration parameters are given in “Annex B”. Finalized Signal List shall be submitted at least 01 month prior to the commissioning as per the format given in Annex D. Finalized signal list shall be submitted to the Communication Branch to do the gateway configurations. All the relevant interlocking and operational functions shall be made available upto the gateway from the relays/IEDs by the contractor to establish the real operations from gateway to NSCC. Configuration of National System Control Center (NSCC) SCADA Master Station for integration of the signals shall be done by the CEB. The integrated signals shall be tested up to the NSCC under the supervision and consultation of the contractor. The separate remote control level for NSCC operations and interlocking operations shall be activated for the NSCC operations. Simulations of any signals shall not be accepted. Bidder should provide signals from the field through New Control & Protection IEDs,during the SCADA signal point to point testing with the NSCC.

Note:

Please submit all the related “Functional Operational and Maintenance Drawings and Related Documents of Solar Collector Power Plant” from the contractor. They shall be compatible to the NSCC operations as well. Please submit relevant documents to NSCC at the design stage. NSCC signals may change if any signals necessary to rearrange as per functional descriptions.

1.2.1.7 SUBSTATION EARTHING

The substation earthing system shall include excavation, backfilling and reinstatement of the ground, laying earth mat, driving the earth rods and making of the connections. This shall include additional earth materials if required to reach the specified value of earth resistance.

An earthing rod shall be installed into each borehole in order to connect with the substation earthing system later. This rod shall be reached to the bottom most level of the borehole. The surrounding space of this conductor shall be filled with electrically conductive aggregate material/earthing enhancement compound conforming to IEC 62561-7:2011 with the approval of the employer. Advancing of boreholes shall be according to the clause 13 of the technical specification.

1.2.1.8 LIGHTNING PROTECTION SYSTEM COMPRISING: -

Design and erection of lightning protection system with shield earth wires.

1.2.1.9 GROUNDING SYSTEM COMPRISING: -

Grounding system including connections of all steel structures and electrical apparatus to earth mesh and grounding electrodes.

1.2.1.10 POWER AND CONTROL CABLES

1.2.1.10.1 36kV Power cables and terminations

02 Lots	36kV, XLPE insulated, PVC sheathed, Armoured single core cables for connections between Power transformer and 36kV indoor switchgear. Note: The current rating of the connections between Power transformer and 36kV indoor switchgear shall be 1400A.
08 Lots	36kV, XLPE insulated, PVC sheathed, Armoured single core cables for connections from switchgear panels to outdoor gantries (termination structures) for Generator feeders. Note: The current rating of the Generator feeders shall be 800A

1.2.1.10.2 All low voltage AC power cables and terminations

1.2.1.10.3 All DC power and control cables and terminations

1.2.1.10.4 All cables required for Protection, Control, Instrumentation, Communication, SCADA and termination.

1.2.1.10.5 All cables required for station lighting, small power, fire protection, ventilation equipment.

The Contractor shall be responsible for the supply, installation, termination and testing of all cables for the execution of the works.

The Contractor is on a turnkey basis and the prices for Definite Works entered by the Bidder in Schedule of Rates & Prices shall be varied only in accordance with contract, including the price adjustment provision. For the purpose of such variations, the rates shall be those in Schedule of Prices & Rates.

The rates for supply and installation shall be those appropriate to order of drum lengths as appropriate to each type and rating of cable.

The cable installation rates shall include excavation, backfilling and reinstatement of the ground, installation in concrete trenches and ducts and fixing to cable tracks and supports as necessary.

Control and power cables shall be armoured and they shall be laid in concrete trenches, in the switchyard and within the buildings, they shall be cleated to cable trays. Cable trays and supports shall be supplied and installed in accordance with the Specification and included in the prices for Definite Work in Schedule of Prices & Rates.

1.2.1.11 TRANSFORMERS

Following transformers as specified in Chapter 10 of Technical Specification -Grid Substation.

Item	Description	Qty	Voltage	Rating	Cooling
1.	Power T/F	2	132/33kV	63MVA	ONAN/ONAF
2.	Earthing T/F	2	33kV	800A, 30s	ONAN
3.	Auxiliary T/F	2	33/0.4kV	160kVA	ONAN

Note 01: 145kV, 36kV & neutral terminals of Power transformers, 36kV & neutral terminals of Earthing transformers and 36kV terminals of Auxiliary transformers shall be supplied with outdoor type bushings and 400V sides of Auxiliary transformers shall be supplied with cable end box type only.

Note 02: Fire protection system shall be applicable for above number of power transformers.

1.2.1.12 DIESEL GENERATOR SYSTEM

A Diesel generator of 50kVA capacity to supply the substation 400V emergency supply. The Generator shall be rated for continuous operation for at least 24 hours.

1.2.1.13 SUPPORTING STRUCTURES INCLUDING GANTRIES

All support structures necessary for the works and all terminating lines specified under the Employer's Requirements shall be provided by the Contractor. Materials used for the structures shall comply with the Technical Specification – Grid Substation.

1.2.1.14 MARSHALLING KIOSK

Marshalling kiosks shall be provided and wired where necessary. (i.e. shall be fabricated with higher grade of stainless steel or galvanized steel with protective coating).

1.2.1.15 MISCELLANEOUS WORKS

Any work other than listed above.

1.2.1.16 SPARE PARTS

All necessary Spare parts.

1.2.1.17 TOOLS AND INSTRUMENTS

As per the price schedule.

1.2.2 MONARAGALA GRID SUBSTATION AUGMENTATION

1.2.2.1 OUTDOOR SWITCHGEAR

1.2.2.1.1 145kV Single busbar system comprising: -

2 Sets - Extension of 2000A, 31.5kA, 145kV three phase tubular bus bars with post insulators, set of bay connections, connectors, clamps, etc.

(Existing arrangement already consists with busbar sets for one future line bay. Therefore, new busbar sets are required only for one Siyabalanduwa line bay. Refer drawings)

1.2.2.1.2 02 Nos. 145kV Line bays for Siyabalanduwa each comprising: -

1 No - 1250A, 145kV, 31.5kA three phase busbar disconnector with hand and motor operating mechanism.

1 No - 1250A, 145kV, 31.5kA three-phase circuit breaker complete with operating mechanism etc.

3 Nos. - 145kV, 31.5kA Single Phase Current Transformers with cores as follows:

Class 5P20, ratio 1600-800/1A for Main 1 protection and control IED.

Class 5P20, ratio 1600-800/1A for Main 2 protection and control IED.

Class 0.2, ratio 1600-800/1A.

Class 5P20, ratio 2000/1A for busbar differential protection and breaker failure protection.

1 No. - 1250A, 145kV, 31.5kA three phase line disconnector with hand and motor operating mechanism and integral with hand and motor operated earthing switch.

3 Nos. - Single-phase Capacitor type voltage transformers with cores,

Class 3P, ratio 132,000/√3V:110/√3V for Main 1 protection and control IED.

Class 3P, ratio 132,000/√3V:110/√3V for Main 2 protection and control IED.

Class 0.5, ratio 132,000/√3V:110/√3V.

3 Nos. - 120kV, 10kA, Class 2 Surge arresters with counters.

1 Lot - Set of bay connections, connectors, clamps, etc.

1.2.2.2 MODIFICATIONS TO THE LVAC SWITCH BOARDS

Necessary modifications to the existing 400V switchboards shall be completed to accommodate all the additional auxiliary loads related to the installation of new 145 kV line bays.

1.2.2.3 MODIFICATIONS TO THE DC DISTRIBUTION BOARDS

Substation DC distribution boards shall be modified to accommodate the loads related to the installation of new 145 kV line bays.

1.2.2.4 PROTECTION, METERING, MONITORING AND CONTROL

1.2.2.4.1 Modification to Substation Automation System: -

Contractor shall provide a price proposal for the below “Option 2”. CEB will decide which option to be implemented.

01 No. Engineering Workstation (EWS) with two 27’ Monitors

01 No. Industrial type layer 2 Manageable Gigabit Ethernet Switches and Ethernet connections To connect Operator Workstation 1 (HMI-1), Operator Workstation 2 (HMI-2), Engineering Workstation (EWS), Gateway 1, and Gateway 2.

01 No. Next-Generation Firewalls To connect Industrial type layer 2 Manageable Gigabit Ethernet Switch and Communication multiplexer.

02 Nos. An industrial type layer 2 Manageable Ethernet Switches and connections For line bays

Option 1

CEB will carry out integration work of new control & protection IEDs to existing Substation Automation Systems at Monaragala Grid Substation after providing training for existing SAS at Monaragala GS, as per the module 14.2.6 Training Module No. 6: Substation Automation for Two (02) Engineers of Substation Automation System Unit of Control & Protection – Transmission for 15 days from the original equipment manufacturer.

The connecting IEDs to network and field signal testing associated with commissioning shall be carried out by the contractor as per the Site Acceptance Tests and

Commissioning section of Clause: 5.24 of Chapter 5, Technical Specification - Grid Substation of bidding document.

Option 2

Existing Substation Automation system shall be updated as per the relevant sections of Clause: 5.24 of Technical Specification - Grid Substation by the original equipment manufacturer of the existing SAS.

If a new Substation Automation System is offered, it shall be provided as per Clause: 5.24 of Technical Specification - Grid Substation and typical architecture drawing provided in Volume 06 of bidding document. All the existing bays shall be integrated and commissioned to the new system.

(Note: Currently, Monaragala GSS is controlled and monitored at Badulla GSS)

1.2.2.4.2 145kV Protection & Control facilities: -

All the control metering and protection panels shall be complied with requirements of Chapter 5 of the Technical Specifications.

The trip circuit supervision scheme shall provide continuous supervision of all the trip coils and trip circuits with the circuit breaker in either the open or closed position for each 145kV bay as per clause 5.19.

1.2.2.4.2.1 For 02 Nos. 145kV Line Bays Each Comprising with Following Functions: -

Protection and control IEDs with panel shall be provided as per Chapter 5 of Technical Specifications. Protection/control and monitoring functions listed under clause 5.9.1 of Technical Specifications shall be included in each IED used in 145kV line protection and control.

Busbar and breaker failure protection bay IED shall also be provided on this protection and control panel.

1.2.2.5 COMMUNICATION EQUIPMENT AND SCADA GATEWAYS/RTUs

Required modifications/ extensions of Communication and SCADA system at Monaragala grid substation. Refer 1.2.1.6.4.

1.2.2.6 EXTENSION OF SUBSTATION EARTHING

Existing substation earthing system shall be extended for the new scope of works. Moreover, extended earthing system should ensure the safe step and touch voltages. The substation earthing system shall include excavation, backfilling and reinstatement of the ground, laying earth mat, driving the earth rods and making of the connections. This shall include additional earth materials if required to reach the specified value of earth resistance.

1.2.2.7 EXTENSION OF LIGHTNING PROTECTION SYSTEM COMPRISING: -

Existing lightning protection system shall be extended to protect the new installations. Design and erection of lightning protection system with shield earth wires.

1.2.2.8 EXTENSION OF GROUNDING SYSTEM COMPRISING: -

Grounding system including connections of all steel structures and electrical apparatus to earth mesh and grounding electrodes shall be extended to the new scope of works.

1.2.2.9 POWER AND CONTROL CABLES

1.2.2.9.1 All low voltage AC power cables and terminations

1.2.2.9.2 All DC power and control cables and terminations

1.2.2.9.3 All cables required for Protection, Control, Instrumentation, Communication, SCADA and termination.

1.2.2.9.4 All cables required for station lighting, small power, fire protection, ventilation equipment.

The Contractor shall be responsible for the supply, installation, termination and testing of all cables for the execution of the works.

The Contractor is on a turnkey basis and the prices for Definite Works entered by the Bidder in Schedule of Rates & Prices shall be varied only in accordance with contract, including the price adjustment provision. For the purpose of such variations, the rates shall be those in Schedule of Prices & Rates.

The rates for supply and installation shall be those appropriate to order of drum lengths as appropriate to each type and rating of cable.

The cable installation rates shall include excavation, backfilling and reinstatement of the ground, installation in concrete trenches and ducts and fixing to cable tracks and supports as necessary.

Control and power cables shall be armoured and they shall be laid in concrete trenches, in the switchyard and within the buildings, they shall be cleated to cable trays. Cable trays and supports shall be supplied and installed in accordance with the Specification and included in the prices for Definite Work in Schedule of Prices & Rates.

1.2.2.10 SUPPORTING STRUCTURES INCLUDING GANTRIES

All support structures necessary for the works and all terminating lines specified under the Employer’s Requirements shall be provided by the Contractor. Materials used for the structures shall comply with the Technical Specification – Grid Substation.

1.2.2.11 MARSHALLING KIOSK

Marshalling kiosks shall be provided and wired where necessary. (i.e. shall be fabricated with higher grade of stainless steel or galvanized steel with protective coating).

1.2.2.12 MISCELLANEOUS WORKS

Any work other than listed above.

1.2.2.13 SPARE PARTS

All necessary Spare parts.

1.2.2.14 TOOLS AND INSTRUMENTS

As per the price schedule.

1.3 CIVIL WORKS, INSTALLATION, OTHER SERVICES AND TRAINING

1.3.1 CIVIL WORKS

1.3.1.1 SIYABALANDUWA GRID SUB STATION

1.3.1.1.1 Preliminary Works

a.) Site Survey

- As per chapter 13 of Technical Specification - Grid Substation.

b.) Sub Soil Investigations

- As per chapter 13 of Technical Specification - Grid Substation.

1.3.1.1.2 Site Clearing

a) Cutting and removing trees/shrubs and boulders.

- Big trees, shrubs and boulders.

1.3.1.1.3 Site formation and up keeping

a) Cutting and filling earth.

- Formation level shall be 1m above high flood level.

b) Rock excavation

- If rock excavation is required during earth works, payment shall be made for actual quantities of rock volume based on the volume ranges mentioned in the price schedule 4 of Volume 2.

c) Earth retaining structures

- Earth retaining walls

  Adequate erosion protection (retaining wall for the boundary) where required.

- All the embankments shall be protected as per specifications and drawings.

- Rubble pitching work

d) Anti Termite soil treatment

- Anti termite treatment with more than 10 years guaranty shall be done for the control building area and site office area.

e) Surface Chipping

- Area covered by the earth mat.

1.3.1.1.4 Cable Trenches & Ducts

- As per chapter 13 of Technical Specification - Grid Substation.

- Provision shall be made for all future cables.

1.3.1.1.5 Foundations

a) For take-off structures & switchgear

- As required for all the equipment support structures.

b) For Main transformers with firewall – 2 Nos.

c) Auxiliary & Earthing transformers

2 Nos. Auxiliary transformers

2 Nos. Earthing transformers.

1.3.1.1.6 Lightning protection system

- As per chapter 13 of Technical Specification - Grid Substation.

1.3.1.1.7 Water supply & drainage system

a) Water supply system

- As per the Specifications

b) Waste water sewerage system

- As per the specifications.

c) Surface water drainage system

- As per the specification

1.3.1.1.8 Construction & Maintenance of Roads

a) Approach Road & Structures

As indicated in the drawing, to be developed as per the chapter 13 of Technical Specification - Grid Substation.

Development of approach road & structures up to the solar collector substation premises is under the PV plant developer's scope.

b) Access road and structures

- As indicated in the drawings and as per chapter 13 of Technical Specification - Grid Substation.

1.3.1.1.9 Fence, Gates and Boundary Walls

a) Chain link fence and remotely operable gates

- For details refer drawings for fence and gates.

b) Barbed wire fence and gate along the periphery of the premises as shown in the drawing

1.3.1.1.10 External Lighting & small power supply services

- Shall include all Switchyard Street and security lighting

1.3.1.1.11 CCTV Camera System

- Cameras shall be located as indicated in the drawings and as per the chapter 13 Technical Specification – Grid Sub Station.

Following items shall be installed and commissioned

1 lot of control/monitoring equipment at the control room of the substation.

1 lot of control/monitoring equipment at guard room of the substation.

CCTV cameras as indicated in drawings.

1 lot of speech facility as specified in specification.

Note: Execution of this system will be decided based on employer's representative's instructions.

1.3.1.1.12 Construction of Control & Other Buildings

a) Control Building at Siyabalanduwa

- As indicated in the drawings and as per chapter 13 of Technical Specification - Grid Substation

b) Site Office at Siyabalanduwa

- Temporary Building (Container Type)

c) Temporary Works (Stores, access, contractor's offices etc)

d) House for Diesel Generator.

- 1 No. Diesel generator shall be covered with a permanent structure.

e) Guard room

f) Shed for car parking

1.3.1.1.13 Construction of Building Services

a) Air conditioning & ventilation system

- Refer chapter 13 of Technical Specification - Grid Substation.

b) Fire protection

- Refer chapter 13 of Technical Specification - Grid Substation.

c) Internal Lighting & small power supply services.

- Refer chapter 13 of Technical Specification - Grid Substation

1.3.1.1.14 Miscellaneous Works

- Any work other than listed above.

1.3.1.2 MONARAGALA GRID SUB STATION AUGMENTATION

1.3.1.2.1 Preliminary Works

a.) Site Survey

- As per chapter 13 of Technical Specification - Grid Substation.

b.) Sub Soil Investigations

- As per chapter 13 of Technical Specification - Grid Substation.

1.3.1.2.2 Site formation and up keeping

a) Surface Chipping

- Area covered by the earth mat.

1.3.1.2.3 Cable Trenches & Ducts

- As per chapter 13 of Technical Specification - Grid Substation.

- Provision shall be made for all future cables.

1.3.1.2.4 Foundations

a) For take off structures & switchgear

- As required for all the equipment support structures.

1.3.1.2.5 Lightning protection system

- As per chapter 13 of Technical Specification - Grid Substation.

1.3.1.2.6 Water supply & drainage system

a) Surface water drainage system

- As per the specification

1.3.1.2.7 Fence, Gates and Boundary Walls

a) Chain link fence and remotely operable gates

- For details refer drawings for fence and gates.

b) Barbed wire fence and gate along the periphery of the premises as shown in the drawing

1.3.1.2.8 External Lighting & small power supply services

- Shall include all Switchyard Street and security lighting

1.3.1.2.9 Construction of Control & Other Buildings

a) Site Office at Monaragala

- Temporary Building (Container Type)

1.3.1.2.10 Miscellaneous Works

- Any work other than listed above.

1.3.2 INSTALLATION

Erection, Installation and commissioning of structures Plant & Equipment specified in the clause 1.2 of Employer's Requirements

a. Siyabalanduwa Grid Substation

b. Monaragala Grid Substation

c. Other Grid Sub Stations

1.3.3 OTHER SERVICES

1.3.3.1 Transport

Transport facility shall be provided to carry out modification work of Substation Automation System.

1.3.3.2 Accommodation for Employer's Personnel

An accommodation facility shall be provided to carry out modification work of Substation Automation System.

1.3.4 TRAINING

The contractor shall provide the following training modules at OEM premises as specified in clause 14.2 of Technical Specification - Grid Substation;

Module Description	Duration	No. of CEB Officers
Training for new SAS Substation Automation Systems, covering the module is given in 14.2.6 Training Module No. 6: Substation Automation for offered new SAS	15 days	Two (02) Engineers from Substation Automation System Unit of Control & Protection - Transmission

Annex A1 - Siyambalanduwa GS

Siyambalanduwa GS	TYPE OF SIGNAL	VOLTAGE	132 kV					132/33 kV T/F 1		132/33 kV T/F 2		33 kV											
		BAY No																					
		BAY TYPE	Monaragala Line 1	Monaragala Line 2	Bus Section	Bus Bar1	Bus Bar2	132 kV side	33 kV side	132 kV side	33 kV side	F1	F2	F3	F4	F5	F6	F7	F8	BS	BB 1	BB 2	Station
C O N T R O L S		**ACTION**																					
Circuit Breaker	DPC	Open/Close							2		2	2	2	2	2	2	2	2	2	2			
BB Isolator 1	DPC	Open/Close							2		2	2	2	2	2	2	2	2	2	2			
BB Isolator 2	DPC	Open/Close																		2			
Line Isolator	DPC	Open/Close	2	2																			
Capacitor Bay Isolators	DPC	Open/Close																					
Earth Switch	DPC	Open/Close																					
Tap Changer (AVR) Raise / Lower	DPC	Raise/Lower						2		2													
Tap Changer (AVR) Auto / Manual	DPC	Auto /Manual						2		2													
AVR Operating mode **(One of the 2 modes will be available)**	DPC	Master/ Follower																					
	DPC	Minimum Circulation Current						2		2													
AVR Independent / Parallel	SPC	Independent/Parallel						1		1													
Protection Master Relay Reset /(Protection Reset Command K86.1) (/Lockout Relay Reset)	SPC	Reset	1	1				1	1	1	1									1			
Protection Master relay Reset Command K86.2	SPC	Reset	1	1				1	1	1	1									1			
Protection Reset Command K96 (BB/BCF relay Reset)	SPC	Reset	1	1				1	1	1	1									1			
Load Shedding OFF	SPC	On/Off																					
STATUS INDICATIONS		**STATUS**																					
Circuit Breaker	DPI	Open/Close							2		2	2	2	2	2	2	2	2	2	2			
BB Isolator 1	DPI	Open/Close							2		2	2	2	2	2	2	2	2	2	2			
BB Isolator 2	DPI	Open/Close																		2			
Line Isolator	DPI	Open/Close	2	2																			
Capacitor Bay Isolator	DPI	Open/Close																					
Earthing Switch	DPI	Open/Close	2	2					2		2	2	2	2	2	2	2	2	2	4			
Bay Control	DPI	Local/Superv/Remote	2	2				2	2	2	2	2	2	2	2	2	2	2	2	2			
TRANSFORMER																							
Tap Control	SPI	Local/Superv						1		1													
T/F AVR Operating mode	DPI	Manual /Auto						1		1													
T/F AVR Operating mode **(One of the 2 modes will be available)**	DPI	Master/Follower																					
		Minimum Circulation Current						1		1													
AVR Parallel / Indipendent	SPI	Paralle/ Indipendant						1		1													
Capacitor Bank																							
Capacitor Bank Operating Mode	DPI	Manual /Auto																					
A L A R M INDICATIONS																							
CIRCUIT BREAKER																							
Breaker Fault (critical) - ***	SPI	Healthy/Faulty	1	1				1	1	1	1	1	1	1	1	1	1	1	1	1			
a	SF6 Gas Presure low. (2nd stage)																						
b	Trip Circuit Supervision Fail 1 (Trip circuit faulty)																						
c	Trip Circuit Supervision Fail 2 ((Trip circuit 2 faulty)																						
d	Spring Not Charge (Spring Supervision)																						
e	Hydraulic Pressure Low																						
f	Pneumatic Pressure Low.																						
g	CB Pole Discrepancy																						
h	Trip Lockout/Close Lockout (SF6 Lock out)																						
i	Control Voltage Failure (DC MCB trip)																						
j	Internal Arc trip																						
h	SF6 Gas Presure low in Bus Bar Chamber																						

Siyambalanduwa GS		TYPE OF SIGNAL	VOLTAGE	132 kV					132/33 kV T/F 1		132/33 kV T/F 2		33 kV											
			BAY No																					
			BAY TYPE	Monaragala Line 1	Monaragala Line 2	Bus Section	Bus Bar1	Bus Bar2	132 kV side	33 kV side	132 kV side	33 kV side	F1	F2	F3	F4	F5	F6	F7	F8	BS	BB 1	BB 2	Station
Bay Fault (Non critical) - ***		SPI	Healthy/Faulty	1	1				1	1	1	1	1	1	1	1	1	1	1	1	1			
a	SF6 Gas Pressure Low - First step																							
b	PT Secondary MCB Trip (Protection VT MCB Failed/ Incoming Voltage MCB trip/ VT MCB trip)																							
c	AC/DC Voltage Failure Indication (Auxiliary Fail)																							
TRANSFORMER MECHANICAL PROTECTION																								
Tap Changer Mechanism Fault (OLTC failure)		SPI	Healthy/Faulty						1	1	1	1												
Tap out of step (TAP OUT ERROR)		SPI	Onset/Reset						1	1	1	1												
Transf Buchholz Alarm - ***		SPI	Onset/Reset						1	1	1	1												
a	Transf Buchholz Alarm																							
b	OLTC Buchholz Alarm																							
Transf Buchholz Trip		SPI	Operated/Normal						1	1	1	1												
OLTC Buchholz Trip (OLTC OIL Flow Relay Trip)		SPI	Operated/Normal						1	1	1	1												
ET Transf Buchholz Trip		SPI	Operated/Normal						1	1	1	1												
AT Transf Buchholz Trip		SPI	Operated/Normal						1	1	1	1												
Temperature Alarm - ***		SPI	Onset/Reset						1	1	1	1												
a	Oil Temperature Alarm																							
b	Winding HV Temperature Alarm																							
c	Winding LV Temperature Alarm																							
Temperature trip - ***		SPI	Operated/Normal						1	1	1	1												
a	Oil Temperature trip																							
b	Winding HV Temperature trip																							
c	Winding LV Temperature trip																							
General Alarm - ***		SPI	Onset/Reset						1	1	1	1												
a	Cooling Fan Fail (Group 1/Group 2)																							
b	Transformer Oil Level low																							
c	OLTC Oil level low																							
General Trip - ***		SPI	Operated/Normal						1	1	1	1												
a	OLTC Surge Trip																							
b	Main tank Presure Release Valve (PRV) Trip																							
c	OLTC Pressure Release Valve																							
d	Transformer Oil Level low TRIP																							
e	OLTC Oil level low																							
PROTECTION SIGNALS																								
LINE PROTECTION																								
Main 1 - Differential protection operated		SPI	Operated /Normal	1	1																			
Main 1 - Distance Zone 1 operated		SPI	Operated /Normal	1	1																			
Main 1 - Distance Zone 2 operated		SPI	Operated /Normal	1	1																			
Main 1 - Distance Zone 3 operated		SPI	Operated /Normal	1	1																			
Main 1 - Distance Zone 4 operated		SPI	Operated /Normal	1	1																			
Main 1 -Distance protection operated		SPI	Operated /Normal	1	1																			
Main 1 - Directional Earth Fault operated		SPI	Operated /Normal	1	1																			
Main 1 - Distance Protection Aided Trip		SPI	Operated /Normal	1	1																			
Main 2- Differential protection operated		SPI	Operated /Normal	1	1																			
Main 2 - Distance Zone 1 operated		SPI	Operated /Normal	1	1																			
Main 2 - Distance Zone 2 operated		SPI	Operated /Normal	1	1																			
Main 2 - Distance Zone 3 operated		SPI	Operated /Normal	1	1																			
Main 2 - Distance Zone 4 operated		SPI	Operated /Normal	1	1																			
Main 2 - Distance protection operated		SPI	Operated /Normal	1	1																			

Siyambalanduwa GS	TYPE OF SIGNAL	VOLTAGE	132 kV					132/33 kV T/F 1		132/33 kV T/F 2		33 kV											
		BAY No																					
		BAY TYPE	Monaragala Line 1	Monaragala Line 2	Bus Section	Bus Bar1	Bus Bar2	132 kV side	33 kV side	132 kV side	33 kV side	F1	F2	F3	F4	F5	F6	F7	F8	BS	BB 1	BB 2	Station
Main 2 - Directional Earth Fault operated	SPI	Operated /Normal	1	1																			
Main 2 - Distance Protection Aided Trip	SPI	Operated /Normal	1	1																			
Over Current Protection trip	SPI	Operated /Normal	1	1								1	1	1	1	1	1	1	1	1			
Earth Fault Protection Operated	SPI	Operated /Normal	1	1								1	1	1	1	1	1	1	1	1			
Pole Discrepancy Protection Operated	SPI	Operated /Normal	1	1																			
Auto Recloser Operated / Success / Progress	SPI	Operated /Normal	1	1																			
Direct Intertrip Send	SPI	Operated /Normal	1	1																			
Direct Intertrip Received	SPI	Operated /Normal	1	1																			
Permissive Intertrip Send (carrier send)	SPI	Operated /Normal	1	1																			
Permissive Intertrip Received (carrier receive)	SPI	Operated /Normal	1	1																			
DEF Protection carrier Send	SPI	Operated /Normal	1	1																			
DEF Protection carrier Receive	SPI	Operated /Normal	1	1																			
Distance Protection Block	SPI	Operated /Normal	1	1																			
Communication Fail (Differential block)	SPI	Operated /Normal	1	1																			
Switch On To Fault trip (SOTF trip)	SPI	Operated /Normal	1	1																			
Over Voltage trip (OV)	SPI	Operated /Normal	1	1																			
Breaker Failure Protection Operated	SPI	Operated /Normal	1	1				1	1	1	1	1	1	1	1	1	1	1	1	1			
Trip Relay Operated/ Protection Relay K86.1 /Lockout Relay operated	SPI	Set/Reset	1	1				1	1	1	1	1	1	1	1	1	1	1	1	1			
Trip Relay Operated/Protection Relay K86.2	SPI	Set/Reset	1	1				1		1										1			
Protection Relay K96	SPI	Set/Reset	1	1																1			
Under Frequency Trip	SPI	Operated /Normal	1	1								1	1	1	1	1	1	1	1				
Over Frequency Trip	SPI	Operated /Normal	1	1								1	1	1	1	1	1	1	1				
Main 1 Protection Relay Fail	SPI	Healthy/ Fail	1	1				1		1										1			
Main 2 Protection Relay Fail	SPI	Healthy/ Fail	1	1				1		1													
Back Up Protection Relay Fail	SPI	Healthy/ Fail	1	1				1		1										1			
Auto Relcose ON/OFF	SPI	ON / OFF	1	1																			
33kV protection Operated	SPI	Operated /Normal										1	1	1	1	1	1	1	1				
BUSBAR PROTECTION																							
Bus Bar Protection Operated	SPI	Operated /Normal	1	1				1		1										1			
TRANSFORMER PROTECTION																							
Differential Protection Operated	SPI	Operated /Normal						1		1													
HV Restricted Earth Fault	SPI	Operated /Normal						1		1													
LV Restricted Earth Fault	SPI	Operated /Normal						1		1													
Transformer earth Fault Protection Operated	SPI	Operated /Normal						1	1	1	1												
Transformer Stand By EF Protection Operated	SPI	Operated /Normal						1	1	1	1												
Transformer Over Current Protection trip (OCProtection I>trip)	SPI	Operated /Normal						1	1	1	1												
Over Voltage Protection	SPI	Operated /Normal						1		1													
Over Fluxing Protection	SPI	Operated /Normal						1		1													
T/F Thermal Overload	SPI	Operated /Normal						1		1													
CAPACITOR BANK																							
Phase OverVoltage Operated	SPI	Operated /Normal																					
STATION ALARMS																							
Under Frequency Load Shedding Operated	SPI	Operated/Normal										1	1	1	1	1	1	1	1				1
Bus Voltage Failure - ***	SPI	Healthy/Faulty																					1
a Auxialary Supply Voltage	SPI	Healthy/Faulty																					
b DC Voltage Failure (110V DC MCB Trip)	SPI	Healthy/Faulty																					
Gateway A Active/fail Alarm	SPI	Healthy/Faulty																					1
Gateway B Active/fail Alarm	SPI	Healthy/Faulty																					1

Siyambalanduwa GS	TYPE OF SIGNAL	VOLTAGE	132 kV					132/33 kV T/F 1		132/33 kV T/F 2		33 kV											
		BAY No																					
		BAY TYPE	Monaragala Line 1	Monaragala Line 2	Bus Section	Bus Bar1	Bus Bar2	132 kV side	33 kV side	132 kV side	33 kV side	F1	F2	F3	F4	F5	F6	F7	F8	BS	BB 1	BB 2	Station
Communication Alarm (Communication Malfuntion)	SPI	Healthy/Faulty																					1
Battery Charger Failure (Communication) - * **	SPI	Healthy/Faulty																					1
a 48V Battery Charger 2 Fail																							
b 48V Battery Charger 1 Fail /(Rectifier 1 Fault)																							
Battery Charger Failure (Station)/	SPI	Healthy/Faulty																					1
a 220 V Battery Charger 2 Fail /(Rectifier 1 Fault)																							
b 220 V Battery Charger 1 Fail (Rectifier 2Fault)																							
Station Urgent Fault - * **	SPI	Operated /Normal																					1
a Fox Faulty Urgent Alarm																							
Station Non Urgent Fault - * **	SPI	Operated/Normal																					1
a Diesel Generator Alarm																							
b Fox Faulty Non Urgent Alarm																							
Station Control Remote/Supervisory	DPI	Remote/Superviosry																					1
ENERGY MEASUREMENTS																							
Active Energy	AI	MWh										1	1	1	1	1	1	1	1				
Re-Active Energy	AI	Mvarh										1	1	1	1	1	1	1	1				
M E A S U R E M E N T S		**UNITS**																					
Voltage	AI	Volts	1	1				1	1	1	1	1	1	1	1	1	1	1	1		1	1	
Frequency	AI	Hertz	1	1																	1	1	
Active Power	AI	MW	1	1				1	1	1	1	1	1	1	1	1	1	1	1	1			
Reactive Power	AI	MVAr	1	1				1	1	1	1	1	1	1	1	1	1	1	1	1			
Current	AI	Amperes	1	1				1	1	1	1	1	1	1	1	1	1	1	1	1			
Transformer Tap Position	AI	Tap number							1		1												
GENERAL																							
Air Condition Temprature	AI	Celcius																					1
Humidity	AI	RH %																					1

Legend

BC = BusCoupler T/F = Transformer G = Generator C = Capacitor F = Feeder BB= Bus Bar BS= Bus Section MH= Mini Hydro D= Dendro Power GF=Generator Feeder BSC= Capacitor Bank

TYPE OF SIGNAL

DPC Double Point Control Command
SPC Single Point Control Command
DPI Double point indication input
SPI Single point indciation input

AI Analogue Measurement
AO Analogue Output

Double points are counted individually
***** :- Grouped Alarms**

Annex A2 - Typical Signal List for Siyambalanduwa Solar Power Station

Signal Description	Type Of Signal
From each Generator Bay	
Status Indications	
Circuit Breaker Open/Close	DPI
Bus Isolator Open/Close	DPI
Line Isolator Open/Close	DPI
Earth Switch Open/Close	DPI
Generaor Running/Stop	DPI
Measurements	
Active Power (MW)	AI
Reactive Power (MVar)	AI
Current (A)	AI
Voltage (kV)	AI
Power Factor	AI
Frequency (Hz)	AI
Solar Iradius	AI
From Total Solar Plant	
Status Indications	
Plant Control NSCC/SAS/Siyambalanduwa GS	DPI
Opeartng Mode I	SPI
Opearting Mode 2	SPI
Operating Mode n	SPI
Active Power Controller Mode	SPI
Reactive Power Controller Mode	SPI
Voltage Controller Mode	SPI
Power Factor Controller Mode	SPI
Control Commands	
Select Operating Mode 1	SPC
Select Operating Mode 2	SPC
Select Operating Mode n	SPC
Select Active Power Control	SPC
Select Reactive Power Control	SPC
Select Voltage Control	SPC
Select Power Factor Control	SPC
Active Power Set Point Command	AO
Reactive Power Set point Command	AO
Voltage Set Point Command	AO
Power Factor Set Point Command	AO
Measurements	
Total Plant Active Power	AI
Total Plant Reactive Power	AI
Plant Control Voltage	AI
Pleant Control Power Factor	AI
Total Active Energy	AI
Total Reactive Energy	AI
No. of Running Solar units	AI
Plant Availability Factor	AI
Plant Factor	AI
Total Available Capacity	AI
Total possible generation (MW) with respect to Solar Forcasting	AI

Legends:

DPI - Double Point Indication
SPI - Single Point Indication
DPC - Double Point Contrl Command
SPC - Single Point Control Command
AI - Measurements (Analog Input)
AO - Analog Output

Annex A3

Monaragala GS Augmentations	TYPE OF SIGNAL	VOLTAGE	132 kV	
		BAY No	106	107
		BAY TYPE	Siyambalanduwa 1	Siyambalanduwa 2
CONTROLS		**ACTION**		
Circuit Breaker	DPC	Open/Close	2	2
BB Isolator 1	DPC	Open/Close	2	2
BB Isolator 2	DPC	Open/Close		
Line Isolator	DPC	Open/Close	2	2
Capacitor Bay Isolators	DPC	Open/Close		
Earth Switch	DPC	Open/Close		
Tap Changer (AVR) Raise / Lower	DPC	Raise/Lower		
Tap Changer (AVR) Auto / Manual	DPC	Auto /Manual		
AVR Operating mode **(One of the 2 modes will be available)**	DPC	Master/ Follower		
	DPC	Minimum Circulation Current		
AVR Independent / Parallel	SPC	Independent/Parallel		
Protection Master Relay Reset /(Protection Reset Command K86.1) (/Lockout Relay Reset)	SPC	Reset	1	1
Protection Master relay Reset Command K86.2	SPC	Reset	1	1
Protection Reset Command K96 (BB/BCF relay Reset)	SPC	Reset	1	1
Load Shedding OFF	SPC	On/Off		
STATUS INDICATIONS		**STATUS**		
Circuit Breaker	DPI	Open/Close	2	2
BB Isolator 1	DPI	Open/Close	2	2
BB Isolator 2	DPI	Open/Close		
Line Isolator	DPI	Open/Close	2	2
Capacitor Bay Isolator	DPI	Open/Close		
Earthing Switch	DPI	Open/Close	2	2
Bay Control	DPI	Local/Superv/Remote	2	2
TRANSFORMER				
Tap Control	SPI	Local/Superv		
T/F AVR Operating mode	SPI	Manual /Auto		
T/F AVR Operating mode **(One of the 2 modes will be available)**	SPI	Master/Follower		
	SPI	Minimum Circulation Current		
AVR Parallel / Indipendent	SPI	Paralle/ Indipendant		
Capacitor Bank				
Capacitor Bank Operating Mode	SPI	Manual /Auto		
A L A R M INDICATIONS				
CIRCUIT BREAKER				
Breaker Fault (critical) - ***	SPI	Healthy/Faulty	1	1
a SF6 Gas Presure low. (2nd stage)				
b Trip Circuit Supervision Fail 1 (Trip circuit faulty)				
c Trip Circuit Supervision Fail 2 ((Trip circuit 2 faulty)				
d Spring Not Charge (Spring Supervision)				
e Hydraulic Pressure Low				
f Pneumatic Pressure Low.				
g CB Pole Discrepancy				
h Trip Lockout/Close Lockout (SF6 Lock out)				
i Control Voltage Failure (DC MCB trip)				
j Internal Arc trip				
h SF6 Gas Presure low in Bus Bar Chamber				
Bay Fault (Non critical) - ***	SPI	Healthy/Faulty	1	1
a SF6 Gas Pressure Low - First step				
b PT Secondary MCB Trip (Protection VT MCB Failed/ Incoming Voltage MCB trip/ VT MCB trip)				
c AC/DC Voltage Failure Indication (Auxiliary Fail)				
TRANSFORMER MECHANICAL PROTECTION				
Tap Changer Mechanism Fault (OLTC failure)	SPI	Healthy/Faulty		
Tap out of step (TAP OUT ERROR)	SPI	Onset/Reset		
Transf Buchholz Alarm - ***	SPI	Onset/Reset		
a Transf Buchholz Alarm				
b OLTC Buchholz Alarm				

Monaragala GS Augmentations	TYPE OF SIGNAL	VOLTAGE	132 kV	
		BAY No	106	107
		BAY TYPE	Siyambalanduwa 1	Siyambalanduwa 2
Transf Buchholz Trip	SPI	Operated/Normal		
OLTC Buchholz Trip (OLTC OIL Flow Relay Trip)	SPI	Operated/Normal		
ET Transf Buchholz Trip	SPI	Operated/Normal		
AT Transf Buchholz Trip	SPI	Operated/Normal		
Temperature Alarm - ***	SPI	Onset/Reset		
a Oil Temperature Alarm				
b Winding HV Temperature Alarm				
c Winding LV Temperature Alarm				
Temperature trip - ***	SPI	Operated/Normal		
a Oil Temperature trip				
b Winding HV Temperature trip				
c Winding LV Temperature trip				
General Alarm - ***	SPI	Onset/Reset		
a Cooling Fan Fail (Group 1/Group 2)				
b Transformer Oil Level low				
c OLTC Oil level low				
General Trip - ***	SPI	Operated/Normal		
a OLTC Surge Trip				
b Main tank Presure Release Valve (PRV) Trip				
c OLTC Pressure Release Valve				
d Transformer Oil Level low TRIP				
e OLTC Oil level low				
PROTECTION SIGNALS				
LINE PROTECTION				
Main 1 - Differential protection operated	SPI	Operated /Normal	1	1
Main 1 - Distance Zone 1 operated	SPI	Operated /Normal	1	1
Main 1 - Distance Zone 2 operated	SPI	Operated /Normal	1	1
Main 1 - Distance Zone 3 operated	SPI	Operated /Normal	1	1
Main 1 - Distance Zone 4 operated	SPI	Operated /Normal	1	1
Main 1 -Distance protection operated	SPI	Operated /Normal	1	1
Main 1 - Directional Earth Fault operated	SPI	Operated /Normal	1	1
Main 1 - Distance Protection Aided Trip	SPI	Operated /Normal	1	1
Main 2- Differential protection operated	SPI	Operated /Normal	1	1
Main 2 - Distance Zone 1 operated	SPI	Operated /Normal	1	1
Main 2 - Distance Zone 2 operated	SPI	Operated /Normal	1	1
Main 2 - Distance Zone 3 operated	SPI	Operated /Normal	1	1
Main 2 - Distance Zone 4 operated	SPI	Operated /Normal	1	1
Main 2 - Distance protection operated	SPI	Operated /Normal	1	1
Main 2 - Directional Earth Fault operated	SPI	Operated /Normal	1	1
Main 2 - Distance Protection Aided Trip	SPI	Operated /Normal	1	1
Over Current Protection trip	SPI	Operated /Normal	1	1
Earth Fault Protection Operated	SPI	Operated /Normal	1	1
Pole Discrepancy Protection Operated	SPI	Operated /Normal	1	1
Auto Recloser Operated / Success / Progress	SPI	Operated /Normal	1	1
Direct Intertrip Send	SPI	Operated /Normal	1	1
Direct Intertrip Received	SPI	Operated /Normal	1	1
Permissive Intertrip Send (carrier send)	SPI	Operated /Normal	1	1
Permissive Intertrip Received (carrier receive)	SPI	Operated /Normal	1	1
DEF Protection carrier Send	SPI	Operated /Normal	1	1
DEF Protection carrier Receive	SPI	Operated /Normal	1	1
Distance Protection Block	SPI	Operated /Normal	1	1
Communication Fail (Differential block)	SPI	Operated /Normal	1	1
Switch On To Fault trip (SOTF trip)	SPI	Operated /Normal	1	1
Over Voltage trip (OV)	SPI	Operated /Normal	1	1
Breaker Failure Protection Operated	SPI	Operated /Normal	1	1
Trip Relay Operated/ Protection Relay K86.1 /Lockout Relay operated	SPI	Set/Reset	1	1
Trip Relay Operated/Protection Relay K86.2	SPI	Set/Reset	1	1
Protection Relay K96	SPI	Set/Reset	1	1

Monaragala GS Augmentations	TYPE OF SIGNAL	VOLTAGE	132 kV	
		BAY No	106	107
		BAY TYPE	Siyambalanduwa 1	Siyambalanduwa 2
Under Frequency Trip	SPI	Operated /Normal	1	1
Over Frequency Trip	SPI	Operated /Normal	1	1
Main 1 Protection Relay Fail	SPI	Healthy/ Fail	1	1
Main 2 Protection Relay Fail	SPI	Healthy/ Fail	1	1
Back Up Protection Relay Fail	SPI	Healthy/ Fail	1	1
Auto Relcose ON/OFF	SPI	ON / OFF	1	1
33kV protection Operated	SPI	Operated /Normal		
BUSBAR PROTECTION				
Bus Bar Protection Operated	SPI	Operated /Normal	1	1
TRANSFORMER PROTECTION				
Differential Protection Operated	SPI	Operated /Normal		
HV Restricted Earth Fault	SPI	Operated /Normal		
LV Restricted Earth Fault	SPI	Operated /Normal		
Transformer earth Fault Protection Operated	SPI	Operated /Normal		
Transformer Stand By EF Protection Operated	SPI	Operated /Normal		
Transformer Over Current Protection trip (OCProtection I>trip)	SPI	Operated /Normal		
Over Voltage Protection	SPI	Operated /Normal		
Over Fluxing Protection	SPI	Operated /Normal		
T/F Thermal Overload	SPI	Operated /Normal		
CAPACITOR BANK				
Phase OverVoltage Operated	SPI	Operated /Normal		
STATION ALARMS				
Under Frequency Load Shedding Operated	SPI	Operated/Normal		
Bus Voltage Failure - ***	SPI	Healthy/Faulty		
a Auxialary Supply Voltage	SPI	Healthy/Faulty		
b DC Voltage Failure (110V DC MCB Trip)	SPI	Healthy/Faulty		
Gateway A Active/fail Alarm	SPI	Healthy/Faulty		
Gateway B Active/fail Alarm	SPI	Healthy/Faulty		
Communication Alarm (Communication Malfuntion)	SPI	Healthy/Faulty		
Battery Charger Failure (Communication) - ***	SPI	Healthy/Faulty		
a 48V Battery Charger 2 Fail				
b 48V Battery Charger 1 Fail /(Rectifier 1 Fault)				
Battery Charger Failure (Station)/	SPI	Healthy/Faulty		
a 220 V Battery Charger 2 Fail /(Rectifier 1 Fault)				
b 220 V Battery Charger 1 Fail (Rectifier 2Fault)				
Station Urgent Fault - ***	SPI	Operated /Normal		
a Fox Faulty Urgent Alarm				
Station Non Urgent Fault - ***	SPI	Operated/Normal		
a Diesel Generator Alarm				
b Fox Faulty Non Urgent Alarm				
Station Control Remote/Supervisory	DPI	Remote/Superviosry		
ENERGY MEASUREMENTS				
Active Energy	AI	MWh		
Re-Active Energy	AI	Mvarh		
M E A S U R E M E N T S		**UNITS**		
Voltage	AI	Volts	1	1
Frequency	AI	Hertz	1	1
Active Power	AI	MW	1	1
Reactive Power	AI	MVAr	1	1
Current	AI	Amperes	1	1
Transformer Tap Position	AI	Tap number		
GENERAL				
Air Condition Temprature	AI	Celcius		
Humidity	AI	RH %		

Legend

BC = BusCoupler T/F = Transformer G = Generator C = Capacitor F = Feeder BB= Bus Bar BS= Bus Section MH= Mini Hydro D= Dendro Power GF=Generator Feeder BSC= Capacitor Bank

TYPE OF SIGNAL

DPC Double Point Control Command
SPC Single Point Control Command
DPI Double point indication input
SPI Single point indciation input

AI Analogue Measurement
AO Analogue Output

Double points are counted individually
***** :- Grouped Alarms**

	Signal Description	Type Of Signal	Signal Type Description				User Data of Class
			For IEC 60870 - 5 - 101		For IEC 60870 - 5 - 104		
			Type ID No.	Description	Type ID No.	Description	
	Control Command						
	Circuit Breaker	DPC	46	C_DC_NA_1	46	C_DC_NA_1	Class 1
	BB Isolator 1	DPC	46	C_DC_NA_1	46	C_DC_NA_1	Class 1
	BB Isolator 2	DPC	46	C_DC_NA_1	46	C_DC_NA_1	Class 1
	Line Isolator	DPC	46	C_DC_NA_1	46	C_DC_NA_1	Class 1
	Capacitor Bay Isolators	DPC	46	C_DC_NA_1	46	C_DC_NA_1	Class 1
	Earth Switch	DPC	46	C_DC_NA_1	46	C_DC_NA_1	Class 1
	TRANSFORMER AVR/TC						
	Tap Changer(Raise/Lower)	DPC	46	C_DC_NA_1	46	C_DC_NA_1	Class 1
	Tap Changer (AVR) Auto / Manual	DPC	46	C_DC_NA_1	46	C_DC_NA_1	Class 1
	AVR Operating mode **(One of the 2 modes will be available)**						
	Master/Follower	DPC	46	C_DC_NA_1	46	C_DC_NA_1	Class 1
	Minimum Circulation Current	DPC	46	C_DC_NA_1	46	C_DC_NA_1	Class 1
	AVR Independent / Parallel	SPC	45	C_SC_NA_1	45	C_SC_NA_1	Class 1
	VARIABLE REACTOR TAP CONTROL						
	Tap Changer(Raise/Lower)	DPC	46	C_DC_NA_1	46	C_DC_NA_1	Class 1
	Tap Changer (AVR) Auto / Manual	DPC	46	C_DC_NA_1	46	C_DC_NA_1	Class 1
	GENERATOR CONTROLS						
	MW Setpoint	AO	50	C_SE_NC_1	50	C_SE_NC_1	Class 1
	MVAr Setpoint	AO	50	C_SE_NC_1	50	C_SE_NC_1	Class 1
	MW Control	DPC	46	C_DC_NA_1	46	C_DC_NA_1	Class 1
	MVAr Control	DPC	46	C_DC_NA_1	46	C_DC_NA_1	Class 1
	WIND/SOLAR PLANT CONTROLLER CONTROLCOMMANDS						
	Plant Operating Mode Selection Command	SPC	45	C_SC_NA_1	45	C_SC_NA_1	Class 1
	Plant Control Mode Selection Command	SPC	45	C_SC_NA_1	45	C_SC_NA_1	Class 1
	Active Power Set Point Command	AO	50	C_SE_NC_1	50	C_SE_NC_1	Class 1
	Reactive Power Set point Command	AO	50	C_SE_NC_1	50	C_SE_NC_1	Class 1
	Voltage Set Point Command	AO	50	C_SE_NC_1	50	C_SE_NC_1	Class 1
	Power Factor Set Point Command	AO	50	C_SE_NC_1	50	C_SE_NC_1	Class 1
	Protection Master Relay Reset /(Protection Reset Command K86.1) (/Lockout Relay Reset)	SPC	45	C_SC_NA_1	45	C_SC_NA_1	Class 1
	Protection Master relay Reset Command K86.2	SPC	45	C_SC_NA_1	45	C_SC_NA_1	Class 1
	Protection Reset Command K96 (BB/BCF relay Reset)	SPC	45	C_SC_NA_1	45	C_SC_NA_1	Class 1
	Load Shedding OFF	SPC	45	C_SC_NA_1	45	C_SC_NA_1	Class 1
	Status Indications						
	Circuit Breaker	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 1
	BB Isolator 1	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 2
	BB Isolator 2	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 2
	Capacitor Bay Isolators	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 2
	Line Isolator	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 2
	Earthing Switch	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 2
	Bay Control	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 2
	TRANSFORMER AVR/TC						
	Tap Control (Local/Remote)	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 1
	Tap Changer (AVR) Auto / Manual	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 1
	AVR Operating mode **(One of the 2 modes will be available)**						
	Master/Follower	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 1
	Minimum Circulation Current	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 1
	AVR Independent / Parallel	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	VARIABLE REACTOR TAP CONTROL						
	Tap Changer(Raise/Lower)	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 1
	Tap Changer (AVR) Auto / Manual	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 1
	CAPACITOR BANK/REACTOR BAY						
	Capacitor Bank Operating Mode	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 1
	Reactor Operating Mode	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 1
	GENERATOR STATUS INDICATIONS						
	Oper. mode of Governor	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 1
	Oper. mode of Gen. AVR	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 1
	Gen ready to Start	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 1
	Generator Status	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 1
	Generator Control	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 1
	Setpoint Validation	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Raise /Lower Enable	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	WIND/SOLAR PLANT CONTROLLER INDICATIONS						
	Plant Operating Mode Indication	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Plant Control Mode Indication	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Alarm Indications						
	CIRCUIT BREAKER						
	Breaker Fault (critical) -***	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
a	SF6 Gas Presure low. (2nd stage)						

	Signal Description	Type Of Signal	Signal Type Description				User Data of Class
			For IEC 60870 - 5 - 101		For IEC 60870 - 5 - 104		
			Type ID No.	Description	Type ID No.	Description	
b	Trip Circuit Supervision Fail 1 (Trip circuit faulty)						
c	Trip Circuit Supervision Fail 2 ((Trip circuit 2 faulty)						
d	Spring Not Charge (Spring Supervision)						
e	Hydraulic Pressure Low						
f	Pneumatic Pressure Low.						
g	CB Pole Discrepancy						
h	Trip Lockout/Close Lockout (SF6 Lock out)						
i	Control Voltage Failure (DC MCB trip)						
j	Internal Arc trip						
k	SF6 Gas Presure low in Bus Bar Chamber						
	Bay Fault (Non critical)-* **	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
a	SF6 Gas Pressure Low - First step						
b	PT Secondary MCB Trip(Protection VT MCB Failed/ Incoming Voltage MCB trip/ VT MCB trip)						
c	AC/DC Voltage Failure Indication (Auxiliary Fail)						
	TRANSFORMER MECHANICAL PROTECTION						
	Tap Changer Mechanism Fault	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Tap out of step	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Transf Buchholz Alarm - * **	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
a	Transf Buchholz Alarm						
b	OLTC Buchholz Alarm						
	Transf Buchholz Trip	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	OLTC Buchholz Trip (OLTC OIL Flow Relay Trip)	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	ET Transf Buchholz Trip	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	AT Transf Buchholz Trip	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Temperature Alarm - * **	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
a	Oil Temperature Alarm						
b	Winding HV Temperature Alarm						
c	Winding LV Temperature Alarm						
	Temperature trip - * **	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
a	Oil Temperature trip						
b	Winding HV Temperature trip						
c	Winding LV Temperature trip						
	General Alarm- * **	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
a	Cooling Fan Fail (Group 1/Group 2)						
b	Transformer Oil Level low						
c	OLTC Oil level low						
	General Trip- * **	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
a	OLTC Surge Trip						
b	Main tank Presure Release Valve (PRV) Trip						
c	OLTC Pressure Release Valve						
d	Transformer Oil Level low TRIP						
e	OLTC Oil level low						
	PROTECTION SIGNALS/ALARMS						
	Main 1 - Differential protection operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 1 - Distance Zone 1 operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 1 - Distance Zone 2 operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 1 - Distance Zone 3 operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 1 - Distance Zone 4 operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 1 -Distance protection operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 1 - Directional Earth Fault operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 1 - Distance Protection Aided Trip	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 2- Differential protection operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 2 - Distance Zone 1 operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 2 - Distance Zone 2 operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 2 - Distance Zone 3 operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 2 - Distance Zone 4 operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 2 - Distance protection operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 2 - Directional Earth Fault operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 2 - Distance Protection Aided Trip	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Over Current Protection trip	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Earth Fault Protection Operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Pole Discrepancy Protection Operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Auto Recloser Operated / Success / Progress	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Direct Intertrip Send	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Direct Intertrip Received	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Permissive Intertrip Send (carrier send)	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Permissive Intertrip Received (carrier receive)	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	DEF Protection carrier Send	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	DEF Protection carrier Receive	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1

	Signal Description	Type Of Signal	Signal Type Description				User Data of Class
			For IEC 60870 - 5 - 101		For IEC 60870 - 5 - 104		
			Type ID No.	Description	Type ID No.	Description	
	Distance Protection Block	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Communication Fail (Differential block)	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Switch On To Fault trip (SOTF trip)	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Over Voltage trip (OV)	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Breaker Failure Protection Operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Trip Relay Operated/ Protection Relay K86.1 /Lockout Relay operated(if any)	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Trip Relay Operated/Protection Relay K86.2(if any)	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Protection Relay K96	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Under Voltage Trip	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Under Frequency Trip	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Over Frequency Trip	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Restricted Earth Fault Protection Operated(Main 2)	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 1 Protection Relay Fail	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Main 2 Protection Relay Fail	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Back Up Protection Relay Fail	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Auto Relcose ON/OFF	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	33kV protection Operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	GENERATOR PROTECTION INDICATIONS						
	Gen. Prot. Operated (critical)	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Gen. Prot. Operated (non critical)	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Over /Under voltage protection operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Over /Under Frequency protection operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Over speed protection operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	BUSBAR PROTECTION						
	Bus Bar Protection Operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	TRANSFORMER PROTECTION						
	Differential Protection Operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	HV Restricted Earth Fault	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	LV Restricted Earth Fault	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Transformer earth Fault Protection Operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Transformer Stand By EF Protection Operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Transformer Over Current Protection trip (OCProtection I>trip)	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Over Voltage Protection	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Over Fluxing Protection	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	T/F Thermal Overload	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	STATION ALARMS						
	Under Frequency Load Shedding Operated	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Bus Voltage Failure - ***	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
a	Auxialary Supply Voltage						
b	DC Voltage Failure (110V DC MCB Trip)						
	Communication Alarm (Communication Malfuntion)	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
	Gateway A Active/fail Alarm	SPI	3	M_SP_TA_2	31	M_SP_TB_2	Class 2
	Gateway B Active/fail Alarm	SPI	4	M_SP_TA_3	32	M_SP_TB_3	Class 3
	Battery Charger Failure (Communication) - ***	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
a	48V Battery Charger 2 Fail						
b	48V Battery Charger 1 Fail /(Rectifier 1 Fault)						
	Battery Charger Failure (Station) - ***	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
a	220 V Battery Charger 2 Fail /(Rectifier 1 Fault)						
b	220 V Battery Charger 1 Fail (Rectifier 2Fault)						
	Station Urgent Fault - ***	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
a	Fox Faulty Urgent Alarm						
	Station Non Urgent Fault - ***	SPI	2	M_SP_TA_1	30	M_SP_TB_1	Class 1
a	Diesel Generator Alarm						
b	Fox Faulty Non Urgent Alarm						
	Station Control Remote/Supervisory	DPI	4	M_DP_TA_1	31	M_DP_TB_1	Class 1
	ENERGY MEASUREMENTS						
	Active Energy	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Re-Active Energy	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Measurements						
	Voltage	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Frequency	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Active Power	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Reactive Power	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Current	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Transformer Tap Position	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	GENERATOR MEASUREMENTS						
	Unit Generation	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Active Power (included above)	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Reactive Power (included above)	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Active Energy	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Reactive Energy	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2

	Signal Description	Type Of Signal	Signal Type Description				User Data of Class
			For IEC 60870 - 5 - 101		For IEC 60870 - 5 - 104		
			Type ID No.	Description	Type ID No.	Description	
	Droop Setting - Hand dressed	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	WIND/SOLAR PLANT CONTROLLER MEASUREMENTS						
	Total Plant Active Power	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Total Plant Reactive Power	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Plant Control Voltage	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Pleant Control Power Factor	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Total Active Energy	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Total Reactive Energy	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	No. of Running Solar units	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Plant Availability Factor	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Plant Factor	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Total Available Capacity	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Total possible generation (MW) with respect to Solar Forcasting	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	GENERAL						
	Air Condition Temprature	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2
	Humidity	AI	13	M_ME_NC_1	13	M_ME_NC_1	Class 2

LEGEND

DPI - Double Point Indication
SPI - Single Point Indication
DPC - Double Point Command
SPC - Single Pont Command
BCP - Binary Coaded Measurement
AI - Analog Input
AO - Analog Out Put
TC -Tap Controller

ASDU Type ID

C_DC_NA_1 :- Double Command
C_SC_NA_1 :- Single Command
M_DP_TA_1 :- Double Point Information with time tag
M_SP_TA_1 :- Single Point Information with time tag
M_ME_NC_1 :- Measured Value, short floating point number
M_DP_TB_1 :- Double Point Information with time tag CP56Time2a
M_SP_TB_1 :- Single Point Information with timw tag CP56Time2a
M_IT_NA_1 :- Integrated Totals
C_SE_NC_1:- Set Point Command,Short Floating point
C_SC_TA_1 :- Single point Command with Timetag CP56Time2a
C_DC_TA_1:- Double point Command with Timetag CP56Time2a

Bit Combinations *** **For Grouped Signals**

Device Open/Close Indications
Open=1
Close = 2
Plant Control NSCC/SAS/Siyambalanduwa GS
SAS = 1
NSCC = 2
Operating Mode Indication
Mode Enable = 1
Mode Disable = 0
Operating Mode Control Commands
Operating Mode Activating = 1
Operating Mode Deactivating = 0

Note : 1)Interlocking shall be enable at power system controllers for reject set point values which are not in the correct range and feed back shall be sent to NSCC.
2) Active Power and Reactive Power shall be configured in 'MW' and 'Mvar' ranges, ' W' and 'Var' ranges are not accepted for NSCC operations.
3) Voltage shall be configured in 'kV' range.
4) Current shall be configured in 'A' range.

Communication Path Configurations for Siyambalanduwa Solar Collector Grid Substation Gateway

a) SCADA Protocol -IEC 60870-5-104

- Speed of the TCP/IP connection : 10/100Mbps
- Gateway IP address : will be provided at commissioning period.

  IP address of the Master Station : 10.3.1.8 & 10.3.1.9

  Subnet Mask : 255.255.255.240
- **Application Layer**

  Fixed lengths are defined in the protocol as below.
  - Common Address of ASDU : 2 octets
  - Information object address : 3 octets
  - Cause of transmission : 2 octets
  - Length of APDU : Maximum length of APDU per system (253)

b) SCADA Protocol -IEC 60870-5-101

SCADA communication link is Serial, Asynchronous, Unbalanced (Master Slave) and Multipoint Party Line System.

- **Physical Layer**

  The transmission speed should be 9600 bits per seconds.
- **Link Layer**

  Link transmission procedure : Unbalanced transmission
- **Application Layer**
  - Link Address (Polling Address) : will be provided at commissioning period.
  - Station Address (Common address of Application Service Data Unit) : will be provided at commissioning period.
  - Length of Link address :1 byte(1 Octet)
  - Length of ASDU : 1 byte(1 Octet)
  - Length of IOA(Information Object Address) : 2 bytes(2 Octets)
  - Length of Cause of Transmission : 1 byte(1 Octet)

Note: There should have a facility to change Length of Link address, Length of ASDU & Length of Cause of Transmission as Octet 1 or 2.

Communication Path Configurations for Siyambalanduwa Solar Power Station Gateway

a) SCADA Protocol -IEC 60870-5-104

- Speed of the TCP/IP connection : 10/100Mbps
- Gateway IP address : will be provided at commissioning period.

  IP address of the Master Station : 10.3.1.8 & 10.3.1.9

  Subnet Mask : 255.255.255.240
- **Application Layer**

  Fixed lengths are defined in the protocol as below.
  - Common Address of ASDU : 2 octets
  - Information object address : 3 octets
  - Cause of transmission : 2 octets
  - Length of APDU : Maximum length of APDU per system (253)

b) SCADA Protocol -IEC 60870-5-101

SCADA communication link is Serial, Asynchronous, Unbalanced (Master Slave) and Multipoint Party Line System.

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  Link transmission procedure : Unbalanced transmission
- **Application Layer**
  - Link Address (Polling Address) : will be provided at commissioning period.
  - Station Address (Common address of Application Service Data Unit) : will be provided at commissioning period.
  - Length of Link address :1 byte(1 Octet)
  - Length of ASDU : 1 byte(1 Octet)
  - Length of IOA(Information Object Address) : 2 bytes(2 Octets)
  - Length of Cause of Transmission : 1 byte(1 Octet)

Note: There should have a facility to change Length of Link address, Length of ASDU & Length of Cause of Transmission as Octet 1 or 2.

(Name of GSS) NSCC SIGNAL LIST - SINGLE POINT INDICATIONS

Bay No.	Bay Name	Signal Description	Type Of Signal	Signal Type Description				User Data of Class	Information Object Address	Remarks	Test Results (OK/Alarm)
				For IEC 60870 - 5 - 101		For IEC 60870 - 5 - 104					
				Type ID No.	Description	Type ID No.	Description				

T/F AVR Operating mode(Manual/Auto) - High(1)=..... Low(0)=.....

Tap Control(Local/Remote) - High(1)=..... Low(0)=.....

T/F AVR Operating mode (Master/Follower; Minimum Circulation) - High(1)=..... Low(0)=.....

AVR Parallel / Indipendent- High(1)=..... Low(0)=.....

(Name of the Station) NSCC SIGNAL LIST - CONTROLS AND DOUBLE POINT INDICATIONS

Bay No.	Bay Name	Signal Description	Type Of Signal	Signal Type Description				User Data of Class	Information Object Address	Remarks
				For IEC 60870 - 5 - 101		For IEC 60870 - 5 - 104				
				Type ID No.	Description	Type ID No.	Description			

86/96 reset command - High(1)=.....command; Low(0)=.....command

Tap Position Command(DPC) - High(10)=.....command; Low(01)=.....command

T/F AVR Operating mode(Auto/Manual) (DPC) - High(10)=.....command; Low(01)=.....command

T/F AVR Operating mode (Master/Follower; Minimum Circulation) (DPC) - High(10)=.....command; Low(01)=.....command

AVR Parallel / Indipendent(SPC)- High(1)=..... Low(0)=.....

(Name of the Station) NSCC SIGNAL LIST - MEASUREMENTS

Bay No.	Bay Name	Signal Description	Type Of Signal	Signal Type Description				User Data of Class	Information Object Address	Remarks
				For IEC 60870 - 5 - 101		For IEC 60870 - 5 - 104				
				Type ID No.	Description	Type ID No.	Description			

Tested By
Name:
Signature:
Date:
(Name of the Contrator):
(Project Name) :

Checked By
Name:
Signature:
Date:
CEB
(Project Name) :

(Name of the Substations) NSCC SIGNALS - SIGNAL GROUPING DETAILS

E01 Bay Fault - Non critical:
CB Heater Fault

E02 Bay Fault - Non criti
CB Heater Fault

E03 Bay Fault - Non critical:
CB Heater Fault

E04 Bay Fault - Non critical:
CB Heater Fault

……..(Substation name)

Name of the contarctor **…….**