Guidelines for Conduct of Facilities Study

A. Background of Facilities Study

This entails the overall scope of the project including the capacity and location of the power plant, identification of connection and transmission assets and implementation schedule/estimated time of commissioning.

B. Overall Connection Scheme and Detailed Single Line Diagram (SLD)

This entails interconnection diagram of Connection Asset and Transmission Asset Substation and its transmission line in between with appropriate equipment and facilities technical parameters i.e., generator capacity, conductor type and ampacity, tower/pole type, line length etc.

- **General Connection Requirements**

All requirements relating to the connection point shall be in accordance with GCR 4.6.1 of the PGC 2016 Edition.

For Transmission Customer's transformer to be connected to the Grid at a voltage equal to or greater than 115 kV, the high-voltage side of the transformer shall be connected in Wye, with the neutral available for connection to ground as seen in Table 1.

Table 1. Transformer Winding Configuration for Generator and Load Customers

Voltage Level	Primary Winding	Secondary Winding
115 kV and Above	Wye - Grounded	Delta
69 kV	Delta	Wye - Grounded

The connection point shall be controlled by a circuit breaker that can interrupt the maximum short circuit current at the connection point. Disconnect switches shall also be provided and arranged to isolate the circuit breaker for maintenance purposes.

C. Substation Electromechanical Components and Associated Works for NGCP Substation Point-of-Connection

This entails the identification of HVE, Structural, Civil, Architectural Works, Control System (Upgrade/Expansion), Auxiliary Power Supply (AC and DC) Equipment and Materials Technical Specifications.

D. Protection and Disturbance Monitoring System

This entails the identification of Protection Scheme (Single Circuit/Double Circuit, Direct Connection or Tap Connection), Protection SLD, Network Disturbance and Protection Monitoring System Equipment, and Devices Technical Specifications.

- **Protection Requirements**

The Transmission Customer shall be solely responsible for the protection of the electrical equipment and facilities, duly agreed and coordinated at its side of the tapping point. List and details of the Transmission Customer's protection system shall be submitted to SO/MTD for approval prior to energization. A circuit breaker fail protection at the tapping point shall be provided by Transmission Customer for connection at 500 kV, 230 kV or 138 kV Grid.

Fault clearance time for a fault in the Grid shall be specified by the Transmission Customer and shall not be longer than:

- 85 ms for 500 kV;
- 100 ms for 230 kV and 138 kV; and
- 120 ms for less than 138 kV

A standard NGCP protection scheme for Generator and Load Customers shall be as seen in the Tables 2 to 5.

Table 2. Standard Tele-Protection Scheme for Grid Connected Generator and Load Customers using Single or Double Circuit Line 115 kV and Above

Protection		**Tele-Protection**
NGCP SS	**Power Plant / Load**	
Line Differential (87L) Main 1	Line Differential (87L) Main 1	* Fiber Optic via OPGW
Line Differential (87L) Main 2	Line Differential (87L) Main 2	* Fiber Optic via OPGW

Note: * Requires two (2) separate Fiber Optic links

Table 3. Standard Tele-Protection Scheme for Grid Connected Generator and Load Customers with Direct Connection via Double Circuit Line 69 kV system

Protection		**Tele-Protection**
NGCP SS	**Power Plant / Load**	
Line Differential (87L) Main 1	Line Differential (87L) Main 1	* Fiber Optic via OPGW
Line Differential (87L) Main 2	Line Differential (87L) Main 2	* Fiber Optic via OPGW

Note: * Requires two (2) separate Fiber Optic links

Table 4. Standard Tele-Protection Scheme for Grid Connected Generator and Load Customers with Direct Connection via Single Circuit Line 69 kV system

NGCP SS	**Power Plant / Load**
Directional Phase & Ground Overcurrent (67/67N) Main 1	Non-directional Phase & Ground Overcurrent (50/51, 50/51N) Main 1
Directional Phase & Ground Overcurrent (67/67N) Main 2	Non-directional Phase & Ground Overcurrent (50/51, 50/51N) Main 2

Table 5. Standard Tele-Protection Scheme for Grid Connected Generator and Load Customers with TapConnection along 69 kV line

NGCP SS	Tapping Point (facing NGCP)	Power Plant / Load (facing Tapping Point)
Directional Phase & Ground Overcurrent (67/67N) Main 1	Non-directional Phase & Ground Overcurrent (50/51, 50/51N) Main 1	Non-directional Phase & Ground Overcurrent (50/51, 50/51N) Main 1
Directional Phase & Ground Overcurrent (67/67N) Main 2	Non-directional Phase & Ground Overcurrent (50/51, 50/51N) Main 2	Non-directional Phase & Ground Overcurrent (50/51, 50/51N) Main 2

The main 1 and main 2 protections listed in Tables 2 to 5 shall be of different manufacturers. All protection schemes by the Transmission Customer with interface with NGCP shall be approved by the EDD.

- **Network Disturbance Monitoring Equipment (NDME) Requirements**

NDME shall be provided at the plant side and should be capable of remote communication to the NGCP master station located at Regional Control Center as seen in Figure 2. Pertinent interface/software as well as associated training necessary for NGCP to communicate with the plants NDME shall be provided.

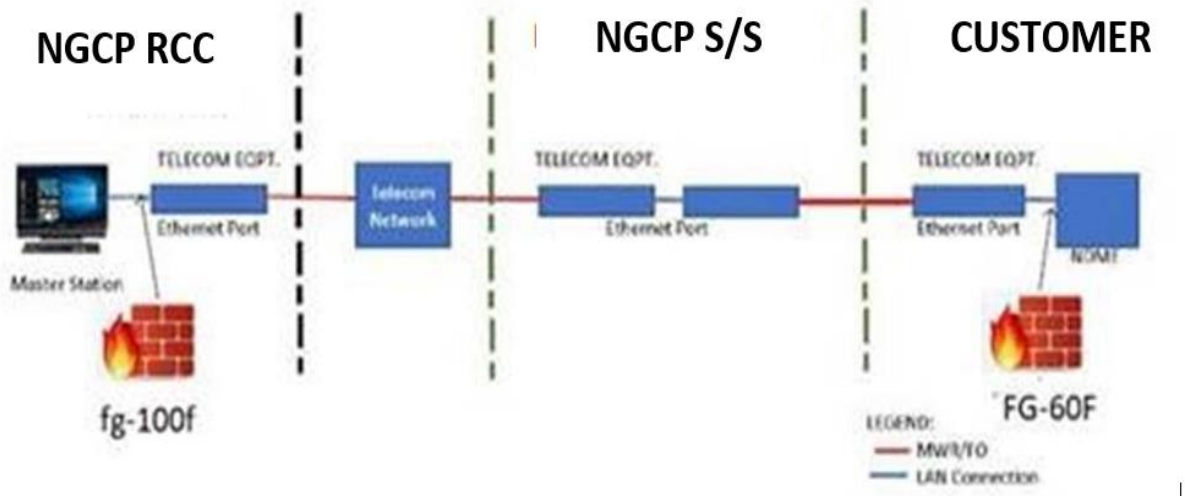

Figure 1. NDME Connection Diagram

E. SCADA-Telecommunications Solution/Scheme

This entails the identification of Communication Scheme (FO, MW, VSAT, VPN), Network Diagram, SCADA System Architecture including Equipment and Devices Technical Specifications (RTU Gateway, Communication Protocol, etc.) and Power Supply for SCADA (125VDC & 48VDC)

- **SCADA Requirements**

NGCP may use a combination of communication media such as digital/analog Power Line Carrier (PLC) or optical ground wire attached in the Transmission Connection Asset, digital/analog microwave radio, and fiber optics to link the Transmission Customer's SCADA System to NGCP's system. Backup communication may be referred to a UHF/VHF half-duplex, hand-held or base radios, and mobile (cellular phones), if applicable.

A Remote Terminal Unit (RTU) for interconnecting with the System Operation's (SO) Control Center, shall be provided by NGCP, to serve as telemetry equipment for monitoring real-time information and the equipment at the Transmission Customer's side. The RTU or alternative method utilized shall be compatible with the master station protocol requirements and modern specifications of the SO. NGCP shall also provide, if applicable, other related equipment such as transducers, cables, modems, telecommunications equipment, etc. necessary for interconnection with the SCADA System to the Grid. All NGCP SCADA and telecom equipment at the power plant shall be segregated and enclosed in a temperature controlled lockable room exclusive for NGCP access. A typical SCADA RTU diagram can be seen in Figure 2.

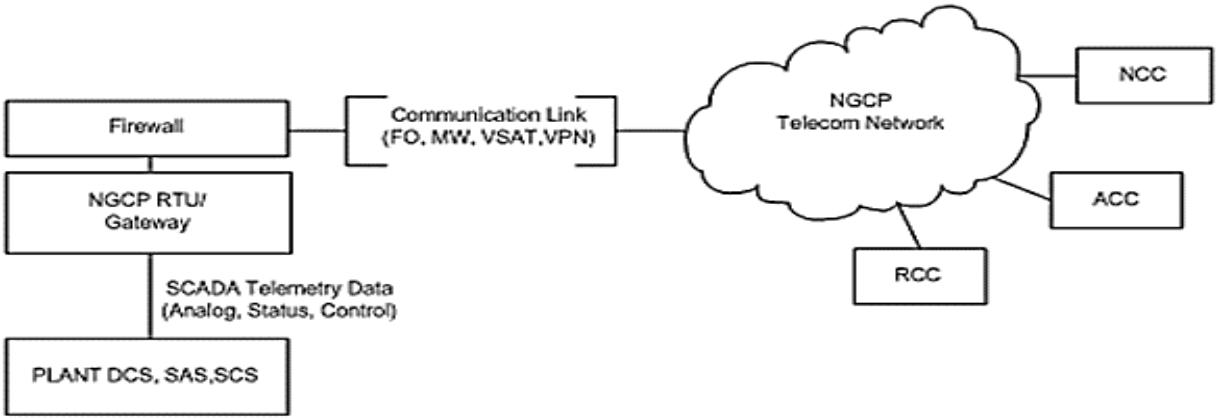

Figure 2. SCADA RTU Diagram

F. Metering Requirements

All Metering Installations shall be provided by the Metering Service Provider in accordance with the requirements of the PGC.

The Metering Point shall be at the Connection Point. However, the Metering Point can also be located away from the Connection Point due to technical, site, and security considerations, as identified by the Metering Service Provider, provided that the Demand and the Energy will be adjusted in order to account for the losses between the actual Metering Point and the Connection Point.

The Metering Service Provider and the Transmission Customer shall both ensure that Metering Installations are provided, tested and maintained in accordance with the requirements of the PGC and ERC Resolution No. 4 of Series of 2021, for their respective scope of responsibility in relation with the Metering Installations.

G. Summary of Transmission Assets with Cost

This entails the bill of quantities with corresponding total cost of identified transmission assets involved in the project.