Equipment for receiving and executing remote monitoring/control commands for RES & CHP Plants connected or connecting to the Hellenic Electricity Distribution Network with installed capacity exceeding four hundred kilowatts (400 kW)

2nd edition - 13.08.2024

Revision History Version 2.0

Version:	Chapter	Change description
2.0	1.	Content improvements for greater clarity
2.0	1.1	Text addition
2.0	1.3	New text addition
2.0	1.4	Text addition
2.0.	1.5	Text addition
2.0	1.6	Text addition
2.0	2.1.1	Text improvements for greater clarity and new text addition
2.0	2.1.2	Text improvements for greater clarity
2.0	2.2.1	Text improvements for greater clarity
2.0	2.2.2	Text addition
2.0	2.2.3	Text improvements for greater clarity
2.0	2.2.4	Text improvements for greater clarity
2.0	2.2.5	Text improvements for greater clarity
2.0	2.2.5.1	Text addition
2.0	2.2.5.2	New text addition
2.0	2.2.6	Text improvements for greater clarity
2.0	2.2.6.1	Text improvements for greater clarity
2.0	2.2.6.2	Text improvements for greater clarity
2.0	2.2.7	Text addition
2.0	2.2.8	Text improvements for greater clarity and Text addition
2.0	2.2.9	Text addition
2.0	2.2.10	Text improvements for greater clarity and text deletion
2.0	2.2.13	Text addition
2.0	2.2.14	Text addition
2.0	2.2.14.1	Text addition
2.0	2.2.14.2	Text addition
2.0	2.2.14.3	Text addition
2.0	2.2.14.4	Text addition
2.0	2.2.14.5	Text addition
2.0	2.2.15	Typo corrections
2.0	2.2.16	Text improvements for greater clarity
2.0	2.3	Text improvements for greater clarity
2.0	2.3.1	Text addition
2.0	2.3.2	Text addition
2.0	2.4.1	Text improvements for greater clarity and Text addition
2.0	2.4.2	Text improvements for greater clarity and Text addition
2.0	2.4.3	Text improvements for greater clarity
2.0	2.4.4	Text improvements for greater clarity
2.0	2.4.5	Text improvements for greater clarity and text addition
2.0	2.5.1	Text improvements for greater clarity and Text addition
2.0	2.5.2	Text addition
2.0	2.5.3	Text improvements for greater clarity
2.0	2.5.4	Text improvements for greater clarity
2.0	2.5.4.1	Text addition
2.0	2.5.4.2	Text addition
2.0	2.5.4.3	Text addition
2.0	2.5.4.4	Text addition
2.0	2.5.5	Text addition
2.0	2.5.6	Text addition
2.0	2.5.6.1	Text addition
2.0	2.5.6.2	Text improvements for greater clarity
2.0	2.5.6.3	Text addition
2.0	2.5.6.4	Text addition
2.0	2.5.6.5	Text addition
2.0	2.5.8	Text improvements for greater clarity
2.0	2.5.9	Text addition
2.0	2.6	Text improvements for greater clarity and text addition
2.0	2.7	Text improvements for greater clarity
2.0	2.7.1	Text improvements for greater clarity
2.0	2.7.1 IV)	Text addition

2.0	2.7.1 V)	Text deletion
2.0	2.7.1 VI)	Text deletion
2.0	2.7.1 VII)	Text addition
2.0	2.7.2	Update existing content with new values
2.0	2.8	Update existing content with new values
2.0	2.8 g	Text deletion and Text addition
2.0	2.8 i	Text deletion and Text addition
2.0	2.9.3	Update existing content with new values
2.0	2.9.3.1	Text addition
2.0	2.9.5 (Table 2)	Update existing content with new values
2.0	3.1	Typo corrections
2.0	Table 3B	Updating of existing content with new values and Addition of new signals
2.0	Table 4	Updating of existing content with new values and Addition of new signals
2.0	4.1	Text improvements for greater clarity
2.0	4.2	Text improvements for greater clarity
2.0	4.3	Text addition
2.0	4.4	Text addition
2.0	5.1.1	Text improvements for greater clarity
2.0	5.1.2	Text improvements for greater clarity
2.0	5.2	Text improvements for greater clarity Text deletion and Text addition

Explanatory table

Abbreviation	Description
Plant	RES & CHP Plants connected or connecting to the Hellenic Electricity Distribution Network with an installed capacity exceeding four hundred kilowatts (400 kW)
Equipment	Appropriate equipment for connecting RES & CHP stations with the Remote Control and Distribution Management System (SCADA/DMS) of HEDNO, designed to receive remote monitoring signals and to execute remote control commands, in compliance with Law 5106/2024 (Government Gazette 63/A/01.05.2024), Article 111.
Producer	Plant Owner.
TE	Telecommunications Equipment comprising an appropriate router for the interconnection of the Equipment with the SCADA/DMS system of HEDNO.
PTM	Plant Technical Manager.
MVR	Medium Voltage Representative.
ICB	Interconnection Circuit Breaker
FoSE	Aggregators.
MV	Medium Voltage.
LV	Low Voltage.

Contents

1. Introduction

The purpose of the document is to list the technical requirements of the equipment for the connection of RES & CHP stations (hereinafter referred to as "Plant(s)") which are connected or are connecting to the Hellenic Electricity Distribution Network with an installed capacity exceeding four hundred kilowatts (400 kW), with the Remote Control and Management System of the Distribution Network (SCADA/DMS of HEDNO), for receiving and executing remote monitoring/control commands in compliance with Law

5106/2024 (Government Gazette 63/A/01.05.2024), Article 111.

It is required that the premises at the Plant accommodate the appropriate equipment (hereinafter referred to as "Equipment"). These can include or be part of one of the following:

- Remote Terminal Unit (RTU).
- Programmable Logic Controller (PLC).
- Power Plant Controller (PPC).

1.1 The appropriate Telecommunications Equipment (TE) including an appropriate router for interconnection with the SCADA/DMS system of HEDNO is specified in a separate document.

1.2 Please see below the requirements for correct programming and configuration of the Equipment for the transmission of signals, statuses and measurements, and for the reception of commands from the SCADA/DMS of HEDNO, which relate to the total energy produced by the Plant and not per cluster or inverter.

1.3 The Producer is responsible for both the supply and maintenance of the Equipment. These may, however, be assigned to a Technical Manager (T.I.).

1.4 If the Plant is supported by a private MV network (other than HEDNO's), the Representative of the specific MV network (MVR) may also handle the operation of the Plant for reasons of maintenance and proper operation of the private MV network.

1.5 Please note that the equipment supports the needs of the interconnection of the Stations with the SCADA/DMS of HEDNO. Any additional equipment that may be required for the management of the Plant by the Producer (or a third party, such as the FoSE or the MVR) and/or to adapt to the requirements and regulations governing the Plant, is not the subject of this document.

1.6 Any third party (such as an MVR, PTM, or FoSE) involved in intervening, operating, or regulating the Plant for their own purposes must ensure that they do not disrupt the communication between the Equipment and the SCADA/DMS system of HEDNO, except as specified in §2.2.14.

2. Equipment and Operational Requirements

2.1 Remote control and remote monitoring of the Plant

2.1.1 HEDNO must be able to perform remote control and monitoring of the Plant in accordance with legislation and to ensure the stability of the System and the proper operation of the Network.

This remote control and remote monitoring will be carried out by sending commands and receiving signals from the SCADA/DMS of HEDNO and shall include:

- The ability to control the opening of the Interconnection Circuit Breaker (ICB) of the Plant.

- The surveillance of the location of the ICB and its Earth Switch.
- The monitoring of the control status of the ICB (local/remote).
- The control of the active injection power of the Plant.
- The capability for immediate full cutback of the Plant's injection power.
- The monitoring the status of the Plant by sending a series of indications of its operation as well as a series of measurements of electricity values.
- The verification of the completion of each command sent by HEDNO.
- The notification on the execution of power set-point commands received from a different entity (FoSE, Producer or TM, MVR, etc. - see §1.6).

2.1.2 The Equipment shall also support the exchange of signals related to the following capabilities, even if these capabilities are not supported by the devices and the general electronic power generation equipment of the Plant.[1]. These capabilities may be utilized in the future to comply with legislative requirements and to ensure the safe operation of both the Network and the Country's Electricity System. Therefore, it is requested that these capabilities be immediately implemented on the equipment level (excluding the Plant level) and that verification is provided regarding the exchange of the relevant signals and commands with the HEDNO's SCADA/DMS during the operational test. These are:

- The capability for reactive power output / power factor / voltage control.
- The capability to control frequency support through the LFSM- O, FSM, LFSM-U functions as per the RfG (Requirements for Generators).

2.2 General

2.2.1 The Equipment shall be include an Ethernet communication port compliant with the 100 Base-TX standard, featuring a female RJ-45 connector. This port shall be used for communication with the SCADA/DMS system of HEDNO via the IEC 60870-5-104 protocol and the TE. In addition, the Equipment shall have all required ports for communication with the devices and equipment (inverter, protection relay, PDD, etc.) of the Plant and/or possibly DI/DO cards for simple cable connections. Through these, it will have the capability control the devices and equipment of the Plant by responding to the commands received from the SCADA/DMS system of HEDNO and send all necessary measurements and statuses, as specified in this document.

2.2.2 The Equipment, as per IEC 60870-5-104, shall be a server (slave) and the SCADA/DMS system of HEDNO shall be the master.

2.2.3 The Equipment must be capable of making decisions in the future based on programmable logic. Consequently, the Equipment should either already possess or be prepared to potentially incorporate the functions of an embedded Programmable Logic Controller (PLC). This means that the Equipment must have either built-in PLC capabilities or available slots for future PLC units, enabling it to perform logic functions based on predefined flow charts in the future,

---

1 This document outlines general requirements for all Renewable Energy Sources (RES), regardless of capacity, technology, installation date, or whether they are required to comply with the relevant provisions of the NC-RfG, etc. The potential of each Plant is to be evaluated and utilized in the future on a case-by-case basis.

making decisions based on the commands it receives, the Plant's operating status and the scheduled instructions.

- This feature is not required to be implemented at this time. In the future, it is anticipated that the Equipment will need to accommodate the potential transmission of commands from multiple representatives or managers (e.g., FoSE, Producer or TM, MVR, etc.) or automatically limit the Plant's injection power if communication with the SCADA/DMS system of HEDNO is lost.

2.2.4 The Equipment is designed to be scalable, allowing for expansion with additional input/output (I/O) units for measuring electrical quantities or upgrading with enhanced computing performance and/or increased measurement and operational accuracy. This scalability ensures that the Equipment can meet future needs arising from the rapid development of energy production from RES and the growing technical challenges associated with maintaining the proper operation and stability of the Electricity Country's Network and System.

2.2.5 The Equipment must be powered by a suitable uninterruptible power supply (UPS) system to ensure continuous operation, including the TE (router), in the event of a power outage. The UPS should provide uninterrupted power for at least two (2) hours. The Plant's existing UPS can be used as an uninterruptible power supply system (if it meets the needs of the Equipment and the TE system).

2.2.5.1 If the TE (router) is located separately and cannot be powered by the same UPS system as the Equipment, it must have its own independent uninterrupted power supply.

2.2.5.2 It is essential that any other telecommunications or network equipment used to connect the Equipment to the router is also powered by a UPS, ensuring at least two (2) hours of backup power.

2.2.6 When a loss of communication with the SCADA/DMS system is detected, the Equipment will initiate a reset process for the TE (router), including a temporary interruption and reset of the electrical power supply. This shall be performed by the Equipment, after successive communication failures with the SCADA/DMS system of HEDNO.

2.2.6.1 The default duration for detecting communication loss before initiating a restart will be 90 seconds, with the option to configure this time frame between 30 and 180 seconds.

2.2.6.2 After each restart, there will be a 10-minute cool-down period during which additional restarts of the TE will be prevented, even if the communication issue has not yet been resolved.

2.2.7 During any loss of communication with the SCADA/DMS system, the Equipment, and consequently the Plant, should continue to operate according to the last settings configured before the communication loss.

2.2.8 A suitable electrical component, such as a relay, must be present to manage the power supply (ON/OFF) for the restart of the TE.

a. If the T.E. is not located near the Equipment, such as due to insufficient mobile telephony network coverage, the command to reset the T.E. should be transmitted effectively to the location where the T.E. is situated. The same space shall also include the appropriate electrical component for managing (ON/OFF) power supply.

2.2.9 If the loss of communication is determined to be the fault of the Producer, HEDNOP may disconnect the Plant using its own means.

2.2.10 The Equipment must use the IEC 60870-5-104 protocol as the Sync Master (Time Server) for communication with the SCADA/DMS system of HEDNO. Under no circumstances should an NTP server or a GPS be used.

2.2.11 The Equipment should be durable and reliable, designed to operate effectively in industrial and harsh environments.

2.2.12 The Equipment must be installed in a protected environment that shields it from the elements and unauthorized interference by third parties.

2.2.13 The Plant Owner and his/her service provider are responsible for the proper operation and good condition of the equipment.

2.2.14 The equipment should be capable of being controlled either locally or remotely (local/remote). The Equipment will normally operate in remote control mode.

2.2.14.1 If for any reason (maintenance, tests etc.) the Equipment is put in local control mode, the Plant can operate based on the last command given to the Equipment when it was in remote mode.

2.2.14.2 In local mode, no commands received from the SCADA/DMS system will be executed.

2.2.14.3 Prior to implementing local mode, HEDNO must be informed and consulted regarding the duration and start time. Placing the Plant in local mode without HEDNO's consent may result in penalties equivalent to those imposed for loss of communication (see **§**2.2.9).

2.2.14.4 When resetting the Equipment to remote mode, the Plant should continue to follow the last operating settings, even if these settings were established while the Equipment was in local mode.

2.2.14.5 An exception to the above paragraph is the operation of the ICB. While the Equipment is in local mode, any ICB opening commands will be declined and will not be executed upon returning to remote mode.

2.2.15 It is up to the Plant Owner or his/her TM to select the appropriate equipment. HEDNO does not intend to recommend or verify suitability for any specific type or make of Equipment.

2.2.16 The Equipment will be tested for proper operation and communication with the rest of the Plant's equipment and the SCADA/DMS system of HEDNO, following specific test protocols provided by HEDNO.

2.2.16.1 These protocols shall be delivered fully completed and signed as attachments together with the Declaration of Compliance under Article 111 of Law 5106/2024 §4) which will also be proved by HEDNO.

2.3 Control of the Interconnection Circuit Breaker (ICB) of the Plant

In general, HEDNO does not intend to open the Interconnection Circuit Breaker (ICB) of the Plant. However, HEDNO reserves the right to do so in exceptional cases to prevent islanding in the Network and to ensure the safety of people, the environment, and technical equipment.

2.3.1 The ICB must be capable of being opened by command. Therefore, command "open" (***A/A:46***) must be executed.

2.3.2 The location of the ICB shall be known to HEDNO through the signal status (***A/A:13***).

2.4 Active Power Output Control

2.4.1 Active power control is carried out by sending analog commands (set-point type according to ASDU) from the SCADA/DMS of HEDNO. Analogue commands for active power control come in two types:

i. Set-point as a percentage (0 - 100%) of the maximum power injection capacity into the Network. A value of -1 indicates that the set-point is canceled, allowing the plant to inject power freely.
ii. The set-point can also be specified as a specific value in kilowatts (kW), ranging from 0 up to the maximum injection power allowed in the Network. A value of -1 indicates that the set-point is canceled, allowing the station to inject power freely.
iii. The maximum injection power of the Plant is set based on the Final Connection Offer (FCO). It is the sole responsibility of the Producer to comply with the value of the maximum injection power in accordance with these.

2.4.2 It shall be at the discretion of HEDNO to choose to send a command of one of the above two types of control commands. In general, only one of the two types will be transmitted. If both set-point types have been sent (though not simultaneously) and remain active, then case iii below ***(§2.4.3)*** applies.

2.4.3 The execution of active power control commands by the SCADA/DMS system of HEDNO must adhere to the following requirements:

i. The stations must be capable of receiving and executing analog commands (either as a set-point percentage or a specific value) to control the active power up to the maximum power injected into the Network (see §2.4.1 III).
ii. The current active power injection of the Plant must not exceed the activated active power command at any time. If the Plant's equipment is unable to achieve the specified set-point value, it should automatically select a lower value. A higher value shall never be selected.
iii. If separate commands are sent by HEDNO or another entity and are active simultaneously, the command that results in a lower active power injection shall be implemented. This also applies when HEDNO has issued both types of commands (percentage and specific value) simultaneously and they are active at the same time.
iv. The plant must immediately limit the total active power injection, and in all cases, within the time specified in Table 1.
v. Additionally, the plant must send a verification of the completed execution of the command (***A/A:32***) to the SCADA/DMS of HEDNO within the same time frame specified in Table 1.
vi. Within the same time the corresponding measurements (***A/A: 1-10***) must also be updated and sent within the same time frame.
vii. If the dispatch of the command (***A/A:32***) is not completed within the specified time, HEDNO reserves the right to disconnect the Plant from the electricity network to ensure the safety and reliability of the country's electricity system.

2.4.4 If the command for an immediate full cut-off (***A/A: 47***) of the plant's injection is activated, it overrides all previous set-point commands (both percentage and specific value) issued by HEDNO or any other entity. The Plant must then reset its injection immediately, within the time specified in Table 1.

Table 1: Times of implementation for production limitation (active power)

Type of production	Time of implementation for production limitation (active power)
Photovoltaics	1 minute
Other	3 minutes*

****For Stations that are not photovoltaic, the three-minute limit for implementation may be extended to five minutes, subject to consultation with HEDNO and provided there is corresponding technical justification.***

2.4.5 The digital command completion verification signals (***A/A:32-35***) will be retained on the equipment only until they are acknowledged by the SCADA/DMS system via IEC 60870-5-104. When the correct transmission of any such signal is acknowledged to the SCADA/DMS system of HEDNO, then this signal will be reset. Consequently, the verification signal will be a toggle signal: Initially, the '***active***' status will be sent, followed immediately by the '***not active***' status upon receipt of the first signal.

HEDNO shall not issue a new control order for the active power output before the time interval specified in Table 1 has elapsed.

2.5 Reactive Power / cosφ power factor Control

2.5.1 The Equipment must be capable of receiving and executing analog commands to control reactive power or the power factor (cosφ) at a frequency of no more than once per minute. Execution of these commands by the Plant is anticipated to be enabled in the future.

2.5.2 HEDNO should be duly informed of the Plant's maximum reactive power injection capacity (kVAr) and the cosφ limits by completing the relevant fields in the Declaration of Compliance.

2.5.3 Executing the analog command to control reactive power in kVAr requires activating the reactive power cosφ function by sending the appropriate command ***(A/A: 48)***.

2.5.4 The reactive power regulation values will range from +60% to -60% of the Plant's maximum power injection into the Network.

2.5.4.1 A positive value indicates inductive injection, while a negative value signifies capacitive injection.

2.5.4.2 If a value exceeds the Plant's capacity, the Plant will adjust it to fit within its available capacity.

2.5.4.3 Even in the above case, a verification of the completion of the command must be provided (***A/A:34***).

2.5.4.4 To execute the set-point command for reactive power, both the activation of the reactive power setting function (***A/A:48***)and the input of value 1 in the plant's set-point command (***A/A: 60***) are required. If either of the above is not true, the command is NOT executed.

2.5.5 An additional option allows for adjusting reactive power based on the voltage at the connection point to the grid, according to the predefined voltage-reactive power characteristic U(Q) set by the Manager. To activate this setting, the value 4 must also be specified in the plant's setting command (A/A: 60) and at the same time the command for voltage control (A/A: 50) must be activated. (A/A: 50).

2.5.6 The power factor setting values will range from 0.85 to 1.

2.5.6.1 A positive value indicates inductive injection, while a negative value signifies capacitive injection.

2.5.6.2 A value of cosφ = 0 means that the set-point for the power factor has not been activated.

2.5.6.3 If a value exceeds the plant's capacity, the plant will adjust it to fit within its available capacity.

2.5.6.4 Even in this case, a verification of the command's completion must be provided. (***A/A:35***).

2.5.6.5 To execute the set-point command for the power factor cosφ, value 2 must be specified in the Plant mode setting command. (***A/A:60***).

2.5.7 The reactive power output of the plant (either in kVAr or via cosφ) must be achieved immediately and, in any case, within one (1) minute.

2.5.8 The plant must send a verification of the correct and complete execution of the command to the SCADA/DMS of HEDNO within one (1) minute. Within the same time frame, the corresponding measurements (***A/A:1-10***) must be updated and sent.

2.5.9 An additional option is the adjustment of cosφ as a function of active power (cosφ = f(P)), which is activated by command A/A:49. In the future, the f(P) curve or the corresponding set-point type analog control command will be defined. To activate this setting, value 3 must also be specified in the Plant setting command. (A/A: 60).

2.6 Frequency support

The Equipment must support the exchange of signals for activating the LFSM-O, FSM, and LFSM-U functions in accordance with the RfG (Requirements for Generators).

These functions may need to be implemented as commands to the plant inverters in the future (***A/A: 51-53***).

2.7 Digital Signals from the Equipment

2.7.1 *General*

I. Loss of communication with any of the production equipment (e.g., inverters) at the Plant (***A/A: 18***).

II. Equipment control status (local/remote) (***A/A: 16***).

III. State of diagnosis of the good condition of the Equipment (***A/A: 31***).

IV. Active power, reactive power, cosφ set-point and operation set-point based on cosφ=f(P) curve or based on U(Q) curve of the plant from third operator (***A/A: 36-40***).

V. Signals confirming the completion of an order (from HEDNO) for setting active power (in % or kW), full cut-off of the Plant, of reactive power, and of cosφ (***A/A:*** 32.-35).

VI. LFSM-O, FSM, LFSM-U verification signals for RfG-type activation of functions (***A/A: 41-43***).

VII. Identification of the plant's operating status (reactive power regulation mode, cosφ regulation mode, cosφ regulation mode based on the cosφ = f(P) curve, reactive power regulation mode based on the U(Q) curve, other relevant modes) (***A/A: 12***).

2.7.2 *Sending indications from Protection Signals and the location of the Interconnection Circuit Breaker (ICB).*

The Plant will immediately send a series of indications regarding the status of the Protection Relay and the position of the Interconnection Circuit Breaker (ICB):

I. ICB status (Open/Close) (***A/A: 13***).

II. ICB control status. (Local/Remote) (***A/A: 14***).

III. Earth Switch Status (ES Status) (Open/Close) (***A/A: 15***).

IV. Relay Status (***A/A: 17***).

V. Disconnection protection alarms:
   a. Phase overcurrent faults (***A/A: 19-21***).
   b. Earth Faults, if available. (***A/A: 22-24***).
   c. Overvoltage (***A/A: 25***).
   d. Undervoltage (***A/A: 26***).
   e. Overfrequency (***A/A: 27***).
   f. Underfrequency (***A/A: 28***).
   g. Homopolar voltage protection, if available (***A/A: 29***).
   h. RoCoF, if available (***A/A: 30***).

When completing the Declaration of Compliance (see §4.1) the activation limits for the items listed above (a-h) must be filled in accurately and with caution.

2.8 Command signals to the power plant

a. Command for opening the ICB of the plant (Open) (***A/A: 46***).
b. Maximum permissible active power (set-point) in kW (***A/A: 56***).
c. Maximum permissible active power (set-point) % (***A/A: 57***).
d. Command for complete cut-off of the Plant's injection power (Active & Reactive) (***A/A: 47***).
e. Analog set-point (discrete integer) command signal for setting reactive power (***A/A: 58***).
f. Analogue set-point (discrete decimal value) command signal for setting the cosφ power factor (***A/A: 59***).
g. Commands to enable or disable the operation of the plant in reactive power control, cosφ based on cosφ = f(P), or reactive power regulation based on the U(Q) curve (***A/A: 48-50***).
h. Commands to enable or disable the operation of the plant in LFSM-O, FSM, and LFSM-U modes (***A/A: 51-53***).
i. Instruction to define the mode of operation of the plant in terms of reactive power/cosφ/voltage regulation (***A/A: 60***).

2.9 Dispatch of Measurements

2.9.1 The Plant, through its equipment, must be capable of continuously updating and sending measurements of active power, reactive power, power factor, frequency, as well as current and voltage for each phase. (***A/A: 1-10***).

2.9.2 Additionally, if possible, the plant should provide the current production capacity of the installed equipment, such as reduced generation capacity due to inverter failure, which is dependent on the condition of the plant equipment rather than meteorological data (***A/A: 11***).

2.9.3 The total error for all measurements must currently be less than 1.5% at nominal values, except for frequency measurements, which must have an error of less than 0.06%. HEDNO reserves the right to mandate an increase in measurement accuracy in the future.

2.9.3.1 Taking measurements is mandatory and should be carried out at a specific point within the plant's Medium Voltage (M.T.) system, rather than from a Low Voltage point. For example, the protection relay could be used to provide these measurements to the Equipment.

2.9.4 The process of taking all measurements must include filtering techniques at both the hardware and software levels to ensure adequate stability and minimize variations in the measured quantities.

2.9.5 The transmission to SCADA/DMS for each measured value will be executed at regular intervals, and in addition only when this changes more than the D threshold specified in Table 2, in which case it will be dispatched immediately.

Table 2: Definition of time intervals and limits for direct transmission of measurements

Type	Time interval	Limit of change of measurement for immediate dispatch (D/deadband)
Voltage	15 min	100V (for nominal voltage: 20KV) or 0,5% of nominal
Current	15 min	5% of the nominal
Power	15 min	5% of the nominal
Frequency	15 min	0,15Hz or 0.3% of nominal
Power factor	15 min	0,03

Note: ***The appropriate cycle timer for the 15 minutes should be implemented.***

3. Equipment Programming Requirements

3.1 General

The General Interrogation (GI) process will be carried out by the SCADA/DMS system and should be supported by the Equipment. During this process the SCADA/DMS system collects all information (Status Data, Updated Measurements etc.) from the equipment. After each loss of communication the General Interrogation (GI) procedure will be activated.

3.2 Signals and Indications

The addresses of all signals/indications/commands exchanged between the SCADA/DMS and the Plant are listed in ***Table 4***.

The exact list of signals may be adjusted by HEDNO during the testing phase of the Plant Equipment, in consultation with the Producer.

3.3 Equipment Timings

In Tables ***3A*** & ***3B*** below, all general timing and type settings of the equipment variables are listed according to IEC 60870-5-104.

The specific timing settings may be modified in consultation with the Producer, if and when required, in order to optimize the response of the Equipment.

3.3.1 *Table 3B General timing settings*

Parameters	Default value	Remarks	Required value
t0	30s	Time out of connection establishment	30s
t1	15s	Time out of send or test APDUs	15s
t2	10s	Time out for acknowledge in case of no data messages t2 < t1	10s
t3	20s	Time out for sending test frames in case of a long idle state	20s
Maximum number of outstanding I format APDUs k and latest acknowledge			
Parameters	default value	Remarks	Required value
k	12 APDUs	Maximum difference for the receive number to send state variable	12 APDUs
w	8 APDUs	Latest acknowledge after receiving w I-format APDUs	8 APDUs
Port number			
Parameters	Value	Remarks	Required Value
port number	2404	Shall not be changed, unless it is dictated by HEDNO	2404

3.3.2 *Table 3B: Signals Standardization*

S/N	Type Based on ASDU	Description
	Measurements	
1	M_ME_NB_1	Active Output Power
2	M_ME_NB_1	Reactive Output Power
3	M_ME_NB_1	Output Current A (Phase 1)
4	M_ME_NB_1	Output Current B (Phase 2)
5	M_ME_NB_1	Output Current C (Phase 3)
6	M_ME_NB_1	Output Voltage A (Phase 1) Polar
7	M_ME_NB_1	Output Voltage B (Phase 2) Polar
8	M_ME_NB_1	Output Voltage C (Phase 3) Polar
9	M_ME_NB_1	Output Frequency
10	M_ME_NA_1	Power Factor
11	M_ME_NB_1	Production Capacity (If the Plant has this feature)
12	M_ME_NB_1	Recognition of the operational status of the Plant
	Digital Signals	
13	M_DP_NA_1	ICB Status.
14	M_SP_NA_1	ICB Control Status
15	M_DP_NA_1	Earth Switch Status
16	M_SP_NA_1	Equipment Control Status
17	M_SP_NA_1	Relay Status
18	M_SP_NA_1	Loss of Communication with some production equipment e.g. Inverter
19	M_SP_NA_1	Overcurrent fault indication phase 1 / Total
20	M_SP_NA_1	Overcurrent fault indication phase 2
21	M_SP_NA_1	Overcurrent fault indication phase 3
22	M_SP_NA_1	Fault indication to earth phase 1 / Total
23	M_SP_NA_1	Earth fault indication phase 2
24	M_SP_NA_1	Earth fault indication phase 3
25	M_SP_NA_1	Overvoltage Indication
26	M_SP_NA_1	Undervoltage Indication
27	M_SP_NA_1	Overfrequency Indication
28	M_SP_NA_1	Underfrequency Indication
29	M_SP_NA_1	Homopolar voltage protection
30	M_SP_NA_1	RoCoF

31	M_SP_NA_1	Status of diagnosis of the good condition of the Equipment
32	M_SP_NA_1	Confirmation of Active Power Set-point Command Completion
33	M_SP_NA_1	Confirmation of Direct Cut-Off Command Completion
34	M_SP_NA_1	Confirmation of Reactive Power Set-point Command Completion
35	M_SP_NA_1	Confirmation of Set-point cosφ Command Completion
36	M_DP_NA_1	Execution of active power commands provided by third operators
37	M_DP_NA_1	Execution of reactive power commands provided by third operators
38	M_DP_NA_1	Execution of cosφ set-point commands provided by third operators
39	M_DP_NA_1	Execution of cosφ adjustment function commands based on a cosφ = f(P) curve provided by third operators.
40	M_DP_NA_1	Application of a reactive power control function command based on a U(Q) curve given by third operator.
41	M_SP_NA_1	LFSM-O mode enabled
42	M_SP_NA_1	FSM function enabled
43	M_SP_NA_1	LFSM-U mode enabled
44	M_SP_NA_1	Confirmation of Backup Activation
45	M_SP_NA_1	Confirmation of Activation of Second Backup Mode
	Control Commands	
46	C_DC_NA_1	ICB location check
47	C_DC_NA_1	Command for immediate full cut-off of the Plant's injection power (Active & Reactive)
48	C_SC_NA_1	Command for activating - deactivating reactive power set-point
49	C_SC_NA_1	Command for activating - deactivating the cosφ adjustment mode based on the cosφ=f(P) curve
50	C_SC_NA_1	Command for activating - deactivating the power regulation mode based on the U(Q) curve
51	C_SC_NA_1	Command for activating - deactivating the LFSM-O mode
52	C_SC_NA_1	Command for activating - deactivating the FSM mode
53	C_SC_NA_1	Command for activating - deactivating the LFSM-U mode
54	C_SC_NA_1	Command for activating - deactivating the standby mode
55	C_SC_NA_1	Command for activating - deactivating the second standby mode
	Set-point commands	
56	C_SE_NB_1	Maximum permissible active power set-point in kW
57.	C_SE_NB_1	Maximum permissible active power set-point %

58	C_SE_NB_1	Reactive Power Set-point: Reactive Power Set-point
59	C_SE_NA_1	Set-point cosφ: Set-point cosφ
60	C_SE_NB_1	Plant operational mode set-point command

3.3.3 *Table 4: Table of signals IEC 60870 - 5 - 104*

Measurements							
S/N	IEC 60870 - 5 - 104 Addresses	Type	Description	Status	Units	Item	REMARKS
1	501	ME	Active Output Power		kW	Required	
2	502	ME	Reactive Power Output		±kVAr	Required	Positive = inductive, Negative = capacitive.
3	503	ME	Output Current A (Phase 1)		A	Required	
4	504	ME	Output Current B (Phase 2)		A	Required	
5	505	ME	Output Current C (Phase 3)		A	Required	
6	506	ME	Output Voltage A (Phase 1) Polar		kV	Required	
7	507	ME	Output Voltage B (Phase 2) Polar		kV	Required	
8	508	ME	Output Voltage C (Phase 3) Polar		kV	Required	
9	509	ME	Output Frequency		Hz	Required	
10	510	ME	Power Factor		±0-1	Required	Positive = inductive, Negative = capacitive.
11	511	ME	Production Capacity (If available from Plant)		%	Pending*	See ***§2.9.2***
12	512	ME	Recognition of the operational status of the Plant	Reactive	0	Pending*	Other values are not acceptable
				Operational State of the Reactive Power Setting	1		
				Operational State of the cosφ Power Factor Setting	2		
				Operational State of the cosφ setting based on the cosφ=f(p) curve	3		
				Operational State of the curve-based reactive power setting U(Q)	4		

Digital Signals							
S/N	IEC 60870 - 5 - 104 Addresses	Type	Description	Status	Units	Item	REMARKS
13.	100.	DP	ICB Status	Undetermined	00	Required	
				Open	01		
				Closed	10		
				Undetermined	11		
14.	101.	SP	ICB Control Status	Remote	0	Required	
				Local	1		
15.	102.	DP	Earth Switch State	Undetermined	00	If available	
				Open	01		
				Closed	10		
				Undetermined	11		
16.	103.	SP	Equipment Control Status	Remote	0	Required:	When the Equipment is in Local state it means that commands are not accepted ***§2.2.13.2***
				Local	1		
17	104	SP	Relay Health Status	Standard	0	Required	
				Damaged	1		
18	105	SP	Loss of Communication with some production equipment e.g. Inverter	Deactivated	0	Required	
				Activated	1		
19	106	SP	Overcurrent fault indication phase 1 / Total	Deactivated	0	Required	CB tripped - Overcurrent phase 1 or all phases
				Activated	1		
20	107	SP	Overcurrent fault indication phase 2	Deactivated	0	If available	CB tripped - Overcurrent phase 2
				Activated	1		
21	108	SP	Overcurrent fault indication phase 3	Deactivated	0	If available	CB tripped - Overcurrent phase 3
				Activated	1		
22	109	SP	Fault indication to earth phase 1 / Total	Deactivated	0	If available	CB tripped - Earth Fault phase 1 or all phases
				Activated	1		
23	110	SP	Earth fault indication phase 2	Deactivated	0	If available	CB tripped - Earth Fault phase 2

				Activated	1		
24	111	SP	Earth fault indication phase 3	Deactivated	0	If available	CB tripped - Earth Fault phase 3
				Activated	1		
25	112	SP	Overvoltage Indication	Deactivated	0	Required	
				Activated	1		
26	113	SP	Undervoltage Indication	Deactivated	0	Required	
				Activated	1		
27	114	SP	Overfrequency Indication	Deactivated	0	Required	
				Activated	1		
28	115	SP	Underfrequency Indication	Deactivated	0	Required	
				Activated	1		
29	116	SP	Homopolar voltage protection	Deactivated	0	If available	
				Activated	1		
30	117	SP	RoCoF	Deactivated	0	If available	
				Activated	1		
31	118	SP	State of diagnosis of the good condition of the Equipment	Standard	0	Required	About any malfunctions of the Equipment itself
				Damaged	1		
32	119	SP	Confirmation of Completion of the Active Power Set- point Command	No verification	0	Required	**
				Confirmation	1		
33	120	DP	Confirmation of Completion of the Direct Cut-off Command	Undetermined	00	Required	**
				No verification	01		
				Confirmation	10		
				Undetermined	11		
34	121	SP	Confirmation of Completion of the Reactive Power Set- point Command	No verification	0	Pending*	**
				Confirmation	1		
35	122	SP	Confirmation of Completion of Set- point cosφ Command	No verification	0	Pending*	**
				Confirmation	1		
36	123	DP		Deactivated	00	Required	

			Execution of active power command provided by third operators (see 1.6)	FoSE	01		Activation of a signal indicating the a command to set the operation of the Plant has been received from a third operator. In the event that a corresponding command is provided by a third operator, the command that results in a smaller amount of active power output.
				MV Representative.	10		
				Owner	11		
37	124	DP	Execution of a reactive power set-point command provided by a third operator 1.6)	Deactivated	00	Pending*	Activation of a signal indicating the a command to set the operation of the Plant has been received from a third operator.
				FoSE	01		
				Representative	10		
				Owner	11		
38	125	DP	Execution of command for setting the cosφ provided by a third operator (see § 1.6)	Deactivated	00	Pending*	Activation of a signal indicating the a command to set the operation of the Plant has been received from a third operator.
				FoSE	01		
				MV Representative.	10		
				Owner	11		
39	126	***DP***	Execution of an operational command for setting cosφ based on a cosφ = f(P) curve provided by a third operator. § 1.6).	Deactivated	00	Pending*	Activation of a signal indicating the a command to set the operation of the Plant has been received from a third operator.
				FoSE	01		
				MV Representative.	10		
				Owner	11		

40	127	DP	Execution of a reactive power set-point command based on a U(Q) curve provided by a third operator (see § 1.6).	Deactivated	00	Pending*	Activation of a signal indicating the a command to set the operation of the Plant has been received from a third operator.
				FoSE	01		
				MV Representative.	10		
				Owner	11		
41	128	SP	LFSM-O mode enabled	Deactivated	0	Pending*	
				Activated	1		
42	129	SP	FSM function enabled	Deactivated	0	Pending*	
				Activated	1		
43	130	SP	LFSM-U mode enabled	Deactivated	0	Pending*	
				Activated	1		
44	131	SP	Confirmation of Backup Activation	Deactivated	0	Pending*	
				Activated	1		
45	132	SP	Confirmation of activation of second backup mode	Deactivated	0	Pending*	
				Activated	1		

Control Commands							
S/N	IEC 60870 - 5 - 104 Addresses	Type	Description	Status	Units	Item	REMARKS
46	201	DC	ICB location check	Unchanged	00	Required	
				Open	01		
				Unchanged	10		
				Unchanged	11		
47	202	DC	Command for immediate full cut-off of the Plant's injection power (Active & Reactive)	Unchanged	00	Required	The injection current should be close to zero.
				Right to join	01		
				Immediate Full Cut-Off	10		
				Unchanged	11		
48	203	SC	Command for activating - deactivating reactive power set-point	Deactivated	0	Pending*	
				Activated	1		
49	204	SC	Command for activating - deactivating the cosφ adjustment mode based on curve cosφ=f(P)	Deactivated	0	Pending*	
				Activated	1		
50	205	SC	Command for activating - deactivating voltage control based on the U(Q) curve	Deactivated	0	Pending*	
				Activated	1		
51	206	SC	Command for activating - deactivating LFSM-O according to RfG	Deactivated	0	Pending*	
				Activated	1		
52	207	SC	Command for activating - deactivating FSM according to RfG	Deactivated	0	Pending*	
				Activated	1		
53	208	SC	Command for activating - deactivating LFSM-U according to RfG	Deactivated	0	Pending*	
				Activated	1		
54	209	SC	Command for activating - deactivating backup	Deactivated	0	Pending*	
				Activated	1		
55	210	SC	Command for activating - deactivating second standby	Deactivated	0	Pending*	
				Activated	1		

Set-point Commands							
S/N	IEC 60870 - 5 - 104 Addresses	Type	Description	Status	Units	Item	REMARKS
56	301	SE	Maximum permissible active power set-point in kW		kW	Required	From 0 to the maximum allowable injection power at the Network. A value of -1 means that this command is not enabled.
57	302	SE	Maximum allowable active power set-point %		%	Required	0-100. A value of -1 means that this command is not enabled
58	303	SE	Reactive Power Set-point: Reactive Power Set-point		kVAr	Pending*	Varies between +60% and -60% (cosφ ≥ 0.85) of the maximum injection power of the Plant. Positive = inductive, Negative = capacitive. A value of 0 means that it has not been activated.
59	304	SE	Set-point cosφ: Set-point cosφ			Pending*	Analog set-point signal, range of values -0.85 to 1 and 1 to 0.85 (positive = inductive, negative = capacitive). A value of 0 means that it is not activated
60	305	SE	Plant mode setting command.	Deactivated	0	Pending*	Other values not acceptable
				Operational State of the Reactive Power Setting	1		
				Operational State of the Power Factor Setting	2		
				Operational State of the cosφ Setting based on the cosφ=f(p) curve	3		
				Operational State of voltage control based on the U(Q) curve	4		

* "Pending" under the Item column means that it should be included, even if it is not currently supported by the Plant's devices or general electronic equipment. HEDNO may request the activation of the corresponding feature at a future date. It is therefore requested that this is applied on the Equipment now and that the exchange of the corresponding signals with SCADA/DMS is confirmed during the communication tests.

** See. ***§2.4.5***

4. Control Procedure

4.1 The Responsible Declaration of Compliance in accordance with Law No. 5106/2024 (Government Gazette 63/A/01.05.2024) Article 111, Paragraph 4, must be accompanied by the signed and fully completed test protocols determined necessary for confirming the Responsible Declaration of Conformity. These are all required for the continuation of the procedure.

4.2 The Solemn Declaration of Conformity and the test protocols are included in the Equipment Control Procedure file for RES & CHP Stations that are connected or are connecting to the HEDN with installed capacity of more than 400 kW for the remote control and supervision by the Energy Control Centre of HEDNO.

4.3 HEDNO will schedule the necessary tests and checks to verify the correct connection of the equipment to HEDNO's SCADA/DMS system. During these tests, the physical presence of HEDNO and the Producer at the site of the Plant is necessary.

4.4 HEDNO shall determine the IP and the numerical address of the Equipment for IEC 60870- 5-104 during the Control and Connection Procedure with the SCADA/DMS system of HEDNO.

5. Modification of operation and maintenance of remote control and remote monitoring equipment of the RES Electricity Generation System

5.1 Modification of operation

5.1.1 The Producer may be required to make modifications to the operation of the RES or CHP Plant in order to comply with any revised requirements of the Legislation, the Transmission and Distribution Rules and/or the Electricity Market. In such cases, all modifications should be carried out in consultation with HEDNO and the modified operation should be re-tested.

5.1.2 Prior to conducting such an operational check, the Producer or its TM should send a detailed list of the modifications they are going to perform.

5.2 Equipment maintenance

In order to ensure the proper operation of the Plant and, by extension, the safety and reliability of the HEDN, Producers and/or their TMs are obliged to carry out, at regular intervals determined by the manufacturers' specifications, preventive maintenance of the Plant's Equipment. During the preventive maintenance process, both on the hardware and software of the Equipment, the Producers and/or their TMs shall communicate and update HEDNO accordingly.

During the maintenance procedure, the Producer and/or the TM is requested to confirm the correct operation of the following equipment/operation:

a. Correct operation of the protection relay and of the ICB (including the Earth Switch) of the Plant and sending the corresponding indications to the SCADA/DMS system of HEDNO.

b. Correct transmission and updating of local measurements in the SCADA/DMS system of the HEDNO.
c. Receipt and correct execution of all commands from the SCADA/DMS system of HEDNO.

In particular, in cases where there is suspicion of a cyber-attack on the equipment, the Producers and/or their TMs are required to take all necessary actions to ensure the Equipment's proper operation and to prevent or limit the spread of the cyber-attack. They must immediately inform HEDNO so that it can take appropriate measures.

The maintenance and/or repair of the Plant's equipment may be required by HEDNO following the detection of a technical problem and/or deviation from its normal operation. In such cases, the Producer or their TM shall be obliged to take all necessary actions to remove the technical problem and/or deviation within the time limit determined by HEDNO. In the event of failure to restore the technical problem in time, HEDNO may impose penalties equivalent to those referred to in ***§2.2.8*** regarding loss of communication.