MINISTRY OF INDUSTRY AND TRADE
ELECTRICITY REGULATORY AUTHORITY OF VIETNAM

Ref: **55**/QD-DTDL

SOCIALIST REPUBLIC OF VIETNAM
Independence – Freedom - Happiness

Hanoi, **22 August** 2017

DECISION

On promulgating technical requirements for operation management of SCADA system

THE DIRECTOR GENERAL OF ELECTRICITY REGULATORY AUTHORITY OF VIETNAM

Pursuant to Decision no.53/2008/QD-TTg dated 28 November 2008 of the Prime Minister on the functions, mandates, power and organizational structure of Electricity Regulatory Authority of Vietnam/Ministry of Industry and Trade;

Pursuant to Circular no.5/2015/TT-BCT dated 30 November 2016 of the Minister of Industry and Trade on power transmission system;

Pursuant to Circular no.39/2015/TT-BCT dated 18 November 2015 of the Minister of Industry and Trade on power distribution system;

At the request of the Head of Planning and Supply - Demand Balance Monitoring Division,

DECIDES:

Article 1. Technical requirements for operation management of SCADA system are issued as attachment to this Decision.

Article 2. This Decision takes effect on the date of its signing.

Article 3. Head of Administration Office, Heads of Divisions under Electricity Regulatory Authority of Vietnam, General Director of Vietnam Electricity (EVN), Directors of power companies and related agencies take responsibility for executing this Decision./.

DIRECTOR GENERAL

(Signed)

Nguyen Anh Tuan

Recipients:
- As listed in Article 3;
- Minister (for reporting);
- Deputy Minister Hoang Quoc Vuong (for reporting);
- Archived at: Archives and Records, Legal Affairs, Planning and Supply - Demand Balance Monitoring Division.

MINISTRY OF INDUSTRY AND TRADE
ELECTRICITY REGULATORY AUTHORITY OF VIETNAM

SOCIALIST REPUBLIC OF VIETNAM
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Hanoi, **22 August** *2017*

REGULATION

On technical requirements for operation management of SCADA

*(Issued as attachment to Decision no.***55** */QD-DTDL dated* ***22 August*** *2017 of the Director General of Electricity Regulatory Authority of Vietnam)*

Chapter I

GENERAL PROVISIONS

Article 1. Adjustment scope

This regulation stipulates technical requirements, connection and operation management of SCADA system in the national power system.

Article 2. Applicable subjects

1. The entity operating the national power system and power market (National Load Dispatch Center).
2. Power transmission unit.
3. Power distribution unit.
4. Power retail and distribution unit.
5. Power generation unit.
6. Transmitter operation unit.
7. Customers receiving power directly from the transmission power grid.
8. Customers using distribution power grid and having separate substations.
9. Vietnam Electricity.
10. Related organizations and individuals.

Article 3. Interpretation of terms

In this Decision, the following terms are construed as follows:

1. *AGC* (Automatic Generation Control) is an equipment system automatically adjusting the increase and reduction of active power of generating unit to maintain the stable frequency of power system within permissible range

under the principles of economic operation of generating unit.

2. *AI* (Analog Indication) refers to an analog metered value.

3. *Transformer* is a device converting physical quantities such as power generation capacity, a current, a voltage level to electrical signals or vice versa.

4. *Load dispatching level with control authority* is a load dispatching level with the power to direct and dispatch a power system under the dispatching hierarchy in the procedures for dispatching of the national power system issued by Ministry of Industry and Trade, including:

a) National load dispatching level;

b) Regional load dispatching level;

c) Provincial load dispatching level.

5. *National load dispatching level* is the highest directing and load dispatching level in the national dispatch system. National load dispatching level is undertaken by the National Load Dispatch Center.

6. *Regional load dispatching level* is the level directing and dispatching a regional power system under the National load dispatching level's direct control authority. Regional load dispatching level is undertaken by the Northern Regional Load Dispatch Center, Southern Regional Load Dispatch Center and Central Regional Load Dispatch Center.

7. *Provincial load dispatching level* is the level directing and dispatching a power distribution system under a respective Regional load dispatching level's direct control authority. Provincial load dispatching level is undertaken by a dispatch unit under a Power distribution unit.

8. *Investor* is an organization or an individual investing, owning a power plants or a power station, and being responsible for investing, equipping and installing adequate SCADA signals to a Load dispatching level with control authority in accordance with the applicable regulations.

9. *DCS* (Distributed Control System) is a system of control equipment in power plants or power station connected to the network on the principle of distributed control to increase the reliability and limit the effects due to breakdown of control elements in power plants or power substations.

10. *DMS* (Distribution Management System) is a software system automatically supporting the management, monitoring and optimal control of distribution power network.

11. *DDI* (Double Digital Indication) is a 2-bit digital signal consisting of closed (10), open (01), unspecified status (00, 11).

12. *Operation management entity* is an organization or an individual managing and operating a Control Center or a power plant or a power station

connected to the national power system, including:

a) Power transmittion unit;

b) Power generation unit;

c) Power distribution unit;

d) Power retail and distribution unit;

e) Customers receiving power directly from the transmission power grid;

f) Customers using distribution power grid and having separate substations.

13. *Power transmission unit* is a power company licensed to work in the field of power transmission, and to take responsibility for managing and operating the national power transmission grid.

14. *Power generation unit* is a power company licensed to work in the field of power distribution and own one or more power plants connected to the power transmission grid, or a power plant with installed capacity of 10MW and above connected to the power distribution grid.

15. *Power distribution unit* is a power company licensed to work in the field of power distribution and selling, including:

a) Power Corporation;

b) Power Company of a centrally-affiliated city/province (hereafter referred to as a Provincial Power Company), which are attached to a Power Corporation.

16. *Power retail and distribution unit* is a power company licensed to work in the field of power distribution and retail, and to wholebuy power from power wholesalers or power distribution units and then retail power to power consumers.

17. *Transmitter operating unit* (Telecommunication and Information Technology Center under Vietnam Electricity) is an unit performing the function of coordinating the establishment and segmentation of fault-handling process and restoration of a transmitter on SCADA transmission system.

18. *EMS* (Energy Management System) is a software system managing energy to enable optimal operation of the power system.

19. *Ethernet (IEEE 802.3)* is a standard in computer network-based communication, including a local-area network (LAN), a metropolitan area network (MAN) and a wide area network (WAN), as recommended by the Institute of Electrical and Electronics Engineers.

20. *Cramp* refers to a device used for connecting metering circuits.

21. *SCADA system* (Supervisory Control And Data Acquisition) is a data collection system for monitoring, control and operation of the power system.

22. *Customer using a power distribution grid with a seperate substation* is

an organization or an individual with a separate substation connected to a power distribution grid.

23. *Point-to-Point test* is an experiment on SCADA signals sent from electrical devices placed at a power plant or a power station to RTU/Gateway device.

24. *End-to-End test test* is an experiment on SCADA signals sent from a power plant, a power station, a switchgear on the power system and a control Center to the Dispatch level with competent control authority.

25. *4W analog* is a telecommunication channel including 03 receiver cables (Rx) and 02 transmitter cables (Tx) sending audio signals.

26. *LAN* (Local Area Network) is a network system used for connecting computers in a small area.

27. *Power grid* is a synchronized system of power lines, power stations and facilities used for power transmission and distribution.

28. *Power distribution grid* in the power grid includes lines and power stations with a voltage level up to 110kV.

29. *Power transmission grid* in the power grid includes lines and power stations with a voltage level above 110kV.

30. *OTS* (Operator Training Simulators) is modules inside EMS/DMS systems, which are used for simulation-based training on power system's operation and incident response drills.

31. *OMS* (Outage Management System) is a system managing power outages.

32. *PICL* (Protocol Interoperability Check List) is a checklist used for verifying the operational standards of information transfer protocols.

33. *RC* (Remote Control) is a remotely controlled signal.

34. *SAS* (Substation Automation System) a system providing substation automation.

35. *SDI* (Single Digital Indication) is a 1-digital signal.

36. *RTU/Gateway* (Remote Terminal Unit/Gateway) is a device placed at a power plant or a substation to support data acquisition and transmission to the SCADA system in a Load Dispatch Center or a Control Center.

37. *IEC standards* are standards concerning electrical technologies published by the International Electrotechnical Commision.

38. *Control Center* is a center equipped with information technology and relecommunication infrastructure system for remotely monitoring and controlling

a group of power plants, a group of substations or switchgears on a power grid.

39. *SIC* (Supervisory Interface Cubicle) is where the devices for data acquisition and transmission to RTU are paired up.

40. *RS232* is a standard protocol used for serial communication connecting a computer and its peripheral devices recommended by the Electronic Industries Association (EIA).

Chapter II

GENERAL TECHNICAL REQUIREMENTS OF THE SCADA/EMS/DMS

Section 1

TECHNICAL REQUIREMENTS OF THE SCADA SYSTEM

Article 4. Basic components of SCADA in a power system

1. SCADA in a power system includes the following components:

a) Central SCADA system;

b) Transmitter system;

c) RTU/Gateway;

d) Other ancillary equipment.

2. Central SCADA system is installed at Dispatch levels with control authority, including the following basic hardware devices:

a) SCADA server collects and stores real-time data including events, status signals, measurement signals and runs SCADA applications;

b) Past database server stores data of events in an order, status signals and measurement signals in a cyclical order. Past database is used for calculating, simulating and analyzing a power system;

c) Application server runs the applications in EMS system or DMS system;

d) Communication server connects all central SCADA systems together, connects central SCADA systems with Control Centers and RTU/Gateway devices placed at power plants or power stations;

e) A screen displaying the system diagram and operational parameters of the power system;

f) Man-Machine Interface (MMI) and Human-to-Machine Interface (HMI) have real-time monitoring and controlling function;

g) GPS device support time synchronization on different devices in the central SCADA system;

h) Other devices supporting information technology, communication and

other ancillary devices.

3. Transmitter system connects all central SCADA systems together, connects central SCADA systems with Control Centers and RTU/Gateway devices placed at power plants or power stations.

Article 5. The configuration of the central SCADA system

1. The central SCADA system must be equipped with at least 01 back-up server per each independent function block inside the system. The back-up server is operated parallel and its real-time databased is synchronized with the main server to ensure no interruption during the process of monitoring and controlling data transfer between the main server and the back-up server.

2. The central SCADA system has an open and distributed structure which meets the following basic requirements:

a) The system can add, upgrade and integrate other compatible servers, processors, functional modules and software devices without changing the structures of the existing hardware and software devices in the central SCADA system;

b) Hardware and software devices must be compatible with multiple systems and devices supplied by different manufacturers;

c) The system can be run on multiple computers in parallel via LAN.

3. The central SCADA system must ensure minimum readiness level of 99.9%.

4. Hardware and software devices in the central SCADA system are interconnected via LAN.

Article 6. The functions of the central SCADA system

1. The central SCADA system performs the following basic functions:

a) Collecting real-time data on measurement values, parameters and operational status of the devices in a power system, of which data and data collection time points must be determined, synchronized and stored.

b) Real-time monitoring of a power system

- Monitoring the change of status;
- Monitoring the critical value of the power system;
- Monitoring the order of events;
- Categorizing and processing data, processing events and giving

warnings.

c) Controlling the devices in a power system

- Controlling switching-on/-off;
- Controlling switching-up/-down;
- Controlling the change of the values set by a Dispatch level with control authority.

d) Storing real-time data to run the applications processing and analyzing the operation of the power system;

e) Displaying graphical interfaces on one or more computers for visualization, including the following information:

- Single thread diagram of the power system can constantly update voltage values, load flow, operating status of circuit breakers, switch disconnectors and other devices in the power system;
- The measurement values in a power system;
- The parameters set in a power system;
- Aggregating faults in a power system and warnings.

2. For large-scale complex power systems: To meeting the requirements of power system dispatch and operation, the central SCADA system must have the following functions:

a) Monitoring the trend of the power system;

b) Aggregating and analyzing data to enable planning and improvement of operational efficiency for the power system;

c) Displaying graphical interfaces on one or more computers for visualization, including the following information:

- The oscillations in the power system;
- The changing trends of the power system.

d) Automatically perform operations in the power system by following the approved operating method.

Article 7. Requirements for connecting, sharing data and network security

1. The central SCADA system must be capable of connecting and sharing data with other central SCADA systems.

2. The central SCADA system must ensure the compliance with the requirements for network safety, network security, confidentiality to prevent

external attacks on the operation management of the national power system.

Section 2

TECHNICAL REQUIREMENTS OF THE SCADA/EMS system

Article 8. The structure of SCADA/EMS

1. The SCADA/EMS system includes the central SCADA system integrated with the EMS system.

2. The EMS system has an open and distributed structure:

a) The system can add, upgrade and integrate other compatible servers, processors, functional modules and software devices without changing the structures of the existing hardware and software devices in the SCADA/EMS system;

b) Hardware and software devices in EMS system must be compatible with each other and with the central SCADA system.

3. The EMS system must be equipped with at least 01 back-up server per each independent function block inside the system. The back-up server is operated parallel and its real-time databased is synchronized with the main server to ensure no interruption during the process of monitoring and controlling data transfer between the main server and the back-up server.

4. The EMS system must ensure the compliance with the requirements for network safety, network security, confidentiality to prevent external attacks on the operation management of the power transmission system.

Article 9. Applications of the EMS system

The EMS system provides the following basic applications:

1. Simulating real-time power system, assisting the assessment on power system security and operation. The system performs the following basic functions:

a) Identifying the changes in the configuration and the system diagram;

b) Evaluating the status of the power system: Using the data which simulates the configuration of the power system, and real-time meter data collected from the central SCADA system to evaluate the status of the power system at a certain point of time;

c) Analyzing load flow: Using the results from the assessment of the power system's real-time operation status at a certain point of time to calculate voltage and phase angle at the busbars, and load ability of the devices in the power system, and to provide solutions to safe and stable operation of the power transmission system;

d) Load flow optimization: Assessing economic dispatch in consideration

of power system security requirements;

e) Assessing the contingency status of the power system in case of faults in one or more elements;

e) Calculating and analyzing short circuits during possible faults in the power transmission system before switching the device on/off or reconfiguring the system for troubleshooting the faults;

g) Results obtained from the application allowing real-time simulation of the power system are considered as reliable provided that the quality of SCADA signals at the busbars simulated in the EMS system satisfies the following condition: for 80% of the busbars, the difference between total input capacity and output capacity on a busbar lower than 05 MW or 5% of maximum rated power of the branch connected to a busbar, depending on whichever smaller.

2. Voltage stability analysis: Analyzing and identifying the areas experiencing voltage instability in the power system to suggest solutions for improving voltage quality and determining voltage-based transmission limits for different transmission interfaces.

3. Determining the transient stability of a power system: Based on the power system simulation, the governor system and the excitation system of the generating sets and the interlocking system in the power grid, warnings of the power system instability will be issued in case of severe incidents.

4. The application for dispatchers training performs the following basic functions:

a) Simulating the Power system model so that the dispatchers can practice operating the power system in normal operating conditions and in case of emergency;

b) Testing and simulating the actual operation scenarios, piloting power system restoration plans, evaluating efficiency and piloting the applications of the EMS system on a real-time basis and in a simulated model.

5. Managing operation and maintenance plans of the generating sets, lines, substations and other devices in the power transmission system; providing inputs to power system scheduling.

6. Making short-term load forecast (STLF) to support hour-ahead, day-ahead and week-ahead scheduling.

7. AGC application can automatically adjust generation capacity of generating sets to execute dispatch orders or maintain stable system frequency

within the allowable limits and monitor transmission flow on interconnected lines.

Section 3

TECHNICAL REQUIREMENTS OF THE SCADA/DMS SYSTEM

Article 10. The configuration of the SCADA/DMS system

1. The SCADA/DMS system includes the central SCADA system integrated with the DMS system.

2. The DMS system has an open and distributed structure.

a) The system can add, upgrade and integrate other compatible servers, processors, functional modules and software devices without changing the structures of the existing hardware and software devices in the SCADA/EMS system;

b) Hardware and software devices in DMS system must be compatible with each other and with the central SCADA system.

3. The DMS system must be equipped with at least 01 back-up server per each independent function block inside the system. The back-up server is operated parallel and its real-time databased is synchronized with the main server to ensure no interruption during the process of monitoring and controlling data transfer between the main server and the back-up server.

4. The DMS system must ensure network safety, network security, confidentiality to prevent external attacks on the operation management of the power system.

Article 11. Applications of the DMS system

Depending on the requirements of operation management, the DMS system can be equipped with one of the following applications:

1. The graphic interface allows a clear display of the status of electricity lines, transformers and other devices on the power distribution system.

2. Monitoring, assessing and identifying the changes in the configuration and the distribution system diagram.

3. Analyzing and optimizing the operation of the power distribution system with the function of assisting dispatchers to monitor, control, analyze, plan and optimize the operation of the power distribution system. This application performs the following key functions:

a) Using grid-connected configuration and real-time operational data from the central SCADA system and customers' information to estimate active power and reactive power at load nodes in the distribution grid;

b) Analyzing load flow: Using the function of calculating current intensity,

voltage, power factor, phase angle, active power and reactive power of each device in the power grid to identify the cases of possible overloads or voltage oscillations in the power distribution grid;

c) Calculating short circuits simulated for different areas in case of failure in the power distribution grid;

d) Managing voltage, reactive power and load: making solutions for installing capacitors and tap changers to control reactive power and improve the quality of voltage in the distribution grid;

e) Quickly locating and isolating possible faults, and identifying the switchgears which can be used for restoring power supply for isolated areas;

f) Reconfiguring grid-connected distribution system in consideration of actual operating conditions:

- Identifying changes (switching on/off) in the distribution grid and calculating, reallocating load between outgoing feeders to reduce power distribution losses;

- Determining the conditions enabling optimal operation of the power distribution system within allowable limits.

g) The load shedding function supports the dispatchers in load shedding and recovery in the distribution grid.

4. Outage management system (OMS): Controlling and handling outages in a timely and efficient manner. Based on operation and maintenance plan, information provided by customers, and real-time data from the central SCADA system, the OMS can quickly identify the elements in trouble and affected areas in order to work out solutions for limiting outages, fixing and restoring power supply as quickly as possible.

5. Simulation-based training on the operation of the power distribution system is equipped with the following basic functions:

a) Simulating the Power system model so that the dispatchers can practice operating the power distribution system in normal operating conditions and in case of emergency;

b) Testing and simulating the actual operation scenarios, piloting power distribution system restoration plans, evaluating efficiency and piloting the applications of the DMS system in a simulated model.

Section 4

TECHNICAL REQUIREMENTS FOR THE SYSTEM OF

TRANSMITTERS AND TRANSMISSION PROTOCOL

Article 12. Overall requirements

1. The system of transmitters connecting the central SCADA systems together, connecting a central SCADA system with Control Centers and RTU/Gateway devices placed at power plants or power stations must satisfy the following technical requirements:

a) Dedicated bandwidth for transferring SCADA signals and control signals in the national power system;

b) Ensuring collection and transfer of adequate SCADA signals and control signals in a safe, reliable, continuous and confidential manner.

2. The systems of transmitters at power plants, power stations or Control Centers must be well invested, equipped and interconnected to meet the requirements under the Regulation on the power transmission system, the Regulation on the power distribution system issued by Ministry of Industry and Trade, and must be compatible with the central SCADA system of the Dispatch level with competent control authority, Power transmission units and Power distribution units.

3. The transmitters transmitting data between the central SCADA system and RTU/Gateway devices at power plants and power stations, which have not performed remote manipulation and control, must ensure a minimum level of readiness at 98%.

4. The transmitters transmitting data between the central SCADA system and RTU/Gateway devices at power plants and power stations, which have performed remote manipulation and control, must ensure a minimum level of readiness at 99.9%.

Article 13. The speed of data transmitter

1. The minimum data transfer rate is 90 Mbps between the central SCADA system at the National dispatch level and that at the Regional dispatch level.

2. The minimum data transfer rate is 02 Mbps between the central SCADA system at the Regional dispatch level and that at the Provincial dispatch level.

3. The minimum data transfer rate is 02 Mbps between the central SCADA system and the Control Center.

4. The minimum data transfer rate is 64 kbps between the central SCADA system or the Control Center and RTU/Gateway devices at power plants or power

stations.

Article 14. Transmission interface

SCADA signal transmitters include the following basic interfaces:

1. 4W interface by ITU-T Rec. G.712 standard.

2. V.24 interface or RS232 interface by ITU-T Rec. V.24 standard.

3. Ethernet interface by IEEE 802.3 standard.

Article 15. Transmission protocol

1. Connecting the information between different function blocks inside the central SCADA system via LAN.

2. Connecting the information between the central SCADA system at the National dispatch level and the systems at the Regional dispatch level, which uses dedicated communication standards and IP network as transmitters.

3. Connecting the information between the central SCADA system, Control Centers, RTU/Gateway devices at a power plant or a substation and the switchgears connected to SCADA signals in the power grid, which uses IEC 60870-5-104 communication standard for newly constructed power plants or power stations, and Control Centers. For the available power plants or power stations and Control Centers, IEC 60870-5-101 communication standard or IEC 60870-5-104 communication standard can be used, depending on the readiness of the transmitters (with priority given to IEC 60870-5-104 communication standard).

4. Control Centers, RTU/Gateway devices at the newly constructed power plants or substations and the switchgears connected to SCADA signals in the power grid must be compatible with the communication/transmission protocol under this Regulation.

5. In case of changes in the communication protocol between the central SCADA system at the Dispatch level with competent control authority and those at Control Centers or the RTU/Gateway devices at power plants or power stations, the Dispatch level with competent control authority is responsible for negotiating with the Operation management unit in advance to adjust and ensure the compatibility of the central SCADA system, Control Centers with the new communication protocol.

6. Depending on operating demand, the newly added RTU/Gateway devices at power plants or power stations can be equipped with relevant functions supporting communication protocol in its connection with smart digital devices

and other monitoring devices in the power system.

Section 5

TECHNICAL REQUIREMENTS FOR RTU/GATEWAY DEVICES

Article 16. General technical requirements

The RTU/Gateway devices placed at power plants or power stations must meet the following technical requirements:

1. Compatibility with the Control Center and the central SCADA system of the Dispatch level with competent control authority according to the transmission protocol agreed by all stakeholders.

2. The minimum response time is 10ms for digital signals, and 02s for measurement signals.

3. Measurement error must not exceed 1% over the entire measurement range.

4. The latency of a digital signal and an analog signal must not exceed 04s.

5. A change in status must be transmitted from RTU/Gateway devices to the Control Center or the central SCADA system at the Dispatch level with competent authority together with a timestamp to reflect the exact point of time when the change in status occurs. A timestamp stores adequate information of year, month, date, hours, minutes, seconds and milliseconds.

6. The intermediate-term memory must be large enough to store the information of changes in status for a minimum of 10 days in case of lost connection with the central SCADA system at the Dispatch level with competent authority. The information will be transmitted to the Control Center or the central SCADA system at the Dispatch level with competent authority once the connected has been restored.

7. Time synchronization is enabled by the GPS device or the server at the Control Center or the central SCADA system at the Dispatch level with competent authority.

8. In case faults occur in a power source self-supplied by a power plan or a power station, the power source supplied for RTU/Gateway devices must be maintained for a minimum of 10 hours.

9. Database memory must be maintained for a minimum of 30 days in case its is not supplied with a power source to ensure that RTU/Gateway devices are restarted without re-updating the database.

10. A minimum of 98% readiness must be ensured for the RTU/Gateway devices at a power plan or a power station, which are not connected to and

remotely controlled by the Control Center.

11. A minimum of 99.9% readiness must be ensured for the RTU/Gateway devices at a power plan or a power station, which are connected to and remotely controlled by the Control Center.

12. The RTU/Gateway devices must response well to the operational conditions at a power plant or a power station.

Article 17. Technical requirements for RTU device

An RTU device must meet the following technical requirements:

1. Its capacity to receive data from electrical devices at a power plant or a power station and transfer the received data to the Control Center and the central SCADA system at the Dispatch level with competent control authority according to the regulated transmission protocol.

2. Its capacity to receive control signals from the central SCADA system at the Dispatch level with competent control authority or the Control Center and send them to electrical devices at a power plant or a power station in case the Dispatch level with competent control authority or the Control Center performs remote manipulation on the devices at the power plant or the power station.

3. An RTU device contains multiple independent blocks, each of which has one dedicated processor with a minimum capacity of 16 bits.

4. The converter converting analog signals into digital signals has a minimum of 12-bit resolution (containing 11value bits and 01 sign bit).

5. The minimum backup level is 20% for each of incoming/outgoing signals at the time of connection.

6. A centralized RTU must have a SIC interface cubicle for pairing the devices involved in collection and transmission of signals to the RTU. SIC interface cubicle is not necessary for a distributed RTU integrated with the function of measuring display performance parameters.

7. With clamps to connect metering circuits with electrical devices at a power plant or a power station, aiming to isolate these electrical devices during experiments or faults.

Article 18. Technical requirements for Gateway device

A Gateway device must meet the following technical requirements:

1. Its capacity to receive signals from DCS/SAS systems at a power plant or a power station and transfer the received data to the Control Center and the central SCADA system at the Dispatch level with competent control authority according to the regulated transmission protocol.

2. Its capacity to receive control signals from the central SCADA system at the Dispatch level with competent control authority or the Control Center and

send them to DCS/SAS systems at a power plant or a power station in case the Dispatch level with competent control authority or the Control Center performs remote manipulation on the devices at the power plant or the power station.

3. A Gateway device can make re-declaration and additional declaration of signals in the event of reconstruction or expansion of a power plant or a power station.

Article 19. Technical requirements for converters

1. A converter has no programming function. A converter must be compatible with metering circuits and incoming/outgoing processors on the RTU devices.

2. For power plants and power stations using multi-function gauges to collect and transmit measurement signals to RTU/Gateway devices, the multi-function gauges must meet the following technical requirements:

a) Compatibility and allowing re-configuration to match with secondary parameters of voltage transformers and current transformers, and parameters of RTU/Gateway devices;

b) Ability to measure multiple parameters;

c) Ability to connect to RTU devices via Modbus protocol;

d) For measured values: Level of accuracy is lower than 0.5%.

3. Converters controlling tap changers on the transformers must be compatible with the Tap Position Indicators on transformers and incoming/outgoing processors on the RTU devices.

Section 6

SCADA SIGNAL INSTALLATION IN THE POWER SYSTEM

Article 20. Connection between different SCADA systems in the power system

1. The central SCADA, SCADA/EMS and SCADA/DMS systems in the national power system is organized in the following order:

a) National dispatch level and Regional dispatch level are equipped with SCADA/EMS systems;

b) Distribution dispatch level under power distribution units is equipped with SCADA/DMS systems;

c) The central SCADA system (if available) is equipped at other power operating units.

2. SCADA/EMS and SCADA/DMS systems at different dispatch levels must be installed, decentralized and their data must be shared to ensure adequate

information and data for safe, stable and reliable operation and dispatch of the national power system.

3. Connection of SCADA signals among different SCADA systems inside the national power system must ensure cyber security, confidentiality and prevention of external attacks during the process of managing and dispatching the national power system.

Article 21. Installation of SCADA signals at control centers

1. Control Centers must meet the requirements for SCADA system installation in accordance with the Regulations on power transmisison system and power distribution system issued by Ministry of Industry and Trade.

2. Ensuring adequate, stable, accurate, reliable and continuous connection of SCADA signals and contact information, supporting the operation of the national power system and power markets, from power plants or power stations to Control Centers and from Control Centers to the central SCADA systems at competent dispatch levels.

Article 22. Installation of SCADA signals at power plants and substations

1. For power plants with installed capacity of 10MW and above, power plants connected to the power transmission grid, and substations with voltage classes of of 110kV and above not connected to Control Centers: RTU/Gateway devices must have 02 gateways allowing simultaneous direct connection to and being physically independent of the central SCADA system at the Dispatch level with competent control authority.

2. For power plants with installed capacity of 10MW and above and power plants connected to the power transmission grid, which have been remotely installed and controlled by Control Centers: RTU/Gateway devices must have 01 gateway allowing direct connection to the central SCADA system at the Dispatch level with competent control authority and 02 gateways allowing direct connection to Control Centers.

3. For substations with voltages classes of 110kV and above, which have been remotely installed and controlled by Control Centers: RTU/Gateway devices must have 02 gateways allowing direct connection to Control Centers.

4. For power plants with installed capacity under 10MW connected to the power distribution grid, the power distribution unit is responsible for collaborating with the Dispatch level with competent control authority and the investor (investing in the power plant) to reach agreement upon the requirements for SCADA system installation. In case all parties have an agreement on connecting SCADA signals from a power plant to a Dispatch level with competent control authority, they must fully comply with all provisions under this Regulation.

5. In case a power plant/substation has more than one Dispatch level with

competent control authority, all levels are responsible for sharing relevant information to support collaboration in power system operation.

Article 23. Installation of SCADA signals on the power distribution grid

Depending on operation management requirements of the Power distribution unit and the Power retail and distribution unit, power stations or switchgears on medium-voltage grid can connect to the central SCADA system at the Dispatch level with competent control authority.

Chapter III

SCADA INSTALLATION IN THE POWER SYSTEM

Article 24. Implementation principles

1. Before the electrification of a power plant or substation, an agreement on SCADA signal connection with the central SCADA system at the Dispatch level with competent control authority must be made to ensure that the requirements of SCADA connected are satisfied under this Regulation and the Regulations on power transmission and distribution systems issued by Ministry of Industry and Trade.

2. The agreement on SCADA system connection and the Agreement on signal connection under the Regulations on power transmission and distribution systems issued by Ministry of Industry and Trade are executed simultaneously.

3. An investor is responsible for implementing SCADA installation agreement which is detailed as follows:

a) For a SCADA installation project is under the management and administration of a Power transmission unit or a Power distribution unit: The Investor will directly make an Agreement on SCADA installation with the Dispatch level with competent control authority;

b) For a SCADA installation project is under the management and operation of a Customer using power transmission grid (except for the power distribution unit) or power distribution grid: After receiving Agreement Documents, the Power transmission unit or a Power distribution unit will lead and collaborate with related Dispatch levels with competent control authority and the Investor to execute the Agreement on SCADA installation.

4. In case of a power plant/substation with multiple Dispatch levels with competent control authority, these levels will take responsibility for collaborating, sharing and reaching agreement on relevant information associated with the Agreement on SCADA installation.

Section 1
REGISTRATION FOR SCADA SYSTEM CONNECTION AT POWER PLANTS AND SUBSTATIONS

Article 25. Registration for SCADA installation

1. In the process of reaching agreement on SCADA installation for new power plants/substations or in the process of preparing for investment and installation of SCADA at the existing power plants/substations, the Investor is responsible for collaborating with a Power transmission unit or a Power distribution unit to register for SCADA installation with the Dispatch level with

competent control authority. Registration Documents include:

a) The Investor's Letter of Request for SCADA installation;

b) Tentative plan for equipping RTU/Gateway devices and system of transmitters;

c) Tentative solutions for connecting the transmitters from a power plant/substation to the central SCADA system at the Dispatch level with competent control authority.

2. Within 10 working days from the receipt of full Registration Documents, the Dispatch level with competent control authority is responsible for sending a written response to the Investor. The correspondence covers the following elements:

a) A list of SCADA signals in the format provided in Appendix 2 of this Regulation;

b) Standard protocol for signal transmission between RTU/Gateway and the central SCADA system at the Dispatch level with competent control authority;

c) Forms: Agreement Letter, Acceptance Letter.

d) Guidelines on the next procedures, which recommend the possibility of the changes in technologies and technical solutions to the central SCADA system.

Article 26. Technical design agreement

1. Before investing in, installing and connecting SCADA signals to the Dispatch level with competent control authority, the Investor must provide the Dispatch level with competent control authority with Technical Design Documents for SCADA installation project, including:

a) Document checklist for RTU/Gateway devices

- Explanation for technical solutions for RTU/Gateway device project;
- Diagram of regional grid connection;
- Main circuit diagram;
- Diagram of protective solutions;
- Diagram of connection of RTU/Gateway and electrical devices;
- List of devices in RTU/Gateway connection project;
- List of SCADA signals in response to the Diagram of protective

solutions and the List of standard SCADA signals.

b) Document checklist for transmitters

- Explanation for technical solutions for transmitter connection project;
- Transmitter connection diagram;
- Letter of Agreement on providing transmitters (if available);
- Checklist of devices in the transmitter connection project;
- Letter of Agreement on the installed locations and transmitter providers.

2. Upon receipt of Technical Design Documents for SCADA installation project, the Dispatch level with competent control authority will be responsible for checking and responding on paper about the completeness and validity of the Documents, following the procedures below:

a) In case the Documents need to be supplemented, within 05 working days from the receival date, the Dispatch level with competent control authority must inform the Investor about the list of documents which need to be supplemented;

b) Within 10 working days from the receival date of full documents, the Dispatch level with competent control authority must respond to the Investor to reach a mutual agreement or to request for revision/edit of the technical design if necessary;

c) In case any revision and supplementation need to be made upon the request of the Dispatch level with competent control authority, the Investor has to finalize and resend technical design documents to the Dispatch level with competent control authority as the basis for discussions.

3. Once both parties have reached agreement on the contents of the SCADA technical design documents, the Dispatch level with competent control authority and the Investor will sign an Agreement Letter to allow the Investor's installation and connection of SCADA signals.

Article 27. End-to-End test

1. Before the tentative date of the first electrification at a new power plant/substation or before the tentative date of an End-to-End test at an existing power plant/substation, the Investor has to send the Dispatch level with competent control authority a Registration Form to register for End-to-End testing plan attached with a detailed List of SCADA signals in response to the technical design and the Diagram of protective solutions agreed by all parties.

2. Except where otherwise stated, the Investor will take responsibility for registering for End-to-End testing plan with the Dispatch level with competent control authority. Deadline for registration is guided as follows:

a) Within 01 month before the tentative date of the first electrification for

newly constructed power plants;

b) Within 15 working days before the tentative date of the first electrification for newly constructed substations;

c) Within 15 working days before the tentative date of the End-to-End test for the existing power plants/substations.

3. Upon receipt of the Registration Form for End-to-End testing plan, the Dispatch level with competent control authority must check and send a written response to the Investor, following the procedures below:

a) In case the List of SCADA signals needs to be edited or supplemented, within 05 working days from receival date of the Registration Form for End-to-End testing plan, the Dispatch level with competent control authority is responsible for informing the Investor about the list of SCADA signals which need to be edited or supplemented;

b) In case the List of SCADA signals needs to be edited or supplemented upon the request of the Dispatch level with competent control authority, the Investor is responsible for finalizing and resending this list to the Dispatch level with competent control authority.

4. Within 10 days from the receival date of the Registration Form for End-to-End testing plan and the finalized list of SCADA signals, the Dispatch level with competent control authority is responsible for sending a written response to the Investor, attached with End-to-End testing plan.

Article 28. End-to-End test

1. Before the date of the End-to-End test, the Investor must complete the following activities:

a) Completing installation of the devices related to the SCADA installation project and connection of the central SCADA system at the Dispatch level with competent control authority;

b) Leading the implementation of acceptance test on transmitters in accordance with the provisions under Section 3, Chapter III of this Regulation, and handing over SCADA transmitters to the Dispatch level with competent control authority;

c) Finalizing Point-to-Point testing procedures in accordance with the provisions under Section 3, Chapter III of this Regulation;

d) Preparing all necessary conditions for the implementation of End-to-End testing procedures;

e) Reaching agreement with the Dispatch level with competent control authority on End-to-End testing plan.

2. Once both parties have agreed on the End-to-End testing plan, the

Dispatch level with competent control authority and the Investor will collaborate and conduct the End-to-End test in accordance with the provisions under Section 3, Chapter III of this Regulation.

3. In case the End-to-End test is not passed, the Investor is responsible for collaborating with the Dispatch level with competent control authority and related agencies to check, identify causes and work out relevant solutions.

4. In case the End-to-End test is passed, the Dispatch level with competent control authority and the Investor will have to agree on and sign End-to-End Test Report and Certificate of SCADA installation.

5. Within 03 working days from the date of signing End-to-End Test Report, the Dispatch level with competent control authority will have to send the Investor and related agencies a letter of confirmation regarding the completion of SCADA installation.

6. Format of Letter of Acceptance (Transmitters), Point-to-Point, End-to-End Test Report are provided in Appendix 3, Appendix 4 and Appendix 5 of this Regulation.

Section 2

REGISTRATION FOR SCADA INSTALLATION AT RENOVATED/EXPANDED POWER PLANTS AND SUBSTATIONS

Article 29. Registration for renovation or expansion of RTU/Gateway devices

1. In preparation for investment, renovation or expansion of RTU/Gateway devices, the Investor is responsible for submitting registration documents to the Dispatch level with competent control authority. Registration documents include a Letter of Request, and a Tentative plan for RTU/Gateway device renovation or expansion.

2. Upon receipt of the registration documents, the Dispatch level with competent control authority must check the completeness and validity of the documents, assess the influence of RTU/Gateway device renovation or expansion.

3. Within 15 working days from the receival date of full registration documents, the Dispatch level with competent control authority must send a written response the Investor, covering the following elements:

a) Format of List of SCADA signals in Appendix 2 of this Regulation;

b) Format of Letter of Agreement and Letter of Acceptance;

c) Guidance on the next steps.

Article 30. Agreement on technical design applicable to renovation

or expansion of RTU/Gateway devices

1. Before renovating or expanding RTU/Gateway devices, the Investor must send Technical Design Documents of SCADA installation project to the Dispatch level with competent control authority. Technical Design Documents cover the following elements:

a) Assessment on the structure and configuration of the existing RTU/Gateway device, renovation or expansion solutions, a diagram of the expanded part – existing part connection;

b) Main power connection diagram before and after the renovation or expansion;

c) Diagram of protective solutions before and after the renovation or expansion;

d) List of SCADA signals on the expanded part;

e) List of equipment/materials used for RTU/Gateway expansion.

2. In case the replacement of all the existing RTU/Gateway devices is compulsory, the Investor is responsible for complete similar procedures to what is applied for the newly constructed power plants/substations or the existing power plants/substations with no SCADA installation.

3. Upon receipt of the Technical Design Documents of SCADA installation project, the Dispatch level with competent control authority is responsible for checking and sending a written response regarding the completeness and validity of the documents to the Investment:

a) In case there is a need of supplementation, within 05 working days from the receival date of the documents, the Dispatch level with competent control authority must inform the Investor about the documents that should be supplemented;

b) Within 15 working days from the receival date of full documents, the Dispatch level with competent control authority must send the Investor a notice of agreement or a request for revised technical design (if any);

c) In case there is a need of revision or supplementation upon the request of the Dispatch level with competent control authority, the Investor must finalize and send the technical design documents to the Dispatch level with competent control authority as the basis for their agreement.

4. Once the technical design documents have been agreed, the Dispatch level with competent control authority and the Investor will sign their Letter of Agreement.

Article 31. Registration for the End-to-End test on RTU/Gateway

renovation or expansion

1. Within 15 working days before the tentative date of End-to-End test, the Investor must send the Dispatch level with competent control authority a Registration Form for End-to-End testing plan attached with a Detailed list of SCADA signals in agreement with the agreed technical design and diagram of protective solutions.

2. Upon receipt of the Registration Form for End-to-End testing plan, the Dispatch level with competent control authority must check and send a written response to the Investor:

a) In case there is a need of revision or supplementation of List of SCADA signals, within 05 working days from the receival date of the Investor's Registration Form for End-to-End testing plan, the Dispatch level with competent control authority must inform the Investor about the list of SCADA signals in need of revision or supplementation;

b) In case there is a need of revision or supplementation of List of SCADA signals upon the request of the Dispatch level with competent control authority, the Investor must finalize and resend the list to the Dispatch level with competent control authority;

c) Within 10 working days from the receival date of the Registration Form for End-to-End testing plan and the Final list of SCADA signals, the Dispatch level with competent control authority must send a written response attached with End-to-End testing plan to the Investor.

Article 32. End-to-End test in the case of RTU/Gateway renovation or expansion

1. Before the tentative date of End-to-End test, the Investor is responsible for completing the following activities:

a) Completing installation of the devices in SCADA installation project at a power plant or a substation, and connection of transmitters and the central SCADA system at the Dispatch level with competent control authority;

b) Completion of Point-to-Point test and acceptance in accordance with the provisions under Section 3, Chapter III of this Regulation;

c) Preparation of adequate necessary conditions for End-to-End testing;

d) Reaching an agreement upon the End-to-End testing plan with the Dispatch level with competent control authority.

2. Once the End-to-End testing plan has been agreed, the Dispatch level with competent control authority and the Investor will collaborate to do the End-to-End test in compliance with the provisions under Section 3, Chapter III of this Regulation.

3. In case the End-to-End test is not passed, the Investor will work with the

Dispatch level with competent control authority to check, determine the causes, and suggest suitable solutions.

4. In case the End-to-End test is passed, the Dispatch level with competent control authority and the Investor will reach agreement on and sign the End-to-End Test Report and the Certificate of SCADA signal connection.

5. Within 03 working days from the date of signing End-to-End Test Report, the Dispatch level with competent control authority will have to send the Investor and related agencies a Confirmation Letter regarding the completion of SCADA signal connection between a power plant or a substation and the Dispatch level with competent control authority.

Section 3
POINT-TO-POINT AND END-TO-END TEST CONTENT

Article 33. The content of Point-to-Point testing from RTU to electrical devices

1. For SDI and DDI signals, Point-to-Point testing covers the following elements:

a) Emulating the signals in agreement with the agreed list of SCADA signals;

b) Checking and comparing the signals at RTU device and the emulated signals.

2. For AI values, Point-to-Point testing covers the following elements:

a) Temporarily disconnecting the circuit, connecting the short-circuit in front of the metering device of the power plant or the substation;

b) Using current and voltage injection systems and to simulate 05 values including 01 minimum value, 03 random values, 01 maximum value in turn for each signal;

c) Checking and comparing the signals at RTU device and those at metering cabinets;

a) Restoring the normal operating mode of current mode and voltage mode;

d) For tap changers, changing the position of a tap changer by raising and lowering 01 voltage level from the existing position, and then comparing with the value indicated at RTU.

3. For RC signals: Point-to-Point test and acceptance cover the following steps:

a) The power plant or the substation to confirm the readiness of all primary devices;

b) Changing the control status of the device control cabinets and at RTU to

remote control mode;

c) On the RTU-connected computer, sending a control order to:

- Close/open circuit breakers, switch disconnectors;
- Raise/lower the tap changer;
- Active power, reactive power (MW/MVAr) and input voltage (kV) for generating sets;

d) Checking and monitoring the device to confirm the receival of the right control signals;

e) Once the Point-to-Point testing is completed, changing the control mode on the device control cabinet and on RTU to the local control mode.

Article 34. The content of Point-to-Point testing from SAS/DCS system to Gateway desktop computer

Emulating, testing and comparing the signals on Gateway with those on SAS/DCS, including:

1. Testing and comparing the location of each signal;
2. Comparing the status of SDI and DDI signals on SAS/DCS and Gateway;
3. Comparing values of AI signals on SAS/DCS and Gateway.

Article 35. The content of testing for transmitter acceptance

1. Transmitters with 4W interface

a) Using a radio frequency transreceiver with a set frequency and transmit power test the transmitter;

b) Testing the transmitter by apply the following 02 methods:

- Measuring the receive level in two separate ways in turn: at the transmitter's terminal at the power plant/power station; and at the transmitter's terminal in the central SCADA system;
- Connecting the transmitter cable (Tx) and the receiver cable (Rx) at the transmitter's terminal at the power plant/power station to measure the receive level at the transmitter's terminal in the central SCADA system.

c) Test content

Transmitting 10dBm power to the pair cables at two transmitters' terminals at frequencies of 300, 600, 1020, 1500, 2000, 2400, 3000, 3400 (Hz) in turn, and resistor 600Ω, and measuring the receive level on the pair cables at the opposite transmitters' terminals;

d) A qualified transmitter must meet the following requirements:

- The receive power at a transmit frequency does not exceed 01dBm

difference from the respective transmit power;

- The stability of the receive level at each frequency level does not exceed ± 0.2dB within a 10-minute period;

- The background noise level measured in the range from 300 Hz to 3400 Hz must be lower than -65dBm.

2. Transmitters with V.24/RS232 interface

a) Using RS232 standard measurement tool to test the channels;

b) Methods for testing transmitters

Connecting the receive cable with the transmit cable at the transmitter's terminal at the power plant/power station to measure a series of bit at 9.6 Kbit/s transmitted by the measurement device within a minimum of 8 hours.

c) A transmitter is qualified when the test results in:

- Bit error rate (BER) < 10-5;

- No severe error (SES = 0).

3. Transmitters with Ethernet interface

a) Using Ethernet standard measurement tool to test the channels;

b) Methods for testing transmitters

Complying with Vietnam's National Standard TCVN 11300:2016 on Point-to-point ethernet leased lines. Transmission requirements issued by the Ministry of Science and Technology.

c) A transmitter is qualified when minimum parameters (bandwidth, latency, frame error) meet Vietnam's National Standard TCVN 11300:2016.

Article 36. The content of End-to-End test

1. General principles

a) Testing the signals one by one in accordance with the agreed list of SCADA signals on RTU/Gateway devices and the central SCADA system of the Dispatch level with competent control authority;

b) For power plants and substations not connected to Control Centers: The End-to-End test is run from the electrical devices at a power plant/substation to the central SCADA system of the Dispatch level with competent control authority;

c) For power plants and substations connected to Control Centers: The End-to-End test is run from the electrical devices at a power plant/substation to the Control Center and the central SCADA system of the Dispatch level with competent control authority.

2. Checking transmission protocol

a) Using a computer equipped with the protocol testing software to scan the

data from RTU/Gateway devices and test the parameters of transmission protocol;

b) Format of a test report on RTU/Gateway protocol is provided in Appendix 6 of this Regulation. TEST REPORT ON RTU/GATEWAY PROTOCOL

3. SDI signal

a) Impacting the SDI signal producing device to make each signal connected with the agreed list of signals;

b) Protective relays' active signals: isolating voltage mode, connecting current mode in front of the respective protective device; and using current and voltage injection systems to simulate active protective signals from these systems;

c) SDI signals must be tested in status 0 and status 1 in turn;

d) For a power plant or a substation not connected to a Control Center, the Dispatch level with competent control authority must check and confirm the right location and status of each signal, and ensure the accuracy of signal transmission between the power plant/substation and the central SCADA system at the Dispatch level with competent control authority;

e) For a power plant or a substation connected to a Control Center, the Dispatch level with competent control authority must simultaneously check and confirm the right location and status of each signal, and ensure the accuracy of signal transmission between the power plant/substation, the Control Center and the central SCADA system at the Dispatch level with competent control authority.

4. DDI signal

a) Impacting the DDI signal producing device to make each signal connected with the agreed list of signals;

b) DDI signal must be tested in closed status, open status and undefined status;

c) For a power plant or a substation not connected to a Control Center, the Dispatch level with competent control authority must check and confirm the right location and status of each signal, and ensure the accuracy of signal transmission between the power plant/substation and the central SCADA system at the Dispatch level with competent control authority;

d) For a power plant or a substation connected to a Control Center, the Dispatch level with competent control authority must simultaneously check and confirm the right location and status of each signal, and ensure the accuracy of signal transmission between the power plant/substation, the Control Center and the central SCADA system at the Dispatch level with competent control authority.

5. For AI values

b) Disconnecting the circuit, connecting the short-circuit in front of the

metering device of the power plant or the substation;

c) Using current and voltage injection systems and to simulate 05 values including 01 minimum value, 03 random values, 01 maximum value in turn for each signal;

d) For a power plant or a substation not connected to a Control Center, the Dispatch level with competent control authority must check and confirm the right location and status of each signal, and ensure the accuracy of signal transmission between the power plant/substation and the central SCADA system at the Dispatch level with competent control authority;

e) For a power plant or a substation connected to a Control Center, the Dispatch level with competent control authority must simultaneously check and confirm the right location and status of each signal, and ensure the accuracy of signal transmission between the power plant/substation, the Control Center and the central SCADA system at the Dispatch level with competent control authority;

f) Restoring the normal operating mode of current mode and voltage mode;

g) For tap changers, changing the position of a tap changer by raising and lowering 01 voltage level from the existing position, and then comparing with the value indicated at the Control Center and the central SCADA system at the Dispatch level with competent control authority.

6. RC signals

a) The power plant or the substation to confirm the readiness of all primary devices;

b) Changing the status of control locks to remote control mode;

c) For a power plant or a substation not connected to a Control Center, the Dispatch level with competent control authority will send the following control orders via SCADA system:

- Close/open circuit breakers, switch disconnectors;
- Raise/lower the tap changer;
- Active power, reactive power (MW/MVAr) and input voltage (kV) for generating sets transmitting electricity to RTU/Gateway device (when the generating sets are not in operation yet) and to generating sets (when the generating sets are in operation);
- The power plant or the substation to check, monitor and confirm that the device has received the right control order and changed the status;
- The Dispatch level with competent control authority to check whether the status has been changed and is suitable for the power plant/substation.

d) For a power plant or a substation connected to a Control Center, the Dispatch level with competent control authority will send the following control

orders:

- Close/open circuit breakers, switch disconnectors;
- Raise/lower the tap changer;
- Active power, reactive power (MW/MVAr) and input voltage (kV) for generating sets transmitting electricity to RTU/Gateway device (when the generating sets are not in operation yet) and to generating sets (when the generating sets are in operation);
- The power plant or the substation to check, monitor and confirm that the device has received the right control order and changed the status;
- The Dispatch level with competent control authority and the Control Center to check whether the status has been changed and is suitable for the power plant/substation;
- On completion of End-to-End testing, changing the control status the device control cabinet and on RTU to the local control mode.

Chapter IV

SCADA/EMS/DMS OPERATION MANAGEMENT

Section 1
RESPONSIBILITIES OF THE ENTITIES INVOLVED IN SCADA/EMS/DMS OPERATION

Article 37. Dispatch level with competent control authority's responsibility

In the process of managing the operation of the central SCADA system, EMS system or DMS system and other ancillary devices, the Dispatch level with competent control authority is responsible for:

1. Managing, operating and maintaining the central SCADA system, EMS system or DMS system and other ancillary devices under its management; ensuring stable, continuous, reliable and confidential operation.

2. Informing the Operation management unit about the person or team in charge of managing, operating and maintaining the central SCADA system, EMS system or DMS system and other ancillary devices under its management. Collaborating with the Operation management unit to timely detect the faults or the unstable operation of RTU/Gateway devices or transmitters under its management for timely restoration.

3. Frequently monitoring and checking the operation of the central SCADA system, EMS system or DMS system and other ancillary devices under its management; timely detecting abnormal events or the risk of faults. In case abnormal events or faults are detected, the handling process must follow the

regulations in Section 3 of this Chapter.

Article 38. Operation management unit's responsibility

During the operating process of RTU/Gateway devices, transmitters and other ancillary devices, the Operation management unit is responsible for:

1. Managing, operating and maintaining RTU/Gateway devices, transmitters and other ancillary devices under its management; ensuring stable, continuous, reliable and confidential operation.

2. Ensuring continuous connection and sufficient SCADA signals from Control Centers, power plants or substations to the central SCADA system under the Dispatch level with competent control authority.

3. Informing the Dispatch level with competent control authority about the person or team in charge of managing, operating and maintaining RTU/Gateway devices, transmitters and other ancillary devices under its management.

4. Frequently monitoring and checking the operation of RTU/Gateway devices, transmitters and other ancillary devices under its management; timely detecting abnormal events or the risk of faults. In case abnormal events or faults are detected, the handling process must follow the regulations in Section 3 of this Chapter.

5. In case the Operation management unit has a plan for temporarily stopping the operation of RTU/Gateway devices or performing manipulation at Control Centers, power plants or substations, which causes interruptions to SCADA signals to the Dispatch level with competent control authority, the Operation management unit has to report to the Dispatch level with competent control authority on paper about its objectives, tentative timeframe for temporary stop and restoration of SCADA signals.

Article 39. Transmitter operation unit's responsibility

1. Transmitter operation unit is responsible for leading, collaborating with the Dispatch level with competent control authority, the Operation management unit to coordinate the set-up and segmentation of the system for handling the faults, and restoration of transmitters in the system of SCADA transmitters.

2. Frequently monitoring and checking the operation of the transmitters under its management and control; timely detecting abnormal events or the risk of faults. In case abnormal events or faults are detected, the handling process must follow the regulations in Section 3 of this Chapter.

Section 2

LISTS OF SCADA SIGNALS

Article 40. Requirements for the power plant's SCADA signals

During operation process, power plants must ensure full connection of

SCADA signals to the Dispatch level with competent control authority, detailed as follows:

1. Status signals SDI and DDI

a) Status signal DDI refers to all signals on circuit breakers, switch disconnectors, ground disconnectors;

b) Status signal SDI refers to all warning signals, protective relays' active signals, generating sets' control mode signals, generating sets' operating signals, control-lock mode signals.

2. Measurement signal AI

a) For busbars: Frequency (Hz), voltage (kV);

b) For generating sets: Active power (MW), reactive power (MVAr), input voltage (kV), high voltage limit (MW), low voltage limit (MW), total active power of a power plant (MW), total reactive power of a power plant (MVAr), High/Low Regulation (MW/MVAr);

c) For transformers: Active power (MW), reactive power (MVAr), voltage (kV), current intensity (A) on different voltage levels of a transformers and a tap changer (if available);

d) For feeders, contact breakers, capacitors, resistors: Active power (MW), reactive power (MVAr), voltage (kV), current intensity (A);

e) For hydropower plants: upstream water level and downstream water level in addition to the measurement values mentioned above.

3. RC signal

a) For circuit breakers, switch disconnectors: open/closed control signals;

b) For tap changers: increased/decreased control signals (excluding those on generator transformers;

c) For generating sets: increased/decreased control signals or active power, reactive power, input voltage.

Article 41. Requirements for the substation's list of SCADA signals

In operation process, a substation must be fully equipped with SCADA signals to the Dispatch level with competent control authority:

1. Status signals SDI and DDI

a) Status signal DDI refers to all signals on circuit breakers, switch disconnectors, ground disconnectors;

b) Status signal SDI refers to all warning signals, protective relays' active

signals, control mode signals, operating signals.

2. Measurement signal AI

a) For busbars: Frequency (Hz), voltage (kV);

b) For transformers: Active power (MW), reactive power (MVAr), voltage (kV), current intensity (A) on different voltage levels of a transformers and a tap changer;

c) For feeders, contact breakers: Active power (MW), reactive power (MVAr), current intensity (A).

3. RC signal

a) For circuit breakers, switch disconnectors: open/closed control signals;

b) For tap changers: increased/decreased control signals.

Article 42. Requirements for the Control Center's list of SCADA signals

1. Power plants or substations connected to and remotely controlled by the Control Center must ensure adequate connection of SCADA signals to the Control Center in accordance with the lists provided by Article 40 and Article 41 under this Regulation and other signals required by different agencies.

2. The Control Center must ensure adequate connection of SCADA signals to the Dispatch level with competent control authority in accordance with the lists provided by Article 40 and Article 41 under this Regulation.

Section 3

HANDLING FAULTS IN SCADA OPERATION

Article 43. General principles

1. The Dispatch level with competent control authority, Operation management unit and Transmitter operation unit take responsibility for leading and collaborating with related agencies to handle the faults in the central SCADA system, EMS system, DMS system, system of transmitters, RTU/Gateway devices and other ancillary devices under their control authority.

2. In case incidents and faults are detected, the Dispatch level with competent control authority, Operation management unit and Transmitter operation unit must inform related agencies promptly for solutions.

Article 44. Handling faults in the central SCADA system

Once faults on the devices in the central SCADA system, EMS system, DMS system or other ancillary devices under its control authority are detected, the Dispatch level with competent control authority will take responsibility for:

1. Informing Operation management unit, Transmitter operation unit and

related agencies.

2. Identifying causes, resolving the faults and recovering the operation of the central SCADA system, EMS system, DMS system and other ancillary devices as soon as possible.

Article 45. Handling faults in the RTU/Gateway devices and the system of transmitters

1. Faults in terminal units

Once the Operation management unit detects or is informed about the faults on RTU/Gateway devices or other ancillary devices under its control authority, the Operation management unit will take responsibility for:

a) Leading, collaborating with related agencies to identify causes to the faults;

b) Promptly informing the Dispatch level with competent control authority about the causes to the faults and tentative deadline for resolution;

c) Resolving the faults, restoring SCADA signal connection to the Dispatch level with competent control authority as soon as possible.

2. Faults in the system of transmitters under the management and administration authority of the Transmitter operation unit

Once the Transmitter operation unit detects or is informed about the faults on the devices in the system of transmitters, the Transmitter operation unit will take responsibility for:

a) Promptly informing the Dispatch level with competent control authority, the Operation management unit and related agencies;

b) Identifying causes, resolving the faults and restoring the operation of the system of transmitters as soon as possible.

3. For the faults in the system of transmitters under the management of multiple agencies:

a) Once an agency detects or receives an information about the faults on the devices in the system of transmitters, that agency will take responsibility for reporting to the Dispatch level with competent control authority, the Transmitter operation unit and related agencies immediately for solutions;

b) Transmitter operation unit is responsible for coordinating the segmentation of the system to locating the faults; informing and requesting different device management units for handling the faults and checking the entire system of transmitters once the faults are resolved;

c) During the segmentation process, the process of resolving faults and checking the entire system of transmitters, the Transmitter operation unit and device management units take responsibility for informing the Dispatch level with competent control authority about the causes to faults, tentative deadline for

resolution, dates when the transmitters are ready for operation, and other related information.

4. In case the faults on RTU/Gateway devices, the system of transmitters or other ancillary devices under the management of the Operation management unit cause interruptions to SCADA signals sent from a power plant or a substation to the Dispatch level with competent control authority in more than 07 consecutive days, the Operation management unit will have to report on paper to the Dispatch level with competent control authority. This report specifies the causes to the faults, tentative deadline for resolution and full restoration of SCADA signals.

5. In case the faults on RTU/Gateway devices, the system of transmitters or other ancillary devices under the management of the Operation management unit cause interruptions to SCADA signals sent from a power plant or a substation to the Dispatch level with competent control authority in more than 30 consecutive days, the Operation management unit will have to collaborate with the Dispatch level with competent control authority and related agencies to make a plan for resolving the faults and immediately report to the Vietnam Electricity Group and the Electricity Regulatory Authority of Vietnam on paper.

6. Once the faults have been resolved, the Transmitter operation unit and the Operation management unit will have to inform the Dispatch level with competent control authority to mutually work on full restoration of SCADA signals sent to the Dispatch level with competent control authority.

Section 4

PRIVACY POLICY AND BACK-UP CONVERSION

Article 46. Privacy policy for SCADA, EMS and DMS systems

1. In operation of SCADA, EMS and DMS systems under their management, the Dispatch level with competent control authority, Transmitter operating unit and Operation management unit are responsible for:

a) Ensuring network safety, security and confidentiality, prevention of external attacks;

b) Periodically collaborating to check and assess network safety and security of SCADA, EMS and DMS systems;

c) Collaborating to develop and organizing incident response drills for network safety, security and confidentiality, prevention of external attacks, and rescue in case of faults;

d) When any incidents associated with network safety and security of SCADA, EMS and DMS systems are detected, competent authorities and related agencies must be informed promptly for solutions in accordance with the existing regulations.

2. Solutions for ensuring network safety, security and confidentiality,

prevention of external attacks to SCADA, EMS and DMS systems:

a) The SCADA system must be isolated from external computer systems including enterprises' information technology systems, administrative information technology systems, public internet by using firewall and other appropriate solutions;

b) Only allowing the connection of servers, processors, human-machine interface, information technology devices and other ancillary devices within the central SCADA system, EMS and DMS systems to LAN network of the central SCADA system;

c) Enabling decentralization of the right to access the central SCADA system, EMS and DMS systems for different agencies, individuals. Their accessibility and controllability vary at different levels, depending on the designated duties. They are not given the access to the functions or database out of the allowable scope;

d) Passwords and compulsory verification methods are required for the agencies and individuals who are given the right to access the central SCADA system, EMS and DMS systems;

e) Dispatch orders, control orders and the history of SCADA access must be monitored and recorded in terms of access IDs, time, locations and activities;

f) Applying necessary solutions to eavesdropping, data falsification, access on the purpose of destruction, illegal control or control exceeding the delegated power.

Article 47. Back-up conversion

When the SCADA system, EMS and DMS systems are equipped with back-up systems or devices, the Dispatch level with competent control authority, Transmitter operating unit and Operation management unit are responsible for:

1. Equipping, installing the automated conversion mode allowing the conversion of main systems, devices to back-up systems, devices under their management in case of faults in the main systems, devices.

2. Ensuring that the database in the back-up SCADA system, EMS and DMS systems is in real-time synchronization with the database in the main systems, and no interruption during the process of monitoring and controlling the conversion between the main systems, devices and the back-up systems, devices.

Section 5

REPORTING POLICY

Article 48. Reporting on SCADA signal connection

1. Before 10th of each month, related agencies must report to the Electricity

Regulatory Authority of Vietnam about the status of SCADA signal connection in the previous month, using the format provided in Appendix 7 of this Regulation and complying the following policy:

a) The National dispatch level is responsible for reporting on the status of SCADA signal connection at power plants and substations under the control of the National dispatch level and the Regional dispatch level;

b) The Vietnam Electricity Group is responsible for reporting on the status of SCADA signal connection at power plants and substations under the control of the affiliated provincial dispatch level.

2. In case of lost SCADA signal connection at power plants and power stations, the Dispatch level with competent control authority, Transmitter operating unit and Operation management unit will report and collaborate to resolve the faults in accordance with the regulations under Section 3 of this Chapter.

3. In case the Operation management unit does not handle the faults or has no solution for restoring SCADA signals sent to the Dispatch level with competent control authority in accordance with the regulations under Section 3 of this Chapter, the Dispatch level with competent control authority will report to the Electricity Regulatory Authority of Vietnam so appropriate sanctions in compliance with the existing regulations./.

DIRECTOR GENERAL

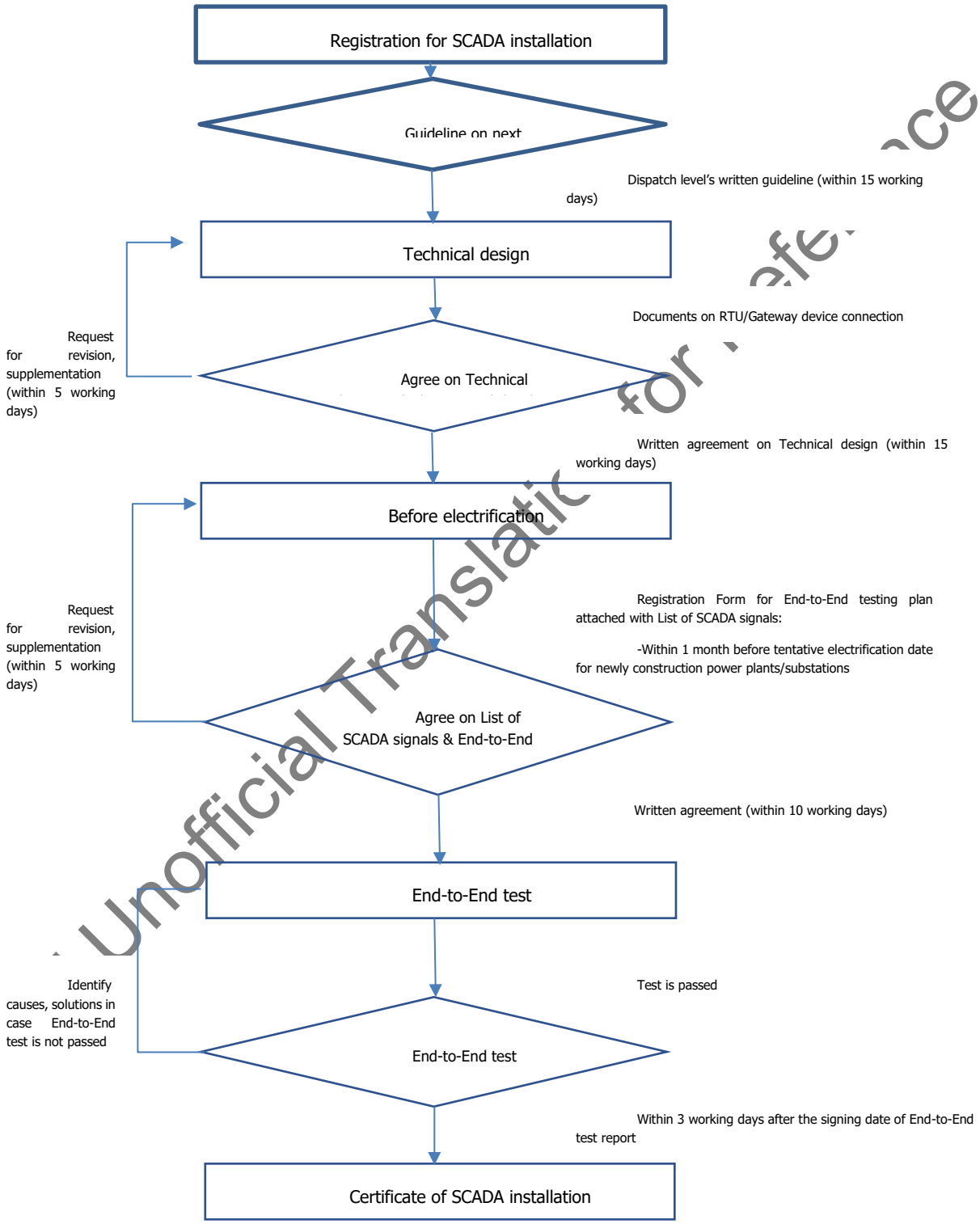
(Signed)

Nguyen Anh Tuan

Appendix 1

FLOW CHART: REGISTRATION FOR SCADA INSTALATION AT NEW POWER PLANTS AND SUBSTATIONS

(Issued as attachment to the Regulation on technical requirements and operation management of SCADA system)



Appendix 2

LIST OF SAMPLE SCADA SIGNALS

(Issued as attachment to the Regulation on technical requirements and operation management of SCADA system)

TYPE OF SIGNAL	NO.	NAME OF SIGNAL	OVERALL SYSTEM	GENERATING SET	BUSBAR	LINE	(HIGH-VOLTAGE) TRANSFORMER	(LOW-VOLTAGE) TRANSFORMER	(MEDIUM-VOLTAGE) TRANSFORMER	TAP CHANGER	CIRCUIT BREAKER	CONTACT BREAKER	BAND KNIFE CUTTING MACHINE	SWITCH DISCONNECTOR	GROUND DISCONNECTOR	VERTICAL CAPACITOR	
Measurement signal (AI)	1	FREQUENCY (HZ)		X													
	2	VOLTAGE (KV)		X	X	X	X	X	X								
	3	ACTIVE POWER (MW)		X		X	X	X	X								
	4	REACTIVE POWER (MVAR)		X		X	X	X	X								
	5	CURRENT (A)		X		X	X	X	X							X	
	6	TAP CHANGER								X							
	7	AGC HIGH REGULATING LIMIT (MW)		X													
	8	AGC LOW REGULATING LIMIT (MW)		X													
	9	AVR HIGH REGULATING LIMIT (MVAR)		X													
	10	AVR LOW REGULATING LIMIT (MVAR)		X													
	11	UP STREAM WATER LEVEL (M)		X(*)													
	12	DOWN STREAM WATER LEVEL (M)		X(*)													
	13	DC SYSTEM 48V FAULT															
1-bit status signal (SDI)	14	DC SYSTEM 110V FAULT	X														

	15	DC SYSTEM 220V FAULT	**X**													
	16	RECTIFIER 48V FAULT														
	17	AC SYSTEM 220V/380V FAULT	**X**													
	18	COMMUNICATION PLC FAULT	**X**													
	19	COMMUNICATION OPTICAL/RADIO/ MICROWAVE FAULT	**X**													
	20	FIRE ALARM	**W**													
	21	SWITCHING EQUIPMENT NOT READY (AIR/OIL/SF6/MECHANICAL)									**X**	**X**	**X**			
	22	EQUIPMENT FAULT		**X**						**W**						**W**
	23	BUSBAR PROTECTION - MAIN			**X**											
	24	BUSBAR PROTECTION - BACK-UP			**W**											
	25	BREAKER FAILURE PROTECTION									**X**	**X**	**X**			
	26	OVERVOLTAGE PROTECTION		**X**	**X**	**X**	**W**	**W**	**W**							
	27	UNDERVOLTAGE PROTECTION		**X**	**X**	**X**	**W**	**W**	**W**							
	28	DISTANCE PROTECTION ZONE 1/TELEPRO. - MAIN		**W**		**X**	**W**	**W**	**W**							

	29	DISTANCE PROTECTION ZONE 2 - MAIN		W		X	W	W	W								
	30	DISTANCE PROTECTION - MAIN		W		X	W	W	W								
	31	DISTANCE PROTECTION ZONE 1/TELEPRO. - BACK-UP (when applicable)		W		W	W	W	W								
	32	DISTANCE PROTECTION ZONE 2 - BACK - UP (When applicable)		W		W	W	W	W								
	33	DISTANCE PROTECTION - BACK - UP (When applicable)		W		W	W	W	W								
	34	LINE DIFFERENTIAL PROTECTION				X											
	35	DIRECTIONAL OVERCURRENT PROTECTION				X	W	W	W								
	36	OVERCURRENT PROTECTION				X											
	37	INTERTRIP SENT				X											
	38	INTERTRIP RECEIVED				X											
	39	AUTORECLOSE ORDER				X											
	40	EQUIPMENT OVERLOAD PROTECTION TRIP		X		X	X	X	X							X	
	41	EQUIPMENT OVERLOAD PROTECTION ALARM		X		X	X	W	W								
	42	EQUIPMENT (VOLTAGE) UNBALANCE PROTECTION		W				W	W								
	43	EQUIPMENT (CURRENT) UNBALANCE PROTECTION		X												W	
	44	EQUIPMENT DIFFERENTIAL PROTECTION		X			X										
	45	EQUIPMENT OVERCURRENT PROTECTION		X			X	X	X							X	

	46	EQUIPMENT RESTRICTED EARTH FAULT PROTECTION					**X**									
	47	BUCCHOLZ					**X**									
	48	WINDING TEMP. TRIP					**W**	**W**	**W**							
	49	WINDING TEMP. ALARM					**W**	**W**	**W**							
	50	OIl TEMP. TRIP					**W**									
	51	OIL TEMP. ALARM					**W**									
	52	PRESSURE RELIEF RELAY					**W**			**W**						
	53	EQUIPMENT TRIP		**X**		**W**	**W**								**W**	
	54	OPERATION MODE REMOTE / LOCAL		**X**						**X**	**X**	**W**	**W**	**X**		
	55	RTU FAULT	X													
	56	RTU REMOTE CONTROL	**X**													
	57	STATOR EARTH FAULT	**X**													
	58	LOSS OF EXCITATION PROTECTION														
	59	OVER/UNDER FREQUENCY PROTECTION		X												
	60	REVERSED POWER PROTECTION														
	61	POWER SWING PROTECTION		**X**												
	62	OVERFLUXING PROTECTION		**X**			**X**									

	63	VOLTAGE RESTRAINT OVERCURRENT PROTECTION														
2-bit status signal (DDI)	64	SWITCHING EQUIPMENT STAUTUS									**X**	**X**	**X**	**X**	**X**		
	65	GENERATOR UNIT (IN / OUT SERVICE)		**X**													
Control signal (RC)	66	SWITCHING EQUIPMENT CONTROL									**X**	**X**	**X**	**X**	**W**		
	67	TAP CHANGER CONTROL								**X**							
	68	GENERATOR ACTIVE POWER CONTROL (MW)		**X**													
	69	GENERATOR REACTIVE POWER CONTROL (MVAR)		**X**													
	70	GENERATOR TERMINAL VOLTAGE CONTROL (KV)		**X**													

Note:

- x: Compulsory signal.
- w: Compulsory signal if effective.
- (*): Applicable for hydropower plants.

Appendix 3

LETTER OF ACCEPTANCE (TRANSMITTERS)

(Issued as attachment to the Regulation on technical requirements and operation management of SCADA system)

SOCIALIST REPUBLIC OF VIETNAM

Independence – Freedom - Happiness

LETTER OF ACCEPTANCE (TRANSMITTERS)

(SCADA transmitter using IEC60870-5-101 interface, hotline channel)

Project: *(Name of the power plant/substation/control center)*

Ref: KTVT.A*x*>.<*ddmmyyyy*>-<*nn*>

Today, …/…/20..., representatives from all parties…

Representative 1 *(Investor)*:……

Mr…….……Title…….....

Mr…….……Title…….....

Representative 2 *(Service provider)*: ……..

Mr…….……Title…….....

Mr…….……Title…….....

Representative 3 (*Central SCADA operator*…….

Mr…….....Title…….....

Mr……..Title…….....

Confirm the results of the test on SCADA channel and Hotline channel connecting central SCADA system at…….. and power ……. station/substation:

I. E1 ITU-T G.703 transmitter

1. Parameter set-up

- Measurement device: ……;
- Speed: 2048 kbps;
- Resistor: 120Ω ☐ 75Ω ☐
- (Loop) Remote receiving/transmitting cables.

2. Time of measurement

Measure in a consecutive 24-hour period is required.

Start:.....hr.....min, dd/mm/yy

End:.....hr.....min, dd/mm/yy

3. Assessment on measurement results

Measuring and recording the results from BER testing: ……..

Assessing measurement results: Passed when BER ≤ 10^{-5}

Passed ☐ Not passed ☐

II. SCADA 4-wire transmitter

1. Parameter set-up

- Measurement tool: …...……;
- Resistor: 600 Ω, balanced;
- Set signal level of the transmitter in this range: -10dBm ÷ +3dBm.

2. Time of measurement

Measure in a consecutive 3-minute period/frequency is required.

3. Assessment on measurement results

Measuring and recording frequencies in the following table:

f(Hz)*	300	600	1024	1500	2000	2400	3000	3400
From substation/power station (Tx) to Central SCADA system (Rx)								
Transmit level (dBm)								
Receive level (dBm)								
From Central SCADA system (Tx) to substation/power station (Rx)								
Transmit level (dBm)								
Receive level (dBm)								
From Central SCADA system (Tx, Rx) to substation/power station (Loopback)								
Transmit level (dBm)								
Receive level (dBm)								

***:** Frequency f(Hz) is adjusted to fit in the system at the time of measurement.

Qualified transmission (passed): the difference between receive level and transmit level does not exceed ±1dBm.

Passed ☐ Not passed ☐

• A test on modem connection based on SCADA V.24 transmitter testing is required.

III. SCADA V.24 transmitter

1. Parameter set-up

- Measurement tool or software: ……...
- Speed: 1200 bps, 4800 bps, 9600 bps.
- (Loop) Remote receiving/transmitting cables.

2. Time of measurement

Measure in a consecutive 60-minute period for each level is required.

Start:.....hr.....min, dd/mm/yy

End:.....hr.....min, dd/mm/yy

3. Assessment on measurement results

Measuring and recording the bit error rate (BER).

3.1 Using a measurement tool:

Speed (bps)	1200	4800	9600
BER			

- Measured at actual operating speed and at 9600bps.

Qualified transmitter: BER ≤ 10^{-5} at respective speed.

Passed ☐ Not passed ☐

3.2 Using a measurement software:

Speed (bps)	1200	4800	9600
Transmit a series of standard signals			
Number of errors			

- Measured at actual operating speed and at 9600bps.

Qualified transmitter: Number of errors = 0 at respective speed.

Passed ☐ Not passed ☐

IV. Hotline

1. Parameter set-up

- Measurement device:…… …….....;
- Resistor: 600 Ω, balanced;
- Generator frequency and transmit level control: 800Hz and 0dB;
- Nominal receive level: -7dB.

2. Time of measurement

Measurement in a consecutive 5-minute period is required.

3. Assessment on measurement results

- Measuring and recording measurement results:

+ Substation/power plant (Tx) – Dispatch center (Rx):……dB;

+ Dispatch center (Tx) – Substation/power plant (Rx):……dB

Assessment is passed when the difference between measurement result and nominal receive level does not exceed ±1,5 dB.

Passed ☐ Not passed ☐

- Testing ring signal and record the results in the following boxes:

+ Substation/power plant – Dispatch center: Available ☐ Not available ☐

+ Dispatch center - Substation/power plant: Available ☐ Not available ☐

Ring signal passes the test when there are two-way ring signals.

Passed ☐ Not passed ☐

- Communication quality: clear two-way communication, no echo.

Passed ☐ Not passed ☐

V. As-built drawing

Available ☐ Not available ☐

CONCLUSION:

……

Responsibilities for resolving the pending issues *(if any):*

.....

.....

.....

REPRESENTATIVE 1 REPRESENTATIVE 2 REPRESENTATIVE 3

SOCIALIST REPUBLIC OF VIETNAM

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TEST REPORT FOR ACCEPTANCE OF TRANSMITTER

(SCADA using IEC 60870-5-104 protocol, Hotline VoIP)

Project: *(Name of power plant/substation/control center)*

Ref: KTVT.A<*x*>.<*ddmmyyyy*>-<*nn*>

Today, …/…/20..., representatives from all parties…

Representative 1 *(Investor):*……

Mr/Ms…….……Title…….……

Mr/Ms…….……Title…….……

Representative 2 *(Service provider)*: ……..

Mr/Ms…….……...Title……..…….....

Mr/Ms…….……Title…….…….....

Representative 3 (*Central SCADA system management unit*): ……....

Mr/Ms…….…….... Title …….…….....

Mr/Ms…….……Title…….…….....

Confirm the results of the test on SCADA channel and Hotline channel connecting central SCADA system at …….. and power ……. station/substation:

I. SCADA channel

1. Parameters set-up

- Using devices (Router or Laptop) placed at two terminals;
- Interface: RJ-45, TIA/EIA 568B.

2. Time of measurement

Measure in a consecutive 60-minute period is required.

Start:.....hr.....min, dd/mm/yy

End:.....hr.....min, dd/mm/yy

3. Assessment on measurement results

a) Testing methods:

- Standing on A0/Ax and ping substation/power plant/control center with parameter -t in 30 minutes continuously, other parameters are default.

b) Results:

- Number of Packets Send: .....;
- Number of Packets Received: …….....……;

- Number of Packets Lost…….....;
- Average Round Trip times: .....;
- The test is passed when:

+ Number of Packets Lost = 0;
+ Average round trip times <=125 ms.

Assessment

Passed ☐ Not passed ☐

II. Hotline VoIP channel

1. Parameters set-up

- Use Hotline VoIP phone placed at two terminals.

2. Assessment on measurement results

- Testing the ring signal and recording testing results in the following boxes:

+ Substation/power plan/control center – Central SCADA system:
  Available ☐ Unavailable ☐
+ Central SCADA system – Substation/power plan/control center:
  Available ☐ Unavailable ☐

- Ring signal passes the test when there are two-way ring signals.

  Passed ☐ Not passed ☐

- Communication quality: passes the test when there is clear two-way communication, no echo.

  Passed ☐ Not passed ☐

III. Telephone number and fax number used for power system operation

1. Telephone number: .....
2. Fax number: .....

IV. Acceptance of telecommunication connection

1. SCADA channel:

Passed ☐ Not passed ☐

Assessment: SCADA passes the test as it's successfully paired with the Front-End system in the central SCADA system.

2. Hotline VoIP channel:

Passed ☐ Not passed ☐

Assessment: Hotline VoIP passes the test as it's successfully paired with the Dispatch Hotline, available two-way ring signals, clear two-way communication, no echo.

3. Test the back-up capacity of the channel:

Passed ☐ Not passed ☐

Assessment: Channel back-up passes the test when: when we switch off 01 transmitter at the emulated central SCADA system, there is no interruption/lost connection of Hotline VoIP and SCADA to the central SCADA system at…

4. Telephone:

Passed ☐ Not passed ☐

Assessment: Telephone passes the test when: when it is paired with the dispatch hotline, there are two-way ring signals, clear two-way communication, no echo.

5. As-built drawing:

Passed ☐ Not passed ☐

6. Overall assessment:

Telecommunication connection passes the test and can be operated when 'Passed' is marked for all the criteria set for the main system and back-up system of central SCADA at ….

CONCLUSION: ……...

Responsibilities for addressing the pending issues *(if any)***:**

.....

.....

.....

REPRESENTATIVE 1 REPRESENTATIVE 2 REPRESENTATIVE 3

Appendix 4

LETTER OF ACCEPTANCE (POINT-TO-POINT)

(Issued as attachment to the Regulation on technical requirements and operation management of SCADA system)

SOCIALIST REPUBLIC OF VIETNAM

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……., …/…/20….

POINT-TO-POINT TEST REPORT

PROJECT: RTU/GATEWAY AND PROJECT INFORMATION: …

Today, …/…/20..., representatives from all parties…

1. Participants at the acceptance meeting:

1.1. Project investor

Mr …… Title ……

1.2. Project construction unit

Mr …… Title ……

2. Time of acceptance

Started on: dd/mm/yy

Finished on: dd/mm/yy

At ……substation/power plant.

3. Test content

- Testing methods
- Test results attached to Point-to-Point Test report

4. Quality assessment and recommendations

4.1. Assessment:

4.2. Recommendations:

INVESTOR	**PROJECT CONSTRUCTION UNIT**

RESULTS OF POINT-TO-POINT TEST ON AI SIGNAL

Substation/power plant ……. Date ……..

No.	Name of feeder	Name of signal	1st time (I=0, U=0)			2nd time			3rd time			Acceptance
			On device	At RTU/Gateway	Differences	On device	At RTU/Gateway	Differences	On device	At RTU/Gateway	Differences	
1												
2												
3												
…												

INVESTOR **PROJECT CONSTRUCTION UNIT**

RESULTS OF POINT-TO-POINT TEST ON DDI SIGNAL

Substation/power plant ……

Date ……..

No.	Name of feeder	Name of signal	Status 00		Status 01 (Open)		Status 10 (Closed)		Status 11		Acceptance
			On device	At RTU/Gateway	On device	At RTU/Gateway	On device	At RTU/Gateway	On device	At RTU/Gateway	
1											
2											
3											
…											

INVESTOR **PROJECT CONSTRUCTION UNIT**

RESULTS OF POINT-TO-POINT TEST ON SDI SIGNAL

Substation/power plant ……. Date ……..

No.	Name of feeder	Name of signal	Status 0		Status 1		Acceptance
			On device	At RTU/Gateway	On device	At RTU/Gateway	
1							
2							
3							
…							

INVESTOR **PROJECT CONSTRUCTION UNIT**

POINT-TO-POINT TEST RESULTS FOR RC SIGNAL

Substation/power plant ……. Date ……..

No.	Name of feeder	Name of signal	Status 01 (Open)		Status 10 (Closed)		Acceptance
			On device	At RTU/Gateway	On device	At RTU/Gateway	
1							
2							
3							
…							

INVESTOR **PROJECT CONSTRUCTION UNIT**

Appendix 5

LETTER OF ACCEPTANCE (END-TO-END)

(Issued as attachment to the Regulation on technical requirements and operation management of SCADA system)

SOCIALIST REPUBLIC OF VIETNAM

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……., .../.../20….

END-TO-END TEST REPORT

PROJECT: RTU/GATEWAY AND PROJECT INFORMATION: .....

Today, …/…/20..., representatives from all parties…

I. Participants at the acceptance meeting:

1.1. Central SCADA system management unit:

Mr …… Title ……

1.2. Project investor

Mr …… Title ……

1.3. Project construction unit

Mr …… Title ……

II. Time of acceptance

Started on: dd/mm/yy

Finished on: dd/mm/yy

At ……substation/power plant.

III. Test content

- Testing methods
- Attached appendix

IV. Quality assessment and recommendations

4.1. Assessment:

4.2. Recommendations:

INVESTOR	PROJECT CONSTRUCTION UNIT	CENTRAL SCADA SYSTEM MANAGEMENT UNIT

RESULTS OF END-TO-END TEST ON AI SIGNAL

Substation/Power plant ……. Date ……..

No.	Name of feeder	Name of signal	1st time (I=0, U=0)			2nd time			3rd time			Acceptance
			In central SCADA system	At RTU/Gateway	Differences	In central SCADA system	At RTU/Gateway	Differences	In central SCADA system	At RTU/Gateway	Differences	
1												
2												
3												
…												

INVESTOR **PROJECT CONSTRUCTION UNIT** **CENTRAL SCADA SYSTEM MANAGEMENT UNIT**

RESULTS OF END-TO-END TEST ON DDI SIGNAL

Substation/Power plant ……

Date……..

No.	Name of feeder	Name of signal	Status 00		Status 01 (Open)		Status 10 (Closed)		Status 11		Acceptance
			In central SCADA system	At RTU/Gateway	In central SCADA system	At RTU/Gateway	In central SCADA system	At RTU/Gateway	In central SCADA system	At RTU/Gateway	
1											
2											
3											
…											

INVESTOR **PROJECT CONSTRUCTION UNIT** **CENTRAL SCADA SYSTEM MANAGEMENT UNIT**

RESULTS OF END-TO-END TEST ON SDI SIGNAL

Substation/Power plant ……. Date ……..

No.	Name of feeder	Name of signal	Status 0		Status 1		Acceptance
			In central SCADA system	At RTU/Gateway	In central SCADA system	At RTU/Gateway	
1							
2							
3							
…							

INVESTOR **PROJECT CONSTRUCTION UNIT** **CENTRAL SCADA SYSTEM MANAGEMENT UNIT**

RESULTS OF END-TO-END TEST ON RC SIGNAL

Substation/power plant ……. Date ……..

No.	Name of feeder	Name of signal	Status 01 (Open)		Status 10 (Closed)		Acceptance
			In central SCADA system	At power plant/substation	In central SCADA system	At power plant/substation	
1							
2							
3							
…							

INVESTOR **PROJECT CONSTRUCTION UNIT** **CENTRAL SCADA SYSTEM MANAGEMENT UNIT**

Appendix 6

TEST REPORT ON RTU/GATEWAY PROTOCOL

(Issued as attachment to the Regulation on technical requirements and operation management of SCADA system)

SOCIALIST REPUBLIC OF VIETNAM

Independence – Freedom - Happiness

……., .../.../20….

TEST REPORT ON RTU/GATEWAY PROTOCOL

PROJECT: RTU/GATEWAY AND PROJECT INFORMATION: .....

Today, …/…/20..., representatives from all parties…

1. Name of the accepted product:

- ……

2. Participants at the acceptance meeting:

2.1. Central SCADA system management unit:

Mr …… Title ……

2.2. Project investor

Mr …… Title ……

2.3. Project construction unit

Mr …… Title ……

3. Time of acceptance

Started on: …….h….min, dd/mm/yy

Finished on: …….h….min, dd/mm/yy

At……. ……

4. Test content

- Testing tools……
- Testing information transmission protocol IEC6087-5-……configuration of RTU/Gateway at …substation/power plant
- Checklist for testing protocol parameters in the attached appendix…….

5. Quality assessment and recommendations

6. Assessment:

7. Recommendations: …….

INVESTOR	**PROJECT CONSTRUCTION UNIT**	**CENTRAL SCADA SYSTEM MANAGEMENT UNIT**

APPENDIX: PROTOCOL TESTING
(Attached to Test Report dated …/…/…)

1. Gateway Operation Testing

1.2. Monitor direction

Configuration: Steady mode – 1.

Result:

P: Passed,

NP: Not Passed,

UA: Unavailable.

No.	Type Identification	Test Result	Note
	Process information in monitor direction		
	<1> := Single-point information		
	<2> := Single-point information with time tag		
	<3> := Double-point information		
	<4> := Double-point information with time tag		
	<5>: = Step position information		
	<9> := Measured value, normalized value		
	<13> := Measured value, short floating point value		
	<30> := Single-point information with time tag CP56Time2a		
	<31> := Double-point information with time tag CP56Time2a		

1.2. Control direction – Step 1

Configuration: Steady mode – 1.

Result:

P: Passed,

NP: Not Passed,

UA: Unavailable.

	Type Identification	Test Result	Note
	Process information in control direction		
	<45> := Single command		
	<46> := Double command		
	<47> := Regulating step command		
	<48> := Set point command, normalized		

1.3. Control direction – Step 2

Configuration: Steady mode – 1.

Result:

P: Passed,

NP: Not Passed,

UA: Unavailable.

	Type Identification	Test Result	Note
	System information in control direction		
	<100> := Interrogation command		
	<103> := Clock synchronization command		
	<105> := Reset process command		
	<106> := Delay acquisition command		

1.4. Control direction – Step 3

Configuration: Steady mode – 1.

Result:

P: Passed,

NP: Not Passed,

UA: Unavailable.

No	Type Identification	Test Result	Note
Station initialization			
1	Remote initialization		
General interrogation			
1	Global		
Clock synchronization			
1	Clock synchronization		
Command transmission			
1	Direct single command transmission		
2	Direct regulation command transmission		
3	Select and execute single command		
4	Direct double command transmission		
5	Select and execute double command		
6	Direct set point command transmission		

1.5. Time Synchronization –Step 4

Configuration: Testing mode.

Action:

- ……..

Result:

- ……..

Appendix 7

FORM: REPORT ON SCADA SIGNAL CONNECTION STATUS

(Issued as attachment to the Regulation on technical requirements, installation and operation of SCADA/EMS/DMS in the power system)

1. SCADA signal connection at power plants/substations under control authority

Power plant/Substation	Total	Connecting and signals available		No signal	
		Sufficient signals[1]	Limited signals	Lost connection[2]	Not connected yet[3]
Power plant >30MW					
10MW≤ Power plant ≤30MW					
Power plant <10MW					
500kV Substation					
220kV Substation					
110kV Substation					

[1]*Sufficient signals: means power plants/substations with the number of SCADA signals transferred to power dispatch levels with competent control authority at statistics time not lower than 90% of the total number of requested SCADA signals, and with sufficient signals sent to Circuit breaker (or Disconnecting switch in the power system diagram with no Circuit breaker), key measurement signals P,Q,U;*

[2]*Lost connection: means power plants/substations that have installed SCADA signals but have lost SCADA signals through power dispatch levels with competent control authority due to signal transmitter failures, control terminals or other causes;*

[3]*Not connected yet: means power plants/substations that have not executed relevant regulations on SCADA signal installation for power dispatch levels with competent control authority.*

List of power plants with available SCADA signals to power dispatch levels with competent control authority

WBS	Name of power plant/sub station	Operation management agency	Capacity	Voltage level at connection point	Dispatch levels with competent control authority	Certificate of Acceptance ETE or Certificate of SCADA installation	SCADA installation status					Connection plan	Progress
							Not connected yet	Lost connection	Limited/ wrong signals	Name the limited/ wrong signals	Causes		
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
...													

(4): For power plants: write level of voltage connected to the grid; For substations: write the highest level of voltage of each substation (35 kV, 110 kV, 220 kV, 500 kV, etc.).

(6) Write "X" for power plants/substations with Certificate of Acceptance ETE for Certificate of SCADA installation available.

(7), (8) and (9): Write "X" for each column stating the SCADA installation status of power plants/ substations.

(10): List the limited/wrong signals in detail.

(11): Specify causes (due to signal transmitter, RTU/Gateway, etc.).

(12): Specify the plan by dates.

(13): Specify the progress of SCADA installation in monthly reports.