Network Code on Emergency and Restoration - Implementation Guide for the Communication Systems Requirements

Final VERSION

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1 INTRODUCTION

1.1 COMMUNICATION SYSTEM REQUIREMENTS IN NCER

Information Exchange is an essential topic for the work of the TSO and for guaranteeing the Operational Security of the Transmission System during each system state including Emergency, Blackout and Restoration State. To be able to gather all the necessary information from all involved parties in any system state it is important to establish reliable communication between all actors in case of blackout/restoration when public communication network is not working anymore.

Therefore each DSO and Significant Grid User identified pursuant to Article 23(4) NC ER, each Restoration Service Provider and each TSO shall have a voice communication system, or where foreseen a data communication system, implemented with sufficient equipment redundancy in case of failure of any individual communication system equipment and backup power supply sources to allow the exchange of the necessary information for Restoration Plan, during at least 24 hours, in case of total absence of external electrical energy supply.

Each TSO shall define, in consultation with DSOs and Significant Grid Users identified pursuant to Article 23(4) NC ER and Restoration Service Providers, technical requirements to be fulfilled by their voice communication systems as well as its own voice communication system in order to allow their interoperability and to guarantee that the TSO's incoming call can be identified by the other party and answered immediately. The TSO may communicate directly with a power plant, or indirectly through a dispatch centre, depending on the case. Communication to both parties is essential for TSOs to securely operate and restore the system. In case of indirect communication through a dispatch centre the dispatch centre their communication to the power plants has to fulfil the same requirements as direct communication from TSO to the power plant.

Voice communication of TSO and DSO includes communication between themselves (company internal) and each other and additionally also to other premises necessary for restoration e.g. substations, backup control rooms, regional (control) centres, headquarters, crisis centres etc.

Each TSO shall define, in consultation with at least its neighbouring TSOs and the other TSOs of its Synchronous Area, technical requirements to be fulfilled by their voice communication systems as well as its own voice communication system in order to allow their interoperability and to guarantee that the TSO's incoming call can be identified by the other party and answered immediately.

Notwithstanding the provisions described before previous paragraph, Significant Grid User identified pursuant to Article 23(4) which are type B Power Generating Modules and Restoration Service Provider which are type A or B Power Generating Modules, shall have the possibility to only have a data communication system instead of voice communication system if agreed upon with the TSO. This data communication system has to fulfil the same requirements related to redundancy and power supply backup as voice communication systems. This reflects the circumstances that small Power Generating Modules of type A and B usually do not have a control room or personnel available 24/7. Therefore it has to be guaranteed that instead of exchanging information and instructions via voice communication these information and instructions are communicated via data communication systems. The system needs to be established in a way to guarantee the controllability of these power generation modules in case of blackout.

1.2 PURPOSE OF THE DOCUMENT

This document has been developed by the European Network of Transmission System Operators for Electricity (ENTSO-E) as a response to ACERs Recommendation on the Network Code on Emergency

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and Restoration concerning the need for a more detailed implementation guide on the topic of communication systems. This implementation guide should be read in conjunction with the NC ER.

The purpose of this document is to ease the understanding, implementation and maintenance of the communication systems by all concerned parties, respecting the NC ER requirements. This implementation guide is designed to assist all parties to implement the necessary communication equipment to fulfil the requirements laid down in the NC ER chapter 5. The document shall help to harmonise the implementation in different countries and defines the acceptable levels of implementation.

The document has been developed in recognition of the fact that the NC ER, which is a legally binding document, inevitably cannot provide the level of explanation, which some parties may desire. Therefore, this document aims at providing all parties with the necessary information and explanation for the requirements specified in the NC ER, as well as the document outlines the necessary steps of the work.

1.3 LEGAL STATUS OF THE DOCUMENT

This document accompanies the Network Code on Emergency and Restoration, but is provided for information only. The mandatory requirements for all involved parties are from the NC ER. In addition this document describes principles/commitments of the involved parties to meet the requirements from NC ER.

Therefore this document has no legally binding status.

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2 COMMUNICATION LEVELS

2.1 REGULAR COMMUNICATION

To achieve the (n-1) criteria also with voice communication usually control rooms of TSOs, DSOs and SGUs use direct, redundant communication lines separate from public communication infrastructure for their regular communication. Therefore all relevant partners (TSOs, DSOs and SGUs) as well as substations can be contacted in case of a blackout or problems with the public communication infrastructure. All of this private, direct communication infrastructure has back-up power supply and is highly reliable.

Further partners who do not have this communication infrastructure use the public communication infrastructure for their regular communication.

2.2 FALL-BACK COMMUNICATION

As fall-back communication for TSOs, DSOs and SGUs usually the public communication infrastructure (public mobile communication or public landline) is used. In daily operation all partners and market participants can be contacted via public communication. In case of blackout or disturbances situations may occur where these parties, only having public communication access, temporary cannot be contacted anymore.

2.3 CONTINGENCY COMMUNICATION

In case of complete shortfall of regular and fall-back communication the most important partners are provided with satellite communication as contingency communication. Therefore this form of communication is also a fall-back solution for all other forms of communication.

Usually Inmarsat or Iridium are the common technologies of satellite communication. It is preferred that TSOs and the relevant partners are equipped with the same technology to guarantee higher availability.

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3 CONCERNED PARTIES

3.1 TSO LEVEL

3.1.1 TSO-DSO communication

Based on NC ER Article 41(1), each TSO on one side and the DSOs connected to its grid or identified as essential for its Restoration Plan procedures on the other side, shall have interoperable voice communication systems implemented.

3.1.2 TSO-SGU & TSO-Restoration Service Provider communication

3.1.2.1 VOICE COMMUNICATION SYSTEMS

Based on NC ER Article 41(1), each TSO on one side and the Significant Grid Users identified pursuant to NC ER Article 23(4) and each Restoration Service Providers directly connected to its grid or identified as essential for its Restoration Plan procedures on the other side, shall have interoperable voice communication systems implemented.

Pursuant to NC ER Article 2(2) Significant Grid Users within the scope of this Network Code shall be:

(a) existing and new power generating modules classified as type C and D in accordance with the criteria set out in Article 5 of Commission Regulation (EU) 2016/631[NC RfG];
(b) existing and new power generating modules classified as type B in accordance with the criteria set out in Article 5 of Commission Regulation (EU) 2016/631 [NC RfG], where they are identified as SGUs in accordance with Article 11(4) and Article 23(4);
(c) existing and new transmission-connected demand facilities;
(d) existing and new transmission connected closed distribution systems;
(e) providers of redispatching of power generating modules or demand facilities by means of aggregation and providers of active power reserve in accordance with Title 8 of Regulation (EU) 2017/XXX [SO GLs]; and
(f) existing and new high voltage direct current ('HVDC') systems and direct current-connected power park modules in accordance with the criteria set out in Article 4(1) of Commission Regulation (EU) 2016/1447[NC HVDC],

Pursuant to NC ER definition Restoration Service Provider are legal entities with a legal or contractual obligation to provide a service contributing to one or several measures of the Restoration Plan.

3.1.2.2 DATA COMMUNICATION SYSTEMS

Based on NC ER Article 41(4), if agreed upon with the TSO to use data communication as an alternative to voice communication, the TSO on one side and the Significant Grid Users identified pursuant to Article 23(4) which are type B Power Generating Modules and Restoration Service Providers which are type A or B Power Generating Modules and which were identified as essential for its Restoration Plan procedures on the other side, shall have interoperable data communication systems implemented.

This alternative form of communication was introduced since it is not necessary to be able to talk to those Significant Grid Users identified pursuant to Article 23(4) which are type B Power Generating Modules and Restoration Service Providers which are type A or B Power Generating Modules directly.

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But it is of utmost importance that TSOs or DSOs are able to directly control these units in the restoration process if agreed upon as relevant for restoration. E.g. if a wind park shall be used for supplying a certain amount of load in the restoration process, a signal need to be send to that wind park so it “knows” what to do.

3.2 INTER-TSO LEVEL

Based on NC ER Article 41(3), each TSO shall have a voice communication system implemented which enables communication with its neighbouring TSOs (regardless the Synchronous Area (SA) they belong to) and the other TSOs of its Synchronous Area due to the fact that they can potentially have a role as frequency leader or resynchronization leader and the fact that inter-TSO assistance can be carried out between SAs e.g. via HVDC links based in NC ER Article 14(2).

The target should be to establish a pan-European inter-TSO voice communication system/network (e.g. the ENTSO-E ATOM network) especially in case of Emergency and Restoration situations. The ENTSO-E Awareness System (EAS) can be taken as a good example of pan-European inter-TSO data communication system using a pan-European inter-TSO data exchange network: Electronic Highway.

It is important to refer to the findings of EH/ATOM convergence project BIA. The result shows that it is not suggested to use the same network for SCADA and voice communication, since in case of failure (operational or force of nature) both systems would be affected simultaneously which is to be avoided.

3.3 COMMITMENT OF THE PARTIES

3.3.1 Voice communication systems

In addition to the application of below described principles for implementation and maintenance of their voice communication system, each concerned party pursuant to 2.1 and 2.2 ensures the availability 24/7 of an operator with appropriate skills and “responsibility level” to guarantee that incoming calls from the TSO can be identified, answered immediately and will lead to the appropriate actions.

3.3.2 Data communication systems

In addition to the application of below described principles for implementation and maintenance of their data communication system, each concerned party pursuant to 2.1 and 2.2 ensures the availability 24/7 of the remote operation in its installation in order to fulfil the TSOs instructions.

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4 TECHNICAL RECOMMENDATIONS

Except for paragraph 3.4, this section aims at giving implementation principles to fulfil NC ER requirements for both voice and data communication systems.

Concerning the TSOs the principles described in this chapter apply for the main control rooms as well as the backup control room or any other relevant control rooms.

4.1 EQUIPMENT REDUNDANCY

NC ER Article 41(1) requirement regarding a "sufficient equipment redundancy […] to allow the exchange of the necessary information for Restoration Plan […] in case of failure of any individual voice [and data] communication system equipment" concerns two kinds of equipment: active and passive network equipment. Figure 1 and Figure 2 provide examples about how to achieve the necessary level of redundant communication infrastructure.

4.1.1 Active network equipment

For the active network equipment there are three relevant types:

1. **Carrier Network Equipment:** Transmission Systems, C/DWDM-Systems
2. **Data Network Equipment:** Router, Switches, Networking Servers (e.g. DNS, NTP, DHCP)
3. **Voice Network Equipment:** PBX, Servers, VoIP switching systems, dispatch telephone consoles, phones

To achieve redundancy of active network equipment each type of active network equipment needs to be installed at least twice in the system for central components (Main Control Centre / Backup Control Centre). The installation is not related to the location of the equipment but on the availability of the function and services.

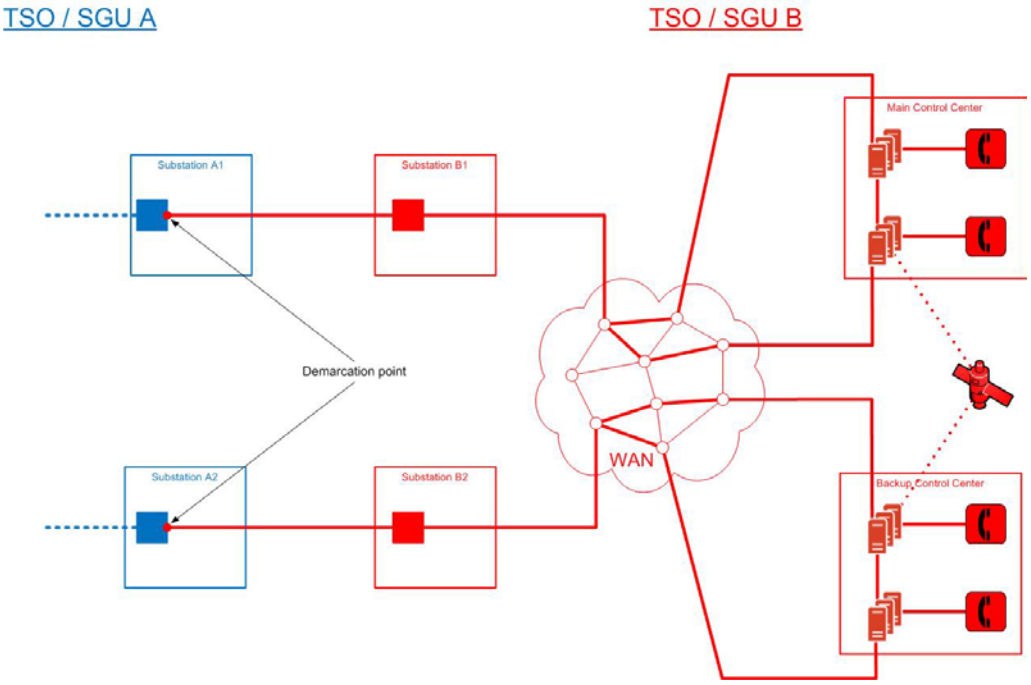

Figure 1: Example 1 of direct redundant communication infrastructure between two TSOs resp. between TSO and SGU.

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4.1.2 Passive network equipment

Passive network equipment are physical communication network lines between different parties.

Redundancy of the passive network equipment can be achieved through one of the following options:

- Meshed communication network with at least 2 communication paths between 2 given nodes,
- 2 direct lines between the entities that need to communicate together:
    - 2 main lines or;
    - 1 main and 1 backup line.

    In that case the 2 lines must be “geographically separated” to avoid e.g. common point of failure.

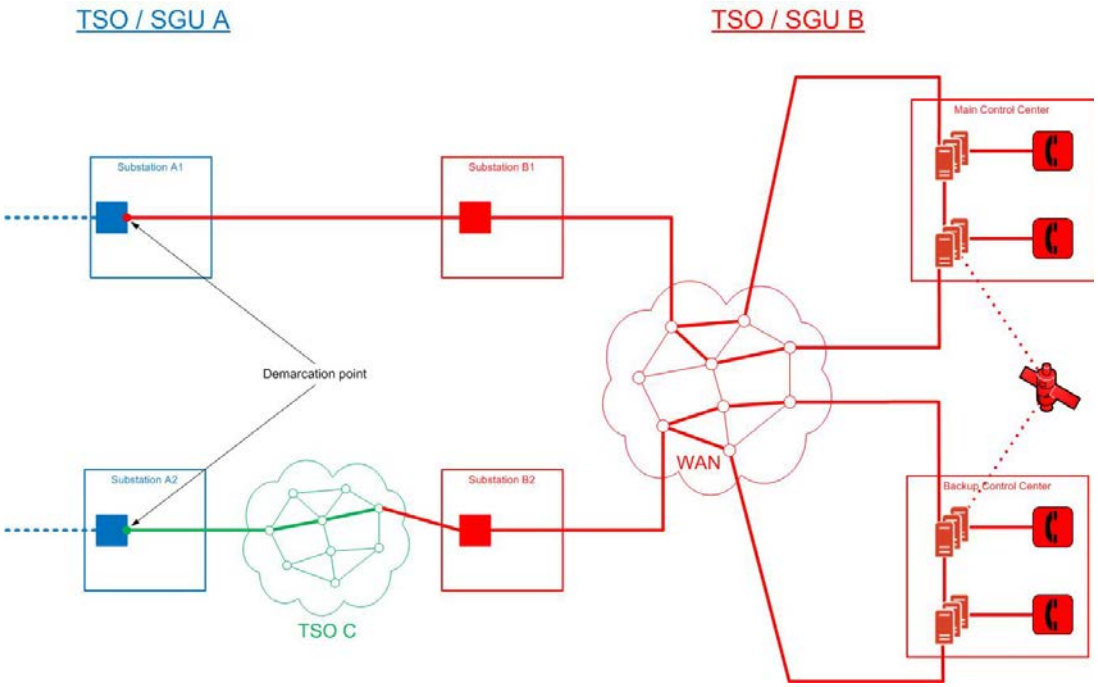

Figure 2: Example 2 of redundant communication infrastructure between two TSOs via a third TSO resp. between TSO and SGU.

4.2 BACKUP POWER SUPPLY

NC ER Article 41(1) requirement regarding “backup power supply sources to allow the exchange of the necessary information for Restoration Plan, during at least 24 hours, in case of total absence of external electrical energy supply” implies that **every active network equipment** is fed by main and backup resilient power supply.

This implies that 24 hours back up power supply is needed for the network operation centre as well as in each site hosting an active network equipment of the communication chain, e.g. dispatching, servers hosting sites, substations hosting equipment emitting the signal on the network, routers and/or switches.

Concerning the backup power supply it is up to the concerned party which type is used. Usually several types are combined, e.g. batteries and diesel generators.

4.3 ADDITIONAL IMPLEMENTATION REQUIREMENT FOR VOICE COMMUNICATION SYSTEMS: USER INTERFACE

Based on NC ER Article 41(2) and (3) the communication system and dispatch telephone consolesas well as the related software have to ensure the identification of the incoming call and the possibility to switch from one call to another. Additionally the system should allow multiple incoming calls and should be able to prioritize the calls.

This means the respective party always has a free line for the other connected party and a Calling-Line-Identification-Presentation (CLIP) so that a direct identification of the calling party is easy possible to decide if it is first priority to take the incoming call or not.

4.4 SPECIFIC CASE OF USE OF THIRD PARTY SYSTEMS

4.4.1 Satellite communication systems

In case the requirements of NC ER have to be met by using satellite communication some limitations have to be considered:

- 3 to 4 seconds of latency between the speakers, making crisis communication tricky and organization of conference calls nearly impossible;
  The delay of the system depends on several factors like the satellite topology, system architecture and the traffic priority. The common standard used for satellite communication show that a system well engineered can present a delay of 550ms in a single hop topology and 1.2-1.5s in a double hop topology.
- the quality of the signal and the costs to assure needed bandwidth;
  Modern satellite systems can provide bandwidth up to 100Mb/s. The limitation is the cost for the bandwidth that has to be taken in considerations.
- temporary unavailability of the service due to physical/weather phenomena;
  The influence of the weather on the satellite communication cannot be removed but can be limited by a right antenna design. and
- when satellite communication systems are used through a service provider, the concerned party should check that this link is blackout proof, taking in consideration that terrestrial active and passive network equipment could be part of the solution provided by the contractor and might not have the same level of guarantees.

In case it is agreed by the concerned parties to use satellite communication it needs to be agreed upon which satellite provider/ standard has to be used (e.g. Iridium).

4.4.2 Public operated networks

Whereas NC ER is not specific on the requirement for using public operated networks it should be the common goal to avoid the using this kind of network due to uncertainty of availability in case of Emergency or Blackout. **Ensuring reliability and access in case of Emergency or Blackout cannot be guaranteed by contracts and seems unfeasible from TSO experience.**

5 PROPERTY LIMITS

The property limits or rights of the communication lines has to be agreed on bilaterally between the involved parties or needs to be decided on national level by the national authorities. For an example see Figure 1 – demarcation point.

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6 MAINTENANCE PRINCIPLES

6.1 PREVENTIVE MAINTENANCE

Pursuant to NC ER Article 48, each TSO, DSO and Significant Grid User identified pursuant to Article 23(4) and each Restoration Service Provider shall test the communication systems, defined in NC ER Article 41 and specified in this implementation guide, at least every year.

This test should include at least

- End-to-end connection test from both sides;
- Prioritization and Calling-Line-Identification-Presentation (CLIP) functionalities; and
- Testing of the equipment guarantying the redundancy of the communication system.

These tests have to be performed by all parties where such connection is established.

Concerning the backup power supply of their communication systems each TSO, DSO and Significant Grid User identified pursuant to Article 23(4) and each Restoration Service Provider shall test the functionality and reliability of the equipment installed to provide backup power supply at least every five years. This test shall ensure that in case of an interruption of supply by the primary energy source the communication system still is operational.

6.2 CURATIVE MAINTENANCE

If in case of failing equipment of the communication system or of the backup power supply equipment requirements set out in NC ER are not fulfilled any longer; thus the responsible party has to replace the damaged equipment in reasonable time after the damage has been detected.

If the redundancy concept shown in 3.1 is implemented correctly in case of a failure the functionality of the communication systems will not be affected. In case of failure only the redundancy is not given any more until the affected component are replaced.

Due to the uncertainty of the cause of a failure it is not possible to give a detailed time for the replacement, e.g. in case an electrical tower is damaged it needs more time to replace it and therefore also the connection line which is attached to the tower compared to e.g. a failure in a switch in a substation.

To achieve the maintenance within the maximum admissible delay, all parties have to prepare and be equipped with spare equipment on site or at least at locations near enough to guarantee the supply of each location within the designated time. Also the availability of staff for maintenance (contracted or within the entity staff) needs to be organized by each party in advance. This includes contracts with vendors or third party support in regard to spare equipment supply and storage.

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Annex 1: Implementation examples

Please find below in Figure 3 an example of the current TSO approach.

Besides the N-1 criterion for the transmission grid TSOs also build its communication network on this criterion.

Figure 3: Graphic of an example of TSOs communication system approach

1. Telephone communication via different communication paths. Therefore this voice communication system is redundantly built.

2. Every important workplace is connected to two different PBX (Private Branch Exchange). The PBX-network is meshed based on own telecommunication equipment. There is no routing or transit provided for connected adjacent networks based on the voice communication network, which usually belongs and operated by TSO and their neighbours.

3. Main locations are connected to different public TELCOs and Satellite Communication providers. In addition there are direct connections to adjacent TSOs and relevant DSOs.

4. In fact, to describe it in a simple way, a redundant voice communication at least is built by two phones, two PBX and two separate communication lines, one for each PBX. As far as possible also local separate routed. For long distance it should be required, that every location, for example on the paths from dispatching location A to dispatching location C (TSO B) is also constructed in the same way. All locations are black-out proofed.

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5. Satellite communication is also installed but is only seen as solution for single disturbances where communication via first and second way is not possible. In case of an ENTSO-E disturbance Satellite communication is not seen as a sufficient way to communicate due to the fact that Satellites will be used by several other entities as well and no clear communication can be guaranteed.

6. There is no additional voice communication technology! There is no use for it, because the better availability is only based by redundancy and the inherent reliability of communication devices.

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