ρυθμιστική αρχή ενέργειας κύπρου
cyprus energy regulatory authority

Risk-Preparedness Regulation - Identification of National Electricity Crisis Scenarios for Cyprus

Μήνας 2025

Αριθμός Έκθεσης .../2025

Οποιαδήποτε αλληλογραφία για το παρόν έγγραφο να αποστέλλεται στη Ρυθμιστική Αρχή Ενέργειας Κύπρου

RISK-PREPAREDNESS REGULATION - IDENTIFICATION OF NATIONAL ELECTRICITY CRISIS SCENARIOS FOR CYPRUS

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Περιεχόμενα

1. CERA Mission Statement

The Cyprus Energy Regulatory Authority's (CERA) main objective is to design and implement a comprehensive set of regulatory measures and actions that will prepare Cyprus to participate in a smooth, organized and efficient way, in the process of incorporating the integrated European energy market. At the same time, it must safeguard the necessary security of energy supply in the country, both on a physical and an economic level, and to ensure energy costs are accessible to the national economy and the consumer.

2. Executive Summary

In accordance with Regulation (EU) 2019/941 on risk-preparedness in the electricity sector (RPR) Article 7, CERA, as competent authority, has identified a set of national electricity crisis scenarios following consultation with relevant stakeholders. This process was conducted in parallel to the work undertaken by European Network of Transmission System Operators for Electricity (ENTSO-E) according to Article 6 of the regulation, thus ensuring consistency with the regional electricity crisis scenarios identified therein, even though article 6 does not apply to Cyprus until Cyprus is directly interconnected with another Member State.

This is the second report published by CERA on the identification of national electricity crisis scenarios, following the first report released in December 2020.

This report sets out information about each scenario. Based on the analysis completed to date, each scenario has been given a score relating to the likelihood of its occurrence. It should be noted that there is no cross-border impact since Cyprus is not interconnected with other Member States.

The work was completed after consultation with the Transmission System Operator of Cyprus (TSOC) and the Distribution System Operator (DSO). CERA has taken into account the comments received and proceeded in developing the final list of national scenarios. The final scenarios will subsequently feed into the development of the Risk Preparedness Plans as required under Article 10 of the Regulation. CERA's second Risk Preparedness Plan, including the final set of national electricity crisis scenarios, is scheduled for publication in January 2026.

3. Public Impact Statement

Regulation EU 2019/941 on risk preparedness in the electricity sector sets out requirements for each EU Member State to ensure that consistent plans are in place to prevent, prepare for and manage crisis events that may result in a loss of electricity supply to customers. These events might include extreme weather conditions, for example, or technical failures.

As part of the work required under the regulation, CERA after consulting TSOC and DSO, developed a set of potential 'crisis' scenarios under which a loss of electricity supply might occur in Cyprus.

The scenarios will be used in the next phase of work under the regulation, which will involve drawing up detailed preparations to manage such events. The plans will contain the arrangements for the electricity sector to follow during the different crisis scenarios, in order to mitigate and minimize the disruption caused to customers.

The purpose of this consultation is to ensure that a reasonable range of potential crisis scenarios have been identified, and that their likelihoods and possible impacts on the electricity system have been fully considered.

The public should note that similar work has historically been undertaken by CERA in close cooperation with the TSOC in order to ensure security of supply in Cyprus.

4. INTRODUCTION

4.1. Risk Preparedness Regulation

The Risk Preparedness Regulation (RPR, EU 2019/941) sets out a requirement for Member States to develop transparent risk-preparedness plans to prevent, prepare for and manage electricity crises, indicating the agreed coordination and cooperation within regions and between Member States.

In developing the risk-preparedness plans, the RPR requires each Member State to produce a set of nationally relevant electricity crisis scenarios. The scenarios are intended to represent situations in which there is a shortage of electricity or an inability to provide electricity to customers.

This document presents the set of national electricity crisis scenarios developed by CERA, in its role as competent authority, in fulfilment of the requirement of Article 7 of the RPR. The scenarios were prepared taking into account the set of regional electricity crisis risk scenarios established by the European Network of Transmission System Operators for Electricity (ENTSO-E) in line with Article 6 of the RPR. Many of the scenarios considered relevant for Cyprus as well even though is not interconnected with any other Member State.

Article 7(2) requires that the competent authority consult with 'the transmission system operators, the distribution system operators that the competent authority considers to be relevant and the relevant producers or their trade bodies'. As the body responsible for the operation of the transmission system, TSOC has been closely consulted and has contributed significant expertise to the development of the scenarios. Apart from TSOC, CERA has also consulted the ~~relevant producers through their trade bodies~~ DSO.

4.2. Related Documents

The most related documents with this report that are worth to note are the following:

- Regulation (EU) 2019/941 on risk preparedness in the electricity sector.
- Council of Ministers' Decision designating CERA as Competent Authority.
- CERA report no. 07/2020, "Identification of national electricity crisis scenarios" – December 2020.
- ACER Decision no. 02/2024, "on the amendment of the methodology for identifying regional electricity crisis scenarios".
- ENTSO-E report, "Identification of the Most Relevant Regional Electricity Crisis Scenarios (2024)".
- Electricity Coordination Group's Recommended amendments to ENTSO-E's identification of regional electricity crisis scenarios dates 16 April 2025

5. ELECTRICITY CRISIS SCENARIOS

5.1. Scenario Development

The electricity crisis scenarios presented in this section are identified as being the most relevant for the case of Cyprus. The electricity crisis scenarios identification have taken into account the risks referred to in Article 5(2) of the Risk Preparedness Regulation and in the "Methodology to Identify Regional Electricity Crisis Scenarios" of ENTSO-E.

In identifying the Cyprus' electricity crisis scenarios, CERA consulted the Transmission System Operators of Cyprus (TSOC), the DSO and the relevant producers through their trade bodies.

Each scenario has been rated according to its likelihood of occurrence. For the classification of the likelihood of crisis, the six-step classification scale of the "Methodology for Identifying Regional Electricity Crisis Scenarios" of ENTSO-E was used. Table 1 presents the crisis likelihood scale and Table 2 the electricity crisis scenarios of Cyprus and their likelihood of occurrence.

Table 1: Crisis likelihood scale

Classification	Events per year	1 x in … years	Description/example of initiating event
Very likely	≥ 0.5	2 or less	Event expected practically every year, e.g. winds/storms causing multiple failures of overhead lines may be expected nearly every year in some areas.
Likely	0.2-0.5	2-5	Event expected once in a couple of years, e.g. heat wave causing limits on output of open-loop water-cooled power plants, low water levels at hydro plants, higher load, etc.
Possible	0.1-0.2	5-10	Event expected or taken into consideration as a potential threat, e.g. cyber or malicious attack.
Unlikely	0.01-0.1	10-100	Rare event, e.g. simultaneous floods causing unavailability of generation, distribution and transmission infrastructure.
Very unlikely	0.001-0.01	100 - 1000	Very rare event, e.g. earthquake causing a huge destruction of transmission, distribution and generation infrastructure
Extremely unlikely	≤ 0.001	1000 or more	Not applicable, impossible, or extremely rare event, expected beyond 1 in 1000 years.

Table 2: Cyprus' electricity crisis scenarios likelihood of occurrence

Crisis Scenario	Name	Likelihood					
		Very likely	Likely	Possible	Unlikely	Very unlikely	Extremely unlikely
1	Cyberattack – entities connected to electrical grid			√			

2	Physical attack – critical assets			√			
3	Physical attack – control centres			√			
4	Threat to key employees			√			
5	Insider attack			√			
6	Precipitation and flooding		√				
7	Winter Incident		√				
8	Fossil Fuel Shortage			√			
9	Local technical failure			√			
10	Multiple failures caused by extreme weather (storm, ice loading)				√		
11	Loss of ICT systems for real-time operation			√			
12	Simultaneous multiple failures				√		
13	Power system control mechanism complexity				√		
14	Human error			√			
15	Serial equipment failure			√			
16	Strike, riots, industrial action				√		
17	Industrial/nuclear accident			√			
18	Unusually big RES forecast errors				√		
19	Pandemic			√			
20	Heatwave	√					
21	Earthquake					√	

22	Forest fire		√				
23	Dunkelflaute (extremely low wind/solar generation)				√		
24	Space weather						√
25	High penetration of RES		√				

6. INDIVIDUAL SCENARIO DETAILS

This section indicates the national electricity crisis scenarios that apply in the case of Cyprus:

6.1. Crisis Scenario 1: Cyberattack – entities connected to electrical grid

6.1.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.1.2 Season(s) of the year when the scenario is relevant

This scenario is relevant at all times. It does not depend neither on season nor on load.

6.1.3 Initiating Event and chain of events

This scenario would be initiated by an attack against critical ICT systems of TSOC, EAC, major RES producers and major loads such as the Vasilikos Cement Works (e.g. central SCADA/EMS, substation SCADA, data storage, power plant's operating systems, office IT).

6.1.4 Description of impacts on the national perimeter

6.1.4.1 Security of supply impacts

The attack could cause unintended outages of lines, transformers, power plants, etc. with possible overloading on remaining lines and transformers and/or direct loss of supply. Due to the small-isolated nature of the system, a successful intrusion into a single power station or disconnection of critical transmission equipment could lead to a black-out. The attack could also cause unintended outages of DSO lines and transformers (loss of supply) with effect on frequency or load flows in the TSO's grid.

6.1.4.2 Operational impacts

The attack could limit the TSOs ability to react to the situation due to the SCADA becoming unavailable and/or corrupted.

6.1.4.3 Structural or systemic degradation

Through switching of devices on the grid and/or manipulating generating units, the attacker may cause system voltage and/or frequency to fall outside allowable limits.

6.1.5 Evolution of the crisis scenario

6.1.5.1 Operational impacts

The attacker (or attackers) is able to enter one or more critical ICT system of TSOC, EAC, major RES producer or major load (Vasilikos Cement Works). During this scenario, the attacker can act as any employee working within these systems and may manipulate lines, transformers, reactive power compensation devices, or change set points of generators.

6.1.5.2 Corruption of control

The attacker is controlling the system and is also able to deny access of regular users to the system.

6.1.5.3 Security of supply impacts

Whilst the attacker is able to take control, they can switch off a particular load or an entire area.

6.2. Crisis Scenario 2: Physical attack – critical assets

6.2.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.2.2 Season(s) of the year when the scenario is relevant

This scenario is relevant at all times. It does not depend neither on season nor on load.

6.2.3 Initiating Event and chain of events

This scenario would be initiated by a physical attack against power lines, transformers, substations, power plants or data centres.

6.2.4 Description of impacts on the national perimeter

6.2.4.1 Security of supply impacts

The attack could directly disconnect load from the grid. The security of supply is in danger due to violations of N-1 security. Electricity transport is in danger and could lead to loss of load, loss of part of the system and even a blackout, particularly in case key substations are destroyed. Destroyed power plants are no longer able to deliver energy. System reserves are no longer sufficient, and the imbalance of load/generation will lead to frequency deviations with automatic load shedding or power plant shedding. Due to the small, isolated nature of the system, a successful attack on a major power station could lead to long lasting lack of adequacy. This will be exacerbated as reliance on a single power station (Vasilikos) increase.

6.2.4.2 Operational impacts

The TSO and/or the DSO may have to react by switching off the remaining elements in order to restore N-1 security. Activation of redispatch measures or energy reserves may be needed.

6.2.4.3 Structural or systemic degradation

Due to the amount of destroyed equipment and/or loss of load, frequency and/or voltage will be impacted. Loss of grid elements may cause overloads on other lines locally.

6.2.4.4 Infrastructure impacts

Destroyed/damaged assets are no longer available for electricity transport and distribution as assets have to be repaired. The time needed for this would depend on the level of damage and the physical security and safety situation in the locations affected. This maintenance possibly needs additional planned outages with a riskier situation for the security of supply.

6.2.5 Evolution of the crisis scenario

6.3.5.1 Operational impacts

The attacker is destroying technical equipment in the TSO or DSO grid or power plants. Such an attack – or even multiple attacks – could affect the system beyond N-1 criteria, with restoration of N-1 security not possible. Electricity delivery for all loads could be impossible. Remedial actions (e.g. redispatch) could be necessary.

6.2.5.2 Security of supply impacts

The destroyed assets and the time for repairing them as well as emergency measures can cause loss of supply in different areas for weeks, while lack of adequacy in case of the destruction of a major power station could persist for months or even years.

6.2.5.3 Infrastructure impacts

The destroyed assets can require a long time for restoration.

6.2.5.4 Structural or systemic degradation

Depending on the amount of destroyed assets and the time to repair them, a long-lasting violation of N-1 security may occur.

6.3. Crisis Scenario 3 – Physical attack – control centers

6.3.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.3.2 Season(s) of the year when the scenario is relevant

This scenario is relevant at all times. It does not depend neither on season nor on load.

6.3.3 Initiating Event and chain of events

This scenario would be initiated by a physical attack of control centres and backup control centres of TSOC or major EAC power plants.

6.3.4 Description of impacts on the national perimeter

6.3.4.1 Security of supply impacts

Electricity transport and supply are still possible, but in case any actions are needed to react to incidents, the security of supply will be in danger and possibly interrupted with even a blackout being a possibility due to the small, islanded nature of the system.

6.3.4.2 Operational impacts

The grid or power plant operators are no longer able to monitor or control the grid/power plants. Operational staff may have to be sent to substations or parts of the power plants to get information via telephone, thus receiving a very low-level knowledge of the current grid and power plant situation. Advice can be given by phone and would have to be performed by staff on site.

6.3.4.3 Structural or systemic degradation

The operation of the electricity grid is no longer under control. Due to missing communication (online or by phone) to reserve power plants and loads, the ongoing operation of the electricity grid could have overloads, frequency deviations, etc. Actions needed to secure the grid cannot be taken.

6.3.4.4. Infrastructure impacts

The scenario could result in destroyed control centres.

6.3.4.5 Corruption of control

There would be a full loss of control functions for the grid or power plants.

6.3.5 Evolution of the crisis scenario

6.3.5.1 Operational impacts

The attacker attempts to destroy the main and back-up control centres of TSOC or a major EAC power plant operation centre. TSOC is no longer able to operate the grid or give instructions to power plants. Power plants could be stopped by the attacker.

6.3.5.2 Corruption of control

TSO or major power plant operation centres are no longer able to operate their assets. Back-up centres are also not available.

6.3.5.3 Security of supply impacts

The security of supply could be directly/indirectly affected by further network failures or changed conditions.

6.3.5.4 Structural or systemic degradation

The overall controllability of the power system is lost.

6.4. Crisis Scenario 4 – Threat to key employees

6.4.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.4.2 Season(s) of the year when the scenario is relevant

This scenario is relevant at all times. It does not depend neither on season nor on load.

6.4.3 Initiating Event and chain of events

This scenario is initiated by critical personnel who are forced to perform system destabilizing actions. Those affected could include system operators, IT administrators, people with access rights to critical systems and installations, Chief Executive Officers, Chief Financial Officers, etc.

6.4.4 Description of impacts on the national perimeter

6.4.4.1 Security of supply impacts

The attacked or threatened employee is able to shut down the whole grid thus causing a blackout.

6.4.4.2 Operational impacts

The whole operation of the grid is unstable by being under the control of an attacked or threatened employee.

6.4.4.3 Infrastructure impacts

The attacked or threatened employee is able to destroy infrastructure elements.

6.4.5 Evolution of the crisis scenario

6.4.5.1 Operational impacts

The employee is in control of the grid at the threat of the attacker. Multiple faults of transmission network elements are possible.

6.4.5.2 Corruption of control

The TSO or power plant operator are no longer in full control. In particular, significant assets are no longer controllable.

6.4.5.3 Security of supply impacts

Security of supply is in danger, as either a significant volume of load or generation may be disconnected.

6.5. Crisis Scenario 5 – Insider attack

6.5.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.5.2 Season(s) of the year when the scenario is relevant

This scenario is relevant at all times. It does not depend neither on season nor on load.

6.5.3 Initiating Event and chain of events

The scenario would be initiated through sabotage by employee(s) or subcontractor(s) via physical intervention or misuse of ICT systems.

6.5.4 Description of impacts on the national perimeter

6.5.4.1 Security of supply impacts

The insider might be able to shut down the grid thus causing a blackout.

6.5.4.2 Operational impacts

The operation of the grid is unstable by being under the control of this insider. This could lead to shutting down the grid.

6.5.4.3 Structural or systemic degradation

Multiple faults of transmission network elements are possible.

6.5.4.4 Infrastructure impacts

The insider is able to destroy infrastructure elements.

6.5.4.5 Corruption of control

The control of the grid is unstable by being under the control of this insider.

6.5.5 Evolution of the crisis scenario

6.5.5.1 Operational impacts

An employee(s) or subcontractor(s) takes control of the grid. In addition to controlling the grid, they can also physically destroy assets.

6.5.5.2 Corruption of control

The TSO or power plant operator are no longer in control. In particular, critical assets are no longer controllable.

6.5.5.3 Security of supply impacts

The security of supply is in danger, as either a significant volume of load or generation may be disconnected.

The insider can also destroy assets of the electrical energy supply for major customers or whole DSOs, power plant connection points or whole power plants.

6.5.5.4 Infrastructure impacts

The insider could use physical means to destroy the assets of TSO, DSO or power plants.

6.5.5.5 Structural or systemic degradation

The insider could force a blackout.

6.6. Crisis Scenario 6 – Precipitation and flooding

6.6.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.6.2 Season(s) of the year when the scenario is relevant

The scenario is more relevant during the winter period, when most of the annual rainfall takes place. However, it should be noted that Cyprus has a generally arid climate, and any issues are usually limited to short duration localised flash flooding.

6.6.3 Initiating Event and chain of events

The scenario is initiated by the rainfall equivalent of weeks or months falling in the space of minutes or hours, causing localised flooding that affects substations and/or power stations.

6.6.4 Description of impacts on the national perimeter

6.6.4.1 Structural or systemic degradation

The scenario can result in flooding of substations, as well as difficulties to travel for personnel, inducing a higher response time.

6.6.4.2 Security of supply impacts

There could be unexpected loss of load in the areas where the flooding is high enough to damage generation and/or transmission and/or distribution infrastructure. In case of single point generation, a blackout is also possible.

6.6.5 Evolution of the crisis scenario

6.6.5.1 Security of supply impacts

Flash flooding results in substations being de-energised. The effects are likely to be localised.

6.7. Crisis Scenario 7 – Winter Incident

6.7.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.7.2 Season(s) of the year when the scenario is relevant

The scenario is more relevant during the winter period. Demand is likely to be high due to low temperatures and/or strong winds prevailing.

6.7.3 Initiating Event and chain of events

Strong winds and/or intense lightning activity disrupt power supply and/or damage transmission lines.

6.7.4 Description of impacts on the national perimeter

6.7.4.1 Security of supply impacts

Faulted conductors and towers could cause loss of load, fragmentation of the network and possible islanding. If key substations are knocked out of service, a black-out is also possible. Fault repair times could be longer than normal due to the storm.

6.7.5 Evolution of the crisis scenario

6.7.5.1 Security of supply impacts

Strong winds and/or intense lightning activity could cause multiple circuit tripping, particularly where towers carry more than one circuit. This could lead to overloads on remaining circuits.

6.8. Crisis Scenario 8 – Fossil Fuel Shortage

6.8.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system. Relevant fossil fuel supply and storage systems remain operational. Fuel supply capacities are not constrained.

6.8.2 Season(s) of the year when the scenario is relevant

This scenario is relevant at all times. It does not depend neither on season nor on load.

6.8.3 Initiating Event and chain of events

The initiating event occurs due external events (eg. Political/economic) leading to a disruption in international oil markets and/or shipping routes.

6.8.4 Description of impacts on the national perimeter

6.8.4.1 Security of supply impacts

There could be forced supply curtailments (selected areas/entities/hours), an increased risk of load shedding or even curtailments that would result both from fossil power plant shutdowns and from curtailing renewable generation.

6.8.4.2 Operational impacts

There could be a limitation or total loss of availability of ancillary services as well as a risk of blackout.

6.8.4.3 Consequential/related impacts

Fuel shortages could be disruptive to many sectors of the economy.

6.8.5 Evolution of the crisis scenario

6.8.5.1 Operational impacts

Initially, electricity generation is dispatched to power plants not dependent on the fuel, then power generation from affected power plants is limited to save fuel. A prolonged supply limitation leads to the shutdown of power generation from some of the power plants affected.

6.8.5.2 Corruption of control

There could be limited availability of reserves, voltage stability support and inertia.

6.8.5.3 Security of supply impacts

There could be possible electricity shortages from affected power plants that were forced to limit generation. Prolonged shutdowns of fossil fuel power plants may require limiting the renewable generation.

6.9. Crisis Scenario 9 – Local technical failure

6.9.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system

6.9.2 Season(s) of the year when the scenario is relevant

The system may initially be stressed by failures, extreme weather, high or low load.

6.9.3 Initiating Event and chain of events

The initiating event may be a local technical failure of key transmission infrastructure and could lead to failure of critical elements (e.g. substation), due to e.g. fires inside a substation or an explosion inside a substation.

6.9.4 Description of impacts on the national perimeter

6.9.4.1 Operational impacts

There could be a limitation or total loss of availability of ancillary services as well as a risk of partial blackout.

6.9.4.2 Infrastructure impacts

The possible impacts on the infrastructure include loss of critical grid elements, possible cascading effects and system instability.

6.9.5 Evolution of the crisis scenario

6.9.5.1 Infrastructure impacts

The infrastructure impacts in this scenario include additional damages to other critical grid elements (e.g. transformers) and possible fire in buildings (battery rooms, rooms with control equipment, etc.).

6.10. Crisis Scenario 10 – Multiple failures caused by extreme weather (severe storm, ice loading)

6.10.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system

6.10.2 Season(s) of the year when the scenario is relevant

The system may initially be stressed by failures, extreme weather, high or low load. The scenario is more relevant during the winter period when storms are more likely and during the summer when heat waves are more likely.

6.10.3 Initiating Event and chain of events

The initiating event may involve multiple failures caused by the extreme weather situation. In particular, multiple network components of the same type, start failing unexpectedly due to a heat wave in a short period of time, or multiple transmission lines fail at the same time due to strong winds.

6.10.4 Description of impacts on the national perimeter

6.10.4.1 Operational impacts

There could be a limitation or total loss of availability of ancillary services as well as a risk of blackout.

6.10.4.2 Infrastructure impacts

The possible impacts on the infrastructure include loss of critical grid elements, possible cascading effects and system instability.

6.10.5 Evolution of the crisis scenario

6.10.5.1 Infrastructure impacts

Several additional network components or third-party installations that support the grid (such as generators) continue to fail.

6.11. Crisis Scenario 11 – Loss of ICT systems for real-time operation

6.11.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.11.2 Season(s) of the year when the scenario is relevant

This scenario is relevant at all times. It does not depend neither on season nor on load.

6.11.3 Initiating Event and chain of events

The initiating event occurs either from the unavailability of a substantial part of telecommunication infrastructure used for power system operation or from the unavailability of one or more ICT systems used in real-time planning and operation of the power system, due to technical failures.

6.11.4 Description of impacts on the national perimeter

6.11.4.1 Security of supply impacts

There could be a possible use of forced (but controlled) disconnection as a remedial measure or a possible emergency disconnection of some demand or supply. In a worst-case scenario, a cascading event may be triggered.

6.11.4.2 Consequential/related impacts

An emergency disconnection (especially a blackout) will result in potential other damages outside the electricity system.

6.11.5 Evolution of the crisis scenario

6.11.5.1 Operational impacts

Remedial measures may need to be invoked, due to unavailability of some of the ICT systems & services.

6.11.5.2 Corruption of control

Control of the electricity system is lost or limited and may go unnoticed for some time (in particular, erroneous forecasts or measurements may be noticed after many hours). TSOC and power producers/large consumers affected have to switch to backup solutions that may not provide all the normal functionality (or may be affected by the same failures). During the time needed to regain control, the system is susceptible to any additional disruption and switching to backup solutions could increase reaction times and is prone to human error.

6.12. Crisis Scenario 12 – Simultaneous multiple failures

6.12.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system

6.12.2 Season(s) of the year when the scenario is relevant

This scenario can materialise at all times; however, it is more likely during bad weather e.g. strong winds and/or lightning activity.

6.12.3 Initiating Event and chain of events

The scenario is initiated by multiple grid elements failing at the same time (or very close together) independently of one another, resulting in N-1 security violation.

Examples of this include faults on:

- multiple generators tripping in close succession
- failures at substations or transmission lines,
- N-1 violations not being detected due to inaccurate or incomplete modelling,
- N-1 violations not being detected due to metering or monitoring failure,
- a security standard violation due to operational error or control reaction not being fast enough.

6.12.4 Description of impacts on the national perimeter

6.12.4.1 Security of supply impacts

There could be a shortage of electricity as well as frequency response being held on the system and therefore the resulting frequency deviation will trigger low frequency demand disconnection.

6.12.4.2 Operational impacts

There could be a limitation of availability of ancillary services as well as a risk of blackout.

Operational parameters (e.g. voltage, active power) go beyond operational security limits, and in extreme cases it can lead to a blackout.

6.12.4.3 Infrastructure impacts

Possible impacts on infrastructure include the loss of critical grid elements and possible cascading effects, leading to an unstable system.

6.12.5 Evolution of the crisis scenario

6.12.5.1 Operational impacts

The activated protection components could cause a cascade of disconnections. Multiple failures of grid elements could cause islanding of part of the system, which could lead to partial or total blackout.

6.12.5.2 Corruption of control

The limited availability of conventional power generation will reduce available system inertia and reserves. The voltage stability could be unsupported by the affected power plants. There could also be an imbalance between demand and supply.

6.13. Crisis Scenario 13 – Power system control mechanism complexity

6.13.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.13.2 Season(s) of the year when the scenario is relevant

This scenario is relevant at all times. It does not depend neither on season nor on load.

6.13.3 Initiating Event and chain of events

The scenario may be initiated by technical failures on IT systems, communication systems or grid protection components due to a signal to other grid/generation/control components, resulting in a cascade failure. This would be a result of high interdependencies in very complex systems.

6.13.4 Description of impacts on the national perimeter

6.13.4.1 Security of supply impacts

The supply could be limited due to cascading event, with even a blackout being a possibility.

6.13.4.2 Infrastructure impacts

Possible impacts on infrastructure include the loss of critical grid elements, possible cascading effects and an unstable system.

6.13.5 Evolution of the crisis scenario

6.13.5.1 Operational impacts

The scenario could create a cascading failure, potentially leading to a blackout.

6.14. Crisis Scenario 14 – Human error

6.14.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.14.2 Season(s) of the year when the scenario is relevant

This is more likely to occur either during maintenance, which normally takes place during spring and autumn when the load is low, or during reactions to faults in the system particularly at times of high load when the system is more stressed.

6.14.3 Initiating Event and chain of events

The initiating event may be a mistake of the operator or service staff, leading to a cascading event due to human error.

6.14.4 Description of impacts on the national perimeter

6.14.4.1 Operational impacts

The operational parameters (e.g. voltage, active power) could go beyond operational security limits. In extreme cases, it could lead to islanding parts of the system and/or a blackout.

6.14.4.2 Infrastructure impacts

System equipment could be damaged as a result of the error.

6.14.5 Evolution of the crisis scenario

6.14.5.1 Infrastructure impacts

N-1 violations or real-time constraints can occur on the grid as well as lead to cascading effects of other critical grid elements.

6.15. Crisis Scenario 15 – Serial equipment failure

6.15.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.15.2 Season(s) of the year when the scenario is relevant

This scenario is relevant at all times. It does not depend neither on season nor on load.

6.15.3 Initiating Event and chain of events

This scenario is initiated by some elements of the transmission or distribution network exhibiting abnormal behaviour that increase their risk of failure or lead directly to failure. An analysis finds that the root cause is a systematic failure in manufacturing, installation or maintenance. All elements of the same type or series are assumed to be susceptible to the same failure. All suspected elements are assumed unsafe, but can't all be immediately replaced or repaired.

6.15.4 Description of impacts on the national perimeter

6.15.4.1 Security of supply impacts

Multiple faults, especially occurring in a short period, may lead directly to power supply interruption, as well as cascading events and in extreme cases, to blackouts. If power plants employ the same types of potentially faulty elements, there is a risk that they will need to be shut down as a preventive measure. If the faulty equipment is directly involved in supplying electricity to end-users, the supply may be affected immediately – either due to failures, or due to limitations imposed on operating conditions.

6.15.4.2 Operational impacts

The electrical grid (and to some extent, other parts of the power system) may have to be operated on, despite the identified risk of failure for many months or even years - until most or all of the potentially faulty elements are replaced or repaired.

6.15.4.3 Infrastructure impacts

There is high risk of damage to the power system infrastructure. A large investment may be required on the power system infrastructure to replace or repair faulty equipment. Emergency replacements or repairs may require other power system investments to be delayed or halted.

6.15.5 Evolution of the crisis scenario

6.15.5.1 Operational impacts

The affected operators (e.g. TSO/DSO/Power station operators) analyse all instances of the same or similar elements for such faults but depending on the actual scope of application of the affected element (electrical grid, power generation, electricity distribution, end-user installation), the full risk assessment may require weeks or even months.

Furthermore, sections of the electric power system are considered unsafe to operate at full capacity.

6.15.5.3 Corruption of control

It is not known if the faulty equipment may operate safely and it is not known what (if any) operating conditions are safe. Depending on the role of the faulty equipment in controlling the electricity system, some control may be lost, or risk of loss of control is increased. There may be a possible need for maintenance services.

6.16. Crisis Scenario 16 – Strike, riots, industrial action

6.16.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.16.2 Season(s) of the year when the scenario is relevant

This scenario is relevant at all times. It does not depend neither on season nor on load.

6.16.3 Initiating Event and chain of events

The initiating event may involve disputes of some kind that lead to industrial action at scale. It also may include riots, blockades or other massive social unrest (regardless of motivation or inspiration). As a direct consequence, staff in the energy sector (power plants, transmission and distribution) refuse to work, work to rule or are prevented from work.

6.16.4 Description of impacts on the national perimeter

6.16.4.1 Security of supply impacts

If power plants are impacted by staff or fuel shortages, the risk of generation inadequacy increases. Possible emergency shutdowns or blackouts will lead to a limitation on the power supply.

6.16.4.2 Operational impacts

Human errors are more likely in this scenario, as employees are working long hours and doing their best to cover multiple roles, with a high level of pressure. Social disturbance on a large scale will lead to unusual energy demand patterns, thus making power system behaviour less predictable. Planned and emergency repairs in the energy sector may be prolonged for a considerable time, possibly towards the period of a year, when energy demand is increased. A combination of difficult conditions may lead to human errors. Faults on the power system may also cause local (or larger) blackouts, and technical problems as well as potential blackouts will take longer than normal to rectify due to staff shortages.

6.16.5 Evolution of the crisis scenario

6.16.5.1 Operational impacts

There could be a staff shortage in the control centres of power plants or the TSO. There may also be a possible shortage of fuel needed in some power plants.

6.16.5.2 Corruption of control

There could be less experienced staff in the control centres, with an increased risk of human error.

6.16.5.3 Security of supply impacts

There may be possible limitations on power generation, due to security concerns or fuel supply issues.

6.17. Crisis Scenario 17 – Industrial/nuclear accident

6.17.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.17.2 Season(s) of the year when the scenario is relevant

This scenario is relevant at all times. It does not depend neither on season nor on load.

6.17.3 Initiating Event and chain of events

This scenario is initiated when a serious industrial accident occurs (e.g. an explosion, toxic substance release, etc.) due to any reason (technical failure, earthquake, sabotage, terrorist attack, human error, etc.).

6.17.4 Description of impacts on the national perimeter

6.17.4.1 Security of supply impacts

In case of an accident, if power plants are shut down, electricity supply may be reduced for a prolonged time. In a worst-case scenario, a partial or total blackout is possible, with the possibility of long-lasting lack of adequacy, as important parts of the system are damaged and out of service.

6.17.4.2 Operational impacts

Because of limitation in electricity generation and unusual consumption patterns, it is difficult to balance the power system. Staff shortage and potential unavailability of control centres will make managing the system riskier and more difficult. Both planned repair work and emergency repairs may be delayed. Increased human error risk may lead to further technical failures and blackouts.

6.17.4.3 Infrastructure impacts

Some of the power system infrastructure may be damaged beyond use for weeks, months or even years.

6.17.5 Evolution of the crisis scenario

6.17.5.1 Operational impacts

Critical transmission system equipment and/or power stations are severely damaged, rendering them unavailable to the system.

6.17.5.2 Corruption of control

In this scenario, not all control is available. Some control centre staff (from any part of the electricity supply chain) may be affected directly and could be unable to work for a prolonged time.

6.18. Crisis Scenario 18 – Unusually big RES forecast errors

6.18.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.18.2 Season(s) of the year when the scenario is relevant

The crisis may be more severe under low load conditions. Furthermore, this kind of scenario is more likely to occur during very windy days or during days with alternating periods of sunshine and clouds/rain. These types of days are expected during winter.

6.18.3 Initiating Event and chain of events

This scenario may be initiated by remarkably different levels of electricity generation of renewables generation units (wind or solar) due to unusually big forecasting errors, errors in forecast data or fast and unforeseen weather changes.

6.18.4 Description of impacts on the national perimeter

6.18.4.1 Security of supply impacts

A big shortfall in renewable generation could lead to temporarily insufficient power generation on the system and forced demand curtailment.

6.18.4.2 Operational impacts

There could be a limitation of ancillary services: The needed amount of downregulation may not be available which may lead to RES curtailment, or the necessary additional generation may not be available.

6.18.5 Evolution of the crisis scenario

6.18.5.1 Operational impacts

Differences in the planned and actual electricity generation could exceed the dimensioning fault. The actual generation could be significantly higher than expected and lead to the unexpected need of downregulation, or significantly lower than expected and lead to the unexpected need of additional conventional generation. In a worst-case scenario, TSOs will exhaust all available remedial actions.

6.19. Crisis Scenario 19 – Pandemic

6.19.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.19.2 Season(s) of the year when the scenario is relevant

This scenario is relevant at all times. It does not depend neither on season nor on load.

6.19.3 Initiating Event and chain of events

The scenario would be initiated by the international spread of a disease. TSO operating staff could be infected. Infections could happen at Control Centres, power stations, power plants and the DSO, which could lead to insufficient staff. Furthermore, containment measures of governments might follow restrictions for operation directly (by directives) or indirectly (e.g. by other affected critical infrastructures).

6.19.4 Description of impacts on the national perimeter

6.19.4.1 Security of supply impacts

There could be emergency load shedding/power outages.

6.19.4.2 Operational impacts

Depending on the spread of the pandemic, the impacts on the power system may vary, but could include limitations in the availability of generation units. It could also lead to an increased risk of human errors. Furthermore, reduced personnel availability may result in increased response times to failures.

6.19.4.3 Infrastructure impacts

There could be a possible decrease of the quality of the maintenance due to understaffing (rescheduling or prolongation of maintenance) as well as supply chain limitations for equipment and limited availability of contractor resources due to a pandemic. There may also be a delay on scheduled maintenance and/or new projects (new grid elements could be ready later) and an increased risk of human error (planning, operations, maintenance, etc.).

6.19.5 Evolution of the crisis scenario

6.19.5.1 Operational impacts

The stressed or curtailed operational staff for field work results in failure to carry out repairs in the field. Collateral governmental containment measurements could further impede field work.

6.19.5.2 Corruption of control

Stressed or curtailed personnel resources of control centres and their processing facilities may jeopardize the performance of system control. Additionally, staff may still choose to be absent once precautions are established due to their circumstances, either personally or in their families.

6.19.5.3 Security of supply impacts

The scenario could create stressed or curtailed operational staff or personnel of service providers, which causes an unscheduled downtime of power plants. Collateral governmental containment measurements could impede maintenance or revision services, followed by unscheduled downtime of power plants.

6.20. Crisis Scenario 20 – Heatwave

6.20.1 Description of initial condition of the system prior to the initiating event

This scenario is initiated due to a prolonged heat wave, ie. extremely high temperatures for several days or even weeks.

In general, this scenario assumes stable power system conditions with the following conditions:

- Increased demand for air conditioning due to the heat wave,
- Extremely low generation from wind turbines (heat waves mean little to no wind),
- Some key generators are in emergency scheduled or emergency unscheduled maintenance.

6.20.2 Season(s) of the year when the scenario is relevant

This scenario is relevant during the summer. During this scenario, there is very high (possibly even record breaking) electricity demand, mainly due to air conditioning.

6.20.3 Initiating Event and chain of events

The heat wave could lead to extremely high electricity demand due to air conditioning load and thus very tight operational security margins, particularly if major generators are unavailable. Furthermore, the weather conditions might trigger equipment failures, particularly on the distribution system.

6.20.4 Description of impacts on the national perimeter

6.20.4.1 Security of supply impacts

Extremely high demand could create adequacy issues. There may be load reduction and/or load shedding and generation reserves could be exhausted or very limited.

6.20.4.2 Operational impacts

Equipment faults due to heat can lead to outages.

6.20.4.3 Structural or systemic degradation

There may be some unplanned outages due to equipment failure, as well as faster material deterioration.

6.20.5 Evolution of the crisis scenario

6.20.5.1 Security of supply impacts

There may be prolonged periods of high temperatures during peak load period, peak demand could begin to exceed the maximum generation and operational and intervention reserves are being called and are rapidly diminishing. The load reduction or shedding are the final measures.

6.20.5.2 Structural or systemic degradation

The scenario may pose a risk of delays in repairs of faulty equipment due to the working conditions for personnel.

6.21. Crisis Scenario 21 – Earthquake

6.21.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.21.2 Season(s) of the year when the scenario is relevant

This scenario is relevant at all times. It does not depend neither on season nor on load.

6.21.3 Initiating Event and chain of events

The scenario would be initiated by a significant magnitude earthquake occurring. The earthquake could damage transmission infrastructure and power plants.

6.21.4 Description of impacts on the national perimeter

6.21.4.1 Security of supply impacts

There could be a massive reduction of transmission and generation capacity, and the inability to balance the system. There may be unavailability of transmission elements and power plants and possible load shedding to keep system security functioning during peak hours or all the time. Damage to key power stations and/or substations could lead to a black out, persistent adequacy issues, an inability to serve certain areas and/or persistent split of the system into islands.

6.21.4.2 Structural or systemic degradation

The scenario may cause damage on building structures, displacement of equipment cabinets and batteries as well as GIS components, porcelain damage of apparatus and the displacement of unsecured transformers. Damage to road infrastructure could impact repair times due to access restrictions. It may also cause a fault or failure of grid elements such as transformers and civil structures.

6.21.5 Evolution of the crisis scenario

6.21.5.1 Corruption of control

If operational control centres are affected, severe damages could disrupt system control.

6.21.5.2 Security of supply impacts

Power plants could be out of operation, leading to possible forced demand disconnection.

6.21.5.3 Structural or systemic degradation

If major substations are affected, severe earthquakes could massively degrade the TSO and its normal operational performance.

6.22. Crisis Scenario 22 – Forest fire

6.22.1 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.22.2 Season(s) of the year when the scenario is relevant

This scenario is more relevant during the summer months, when temperatures are higher, and precipitation is almost non-existent. It is more likely to be severe during windy days. Load is likely to be high, due to the hot weather.

6.22.3 Initiating Event and chain of events

Forest fires could start and spread because of the wind combined with a dry and hot period. The fires cannot be controlled for days. Uncontrolled wildfires may initiate unavailability or inoperability of some transmission and distribution infrastructure, with the 66kV transmission line through the Troodos Mountain being particularly at risk. This may trigger structural degradation or violation of N-1.

6.22.4 Description of impacts on the national perimeter

6.22.4.1 Security of supply impacts

There may be load reduction and/or load shedding and a high level of wind generation. Unavailability of transmission capacity could lead to partial blackout, with villages on the Troodos Mountain being at most risk.

6.22.4.2 Operational impacts

There may be non-fulfilment of the N-1 criterion.

6.22.4.3 Structural or systemic degradation

There could be the postponement of the maintenance or repair of affected power lines due to difficult working conditions for personnel (up to the limitation in transfer capacity), as well as asset degradation and direct damage to overhead lines.

6.22.5 Evolution of the crisis scenario

6.22.5.1 Operational impacts

Windy conditions could help the fire spread faster. The fire may spread towards residential areas. High and low voltage power lines and substations are tripped off because of burning trees falling on the electrical grid infrastructure. Other power lines might be disconnected due to the firefighters’ work to control the fires.

6.22.5.2 Infrastructure impacts

Some power line towers and substations are damaged in the process.

6.23. Dunkelflaute (extremely low wind/solar generation)

6.23.1 Description of the scenario

Total available energy resources are insufficient to meet demand, due to lack of renewable generation (particularly, the lack of solar PV at winter evening peak associated with periods of very low wind).

6.23.2 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.23.3 Season(s) of the year when the scenario is relevant

This scenario is more relevant primarily during Winter months, but also other seasons (Autumn, Spring).

6.23.4 Initiating Event and chain of events

Over an extended period, there are minimal to no wind conditions, both day and night, limited solar energy during the day, and a critical shortage of operational conventional power plants, or restricted import capabilities (e.g. due to grid incidents), culminating in a convergence of these factors. As a result, the affected energy market areas do not have adequate electricity generation to match demand.

6.23.5 Evolution of the crisis scenario

The situation worsens over several days, particularly during periods of high demand. As evening demand peaks, the strain on available energy resources approaches capacity limits.

Any additional faults, whether technical, human errors, unsolved N-1 contingencies, or depleted redispatch options, can deplete all available reserves. The TSOC must implement additional measures to maintain grid balance.

6.22.5.1 Operational impacts

- Increasing number of N-1 violations in the transmission grid observed. Tripping off certain grid elements. Automatic disconnection of the overloaded element, risk of the cascading trips.
- Redispatch is necessary to change active power flow, but decreased number of generation units available for redispatch.
- Especially during situations with a high loaded a certain risk of voltage instability (reactive power demand) could occur. Therefore, there may be significant voltage drops (in the extreme, leading to voltage collapses) in the grids.

6.22.5.2 Structural or systemic degradation

- Reduced transmission or distribution capacities due to low level of redispatch possibilities.
- Energy price increases due to high load and insufficient available power generation and import.
- The given energy mix with conventional power plants and renewable injections could be unbalanced, unable to fulfil all demand in time of no sunlight and no wind (evening/nights in dark periods of the year).

6.22.5.3 Security of supply impacts

- Peak demand begins to exceed maximum of available generation + import capacity.
- Operational and intervention reserves are being called and rapidly (in a short time) diminishing up to unavailability.
- Available redispatch possibilities are getting lower due to the demand and market activities using all available power from power plants to supply energy to customers.

6.24. Space weather

6.24.1 Description of the scenario

A Coronal Mass Ejection (CME) from the sun causes geomagnetically induced currents (GICs) that circulate in the power grid through the grounded transformer neutrals, resulting in the tripping of circuit elements, degradation of or permanent damage to grid infrastructure (particularly transformers), and disturbances of the ionosphere (disrupting high-frequency and satellite communications, navigation, and air travel).

Though significant solar storms can occur at any time, historical data suggests that these are more likely in the peak of the 11-year solar cycle. The next solar peak is expected in 2025.

The threats presented by solar storms are greater at high latitudes than middle latitudes, although lower latitudes can also be impacted by extreme storms. Ground conductivity can influence the intensity of solar storms.

The frequency of extreme space weather events is difficult to estimate, but the data suggests that relatively strong events happen about every 50 years, and that extreme storms such as the Carrington event may occur between 150 to 500 years.

6.24.2 Description of initial condition of the system prior to the initiating event

This scenario may be initiated without any preconditions, in particular also in the normal state and operation of the electrical power system.

6.24.3 Season(s) of the year when the scenario is relevant

Summer, Autumn, Winter, Spring.

6.24.4 Initiating Event and chain of events

A series of strong CMEs occur on the sun. A "severe" geomagnetic storm watch may be issued 3 days ahead, with an indication that the CMEs could combine. This may be upgraded or downgraded as time progresses. 15-45 min before it hits earth this could be upgraded to an (extreme) incident with a planetary index in the upper 9's when it impacts earth.

This gives rise to:

- Disturbances of the earth's magnetic field, giving rise GICs. These low-frequency currents enter the power system through grounded-neutral of transformers and are significant enough to saturate some types of magnetic cores of substation transformers. This in turn results in:
  - Significant heating of the transformer core and windings, potentially resulting in longer-term degradation (increasing the risk of failure in the future) and possible destruction of the transformer.
  - Significant reactive power flows, giving risk to voltage problems and possible collapse.

  - Distorted currents, potentially impacting reactive power compensation and protection equipment that is sensitive to harmonic distortion.
- Satellite communications, high-frequency radio communications, and global navigation satellite system services are impacted.

6.24.5 Evolution of the crisis scenario

Given the advance warning TSOs may take operational measures to mitigate the potential impact.

6.24.5.1 Security of supply impacts

- Preparation for a blackout.
- Progressive restoration of the system, complicated by the damaged telecommunications and equipment.

6.24.5.2 Infrastructure impacts

- Interventions on equipment to protect them from the incoming solar storm.
- Induction on power lines and transformers causing voltage disturbance leading to isolation failures.
- Necessity to analyse the grid to identify faulty equipment.
- Intervention on protected equipment to put them on service again.

6.24.5.3 Corruption of control

- Due to the unavailability of telecommunication impacted by the solar storm.
- Stability problems.

6.25. High penetration of RES in the energy system

6.25.1 Description of the scenario

The growing share of RES (particularly solar PV and wind) in the electricity mix leads to challenges in balancing supply and demand, ensuring system stability, and maintaining secure operation. The variability and intermittency of RES can result in frequent imbalances, operational uncertainty, and increased reliance on flexible resources and grid services.

6.25.2 Description of initial condition of the system prior to the initiating event

The power system is operating under normal conditions with a high contribution from RES to the overall energy mix. The system may appear stable but operates closer to technical limits due to variability and limited inertia.

6.25.3 Season(s) of the year when the scenario is relevant

This scenario can occur year-round but is particularly relevant during Spring and Summer, when solar generation peaks, and electricity demand patterns fluctuate. It also affects low-load periods during weekends or public holidays.

6.25.4 Initiating Event and chain of events

A period of prolonged high renewable generation leads to excess electricity production, surpassing local demand and creating export bottlenecks due to limited interconnection capacity. Curtailment of RES becomes necessary. Simultaneously, the system lacks sufficient dispatchable and flexible generation to manage ramp-downs when solar and wind output sharply drop. Rapid changes in net load require fast-response balancing, which may not be sufficiently available, leading to instability.

6.25.5 Evolution of the crisis scenario

System stress increases as conventional power plants operate below technical minimums or are offline, reducing inertia and frequency stability. RES variability and forecast errors exacerbate the difficulty of maintaining grid balance. Inadequate flexibility, insufficient storage, or lack of demand response options result in frequency deviations, grid congestion, and difficulty covering peak demand when RES drops.

6.25.5.1 Operational impacts

- Frequent redispatching due to congestion or oversupply in certain areas.
- Risk of frequency instability due to low system inertia.
- More frequent activation of curtailment procedures for RES.

6.25.5.2 Structural or systemic degradation

- Possible ‘breakdown’ of conventional plants due to frequent start-up and shut-down operations.
- Inefficient use of grid infrastructure or RES assets due to curtailment.
- Limited market signals to incentivize flexible demand or storage investments.

6.24.5.3 Security of supply impacts

- Risk of not meeting demand during sudden RES drop.
- Reduced availability of fast-reacting backup capacity.
- Strain on operational reserves.

7. Consultation Results

To be finalised after the comments.

8. Next Steps

CERA in the coming months will use the final electricity crisis scenarios in order to develop the Risk Preparedness Plan as required under Article 10 of the Regulation. CERA's Risk Preparedness Plan, is scheduled for publication in January 2022.

9. ΣΥΝΤΟΜΟΓΡΑΦΙΕΣ

CERA	Cyprus Energy Regulatory Authority
DSO	Distribution System Operator
EAC	Electricity Authority of Cyprus
EMS	Energy Management System
ENTSO-E	European Network of Transmission System Operators for Electricity
GIS	Gas-Insulated Switchgear
ICT	Information and Communications Technology
IT	Information Technology
RES	Renewable Energy Sources
RPR	Risk Preparedness Regulation (EU) 2019/941
SCADA	Supervisory Control and Data Acquisition
TSO	Transmission System Operator
TSOC	Transmission System Operator - Cyprus