Energistyrelsen

Risk-Preparedness Plan for the Danish Electricity Sector (Public)

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NOTE: Some parts of this document has been redacted to protect the confidentiality of sensitive information in accordance with art. 10(7) and 19(1) of the REGULATION (EU), 2019/941 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 June 2019 on risk-preparedness in the electricity sector and repealing directive 2005/89/EC.

General information

The Risk-Preparedness plan is an element in complying with the EU regulation concerning security of the electricity supply ("the Regulation").[1] The Risk-Preparedness plan has been prepared by the Danish Energy Agency hereinafter "the competent authority", and is based on information provided by the Danish Electricity TSO Energinet.

In Article 10(1) of the Regulation, it is stated that the national competent authority shall establish *"a risk-preparedness plan, after consulting distribution system operators considered relevant by the competent authority".*

The Emergency plan must according to the Regulation, be updated every four years, unless the circumstances warrants more frequent updates.

The member states in the region:

Continental Europe: Austria, Albania, Belgium, Bosnia-Herzegovina, Bulgaria, Czech Republic, Croatia, Denmark (West),,France, Republic of North Macedonia, Germany, Greece, Hungary, Italy, Luxemburg, Montenegro, Nederland, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Switzerland and Turkey (observer member).

Nordic: Denmark (East), Finland, Norway and Sweden.

The most relevant states for the security of the Danish supply of electricity are Norway, Sweden, Germany, and the Netherlands due to the capacity of electricity Denmark is able to import from and export to those countries.

This Risk-preparedness plan lays down the measures necessary to ensure the security of electricity supply in the Danish market, and the measures taken by the Danish Energy Agency and the TSO Energinet to heighten the national and regional resilience in the electricity grid.

[1] REGULATION (EU), 2019/941 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 June 2019 on risk-preparedness in the electricity sector and repealing directive 2005/89/EC.

1. Summary of the Electricity Crisis Scenarios

The executive order 819 "*Executive order on emergency preparedness for the electricity sector*", and the executive order 820 "*Executive Order on IT preparedness for the electricity and natural gas sectors*" states that every company in the electricity sector shall submit a ROS (Risk and vulnerability assessment), to the Danish Energy Agency.

The companies must answer 2 risk and vulnerabilities assessments one with only IT/OT questions and one based on none IT/OT vulnerabilities.

Energinet afterwards submits a full scale ROS for the entire electricity sector including their own risk and vulnerabilities to the Danish Energy Agency. This analysis includes analyses of fuel shortages. The provisions for performing ROS have been in place since 2005 with increasing focus on cyber security, and in 2017 specific provisions for ROS with focus on IT/OT were obliged. The IT/OT ROS are done every year while the none IT/OT ROS are done every third year.

1.1 Risk and vulnerabilities 2020

The electricity crisis scenarios identified at regional and national level in accordance with the procedure laid down in Articles 6 and 7, including the description of the assumptions applied.

Identified regional electricity crisis scenarios

The ENTSO for Electricity have identified 31 regional crisis scenarios in 2020, which can be classified in the following categories: [– Redacted – Confidential –]

Risk and vulnerabilities 2020.

In this section, a brief summary of the most critical areas discovered by the risk and vulnerabilities assessment will be described. The scenarios described below have been chosen based on the criticality for the Danish electricity grid.

1: The scenarios has been chosen based on all the electricity companies risk and vulnerabilities.
2: The scenarios has been chosen based on the TSO Energinet and the Danish Energy Agency experience in contingency work.
3: The scenarios has been chosen based on the ENTSO risk and vulnerability report.
4: The scenarios has been chosen based on the impact considering the indicators LOLE (Loss of load expectation) and EENS (Expected energy not served),

[– Redacted – Confidential –]

Cyberattack entities connected to the electrical grid and IT/OT systems in general.

[– Redacted – Confidential –]

This is a large scenario, in the risk and vulnerabilities assessments made by the Danish Energy Agency; this question are divided into many more detailed questions to make sure the vulnerabilities are detailed when submitted to the Danish Energy Agency. [– Redacted – Confidential –]

[– Redacted – Confidential –], the Danish risk and vulnerabilities assessment, has the similar outcome, but with more details. As an example the SCADA question in the Danish risk assessment, has eight questions to take into account when answering;
The consequence if the SCADA system disconnects from the internet, if they are not accessible, damages to technical property, etc.

[– Redacted – Confidential –]

In the tables below the most critical scenarios for entities connected to electrical grid is listed.

[– Redacted – Confidential –]

Extreme weather – (winter, storms and solar storms)

The Danish Climate and geography sets a limit for how critical the weather can get. However, in rare cases winter, storms, and heavy rain can become an issue. Due to Denmark's location earthquakes, volcanic eruptions, forest fires and heatwaves are not relevant.

The TSO Energinet, is in direct contact with the Danish metrological institute and in case of severe weather, the national operative staff (NOST), will be gathered to hold a meeting about eventual effects of the weather.

Winter:

The Danish electrical grid has been designed to withstand severe winters due to Denmark's location. Some hazards will be impossible to mitigate entirely, ice loading will always be a risk in the electrical grid. The best way to mitigate most winter scenarios is to monitor the systems closely to make sure; there is not a situation with ice loading, heavy snowfall, etc. In which could have been prevented with early action.

Scenario:	Extreme winter
Description and mitigation:	The consequence of this scenario is very limited due to a lot of mitigation and because the Danish electricity grid is designed to withstand extreme winters. The Danish electricity plants and wirings paths are dimensioned to withstand extreme winter scenarios and there should be no more technical errors than usual in normal weather conditions. The response time to assets could be affected by the weather. (Energinet, TSO)

Storms:

Storms are quite common in the autumn and in some cases create floods in some areas of Denmark with big inlets. The Danish metrological institute monitors these areas and if the forecast predicts high waters, the Danish Emergency Management Agency will get involved to set up mobile flood barriers.

There will always be hazards needed to be monitored when a storm hits, power lines cut down due to falling trees, etc. Most of these situations will be handled by the local power utility company, due to placement of big power lines these will mostly be out of reach from falling trees. Since 2005 large parts of the Danish distribution grid has been cabled thus reducing the impact of storms on the system.

Scenario:	Country wide hurricane

Description and mitigation:	The scenario are moving towards a lower consequence because the Danish distribution grid has largely been cabled underground. Today there are still a lot of assets that won't be cabled underground due to the technical aspect. Such as transformer stations and high voltage power lines that crosses the country. To mitigate the risk a review of the assets is often committed to make sure that there are no trees within range of the assets.

Insider attack and unsafe employees.

[– Redacted – Confidential –]

Physical attack & Critical fires.

In the assessment, it focuses on critical equipment failures that have the potential to make an impact in the security of supply.

The assessment holds many different perspectives; the Danish Energy Agency points of many different things to take into account when the companies needs to assess their current vulnerabilities.

Questions in the assessment; "Is there sufficient and effective fire precautions in place, such as fire extinguishers, Emergency control rooms, special measures taken for server rooms, plans for fires in transformer stations, perimeter security at control rooms/transformer stations, etc.

Physical malicious attacks on employees and physical components in the electricity grid are taken into the account in the risk and vulnerability assessment. Due to the categorization of the importance of stations, the companies shall implement perimeter security, such as fences, and movement detectors to prevent or give early warnings to physical attacks.

[– Redacted – Confidential –]

Future of risk assessments

In the future, the risk assessment will have to take into account that most of the energy will be produced by green energy alternatives such as windmills, solar panels, etc. Therefor many new companies is currently being opened and are

constructing windparks and solarparks, these companies are currently being taken into account and needs to submit a risk and vulnerability report.

Therefore the risk and vulnerabilities will probably get new scenarios in the future and new knowledge will have to be obtained to secure the high level of supply security in the electricity grid.

2. Roles and Responsibilities of the Competent Authority

The Competent Authority

The Danish Energy Agency

In accordance with Danish Risk Preparedness Act the Minister for Climate, Energy and Supply has the responsibility to plan for a crisis within his or her own sector. This responsibility has been delegated to the Danish Energy Agency, who thusly is the authority responsible for planning of the risk preparedness for the electricity sector, the gas sector and the oil sector.

In accordance with above national legislation the Danish Energy Agency has been appointed as the competent authority after Regulation (EU) 2019/941 of the European Parliament and of the Council of 5 June 2019 on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC.

The competent authority is responsible for declaring the relevant crisis level in case of a Union or Regional crisis situation.

According to the Regulation “When the competent authority declares one of the crisis levels referred to in paragraph 1, it shall immediately inform the Commission as well as the competent authorities of the Member States with which the Member State of that competent authority is directly connected and provide them with all the necessary information, in particular with information on the action it intends to take.

In the event of an emergency which may result in a call for assistance from the Union and its Member States, the competent authority of the Member State concerned shall without delay notify the Commission's Emergency Response Coordination Centre (ERCC).”

The Danish Energy Agency notifies the authorities in Sweden, Norway, The Netherlands and Germany. Likewise Energinet notifies the Swedish, Norwegian, Dutch and German TSOs about the situation.

In a situation with a determined Emergency level, the Danish Energy Agency and Energinet stay in close contact.

In case of large national or international crises, the Danish National Police can activate the National Operational Staff (NOST), if there is a need to coordinate the risk preparedness response across several sectors on a national level. The Danish Energy Agency participates in the NOST, and can call on Energinet to participate and the Danish Energy Agency can also activate the NOST in case of an electricity crisis.

Delegated Tasks

Energinet TSO

Energinet is a state owned organization and the transmission system operator on electricity and gas. The TSO is in a close cooperation with the Danish Energy Agency and once a year audited by the Danish Energy Agency to comply with the national legislation on risk preparedness.

Energinet is responsible for upholding the required level of security of supply in the Danish electricity system as described in the Electricity Supply Act § 27 a. The Minister for Climate, Energy and Supply determines the level of security of supply cf. § 27 in the Electricity Supply Act.

Energinet has thus also been delegated the overall responsibility for the risk preparedness in the electricity sector. The delegated tasks relate not only to the planning but also include many operational tasks in the handling of an electricity crisis scenario.

Energinet is responsible for declaring the relevant crisis level in the sector in case of a national crisis.

In a crisis scenario Energinet has the responsibility of coordinating the handling of the crisis and the re-establish the supply – incl. sending representatives to the local risk preparedness staffs and participating in the National Operational Staff together with the Danish Energy Agency if relevant. Additionally Energinet continuously informs the Danish Energy Agency and other relevant authorities about relevant circumstances, provides professional (technical) advice along with recommendations about overall decisions, which have to be made by the authorities.

In a national crisis, Energinet (TSO) decides on the crisis level in the electricity sector due to their everyday control of the transmission electricity grid. The TSO will immediately inform the Danish Energy Agency and the relevant companies in the electricity sector of the nature of the incident and effects on the supply situation.

Thereafter the Danish Energy Agency will as the competent authority have the power to upscale the crisis to a national crisis management level. The Danish

Energy Agency will have the authority to instruct the TSO and other involved parties to adjust their actions in order to secure a coordinated and prioritized handling of the crisis.

Distribution System Operators and Production companies

Distribution System Operators (DSO's) and Production companies with license after the Danish Act on Electricity Supply have responsibilities for risk preparedness in the electricity sector. These companies have to comply with the executive orders 819 and 820 of the 14th of august 2019 on risk preparedness and it-risk preparedness. All companies are audited according to their categorization based on their importance for the overall electricity grid by the Danish Energy Agency at least every three years. The DSO's and electricity producers have the responsibility for:

- Making risk-preparedness plans for their own companies, so that they can handle crisis scenarios for both ordinary- and it-risk preparedness scenarios.
- Handling crises.
- To limit the consequences of electricity crisis situations for the company
- To be compliant with the technical codes and regulations from Energinet.

In a crisis, the individual company must:

- Reestablish the supply as fast and effectively as possible and through coordination with the dispatch centres of relevant companies.
- Inform partners of the situations – E.g. Energinet, their it-security service or other companies in the sector.
- Notify the police, fire department and others when necessary.
- Receive information from other partners – E.g. Energinet, their it-security service or other companies in the sector.
- Inform consumers, the press and the public at large about the status of the crisis when deemed necessary (only DSO's and Energinet).
- Coordinate with Energinet and other adjacent companies if the situations calls for it.

As stated earlier the Danish Energy Agency audits all companies and has the authority to make an injunction if the certain company are not complying with the executive orders 819 and 820 on risk preparedness on the physical, IT, and OT.

3. Procedures and Measures in the Electricity Crisis

In case of crisis in the Danish electricity grid or supply, the Danish electricity TSO Energinet will be the authority to declare an Emergency and will immediately call the 24-hours hotline in the Danish Energy Agency to declare an emergency.

3.1 National procedures and measures

a) National procedures to followed in the case of an electricity crisis

The cooperation in the electricity sector takes place through direct contact between Energinet and the risk preparedness coordinators or it-risk preparedness responsible employees that the companies has appointed. [– Redacted – Confidential –]

Operative risk preparedness issues will be discussed regularly at operational meetings between Energinet, balance responsible companies and the DSO's, and the risk preparedness coordinators can contact each other for exchange of best practices.

Operational cooperation

During a crisis the cooperation in the electricity sector takes place through the "The Control Structure". "The Control Structure" can be found in Danish in the appendences as appendix 1. "The control structure" consists of dispatch centres and other 24-7 manned entities in Energinet, the DSOs and balance responsible companies.

Energinets Control Center for electricity will furthermore distribute warnings that they receive about electricity crises, to the balance responsible companies and grid dispatch centres which again will be distributed to the production facilities, consumer facilities and the DSO's within their own supply area through "The Control Structure".

This could happen if Energinet receives warnings from:

- The Danish Metrologic Institute about extreme weather conditions like hurricanes or ice storms etc.
- The Police Intelligence Service about increase in terrorism threat levels
- The Center for Cyber Security about IT-threats
- From Energinet or an electricity company's own it-security service.

If a company receives warnings, that does not come from Energinet, the company must inform Energinets Control Center for electricity. Energinets Control Center for Electricity will then assess if the received warning is relevant for the sector, and distribute it through the appropriate channel depending on whether it regards "classic risk preparedness" or it-risk preparedness..

Classic Risk Preparedness:
Energinet Control Center for electricity will immediately distribute the warning through “The Control Structure”.

IT-risk preparedness:
Energinet Control Center for electricity will without delay bring the warning to Energinets own it-security experts. The it-security experts will then evaluate whether the warning is relevant for the rest of the sector and thusly should be sent out through the ITCT-system. The it-security experts will decide whether Center for Cybersecurity (CFCS), The Danish Energy Agency or other authorities should be sent the warning.

Warnings that are received by Energinet from other companies it-security services will be treated the same as other warnings. If warnings from a company’s own it-security service is deemed relevant for other companies in the electricity sector, the company has a duty to relay the warning to Energinet.

Energinet will assist the companies in the electricity sector with contact information to other companies or relevant authorities in a crisis.

Energinet will assist the companies in the electricity sector with information about the operational status of the sectors supply critical it-systems for the use of handling it-risk preparedness situations.

Cooperation with authorities

Companies with production license or DSO license will maintain the cooperation with the local authorities, the police and fire department during a crisis.

Energinet maintains the cooperation with central authorities on behalf of the rest of the electricity sector during a crisis, such as:

- The police (in regards to local risk preparedness staffs)
- The Danish Energy Agency
- The National Police
- The National Operational Staff (through the Danish Energy Agency)
- The Police Intelligence Service
- Center for Cyber Security / The Military Intelligence Service

Handling of electricity crisis

Handling the operation during an electricity crisis

The operational cooperation in the sector is carried out through “The Control Structure” as described above, which ensures that:

- That the responsibilities of Energinets Control Center for Electricity and the responsibilities for coordination is well defined as stated in the technical operational guidelines.
- That no Control Center has the responsibility to have contact with more cooperating control centers than they can handle – not even in a highly pressured situation.
- Operational chains of commands between Control Center personale is establish in the control hierarchy and that it happens with relevant control rooms.

Energinets Control Center for Electricity cooperates directly with grid control centers (at the point of delivery from Energinet) Control Centers for production and consumer facilities (that are connected to the transmission grid), and the Control Centers of the balance responsible companies. The overall structure and division of responsibilities in "The Control Structure" can be found on Energinets homepage.

In the Control Centers the operational staff must contribute to the secure operations of the collective electricity system. The coordination between the Control Centers is essential and is carried out in "The Control Structure". The practical workflows in connection to the handling of operations is clearly stated in the technical operational guidelines for electricity.

Handling of the electricity market during a crisis

The continued functioning of the market presupposes that the market actors have information about the operational status, possibilities of exchanging plans, access to market platforms, as well as the possibility of collecting consumption data to bill the consumers.

Based on a collected assessment of the above mentioned circumstances and the variedness of the situation, Energinet will determine how the market should be handled during the crisis.

The practical workflows in relation to the handling of the market is stated in the market guidelines[2].

b) Preventive and preparatory measures

General preventive and preparatory measures

The Danish Energy Agency has the overall responsibility for the electricity sector in a crisis situation. The responsibility of other companies are described in the execute orders 819 "Executive order on emergency preparedness for the electricity sector" and 820 "Executive order on IT preparedness for the electricity and natural

[2] https://energinet.dk/El/Elmarkedet/Regler-for-elmarkedet/Markedsforskrifter#C1

gas sectors" of the 14/08/2019[3]. The legislations provides foundation for the Danish Energy Agency to categorize all electricity providers, in three different categories based on their importance for the electricity grid.

Based on the companies' categorization, the Danish Energy agency will audit each company to make sure they comply with the executive orders.

The execute orders states the level of security and preparedness needed to prevent and avoid crises in the energy sector.

The Danish Electricity Act has a number of legal obligations for both TSO and electricity producers that is constitutes preparatory and preventive measures. These are as follows:

- § 27 b. Transmissions facilities at the Energinets disposal and electricity production facilities with a capacity of more than 25 MW can not be taken out of operation for a prolonged period with out the approval from Energinet. For the purposes of maintaining the security of supply Energinet can demand operational stops be postponed or brought forward.
- § 27 b, stk. 2. For the purposes of maintaining security of supply production companies must upon the instructions of Energinet, report which facilities with a capacity of more than 25 MW the production company for period of up to 4 weeks expects to hold operational in the operational day for period.
- § 27 b, stk. 3. If Energinet assess that there is not sufficient security of electricity supply can be maintained with the facilities that are expected to be kept operational after stk. 2 and the European Commissions regulation on determination of guidelines for the operation of electricity transmission systems, Energinet can demand that additional electricity production facilities are kept operational, so that the facilities can produce electricity after a notification given by Energinet.
- § 27 c, stk. 2. Energinet must give fair financial compensation for services relating approved operational stops of transmissions- or production facilities that been demanded be postponed or brought forward after § 27 b, stk. 1, that electricity production facilities has been demanded to be kept operational after § 27 b, stk. 3, or to decisions regarding the change of plans or activation of mitigating actions after the European Commissions regulation on determination of guidelines for the operation of electricity transmission systems.
- § 27 c, stk. 3. If there is an imminent risk of grid collapse, or during a grid collapse or during grid reestablishment Energinet can with out payment demand the necessary changes of production, trade or consumption.

[3] https://www.retsinformation.dk/eli/lta/2019/819 , https://www.retsinformation.dk/eli/lta/2019/820

- § 27 c, stk. 4. All market participants are balance responsible in accordance with the European Parliament and Councils regulation on the internal market for electricity with the exception of 3. pkt. and rules set out in accordance to stk. 8. In case a user's actual production, consumption or trade in an operational day does correspond to what was been notified after the European Commissions regulation on determination of guidelines for the operation of electricity transmission systems, Energinet will collect payments for imbalance brought on the system in accordance with the European Parliament and Councils regulation on the internal market for electricity. Energinet will however pay the costs for imbalance as mentioned in pkt. 2, for electricity production a windmill included in §§ 39 and 41 in the act of promoting renewable energy, and from RE-production facilities included by § 43 f, stk. 1, § 43 g, stk. 1, § 44, stk. 2, and § 47 in the act of promoting renewable energy.
- § 27 c, stk. 5. Changes as mentioned in § 27 c, stk. 1, must take places on the grounds of objective criteria which are determined by Energinet on the basis of socioeconomic and environmental considerations. Energinet furthermore sets objective criteria for the calculation of payment for the reduction or stop of production after § 27 c, stk. 1.
- § 27 d, stk. 2. The minister for Climate-, Energy and Supply can determine rules on Energinets initiation of actions, if these acions are deemed necessary for maintaining a sufficient level of security of supply. The Minister can additionally determine rules that the actions must be initiated after tender or another transparent and non-discriminatory procedure.
- § 27 d, stk. 3. Energinets initiation of the actions after § 27 d, stk. 2, must be approved by the minister.
- § 28, stk. 2. Energinet must complete the following tasks.
    - 3) Cooperate with TSO's from other countries about the establishment of reciprocal, equal principles for the electricity supply, grid tariffs, grid access and transmission, market questions etc., interconnection of transmission, including, handling of balance and capacity problems as well as entering into necessary system operation agreements, which must secure that advantages that comes with interconnection are being used.
    - 9) Develop a plan for the future needs for transmission capacity in the collected electricity grid and transmissionslinks to other grids.
    - 10) Secure that the necessary rebuilds and new builds of transmissiongrids happens in accordance with the transmissiongridplan in nr. 9.
    - 16) Use transparent, non-discriminatory, market based methods when procuring the energy which Energinet uses to fulfill its duties.

Handling of security threats in the electricity sector

In accordance to the National risk preparedness plan[4] it is Energinet who determines the risk preparedness level for the electricity sector (and the gas sector). The determination is among other things based on intelligence from the Police Intelligence Service and the Military Intelligence Service that issues threat assessments and determines the National Threat Level. The Police forwards messages to relevant stakeholders.

The National Operational Staff will orientate ministries, agencies and local risk preparedness staffs. The local risk preparedness staffs informs the relevant authorities in their local region.

Energinet will receive information about risk- and vulnerability assessments and will on the basis of these information determine the risk preparedness level of the sector and which preventive or preparatory measures (risk preparedness measures) that must be initiated by the sector incl. which specific companies and facilities there must initiate the risk preparedness measures[5]. Energinet will thereafter relay this information and decisions to the companies of the sector. Companies with facilities in class 1 and 2 must be capable of quickly executing the risk preparedness measures through their own risk preparedness plans[6].

Procedure for announcing the sector risk preparedness level and risk preparedness measures

[– Redacted – Confidential –]

The risk preparedness levels

When treats are able to threaten the security of supply, Energinet TSO can chose to heighten the sector contingency level, and initiate preparatory measures to accommodate the risk.

All companies in the Danish electricity grid shall have the sector contingency levels incorporated in their contingency plans. All companies needs to make sure that they in a crisis quickly are able to initiate contingency measures, based on Energinet TSO sector contingency levels.

Warning of sector contingency level

It is Energinet TSO crisis management, who has the responsibility to determined and change the sector contingency levels. It is important to be

[4] Den nationale beredskabsplan, udgave 7.1 af 16. august 2019 [– Redacted – Confidential –].
[5] Executive order 819 § 25, stk. 2.
[6] Executive order 819 § 10.

observant of the timeframe in the five sector contingency levels, when the sector contingency levels are changed.

When Energinet TSO, crisis management team changes the sector contingency level, the companies in the electrical grid, will get the information from the control structure, a telegraph message will also be distributed.

Sector contingency levels:

Energinet TSO has the responsibility to determine the sector contingency level to accommodate eventual treats. All Sector contingency levels, has a color which describes the scope and severity of the situation. Energinet will be decide the sector contingency level based on an assessment of the situation. Energinet will chose specific measures to avoid or minimize the damage caused by the current situation.

The sector contingency levels are divided into five levels.

White – Daily operation

Green – Slightly raised operation

Yellow – Raised operation

Orange – Remarkable raised contingency operation

Red – fully established crisis management

WHITE – Daily operation

The daily operation none indications of security of supply treats. All companies and ministries are in normal operation and withholds the security of supply through scheduled tasks.

GREEN – slightly elevated operation

Green level, establishes when there are a potential security treat. Designated and relevant personal goes through contingency plans, and initiates renewed plans for eventual upcoming situations.

YELLOW – Raised operation

Yellow level, initiates when there has been identified a general treat. The management in all relevant authorities and key functions will be informed of the situation and the general procedures will be reviewed. A roster of key employees with 24/7 coverage, will be formed.

- This level will be able to maintain operations for months.

ORANGE – Remarkable raised contingency operation

Orange level is initiated when a general treat has been identified a security treat. The management and key personnel in relevant authorities will be summoned to initiate preparatory measures to avert or minimize the extent of the situation. Relevant task forces will be summoned and a decision on how the entire situation shall be handled will be made.

- This level will be able to maintain operations for weeks.

RED – Fully established contingency operations

Red initiates when a treat are identified in time and space. All measures to prevent or minimize the extent of the crisis are initiated. The crisis management is in full force.

- This level will be able to maintain opreations for a few days.

The risk preparedness measures

The risk preparedness measures can be found in Danish in appendix 2

c) Demand- and supply-side measures

In order to maintain the system balance in the Danish grid Energinet utilises system services.

The reserves are bought through agreements between Energinet and companies responsible for production balance and companies responsible for consumer balance companies. The agreements includes provisions about ensuring that capacity is available for a fixed period of time.

The following system services and reserves are utilised in Denmark in respectively the east and west power systems of Denmark.

Funktion	Terminologi		
	ENTSO-E	**Vestdanmark**	**Østdanmark**
Fast Frequency Reserve (Primær reserve)	Fast Frequency Reserve (FFR)	-	FFR
Frekvensstabilisering (Primær reserve)	Frequency Containment Reserve (FCR)	Primær reserve	Frekvensstyret normaldriftsreserve (FCR-N)
			Frekvensstyret driftsforstyrrelsesreserve (FCR-D)
Frekvensgenopretning (Sekundær reserve)	Frequency Restoration Reserve (aFRR)	Load Frequency Control (LFC)	
Balanceudligning (tertiær reserve)	Frequency Restoration Reserve (mFRR)	Manuel reserve	Manuel reserve
	Replacement Reserve (RR)	*(Benyttes ikke i DK)*	*(Benyttes ikke i DK)*

d) Framework for manual load shedding

The intent of this paragraph is to ensure unidirectional instructions for all companies involved in handling a critical effect failure (kritisk effektbrist). The paragraph describes how the individual companies generally are to handle this type of crisis.

The paragraph especially applies to all DSO's in Denmark with license after the Danish Electricity Act.

Critical effect failure is a crisis that affects all societal functions as consumers are disconnected through controlled manual load shedding in order to ensure a stabile electricity system.

This type of crisis sets itself apart from other types of crises, as it will often be anticipated within a reasonable time in advance- Thusly it is often possible to warn and inform the authorities and the public at large about the crisis and its consequences prior to the initiation of manual load shedding.

Manual load shedding will be carried out in compliance with Denmarks international obligations.

Definitions

This plan is made with the intent to handle a critical effect failure for a larger area, such as West Denmark (DK1), East Denmark (DK2) or both areas simultaneously.

If the situation alone is occurring in a smaller regional area of Denmark the instructions must still be followed though adapted to the situation as it is.

Effect failure can be defined in two ways; either when considering an assessment of the situation in the operating hour (driftstimen) or when considering the area affected.

Definitions of effect failure when considering the situation in the operating hour:

1. **Risk of effect failure** is present when prognosis shows that part of a system (DK1/DK2) no longer can uphold the need for manual active reserves that can be activated within 15 minutes of the planning period.
2. **Effect failure** happens in the operating hour when part of a system no longer can uphold the needed manual active reserves which can be activated within 15 minutes.
3. **Critical effect failure** happens in the operating hour when consumption must be reduces or shedded without the existence market agreements of this reduction/shedding of consumption.

Definitions of effect failure when considering the affected area:

1. **General effect failure** in part of a system (DK1/DK2 or both) without bottleneck in the transmission grid. Effect balance for part of the whole system is tight and there is no or low possibilities to get (more) help from neighbouring electricity systems.
2. **Regional effect failure** sustained by bottlenecks and operational disruptions in the transmission grid. The effect balance in a part of the national system is tight and there is no or low possibilities that the area can get (more) help from the rest of the national system or other neighbouring systems. The area affected can be a bigger or smaller number of DSO's.

Basic conditions

In an electricity system it is a basic premise that there always must be balance between production and the immediate consumption. Critical effect failure is the situation where all reserves has been spend (both production capacity and import

possibilities), and the consumption is still higher than the production incl. emergency reserves.

Critical effect failure must be handled while being compliant with the general principles of this National Risk Preparedness Plan and the following instructions in this paragraph.

In the situation Energinet will order manual load shedding of consumers. Initiation of systematic manual load shedding happens only to prevent the complete collapse of the electricity system.

Critical effect failure can be very short (from 15 min to a few hours) but can in rare situations be prolonged state of the electricity system. In situations where the critical effect failure continues for a longer time period it will be necessary to apply rolling load shedding in the affected area.

Initiation of manual load shedding

Initiation of systematic manual load shedding happens only to prevent a total collapse of the electricity system. Thusly manual load shedding of the indicated percentage given by Energinet in the operational order must be carried out within 15 minutes or at the time specified by Energinet in the operational order.

Before the order for manual load shedding is given by Energinet, there will often be given information about the cause for need for manual load shedding, the expected time the effect failure will last and the percentage of load that must be shed by each load shedding region.

In case of long lasting effect failure situations (multiple days) Energinet will discuss the need for establishment of local risk preparedness staffs with the National Police. The local risk preparedness staffs will to the extent possible be manned with representatives from grid control room (from the point of delivery from Energinet), who will undertake the coordination within the load shedding region and with Energinet.

Instructions for handling manual load shedding

Prioritisation

Generally, there shall not be prioritised between consumers when implementing manual load shedding. The DSO shall therefore not take any considerations to special categories of consumers or consumption area other than what follows for the planning of long term rolling load shedding:

- Energinet indicates which percentage of the load there must be shed pr. load shedding region.
- The DSO's carries out the load shedding in accordance with the defined load shedding steps.
- Areas with net production must not be load shed.
- The consumers must only be load shed 2 hours at the time.
- If the effect failure situation is expected to last more than 2 operational hours, the DSO must on their own initiative implement systematic rolling load shedding.
- Energinet will incrementally allow on-loading (tillastning) as the effect balance in the affected area is improved.

Cooperation in the load shedding region (national)

It is the individual DSO, who in cooperation with Grid controlroom (point of delivery from Energinet) develops plans for systematic manual load shedding.

The plans must ensure:

- Uniformity in regards to the consumers
- General coordination
- Meeting the goals within the load shedding region
- Locally anchored contact and information to the local risk preparedness staffs
- Uniform and structured feedback about the number of consumers that has been hit by the load shed, the load shedding effect etc. that can be given to Energinet during the load shedding.

e) Mechanisms to inform the public

In a national crisis, TSO Energinet will inform the Danish Energy Agency about the crisis. Thereafter the Danish Energy Agency will activate the national operative staff (NOST). In an emergency where information is required to the public, the NOST will activate the Central communication staff, which monitoring the information on social media, news, etc. and will be the staff who coordinate the press releases between relevant stakeholders.

In smaller crisis, on regional level in Denmark the TSO Energinet will coordinate with the production companies on informing the customers, press, and public.

Energinet can communicate the general situation to the press on the national television channels DR and TV2, due to the warning agreement and the execute order 164 on obligations to broadcast messages of importance in a crises.

Mechanisms for informing the public of load shedding

Energinet

Energinet plans and carries out the following tasks;

- Send information to the Danish Energy Agency and other authorities,
- Send other information according to this National Risk Preparedness Plan
- Until 3 hours before planned effectuation of manual load shedding will through editorial mention in electronic media to use less electricity in certain periods.

The DSO's

The DSO shall quickly inform the public about the effect failure crisis (possibly with reference to www.energinet.dk), and continuously update the information to the consumers in the areas that has been load shed and about additional load sheds in the area.

The DSO's plan and carries out the following tasks in informing the public;

- Possibilities for the consumers to take mitigating actions that can reduce the consequences of a power cut.
- Energy conserving actions there completely or partly can eliminate the need for manual load shedding.
- How the public should act until it is expected that their power be cut.

- When the consumers in each area can be expected to load shed or on-loaded in the next 24 hours. The Information must be given as precise as possible with the reservation for adjustments depending status of operation.

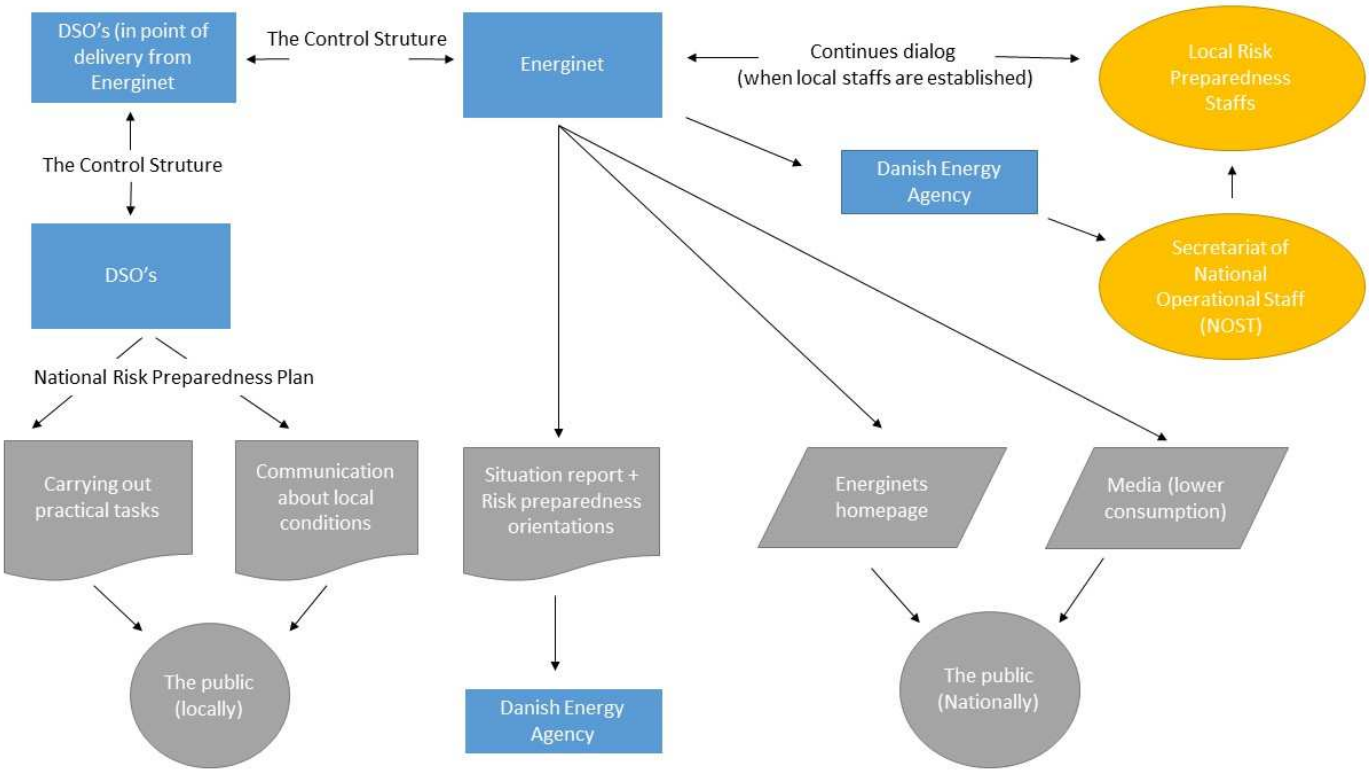

Figure 1: Ways of communication in a crisis situation due to critical effect failure

Mechanisms to inform the public in case of other crisis

All companies in the electricity sector must in their risk preparedness plans have procedures for informing the authorities, collaborators, it-security services, electricity consumers, the press and the public in general[7].

The guiding principal for division of responsibilities in regards to informing the stakeholders incl. the public, is that the information responsibility must be kept as close to the source of the operational disruption as possible, and that the information responsibility cannot be shared by several companies.

- The local DSO carries out the direct contact to the electricity consumer about concrete circumstances regarding the consumer.
- Contact to The Danish Energy Agency or other central authorities is carried out by Energinet.

[7] Executive order 819 § 7, stk. 3 and Executive order 820 § 14, stk. 2, pkt. 5.

- In case of supply disruptions that are caused by errors in the DSO's physical infrastructure or supply critical it-infrastructure, and that only affects the consumers within that DSO's distribution area, that DSO carries out the information responsibility. This incl. contact to local police, local press and the public.
- In case of supply disruptions that are caused by errors in the Energinets physical transmission infrastructure or supply critical it-infrastructure on the transmission level, Energinet carries out the information responsibility. This incl. contact to local police, local press and the public.
- In case of events that hits several companies at once like hurricanes, the individual company carries out the information responsibility to the local police and the local press.
- Energinet carries out the responsibility of informing the authorities and the public.

3.2 Regional and Bilateral Procedures and Measures

a) Agreed mechanisms for cooperation within the region

The TSO Energinet, have cooperation with the following TSO's:

Nordic:	**Continental:**
Statnett in Norway	TenneT TSO GmbH
Svenska Kraftnät in Sweden	50 Hz Transmission GmbH
	TenneT TSO B.V

In Denmark region are Zealand connected with the Nordic synchronized area and the continental European through region Jutland.

The Transmission system operator Energinet is a part of the Nordic system area and the continental European. Energinet and the neighbouring TSO's shall as quick as possible inform each other about security vulnerabilities or operational disruptions. The procedures and measures in a regional crisis are based on SOGL (System Operation Guideline).
In continuation of the SOGL operation guideline the Nordic countries has composed a joint system operation agreement (ref X), where the principles are further described.

In the continental system, the principles to strengthen the security of electricity supply are described in a set of rules named SAFA (Synchronous Area Framework Agreement).

Energinet develops and maintains the agreements though the regional group Nordic (RGN), and the regional group continental Europe (RGCE).

In interruptions of the electricity supply, it's the affectedest own responsibility to start corrective measures. In cases with cooperation between the affected TSO's, they'll cooperate to insure the minimal consequences of interruptions of supply.

In cases of power deficit, the TSOs will cooperate, so that the available resources are utilized in the best way possible to minimize the amount of customers needed to be disconnected from electricity.

Energinet and the neighbouring TSOs shall as quick as possible inform each other about security treats and interruptions in the electricity sector. The information requirements regarding neighbouring TSO, is describes in Energinets own contingency plans.

b) Regional and bilateral measures

The regional and bilateral measures are currently set out in the Nordic System Operation Agreement[8] and SAFA (Synchronous Area Framework Agreement)[9].

The Danish Energy Agency will along with its fellow authorities from Nordic and Continental Synchronous Area analyse whether further measures should be agreed and which financial agreements must be made to fulfil the obligations under the Electricity Risk Preparedness Regulation.

c) Mechanisms for cooperation and coordinating actions

Nordic Contingency Planning and Crisis Management Forum (NordBER)

Together the five Nordic countries' (Denmark, Finland, Iceland, Norway and Sweden) energy and power emergency authorities and the five TSO companies formed a forum in 2004 to prioritize and ensure a goal-oriented Nordic emergency preparedness cooperation regarding the power sector.

The cooperation concerns contingency planning and crisis management for the Nordic power sector and relevant issues in this regard between the Nordic energy and power emergency authorities and TSO companies.

The cooperation has two main goals:

[8] https://eepublicdownloads.entsoe.eu/clean-documents/Publications/SOC/Nordic/20190807_SOA%20Main%20Agreement%20(signed).pdf
[9] https://www.entsoe.eu/publications/system-operations-reports/

- Cooperation regarding regular exchange of information and experiences
- Contingency planning for the overall Nordic power sector as a supplement to the national emergency work.

The cooperation in NordBER takes place partly through meetings in NordBER and partly in working groups, forums and thematic meetings established about specific tasks and themes.

NordBER is structured in a Central Group taking care of the strategic work and with 5 permanent working groups as well as a few ad hoc working groups that takes care of carrying out the strategic goals set out by the Central Group.

The 5 permanent groups are:

- Nordic Risk and Vulnerability Evaluation
- Nordic Plan for Preparedness of Repair
- Nordic Program for Coordinated Training, Exercises & Workshops
- Authorities Cyber Security Working Group
- Authorities Working Group

There are currently 2 ad hoc working groups:

- Ad hoc Working Group on legislative matters
- Ad hoc Working Group on implementation on EU Risk Preparedness Regulation

If the Danish Energy Agency receives a notification of declaration of an Emergency from the Commission, this are communicated to the TSO Energinet and other relevant authorities.

Nordic Asset Management (NordAM)

In 2009, the TSO companies have established Nordic Asset Management (NordAM), which will be a key instrument for the TS0 companies with respect to their Nordic emergency preparedness cooperation.

NordAM is in effect the NordBER working group on Nordic Plan for Preparedness of Repair, as a representative from NordAM annually presents the work of NordAM to NordBER Central Group. This setup was made in order to avoid having to parallel groups making exactly the same work.

Nordic Points of Contact

Finland

[– Redacted – Confidential –]

Sweden
[– Redacted – Confidential –]
Norway
[– Redacted – Confidential –]

Continental Points of Contact
The Netherlands
[– Redacted – Confidential –]

Germany
[– Redacted – Confidential –]

EU-Commission points of Contact
[– Redacted – Confidential –]

Agreements among Member States
Denmark is currently working together with Federal Ministry for Economic Affairs and Energy of Germany and the Ministry of Economic Affairs and Climate Policy of the Netherlands on entering into one or more Memorandum(s) of Understanding on Risk Preparedness in the Electricity Sector.
This MoU will work as an interim solution while work continues on the technical, legal and financial arrangements with Germany and The Netherlands for the application of the assistance mechanism under Article 15 of the Risk Preparedness Regulation.

Denmark has together with the countries of the Nordic Region been working on surveying the foundation on how such technical, legal and financial agreements can be made for the Nordic Region. There is already similar agreements between the Nordic TSO's as well as a Letter of Intent between the Nordic Energy Ministries and TSO's on cooperation on Risk Preparedness Planning for the electricity system.

Until such time where agreements on the technical, legal and financial obligations can be made, Denmark will:

1) apply the "market-first" principle in managing crisis situations and that all market-based measures should be given priority to mitigate the effects of a potential supply disruption. Non-market-based measures will be activated in an electricity crisis only as a last resort if all options provided by the market have been exhausted or where it is evident that market-based measures alone are not sufficient to prevent a further deterioration of the electricity supply situation.

2) only request assistance to prevent or manage electricity crises if all national measures in the Danish risk preparedness plan and inter-TSO (Transmission System Operator) support measures have been exhausted or where it is evident that these measures are not sufficient to prevent a further deterioration of the electricity supply situation.

3) regularly meet with experts from the Ministries, NRAs and TSOs of connected countries to facilitate an exchange on security of supply situation and the functioning of crisis management policies.

4) in case of an imminent electricity crisis, or when confronted with an electricity crisis, inform all competent authority in the other connected countries of the situation, the measures taken and planned at national level and the possible regional measures identified.

5) when Denmark have the necessary technical ability during a national electricity crisis in another EU country or regional electricity crisis, in solidarity offer other countries assistance by means of ad hoc regional measures. To that end, and with the purpose of protecting public safety and personal security, Denmark aims to decide as quickly as possible on ad hoc regional measures that are most suitable to address the crisis. Possible measures of assistance will need to be coordinated with the concerned national TSOs before such assistance is activated

Crisis coordination

The crisis coordinator of Denmark are the Danish Energy Agency. The Danish Energy Agency has a 24/7 emergency number which will be the single point of contact in a crisis or declaring of an Emergency.

The 24/7/365 Emergency contact information for the Danish Energy Agency:

[– Redacted – Confidential –]

In case of a crisis, the Danish Energy Agency will function as a top-up to the control structure at Energinet. The crisis team at the Danish Energy Agency will be the contact point for ENTSO-E, NordBER, the National Operative Staff, Energinet, the Electricity Coordination Group, and all companies in the electricity grid. The information received by the Danish Energy Agency, will be shared with relevant partners and neighboring ministries.

Energinet TSO, will be in close correspondence with the Danish Energy Agency in case of a crisis. In a crisis, procedures made and audited by the Danish Energy Agency will be followed, in compliance with the contingency plans. Energinet continuously informs the Danish Energy Agency about relevant circumstances, pro-

vides professional (technical) advice along with recommendations about overall decisions which have to be made by the authorities.

The Danish Energy Agency will in crisis activate the crisis management staff to handle the situation and function as the main point for information gathering and coordination between relevant partners in Denmark and outside of Denmark.

Roles in the crisis management staff:

- Crisis manager: Lead and delegate tasks within the crisis team
- Logging (overview): Keep an overview and create a log on the crisis team's decisions, lead meetings, and ensure compliance with defined.
- Preparedness adviser: Support the crisis team with relevant contingency information
- Communication: responsible for communicating the crisis "position" to internal and external stakeholders (actors) and advice the crisis team in strategic communication
- Spokesperson: Responsible for public announcements
- Practical conditions: Facilitate the practicalities within the crisis team, such as IT, catering etc.

4. Stakeholder Consultations

The Danish Energy Agency has consulted with Energinet prior to submitting this draft version of the national risk preparedness plan. The Danish Energy Agency has not found it necessary to consult with DSO's, Producers, organisations representing non-industrial or industrial electricity customers or regulatory authorities.

The Danish Energy Agency has not found it necessary as this plan is in almost all aspects based on Energinets Risk Preparedness Plan for the Electricity Sector which is available to all DSOs, Producers and Balancing Responsible Companies on The Danish Energy Agency closed site for risk preparedness.

5. Test of Emergency plans

Energinets is legally obligated to test of the risk preparedness plan at least once every two years. These test has to in the course of 5 years have tested all major aspect of the plan. This is audited by the Danish Energy Agency.

The Danish Energy Agency along with invited, electricity producers, DSOs and Balance Responsible Companies participates in these test whenever it is deemed relevant by Energinet.

The Danish Energy Agency and Energinet also participates in tests of the risk preparedness nationally and in a Nordic context when the Danish Risk Preparedness Agency, The Center for Cyber Security or other Nordic Energy Agencies/TSOs has test of their respective risk preparedness plans. These partners are also sometimes invited to participate in Energinets test of the risk preparedness plan.

6. References