
Methodology to Identify Regional Electricity Crisis Scenarios in accordance with Article 5 of the REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC

DISCLAIMER

This document is released on behalf of the ENTSO-E only for the purposes of the public consultation on the ENTSO-E proposal for Methodology to Identify Regional Electricity Crisis Scenarios on risk-preparedness in the electricity sector in accordance with Article 5 of the Commission Regulation (EU) No 2019/941 of European Parliament and of the Council of 5 June 2019. This version of the methodology proposal does not in any case represent a firm, binding or definitive ENTSO-E position on the content.

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Whereas

- (1) This document is a methodology developed by the European Network of Transmission System Operators for Electricity (hereafter referred to as 'ENTSO-E') for identifying regional electricity crisis scenarios in accordance with Article 5 of the REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC¹ ('RP Regulation') establishing appropriate tools to prevent, prepare for and manage electricity crisis situations. It is hereafter referred to as the 'methodology'.
- (2) The methodology has been developed by ENTSO-E, in cooperation with the TSOs and the Regional Security Coordinators (RSCs). It takes into account the general principles and goals set in the RP Regulation as well as the relevant EU legal framework, in particular:
 - Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU, (OJ L 158, 14.6.2019, p. 125–199). ('Electricity Directive');
 - Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity, (OJ L 158, 14.6.2019, p. 54–124). ('Electricity Regulation') hereafter 'Electricity Regulation';
 - Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation, (OJ L 220, 25.8.2017, p. 1–120). [...] ('SO GL');
 - Regulation (EU) 2019/942 of the European Parliament and of the Council of 5 June 2019 establishing a European Union Agency for the Cooperation of Energy Regulators, (OJ L 158, 14.6.2019, p. 22–53).('Acer Regulation')
 - Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union, (OJ L 194, 19.07.2016, p. 1–30. ('NIS Directive');
 - Commission Regulation (EU) 2017/2196 of 24 November 2017 establishing a network code on electricity emergency and restoration, (OJ L 312, 28.11.2017, p. 54–85). ('Network code on emergency and restoration');
 - Regulation (EU) 2017/1938 on measures to safeguard security of gas supply to ensure consistency with the gas disruption scenarios, (OJ L 280, 28.10.2017, p. 1–56);
 - COMMISSION RECOMMENDATION (EU) 2017/1584 of 13 September 2017 on coordinated response to large-scale cybersecurity incidents and crises;
 - COMMISSION RECOMMENDATION of 3.4.2019 on cybersecurity in the energy sector {SWD(2019) 1240 final};
 - Commission Recommendation of 26.3.2019 Cybersecurity of 5G networks (Com C(2019) 2335): and
 - Council Directive 2008/114/EC of 8 December 2008 on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection (OJ L 345, 23.12.2008, P.75).
 - Decision No 1313/2013/EU of the European Parliament and of the Council of 17 December 2013 on a Union Civil Protection Mechanism (OJ L 347, 20.12.2013, p 24).

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, OJ L158, 14.6.2019, p.1–21.

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- (3) The goal of the RP Regulation is to ensure the most effective and efficient risk preparedness within the Union. To this end, the RP Regulation aims at building trust between Member States by ensuring coherence of risk evaluations in a crisis situation. A common approach in identifying risk scenarios is needed at regional and national levels to achieve coherence. The first step toward common approach is the identification of scenarios at regional level which shall be achieved by applying this methodology prepared by ENTSO-E.
 - (4) Once adopted, ENTSO-E shall use the methodology to identify the most relevant electricity crisis scenarios at regional level (including cross-border dependencies) and update the regional electricity crisis scenarios at least every four years as required by Article 6 of the RP Regulation. The national electricity crisis scenarios shall be identified on the basis of at least the risks referred to in Article 5(2) RP Regulation and shall be consistent with the regional electricity crisis scenarios identified in accordance with Article 6(1) RP Regulation, as required by Article 7 of the RP Regulation. Consequently, national competent authorities will use the regional crisis scenarios for establishing risk preparedness plans as required by Article 10 of the RP Regulation. For the sake of clarity, it is stated that ultimately Article 7 of the RP Regulation lays down the legal requirements for the national scenarios that the competent authorities shall adopt and that this methodology does not intend to go beyond or contradict those requirements.
 - (5) Mitigation of the cross-border impacts of electricity crises is outside of the scope of this methodology. This mitigation falls into the scope of the risk preparedness plans.
 - (6) The identification of electricity crisis scenarios at a regional level requires close cooperation between ENTSO-E and stakeholders as defined in Article 6 of the RP Regulation.
 - (7) In particular, the TSOs play an important role to support ENTSO-E in the identification of crisis scenarios at a regional level. In this task, TSOs may seek support from the Member States competent authorities in the identification of all candidate risks to the electricity system at a national level, following the bottom-up approach of the methodology.
 - (8) The Members States' competent authorities should also establish effective cooperation with other relevant authorities in the Member State to ensure an integrated approach to the risks of the electricity system. With a view of obtaining all the relevant information for regional scenarios developed by ENTSO-E, the methodology assumes adequate information sharing at national level. This is understood to include among others, the competent authorities consulting with other authorities, at least, the national authorities implementing Council Directive 2008/114/EC (European Critical Infrastructure Directive), the national authorities in charge of the networks and information system security under the Directive (EU) 2016/1148 (NIS Directive), and where appropriate, the national defence authorities.
 - (9) In accordance with Article 6 (1) of RP Regulation, ENTSO-E may delegate tasks relating to the identification of regional electricity crisis to the regional coordination centres (RCCs).
 - (10) In accordance with Article 3 (3) of RP Regulation, Member States may allow the competent authority to delegate the operational tasks regarding risk-preparedness planning and risk management to other bodies.

SUBMITS THE FOLLOWING METHODOLOGY TO THE AGENCY:

TITLE 1

General provisions

Article 1

Subject matter and scope

1. This methodology has been developed in accordance with Article 5 of the RP Regulation. The Appendices constitute an integral part of this methodology and shall be read together with its provisions.
2. This methodology shall establish the process for identification of the most relevant regional electricity crisis scenarios.

Article 2

Definitions and interpretation

1. For the purposes of this document, the definitions in Article 2 of the RP Regulation shall apply.
2. The following additional definitions shall also apply:
 - (a) ‘likelihood’ means a chance of something happening;
 - (b) ‘impact’ means an evaluated consequence of a particular outcome;
 - (c) ‘severity’ means the combination of the likelihood and impact ratings of an electricity crisis scenario;
 - (d) ‘expected energy not-served’ (EENS) in a given zone (Member State) and in a given time period (duration of load curtailment due to the electricity crisis scenario), energy which is expected not to be supplied due to insufficient resources to supply demand;
 - (e) ‘expected energy not-served percentage’ (or EENS%) is calculated by dividing expected energy not served by the estimated total annual energy consumption of a Member State;
 - (f) ‘Energy consumption of a Member State’ is a sum of electricity consumption over control areas of all TSOs operating in that Member State;
 - (g) ‘loss of load expectation’ (or LOLE) represents expected number of hours in which in a given zone (Member State) resources are insufficient to supply the demand due to the electricity crisis scenario;
 - (h) ‘electricity crisis scenario’ means a description of an event or a chain of events that will (or is expected to) lead to a deterioration of security of supply of electricity affecting community or whole society. An electricity crisis scenario may include more than one region or subgroup defined by Member States or may include parts of two or more regions or subgroups;
 - (i) ‘regional electricity crisis’ means a present or imminent situation in which more than one Member State has declared an electricity crisis at the same time (simultaneous crisis in two or more Member States);
 - (j) ‘electricity crisis scenario candidate’ is an electricity crisis scenario identified by TSOs to have an impact on at least one other Member State and therefore have the potential to form a ‘regional electricity crisis scenario’;

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- (k) ‘initiating event’ is an event which initiates the electricity crisis; the initiating event can be momentary and can be significant enough to cause the electricity crisis by itself or can cause an existing critical grid situation to become an electricity crisis.

Article 3 Cross-border dependencies

1. Cross-border dependencies shall be identified both in regional electricity crisis scenarios and in electricity crisis scenario candidates.
2. In order to be identified as a cross-border dependency within the meaning of this article, the cross-border dependency shall be deemed likely to initiate a crisis or aggravate the situation in other Member States.
3. When identifying cross-border dependencies the following categories shall be assessed:
 - (a) Dependencies that result as a direct impact of a crisis on other Member States, for reasons such as unavailability of several (beyond N-1) interconnectors or internal lines in close electrical proximity, or unavailability of generation;
 - (b) Dependencies that result as an indirect impact of a crisis on other Member States, either:
 - i. Consequences in one Member State due to actions taken by another Member State in crisis; or
 - ii. Actions taken in one Member State following a request by a Member State in crisis with a significant negative impact on a third Member State, such as re-planning of maintenance work or higher level of generation in accordance with the relevant Articles of SO GL, in particular Articles 20, 21, 22 and 23.
4. Cross-border dependencies shall be evaluated in accordance with Article 9.

Article 4 Initiating events

In accordance with Article 5(2) of the RP Regulation, potential initiating events for electricity crisis scenarios shall be based on at least the following hazards:

- (a) rare and extreme natural hazards;
- (b) accidental hazards going beyond the N-1 security criterion, and exceptional contingencies;
- (c) consequential hazards including consequences of malicious attacks and of fuel shortages.

As a basis to identify initiating events, the above list of hazards has been expanded in Appendix II - Hazards that could initiate an electricity crisis scenario. At least the hazards contained in Appendix II need to be considered as possible initiating events in developing regional electricity crisis scenarios.

Article 5 Requirements for an electricity crisis scenario

1. Each electricity crisis scenario candidate and regional electricity crisis scenario shall fulfil the following quality criteria:

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- (a) it is specific enough for each TSO to individually, qualitatively and quantitatively describe the consequences in the TSO's Control Area;
 - (b) it allows for creation of a risk preparedness plan;
 - (c) its symptoms shall be observable, so that it is possible to execute risk preparedness plans.
2. The scenario description shall be precise and consistent. It shall consist of at least:
- (a) a description of the initial condition of the electricity system relevant to the scenario;
 - (b) a list of initiating event(s) and a chain of event(s);
 - (c) season(s) of the year when the scenario is relevant and type of load;
 - (d) the evolution of the crisis scenario;
 - (e) the most likely impacts of the scenario;
 - (f) cross-border dependencies;
 - (g) if applicable, quantitative data expressed as ranges for all the items above; and
 - (h) other important information related to the scenario, relevant to managing it.

Article 6

TSOs' obligation to provide information to ENTSO-E to support scenario identification and evaluation

- 1. Each TSO shall share scenario information — including sensitive information — with ENTSO-E in accordance with national and EU policies and legislation concerning handling of sensitive information.
- 2. Information provided to ENTSO-E shall be detailed enough to enable ENTSO-E to identify the regional electricity crisis scenarios, as referred to in Article 12. ENTSO-E is entitled to request more details where it deems that the information provided is insufficient to identify the regional electricity crisis scenarios.
- 3. TSOs shall take into account the checklists of information contained in Appendix III when evaluating scenarios.
- 4. Information which is already shared between TSOs, ENTSO-E, regulatory authorities and other third parties to ensure operational or planning tasks in accordance with requirements of SO GL, NC ER and other regulations shall not be considered as sensitive information as described in Article 17.

TITLE 2

Electricity crisis scenario evaluation methods

Article 7

Evaluation of electricity crisis scenarios

1. The evaluation of electricity crisis scenario likelihood shall consider at least the following elements:
 - (a) the expected frequency of occurrence of an initiating event (or a combination of multiple initiating events); and
 - (b) the classification of likelihood of each crisis scenario ranges from “very unlikely” to “very likely”, corresponding to a quantitative likelihood range, as shown in Appendix I.1 – Crisis likelihood scale.
 - (c) the derivation of likelihood classification shall be documented allowing for retracing when the analysis is updated or verified.
2. The evaluation of the direct operational impact of a given electricity crisis scenario shall include at least the following elements:
 - (a) the impact estimated for each defined crisis scenario in terms of the expected energy not served percentage (EENS%) and loss of load expectation (LOLE);
 - (b) the classification (ranging from “insignificant” to “disastrous”), as defined in Appendix I.2. EENS% and LOLE shall be classified independently; and
 - (c) the derivation of impact classification shall be documented allowing for retracing when the analysis is updated or verified.
3. Electricity crisis scenarios are evaluated using the classification of likelihood and impact described in paragraphs 1 and 2. The overall crisis scenario rating is determined according to the table shown in Appendix I.3. The electricity crisis scenario rating, ranging from ’insignificant’ to ’disastrous’, is evaluated by combining the operational impact rating (resulting from EENS% and LOLE evaluation) and likelihood rating;
4. This crisis scenario rating, in combination with the cross-border dependency rating described in Article 9 and Appendix I.4, are used for the identification of regional electricity crisis scenarios, as described in Article 13.

Article 8

Methods for the evaluation of likelihood and impact

1. During electricity crisis scenario identification and evaluation, either a probabilistic or a deterministic method of evaluating the likelihood and impact of a crisis shall be used. A probabilistic method shall be favoured over a deterministic one where appropriate. ENTSO-E shall propose use of a scenario-specific method (or methods) for evaluating the likelihood and impact measures relevant to the particular scenario and the nature of its uncertainty when appropriate. Such a method shall be identified by ENTSO-E not later than six months prior to the mandatory update of the regional crisis scenarios in accordance with Article 5.6 of RP Regulation.
2. No later than 12 months following the publication of the report as described in Article 15, ENTSO-E shall publish a report assessing whether there would be the need for the development of necessary computational methods and tools to be used as a pan-European method for the assessment of regional electricity crisis scenarios.

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3. Following the publication of this report, ENTSO-E shall assess its results and consider whether significant new information has become available. If so, ENTSO-E shall update and improve the methodology in accordance with Article 5 (7) of the RP Regulation.
 4. Once the tools and methods are implemented and made available by ENTSO-E, TSOs shall use them in future evaluations of crisis scenarios, for which they were designed.
 5. Until the methods and tools are developed and made available in accordance with paragraph 3, the TSOs shall evaluate likelihood and impact for their Member State using the best method available to them at the time of evaluation.

Article 9 **Evaluation of cross-border dependencies**

1. For each electricity crisis scenario described, the TSOs shall analyse the cross-border dependencies with other TSOs through two perspectives:
 - (a) as an aggravating input for the scenario, if the crisis prevents other TSOs to offer necessary support, either in active or reactive power, in counter trading or redispatch;
 - (b) as a national output of the regional electricity crisis scenario, if the crisis prevents the TSO to offer support to other TSOs, either in active or reactive power, in counter trading or redispatch.
2. The two aspects described in paragraph 1 shall be included in the description of scenarios following Appendix III.3 – Evaluation of national impact of the regional electricity crisis scenarios. Cross-border dependencies shall be considered as aggravating factors and thus shall be included in the relevance rating of the regional electricity crisis scenarios, as defined in Appendix I.4 – Cross-border dependency rating. A general overall rating of the strength of the cross-border dependencies is to be evaluated in accordance with Appendix I.4.

TITLE 3

Methodology outline

Article 10

Identification of electricity crisis scenario candidates

1. In order to initiate or update regional electricity crisis scenarios in accordance with Article 16, ENTSO-E shall send a request to TSOs for the identification of electricity crisis scenario candidates.
2. Electricity crisis scenario candidates shall be determined by the TSO(s) in close cooperation with the national competent authority. The identification shall follow a three-step-process consisting of:
 - (a) identification of scenarios and their cross-border dependencies,
 - (b) description of electricity crisis scenario candidates; and
 - (c) submission of electricity crisis scenario candidates to ENTSO-E as laid down in this Article.
3. TSOs who belong to the same Member State shall coordinate and submit a common list of electricity crisis scenario candidates.
4. The TSO(s) shall identify credible electricity crisis scenario candidates based upon, but not limited to, consideration of:
 - (a) historical electricity crises that may occur again (both experienced nationally and by other Member States); and
 - (b) available operational expertise and experience on credible future crisis scenarios (see Appendix II. for a list of possible initiating events).
5. In accordance with Article 3.3, for each Member State, the TSO(s) shall define electricity crisis scenario candidates and evaluate its cross-border dependencies in terms of available capacity for providing:
 - (a) energy support;
 - (b) active power (through redispatch, counter trading, demand-side response, and cross-border exchange of ancillary services);
 - (c) reactive power (to support system stability).
6. For each Member State, the TSO(s) shall complete a detailed description of electricity crisis scenario candidates (using the template in Appendix III.1), in close cooperation with the national competent authority. This description shall fulfil the requirements outlined in Article 5.2.
7. For each Member State, the TSO(s) shall submit descriptions of relevant electricity crisis scenario candidates to ENTSO-E within 6 weeks of receipt of the request. TSO contact information of the authors shall be included in this description.
8. ENTSO-E may contact the relevant TSO(s) to clarify the descriptions of electricity crisis scenario candidates. The clarification shall be provided to ENTSO-E without undue delay, and no later than ten working days from receipt of request for clarification.

Article 11

Steps for establishing the relevance of regional electricity crisis scenarios

Following the identification of electricity scenario candidates in accordance with Article 10, ENTSO-E shall establish the relevance of regional electricity crisis scenarios through the following steps:

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- i. carrying out quality and compliance checks to ensure that the minimum required data is completed according to Article 5.2 (Article 12 (1)) and if submissions are considered deficient, asking the relevant TSOs to address the deficiency (Article 12 (2));
 - ii. aggregating the relevant electricity crisis scenario candidates into regional crisis scenarios (Article 12 (4));
 - iii. carrying out a gap analysis performed against the initiating events list (Article 12 (5)) and if necessary, adding any regional electricity crisis scenarios that have been overlooked (Article 12 (6));
 - iv. identifying groups of electricity crisis scenario candidates which can be reasonably expected to coincide in more than one Member State and thus form a simultaneous regional electricity crisis (in accordance with Article 12 (7) a)).
 - v. preparing a description of the final set of regional electricity crisis scenarios identified (Article 12 (8));
 - vi. submitting the regional electricity crisis scenario template to TSOs (Article 12 (9));
 - vii. collecting the evaluations of national impact to the regional electricity crisis scenarios (Article 14 (2));
 - viii. ranking the regional electricity crisis scenarios evaluated at national level in accordance with Article 13, following the process described in Article 14 (1);
 - ix. reporting of the most relevant regional crisis scenarios according to their ranking, as specified in Article 15.

Article 12 **Identification of regional electricity crisis scenarios**

1. Upon collecting the electricity crisis scenario candidates, ENTSO-E shall carry out quality and compliance checks to ensure that the minimum required data is completed according to Article 5.2.
2. In the event national submissions are considered deficient, ENTSO-E shall ask the relevant TSOs to address the deficiency in line with Article 10.8. In the case clarification is not forthcoming, missing information will be resolved by ENTSO-E during the gap analysis as set out in paragraph 6.
3. TSOs who belong to the same Member State shall coordinate and submit a common clarification of electricity crisis scenario candidates.
4. ENTSO-E shall aggregate the relevant electricity crisis scenario candidates into regional crisis scenarios compliant with Article 5. In particular, electricity crisis scenario candidates shall be considered relevant if at least one of the following conditions are fulfilled:
 - (a) the scenarios are likely to develop simultaneously or consequently by the same initiating event (e.g. a widespread disaster), or by the same combination of initiating events as defined in Article 4; and
 - (b) the electricity crisis scenario candidates are likely to coincide in time in Member States and have a cross-border relevance as defined in Article 3.
5. Following the aggregation of the relevant electricity crisis scenario candidates into regional electricity crisis scenarios, ENTSO-E shall carry out a gap analysis performed against the initiating events listed in Appendix II in order to determine whether any hazard capable of causing a regional scenario has been overlooked in the electricity crisis scenario candidates.
6. If a relevant regional electricity crisis scenario has been overlooked by the TSOs, it shall be added by ENTSO-E in cooperation with the relevant TSOs and stakeholders as defined in Article 6 of the RP Regulation, if necessary. The list of initiating events in Appendix II includes infrastructure and fuel supply disruption scenarios. At least, scenarios related to the natural gas supply disruption shall be considered, as developed by ENTSO-G pursuant to Article 7 of the Regulation (EU) 2017/1938 of the

European Parliament and of the Council. Additional scenarios related to interdependent infrastructure (e.g. gas, telecommunication, water) may be considered and included where appropriate, by ENTSO-E in cooperation with the relevant Agencies of the European Union, TSOs and Stakeholders as defined in Article 6 of the RP Regulation.

7. ENTSO-E shall identify groups of electricity crisis scenario candidates which can be reasonably expected to coincide in more than one Member State and thus form a simultaneous regional electricity crisis. Simulations of simultaneous electricity crisis scenarios shall be carried out by:
 - (a) identifying groups of electricity crisis scenario candidates which can be reasonably expected to coincide and thus form a simultaneous regional electricity crisis;
 - (b) combining the relevant electricity crisis scenario candidates into regional electricity crisis scenarios; and
 - (c) evaluating such regional electricity crisis scenarios according to Articles 13 and 14.
8. Upon concluding on the results of the gap analysis and creation of simultaneous electricity crisis scenarios, ENTSO-E shall prepare a description of the final set of regional electricity crisis scenarios identified in compliance with the template in Appendix III.2.
9. ENTSOE shall submit the regional electricity crisis scenario template in Appendix III.2 to TSOs 4 weeks after the receipt of the completed electricity crisis scenario candidate descriptions to enable assessment in accordance with Article 13.

Article 13

Evaluation of regional electricity crisis scenarios at a national level

1. Each relevant regional electricity crisis scenario identified in accordance with Article 12, shall be assessed at a national level by TSOs, in close cooperation with the national competent authority.
2. For each Member State, regarding each relevant regional electricity crisis scenario, the TSO(s) shall assess their severity and cross-border dependencies in accordance with Articles 7, 8 and 9.
3. For each Member State, the TSO(s) shall specify the likelihood and the impact on the electricity system of each regional scenario consistent with the rating scales provided (Appendix I), in accordance with paragraphs (1) and (2) of Article 7. TSOs shall collaborate with their competent authority and provide a single evaluation for each electricity crisis scenario. TSOs who belong to the same Member State shall coordinate with other TSOs within the Member State.
4. Within 6 weeks from receiving the regional scenarios for a national impact evaluation, for each Member State, the TSO(s) shall provide to ENTSO-E the completed national impact evaluation template in accordance with Appendix III.3 on the evaluation of national impact to the regional electricity crisis scenarios.

Article 14

Ranking of electricity crisis scenarios

1. ENTSO-E shall rank the regional electricity crisis scenarios evaluated at national level in accordance with the following process:
 - (a) gathering the national impact evaluations per Member State (paragraph 2);

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- (b) checking the consistency of cross-border dependencies (paragraph 2) and addressing any deficiencies (paragraph 3);
- (c) evaluating regional impacts (paragraphs 4 and 5); and
- (d) final ranking of regional electricity crisis scenarios according to their relevance (paragraph 6).
2. ENTSO-E shall first collect the evaluations of national impact to the regional electricity crisis scenarios according to Article 13, completed by the TSOs. ENTSO-E shall check the evaluations for completeness and consistency with the impacted power systems. ENTSO-E may delegate this task to the RCC(s). In cases of detected inconsistencies or missing submissions, ENTSO-E shall notify the concerned TSOs. Missing or non-compliant submissions:
 - i. may be treated as rating a particular crisis scenario as irrelevant to the Member State (national impact rating “insignificant”); or
 - ii. may be treated as not having a cross-border dependency (cross border dependency rating “none”); or
 - iii. may be brought to compliance by ENTSO-E in cooperation with the relevant TSOs, RCCs at ENTSO-E’s discretion.
 3. In case of any doubts regarding any content of the submitted national evaluations, ENTSO-E shall ask the concerned TSOs to address the deficiency in line with Articles 7 and 9. TSOs who belong to the same Member State shall provide a single clarification. The clarification shall be provided to ENTSO-E without undue delay, but not later than ten working days from receipt of request for clarification.
 4. ENTSO-E shall then apply the following steps to evaluate the regional impact of each regional crisis scenario:
 - i. the national impact rating and national rating of the cross-border dependencies shall be collected (cf. Appendix III.3);
 - ii. a rating of a regional crisis scenario is calculated as a sum over all Member States of national impact ratings weighted by the national ratings the cross-border dependencies.
 5. Those electricity crisis scenarios, that are evaluated as not having a regional significance (only one Member State rated the scenario higher than “insignificant”) are captured for future reference. As these scenarios are not considered regional, they shall not be included in the evaluation and ranking.
 6. ENTSO-E shall rank the regional crisis scenarios according to their relevance: as a result of the calculation in accordance with paragraph 3, a single number is assigned to each scenario. The higher the number, the more relevant the regional scenario is.

Article 15

Reporting of most relevant regional electricity crisis scenarios

1. The reporting of the most relevant regional electricity crisis scenarios shall be done in accordance with Article 6 of the RP Regulation.
2. The reporting mentioned in paragraph 1 shall consist of a single report comprising the regional electricity crisis scenarios which shall be prepared by ENTSO-E. The relevance of each regional electricity crisis scenario shall be indicated by the score according to Appendix I. The most relevant scenarios shall be the highest scoring scenarios. Each scenario shall be reported in terms of the following minimal information collected:
 - (a) initiating event(s);
 - (b) area of geographical relevance;

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- (c) RCCs and Member States affected by the crisis scenario;
 - (d) national impact & likelihood;
 - (e) ranking;
 - (f) presence and importance of cross-border dependencies.

Additional information, including any visualisation, may be included in the report.

Article 16

Review

1. ENTSO-E shall update the regional electricity crisis scenarios every four years unless circumstances warrant more frequent updates according to Article 6.3 of the RP Regulation. Such updates could be triggered by ENTSO-E as a result of events such as a significant change in national or regional risk evaluations, or the detection of a major risk previously not integrated in the regional electricity crisis scenarios (for instance, new studies on climate change highlighting a significant increase in the frequency or severity of various hydro-meteorological hazards could trigger an update). For this purpose, following a request by ENTSO-E, the process described in the methodology shall be applied.
2. ENTSO-E shall update and improve this methodology when significant new information becomes available according to Article 5.7 of the RP Regulation.

TITLE 4

Final provisions

Article 17

Handling of sensitive information

1. TSOs and national competent authorities are expected to communicate the open national risk information in sufficient detail to allow ENTSO-E to assess if a regional risk may exist as described in Article 12.
2. Directive 2008/114/EC is applied to the energy sector and certain parts of the electricity transmission system can be identified as sensitive critical infrastructure.

Accordingly, the following principles are established:

(a) Confidentiality

- i. Any confidential or sensitive information received, exchanged or transmitted pursuant to this methodology shall be subject to the conditions of professional secrecy laid down in ii, iii, and iv;
- ii. The obligation of professional secrecy shall apply to any natural or legal person subject to the provisions of this methodology;
- iii. Confidential information received by the natural or legal person in the course of their duties may not be divulged to any other person or authority, without prejudice to cases covered by national law, the other provisions of this methodology or other relevant EU legislation;
- iv. Without prejudice to cases covered by national law, regulatory authorities, bodies or persons which receive confidential information pursuant to this methodology may use it only for the purpose of the performance of their functions under this methodology.

(b) Publication

- i. For clarity, the owner of the disclosed information has the right to decide which, if any, disclosed information may be communicated outside of ENTSO-E and to whom and in what format.

Article 18

Publication of the methodology

1. ENTSO-E shall publish the methodology without undue delay after the Agency has approved it.

Article 19

Language

1. The reference language for the methodology for identifying electricity crisis scenarios at a regional level shall be English.

Appendix I: Scenario rating scales

I.1 Crisis likelihood scale

For classification of likelihood of crisis, a five-step scale is used:

| 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 | very rare event, e.g. simultaneous floods causing unavailability of generation, distribution and transmission infrastructure |
| Very unlikely | ≤ 0.01 | 100 or more | event irrelevant, or extremely rare, e.g. earthquake causing a huge destruction of transmission, distribution and generation infrastructure |

I.2 Crisis impact scales

The consequences should be simulated based on the present knowledge of the system over at least the next four years.

For classification of operational impact of crisis, a five-step scale is used. Two different dimensions of impact (EENS% and LOLE) are used. These are treated independently as shown in Appendix I.3.

| Classification | EENS% (of annual demand) | LOLE [hours] |
|----------------------|-------------------------------|-----------------------|
| Disastrous | $\geq 0,25\%$ | ≥ 168 |
| Critical | $\geq 0,05\%$ and $< 0,025\%$ | ≥ 48 and < 168 |
| Major | $\geq 0,01\%$ and $< 0,05\%$ | ≥ 12 and < 48 |
| Minor | $\geq 0,002\%$ and $< 0,01\%$ | ≥ 3 and < 12 |
| Insignificant | $< 0,002\%$ | < 3 |

I.3 Crisis scenario rating at the Member State level

Crisis scenario rating is performed by combining the operational impact rating (resulting from EENS% and LOLE evaluation) and likelihood rating, as illustrated in the Likelihood – Impact Matrix below.

For example, if a certain crisis is Likely and has Critical EENS% impact and Minor LOLE impact, it would be defined as Major.

| Impact | | Likelihood | | | | |
|---------------|---------------|-------------|------------|---------------|---------------|---------------|
| EENS% | LOLE | Very likely | Likely | Possible | Unlikely | Very unlikely |
| Disastrous | Disastrous | Disastrous | Disastrous | Critical | Major | Minor |
| Disastrous | Critical | Disastrous | Critical | Critical | Major | Minor |
| Critical | Disastrous | Disastrous | Critical | Critical | Major | Minor |
| Disastrous | Major | Disastrous | Critical | Major | Major | Minor |
| Major | Disastrous | Disastrous | Critical | Major | Major | Minor |
| Disastrous | Minor | Disastrous | Critical | Major | Major | Minor |
| Minor | Disastrous | Disastrous | Critical | Major | Major | Minor |
| Disastrous | Insignificant | Disastrous | Critical | Major | Major | Minor |
| Insignificant | Disastrous | Disastrous | Critical | Major | Major | Minor |
| Critical | Critical | Disastrous | Critical | Major | Minor | Minor |
| Critical | Major | Disastrous | Critical | Major | Minor | Minor |
| Major | Critical | Disastrous | Critical | Major | Minor | Minor |
| Critical | Minor | Disastrous | Critical | Major | Minor | Minor |
| Minor | Critical | Disastrous | Critical | Major | Minor | Minor |
| Critical | Insignificant | Disastrous | Critical | Major | Minor | Minor |
| Insignificant | Critical | Disastrous | Critical | Major | Minor | Minor |
| Major | Major | Disastrous | Critical | Major | Minor | Insignificant |
| Major | Minor | Disastrous | Major | Major | Minor | Insignificant |
| Minor | Major | Disastrous | Major | Major | Minor | Insignificant |
| Major | Insignificant | Disastrous | Major | Major | Minor | Insignificant |
| Insignificant | Major | Disastrous | Major | Major | Minor | Insignificant |
| Minor | Minor | Disastrous | Major | Minor | Insignificant | Insignificant |
| Minor | Insignificant | Disastrous | Major | Minor | Insignificant | Insignificant |
| Insignificant | Minor | Disastrous | Major | Minor | Insignificant | Insignificant |
| Insignificant | Insignificant | Disastrous | Minor | Insignificant | Insignificant | Insignificant |

For the purpose of combining and computing consequences across multiple Member States, the above crisis scenario ratings are assigned values, shown in the table below:

| Crisis scenario rating <i>(used for regional scenario rating)</i> | Value |
|--|--|
| | <i>(used for regional scenario rating)</i> |
| Disastrous | 10 |
| Critical | 5 |
| Major | 2 |
| Minor | 1 |
| Insignificant | 0 |

I.4 Cross-border dependency rating

The cross-border dependencies that must be considered are described in Article 3. For each scenario, the level of cross-border dependency must be evaluated using the following scale:

| Cross-border dependency rating | Value | Description |
|--------------------------------|-------|---|
| None | 1 | The crisis has no impact on other countries, even if they are facing simultaneous crisis. |
| Minor | 1.2 | The crisis is susceptible to aggravate a simultaneous crisis in at least one other country, either through direct or indirect causes (cf. Article 3). |
| Major | 2 | The crisis is susceptible to generate a cross-border crisis in at least one other country, either through direct or indirect causes (cf. Article 3). |

It is accepted that the impact of local events on other TSOs will be estimated using the TSOs' expertise on its own network.

I.5 Example of regional scenario rating

The values of crisis scenario ratings (Appendix I.3) and cross-border dependency ratings (Appendix I.4) are used to compute a national rating for the scenario using the following equation:

$$\text{National Rating} = \text{Crisis Scenario Rating} \times \text{Cross Border Dependency Rating}$$

A regional crisis scenario is then evaluated as the sum of all national ratings. The resulting numbers are used only for the relative ranking of scenarios. An example computation of regional crisis scenario ratings, based on three national scenario ratings, is provided below (using values from Appendices I.3 and I.4). Note that in the table below, CBD is an abbreviation of Cross-Border Dependency rating. The values in this table represent the expected output from the national scenario evaluations in Article 13. The computation of regional ratings, as in the example below, shall take place in line with Article 14.

| Scenario Name | Member State 1 | | | Member State 2 | | | Member State 3 | | | Regional Rating |
|---------------|-----------------|-----|-----------------|-----------------|-----|-----------------|-----------------|-----|-----------------|-----------------|
| | Scenario Rating | CBD | National rating | Scenario Rating | CBD | National rating | Scenario Rating | CBD | National rating | |
| Fuel Shortage | 1 | 1 | 1 | 5 | 1.2 | 6 | 10 | 2 | 20 | 27 |
| Cyberattack | 2 | 1.2 | 2.4 | 2 | 1 | 2 | 5 | 2 | 10 | 14.4 |
| Heat wave | 1 | 1.2 | 1.2 | 5 | 1.2 | 6 | 0 | 2 | 0 | 7.2 |
| Cold spell | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |

Appendix II: Hazards that could initiate an electricity crisis scenario (initiating events)

At least the following hazards² need to be considered as possible initiating events in developing both national and regional electricity crisis scenarios:

- 1) rare and extreme natural hazards:
 - a) flooding;
 - b) drought and associated water shortage
 - c) extreme weather (incl. storms, extreme winds, ice storms, snowfall, heavy precipitation, hurricanes, cold spells, heat waves);
 - d) forest fire;
 - e) seismic and volcanic activities;
 - f) infectious threats, incl. pandemic;
 - g) space weather hazards;
- 2) accidental hazards going beyond the N-1 security criterion, and exceptional contingencies:
 - a) simultaneous failure of multiple grid elements;
 - b) accidental (unintended) violation of N-1 criterion due to human error:
 - i) error during operation;
 - ii) failure or omission during the maintenance;
 - iii) substandard quality of a series of manufactured grid elements.
- 3) consequential hazards including consequences of malicious attacks and of fuel shortages:
 - a) malicious attacks:
 - i) terrorism / sabotage;
 - ii) cyberattack;
 - iii) manipulation of the market.
 - b) disruption of fuel supply for electricity generation;
 - c) not electricity-related industrial accident (e.g. chemical spill, collapse, explosion, gas leak, radiation, transport disruption);
 - d) not electricity-related critical infrastructure disruption (incl. water & food supply, garbage & sewage collection, fuel supply excl. fuels for electricity generation, telecommunications);
 - e) electricity market failure with significant impact in SoS (e.g. speculation or failure of one or more stakeholders to meet its/their obligations);
 - f) nuclear / radiological accident.

Note: It is expected, that for many Member States and TSOs some of the above hazards will not be relevant, while some other will be relevant, but not to an electricity crisis scenario. The list given above is meant to help Member States and TSOs only as a checklist against which the electricity crisis scenario candidates and regional electricity crisis scenarios should be checked for completeness of coverage. It is not required (nor expected) for any TSO to produce a list of electricity crisis scenario candidates that would cover all of the above, but it should be consistent with National Risk Evaluations.

² The list of hazards is adapted from *Commission Staff Working Document: Overview of Natural and Man-made Disaster Risks the European Union may face*, Brussels, 23.5.2017, SWD(2017) 176 final.

Appendix III: Electricity crisis scenario description templates

The electricity crisis scenario description templates below shall be used during the electricity crisis scenario identification and evaluation. Columns are to be interpreted as follows:

- (a) “Item” contains a definition of information needed;
- (b) “Information to provide” must be filled by the relevant data provider.

All the template fields below are required and must be completed by the provider. For each item an understandable general description is needed, without indicating exact locations, equipment, measurements etc., and a range of values is preferable to an exact number.

Check lists are provided in paragraphs III.2 and III.3 as a tool for building a comprehensive description of each scenario. They must be followed to ensure that an important aspect of the scenario is not omitted. Some of the questions may lead to sensitive information that will not be shared by the provider, but may be useful for the provider to do a self-evaluation of a given crisis scenario impact.

III.1 Description of electricity crisis scenario candidate

For each electricity crisis scenario candidate as mentioned in Article 10, the description must follow the following template:

| Item | Information to provide |
|--|--|
| Name of entity and date of submission of the scenario | |
| Contact information if more information is required on the scenario in the following weeks. | |
| Description of initial condition of the system relevant to the scenario | <p>Describe potential initial conditions for the scenario, using a range for these conditions. They do not have to be very specific. The range of years when scenario is relevant.</p> <p>Ex: on the national perimeter, temperatures between 30°C and 35°C for 2 to 5 weeks, associated with low water levels in reservoir, etc.</p> |
| Initiating event(s) and chain of event(s) | <p>Brief description of the initiating event (or combination of events) generating the crisis.</p> |
| Season(s) of the year when the scenario is relevant and type of load | <p>Winter/Spring/Summer/Autumn/All Peak/Base load/Minimum load/Any</p> |
| Evolution of the crisis scenario | <p>A sequence of events leading from initiating events to electricity crisis</p> |
| Description of the most likely impacts of the scenario | <p>Description of potential impacts of the crisis of the scenario, focusing on range/general areas instead of details</p> <p>Ex: describe potential impacts in the south of the country/in maritime areas; instead of naming a district or a city</p> |

| Item | Information to provide |
|--|---|
| Does the event cause a cross-border dependency? | Yes/No |
| Description of cross-border dependency | All categories described in Article 3 and 9 must be considered here for relevance |
| Other important information related to the scenario | |

Checklist to use for a comprehensive description of the electricity crisis scenario candidate

| Section | Item | Considered | Not relevant |
|---|--|------------|--------------|
| Description of initial condition of the system relevant to the scenario | load, generation, frequency, available reserves, import capabilities, stability, level of system control | | |
| | weather conditions (temperature, wind speed, rain, hail, snow, etc.) | | |
| | internal and cross-border congestions | | |
| | re-dispatching performed before the start of the initiating event | | |
| | internal and regional generation and transmission limitations | | |
| Initiating event(s) and chain of event(s) | details of the initiating events (their parameters and related circumstances, if relevant) | | |
| | the course of events (event chain) | | |
| Season(s) of the year when the scenario is relevant and type of load | season of the year | | |
| | type of day (week, weekend, holiday, day before holidays) | | |
| | peak or base load | | |
| Evolution of the crisis scenario | system parameters (frequency, voltage drop at critical points, etc.) at every stage of scenario | | |
| | expected system response (automatic or manual) to the trigger and to every event in the chain | | |
| | spontaneous propagation of the scenario vs the need for human action in the following stages of the crisis | | |
| | potential for human error/omission/wrong decision | | |

| | | | |
|-------------------------|--|--|--|
| | required availability of the power system elements or fuel supply | | |
| | possible mitigation and/or corrective actions to be taken before the crisis occurs and their availability | | |
| | time required for mitigation and/or corrective actions, including time before overloading of successive grid elements | | |
| Broad geographical area | the likely geographic location or part of the system affected by the event (type of line, substation, PST, interconnector, dispatching centre, etc.) | | |

III.2 Description of regional electricity crisis scenarios by ENTSO-E

The description of regional electricity crisis scenarios as mentioned in Article 12 must follow the following template. The scenario must be sufficiently detailed and specific for each TSO to individually evaluate the relevance.

| Item | Information to provide |
|--|------------------------|
| Name of the scenario | |
| Description of Initial Condition of the system relevant to the scenario | |
| Initiating event(s) and chain of event(s) | |
| Time horizon for evaluation (years) | |
| Season(s) of the year when the scenario is relevant and type of load | |
| Evolution of the crisis scenario | |
| Broad geographical area | |
| Description of possible impacts | |
| Potential for cross-border dependencies | |
| Other important information related to the scenario | |

III.3 Evaluation of national impact of the regional electricity crisis scenarios

The national impact evaluation of the regional electricity crisis scenarios by TSOs (as mentioned in Article 13) must follow the following template. The checklist below is to be used to ensure the evaluation is comprehensive.

| Item | Information provided |
|--|--|
| Name of entity and date of submission of the scenario | |
| Contact information if more information is required on the scenario in the following weeks. | |
| Name of the scenario (as described by ENTSO-E) | |
| Crisis scenario rating at the Member State level (as described in Appendix I.3) | Disastrous/Critical/Major/Minor/Insignificant |
| Cross-border dependency rating (as described in Appendix I.4) | Major/Minor/None |
| Method used for evaluation of likelihood | deterministic calculation/probabilistic calculation/statistical data, number of sub-scenarios taken into account |
| Method used for evaluation of impact | deterministic calculation/probabilistic calculation/number of sub-scenarios taken into account |
| Description of identified cross-border dependencies | |
| Explanation of the severity of the scenario – national specificities to ENTSO-E description | National specificities relevant for the scenario: duration, length of direct impact, consequential hazards, incl. potential impact on fuel and energy markets (gas, electricity), etc. |
| Other important information related to the scenario | |

Checklist to consider for a comprehensive impact evaluation of regional electricity crisis scenario

Crisis scenario rating at the Member State level:

| Section | Item | Considered | Not relevant |
|--------------------------|---|------------|--------------|
| Severity of the scenario | duration of the scenario | | |
| | evaluation of likelihood of scenario materialisation | | |
| | evaluation of direct impact on security of supply (EENS%) – the most likely and the worst case | | |
| | overall risk evaluation (taking into account EENS%, LOLE likelihood) | | |
| | impact & likelihood evaluation – one of: deterministic calculation or probabilistic calculation | | |
| | sufficient number of sub-scenarios considered for likelihood & impact evaluation (in case of a probabilistic approach). | | |
| | the length of the direct impact | | |
| | consequential hazards, incl. potential impact on fuel and energy markets (gas, electricity) | | |

| | | | |
|--|--|--|--|
| | subjects of protection negatively affected by the event (persons, environment, infrastructure, etc.) time required to restore the system to a normal state need for remedial actions or other coordinated actions beyond TSO (national/regional) | | |
| Reference crises of the past | list of comparable events that have occurred in the past (regardless of whether the crisis developed to the full extent, or not) post crisis review (lessons learnt): main similarities and differences between the scenario and past crises, including the improvements/deterioration of the system condition/robustness, operational standards, maintenance practices, etc. | | |
| Readiness of operators and authorities to handle the crisis | ability of TSOs and DSOs to prepare and/or react: <ul style="list-style-type: none"> • availability of backup/support/spare components; • established activation protocol; • availability of clear and precise crisis procedures. readiness of the local and national authorities/TSOs: <ul style="list-style-type: none"> • existence and verification (tests, exercises) of relevant national crisis plans; • existence of a clear/unambiguous chain of command; • legal basis for handling crisis situations. <u>national crisis plans drafted/implemented/verified;</u> readiness/limitations of the relevant rescue/relief services; ability to provide for a cross-border coordination; availability of communication channels; findings concerning the damage susceptibility and/or robustness of the affected persons/elements, incl.: <ul style="list-style-type: none"> • robustness of the transmission system; • match/adequacy of the system response to events; • flexibility of reaction to the scenario; • simulation exercises. | | |
| Other important information related to the scenario relevant to managing it. | | | |

Cross-border dependency rating:

| Section | Item | Considered | Not relevant |
|--|---|------------|--------------|
| Strength and type of cross-border dependencies | Description of cross-border dependencies as a possible aggravating input for the scenario (reliance on assistance from other TSOs); | | |
| | Description of cross-border dependencies as a possible output of the national crisis (decreased ability to assist other TSOs). | | |

| Section | Item | Considered | Not relevant |
|--|---|------------|--------------|
| Interdependencies In the described scenario, will your situation worsen if other TSOs are unable to offer the following support? | Availability of redispatch/counter trading/cross-border exchange of ancillary services to make it possible to inject or to withdraw power from power plants in a certain neighbouring power system; | | |
| | Availability of reactive power (to support system stability); | | |
| | Availability of energy support. | | |
| Interdependencies During the described scenario, would you be able to assist other TSOs in the following fields if they face simultaneous crisis? | Availability of redispatch/counter trading/cross-border exchange of ancillary services to make it possible to inject or to withdraw power from power plants in a certain neighbouring power system; | | |
| | Availability of reactive power (to support system stability); | | |
| | Availability of energy support | | |