
INCIDENTS CLASSIFICATION SCALE METHODOLOGY

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WORKING GROUP INCIDENT CLASSIFICATION SCALE UNDER SYSTEM
OPERATIONS COMMITTEE

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Revisions

| <i>Version</i> | <i>Date</i> | <i>Author</i> | <i>Summary of Changes</i> | <i>Changed Chapters</i> |
|----------------|-------------|---------------|------------------------------------------------|-------------------------|
| <v1.0> | <8-05-2014> | C DUVERT | Final Version for approval by SOC and Assembly | |
| | | | | |
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References and Related documents

- [1] Operational Security Network Code.
- [2] Load-Frequency Control and Reserve Network Code.
- [3] Operational Planning and Scheduling Network Code.

Change request

Each TSO can submit a proposal to change or supplement the Incidents Classification Scale to the SOC for further consideration.

1. Overview

1.1 Objectives and Definitions

This document describes the Incidents Classification Scale (ICS) methodology pursuant to Articles 8.3(a) of the Regulation (EC) 714/2009:

- The Incidents Classification Scale has to be used by each Transmission System Operator (TSO) of the ENTSO-E area.
- Each Transmission System Operator will have to report grid and system incidents on a **four degrees scale (0 to 3)** corresponding to incidents of increasing seriousness up to a general Europe-wide incident.
- Each Transmission System Operator has to define its own internal organization to use the Incidents Classification Scale.
- Depending on the type of incident, Transmission System Operators will exchange data to enable each TSO to investigate.
- Generally, reporting will have to be done by the Transmission System Operator in whose system the incident has occurred and all other Transmission System Operators affected by the original incident – if the consequences in their own systems reach at least Scale 0.

Criteria have been defined by using **definitions** from ENTSO-E network codes and IEC standards.

The incidents in this ICS methodology are reported only if the effects or initiating events occur in the Transmission Network with an operating voltage at or above **220 kV**.

Incidents can be described by one or more of the following statements:

- A deliberate outage of Power Generating Modules or Facilities or load in response to high or low voltage/frequency, over a large part of a Transmission Network.
- Lack of reserve capacity from Power Generating Modules, Demand Side Response or HVDC Systems.
- Lack of transmission transfer capability in the Transmission Network.
- The unplanned and urgent removal from service of part of the transmission system for a reason that is outside the operational control of the TSO.
- Outage due to manual or automatic unintended disconnecting without re-connection.
- Outage due to disconnection with failed re-connection as a result of incident in the Transmission Network.

TSOs shall report all factors which contributed either directly or indirectly to the incidents.

The status of the System State (Alert, Emergency or Black-out) is reported through the ENTSO-E Awareness System (EAS).

EAS is focused on real time consequences of incidents. It means that all the incidents which are declared in the EAS can be categorised according to the scales defined in the ICS.

Real time incidents which do not affect the reliability of the system would not be declared under the EAS. However they would be recorded by TSOs, for example in scale 0, in the ICS database.

The criteria and the messages implemented in EAS are consistent with the performance indicators from NC OS, NC OPS and NC LFC&R. Moreover the thresholds used in EAS will be consistent with the current ICS.

1.2 Application of ICS Methodology

TSOs shall record and report on the incidents occurring between 1st January and 31st December.

2. Reporting Rules Overview

2.1 Fundamental Principles and Responsibilities

The reporting has to be done by the Transmission System Operator in whose system the incident has occurred and by all Transmission System Operators, if the consequences in their own systems reach at least Scale 0.

The specificity of the frequency deviations needs to be reported by an ad hoc organisation per Synchronous Area.

Each Transmission System Operator shall only focus on its own Responsibility Area and report if the causes or consequences of the incidents are covered by the criteria and are in the range of thresholds.

It is obligatory to report the Scale 0 incidents so that they can be used for the internal analysis. In the annual report they will be reflected in a statistical way.

The detailed contents of the data and information necessary for the reporting and analysis of incidents will be defined in accordance with Article 15.5 (e) of the Operational Security Code. This will include the time interval over which dynamic measurements, e.g. frequency, should be averaged.

2.2 Thresholds for Incidents on Power Generating Facilities and Frequency Degradation

For each Synchronous Area the loss of generation and frequency deviation thresholds have been chosen taking into account the different physical characteristics of the area to ensure that the effect of an incident on the operation of the system will be similar for all Synchronous Areas.

2.2.1 Comparison with Transparency Guidelines

Under Commission Regulation 543/2013 (Transparency) TSOs are obliged to obtain and publish data to provide themselves and market participants with an insight into the supply and demand situation from three years ahead down to real time. To enable a detailed analysis of supply and demand, market participants and TSOs also need to have information in regard to unplanned/planned availability and the output of individual generators above a certain capacity threshold. In setting the threshold at 100 MW a balance has been struck between collecting sufficient information for the analysis and avoiding a situation where Power Generating units of limited significance (due to their size) are burdened with providing detailed data.

The ability to withstand a loss of generation infeed is based upon multiple factors including the network design and operational reserve policy. All Synchronous Areas covered by this Methodology are able to withstand a loss greater than 100MW without there being any significant effect on the system. Therefore lowering the threshold to 100 MW to align with the transparency rules would result in unnecessary reporting of incidents.

2.2.2 Variations in Power Generation Incident Thresholds

The thresholds for an incident on Power Generating Facilities vary across the Synchronous Areas. In smaller areas the predominant effect of losing generation infeed is a drop in frequency. This is managed by holding reserves to ensure that, for the loss of the largest credible generation infeed, the frequency will remain within a defined limit. If the loss is greater than this the frequency may fall below this limit and it is therefore appropriate that the loss should be classified as an incident by setting the threshold equal to the largest credible loss. In larger areas the threshold at which a loss of generation infeed is deemed to be an incident is driven by the effects on system flow rather than the drop in frequency. Hence the threshold is dependent on the location of the loss as well as the size so it could be less than the largest credible loss.

In Synchronous Areas where the threshold is set by the size of largest credible loss of generation infeed, there are only a few generators capable of initiating an incident. Whereas in areas where the threshold is set by the effect on system flows there are more generators capable of initiating an event. This difference is likely to result in a difference in the numbers of reported incidents between the Synchronous Areas.

2.2.3 Variations in Frequency Incident Thresholds

The thresholds for reporting frequency degradation incidents vary across the Synchronous Areas. Frequency thresholds are determined by the largest credible loss of generation infeed or demand, the benefits v dis-benefits for the quality of supply and system security of having narrower or wider thresholds and the cost of maintaining frequency.

Based on this principle large systems tend to have narrower thresholds than smaller systems. The reason for this is that larger the system the greater inertia and therefore less frequency responsive plant is required to control frequency per MW of loss and costs are lower. Furthermore larger systems have more providers of frequency services which again tends to reduce the cost. Generally these factors result in the cost of maintaining frequency being less in larger areas than smaller areas hence narrower thresholds can be economically justified.

2.3 Identification of the Different Criteria Related to a Single Incident

Each Transmission System Operator will have to perform following actions:

- To identify, for a single incident, the consequences in its own area.
- To identify if the original incident is internal or external. As the incidents are measured in terms of consequences, it is possible that the Transmission System Operator has to report consequences caused by event, outside its Responsibility Area.
- To characterize the main consequences in its own Responsibility Area.
- Incidents ranked on Scale 1, 2 and 3, may require the collection of information related to the situation before, during and after the incident occurs.

2.4 Characterization of Dominating Criterion

Each Transmission System Operator will have to perform following actions:

- Characterization of dominating criterion in terms of consequence. A priority order has been defined to identify the criterion to use for ranking.
- Any other consequences may be identified as subsidiary criteria.
- Where an incident (knowingly or unknowingly) affects multiple TSOs, each TSO will report on the incident as it affects their Transmission Network. This will aid incident investigation. Where TSOs become aware that multiple incidents were indeed caused by a single incident, such multiple incidents may be combined into a single incident as per the prioritisation in the methodology. An incident report will be prepared (as per the ICS methodology section 5) containing all the system impacts affecting TSOs.

There is a need for integrating incidents which affect a region (i.e. synchronous area) and of incidents of Scale 2 or 3. In these cases, the final integration will be done in a coordinated way by impacted Transmissions System Operators during the investigation phases described in this document.

3. Incidents Classification Scale Description

Each criterion describes “factually” an incident which is observable. Only significant incidents are recorded and classified at their right Scale of gravity.

Incidents Classification Scale counts 4 Scales of gravity corresponding to incidents of growing seriousness up to a general Europe wide incident. It is compliant with System State definitions from the Operational Security Network Code ([1], chapter 2, article 8):

- **Scale 0** for anomaly Local incidents.
- **Scale 1** for noteworthy Local incidents, probability of Wide Area incidents.
- **Scale 2** for extensive Wide Area incidents.
- **Scale 3** for Wide Area incident or major incident on one Transmission System Operator.

3.1 Incidents Classification Scale General Overview

| Scale 0 Anomaly | | Scale 1 Noteworthy incident | | Scale 2 Extensive incidents | | Scale 3 Wide Area incident or major incident / 1 TSO | |
|-------------------------------------------------------|-------------------------------------------------|-------------------------------------------------------|-------------------------------------------------|-------------------------------------------------------|-------------------------------------------------|------------------------------------------------------------|-----------------|
| Priority / Short definition (Criterion short code) | | Priority - Short definition (Criterion short code) | | Priority - Short definition (Criterion short code) | | Short definition (Criterion short code) | |
| #17 | Incidents leading to frequency degradation (F0) | #9 | Incidents on load (L1) | #2 | Incidents on load (L2) | #1 | Black out (OB3) |
| #18 | Incidents on Transmission Network elements (T0) | #10 | Incidents leading to frequency degradation (F1) | #3 | Incidents leading to frequency degradation (F2) | | |
| #19 | Incidents on Power Generating Facilities (G0) | #11 | Incidents on Transmission Network elements (T1) | #4 | Incidents on Transmission Network elements (T2) | | |
| #20 | Violation of standards on voltage (OV0) | #12 | Incidents on Power Generating Facilities (G1) | #5 | Incidents on Power Generating Facilities (G2) | | |
| #21 | Lack of reserve | #13 | N-1 violation (ON1) | #6 | N violation (ON2) | | |
| | | #14 | Violation of standards on voltage (OV1) | #7 | Separation from the grid (RS2) | | |
| | | #15 | Lack of reserve (OR1) | #8 | Loss of tools and facilities (LT2) | | |
| | | #16 | Loss of tools and facilities (LT1) | | | | |

Table 1 - Incidents Classification Scale overview

Criteria Prioritization

The table 2 below, represents criteria in terms of growing seriousness (from left to right). A single criterion dominates all criteria placed to its left.

| Lowest priority | | | | | | | | | | | | | | | | | | | Highest priority | |
|-----------------|-----|----|----|----|-----|-----|-----|-----|----|----|----|----|-----|-----|-----|----|----|----|------------------|-----|
| 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| OR0 | OV0 | G0 | T0 | F0 | LT1 | OR1 | OV1 | ON1 | G1 | T1 | F1 | L1 | LT2 | RS2 | ON2 | G2 | T2 | F2 | L2 | OB3 |

Table 2 - Criteria Prioritization Table

3.2 Scale 0 Considerations

Scale 0 (anomaly) is assigned to Local incidents with low effect on Operational Security:

- The primary failure may have low security influence and/or low market influence consequences.
- After the incident, the system is still in Normal State [1].

Scale 0 includes four criteria.

3.2.1 Scale 0 Criteria General Overview

The following criteria are presented corresponding to Scale 0 priority order.

| Criterion short code | Priority | Criteria short definition |
|----------------------|----------|-------------------------------------------|
| F0 | 1 | Incident leading to frequency degradation |
| T0 | 2 | Incident on Transmission Network elements |
| G0 | 3 | Incidents on Power Generating Facilities |
| OV0 | 4 | Violation of standards on voltage |
| OR0 | 5 | Lack of reserve |

Table 3 - Scale 0 criteria general overview

3.2.2 Scale 0 Criteria #1 – Incidents Leading to Frequency Degradation (F0)

The Annex contains the incident classification matrix dealing with frequency criteria and graphs illustrating (per Synchronous Area) the evolution of the frequency deviation.

Description

Steady State Frequency Deviation. All incidents included in the range of table 4 (see table below) [2] must be reported:

- After Alert State Trigger Time, if the frequency deviation is between 50% of the Maximum Steady State Frequency Deviation and the Maximum Steady State Frequency Deviation, this incident must be reported in Scale 0.
- After Alert State Trigger Time, if the frequency deviation is larger than the Maximum Steady State Frequency Deviation, this incident must be reported in Scale ≥ 1 (see § 3.3.3).
- After Time to Restore Frequency, if the frequency deviation is between the Standard Frequency Range and 50% of the Maximum Steady State Frequency Deviation, this incident must be reported in Scale 0.
- After Time to Restore Frequency, if the frequency deviation is larger than 50% of the Maximum Steady State Frequency Deviation, this incident must be reported in Scale ≥ 1 (see § 3.3.3).

All Steady State Frequency Deviations should be reported, even if there is no loss of generation. There could be other reasons, which should be reported, e.g. driven by market activities, RES, unexpected discrepancies of demand or generation forecasts, etc. Deviation above the threshold is an incident.

| Scale 0 - Normal State | Baltic | Continental Europe | Great Britain | Ireland | Northern Europe | Isolated system |
|-------------------------------------------------|--------|--------------------|---------------|---------|-----------------|-----------------|
| Standard Frequency Range | 50mHz | 50mHz | 200mHz | 200mHz | 100mHz | 100mHz |
| 50% of Maximum Steady State Frequency Deviation | 200mHz | 100mHz | 250mHz | 250mHz | 250mHz | 250mHz |
| Maximum Steady State Frequency Deviation | 400mHz | 200mHz | 500mHz | 500mHz | 500mHz | 500mHz |
| Time to Restore Frequency | 15min | 15min | 10min | 20min | 15min | 20min |
| Alert State Trigger Time | 10min | 5min | 10min | 10min | 5min | 10min |

Table 4 - Scale 0 (Normal State) Steady State Frequency Deviation thresholds

General remarks concerning reporting and incident analysis

Following information should be included in the reporting form to allow a compilation of pan-European statistics. Those statistics will be used to produce an overview of the System Operation performance:

- Time and duration of incident.
- Frequency deviation in the range of the Scale 0 table 4 (\pm xx mHz) and the time needed to restore frequency within the Standard Frequency Range. The counting of time starts the instant the frequency violates the limits of the Standard Frequency Range.
- Estimate of:
 - Load disconnected (MW loss) and time duration.
 - Generation disconnected at different time intervals (MW loss) and time duration.
 - Voltage excursions (voltage level, location, deviation, duration).
- General information regarding number and category of equipment affected by the primary failure (e.g.: 220kV circuit breakers, 330kV overhead lines, HVDC System, 400kV Tie-Lines, transformers).

3.2.3 Scale 0 Criteria #2 – Incidents on Transmission Network Elements (T0)

Description

- Final tripping or manual emergency disconnection of grid equipment 220 kV and higher from Contingency List [1], other Exceptional Contingencies and Out-of-Range Contingencies (to be indicated in the report) if the Operational Security remains within the Operational Security Limits after curative Remedial Actions and has no effect on the available cross border transmission capacity.
- For equipment not capable of automatic reconnection, tripping is deemed to be final if reconnection has not occurred after 3 minutes.
- Tripping of the transmission lines where successful automatic re-closure has occurred is NOT reported.
- Planned manual disconnection of the transmission lines is NOT reported.

General remarks concerning reporting and incident analysis

The following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the System Operation performance:

- General information regarding equipment affected by the primary failure e.g.: 220kV circuit breakers, 330kV overhead lines, HVDC System, 400kV Tie-Lines, transformers.
- Number of equipment affected by the primary failure and final tripping time duration.
- An estimate of:
 - Load disconnected (MW loss) and time duration.
 - Generation disconnected (MW loss) and reserve properties.
 - Voltage excursions (voltage level location, deviation, duration).
- The unplanned and urgent removal from service of part of the transmission system for a reason that is outside the operational control of the TSO

3.2.4 Scale 0 Criteria #3 – Incidents on Power Generating Facilities (G0)

Description

- Unexpected reduction or disconnection from the grid of Power Generating Facilities connected to Transmission System or Distribution Network in one Responsibility Area with an output greater than the thresholds in table 5 in less than 30 minutes.
- Table 5 below contains the thresholds defined for each Synchronous Area and isolated systems (from a minimal threshold defined specifically for each Synchronous Area and isolated systems to the tripping of the most important power station in the Transmissions System Operator area).

| Scale 0 Normal State | Baltic | Continental Europe | Great Britain | Ireland | Northern Europe | Isolated system |
|----------------------|-----------------------|------------------------|-------------------------|-----------------------|-------------------------|------------------------|
| Thresholds | from 200 MW to 450 MW | from 600 MW to 1500 MW | from 1320 MW to 1800 MW | from 200 MW to 500 MW | from 1200 MW to 1500 MW | Biggest unit in system |

Table 5 - Thresholds for incidents on generation facilities - Scale 0

- There should be no distinction between reduced or total loss of infeed from a Power Generating Facility failure of several Power Generating Facilities or Power Generating Modules (in overlapping periods of time) is considered combined.
- If an incident in a Power Generating Facility forces it to reduce infeed into the Transmission Network by a certain percentage (<100%) of the momentarily scheduled feed-in, this incident will have to be reported if the power thresholds are reached. Actually, this kind of generation reduction needs the same containment and restoration reserves, so it has to be treated as disconnection of certain capacity.
- If in 30 minutes the loss of generation reaches the thresholds it should be reported. If the criteria is reached immediately it should be reported even if it lasted for less than 30 minutes.
- The number of generators in Great Britain and Northern Europe which could trigger a Scale 0 incident is much less than in the other Synchronous Areas. This difference will be reflected in the number of reported incidents i.e. fewer in GB and Northern Europe.

General remarks concerning reporting and incident analysis

The following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the system operation performance:

- Generation disconnected at different time intervals (MW loss) and time duration.
- An estimate of:
 - Load disconnected (MW loss) and time duration.
 - Voltage excursions (voltage level, location, deviation, duration).
- General information regarding number and category of equipment affected by the primary failure.

3.2.5 Scale 0 Criteria #4 – Degradation in Operational Conditions – Voltage (OV0)

Description

- All Synchronous Areas: network node operated at steady state voltage outside the range defined in the tables 6 and 7 below [1] for between 5min and 15min.
- Voltage incidents outside the range defined in table 6 and 7 of a duration less than 5 min are not reported.

| Scale 1 Alert State | Baltic | Continental Europe | Great Britain | Ireland (Ireland offshore) | Northern Europe |
|---------------------|-------------------|--------------------|-------------------|-------------------------------------------|-------------------|
| Thresholds | 0.90 pu – 1.12 pu | 0.90 pu – 1.118 pu | 0.90 pu – 1.10 pu | 0.90 pu – 1.118 pu (0.90 pu – 1.10 pu) | 0.90 pu – 1.05 pu |
| Time duration | Unlimited | | | | |

Table 6 - Voltage ranges for reference voltages between 110 kV to 300 kV (excluding)

| Scale 1 Alert State | Baltic | Continental Europe | Great Britain | Ireland (Ireland offshore) | Northern Europe |
|---------------------|-------------------|---------------------------------------------------------------------------------|---------------|----------------------------|-----------------|
| Thresholds | 0.90 pu – 1.10 pu | 0.90 pu – 1.05 pu or 1.0875 pu (according to the NC RfG) (0.90 pu – 1.10 pu) | | | |
| Time duration | Unlimited | | | | |

Table 7 - Voltage ranges for reference voltages between 300 kV to 400 kV

- Isolated systems: network node operated at voltage exceeding voltage $\pm 10\%$ of the pre-incident level (downward or upward) for 15 minutes.

General remarks concerning reporting and incident analysis

The following information should be included in the reporting form to allow elaboration and compilation of pan-European statistics. Those statistics will be used to produce an overview of the System Operation performance:

- Description of voltage excursions (voltage level, location, deviation, duration).
- An estimate of:
 - Load disconnected (MW loss) and time duration.

- Generation disconnected (MW loss) if it is not included in the Scale 0 incidents on Power Generating Facilities range.
- General information regarding number and category of equipment affected by the primary failure (e.g.: 220kV circuit breakers, 330kV overhead lines, HVDC Systems, 400kV Tie-Lines, transformers)

3.2.6 **Scale 0 Criteria #5 – Lack of Reserve (OR0)**

- Lack of more than 20% of Frequency Restoration Reserve capacity [1] and [2] in a Responsibility Area between 15 minutes and 30 minutes. This criteria applies to all Synchronous Areas and isolated systems.
- When assessing the time duration of lack of reserve incidents an allowance has to be made for the inherent time delay between an incident occurring and restoration of reserve levels back to the normal state.

3.3 **Scale 1 Considerations**

Scale 1 is assigned to noteworthy incidents and Wide Area incidents affecting one Synchronous Area or more than one Transmission System Operator and could lead to an Emergency State.

- The primary failure may have security influence and/or market influence or cause violation of Operational Security limits.
- In the case of isolated systems, Scale 1 applies to incidents that lead to load shedding activation or serious degradation of operational conditions.
- Those incidents may lead to operational incident on other Transmission System Operators, OR N-1 violation, OR consequences on capability of exchange, OR leading to reliability degradation.

If a TSO announces the Alert State [1] in the EAS system, it should be based on the criteria in Scale 1. But not all incidents of Scale 1 necessarily lead to the Alert State.

Scale 1 contains eight criteria.

3.3.1 **Scale 1 Criteria General Overview**

The following criteria are presented in table 8 corresponding to Scale 1 priority order.

| Criterion short code | Priority | Criteria short definition |
|----------------------|----------|--------------------------------------------|
| L1 | 1 | Incidents on load |
| F1 | 2 | Incidents leading to frequency degradation |
| T1 | 3 | Incidents on Transmission Network elements |
| G1 | 4 | Incidents on Power Generating Facilities |
| ON1 | 5 | N-1 violation |
| OV1 | 6 | Violation of standards on voltage |
| OR1 | 7 | Lack of reserve |
| LT1 | 8 | Loss of tools and facilities |

Table 8 - Scale 1 Criteria general overview

3.3.2 Scale 1 Criteria #1 – Incidents on Load (L1)

Description

- All Synchronous Areas: Energy Not Supplied (MWh) after disconnection of load representing from 1 to 10% of estimated load of TSO just prior to the time of the incident (MW) where the incident lasted longer than three minutes. A disconnection of load less than 200 MW need not be reported.
- Isolated systems: load shedding from 5% to 15% of load at the time of the incident. There is no minimal time duration of disconnection.

General remarks concerning reporting and incident analysis

Following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the System Operation performance:

- An estimate of load disconnected (MW loss) and time duration.
- An estimate of:
 - Generation disconnected at different time intervals (MW loss) and time duration.
 - Frequency deviation at different time intervals if it is equal to or greater than the Scale 0 frequency thresholds (F0) table.
 - Secondary reserve properties and time duration within which there was a lack of reserves identified.
 - Voltage excursions (voltage level, location deviation, duration).
 - If Alert State was declared and time duration as reported in EAS.
- General information regarding number and category of equipment affected by the primary failure (e.g.: 220kV circuit breakers, 330kV overhead lines, HVDC Systems, 400kV Tie-Lines, transformers...).
- Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation, capacity calculation, security assessment, etc.

3.3.3 Scale 1 Criteria #2 – Incidents Leading to Frequency Degradation (F1)

The Annex contains the incident classification matrix dealing with frequency criteria and graphs illustrating the evolution of the frequency deviation.

Description

Steady State Frequency deviation. All incidents included in the range of the table 9 (see table below) must be reported and qualified as an **Alert State**:

- After Alert State Trigger Time, if the frequency deviation is larger than the Maximum Steady State Frequency Deviation, this incident must be reported in Scale 1.
- After Time to Restore Frequency, if the frequency deviation is between 50% of the Maximum Steady State Frequency Deviation and the Maximum Steady State Frequency Deviation mentioned in table 9, this incident must be reported in Scale 1.
- After Time to Restore Frequency, if the frequency deviation is above the Maximum Steady State Frequency Deviation mentioned in table 9, this incident must be reported in Scale 2 (see § 3.4.3).

All deviations of the frequency should be reported, even if there is no loss of generation. There could be other significant reasons, e.g. driven by market activities, unexpected discrepancies of demand or generation forecasts, etc. deviation above the threshold is already an incident.

| Scale 0 - Normal State | Baltic | Continental Europe | Great Britain | Ireland | Northern Europe | Isolated system |
|-------------------------------------------------|--------|--------------------|---------------|---------|-----------------|-----------------|
| Standard Frequency Range | 50mHz | 50mHz | 200mHz | 200mHz | 100mHz | 100mHz |
| 50% of Maximum Steady State Frequency Deviation | 200mHz | 100mHz | 250mHz | 250mHz | 250mHz | 250mHz |
| Maximum Steady State Frequency Deviation | 400mHz | 200mHz | 500mHz | 500mHz | 500mHz | 500mHz |
| Time to Restore Frequency | 15min | 15min | 10min | 20min | 15min | 20min |
| Alert State Trigger Time | 10min | 5min | 10min | 10min | 5min | 10min |

Table 9 - Scale 1 (Alert State) Steady State Frequency Deviation thresholds

General remarks concerning reporting and incident analysis

Following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the System Operation performance:

- Time and duration of incident;
- Frequency deviation in the range of the Scale 1 table 9 ($\pm xx$ mHz) and Time to Restore Frequency [2]. The counting of time starts after frequency violates the limits of the Standard Frequency Range.
- An estimate of :
 - Load disconnected (MW loss) and disconnection time duration if the figure is not included in the Scale 1 Incidents on load (L1) range.
 - Generation disconnected at different time intervals (MW loss).
 - Voltage excursions (voltage level, location, deviation, duration).
 - Alert State time duration as reported in EAS.
 - Frequency Restoration Reserve properties and time duration within which there was a lack of FRR identified.
- General information regarding number and category of equipment affected by the primary failure.
- Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation.
- Discrepancy of demand (difference in MW between the forecast and the real time estimation of demand)
- Discrepancy of generation (difference in MW between the forecast and the real time estimation of generation)

3.3.4 Scale 1 Criteria #3 – Incident on Transmission Network Elements (T1)

Description

- Final tripping or manual emergency disconnection of grid equipment from Contingency List [1], other Exceptional Contingencies and Out-of-Range Contingencies (to be indicated in the report) with consequences on Responsibility Area or/and the available cross border transmission capacity. (e.g. final tripping of cross border Tie-Lines or “internal” equipment of one Transmission System Operator limiting cross border transmission capacity).

- For equipment not capable of automatic reconnection, tripping is deemed to be final if reconnection has not occurred after 3 minutes.
- Tripping of transmission lines where successful automatic re-closure has occurred is NOT reported.

Planned manual disconnection of transmission lines is NOT reported.

General remarks concerning reporting and incident analysis

The following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the System Operation performance:

- General information regarding equipment affected by the primary failure (e.g.: 220kV circuit breakers, 330kV overhead lines, HVDC System, 400kV Tie-Lines, transformers...).
- Number of equipment affected by the primary failure and final tripping time duration.
- An estimate of :
 - Generation disconnected and/or load disconnected (if not included in the Scale 1 Incidents on load (L1) table) at different time intervals (MW loss) and disconnection time duration.
 - Voltage excursions (voltage level, location, deviation, duration).
 - If Alert State was declared and time duration as reported in EAS.
 - Frequency Restoration Reserve properties and time duration within which there was a lack of FRR identified.
 - Frequency deviation at different time intervals if it is equal to or greater than the Scale 0 frequency thresholds (F0) table.
- Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation.
- Manual emergency disconnection means all unplanned switching of transmission equipment regardless of its impact on the network security.
- Remedial actions implemented

3.3.5 Scale 1 Criteria #4 – Incidents on Power Generating Facilities (G1)

Description

- Unexpected reduction or disconnection from the grid of Power Generating Facilities connected to Transmission System or Distribution Network in one Control Block with an output greater than the thresholds in table 10 in less than 30 minutes

| Scale 1 Alert State | Baltic | Continental Europe | Great Britain | Ireland | Northern Europe | Isolated system |
|---------------------|-----------------------|-------------------------|-------------------------|-----------------------|-------------------------|-------------------------------|
| Thresholds | from 450 MW to 900 MW | from 1500 MW to 3000 MW | from 1800 MW to 3000 MW | from 500 MW to 850 MW | from 1500 MW to 3000 MW | Larger than the biggest unit. |

Table 10 - Thresholds for incidents on Power Generating Facilities - Scale 1

- If an incident in a Power Generating Facility forces it to reduce infeed into the Transmission Network by a certain percentage (<100%) of the momentarily scheduled feed-in, this incident will have to be reported if the power thresholds are reached. Actually, this kind of generation reduction needs the same Frequency Containment Reserves and Frequency Restoration Reserves, so it has to be treated as disconnection of certain capacity.
- If in 30 minutes the loss of generation reaches the thresholds it should be reported. If the criteria is reached immediately it should be reported even if it lasted shorter than 30 minutes.

General remarks concerning reporting and incident analysis

The following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the system operation performance:

- An estimation of generation disconnected at different time intervals (MW loss) and time duration.
- An estimation of:
 - Load disconnected (MW loss) and time duration if the figure is not included in the Scale 1 Incidents on load (L1) range.
 - Frequency Restoration Reserve deficit (amount and percentage) and time duration of the deficit.
 - Voltage excursions (voltage level, location, deviation, duration).
 - If Alert State was declared and time duration as reported in EAS.
 - Frequency deviation at different time intervals if it is equal to or greater than the Scale 0 frequency thresholds (F0) table.
- General information regarding number and category of equipment affected by the primary failure.
- Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation.

3.3.6 Scale 1 Criteria #5 – Degradation in Operational Conditions – N-1 Violation (ON1)

Description

- At least one Contingency from the Contingency List can lead to deviations from Operational Security Limits, even after effects of Remedial Actions.
- If after a Contingency the Transmission System is not compliant with the (N-1)-Criterion, the TSO shall initiate Remedial Actions to recover compliance with the (N-1) Criterion as soon as reasonably practicable. If there is a risk of a post-Contingency incident propagation involving interconnected TSOs, the TSO shall initiate Remedial Actions as soon as possible. Non-compliance with the (N-1) Criterion is acceptable:
 - During switching sequences.
 - As long as there are only Local consequences within the TSO's Responsibility Area.
 - During the time period required to activate the Remedial Actions.
- This criterion does not apply to isolated systems.

General remarks concerning reporting and incident analysis

The following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the system operation performance:

- Description of the N-1 situation (transmission equipment affected, Remedial Actions, identification of Out-of-Range Contingencies, etc.).
- An estimate of:
 - Generation disconnected, if not included in the Scale 1 Incidents on Power Generating Facilities (G1) table) and/or load disconnected, if not included in the Scale 1 Incidents on load (L1) table at different time intervals (MW loss) and time duration.
 - Frequency deviation at different time intervals if it is equal to or greater than the Scale 0 frequency thresholds (F0) table.
 - Voltage excursions (voltage level, location, deviation, duration).
 - Alert State time duration as reported in EAS.

- Frequency Restoration Reserve deficit (amount and percentage) and time duration of the deficit.
- General information regarding number and category of transmission equipment affected by the primary failure (e.g.: 220kV circuit breakers, 330kV overhead lines, HVDC Systems, 400kV Tie-Lines, transformers, etc.).
- Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation.
- Time duration of the violation

3.3.7 Scale 1 Criteria #6 – Degradation in Operational Conditions – Voltage (OV1)

Description

- Network node operated at steady state voltage outside the range defined in the tables 11 and 12 below [1] for more than 15 minutes.
- This criterion does not apply to isolated systems.

| Scale 1 Alert State | Baltic | Continental Europe | Great Britain | Ireland (Ireland offshore) | Northern Europe |
|---------------------|-------------------|--------------------|-------------------|-------------------------------------------|-------------------|
| Thresholds | 0.90 pu – 1.12 pu | 0.90 pu – 1.118 pu | 0.90 pu – 1.10 pu | 0.90 pu – 1.118 pu (0.90 pu – 1.10 pu) | 0.90 pu – 1.05 pu |
| Time duration | Unlimited | | | | |

Table 11 - Voltage ranges for reference voltages between 220 kV to 300 kV (excluding)

| Scale 1 Alert state | Baltic | Continental Europe | Great Britain | Ireland (Ireland offshore) | Northern Europe |
|---------------------|-------------------|---------------------------------------------------------------------------------|---------------|----------------------------|-----------------|
| Thresholds | 0.90 pu – 1.10 pu | 0.90 pu – 1.05 pu or 1.0875 pu (according to the NC RfG) (0.90 pu – 1.10 pu) | | | |
| Time duration | Unlimited | | | | |

Table 12 - Voltage ranges for reference voltages between 300 kV to 400 kV

General remarks concerning reporting and incident analysis

- Description of the situation (transmission equipment affected, Remedial Actions).
- An estimate of:
 - Generation disconnected, if not included in the Scale 1 Incidents on Power Generating Facilities (G1) table and/or load disconnected, if not included in the Scale 1 Incidents on load (L1) table at different time intervals (MW loss) and disconnection time duration.
 - Voltage excursions (voltage level, location, deviation, duration).
 - If Alert State was declared and time duration as reported in EAS.
 - Frequency Restoration Reserve deficit (amount and percentage) and time duration of the deficit.
 - Frequency deviation at different time intervals if it is equal to or greater than the Scale 0 frequency thresholds (F0) table.
- General information regarding number and category of transmission equipment affected by the primary failure.

- Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation.

3.3.8 Scale 1 Criteria #7 – Degradation in Operational Conditions – Lack of Reserve (OR1)

Description

- Lack of more than 20% of Frequency Restoration Reserve capacity [1] and [2] on a Responsibility Area for at least 30 minutes for all Synchronous Areas and isolated systems.

It is recognised that the evaluation of the lack of reserves could constitute an issue in itself because the reserves are restored some time after the incident during which Transmission System Operators do not have sufficient reserves. To report these incidents, Transmission System Operators will act according to the existing rules (regional, national grid codes or agreements and NCs) and if the reserves are restored accordingly, Transmission System Operators do not have to report the temporary lack of reserves.

- The number of incidents leading to degradation in system operation conditions due to lack of Active Power Reserves (Indicator OPS 3 [3]).

General remarks concerning reporting and incident analysis

The following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the system operation performance:

- An estimate of Frequency Restoration Reserve deficit and time duration of the deficit.
- An estimate of:
 - loss of generation (amount of MW), if not included in the Scale 1 Incidents on Generation Facilities (G1) table, and/or load, if not included in the Scale 1 Incidents on load (L1) table disconnected at different time intervals (MW loss) and time duration.
 - Frequency deviation at different time intervals if it is equal to or greater than the Scale 0 frequency thresholds (F0) table.
 - Voltage excursions (voltage level, location, deviation, duration).
 - Alert State time duration as reported in EAS.
 - Frequency Restoration Reserve deficit (amount and percentage) and time duration of the deficit.
- General information regarding number and category of transmission equipment affected by the primary failure (e.g.: 220kV circuit breakers, 330kV overhead lines, HVDC Systems, 400kV Tie-Lines, transformers, etc.).
- Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation.

3.3.9 Scale 1 Criteria #8 – Degradation in operational conditions – Loss of tools and facilities (LT1)

Description

- The TSO has a loss of one or more real time tools and facilities for more than 30 minutes. If all the tools and facilities are lost, this incident must be reported in Scale 2 criteria 7 (paragraph 3.5.8). The referred tools and facilities are:
 - Facilities and tools for monitoring the system State of the Transmission System, including State Estimation applications, EAS.
 - Means for controlling isolators and circuit breakers.
 - Means of communication with control centres of other TSOs.
 - Tools for Operational Security Analysis.

General remarks concerning reporting and incident analysis

Following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the System Operation performance:

- If Alert State was declared and time duration.
- Origin of the incident (software bug, hardware failure, loss of data lines ...).
- List of measures which have been activated to cope with the incident.
- General information regarding number and category of equipment affected by the primary failure.

Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation.

3.4 Scale 2 Considerations

Scale 2 (extensive incidents) is assigned to Wide Area regional incidents (covering Synchronous Area, or beyond Responsibility Areas and Member States due to extensive incidents. The primary failure may lead to:

- Degradation of System Adequacy with the necessity to activate at least one measure of the System Defence Plan [1].
- Operational incident on a regional scale with N-1 violation or load shedding reported on two Transmission System Operators or more.

If a TSO announces the Emergency State [1] in the EAS, it should be based on any criteria in Scale 2.

Scale 2 contains seven criteria.

3.4.1 Scale 2 Criteria General Overview

The following criteria are presented corresponding to Scale 2 priority order.

| Criterion short code | Priority | Criteria short definition |
|----------------------|----------|--------------------------------------------|
| L2 | 1 | Incidents on load |
| F2 | 2 | Incidents leading to frequency degradation |
| T2 | 3 | Incidents on Transmission Network elements |
| G2 | 4 | Incidents on Power Generating Facilities |
| ON2 | 5 | N violation |
| RS2 | 6 | Separation from the grid |
| LT2 | 7 | Loss of tools and facilities |

Table 13 - Scale 2 Criteria general overview

3.4.2 Scale 2 Criteria #1 – Incidents on Load (L2)

Description

- All Synchronous Areas: Energy Not Supplied (MWh) after disconnection of load representing from 10 to 50% of estimated load of TSO just prior to the time of the incident (MW) where incident lasted greater than 3 (three) minutes.
- Isolated systems: load shedding from 15% to 70% of load at the time of the incident. There is no minimal time duration of disconnection.

General remarks concerning reporting and incident analysis

The following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the System Operation performance:

- An estimate of load disconnected (MW loss) and disconnection time duration.
- A list of System Defence Plan measures which have been activated to cope with the incident.
- An estimate of:
 - Generation disconnected at different time intervals (MW loss) and disconnection time duration.
 - Frequency deviation at different time intervals (deviation, duration).
 - Frequency Restoration Reserve deficit (amount and percentage) and time duration of the deficit.
 - Voltage excursions (voltage level, location, deviation, duration).
 - Emergency State time duration, as reported in EAS.
- General information regarding number and category of transmission equipment affected by the primary failure (e.g.: 220kV circuit breakers, 330kV overhead lines, HVDC Systems, 400kV Tie-Lines, transformers, etc.).
- Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation, capacity calculation, security assessment, etc.

3.4.3 Scale 2 Criteria #2 – Incidents Leading to Frequency Degradation (F2)

The Annex contains the incident classification matrix dealing with frequency criteria and graphs illustrating the evolution of the frequency deviation.

Description

All incidents included in the range of the table 14 [2] must be reported:

- After Time to Restore Frequency, if the frequency deviation is above the Maximum Steady State Frequency Deviation range mentioned in table 14, this incident must be reported in Scale 2.

All deviations of the frequency should be reported, even if there is no loss of generation. There could be other significant reasons, e.g. driven by market activities, unexpected discrepancies of demand or generation forecasts, etc. deviation above the threshold is already an incident.

| Scale 2 / Emergency State | Baltic | Continental Europe | Great Britain | Ireland | Northern Europe | Isolated system |
|------------------------------------------------------|---------|-----------------------|------------------|---------|--------------------|-----------------|
| Maximum Steady State Frequency Deviation range | >400mHz | >200mHz | >500mHz | >500mHz | >500mHz | >500mHz |
| Time to Restore Frequency | 15min | 15min | 10min | 20min | 15min | 20min |

Table 14 - Scale 2 (Emergency State) Steady State Frequency Deviation thresholds

General remarks concerning reporting and incident analysis

The following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the system operation performance:

- Time and duration of incident.
- Frequency deviation in the range of the Scale 2 table 14 (\pm xx mHz) and Time to Restore Frequency [2]. The counting of time starts after frequency violates the limits of the Standard Frequency Range.
- A list of System Defence Plan measures which have been activated.
- An estimate of:
 - Generation and/or load, if the figure is not included in the Scale 2 Incidents on load (L2) or Incidents on Power Generating Facilities (G2), disconnected (MW loss) and disconnection time duration.
 - Frequency Restoration Reserve deficit (amount and percentage) and time duration of the deficit.
 - Emergency State time duration as reported in EAS.
 - Voltage excursions (voltage level, location, deviation, duration).
- General information regarding number and category of transmission equipment affected by the primary failure.
- Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation.

3.4.4 Scale 2 Criteria #3 – Incidents on Transmission Network elements (T2)

Description

- Final tripping or manual emergency disconnection of grid equipment (including HVDC Systems) from Contingency List [1], other Exceptional Contingencies and Out-of-Range Contingencies (to be indicated in the report) with Wide Area consequences on Synchronous Area or regional level (i.e. beyond both Responsibility and Member States Area) with necessity to activate at least one measure of the System Defence Plan [1].
- This criterion does not apply to isolated systems.

General remarks concerning reporting and incident analysis

The following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the system operation performance:

- General information regarding transmission equipment affected by the primary failure (e.g.: 220kV circuit breakers, 330kV overhead lines, HVDC System, 400kV Tie-Lines, transformers, etc.).
- Number of transmission equipment affected by the primary failure and final tripping time duration.
- A list of System Defence Plan measures which have been activated to cope with the incident.
- An estimate of:
 - Generation and/or load, if the figure is not included in the Scale 2 Incidents on load (L2) or Incidents on Power Generating Facilities (G3), disconnected (MW loss) and disconnection time duration.
 - Voltage excursions (voltage level, location, deviation, duration).
 - Emergency State time duration as reported in EAS.
 - Frequency Restoration Reserve deficit (amount and percentage) and time duration of the deficit.
 - Frequency deviation at different time intervals (deviation, duration).if it is not included in the Scale 2 Frequency thresholds (F2) table.

- Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation.
- Manual emergency disconnection means all unplanned switching of transmission equipment regardless of its impact on the network security.

3.4.5 **Scale 2 Criteria #4 – Incidents on Power Generating Facilities (G2)**

Description

- Unexpected reduction or disconnection from the grid of Power Generating Facilities connected to Transmission System or Distribution Network in one Control Block with an output greater than the thresholds in table 15 in less than 30 minutes.

| Scale 2 Emergency State | Baltic | Continental Europe | Great Britain | Ireland | Northern Europe | Isolated system |
|----------------------------|----------|-----------------------|---------------|----------|--------------------|--------------------------------------------------|
| Thresholds | > 900 MW | > 3000 MW | > 3000 MW | > 850 MW | > 3000 MW | power plant with the biggest units in the system |

Table 15 - Thresholds for incidents on generation facilities - Scale 2

General remarks concerning reporting and incident analysis

The following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the system operation performance:

- An estimate of generation disconnected at different time intervals (MW loss) and disconnection time duration.
- A list of System Defence Plan measures which have been activated to cope with the incident.
- An estimate of:
 - Load disconnected (MW loss) and disconnection time duration if the figure is not included in the Scale 2 Incidents on load (L2) range.
 - Emergency State time duration as reported in EAS.
 - Voltage excursions (voltage level, location, deviation, duration).
 - Frequency deviation at different time intervals if it is not included in the Scale 2 Frequency thresholds (F2) table.
 - Frequency Restoration Reserve deficit (amount and percentage) and time duration of the deficit.
- General information regarding number and category of transmission equipment affected by the primary failure.
- Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation.

3.4.6 **Scale 2 Criteria #5 – Degradation in Operational Conditions – N Violation (ON2)**

Description

- There is at least one Wide Area deviation from Operational Security Limits after effects of Remedial Actions.
- This criterion does not apply to isolated systems.

General remarks concerning reporting and incident analysis

The following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the system operation performance:

- Description of the N situation (transmission equipment affected, Remedial Actions, identification of Out of Range Contingencies, etc.).
- An estimate of:
 - Generation disconnected, if not included in the Scale 2 Incidents on Power Generating Facilities (G2) table, and/or load disconnected, if not included in the Scale 2 Incidents on load (L2) table, at different time intervals (MW loss) and disconnection time duration.
 - Frequency deviation at different time intervals, if it is not included in the Scale 2 Frequency thresholds (F2) table.
 - Voltage excursions (voltage level, location, deviation, duration).
 - Emergency State time duration as reported in EAS.
 - Frequency Restoration Reserve deficit (amount and percentage) and time duration of the deficit.
- General information regarding number and category of transmission equipment affected by the primary failure (e.g.: 220kV circuit breakers, 330kV overhead lines, HVDC Systems, 400kV Tie-Lines, transformers, etc.).
- Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation.

3.4.7 Scale 2 Criteria #6 – Reliability Degradation – Separation from the Grid (RS2)

Description

- System incident leading to separation of a significant part from the grid representing at least one Transmission System Operator Responsibility Area.
- This criterion does not apply to isolated systems.

General remarks concerning reporting and incident analysis

Following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the System Operation performance:

- Description of the grid separation (number of substations, rough estimate of load/generation separated (MW)).
- A list of System Defence Plan measures which have been activated to cope with the incident.
- An estimate of:
 - Load, if the figure is not included in the Scale 2 Incidents on load (L2) range, disconnected (MW loss) and disconnection time duration.
 - Emergency State time duration as reported in EAS.
 - Frequency deviation at different time intervals if it is not included in the Scale 2 Frequency thresholds (F2) table.
 - Frequency Restoration Reserve deficit (amount and percentage) and time duration of the deficit.
 - Voltage excursions (voltage level, location, deviation, duration).
- General information regarding number and category of transmission equipment affected by the primary failure.
- Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation.

- Time duration of the violation

3.4.8 Scale 2 Criteria #7 – Loss of Tools and Facilities (LT2)

Description

- The TSO has a complete loss of all real time tools and facilities for more than 30 minutes. The referred tools and facilities are:
 - Facilities and tools for monitoring the system State of the Transmission System, including State Estimation applications, EAS.
 - Means for controlling isolators and circuit breakers.
 - Means of communication with control centres of other TSOs.
 - Tools for Operational Security Analysis.

General remarks concerning reporting and incident analysis

The following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the System Operation performance:

- Emergency State time duration as reported in EAS.
- Origin of the incident (software bug, hardware failure, loss of data lines).
- List of System Defence Plan measures which have been activated to cope with the incident.
- An estimate of:
 - Load, if the figure is not included in the Scale 2 Incidents on load (L2) range, disconnected (MW loss) and disconnection time duration.
 - Frequency deviation at different time intervals if it is not included in the Scale 2 Frequency thresholds (F2) table.
 - Frequency Restoration Reserve deficit (amount and percentage) and time duration of the deficit.
 - Voltage excursions (voltage level, location, deviation, duration).
- General information regarding number and category of transmission equipment affected by the primary failure.
- Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation.

3.5 Scale 3 Considerations

Scale 3 is assigned to major Wide Area incidents.

After the incident occurs, the system is in Blackout State [1].

Scale 3 counts only one criterion which is Blackout (OB3).

Description

- At least one TSO declares a Blackout State [1].
- This criterion does not apply to isolated systems.

OR

- For all Synchronous Areas: loss of more than 50% of the estimated load in the Responsibility Area just prior to the time of the incident (MW) or
- A total absence of voltage in the system lasting for more than 3 minutes and the initiation of restoration plans.
- For isolated systems: 70% of load (load-shedding) at the time of the incident or total shut down.

General remarks concerning reporting and incident analysis

The following information should be included in the reporting form to allow the compilation of pan-European statistics. Those statistics will be used to produce an overview of the system operation performance:

- Description of the grid collapse (number of substations, an estimate of load/generation disconnected (MW)).
- List of System Defence Plan measures which have been activated to cope with the incident.
- General information:
 - If data available, an estimate of Frequency Restoration Reserve properties and time duration within which a lack of FRR was identified.
 - Blackout State time duration as reported in EAS.
 - General information regarding number and category of transmission equipment affected by the primary failure (e.g.: 220kV circuit breakers, 330kV overhead lines, HVDC Systems, 400kV Tie-Lines, transformers, etc.).
 - Global description at different time intervals of cross-border transfer capacity impact and/or consequences on market operation, capacity calculation, security assessment, etc.
- Overview of the system response:
 - Description of frequency response at different time intervals before collapse (deviation, duration).
 - Description of voltage excursions before collapse (voltage level, location, deviation, duration).
 - If data available, an estimate of generation disconnected at different time intervals (MW loss).

The criteria should be reported if the reason is unexpected discrepancies of demand or generation forecasts.

4. Pan-European ICS Annual Reports

The European-wide Incidents Classification Scale will allow ENTSO-E and Transmission System Operators each year to draw up an ICS Annual Report, with figures and qualitative analysis, producing an overview of the system operation performance. It will represent a real opportunity for Synchronous Areas and isolated systems to characterize main issues and to identify means of improvement. Therefore, the ICS Annual Report shall, at least, contain the following information:

- Operational Security Performance Indicators per Synchronous Area, isolated systems, or any other geographical region with electrical interdependencies between the TSOs' Responsibility Areas according to thresholds of levels 1-3:
 - Number of tripped Transmission Network elements.
 - Number of tripped Power Generating Facilities per year.
 - Energy [MWh] of disconnected Demand Facilities per year.
 - Time duration of being in Operational States other than Normal State (Alert, Emergency, Blackout).
 - Time duration and number of incidents (indicator OPS 3 [3]) within which there was a lack of reserves identified.
 - Voltage deviation exceeding the voltage thresholds.
 - Frequency deviation per Synchronous Area.
 - Number of system-split separations or local blackouts.
 - Number of blackouts involving two or more TSOs.

- Explanation of reasons for incidents at the Operational Security Ranking Scales 2 and 3.
- The number of incidents:-
 - in which an incident contained in the Contingency List [1] led to a degradation of system operation conditions (Indicator OPS 1A [3]).
 - counted by indicator OPS 1A in which a degradation of system operation conditions occurred as a result of unexpected discrepancies of demand or Generation forecasts (indicator OPS 1B [3]).
 - in which there was a degradation in system operation conditions due to an Out-of-Range Contingency (Indicator OPS 2A [3]).
 - counted by indicator OPS 2A in which a degradation of system operation conditions occurred as a result of unexpected discrepancies of demand or Generation forecasts (indicator OPS 2B [3]).

The ICS Annual Reports will be published in ENTSO-E website.

5. Incident Analysis

5.1 Use of information Included in the Reporting Form

Each time a new incident is recorded (no matter its scale of gravity), it is important to provide the available information necessary for a quick evaluation of the system response.

For instance, if the Transmission System Operator is able to provide general comments about category of equipment affected by the primary failure while recording Scale 0 incidents on load (L0), then, it will be possible to elaborate pan-European statistics about availability of transmission system elements and its consequences on large disconnections of load.

The information provided by the Transmission System Operator will be used to compile pan-European statistics. Then, while producing the pan-European ICS Annual Report, ENTSO-E will use those statistics to produce an overview of the system operation performance.

In the future, ENTSO-E will accumulate information on incidents to bring decisive improvements for any activities conducted by Transmission System Operators prior to real time operation:

- Classification of both high and low impact incidents to isolate key issues.
- Communication among Transmission System Operators with the definition of a proper organization to pave the way for incorporating key lessons in processes.
- Incorporation of lessons learnt into process assets and feedbacks.

5.2 Ex-post Analysis and Detailed Reports

In some situations the information recorded in the reporting form will be insufficient to perform a full evaluation of the system response. Consequently, it is vital to determine the correct Scale to launch ex-post incident analysis. The main objective is to ensure that all the incidents which have significantly affected the integrity of interconnected system operations are analysed.

The investigation procedure aims at defining:

- Agreed criteria to decide specific ex-post analysis.
- The data needed to run ex-post analysis.
- The items to be dealt with.
- The organization to perform ex-post analysis.
- Main milestones about the realization of ex-post analysis.

5.2.1 Scale 0 Incidents

The incidents related to Scale 0 have very low effect on reliability (the primary failure may have very low security influence and/or low market influence consequences) so there is no obligation to run specific analysis on those incidents.

This Scale 0 was created to allow ENTSO-E to run statistical analysis and Transmission System Operators to report incidents for internal purposes.

5.2.2 Scale 1 Incidents

The incidents related to Scale 1 do not significantly affect the integrity of interconnected system operations so there is no obligation to perform ex-post analysis. Therefore ex-post analysis will only be undertaken where a TSO, Coordinated System Operation or any type of working group dedicated on operating issues decides it is necessary. For this situation investigation procedures and information sharing have been simplified:

- Relevant information will be shared among Transmission System Operators by using the reporting tool.
- Where a decision to launch ex-post analysis is taken by Transmission System Operators, a shortened Report (one A4 sheet describing facts around the incident, actions, anomalies and learning) will be prepared by impacted Transmission System Operators to be included in the yearly report.

5.2.3 Scale 2 and Scale 3 Incidents

All the incidents ranked **on Scale 2 and 3** have to be analysed according to the following procedure:

- A typically detailed report will be prepared by expert panel composed of impacted Transmission System Operators representatives.

6. Investigation Procedure of Scale 2 and 3 Incidents and Production of Detailed Reports

6.1.1 Expert Panel Appointment

An expert panel is appointed to perform the ex-post analysis, based on a Transmission System Operators (or working group dedicated to operating issues) proposal approved by Transmission System Operators representatives according to the area impacted.

In case Transmission System Operators are asked for quick answers from their regulator or stakeholders, they will report to the ENTSO-E System Operation Committee the need to accelerate the process to establish the expert panel.

- This expert panel will have to include people from Transmission System Operators impacted by the incident.
- The leadership of the expert panel will have to be given to a Transmission System Operator not involved in the incident, to ensure a neutral leadership.

6.1.2 Data Collection

To perform relevant analysis, the expert panel will have to collect data. A questionnaire, prepared by the expert panel will be delivered to concerned Transmission System Operators requesting all the information needed:

- Ex-ante data (DACF, D2CF...).
- Real time snapshots.
- Measurements from SCADA or equipment in substation (behaviour of protections + actions of SPS, automation, PMU WAMS...).
- Necessary data and information.

6.1.3 Factual Report

After collecting the data, the expert panel realizes a **factual (or preliminary) report**. This factual report aims at providing a very clear understanding of main causes a clear description of incident (situation ahead and after), preliminary evaluation of activities of dispatchers and functioning of equipment (according to interviews of people involved).

All the parties involved must approve this report, before performing analysis and proposing action plans including the production of the analysis report.

6.1.4 Final Report

The **analysis (or final) report** will include conclusions and recommendations (action plans, lessons learnt) related both to technical and “human behaviour” aspects. The method used to analyse incidents should be based on well-known method such as the “causes tree” method.

6.1.5 Publication

The final report of incident Scale 2 and 3 will be published in ENTSO-E website.

6.1.6 Incidents Analysis Planning Overview

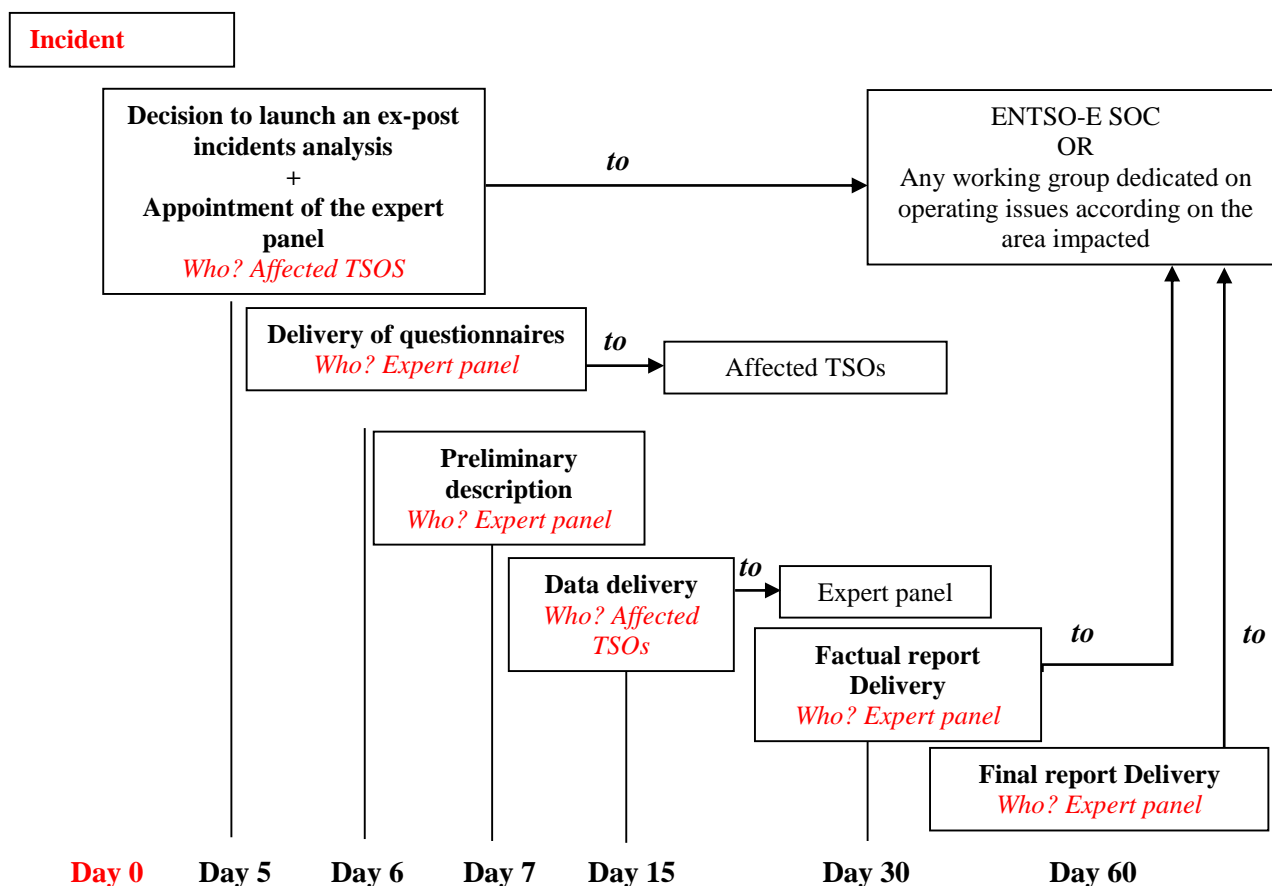


Figure 1 - Investigation procedure

The following planning gives guidelines for setting milestones in case ex-post analysis is needed, but in cases of complex incidents the investigation time can be increase to 4 months:

- **Day 0 : The incident occurs**
As soon as possible a short report is sent by e-mail by each affected Transmission System Operators to ENTSO-E System Operation Committee or any working group dedicated to operational issues, according to the area impacted.
- **Between Day 1 and Day 5: Official decision to launch an ex-post incident analysis and appointment of the expert panel (including the leader)**
 - Each affected Transmission System Operators sends its proposal to ENTSO-E System Operation Committee or any working group dedicated to operational issues according to the area impacted.
 - At the same time, each affected Transmission System Operator records the incident in the reporting tool.
 - On this occasion, as an ex-post analysis is needed, the due date for reporting has to be anticipated. Therefore, each affected Transmission System Operator will upload the reporting file into ENTSO-E extranet workspace before Day 5 after the incident.
- **Between Day 1 and Day 6: Delivery of questionnaires**
The questionnaires are sent by the Expert panel to each impacted Transmission System Operators.

-
- **Between Day 1 and Day 7: Preliminary description of the incident prepared**
By using the reporting files uploaded by impacted Transmission System Operators, the expert panel prepares a preliminary description.
 - **Between Day 1 and Day 15: additional data and information, asked by the expert panel, are delivered by requested Transmission System Operators.**
 - **Between Day 1 and Day 30 (1 month) after the incident: Factual report Delivery**
The factual report (which identifies original incidents) is delivered to Transmission System Operators, ENTSO-E System Operation Committee or/and any working group dedicated to operational issues according to the area impacted for approval and further decision.
 - **Between Day 1 and Day 60 (2 months) after the incident: Final report delivery**
The final report is delivered to Transmission System Operators, ENTSO-E System Operation Committee or/and any working group dedicated on operational issues according to the area impacted for approval.

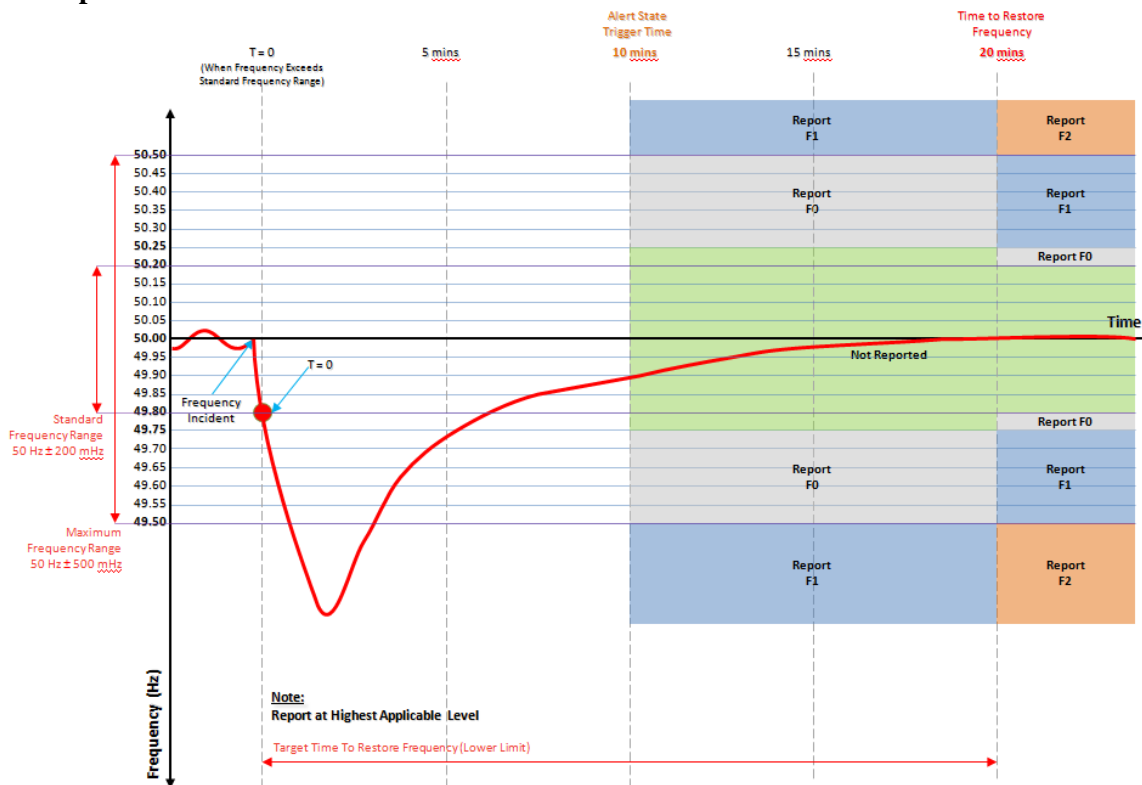
7. Annex

Visualization of Frequency Criteria

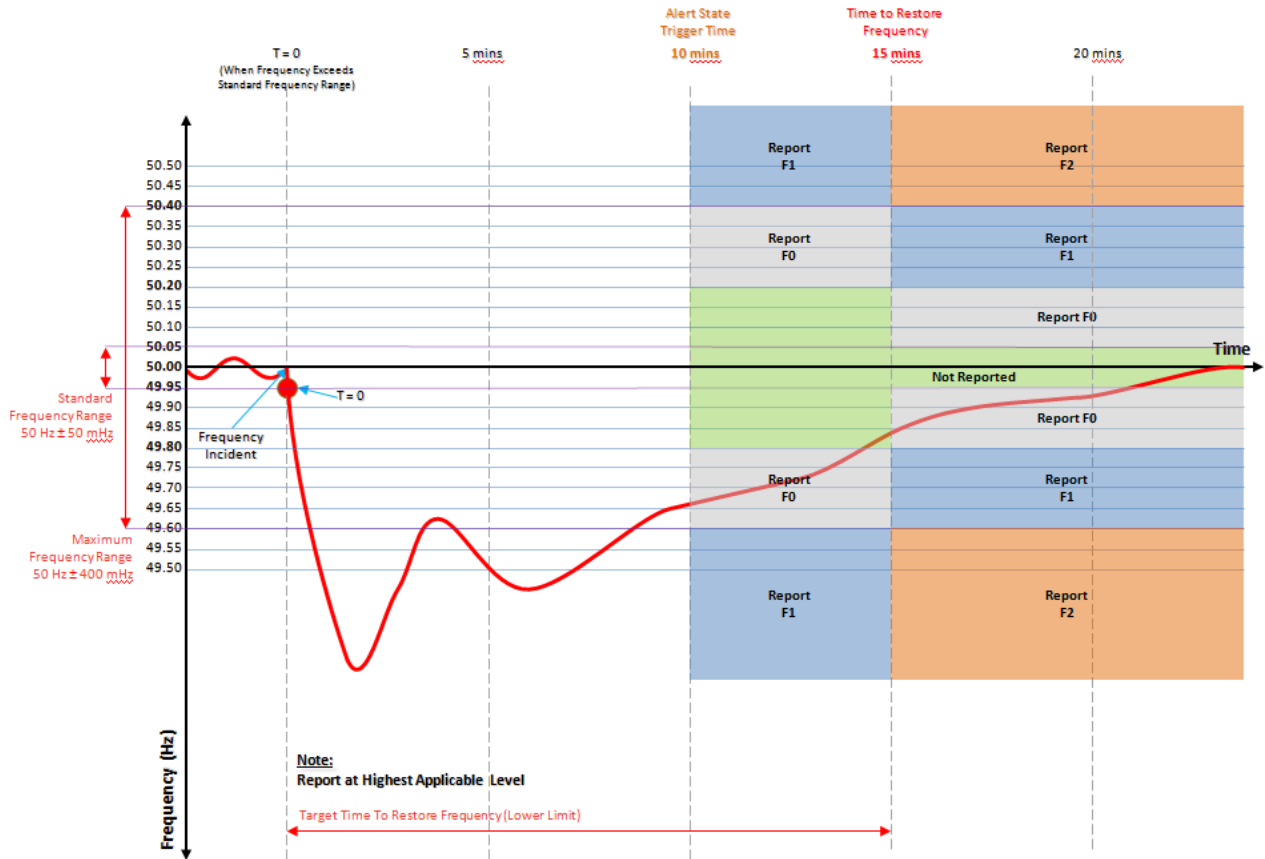
ENTSO-E – Frequency Incident Matrix



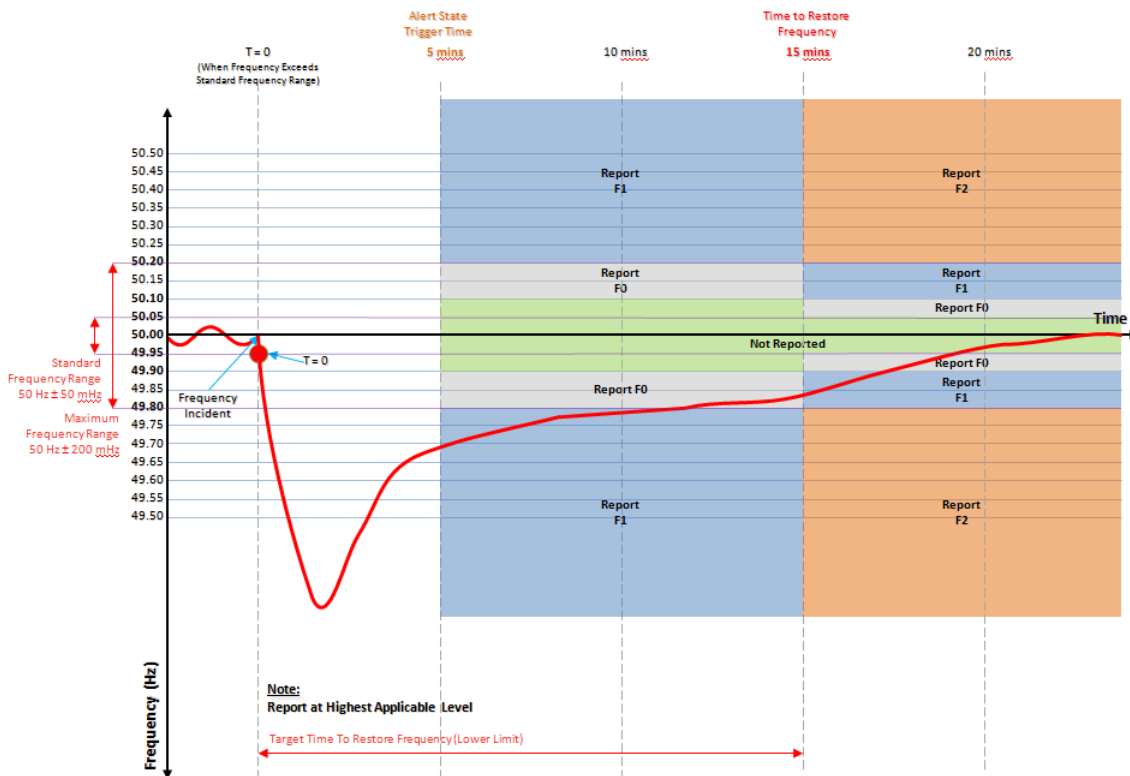
Example for Ireland



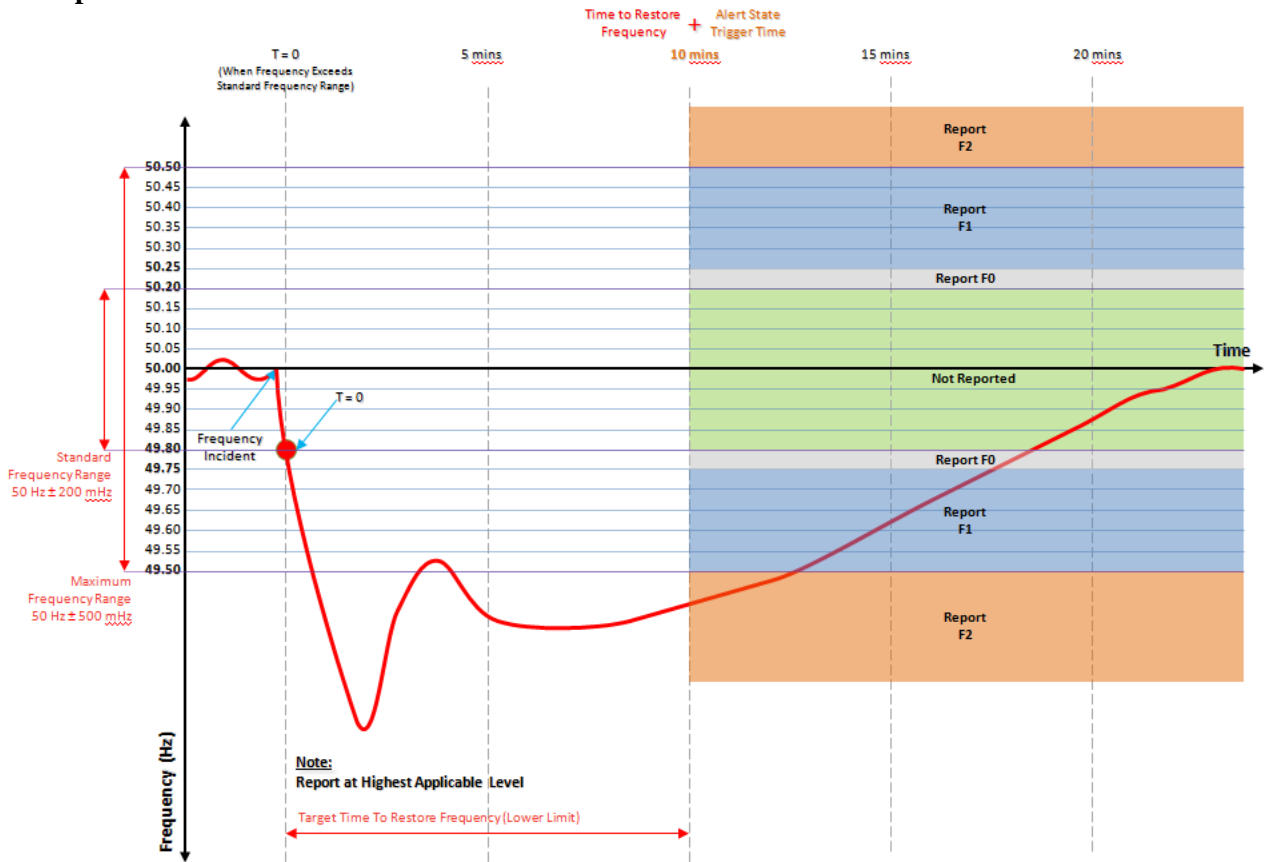
Example for Baltic



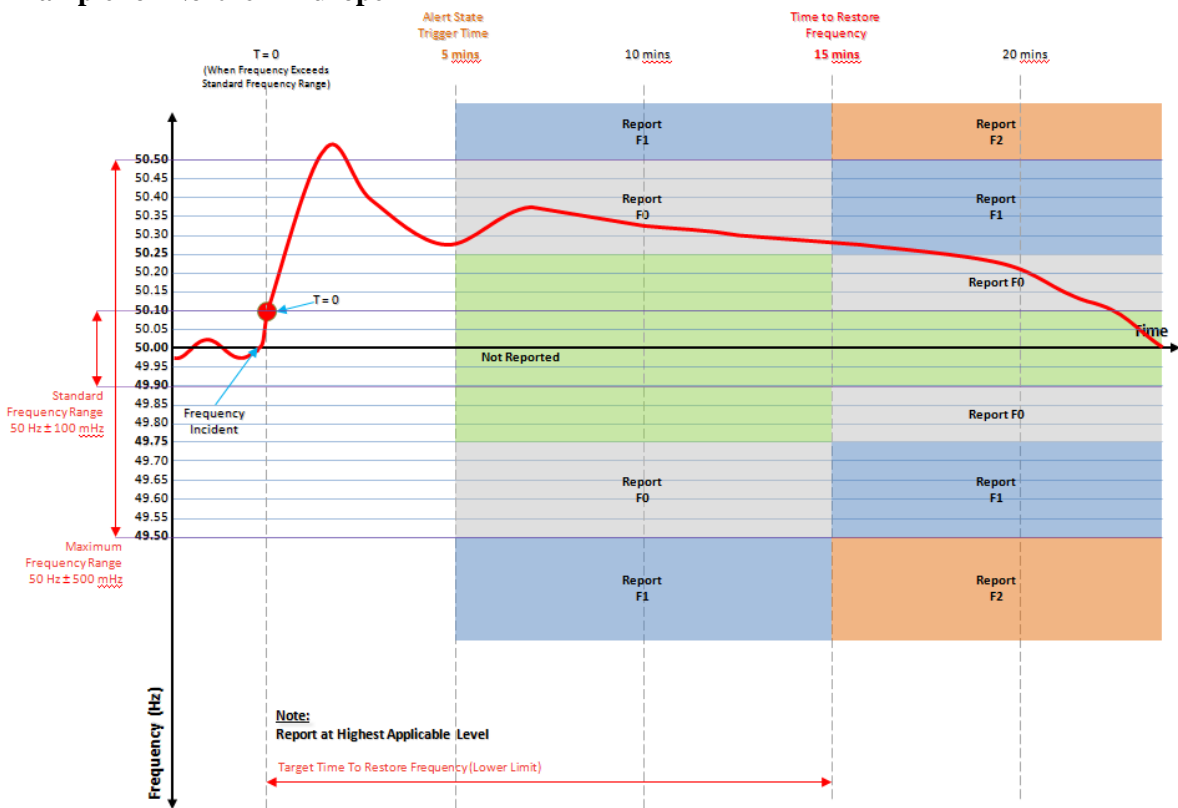
Example for Continental Europe



Example for Great Britain



Example for Northern Europe



Example for Isolated System

