Explanatory document to the IU Capacity Calculation Region methodology for common provisions for regional operational security coordination in accordance with Article 76 of Commission Regulation (EU) 2017/1485 of 2 August 2017

“Explanatory Note”

18 December 2019

***Disclaimer**:*
This document is released on behalf of the transmission system operators (“TSOs”) of the Capacity Calculation Region IU solely for the purpose of providing additional information on the methodology for common provisions for regional operational security coordination in accordance with Article 76 of Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on system operations guideline (“SO Regulation”).

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INTRODUCTION

In accordance with Article 76 of Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on system operations (hereafter referred to as the “SO Regulation”) the IU Transmission System Operators (hereafter referred to as “IU TSOs”) submitted the Common Methodology for Regional Operational Security Coordination for the IU Capacity Calculation Region (hereafter referred to as “CCR”) to IU NRAs. This methodology aims at the day-ahead and intraday regional operational security coordination within the IU CCR.

The aim of this explanatory note is to provide additional information with regard to the Methodology for Regional Operational Security Coordination for the IU CCR (hereafter referred to as “IU ROSC Methodology”). In particular, it provides insight on the whole process chain defined in IU ROSC Methodology, from the preparation of input data to the optimisation and implementation of Remedial Actions. This paper considers the main elements of the relevant legal framework (i.e. SO Regulation, CACM Regulation and EB guideline), and is provided to gain additional insight on the methodology only.

1. GENERAL PROVISIONS

1.1 Subject matter and scope

IU On-shore TSO principle has been introduced in order to differentiate TSOs in charge of a control block area from IU TSOs made of an Interconnector only. Goal of this methodology is to make as efficient as possible the coordination of Remedial Actions to relieve operational security limit violations, especially on current violations.

As long as Interconnectors are composed of HVDC links they are not impacted by a Remedial Action which may be applied in their neighboring network. Consequently Interconnectors are not concerned by the scope of this methodology.

Regarding their Remedial Action contribution, Interconnector role is already described into the IU Redispatch and Counter Trading (RDCT) Methodology pursuant to Art.75 of CACM.

1.2 Constraints

Different kinds of constraints are mentioned in the IU ROSC Methodology.

- Operational security constraints are most commonly current, short-circuit, voltage or stability constraints. The IU ROSC Methodology shall detect if current limits in N-situation or after occurrence of a contingency are violated. If this is the case, there is a need to prepare and activate a remedial action in order to respect those current limits. For the detection of other constraints, such as voltage violations, violations of short-circuit current limits or violations of stability limits, each IU On-shore TSO should perform local preliminary assessment and long-term operational security analysis in accordance with articles 31, 38 and 73 of SO Regulation. IU On-shore TSOs will deal with these constraints themselves in line with the definition of system constraints or/and local preliminary assessment.

- Constraints on remedial actions are constraints related to all aspects required to be taken into account when using RAs in accordance with article 20(1) SO Regulation and classified as following:
    - Technical constraints are all the rules that a power source has too comply with for technical reasons such as preparation period, ramping period, full activation time, minimum and maximum power output, deactivation period, minimum and maximum duration of delivery period, limit values for voltage, current or power, etc. As consequence, for Redispatching & Countertrading, at least the following technical constraints are considered:
        i. Minimum and maximum redispatch values (MW)
        ii. Maximum power increase and decrease gradient (MW/h)
        iii. Minimum up and down time
        iv. Lead and Lag time
        v. Start-up and Shut down allowed
        vi. constraints for storage
    - Operational constraints means all the operational conditions and usage rules taking into account the timings to operate the grid (for example, an operator can only activate a

limited number of remedial actions in a given period) and avoid a premature use of the network elements (limitation of the frequency of switching of one breaker, synchronised change of PST taps).

- Procedural constraints mean all the timing constraints due to local or regional processes e.g.:
  i. timings T0 to T5 according to article 45 CSAM to be respected during Day Ahead (DA) CROSA;
  ii. Maximal time to perform the remedial actions optimisation
  iii. time to perform a local security analysis
  iv. Timings to request a Remedial Action from a non-IU TSO, etc.
- Legal constraints mean the legal requirements stated in national laws regarding the priority of activation of remedial actions.

- System Constraints are additional optimisation constraints added by IU On-shore TSOs, expressed as flow limitation on one or a sum of Secured and/or Scanned elements and necessary to simulate stability limits or operational security limits other than current limits. For example, to prevent stability violations, a TSO could limit the overall amount of power flow on three network elements (for example 1000 MW) even though the sum of the capacity of these three elements is above 1000 MW. IU On-shore TSOs specifying such system constraints shall share transparently with IU's RSC and TSOs the information justifying their application. Rate of Change of Frequency (ROCOF), Commutation Failure, Voltage Stability and Sub-Synchronous Resonance are also part of system constraints that are specified by TSOs to RSCs.

2. REGIONAL OPERATIONAL SECURITY COORDINATION

As illustrated in figure 1, the IU Regional Operational Security Coordination (ROSC), that shall be executed for each hour of the target day, is composed of the following activities:

- One day-ahead and several intraday Coordinated Regional Operational Security Assessment (hereafter referred to as 'CROSA').
- Intraday CROSAs shall be performed at least three times in intraday timeframe in accordance with article 24 of CSAM. Each CROSA shall consist of:
  i. Preparation phase;
  ii. Coordination phase;
  iii. Validation phase.
- The implementation of the Agreed Remedial Actions (RAs) in the subsequent Individual Grid Models (IGMs) and activation of the Ordered RAs.
- Modification of an Ordered RA or activation of a new RA might be considered following the fast activation process.

The different steps of the DA CROSA process will be performed respecting the timings T0 to T5 defined in accordance with the Methodology for coordinating operational security analysis in accordance with article 75 of SO Regulation (hereafter referred to as 'CSAM').

A minimum of three ID CROSA shall be performed considering the three mandatory CGMs which have to be built for 00h00, 08h00 and 16h00 according to CGMM.

More details about the preparation and coordination phases are given in the relevant chapters of this Explanatory Note.

The validation phase shall mainly consist of the formalisation, communication, reporting and archiving of the CROSA results. In DA, in line with the Methodology for coordinating operational security analysis in accordance with article 75 of SO Regulation (hereafter referred to as 'CSA'), this formalisation shall take place through a pan-European conference with representatives of all RSCs and TSOs.

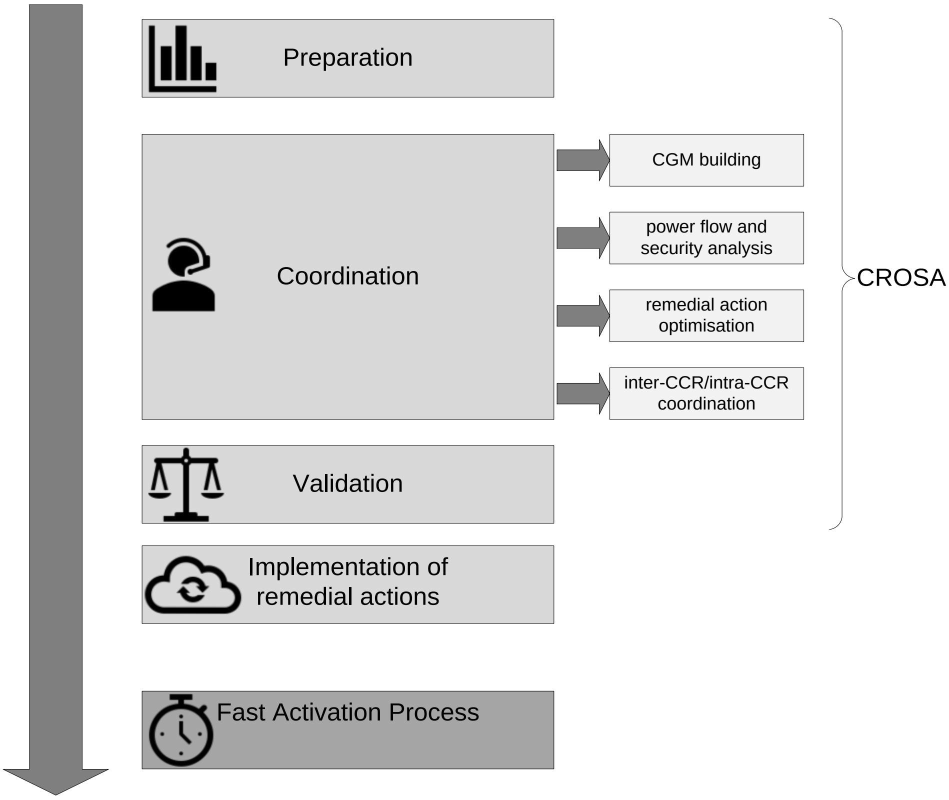

Figure 1: Overview Coordinated Regional Operational Security Assessment (CROSA) process

On top of the ROSC process, IU On-shore TSOs with the IU'S RSC shall perform Intraday regional security analysis ('ID CROSA'). The goal of the ID CORSA is to provide IU On-shore TSOs each hour of the day with the latest information about the loading of the grid and previously undetected violations of operational security limits, which may serve as a trigger for a fast activation process.

3. DEFINITION AND DETERMINATION OF IU XNES, XRAS, CONSTRAINTS AND CONTINGENCIES

According to article 15 of CSAM, *cross-border relevant network elements (XNEs) shall be all critical network elements ('CNEs') and other network elements above the voltage level defined by TSOs, except for those elements for which all TSOs in a CCR agree that they are not cross-border relevant for the concerned CCR and may therefore be excluded*.

3.1 Secured and scanned elements

In order to harmonise definitions used across CCRs and to use same terminology in future processes, ENTSO-E proposed to define and use the following wording in all regional ROSC methodologies:

- A **Secured element** is an assessed element on which, when violations of an operational security limit are identified during the regional or cross-regional security analysis, remedial actions needed to relieve these violations shall be identified.
- A **Scanned element** is an assessed element on which the electrical state (at least flows) may be computed and may be subject to an observation rule during the regional security analysis process. Such observation rule can be for example to avoid increasing a constraint or to avoid creating a constraint on this element, as a result of the design of the remedial actions needed to relieve violations on the secured elements.

Having this in mind, IU On-shore TSOs decided that **secured elements are the elements identified as cross-border relevant network elements** (XNEs) in accordance with CSAM within the IU CCR.

IU On-Shore TSOs include network elements in their IGMs in line with the CGMM and CSAM, which include network elements of different voltage levels (which can include elements <110 kV). Most relevant network elements for the CROSA process to be defined as Secured elements are the network elements on 110kV, 132kV, 220kV, 275kV, 380kV and 400kV level,. Yet, it should be noted that in some countries the grid of a voltage level lower than 110kV is not operated by the TSOs but by distribution system operators. Although in accordance with Article 6 of CGMM, grid elements of a voltage level lower than 110 kV may be included in the grid model, this does not mean that TSOs have to actively relieve congestions in these grids during the CROSA. It is rather meant to ensure that a RA used for the High Voltage grid will not lead to (further) congestions in the lower voltage grids and determine the impact of these grids on the 110. 132, 220, 275, 380 and 400kV grids. This will be achieved by introducing scanned elements into the ROSC methodology.
In contrast, considering only elements with a voltage level equal or higher than 380kV as XNEs, would mean that 110, 132, 220 and 275kV elements which have cross-border relevance would not be considered in the regional or cross-regional process. Having this in mind, IU On-shore TSOs decided to consider all elements with voltage level equal or higher than 110kV as XNEs (IU XNEs) and decided to define criteria for which certain elements can be discarded as XNE.

If one of the following criteria is fulfilled, IU On-shore TSOs shall have the right to exclude elements from the set of secured elements:

a. Element is a power plant line: e.g. line connecting a substation to which only generation is connected to the meshed grid and is therefore not relevant for cross-regional processes.
b. Element is a radial line: e.g. elements operated in radial topology; connected to a substation that is not connected to any other substation at a voltage level higher or equal than 110kV.
c. Element is connected to a DSO grid: e.g. elements operated by DSOs at a voltage level equal or higher than 110kV that have distribution character.
d. Element is a transformer with the secondary voltage side lower than 110kV e.g. transformers connected to DSO grids.

The following figure 2 shows which elements (highlighted in yellow) can be discarded from the set of secured elements in accordance with the provisions explained above.

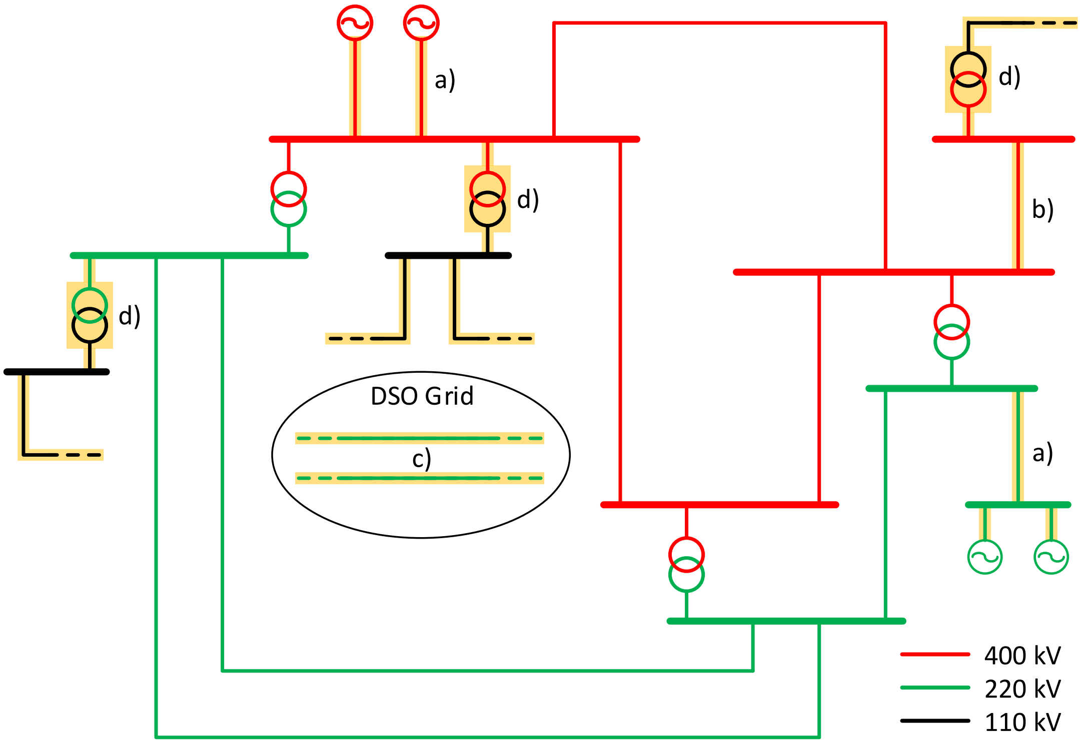

Figure 2: Elements (highlighted in yellow) which can be discarded from the set of IU XNEs

In addition to these criteria, any element can be discarded from the set of secured elements, when a common agreement among IU On-shore TSOs is reached. This could be the case, if a part of the grid is almost not influenced trans-regionally.

TSOs which are part of more than one CCR shall have the right to discard any of their elements from the set of secured elements which are regarded as XNE in another CCR.

As suggested by ENTSO-E, IU On-shore TSOs define scanned elements as a set of elements on which the CROSA shall not create new operational security limits violations or worsen any existing violation. Such elements can be elements which are discarded from the set of secured elements with voltage level lower than 110kV. In the latter case, these elements have to be included in the IGM and TSOs shall provide justification of their inclusion in the set of scanned elements (e.g. elements influenced by RA used to solve constraints on secured elements). Such an inclusion must be compliant with the CGMM.

IU On-shore TSOs shall have the right to update the lists of secured and scanned elements at any time (e.g. due to commissioning of a new element or seasonal changes) considering that:

- Any element with a voltage level equal or higher than 110kV can be included in this list of secured elements.
- Discarding an element from the list of secured elements is subject to common agreement by IU On-shore TSOs, except for those elements, that fulfil one of the criteria defined in this chapter.
- Any discarded element from the list of secured elements can be included in the list of scanned elements, but it is not mandatory.
- Each IU On-shore TSO shall have the right to move any elements it operates with a voltage level equal or higher than 110kV from the list of scanned elements to the list of secured elements.

- Each TSO shall have the right to include any new element with a voltage level lower than 110kV in the list of scanned elements providing justification for its inclusion. Such elements have to be modelled in IGM.

IU On-shore TSOs shall have the right at any time to exclude any element from the set of scanned elements. IU On-shore TSOs shall update the secured elements list and scanned elements list when necessary and inform the IU'S RSC about the change. Both lists shall be reassessed by each IU On-shore TSO at least once a year.

Lists of secured and scanned elements will be made available before each CROSA process.
Each IU On-shore TSO shall have the right to set individual thresholds for overloads for the scanned elements (e.g. 110kV line), for CROSA purposes only, reflecting the fact that TSOs are able to accept certain overloads on such elements. This could be the case, if there are for example additional RAs not explicitly modelled in the CGM, which can further relieve the violation on the scanned element.

3.2 Classification of remedial actions

Each IU On-shore TSO has to prepare a list of remedial actions which can be used to relieve at least violation of the IU On-shore TSO's current limits. IU On-shore TSOs shall design these RAs taking into account the categories defined in article 22 of the SO Regulation but not limited to them.
Within one month, after the set of secured elements has been defined, IU On-shore TSOs shall share with the IU'S RSC all potential RAs.

In accordance with article 14(2) of CSAM, a RA can be designed as a single action or a combination (set) of actions as listed in article 22 of the SO Regulation. If a RA consists of multiple actions, it still should be treated as one.

When designing a RA, IU On-shore TSOs have to include all the relevant information such as availability timeframe, activation time, costs (for costly RAs) and all constraints limiting its usage. In accordance with article 16 of CSAM for each RA shall be identified its cross-border relevance. How to identify the cross-border relevant remedial actions has been introduced in Articles 10, 11 and 13 of this Methodology.

3.3 Cross-border relevance of remedial actions

The CSAM defines a cross-border remedial action (XRA) as a RA identified as cross-border relevant and which needs to be applied in a coordinated way. The cross-border relevance of a RA shall be evaluated qualitatively or quantitatively for at least each cross-border relevant network element and each contingency. A new remedial action identified in DA or Intraday requires a quantitative approach, and can only be justified by the default 5% threshold on the operational security limits. A new remedial action identified in between the IU TSOs re-assessing XRAs at their yearly re-assessment follows a qualitative approach, and in case of any IU TSOs disagreement, a quantitative approach.

Considering the definition of IU XNEs, it is obvious that some RAs will only have a relevant impact on XNEs located in the same control area and will therefore only affect its connecting TSO. Nevertheless, these remedial actions will still be named “cross-border relevant” and flagged as XRAs.

However, during the fast activation process, the activation of such XRA by the connecting TSO will not be subject to further coordination.

3.3.1 Qualitative assessment of XRAs

IU On-shore TSOs shall aim at agreeing on a qualitative approach to determine RAs that are deemed cross-border relevant and to identify corresponding TSOs affected by those RAs. This process consists of the following steps:

- In order to assess if a RA is cross-border relevant, each IU On-shore TSO shall assess the impact of the RA on its control area.
    - This assessment can be based on operational experience, but it is not limited to it;
- In order to assess the cross-border relevance of the RA, the RA Connecting TSO shall assess the impact on the control area of other TSOs;
    - It is needed to assess relevance of the RA on the grid of other TSOs and on its own grid in order to compare the results among TSOs, as TSOs might have different views on certain RAs. This can be expected when quantities for redispatch or tap positions of PSTs will be assessed.
- If the RAs are quantifiable such as redispatching, countertrading, change of set point on HVDC systems or change of taps on phase-shifting transformers, the quantity above which this RA is deemed cross-border relevant on the grid of other TSOs and its own grid has to be specified.
    - In case of PST number of TAPs or change in the flow can be specified
    - In case of redispatching, the amount for internal redispatching and the amount per TSO/TSO border shall be specified.
    - In case of HVDC change from set point shall be specified.
- IU On-shore TSOs will share the results of the assessment and provide justifications to connecting TSOs why RAs have been selected as relevant.
- If common agreement is reached among IU On-shore TSOs, then RA is defined as cross-border relevant and affected TSOs will be identified.
- If a RA is not proposed as cross-border relevant by any IU On-shore TSO, it is considered as non-cross-border relevant.
- If a RA is identified as cross-border relevant only for the RA Connecting TSO, this TSO shall be considered as the only XRA affected TSO.

3.3.2 Quantitative assessment of XRAs

In case that IU On-shore TSOs cannot agree on a qualitative approach for a certain RA, a quantitative approach as described in article 15 (4) of CSAM shall be used:

“In case of a quantitative approach, the cross-border relevance of remedial actions shall be assessed with the remedial action influence factor. The remedial action influence factor shall be calculated for at least each cross-border relevant network element and each contingency (for example each ‘XNEC’) as a simulated flow deviation on a XNEC resulting from the simulated application of a remedial action normalised by the permanent admissible load of the associated XNE.”

The influence factor is calculated as follows:

$$IF_{RA} = MAX_{\forall s, \forall x \epsilon X, \forall c \epsilon C}\left(\frac{P_{s,RA}^{x,c} - P_{s}^{x}}{PATL^{s,x}} \cdot 100\right)$$

Where

IF_{RA}: Influence factor of a RA on the TSO’s control area (in %);

s: Scenarios;

x: XNE connected inside TSO’s control area where the active power difference is observed;

X: set of XNEs connected inside TSO’s control area for which the assessment is performed

c: Contingency;

C: set of contingencies to be assessed;

$P_{s,RA}^{x,c}$: Active power flow or current through the XNE in scenario s with contingency c and RA applied;

$P_{s}^{x,c}$: Active power flow or current through the XNE in scenario s with contingency c;

$PATL^{s,x}$: Permanently Admissible Transmission Loading is the loading in A (MW or MVA) that can be accepted by XNE in the scenario s for an unlimited duration

IU On-shore TSOs shall use the common grid models established in accordance with article 67 of the SO Regulation when computing remedial action influence factor.

If a RA consists of a combination of actions, its cross-border relevance shall be assessed for the effect of the combination. All remedial actions which have influence factor greater than the threshold defined in article 15 (5)[1] of CSAM shall be considered as cross-border relevant, otherwise RAs shall be considered as non-cross-border relevant. All IU On-shore TSOs that have at least one affected XNEC for which the remedial action influence factor is greater than the threshold shall be considered as XRA affected TSOs,

TSOs shall delegate tasks described above to the respective IU’S RSC.

- Once the assessment of remedial actions has been performed, the list of cross-border relevant remedial actions together with the affected TSOs will be shared among IU On-shore TSOs and will be provided to the IU’S RSC.

[1] 5%

- Reassessment of the list of cross-border relevant RAs shall be done on a yearly basis. Nevertheless, each IU On-shore TSO shall have the right to request an additional assessment of a RA providing justification for such a request to the RA Connecting TSO and respective the IU'S RSC.

In the CROSA process step it can only be analysed which TSOs are affected by the application of the determined whole solution by determining the effect of the overall solution on the XNEC of each TSO. If the influence factor of the overall CROSA solution on given XNEC, calculated in the same way as for determination of XRAs, is greater than the threshold defined in article 15 (5) of CSAM, than the XNEC is considered affected. IU On-shore TSO which has at least one affected XNEC will be than considered as CROSA affected TSO. All CROSA affected TSOs and RAs connecting TSOs participate in the further coordination steps.

The determination of the cross-border relevance of RAs in the process of fast activation is different. Due to the manual nature of this process and in most cases only corrective actions in an existing result, for these measures a clear assignment of individual measures also in terms of redispatching and countertrading can be done. In order to determine the cross-border relevance of these measures, use can be made of the process described in Articles 10-12 of the IU ROSC methodology. The TSOs first determine ex-ante, the usual RD & CT measures and determine their cross-border relevance for these and all non-costly RAs based on their experience. For RD & CT, the determination for each selected combination could be done per MW, for PSTs per tap position and for topological measures based on their binary state (qualitative approach). The resulting list will be harmonised with all other TSOs in accordance with Article 11 of the IU ROSC. In the case of a lack of agreement, a quantitative determination as in Article 12 of IU ROSC will be applied. If RAs or combinations of RAs are selected in the context of the Fast Activation Process and were not determined ex-ante (e.g. very unusual ones), it is to be determined by the activating TSO to what extent the measures have an impact on other TSOs by means of appropriate tools based on load flow calculations and coordinate with these TSOs prior to ordering the measures. The task of ad hoc determination of the cross-border relevance of RAs can be transferred to the RSC.

3.3.3 Remedial Action Cost Estimation

In line with Article 4 of the IU RD and CT methodology, the yearly reassessment of RD & CT RAs will include an estimation of costs and income by summing up:

- costs or incomes related to changing the set point flows of Interconnectors estimated using historic costs paid from interconnector imbalance resulting from TSO action
- costs or incomes related to bidding off or buying on additional generation estimated using historic data from generators by the Requesting TSO

This estimate is refined when the RA is updated at DA for the interconnector trading . These prices, multiplied by the volume of trade required will provide the estimate for countertrading. Redispatching costs will also be added by each TSO using the Bid and Offer prices submitted by the least costly generators to balance, in non-congested regions.

The details and procedures of this total cost of coordinated Redispatching and Countertrading calculation process will be described in the relevant RD and CT Procedures that will be established during the implementation phase.

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3.4 Contingency list

When performing operational security analyses, each TSO shall, in the N-Situation, simulate each contingency from its “contingency list” and verify that the operational security limits in the (N-1) situation are not exceeded in its control area (Art.72.3 SO GL). Such contingency list, in a highly meshed network, shall include all the internal (inside the TSO’s control area) and external (outside TSO’s control area) contingencies that can endanger the operational security of the TSO’s control area (Art.33 SO GL).

This list should be established based on provisions defined in CSAM (article 10 and related articles). Each IU On-shore TSO should prepare a contingency list only with elements relevant for IU CCR and used in IU CROSA process. That means elements located in the TSO’s control area which are assigned to different CCR should not be placed on the contingency list provided to the IU’S RSC unless contingency on that element can endanger the operational security limits on the secured or scanned elements defined in IU CCR.

The established contingency list should be made available to both the IU’S RSC and IU On-shore TSOs during the preparation phase and should be updated by IU On-shore TSOs when relevant, especially when the conditions are met to apply temporary occurrence increasing factors for exceptional contingencies or when a significant change in the grid occurred. The RSC shall always use the latest Contingency lists shared by the IU On-shore TSOs, which means that it is up to IU On-shore TSOs to decide if they want to send the contingency list for each CSA run or only if there is an update of the list.

4. COORDINATED REGIONAL OPERATIONAL SECURITY ANALYSIS PROCESS

4.1 Preparation

The preparation phase aims at gathering all relevant inputs for the CROSA. Each IU On-shore TSO shall make available the following input data to the IU’S RSC:

- IGMs in line with the CGM methodology, including the operational security limits for each secured or scanned element;
- Available remedial actions within his control area;
- When relevant, System Constraints;
- Secured and scanned elements;
- Contingency list

The input data shall cover all remaining hours for a relevant business day. IU On-shore TSOs shall deliver or update when required the input data respecting format and process deadlines commonly agreed during the implementation. When providing an update of the list with available RAs, IU On-shore TSOs shall re-assess their availability and consider the agreed outcome of previous optimisations in accordance with Article 16 of IU ROSC Methodology.

When receiving any input data, the IU'S RSC shall perform a quality and consistency check aiming at identifying any format error or any inconsistency with the information contained in the IGMs. The IU'S RSC shall then report these errors to the IU On-shore TSOs to give them the opportunity to correct them prior to the coordination phase.

4.2 Coordination

4.2.1 General provisions of coordination process

The coordination run consists of the following four steps. These steps are further described in the Articles 22 to 32 of the IU ROSC Methodology.

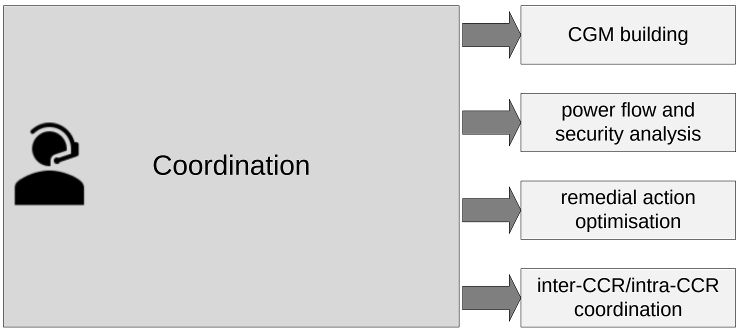

Figure 3: Overview coordination process

The day-ahead CROSA includes two of those coordination runs. There will be at least three ID CROSAs and each will include at least one coordination run. Two runs are needed in day-ahead so that the impact of every RA identified during the first run can be assessed during the 2nd run not only on lower voltage levels within IU On-shore TSOs but also by the other CCRs and non-IU On-shore TSOs.

Intra-CCR coordination describes the coordination between IU On-shore TSOs and the IU'S RSC, inter-CCR coordination means the coordination between IU On-shore TSOs and IU'S RSC with the TSOs and RSCs of other CCRs.

4.2.2 Power flow and security analysis

The validation aims at identifying input mistakes which would make the outcomes of the operational security analysis non-realistic and to give IU On-shore TSOs the opportunity to correct these errors. It doesn't mean that TSOs have to perform a power flow and security analysis on their own and then compare the results to validate them.

4.2.3 Optimisation of remedial actions

An optimisation of RAs has to be done in order to identify in a coordinated way the most effective and economically efficient RAs. In order to minimise the complexity for the optimisation and considering violations of short-circuit current limits, voltage limits and stability limits are more local issues, the described optimisation will aim at solving current operational violations while violations of short-circuit current limits, voltage limits and stability limits shall be tackled by TSOs local security assessment as specified in article 25 (3) of IU ROSC Methodology or by adding further system constraints. The results of the violations of operational security limits resulting from these TSOs local assessments which have impact on the status of available XRAs will be communicated to other IU On-shore TSOs and IU'S RSCs.

Main goal of the optimisation process and part of the CROSA is that each TSO shall maintain current (or translated power flows) through XNEs within the operational security limits defined when the system is in normal state and after the occurrence of a contingency.

The optimisation should be able to identify RAs relevant for congestion management among the categories of remedial actions as described in Article 22 of SO Guideline but not limiting to them. To facilitate the implementation of the optimisation solution, the following RAs shall be taken into account:

- redispatch transmission or distribution-connected system users within the TSO's control area, between two or more TSOs;
- countertrade between two or more bidding zones;
- adjust active power flows through HVDC systems;
- modify the duration of a planned outage or return to service transmission system elements to achieve the operational availability of those transmission system elements.

When optimizing RAs, technical constraints shall be considered. For example, for topological RAs (including PST), TSOs consider a maximum number of preventive topological actions per TSO between successive hours (either by taking into account a maximum number X of preventive topological actions per TSO between successive hours. The value X depends on each TSO operational constraints or by progressively penalizing the number of actions above a threshold Y.

To avoid damage or cause too high an impact on the life cycle of an electrical asset, the optimisation shall consider technical flexibility:

- Regarding topological RAs, the optimisation shall take into account a maximum frequency of switching per element in a given time interval defined by each TSO or shall aim at minimizing the frequency of switching.
- Maximum number of curative RAs after contingency: Because there is a maximum time to activate curative remedial actions after the occurrence of a contingency, the optimisation shall consider a maximum number of curative RAs per outage. Each TSO shall specify this number according to their own risk assessment.
- Curative RA associated to specific contingency: To activate a Curative RA, the contingency causing the constraint has to be in the observability area of the RA Connecting TSO. The occurrence of the contingency is then the trigger to activate the curative RA.

Cancellation or modification of the duration of a planned outage is considered non-costly RA. The TSOs shall provide its availability on a voluntary basis. If TSOs provide its availability, RAs shall be accordingly taken into account during the optimisation.

In accordance with article 14(2) of CSAM, a remedial action can be designed as a combination of actions. In that sense, the optimisation should also take this kind of remedial actions into account.

The remaining RAs related to Article 22 of SO guideline might be considered by each TSO when performing its local assessment regarding violation of voltage, short-circuit and stability operational limits. These actions are:

- control voltage and manage reactive power by means of:
    - tap changes of the power transformers;
    - switching of the capacitors and reactors;
    - switching of the power-electronics-based devices used for voltage and reactive power management;
    - instructing transmission-connected DSOs and significant grid users to block automatic voltage and reactive power control of transformers or to activate on their facilities the remedial actions set out in points (i) to (iii) if voltage deterioration jeopardises operational security or threatens to lead to a voltage collapse in a transmission system;
    - requesting the change of reactive power output or voltage set point of the transmission-connected synchronous power generating modules;
    - requesting the change of reactive power output of the converters of transmission-connected non-synchronous power generating modules;
- The following RAs listed in article 22 of SO Guideline will not be considered in the optimisation, because they are not relevant to identify the most effective and economically efficient RAs for congestion management:
    - Inclusion of the normal or alert state manually controlled load-shedding;
    - Activation of frequency deviation management procedures;
    - Curtailment, pursuant to Article 16(2) of Regulation (EC) No 714/2009, the already allocated cross-zonal capacity in an emergency situation where using that capacity endangers operational security, all TSOs at a given interconnector agree to such adjustment, and re-dispatching or countertrading is not possible;
    - Re-calculation of day-ahead and intraday cross-zonal capacities in accordance with CACM guideline.

4.2.4 Time coupled optimisation

Taking into account that:

- Certain remedial actions, like generation units, have a minimum up-time/runtime or down-time taking more than 1 hour;
- Electrical equipment has limitation on number of switching actions per day,
- Operators can only manage a maximum number of topological changes between hours

Only the time-coupled optimisation can lead to practical and least costly solution jointly considering all remaining hours of a day, and therefore is required.

For time-coupling optimisation, it is crucial to make use of constant identifiers for all relevant grid elements (as described in CGMM).

Depending on the timeframe the time-coupled optimisation taking into account technical, organisational and legal constraints should be performed for the 24h in day-ahead timeframe and for the remaining hours till the end of the day in the intraday timeframes. In order to avoid dramatic changes and mitigate too high influence of the first hour(s), the optimiser should consider the result of the previous hours (e.g. from the previous day).

4.2.5 Relieving operational security limit violations with balanced RAs

The optimisation shall identify RAs to avoid overloads on secured elements in base and contingency cases. A curative RA may be used to avoid the overload in contingency case on a secured element as long as the temporarily limit (TATL) of the element is not exceeded (as appropriate) unless the TSO has provided an instantaneous acting curative remedial action which restores the flow on the secured element to the PATL for the relevant contingency. The overall optimisation result after application of preventive and curative RAs shall respect the permanent limits (PATL) of the secured network elements.

In order to reassess the need of the Agreed but Not Ordered RAs (ANORAs), ANORAs are removed from the CGM for the next CROSA. It allows for the adjustment of the volume of costly measures and avoids unnecessary costs. The removed ANORAs are added to the list of available RAs before the new optimisation is performed unless those removed ANORAs are no longer available for technical reasons.

Due to the possibility of re-dispatching of generation units, the cumulated fed-in active power into the electrical grid could change. To avoid this kind of behaviour and guarantee a balance between active power generation before and after optimisation the redispatch needs to be activated in a balanced way.

In case a removed ANORA has an influence on the balance of the grid, the subsequent optimisation needs to take this into account by reasonable means and ensure that the new proposed RAs are balanced in accordance with Article 28.

4.2.6 Avoid additional violations of operational security limits on secured and scanned elements

The optimisation shall guarantee that no new operational security limits violations regarding current are created on secured and scanned elements nor existing ones are worsened. In case of scanned elements, the optimisation will take the threshold which is described in article 6 (1) of IU ROSC into consideration.

4.2.7 Minimise total incurred costs

Because all incurred costs of applied costly RAs have to be incurred by TSOs, regardless of applied payment principle (i.e. requester pays or polluter pays), as it is also required by SO guideline that the CSA outcome has to be “most effective and economically efficient”, the minimisation of RAs incurred costs should be a principle of the optimisation. The most effective and efficient activation of RA is depending on the location of the overload, actual availability and location of RAs.

The total incurred costs consist of estimated costs incurred by costly RAs (e.g. redispatching and countertrading) for congestion management as defined in IU RD and CT Methodology. It may include ramping costs, costs/revenues for balancing, and where applicable start-up costs and shut-down costs where IU On-shore TSOs agree to start or stop a generating asset to solve congestions.

4.2.8 RA effectivity

With the objective to determine the most effective set of remedial actions, the IU RAO when considering the selection of an individual costly or non-costly remedial action, shall consider the sensitivity of these actions on each of the overloaded optimized grid elements. This sensitivity factor shall be expressed in percentage of the maximum current of the concerned optimized grid elements.

For costly RA, the sensitivity of any change of power on a generating unit shall require a definition of the compensation. This will be defined during the implementation.

The objective to minimise the total cost of costly remedial action will lead to the fact that, at identical sensitivity, a less costly RA shall always be preferred to one with higher costs. But using low effective RA to solve far away congestions might also have side effects in term of grid stress and reduction of available means close to their activation. The exact ratio between cost and sensitivity might have to be tuned in order to avoid over-used of far and less sensitive non-costly remedial action just to provide limited gain in the incurred costs.

The main driver of the optimisation, as part of the CROSA process, is the security of supply by finding the most optimal set of RAs taking into account their effectivity and efficiency.

During CROSA it will be indicated if a bidding zone/TSO is affected by a RA. This is required to determine the affected TSOs and required when a RA gets rejected.

4.2.9 Robustness

In circumstances where the initial loading of secured elements is above its current limits, the result of the regional operational security coordination will lead to loadings on one or several secured elements very close to its current limits. Any variation for example of forecasts in consumption, RES production, market activities or unforeseen outages could lead again to overloads of the secured elements. In these situations, the IU On-shore TSOs must still have access to short-term potential of Remedial Actions to react on these overloads. Therefore, the solution of the regional operational security coordination shall not recommend additional RAs for these circumstances but shall, whenever possible, free them up in case they are needed. As example, Redispatching in a short-term period could not be possible due to the fact, that the respective Power plant is offline and requires a too long lead time before it can be used for the demanded Redispatching. A robust solution could take this into account and finds results, where instead of one Power plant is fully used for Redispatching, two Power plants are used in each case with minimum power infeed.

A technical possibility to achieve a robust solution regarding Redispatching may be to perform a pre-run of the optimisation, where the current limits of secured elements are reduced to a value smaller than 100%. Power plants which are started up for Redispatching and which cannot be re-evaluated in the next CROSA are "Must-use" Redispatching for the consecutive ordinary optimisation at least with its minimum power. The consecutive ordinary optimisation will use current limits without reliability margin in accordance to CSAM Article 23 (1)(a) and CSAM Article 24 (3)(a).

Example:

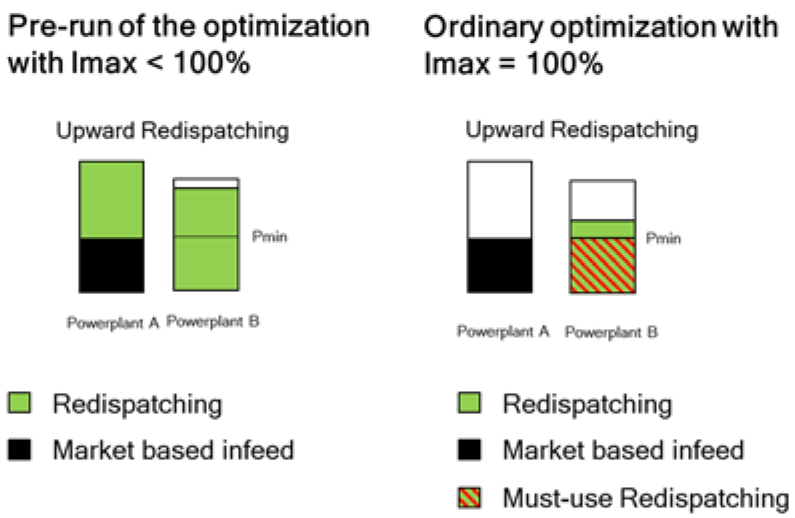

Figure 4: Example of robustness

Further possibilities exist to reach this goal as among others:

1. Considering additional margin respecting uncertainties to monitor and solve congestions,
2. Ensuring that non-used RAs provide sufficient margin on highly loaded elements,
3. Limiting the number of used actions in function of the time horizon of computation.

During the implementation of the ROSC methodology, RSCs and TSOs will further assess and experiment the possibilities and amend the methodologies with the most appropriate solution.

4.2.10 Coordination of RAs

IU On-shore TSOs are allowed to reject RAs proposed by IU'S RSCs. The following list includes some examples for a required rejection of a RA:

- Power plants are currently not available;
- Provided input data is not correct;
- A network element trips;
- Violations of voltage or stability limits identified in local assessments;

- Violations of operational limits in voltage levels below 110 kV identified in local assessments.

Normally, only the RA connecting TSOs and CROSA affected TSOs (as described in p. 3.3.2) will have right to reject the CROSA solution proposed by RSC. The rejection of a RA by a TSO must not mean that the whole solution is rejected but only particular RAs. Such rejection may not imply new calculation. In case of rejection of RAs connecting and/or affected TSOs with the support of IU'S RSCs shall identify and plan alternative RAs taking into account cost and efficiency to relieve the operational security limits violations.

If a IU On-shore TSO rejects a RA proposed by IU'S RSC, the reasons shall be justified, documented by the relevant IU On-shore TSO(s) and provided to IU'S RSC.

Output of coordination: As outcome of a CROSA, the list of Agreed RAs is defined. This list identified the best estimation of the RAs that will need to be used to relieve violation of flow operational security limits on Secured elements. When the foreseen time of a congestion and technical or other constraints allow so, TSOs might reassess the need to apply already Agreed RAs during ID CROSAs. Based on updated CGM (including better load and generation forecast, unplanned outages etc.), RAO process may result in a need to increase or decrease the volume of certain RAs (such as RD, CT or PST tap change) or not using the RA at all and therefore find a more efficient and effective way to handle identified congestions. To be able to distinguish between Agreed RAs which might yet be reassessed in next ID CROSA(s) and those which cannot be reassessed, IU On-shore TSOs have developed two terms to divide between Agreed RAs which can or cannot be reassessed in next ID CROSAs:

- ANORA (Agreed but Not Ordered Remedial Actions) – their activation time allows reassessment in next ID CROSA and therefore steps leading towards their activation do not have to be made. ANORA is only the best estimate of a final solution that will be activated.
- Ordered Remedial Actions – cannot be reassessed later either due to its activation time or due to necessity to relieve a congestion forecasted to happen before next ID CROSA. Therefore, steps leading to ORAs activation should be made. Only Fast activation process can lead to a change in Ordered RA.

4.2.11 Inter-CCR coordination

Article 46 of CSAM states that no later than eighteen months after the adoption of the CSAM, all TSOs shall jointly issue a request for amendment of the CSAM with rules for the identification and definition of overlapping zones, overlapping XNEs, overlapping XRAs, impacting CCRs and competent RSC(s), as well as, rules for the sharing of costs of the activated overlapping XRAs, in accordance with Article 27(3). This amendment will be the basis for Inter-CCR coordination, will be ready before the end of the implementation of the target solution for the IU ROSC and will be agreed among all CCRs. Therefore, IU On-shore TSOs decide not to develop Inter-CCR coordination principles in the meantime because such principles will never be implemented before the CSAM amendments and IU On-shore TSOs cannot enforce such principles on other CCRs. The non-development of such principles will not delay the implementation of the IU ROSC Methodology and in the meantime IU On-shore TSOs and the IU'S RSC will apply the bilateral or multilateral agreements that already exist between IU On-shore TSOs and other CCR TSOs or between IU'S RSC and other RSCs.

4.3 Validation

4.3.1 Outcome of validation

After the validation session, Ordered RA and ANORAS are known and can be logged and implemented in the IGM in accordance with article 36.

It may happen that there are some remaining violations at the end of the validation session for several reasons, e.g.:

- the optimisation didn't find enough RA to remove every violation
- during the coordination of RAs according to article 31, some RAs have been rejected for relevant reasons
- some RAs are not available anymore because of a contingency

In those situations, depending on when the violation is forecasted to happen, TSOs can propose new RAs in the set of available RAs, can look for RAs coming from others CCRs, or can launch a Fast Activation Process.

The procedure for the determination of cross-border relevant RA is largely dependent on the process step. The DA- or ID-CROSA will typically be characterized by the need to remove multiple congestions at the same time. As a result, a mix of non-costly and costly RAs can be expected, which must be understood as an overall measure to address all congestions. A clear allocation of individual measures, especially with regard to redispatching & countertrading, does not make sense.

5. IMPLEMENTATION OF REMEDIAL ACTIONS

5.1 Activation of remedial actions

Respecting the results of the last CROSA process, TSOs shall activate Agreed Remedial actions as close to real time as possible respecting their technical, operational, procedural and other constraints.

To prevent intraday market trading further worsening the congestion and mitigating the relieving effect of the RA, the available cross-border capacities shall be updated. TSOs should not reduce available cross-border capacities unless it is considered that the N-1 security of the system is endangered. If it is, then only available capacities in the direction that worsens the congestions would be reduced. As an example, in case of Countertrading or Redispatching between 2 control area, IU On-shore TSOs might reduce available cross-border capacity on the borders between these 2 control areas to prevent intraday market trading further worsening the congestion and mitigating the relieving effect of the RA. The available cross-border capacity in directions not impacting the RA negatively won't be modified. When timings allow, Agreed RAs will figure as inputs for the ID CC process (incl. IGMs).

5.2 Consideration of remedial actions in next IGM

Both the EU regulations (SO Guideline, CACM) and Methodologies (CGMM, CSAM) require that Agreed RAs shall be put into IGMs and also shall be distinguishable from the base (“clean”) model. To be able to fulfil this requirement, IU On-shore TSOs aim to log all Agreed RAs in a platform separate from IGMs. CSAM article 28 requires RSCs to monitor inclusion of Agreed RAs into IGMs. To be able to do so, RSCs might for instance compare each TSOs IGMs against logged RAs and inform TSOs about identified inconsistencies.

Unlike ORA, the status of which won’t be modified in next ID CROSAs, the logged information about ANORAs will be used to remove those ANORAs from CGM and hence get a “clean” CGM. In this way, IU On-shore TSOs and RSCs will be able to correctly identify congestions and possibly propose more efficient and effective set of RAs.

5.3 Fast activation process

Fast Activation Process is defined as a process to relieve operational security limits violation where detection of this violation occurs either between or after the standard CROSA processes. In such a situation, fast activation of a RA is required and cannot wait for the next ID CROSA. For example, in case a sudden operational security limits violation arises close to real-time or in real-time (due to incorrect forecast, unplanned outage, unavailability of a RA etc.), a TSO has the responsibility to relieve the congestion as soon as possible. In case the RA meant to relieve the violation is not considered as XRA (has no cross-border impact), no coordination with RSCs or neighbouring TSOs is needed. However, in case it concerns a XRA (the RA has cross-border impact), the Fast Activation Process will be applied. When doing so, the activation of this XRA shall be coordinated with impacted TSOs (in Normal or Alert system state). In Emergency system state, when a violation occurs, coordination is recommended only if time allows it. If not, then affected TSOs would be only informed about the activation.

It might also happen that due to e.g. improved forecast, activation of certain RA is no longer necessary. In such cases, affected TSOs may reassess the need of the activation via Fast activation process. For example, cancelling a non-costly RA, such as topology change, might be very simple and easily done. However, cancelling RD or CT RA could be quite difficult when the generators have already started ramping etc. Therefore, to decide whether to cancel activation of the RA, Affected TSOs must carefully consider technical and operational feasibility and economic efficiency of doing so.

Depending on time restrictions, RSCs could be asked to participate in the Fast activation process and should be at least informed about its outcome once the constraint has been successfully relieved. Once RAs to relieve the violation has been identified, coordinated and agreed, the Fast activation process ends. Lastly, all RAs activated as a result of Fast activation process shall be taken into account in following IGMs. New congestions as a result of these RAs should be avoided.

6. IMPLEMENTATION

6.1 Implementation

As described in the SO Regulation and CSAM, when developing solutions for the application of Coordinated Regional Security Analysis, TSOs and RSCs will consider the global efficiency and effectiveness. In this spirit, some of the functionalities and tools necessary for the ROSC need to be developed at regional and even pan-European level. Moreover, the CGMES format developed in accordance with the CGMM will be the basis for the target solution. Furthermore, the RSCs will aim at automatizing the optimisation step. Considering the different principles and the size of the IU region, this automatization will represent a challenge that should not be underestimated. Overall, the challenges and uncertainties behind the new processes and functionalities and the dependencies on parties, which are not part of the IU governance, need to be considered within a realistic timeframe for the implementation of the target solution.

In this respect, IU On-shore TSOs and IU'S RSCs have decided to describe in the IU ROSC Methodology the different steps that will be necessary for the definition, the development and the testing of the target including an estimation of the maximum time for each step.
As the maximum timing of some of the steps will also be highly dependent of the development phase and is fixed when the contracts with the vendors are signed, it is also proposed to review and amend these timing in the Methodology once the tendering process for the different tools and hardware is finished.

Nevertheless, considering the importance to improve the efficiency of the coordination at the regional level, IU On-shore TSOs and IU'S RSCs are aware and convinced that they cannot wait for the full implementation of the target solution. This is the reason why they also engage themselves to define and develop a stepwise approach considering interim solutions in a more ambitious but still realistic timing and to amend the IU ROSC Methodology before 1 year after its approval accordingly. This stepwise approach and related interim solution shall be based on the following principles:

1. Improve the current level of coordination on IU regional level, i.e. that the stepwise approach will respect the spirit and ambition of the provisions as defined in the IU ROSC Methodology regarding the determination and activation of Agreed remedial actions and not develop a sub-regional solution;
2. Shall consider existing processes and tools without delaying the implementation of more advanced regional or pan-European solutions or processes when necessary, i.e. the interim solution might use the existing UCTE format and move to the CGMES format once this will be proven robust at pan-European level or might use a much simpler way to exchange and report data and results;
3. Shall be implemented faster and more ambitious, but within a realistic timing, i.e. IU On-shore TSOs and IU'S RSCs expect this interim solution implemented in less than 24 months and
4. Shall require reasonable implementation effort, i.e. the required time and costs for the development and implementation of an interim solution have to be taken into account.

The IU ROSC Methodology shall be implemented in a consistent manner with the IU RD and CT Methodology and IU Cost Sharing Methodology.

7. ALLOCATION OF TASKS BY RSCS

The elements that need to be described under the organisation of regional operational security coordination are further defined in article 77(1) of SO Regulation.

It should also be considered that on 4th July 2019 Electricity Market Regulation (EMR) entered into force that also contains in Art. 37 EMR tasks that shall be performed by regional security coordinators (in the future regional coordination centres) and references to SO Regulation. As a consequence, SO Regulation needs to be interpreted in the light of EMR and should not be considered as a stand-alone regulation.

7.1 Appointment of RSCs and delegation of tasks to RSCs

The Article 41 covers the formal appointment, by IU On-shore TSOs, of the RSC that will perform the tasks listed in the article 77(3) of the SO Regulation, allocated by the model that shall be defined before formal approval of IU ROSC Methodology.

TSOs of IU CCR are shareholders of CORESO. Consequently, CORESO has been appointed as IU'S RSC to perform the tasks listed in the article 77(3) of SO Regulation and listed in Article 41.

APPENDIX A: LOCAL PRELIMINARY ASSESSMENT

Purpose of Local Preliminary Assessment (LPA)

SONI TSO and EirGrid TSO have carried out operational security analysis on an all island (Ireland and Northern Ireland) basis since the beginning of SEM in 2007 using the Reserve Constrained Unit Commitment (RCUC) security model. This included the scheduling of generation on an all island basis taking each TSO's Transmission Constraints Groups (TCG's) as set out in the Monthly Operational Constraints document into consideration. Note that this operational security analysis did not include modelling the transmission network or transmission outages. This analysis was carried out on a day-ahead and intra-day basis.

Since the beginning of I-SEM (Oct 2018) SONI TSO and EirGrid TSO have carried out operational security analysis on a day-ahead and intra-day basis using the Market Management System (MMS) security model. This includes scheduling generation on an all island basis taking each TSO's Transmission Constraints Groups (TCG's) as set out in the Monthly Operational Constraints document into consideration as well as a model of the all-island transmission network including transmission outages.

The all-island transmission network model is made up of the Individual Grid Model (IGM) for Northern Ireland and the IGM for Ireland. The IGM's are merged and used within the MMS to provide a generation schedule that is Network Secured (i.e. the schedule respects operational limits of the all-island transmission system considering the physical limitations of the network, transmission outages and all TCGs in Northern Ireland and Ireland).

This is the Local Preliminary Assessment (LPA) that is performed by SONI and EirGrid for the all-island system using their respective IGMs and is fundamental to the design and operation of the SEM. The purpose of the LPA is to produce an economically optimised, network secured generation schedule. This generation schedule is for the synchronous island of Northern Ireland and Ireland. It is designed to meet the Operational Security Standards of both SONI TSO and EirGrid TSO.

All costs of remedial actions required to secure the network in Northern Ireland and Ireland are settled within the SEM bidding zone in line with the all island market design.

Pan-European Hybrid Electricity Market Integration Algorithm (EUPHEMIA)

The output of EUPHEMIA sets the direction and size of the power flows HVDC interconnectors on a pan-European basis. This provides market coupling on a day-head and intraday between the following TSO areas;

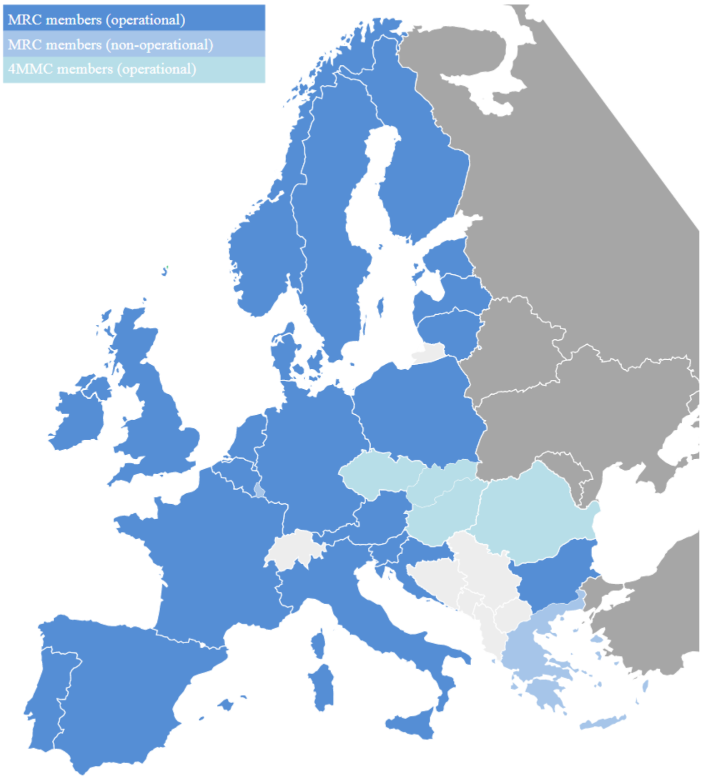

Figure 5: EU coupling from beginning of I-SEM, October 2018

The EUPHEMIA day-ahead market produces an indicative (non-firm) schedule for Moyle and East West HVDC interconnectors at 11:54hrs daily. The day-head EUPHEMIA market process schedules HVDC interconnector power flows between 23:00hrs on the day to 23:00hrs the next day.
The 1st EUPHEMIA Intra-day market schedule is produced daily at18:10hrs daily. This schedule covers the time periods from 23:00hrs on the day to 23:00hrs day-ahead.

The 2nd EUPHEMIA intra-day market schedule is produced daily at 08:40hrs. This schedule covers the time periods from 11:00hrs to 23:00hrs on the day.

DA LPA executed by SONI TSO and EirGrid TSO

At 11:54am a daily LPA for the Day Ahead Market (DAM) process begins with the output of the EUPHEMIA.
The MMS schedules generation (and demand reduction) for Northern Ireland and Ireland on an all island basis which aims to comply with the following;

1. Operational Security Standard of the Ireland Transmission Network (EirGrid TSO);
2. Operational Security Standard of the Northern Ireland Transmission Network (SONI TSO); and
3. EirGrid/SONI Monthly Operational Constraints document.

The MMS schedules generation (or demand reduction) for Northern Ireland and Ireland on an all Island basis using the following data:

1. HVDC interconnector power flows from EUPHEMIA algorithm

2. Forecasts of energy demand
3. Forecasts of renewable generation
4. SONI TSO IGM
5. EirGrid TSO IGM
6. Network and operational constraints
7. Market Participants Technical Offer Data (TOD)
8. Market Participants Commercial Offer Data (COD)
9. HVDC interconnector power flows from EUPHEMIA algorithm

The MMS is used to provide an all Island generation schedule bases on Commercial Offer Data (COD) from market participants. The COD provided from market participants can include complex and simple bids.

ID LPA executed by SONI TSO and EirGrid TSO

The intra-day scheduling process takes the information from the day-head process and updates this information closer to real time operation. This information to be updated between the day-ahead and intra-day will include;

1. Forecasts for energy demand and renewable generation
2. Network constraints
3. Market Participants COD
4. Changes to HVDC interconnector power flows from EUPHEMIA algorithm
5. Changes to network topology

The 1st LPA intra-day process is carried daily 18:10hrs using the output from the EUPHEMIA 1st intraday process. The 1st LPA schedules generation between the following time periods; 23:00hrs on the day to 23:00hrs next day.

The 2nd LPA intra-day process is carried daily 08:40hrs using the output from the EUPHEMIA 2nd intraday process. The 2nd LPA schedules generation between the following time periods; 11:00hrs on the day to 23:00hrs on the day.

Additional DA or ID LPA executed by SONI TSO and EirGrid TSO

It is be deemed necessary to carry out an additional day-ahead LPA if any of the following situations occur;

- A forced outage of a significant generator plant.
- A forced outage of a significant network element.
- A significant change to the day-ahead load forecast.
- A significant change to the day-ahead wind/renewable energy forecast.
- A forced outage of a HVDC interconnector.

Counter Trading

If within the intra-day time frame counter trading is required for system security reasons, the costs associated with this will be dealt with in accordance with the IU Redispatching and Countertrading Cost Sharing Methodology.

The costs or income from such counter trading to the all island energy market of Northern Ireland and Ireland will be socialised across the island in line with the SEM market design, regardless of the TSO (SONI or EirGrid) requesting the trade with NGESO.

APPENDIX B: EXAMPLE OF REMEDIAL ACTION

A typical example of a cross-border relevant Relevant Action (XRA) that can be utilised to relieve cross-border congestion in the IU region is Redispatching or Countertrading across interconnectors. In the diagram below, which captures the Dumfries and Galloway group in Scotland, the scenario is set with high Northern Ireland to Scotland flows coming in at Auchencrosh. This is in combination with high wind generation at Coylton, Glenlee and Hadyard Hill. This high generation export group is also made worse at times of high embedded hydro generation. In such a scenario, the contingency of a Double Circuit Hunterston – Kilmarnock South trip will cause the Kilmarnock South – Strathaven 1 circuit (122) to breach operational security limits.

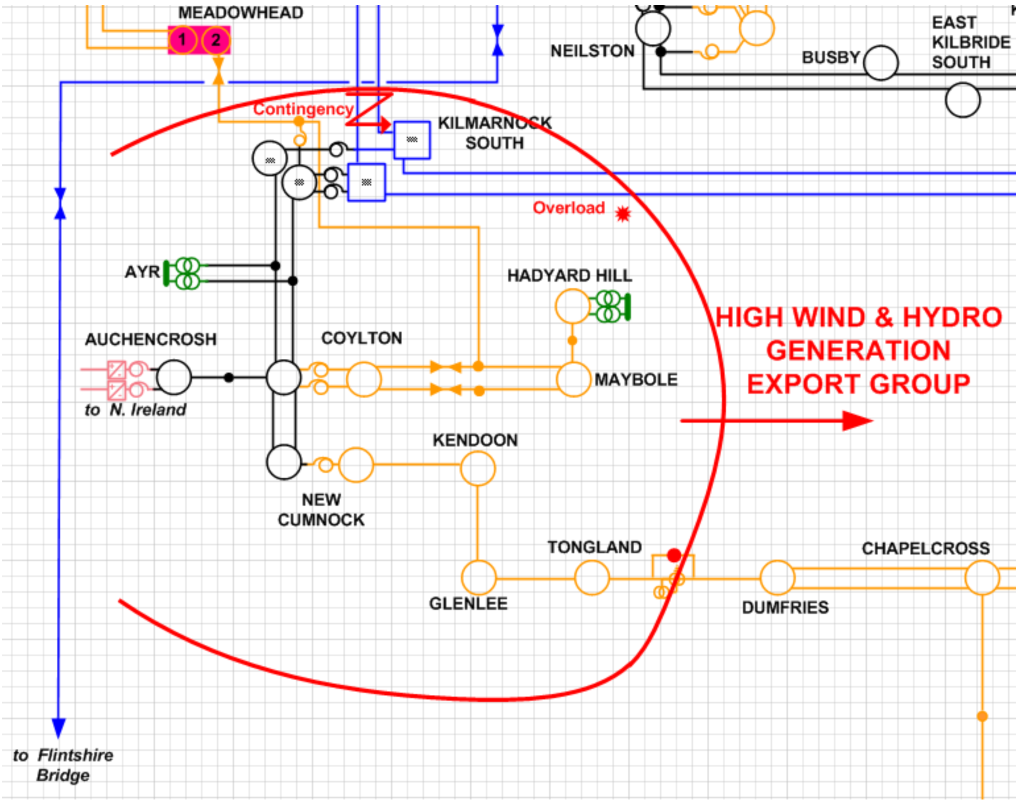

Figure 6: Remedial Action example

In case the thermal overload on the Kilmarnock South – Strathaven 1 (122) exceeds PATL by 40MW but is within TATL, a series of RAs will be proposed by the GB TSO to manage the operational security limit violation on the circuit.

Typical RAs would be:

1. Redispatching of 100MW Wind generation at Coylton at 40% effectiveness at a price of £60/MWh, balanced elsewhere in England & Wales
2. Redispatching of 200MW Hydro generation at Hadyard Hill at 20% effectiveness at a price of £ 75/MWh, balanced elsewhere in England & Wales
3. Countertrading of 80MW of Moyle at 50% effectiveness at a price of £55/MWh, balanced both in GB and in IU SEM (this includes the costs or incomes related to change of flow incurred by the Interconnector or Facilitating TSO, the charges for RD & CT actions incurred both by the Requesting and the Assisting TSOs)

In this case, the RAO will likely propose the optimal RA of Countertrading on Moyle being both the cheapest and the most effective to relieve cross-border congestion after performing a CROSA. Because the proposed RA is cross-border impacting, the RSC will have to validate the RA with all affected TSOs before coordinating with NGESO for GB and SONI for NI a countertrading action for the hours at which the scenario is expected to last. This can either be proposed as a Preventive Action for the hours that the issue is active or as a Curative Action following the Hunterston – Kilmarnock DC contingency.