Italy North TSOs proposal for an intraday common capacity calculation in accordance with Article 21 of Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management

August 2019

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TSOs of the Italy North Region taking into account the following:

Whereas

(1)   This document (hereafter referred to as "ID CCC methodology Proposal"), including its annexes, is a common proposal developed by all Transmission System Operators (hereafter referred to as "TSOs") within the Italy North Capacity Calculation Region (hereafter referred to as "Italy North Region") regarding the proposal for the common capacity calculation performed for the capacity allocation within the intraday timeframe. This proposal is required by Article 21 of Regulation (EU) 2015/1222 on Capacity Allocation and Congestion Management (hereafter referred to as the "CACM Regulation").

(2)   This proposal takes into account the general principles and goals set in the CACM Regulation as well as the Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity (hereafter referred to as "Regulation (EC) No 714/2009").

In addition, this proposal takes into account the effective structure of the grid and the borders between Italy and third countries by establishing TSO-TSO based contractual frameworks to include third countries as Technical Counterparties. Therefore, this proposal is developed by TSOs of the Italy North Region, taking into account Technical Counterparties' grid elements.

(3)   This proposal takes into account the general principles and goals set in CACM Regulation. Ensuring optimal use of the transmission infrastructure and operational security, which are among the objectives of capacity allocation and congestion management cooperation, laid down by Article 3 of CACM Regulation, requires the inclusion of Third Countries' grid elements in the capacity calculation process of Italy North Region. CACM Regulation's objectives cannot be achieved in any other way but by including Third Countries' grid elements. This inclusion is in line with Article 13 of Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (hereafter referred to as "SOGL Regulation"), providing that EU TSOs must establish "cooperation concerning secure system operation" with non-EU TSOs belonging to the same synchronous area via an agreement with these non-EU TSOs. In order to comply with the requirement laid down by EU Regulation, this methodology will include Third Countries as Technical Counterparties.

Coordinated capacity calculators will take into account the whole Area of Common Interest (hereafter referred to as "ACI") of the Italy North Region and include Technical Counterparties' remedial actions into coordinated remedial action preparation and the optimization procedure. TSOs of Italy North Region will conclude an agreement with relevant Technical Counterparties. In order to be taken into consideration in the capacity calculation process and enter into a TSO-TSO based contractual framework, Technical Counterparties must fulfil the conditions laid down by Article 1(3) of the *"All TSOs' proposal for a common grid model methodology in accordance with Article 17 of Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management"*, applicable to TSOs from jurisdictions outside the area referred to in Article 1(2) of CACM Regulation. The

agreement between Italy North Region TSOs and the Technical Counterparty will include ID CCC methodology's provisions and ensure that the Technical Counterparty is contractually bound by equivalent obligations as the ones binding upon TSOs of the Italy North Region by virtue of EU Regulations. Such agreement will govern mutual obligations and responsibilities of the Technical Counterparty with TERNA, ELES, APG and RTE in relation to the capacity calculation process on all elements of the Area of Common Interest. Ensuring optimal use of the transmission infrastructure and operational security, which are among the objectives of capacity allocation and congestion management cooperation, laid down by Article 3 of CACM Regulation, requires the inclusion of Technical Counterparties' grid elements in the capacity calculation process of Italy North Region.

(4)   The goal of the CACM Regulation is the coordination and harmonisation of capacity calculation and allocation in the day-ahead and intraday cross-border markets. To facilitate the achievement of these aims and implement single day-ahead and intraday coupling, it is necessary for TSOs to calculate in a coordinated manner the available cross-border capacity. In line with the requirements of CACM Regulation, the TSOs of Italy North Region will strive to cooperate with Capacity Calculation Regions (hereafter referred to as "CCR") connected to Italy North Region order to ensure that capacity calculation takes place in the most efficient and thorough way.

(5)   Article 21 (1) of the CACM Regulation constitutes the legal basis for this proposal and defines several specific requirements that the ID CCC methodology Proposal should take into account:
"1. *The proposal for a common capacity calculation methodology for a capacity calculation region determined in accordance with Article 20(2) shall include at least the following items for each capacity calculation time-frame:*

(a)   *methodologies for the calculation of the inputs to capacity calculation, which shall include the following parameters:*

(i)   *a methodology for determining the reliability margin in accordance with Article 22;*

(ii)   *the methodologies for determining operational security limits, contingencies relevant to capacity calculation and allocation constraints that may be applied in accordance with Article 23;*

(iii)   *the methodology for determining the generation shift keys in accordance with Article 24;*

(iv)   *the methodology for determining remedial actions to be considered in capacity calculation in accordance with Article 25.*

(b)   *a detailed description of the capacity calculation approach which shall include the following:*

(i)   *a mathematical description of the applied capacity calculation approach with different capacity calculation inputs;*

(ii)   *rules for avoiding undue discrimination between internal and cross-zonal exchanges to ensure compliance with point 1.7 of Annex I to Regulation (EC) No 714/2009;*

(iii)   *rules for taking into account, where appropriate, previously*

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> *allocated cross-zonal capacity;*
>
> *(iv)   rules on the adjustment of power flows on critical network elements or of cross-zonal capacity due to remedial actions in accordance with Article 25;*
>
> *(v)   for the flow-based approach, a mathematical description of the calculation of power transfer distribution factors and of the calculation of available margins on critical network elements;*
>
> *(vi)   for the coordinated net transmission capacity approach, the rules for calculating cross-zonal capacity, including the rules for efficiently sharing the power flow capabilities of critical network elements among different bidding zone borders;*
>
> *(vii)   where the power flows on critical network elements are influenced by cross-zonal power exchanges in different capacity calculation regions, the rules for sharing the power flow capabilities of critical network elements among different capacity calculation regions in order to accommodate these flows.*
>
> *(c)   a methodology for the validation of cross-zonal capacity in accordance with Article 26."*

(6)   Article 14 of the CACM Regulation defines the capacity calculation time-frames as "*intraday, for the intraday market. For the intraday market time-frame, individual values for cross-zonal capacity for each remaining intraday market time unit shall be calculated. All TSOs in each capacity calculation region shall ensure that cross-zonal capacity is recalculated within the intraday market time-frame based on the latest available information. The frequency of this recalculation shall take into consideration efficiency and operational security."*

(7)   Article 20 (1) of the CACM Regulation defines the approach to use in the common capacity calculation methodologies as "*flow-based approach"* and Article 20 (3) of the CACM Regulation specifies that: "*The TSOs from the capacity calculation region where Italy, as defined in point (c) of point 3.2 of Annex I to Regulation (EC) No 714/2009, is included, may extend the deadline without prejudice to the obligation in paragraph 1 for submitting the proposal for a common coordinated capacity calculation methodology using flow-based approach for the respective region pursuant to paragraph 2 up to six months after Switzerland joins the single day-ahead coupling."*

(8)   Article 20 (2) of the CACM Regulation defines the deadline to submit the common proposal based on the coordinated net transmission capacity approach for the TSOs from the capacity calculation region where Italy, as defined in point (c) of point 3.2 of Annex I to Regulation (EC) No 714/2009, is included:
2.   "No later than 10 months after the approval of the proposal for a capacity calculation region in accordance with Article 15(1), all TSOs in each capacity calculation region shall submit a proposal for a common coordinated capacity calculation methodology within the respective region. The proposal shall be subject to consultation in accordance with Article 12."

(9) TSOs of Italy North Region intend to apply a coordinated net transmission capacity methodology as interim approach for capacity calculation within the Italy North Region, without prejudice to the future implementation of a Flow Based approach as the target methodology for the Italy North Region as foreseen in Article 20(1) of the CACM Regulation.

(10) Article 2 (8) of the CACM Regulation defines the coordinated net transmission capacity approach as *"the capacity calculation method based on the principle of assessing and defining ex ante a maximum energy exchange between adjacent bidding zones"*.

(11) In the context of this proposal, the definition of "coordinated capacity calculator" is important and is defined in Article 2 (11) of the CACM Regulation as: *"the entity or entities with the task of calculating transmission capacity, at regional level or above"*.

(12) Article 9 (9) of the CACM Regulation requires that the proposed timescale for the implementation and the expected impact of the ID CCC methodology Proposal on the objectives of the CACM Regulation is described. The impact is presented below in the point (12) of this Whereas Section.

(13) The CCC methodology Proposal contributes to and does not in any way hinder the achievement of the objectives of Article 3 of the CACM Regulation:

Article 3 (a) of the CACM Regulation aims at promoting effective competition in the generation, trading and supply of electricity.
The ID CCC methodology Proposal serves the objective of promoting effective competition in the generation, trading and supply of electricity by defining a set of harmonised rules for capacity calculation and congestion management which contributes to the effectiveness of the intraday market. Establishing common and coordinated processes for the capacity calculations within the intraday market timeframe contributes to achieving this aim.

Article 3 (b) of the CACM Regulation aims at ensuring optimal use of the transmission infrastructure.
The ID CCC methodology Proposal contributes to the objective of ensuring optimal use of the transmission infrastructure by using last available inputs based on the best possible forecast of transmission systems at the time of each capacity calculation, updated in a timely manner.

Article 3 (c) of the CACM Regulation aims at ensuring operational security.
The ID CCC methodology Proposal contributes to the objective of ensuring operational security by coordinating the capacity calculation with updated inputs for the intraday market timeframe at regional level to ensure its reliability.

Article 3 (d) of the CACM Regulation aims at optimising the calculation and allocation of cross-zonal capacity.
By coordinating the timings for the delivery of inputs, calculation approach and validation requirements of the CCC between TSOs and the coordinated capacity calculator, the ID CCC

methodology Proposal contributes to the objective of optimising the calculation and allocation of cross-zonal capacity.

Article 3 (g) of the CACM Regulation aims at contributing to the efficient long-term operation and development of the electricity transmission system and electricity sector in the Union.
By using the best possible forecast of the transmission systems at the time of each capacity calculation within the Italy North region, the results of the coordinated capacity calculation contribute to determine the most limiting branches within this region, by then help TSOs for a more efficient development of the electricity transmission system.

(14)   In conclusion, the ID CCC methodology Proposal contributes to the general objectives of the CACM Regulation.

SUBMIT THE FOLLOWING ID CCC METHODOLOGY PROPOSAL TO THE NATIONAL REGULATORY AUTHORITIES OF THE REGION:

Article 1
Subject matter and scope

The ID CCC methodology as determined in this ID CCC methodology Proposal is the common proposal of all Italy North TSOs in accordance with Article 21 of the CACM Regulation.

Considering the structure of the grid, Third Countries' borders are taken into account via a separate agreement in the capacity calculation process and referred to, in this methodology proposal, as Technical Counterparties.

Article 2
Definitions and interpretation

1. For the purposes of the ID CCC methodology Proposal, the terms used shall have the meaning given to them in Article 2 of Regulation (EC) 714/2009, Article 2 of Regulation (EC) 2013/543 and Article 2 of the CACM Regulation.

2. In addition, the following definitions shall apply:

    a. 'APG' means Austrian Power Grid AG, the Austrian system operator;
    b. 'AT-IT border' means bidding zone border between Austria and Italy;
    c. CH-IT border' means bidding zone border between Switzerland and Italy;
    d. 'ELES' means ELES, d.o.o. , the Slovenian system operator;
    e. 'FR-IT border' means bidding zone border between France and Italy;
    f. 'RTE' means Réseau de Transport d'Electricité, the French system operator;
    g. 'SI-IT border' means bidding zone border between Slovenia and Italy;
    h. 'Technical Counterparty' means any non-EU TSO to be included in the procedures of this methodology through respective agreements;
    i. 'TERNA' means TERNA S.p.A. Rete Elettrica Nazionale, the Italian system operator;
    j. Third Country means country from jurisdiction outside the area referred to in Article 1(2) of the CACM Regulation.

3. Definition of Acronyms

CC	Capacity Calculation
CCC	Common Capacity Calculation
CGM	Common Grid Model
CGMES	Common Information Model (CIM) for Grid Model Exchanges
CNE	Critical Network Element
CNEC	Critical Network Element and Contingency. For the purpose of this methodology, the term CNEC also cover the case where a CNE is used in capacity calculation without a specified contingency.
CRA	Curative Remedial Action
D-2	Two Days Ahead
DACF	Day Ahead Congestion Forecast

ID	Intraday
IDCF	Intraday Congestion Forecast
IDCM	Intraday Coupling Model
IGM	Individual Grid Model
MC	Market Coupling
MNE	Monitored Network Element
NEMOs	Nominated Electricity Market Operators
NRAs	National Regulatory Authorities
NTC	Net Transfer Capacity
PRA	Preventive Remedial Action
PST	Phase Shifter Transformer
RAO	Remedial Action Optimization
RSC	Regional Security Coordinator
SPS	Special Protection Scheme
TRM	Transmission Reliability Margin
TTC	Total Transfer Capacity (of the Italy North Region)
Ur	Uncertainty of regulation
Us	Uncertainty of scenario
σ	Standard Deviation

4. In this ID CCC methodology Proposal, unless the context requires otherwise:

    a) the singular indicates the plural and vice versa;

    b) headings are inserted for convenience only and do not affect the interpretation of this proposal; and

    c) any reference to legislation, regulations, directives, orders, instruments, codes or any other enactment shall include any modification, extension or re-enactment of it when in force.

Article 3
Application of this proposal

This proposal applies solely to the ID common CC methodology based on the coordinated net transmission capacity approach within the Italy North CCR. For the avoidance of doubt the respective or relevant provisions of this proposal apply to any relevant Technical Counterparty of the Italy North CCR, by virtue of separate contracts as mentioned above in Article 1. The ID CCC methodology using the flow-based approach, the CCC methodologies within others CCRs and other timeframes are outside the scope of this proposal.

Article 4
Cross-zonal capacities for the intraday market

For the intraday market time-frame, individual values for cross-zonal capacity for each remaining intraday market time unit shall be calculated using the ID CCC methodology.

Article 5
Reliability margin methodology

1. For the CC performed in ID, the TSOs and Technical Counterparties of Italy North Region shall define the reliability margin in line with Article 22 of the CACM Regulation and based on the analysis of the following data:

   a. unintended deviations of physical electricity flows within a market time unit caused by the adjustment of electricity flows within and between control areas, to maintain a constant frequency;

   b. uncertainties which could affect CC, and which could occur between ID and real time, for the market time unit being considered.

   More details on the computation of the reliability margin are provided in the technical Annex of the ID CCC methodology Proposal.

2. The reliability margin in the first year after the approval of the ID CCC methodology Proposal shall be defined as a fixed value, similar to the one described in the Italy North TSOs' proposal for a D-2 CCC in accordance with Article 21 of CACM Regulation. Not later than one year after the approval of the ID CCC methodology Proposal the TSOs of Italy North Region shall perform the analysis according to the paragraph 1 of this Article and define the appropriate risk level for the definition of reliability margin via a request for amendment.

3. The TSOs and Technical Counterparties of Italy North Region shall review once a year the reliability margin for the whole Italy North Region.

Article 6
Methodologies for operational security limits, contingencies and allocation constraints

1. For the CC, each TSOs and Technical Counterparties of Italy North Region shall provide the coordinated capacity calculator with its individual list of CNECs created based on a common contingency list. The CCC shall then define the initial list of CNECs to be considered during the CC, by merging the individual list of CNECs provided by all TSOs and Technical Counterparties of Italy North Region into a single list.

2. Subsequently, the CCC shall use the initial list of CNECs pursuant to paragraph 1 to create the final list of CNECs to be considered in the CC by selecting only network elements significantly influenced by cross-zonal power exchanges. The selection of these CNECs shall be based on a sensitivity analysis performed for each calculated timestamp in the different network states including but not limited to base case, after contingency and after remedial action.

3. Only CNECs with a sensitivity to cross-zonal power exchanges equal or higher than 5% shall be monitored during the CC process. The sensitivity shall be assessed as explained in Annex I. Any

change to the sensitivity threshold shall lead to an amendment of the entire ID CCC methodology Proposal according to Article 9(13) of CACM Regulation.

4. TSOs of Italy North Region will provide Italy North NRAs with a quarterly report including the following information:
    a. List of all the CNECs relevant in each timestamp adopted for capacity calculation, along with the associated sensitivity to cross-zonal exchanges;
    b. List of all the CNECs limiting the capacity in each timestamp;
    c. List of the cross-zonal interconnectors, if any, that are not considered in the capacity calculation process, along with the associated sensitivity to cross-zonal exchanges.

5. The first release of the report referred to in paragraph 3 will be submitted by 10 working days after the end of the quarter when the go-live of the export capacity occurs. The subsequent releases shall be submitted by 10 working days after the end of each quarter.

6. The TSOs and Technical Counterparties of Italy North Region may define also a list of monitored network elements (MNEs) that are influenced by the application of cross-border-impacting remedial actions in line with Articles 75 and 76 of the Regulation (EU) 2017/1485, but are not significantly influenced by the cross-zonal power exchanges. These MNEs shall only be monitored during the RAO if, in accordance with Article 10(5), at least one country is in import from Italy. The additional loading, resulting from the application of RAs, on these monitored elements may be limited during the RAO, in accordance with Article 8(6)).

7. The MNE concept is allowed for a temporary period of 18 months from the implementation of the export capacity. During this period the TSOs of the Italy North Region will send a quarterly report listing all the market time units for which a MNEs has limited the capacity. The report shall be submitted within 10 working days after the end of each quarter starting from the quarter of the Export corner go-live. Furthermore, the TSOs of Italy North Region shall assess the avoided costs of remedial actions due to the MNE concept against the loss of social welfare due to the reduction of the cross-zonal capacity, and submit the results to the NRAs of the Italy North Region within 12 months after the go live of the export corner calculation, along with a proposal to phase out or to keep using the MNE concept.

8. Where the power flows on CNEs monitored in the CC are influenced by cross-zonal power exchanges in different CCRs, the TSOs and Technical Counterparties of the Italy North region shall define the rules for sharing the power flow capabilities of CNEs among different CCRs in order to accommodate these flows. These rules will be detailed in cooperation with the other CCRs during the implementation phase of this methodology.

9. The coordinated capacity calculator shall use the CNECs in accordance with Article 7(3) for the CC performed within Italy North Region in order to determine the maximum net transmission capacity for each bidding-zone border.

10. The Italian operational constraints related to the control of voltage profiles and dynamic stability of Italian system, which are needed to maintain the transmission system within operational security

limits but cannot be transformed efficiently into maximum flows on CNEs, shall be expressed via allocation constraints.

11. Ramping constraints, which are needed to avoid large variations of the exchange programs between one hour and the next that may endanger the grid security during real time operations, shall be expressed via allocation constraints.

12. As a temporary solution, allocation constraints indicated in Article 6(7) and 6(8) will be directly applied to the results of the calculation performed by the coordinated capacity calculator. During this period, the unconstrained capacity will be computed in any case and made publicly and easily accessible. Once the market coupling algorithm will be fully capable of managing allocation constraints pursuant to Article 2(6) of the CACM Regulation, computation constraints will be abandoned in favour of allocation constraints pursuant to Article 2(6) of the CACM Regulation.

13. Allocation constraints will be given with a level of discretization of 50 MW.

14. For voltage and stability constraints, TSOs of the Italy North Region will publish at least the following elements for each market time unit:
    a. the expected total load in the Italian system;
    b. the expected total non-dispatchable production in the Italian system;
    c. the minimum dispatchable thermal generation needed to grant voltage and system stability in the Italian system.
    TSOs of the Italy North Region will publish also a feature to provide an estimation of the cross-dependence between the level of the allocation constraint and the parameters listed above.

15. TSOs of Italy North Region will perform a proper study about allocation constraints and will submit it to Italy North NRAs by 18 months after the implementation of the ID CCC methodology Proposal, along with the proposal to phase out or to keep such constraints.
    The study will include at least:
    a. An estimation of the loss of social welfare due to the reduced cross-zonal capacity;
    b. An estimation of the loss in the long-term transmission rights revenues due to the reduction periods included in the base products;
    c. An estimation of the cost of the alternative measures (both curative ones and preventive ones).

Article 7
Generation shift keys methodology

1. The TSOs of Italy North Region shall define the generation shift keys in accordance with Article 24 of the CACM Regulation.

2. RTE shall define generation shift keys proportional to the base case scenarios for each market time unit with all expected generating units in the IGM, reflecting RTE's best forecast of market behaviour.

3. TERNA shall define generation shift keys merit order to the base case scenarios for each market time unit with all expected generating units in the IGM, reflecting TERNA's best forecast of market behaviour.

4. ELES shall define generation shift keys proportional to the base case scenarios for each market time unit with all expected generating units and selected loads in the IGM, reflecting ELES's best forecast of market behaviour.

5. APG shall define generation shift keys participation factors to the base case scenarios for each market time unit with all expected generating units in the IGM, reflecting APG's best forecast of market behaviour. To achieve this the shift is done in generation/load nodes (PV or PQ nodes), according to a participation factor. The chosen nodes are evaluated by APG and are nodes with generation/load units that will change along with a market change. The participation factor for each node is set by APG and reflects the best forecast of generation/load distribution in the Austrian grid.

6. The TSOs of the Italy North Region have the possibility to use some nodes belonging to non-participating TSOs for the shifting during winter period (from October 1st to April 30th).

Article 8
Methodology for remedial actions in capacity calculation

1. The TSOs of Italy North Region shall define the remedial actions in accordance with Article 25 of the CACM Regulation.

2. Each TSO of Italy North Region shall define individually the remedial actions of its responsibility area to be used in the intraday CCC within Italy North Region.

3. The remedial actions to be defined by each TSO of Italy North Region shall be either preventive (pre-fault) or curative (post-fault). The TSOs of Italy North Region may use the following remedial actions, but not limited to:
   a. changing the tap position of a phase shifter transformer;
   b. topology measure: opening or closing of a line, cable, transformer, bus bar coupler;
   c. switching of a network element from one bus bar to another; or
   d. modification of generation.

   The remedial actions given to CC process are assessed by each TSO of the Italy North Region on a daily basis.

4. All types of remedial actions can be used in preventive and/or curative state. SPS will act only in curative stage, after tripping of grid elements. Due to this there are three different types of remedial actions used in the Italy North CC process:
   a. PRA: They correspond, in operation, to remedial actions to be implemented independently of the occurrence of any outage to relieve the grid. They are also implemented in the CGM.
   b. CRA: Each CRA is associated with a given Outage and applied after the Outage happened. They are taken into account during the CC process but not implemented in the model.

c. SPS: This represents an automatic change in grid topology in case of predefined conditions (e.g. outage of 2 parallel lines) are met. They are taken into account during the CC process but not implemented in the model.

5. Preventive Remedial Actions are implemented in the final CGM of the CC. Their application during later operational security timeframes (IDCF and real time) shall be evaluated based on the Security Analysis taking into account the latest grid information and in line with the methodologies to be defined according to the Articles 75 and 76 of the Regulation (EU) 2017/1485 establishing a guideline on electricity transmission system operation.

6. In accordance with Article 6(4), each TSO of the Italy North Region may define a list of MNEs, for the cases with export direction described in Article 10(5). During the RAO, all the available transmission capacity of the MNEs can be used under the condition that MNEs' operational security limits including contingencies are respected. For the case where MNE is already overloaded over its operational limits in a contingency case, 5% of each MNE's respective thermal capacity in contingency case can be made available for the RAO, except for cases where the same percentage exceeding the operational security limits including contingencies was already deployed during D-2 CCC process.

7. Each TSO of Italy North Region shall inform the coordinated capacity calculator in a timely manner on any change in its remedial actions within Italy North Region to ensure an efficient CC.

8. TSOs of the Italy North Region shall coordinate with each other regarding the use of remedial actions to be taken into account in CC and their actual application in real time operation. The coordination of remedial actions is ensured by the CC methodology.

9. Each TSO and Technical Counterparty of the Italy North Region shall ensure that the available remedial actions after CC are sufficient to ensure operational security. Furthermore, all TSOs of the Italy North Region shall ensure that remedial actions agreed in the CC are also made available in the subsequent timeframes. In case multiple market directions are calculated, the remedial actions representing the result closest to market outcome shall be considered. All TSOs and Technical Counterparty of the Italy North Region shall in the day-ahead or intraday operational planning, when preparing a remedial action, make sure that cross-border relevant remedial actions agreed in the CC are coordinated pursuant to the processes defined in the methodologies developed according to Articles 75 and 76 of the SO Regulation.

Article 9
Cross-zonal capacity validation methodology

1. The TSOs of Italy North Region shall validate the cross-zonal capacities calculated by the coordinated capacity calculator of the Italy North Region.

2. The coordinated capacity calculator shall make available the common grid model for Italy North Region for all scenarios for the relevant market time unit to the TSOs of Italy North Region.

3. TSOs of the Italy North Region shall validate the cross-zonal capacities calculated by the coordinated capacity calculator with grid model provided in accordance with Article 9(2).

4. In case one of the following situations endangers the operational security, the TSOs of Italy North Region shall assess and validate a secure capacity value.
   a. Contingencies or critical network elements are missing in the list of CNECs to be monitored in the CC process;
   b. A mistake in an IGM, GSK or a CGM was found (e.g. a wrong topology);
   c. Unplanned outages or a trip of an element in the respective TSO grid occurred;
   d. An issue with the tools used in the CC process occurred;
   e. Expectation of significant changes in the flow distribution due to high discrepancies between forecast in ID CC and the expected real-time market outcome (e.g. change of net positions or market directions) which are not covered by the statistical uncertainty related to the TRM.

5. Where one or more TSOs of the Italy North Region do not validate the cross-zonal capacity calculated, the concerned TSO(s) shall provide the updated amount of cross-zonal capacities for the border(s) considered and the reasons for the change. The final cross-zonal capacity is the minimum value sent by the TSOs of the Italy North Region.

6. Whenever a TSO of the Italy North Region is reducing the amount of cross-zonal capacity during the validation, a report with the reasons and further details about the reduction shall be created. This report shall be submitted to the NRAs on regularly basis.

7. In accordance with Article 26(5) of the CACM Regulation, the coordinated capacity calculator shall, every three months, report all reductions made during the validation of cross-zonal capacity to all regulatory authorities of the Italy North Region. This report shall include the location and amount of any reduction in cross-zonal capacity and shall give reasons for the reductions.

Article 10
Intraday capacity calculation

1. In accordance with Article 8 of the CACM Regulation, the TSOs of Italy North Region shall calculate cross-zonal capacities for each bidding-zone border of Italy North Region.

2. The TSOs of Italy North Region shall provide the coordinated capacity calculator with the last updated information on the transmission systems in a timely manner for the CC that is started in the end of D-1.

3. The coordinated capacity calculator shall use the CGM built in accordance with Article 28 of the CACM Regulation no later than 6 months after the implementation of the CGM methodology developed in accordance with Article 17 of the CACM Regulation, provided that the necessary tools are developed, and compatibility is ensured.

4. Before using the CGM built in accordance with Article 28 of the CACM Regulation, the CGM is created by merging the whole IDCF data set which contains the single IDCF data sets from the participating and non-participating TSOs.

5. The import direction to Italy is still expected to be the primary market direction. Therefore, a calculation in import direction from all the concerned countries to Italy is always performed. The export capacity from Italy for each border is principally reassessed every year, and this value is used for the daily allocation.

   Due to the increased probability of exports from Italy on one or more borders, the TSOs and Technical Counterparties of the Italy North Region created a roadmap for the implementation of the CC process in export direction from Italy. This includes as well a method for the determination of the most likely market direction based on specific criteria. In case of forecasted exports from Italy on one or more borders, a second, parallel calculation based on this most likely market direction is performed. TSOs and Technical Counterparties of the Italy North Region shall implement this capacity calculation process according to the roadmap (Article 12(5)).

6. The CC process is based on a RAO methodology which aims to find the highest secure capacity based on the inputs provided by the TSOs of the Italy North Region. The algorithm tests several levels of cross-zonal exchanges and determines if these exchanges are secure after the occurrence of all the monitored contingencies, applying available remedial actions when necessary.

7. The purpose of the RAO is to find an optimal set of Remedial Actions to secure the CGM. In case the operational limits of a CNEC defined in Article 6 are exceeded, Remedial Actions are applied. The final set of Remedial Actions that has the highest positive effect on the congested CNEC without creating any negative impact on other CNECs and MNEs (as defined in Article 6) is chosen based on sensitivities.

8. The coordinated capacity calculator shall define the values of TTC for each market time unit. These values shall be provided to TSOs and to the Technical Counter Parties of the Italy North Region via separate contracts, for validation.

9. In case several coordinated capacity calculators compute the values of TTC for each market time unit in parallel, the minimum value of the computed TTCs is provided to TSOs and Technical Counterparties of the Italy North Region for validation. The provided value shall ensure maximisation of social welfare while respecting operational security constraints. The TSOs of Italy North Region shall in cooperation with the coordinated capacity calculators deliver a yearly report to the NRAs with explanations on the significant differences in the calculated values.

10. The NTC Calculation for each border is achieved according to the following steps:

    a. TTC Selection: In this sub process, the TTC value is forced to be within a limiting band. The band is limited by two values, the Upper Total Transfer Capacity (UTTC) and Lower Total Transfer Capacity (LTTC).). The values that set the band are the following (for peak/off-peak and summer/winter):

       - UTTC = D-2 TTC + 1000 MW
       - LTTC = ID schedule + TRM

    b. TTC Validation, performed in accordance with Article 9.

c. Border NTC Calculation: The lowest value provided by the TTC Validation sub process is considered, reduced by the TRM and then split between the borders according to agreed splitting factors.

11. The coordinated capacity calculator of the Italy North Region shall provide the relevant NEMOs with the validated NTCs for each bidding-zone border of Italy North Region after application of the reliability margin defined in accordance with Article 6.

12. In accordance with Article 58 of the CACM Regulation, the coordinated capacity calculator and TSOs of the Italy North Region shall ensure that cross-zonal capacity shall be provided to relevant NEMOs 15 minutes before the intraday cross-zonal gate opening time as defined in accordance with Article 59 of the CACM Regulation.

13. Discrimination between internal and cross-zonal exchanges is avoided by the proper bidding zones configuration and CNEC selection in accordance with Article 6 based on the methodology described in Annex I.

Article 11
Fallback procedures

1. Prior to each CC performed in ID, the TSOs of Italy North Region shall ensure the coordinated capacity calculator is provided with the already allocated capacities within the day-ahead timeframe.

2. For the CC performed in ID, where an incident occurs in the CC process and the coordinated capacity calculator is unable to produce results within the allotted time for the calculation process, the TSOs of the Italy North Region shall validate the last coordinated cross-zonal capacities calculated within the day-ahead timeframe. After this validation step, the coordinated capacity calculator or TSOs of the Italy North Region where applicable, shall provide the relevant NEMOs with this coordinated value.

Article 12
Publication and Implementation of the ID CCC methodology Proposal

1. The TSOs of Italy North Region shall publish the ID CCC methodology Proposal without undue delay after all national regulatory authorities have approved the proposed ID CCC methodology or a decision has been taken by the Agency for the Cooperation of Energy Regulators in accordance with Article 9(10), Article 9(11) and 9(12) of the CACM Regulation.

2. The TSOs of Italy North Region currently experiment the ID CCC methodology Proposal. The individual values for cross-zonal capacity for each remaining intraday market time unit will be calculated and offered to the intraday market as soon as a proper level of reliability of the process will be reached and, in any case, at the latest by the end of 2019 provided that the ID CCC methodology is approved by the regulators of the Italy North region. In a first step, the individual values for cross-zonal capacity will be calculated and offered to the intraday market time units covered by XBID2 auction (16h-24h). No later than when the IDCM developed in accordance with Articles 55 and 63 of the CACM Regulation is implemented in the Italy North Region, the ID CCC

methodology Proposal will be used to calculate the individual values for cross-zonal capacity offered to the complementary regional intraday auctions.

3. The TSOs of Italy North Region currently develop a common coordinated CC methodology using flow-based approach. The TSOs of Italy North Region intend to submit this proposal based on the following planning:
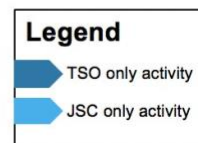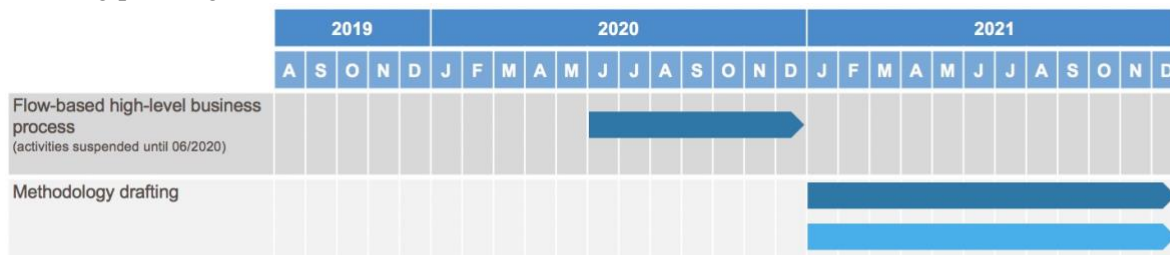
This planning is subject to adjustment due to dependencies with other deliverables. In any case, the TSOs of Italy North Region shall respect the deadline for submitting the proposal for a common coordinated CC methodology using flow-based approach up to six months after Switzerland joins the single day-ahead coupling, in accordance with Article 20(3) of the CACM Regulation.

4. The TSOs of Italy North Region will abandon the UTTC in the TTC selection as soon as possible and no later than Q4 2019.

5. The TSOs of Italy North Region foresee the step-wise implementation of the following parts of this methodology, based on the timeline below:

IDCC	Deadline
IDCC Process	
Implementation of IDCC v1 (16-24)	Once the KPIs of the process reach a proper level
Implementation of IDCC v2 (0-24)	IDCM implementation
Export Corner Methodology Implementation	01/09/2020
CNEC selection Implementation	1 year after approval
Reliability Margin Methodology Implementation	1 year after approval
Allocation Constraints Adaptation of IDCC process to temporary solution	01/01/2020
RfC for market coupling algorithm	By the approval of the CCM
Adaptation of IDCC process to long term solution	As soon as RfC is implemented
Adaptation of AC discretization level	By the approval of the CCM

6. The TSOs of Italy North Region shall submit an amended methodology in line with Article 9(3) of CACM Regulation to the NRAs by the 30th of November 2019, considering the provisions of Regulation (EU) 2019/943 of 5 June 2019 on the internal market for electricity.

Article 13
Language

1. The reference language for this CCC Proposal shall be English.

2. For the avoidance of doubt, where TSOs of the Italy North Region need to translate this ID CCC methodology Proposal into their national language(s), in the event of inconsistencies between the English version published by TSOs of the Italy North Region in accordance with Article 9(14) of the CACM Regulation and any version in another language, the relevant TSOs of the Italy North Region shall be obliged to dispel any inconsistencies by providing a revised translation of this ID CCC methodology Proposal to their relevant national regulatory authorities.

Annex I

Load Flow Algorithm

The CC process is performed using Alternate Current (AC) load flow algorithms (available in the technical literature), considering reactive power capability limits of generators.

**Iterative Approach for TTC Calculation**

The CC step can be described as a calculation by dichotomy. The coordinated capacity calculator will define a starting capacity level and check if this level of exchange allows the transmission system to be operated within its operational security limits (i.e. no overloads are observed on CNECs).
Starting capacity level is equal to the latest available control program of Italy.
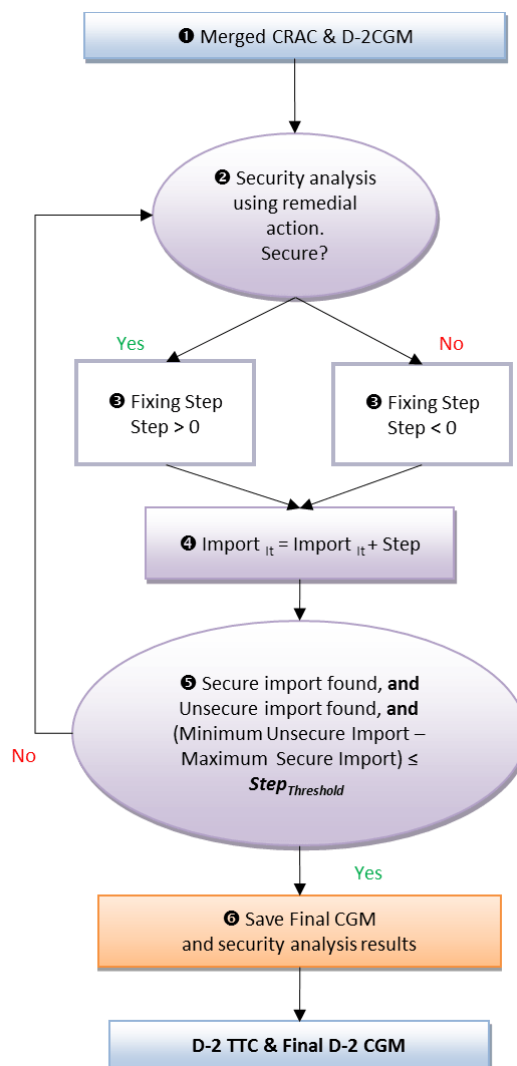
If the level is secure or can be made secure by optimizing remedial actions, the coordinated capacity calculator will then test a higher value of TTC. Otherwise, it will then test a TTC value in between the

secure and unsecure TTC values until it reaches the last secure TTC. Stopping criteria for optimization is finding last secure and first unsecure level of import. Once both are found, last secure import is considered as maximum Italian import.
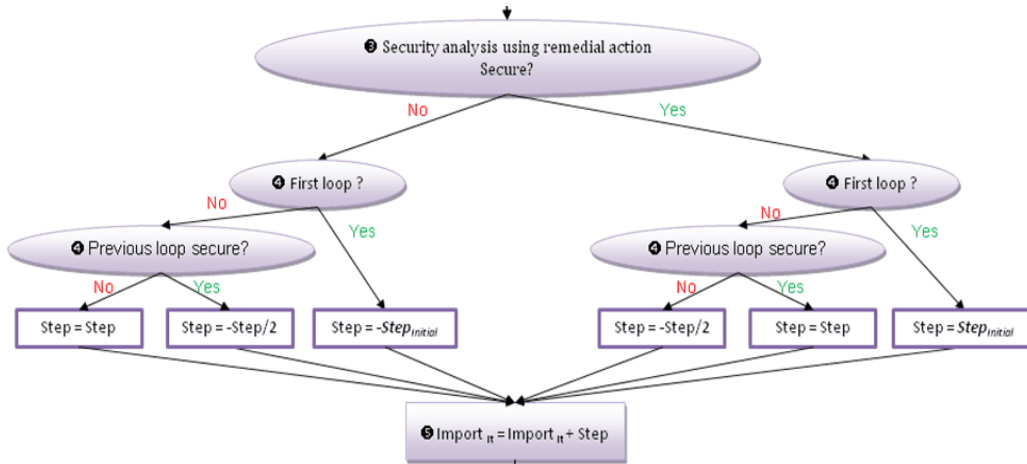
The dichotomy is set with a 50 MW step in order to optimize the capacity offered to the market while reducing the computation time. Considering optimal remedial actions have been applied in each step of CC, the dichotomy approach guaranties final solution is less than 50 MW suboptimal compared to absolute maximum Italian import.

PTDF computation for the selection of critical network elements

Critical network elements are selected based on their sensitivity to cross-zonal power exchanges, evaluated through a *PTDF* matrix. The elements of this matrix represent the influence of a commercial exchange between bidding zones on power flows on the considered combinations of CNECs. The calculation of the *PTDFs* matrix is performed on the basis of the CGM and the *GSK*.

The nodal *PTDFs* are first calculated by subsequently varying the injection on each node of the CGM. For every single nodal variation, the effect on every CNECs loading is monitored and calculated[1] as a percentage (e.g. if an additional injection of a 100 MW has an effect of 10 MW on a CNEC, the nodal *PTDF* is 10 %).
Then the *GSK* translates the nodal *PTDFs* into zonal *PTDFs* (or zone-to-slack *PTDFs*) as it converts the zonal variation into an increase of generation in specific nodes.

PTDFs can be defined as zone-to-slack *PTDFs* or zone-to-zone *PTDFs*. A zone-to-slack *PTDF*$_{Ail}$ represents the influence of a variation of a net-position on a CNEC. A zone-to-zone *PTDF*$_{A->Bi}$ represents the influence of a variation of a commercial exchange from A to B on a CNEC *i*. The zone-to-zone *PTDF*$_{A->Bil}$ can be linked to zone-to-slack *PTDFs* as follows:

$$PTDF_{A->Bil} = PTDF_{A,i} - PTDF_{Bil} \qquad \textit{Equation 1}$$

---

[1] In this load flow calculation the variation of the injection of the considered node is balanced by an inverse change of the injection at the slack node.

Zone-to-zone *PTDFs* must be transitory i.e.

$$PTDF_{A \to C,i} = PTDF_{A \to Bil} + PTDF_{B \to C,i} \qquad \textit{Equation 2}$$

The validity of i   Equation *2* is ensured by   Equation 1

Once all $PTDF_{A \to B,i}$ are computed for each element *i*, all the elements which satisfy the condition:

$$PTDF_{FR \to IT,i}*SF_{FR\text{-}IT} + PTDF_{CH \to IT,i}*SF_{CH\text{-}IT} + PTDF_{AT \to IT,i}*SF_{AT\text{-}IT} + PTDF_{SI \to IT,i}*SF_{SI\text{-}IT} \geq threshold$$
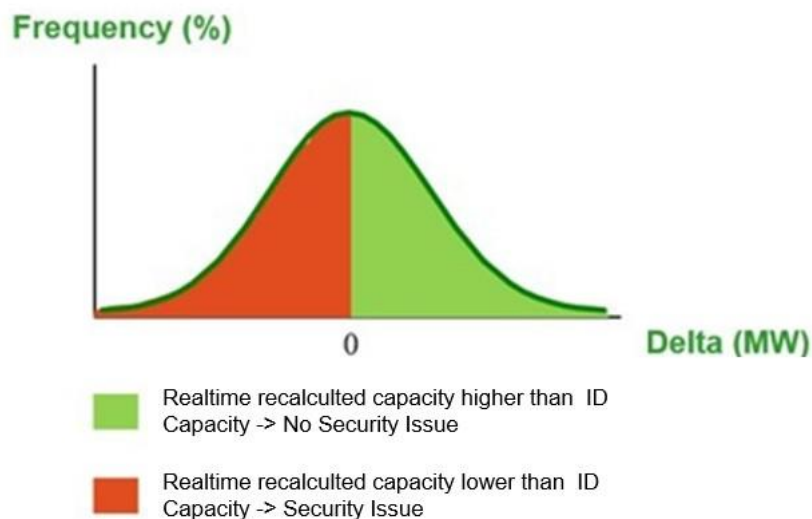
can be classified as CNEC significantly impacted by cross zonal power exchanges of the Italy North Region, where $SF_{j\text{-}IT}$ represents the splitting factor for the border j-IT, in line with the shifting methodology applied during CC.

TRM figure computation

The process for the TRM_1 determination could be described as follows:

- Step 1: define the statistical period: one full year.
- Step 2: discard the timestamps (TSs) of the statistical period not useful for the study (e.g. TS where no CC has been performed, TS with the capacity limited by Additional Constraint, etc.).
- Step 3: retrieve the following data for all the selected TS:

    o   ID TTC without cap/floor (referred as "TTC ID"),

    o   the Real time CGM for the selected TS,

    o   reduced Splitting factors.

- Step 4: estimate the TTC on the real time CGM (referred as "TTC RT") selected after step 3 for all the selected TS. The estimation will be based on a linearised approach checking the operational security limits of a fixed set of CNECs. Then compute all the difference between ID and real-time estimated TTCs ("TTC RT" – "TTC ID") and plot those deltas in a distribution curve.

Δ (« SN TTC » - « ID TTC ») Distribution

Frequency (%)

Delta (MW)

0

■ Realtime recalculted capacity higher than ID Capacity -> No Security Issue

■ Realtime recalculted capacity lower than ID Capacity -> Security Issue

TRM$_1$= uncertainties of the forecast

The process for the TRM$_2$ determination could be described as follows:

- Step 1: define the statistical period: one full year.
- Step 2: for the statistical period retrieve the control program error for the Italian control area (difference between the scheduled program and the actual physical exchange at the Northern Italian interconnection). One minute average values could be used.
- Step 3: plot those deltas in a distribution curve:

Control Program Deviation Distribution

Frequency (%)

0   Delta (MW)

Real time exchanges lower than scheduled exchanges

Real time exchanges higher than scheduled exchanges
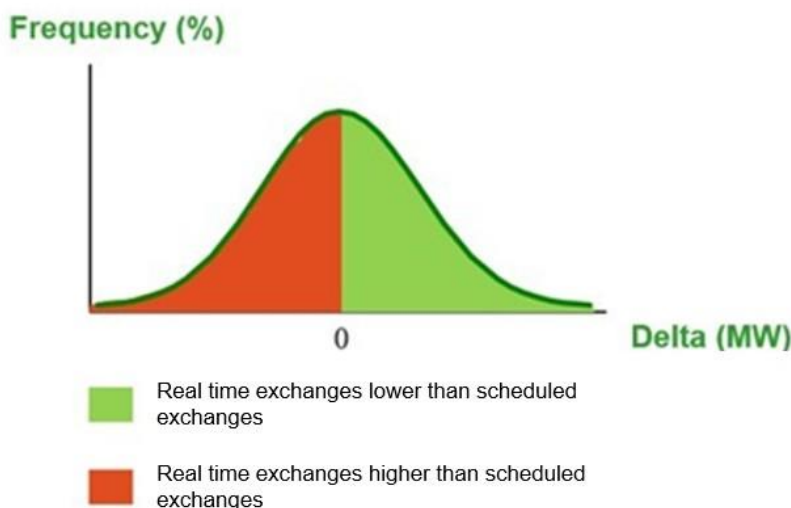
TRM2= unintended deviation

Once TRM1 and TRM2 distribution functions have been calculated (f_{TRM1} and f_{TRM2}, respectively) the TRM distribution function (f_{TRM}) can be calculated as convolution of above mentioned distribution functions:

$$f_{TRM} = f_{TRM1} * f_{TRM2}$$

The TRM shall be defined as the percentile of the convolution of the probability distribution functions of the two variables TRM1 and TRM2, with risk level kept below 10% (e.g. 90 percentile means 10% risk, 99 percentile 1% risk). When defining the percentile and the risk level, the historical experiences (i.e. TRM of 500 MW) should be taken into account.

Generation and Load Shift Keys

GSK file is defined for:

- an area;
- a time interval: GSK is dedicated to individual daily hours in order to model differences between peak and off-peak conditions per TSO.

Generation and Load shift keys are needed to transform any change in the balance of control area into a change of injections in the nodes of that control area. In order to avoid newly formed unrealistic congestions caused by the process of generation shift, TSOs define both generation shift key (GSK) and load shift key (LSK), where GSKs constitute a list specifying those generators that shall contribute to the shift and LSKs constitute a list specifying those load that shall contribute to the shift in order to take into account the contribution of generators connected to lower voltage levels (implicitly contained in the load figures of the nodes connected to the 220 and 400 kV grid). Each TSO can decide how to represent its best generation shift.

If GSK and LSK are defined, a participation factor is also given:

- G(a) Participation factor for generation nodes
- L(a) Participation factor for load nodes

The sum of G(a) and L(a) for each area has to be to 1 (i.e. 100%).

Definition of GSK and LSK Nodes:

The list of GSK nodes contains one or more node defined by:

- the name of UCTE Node
- the maximum power production of the node (optional for prop and fact, mandatory for the other methods)
- the minimum power production of the node (optional for prop and fact, mandatory for the other methods)

Several methods are supported by the process:

- *Proportional:*

Shift in defined generation/load nodes, proportionally to the base case generation/load.

- Pg(n) Active generation in node n, belonging to area a (nodes n defined in GSK list) or
- Pl(n) Active load in node n, belonging to area a (nodes n defined in LSK list)

The participation of node n in the shift, among selected gen. nodes (GSK) is given by:

$$Kg(n,a) = G(a) \cdot \frac{Pg(n)}{\sum_n Pg(n)}$$

The participation of node n in the shift, among selected load nodes (LSK) is given by:

$$Kl(n,a) = L(a) \cdot \frac{Pl(n)}{\sum_n Pl(n)}$$

- *Participation factors:*

Shift in defined generation/load nodes (PV or PQ nodes), according to the participation factors:

- kg(n) Participation factor for generation in node n, belonging to area a
- kl(n) Participation factor for load in node n, belonging to area a

The participation of node n in the shift, among selected gen. nodes (GSK) is given by:

$$Kg(n,a) = G(a) \cdot \frac{kg(n)}{\sum_n kg(n)}; 0 \leq kg(n) \leq 10$$

The participation of node n in the shift, among selected load nodes (LSK) is given by:

$$Kl(n,a) = L(a) \cdot \frac{kl(n)}{\sum_n kl(n)}; \ 0 \leq kl(n) \leq 10$$

- *Reserve:*

All power plants, which are chosen for the shift, are modified proportionally to the remaining available capacity, as presented hereafter in these equations (1) and (2).

$$P_i^{inc} = P_i + \Delta E \cdot \frac{P_i^{max} - P_i}{\sum_{i=1}^{n}(P_i^{max} - P_i)} \ (1)$$

$$P_i^{dec} = P_i + \Delta E \cdot \frac{P_i^{min} - P_i}{\sum_{i=1}^{n}(P_i^{min} - P_i)} \ (2)$$

Where:

P_i = Actual power production.

P_i^{min} = Minimal power production.

P_i^{max} = Maximal power production.

ΔE = Power to be shifted.

P_i^{inc} = New power production after positive shift.

P_i^{dec} = New power production after negative shift.

- *Merit order*

The chosen generation nodes shift up or down according to the correspondent merit order list GSKup or GSKdown, as described following:

- upward list contains the generation nodes which performs the total positive shift.
- downward list contains the generation nodes which performs the total negative shift.

Merit order factor defines the number of generation node to be shifted simultaneously.
It means that the first group (number defined with Merit order factor) of generating nodes are shifted together and if it is not sufficient, the next group generating nodes are used to complete the total shift, and so on.
The total shift is distributed to the last group of Merit order factor generation nodes proportionally to their available margin as defined for Reserve shift.
Generation shift keys in Italy North region are determined by each TSO individually on the basis of the latest available information about the generating units and loads.

Activities and timings of the process

The main activities of the process are summarized in the following table:

ID	Activity	Start Time	End Time
001	Italy North TSOs deliver input files to Coordinated Capacity Calculator	-	2:15
002	Quality check of the inputs by the Coordinated Capacity Calculator	2:15	2:40
002	Merge of the inputs, TTC Calculation and transmission of the selected results to Italy North TSOs	2:40	7:00
003	Validation of the results by Italy North TSOs and NTC Calculation	7:00	9:30

The intermediate timings may be subject to adjustments in the future if deemed necessary by Italy North TSOs.

Annex II

Handling of Remedial Actions

The scheme below summarizes the conditions to be fulfilled with this combination of remedial actions to state that all security constraints are respected. Each rounded square represents a different network state.
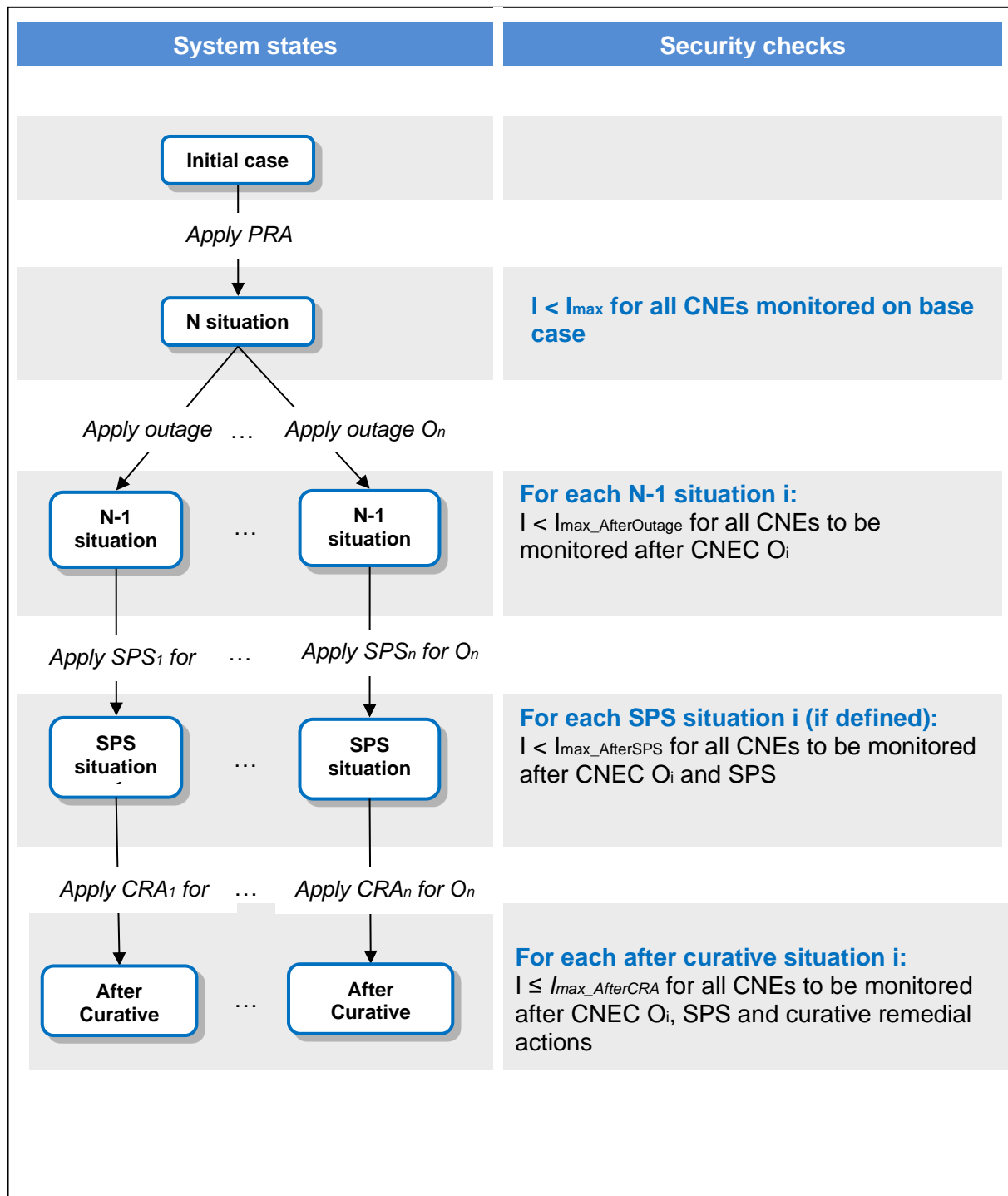
On N state, preventive remedial actions are implemented and Imax of "base case" CNEs are monitored.

On N-1 states, CNECs are applied and Imax_AfterOutage are monitored. They represent transient admissible current on the monitored branches. Transient current can exceed permanent admissible current provided that available SPS and curative remedial actions are sufficient to keep permanent current not greater than permanent admissible current.

On After Curative states, outage, SPS and curative remedial actions are implemented and Imax_AfterCRA are monitored. They represent permanent admissible current on the monitored branches.

If an outage or a remedial action leads to an unbalance situation due to a modification of generation or load pattern, this unbalance has to be compensated inside the concerned country, by using the GSK of this one.

On SPS states, outage and SPS are applied, Imax_AfterSPS are monitored. Imax_AfterSPS represent transient admissible current on the monitored branches after SPS. Transient current can exceed permanent admissible current, provided that available curative remedial actions are sufficient to keep permanent current not greater than permanent admissible.

System states	Security checks
Initial case	
Apply PRA	
N situation	**I < Imax for all CNEs monitored on base case**
Apply outage … Apply outage O_n	
N-1 situation … **N-1 situation**	**For each N-1 situation i:** I < $I_{max\_AfterOutage}$ for all CNEs to be monitored after CNEC O_i
Apply SPS$_1$ for … Apply SPS$_n$ for O_n	
SPS situation … **SPS situation**	**For each SPS situation i (if defined):** I < $I_{max\_AfterSPS}$ for all CNEs to be monitored after CNEC O_i and SPS
Apply CRA$_1$ for … Apply CRA$_n$ for O_n	
After Curative … **After Curative**	**For each after curative situation i:** I ≤ $I_{max\_AfterCRA}$ for all CNEs to be monitored after CNEC O_i, SPS and curative remedial actions

In order to prevent overloading of network elements that are influenced by the application of cross-border-impacting remedial actions during the CC in export direction from Italy, these network elements can be included as MNEs in the RAO. For each MNE i in a contingency case, the following has to hold:

$$Loading_{after\ RAO,i} \leq max(OL_i; Loading_{before\ RAO,i})$$

$Loading_{before\ RAO\ i}$ … Loading of the MNE in a contingency case (based on maximum thermal capacity) before RAO

$Loading_{after\ RAO\ i}$ … Loading of the MNE in a contingency case (based on maximum thermal capacity) after application of a remedial action during the RAO

OL_i … Represents operational limits of the respective MNE in a contingency case

In words:
If $Loading_{before\ RAO}$ is over OL_i the $Loading_{after\ RAO}$ cannot become bigger than $Loading_{before\ RAO}$.