



European Network of
Transmission System Operators
for Electricity

ENTSO-E CRITICAL NETWORK ELEMENT IMPLEMENTATION GUIDE

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VERSION 2.6

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The force of the following words is modified by the requirement level of the document in which they are used.

- SHALL: This word, or the terms "REQUIRED" or "MUST", means that the definition is an absolute requirement of the specification.
- SHALL NOT: This phrase, or the phrase "MUST NOT", means that the definition is an absolute prohibition of the specification.
- SHOULD: This word, or the adjective "RECOMMENDED", means that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications shall be understood and carefully weighed before choosing a different course.
- SHOULD NOT: This phrase, or the phrase "NOT RECOMMENDED", means that there may exist valid reasons in particular circumstances when the particular behaviour is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behaviour described with this label.
- MAY: This word, or the adjective "OPTIONAL", means that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item. An implementation which does not include a particular option MUST be prepared to interoperate with another implementation which does include the option, though perhaps with reduced functionality. In the same vein an implementation which does include a particular option MUST be prepared to interoperate with another implementation which does not include the option (except, of course, for the feature the option provides.).

Revision History

Version	Release	Date	Comments
0	0	2015-01-15	Initial release
1	0	2015-09-01	Review by WG EDI and PT CGM
1	1	2015-11-10	Following the maintenance request from EMFIP, change to the UML model to enable “anonymous” publication.
2	0	2017-10-24	Update of the UML model and the associated dependency tables following alignment with the CRAC document for capacity calculation processes: <ul style="list-style-type: none"> - Addition of the classes present in the CRAC document with the related associations and attributes - Addition of a new Border_Series class to describe corners - Addition of a new ReferenceCalculation_DateAndOrTime class to describe reference dates used for capacity calculation
2	1	2018-06-19	Approved by MC <ul style="list-style-type: none"> - Addition of a MarketObjectStatus.status attribute in the AdditionalConstraint_RegisteredResource - Addition of a Monitored_Series - Addition of an association between the Party_MarketParticipant class and the sub_Series - Creation of an association between Border_Series and Point
2	2	2018-10-10	<ul style="list-style-type: none"> - Addition of a businessType attribute in the Border_Series class - Addition of an association between Border_Series and Monitored_RegisteredResource (ConnectingLine_RegisteredResource)
2	3	2019-06-26	Following the maintenance request from EMFIP 54: <ul style="list-style-type: none"> • Addition of a 0..1 constraint status attribute in Constraint_Series class to specify whether a constraint is resolved or not. • Addition of 0..1 psrType and location attributes in Contingency_RegisteredResource class and Monitored_RegisteredResource class to include the type and location of the network elements when downloading publications from transparency platform. • New dependency tables for the Flow-Based publication in TP. Changes due to the alignment between CRAC and CNE document: <ul style="list-style-type: none"> • -Addition of a 0..* association between the RemedialAction_RegisteredResource class and the Analog class. • Addition of the optional “currency_Unit.name” and “price_Measure_Unit.name” attributes at TimeSeries level

			<ul style="list-style-type: none"> -Addition of the optional "priceAmount" attribute at RemedialAction_Series level - mRID of Document, Series and Timeseries (ID_String type) was enlarged from 35 to 60 characters. <p>Approved by MC.</p>
2	4	2023-05-10	<p>Maintenance request EMFIP83 - table 2 updated accordingly:</p> <ul style="list-style-type: none"> - Transparency publications of flow-based allocations, as mandated by TR art. 11.1.b, extended with additional attributes for the Nordic and Core regions - Added distinction of anonymous and combined dynamic constraints and TSO(s) introducing the constraint - Deprecated distinction of spanning and default values, virtual constraints, reason for AMR exclusion and FAV. <p>Approved by ICTC.</p>
2	5	2023-11-10	<p>Maintenance request EMFIP88 - transparency publications of flow-based allocations, as mandated by TR art. 11.1.b, amended for Core region. Table 2 updated accordingly: Introduced new attributes for flows from assumed commercial exchanges outside the region (F_uaf) and target capacity for exchanges (minRAM_target).</p>
2	6	2025-03-11	<p>Maintenance request EMFIP87 – transparency publications of flow-based allocations, as mandated by TR art. 11.1.b, amended for long-term time horizons in the Nordic and Core regions. Table 2 updated accordingly:</p> <ul style="list-style-type: none"> - Extended permitted values for the time horizon with month ahead and year ahead - Extended permitted resolution values with year and month - Introduced new attributes for average voltage (U), average power factor (cos phi) and clarified which values apply, depending on time horizon and region. <p>Maintenance request EMFIP92 - transparency publications of flow-based allocations, as mandated by TR art. 11.1.b, amended to support negative values in Analog class. Table 2 updated accordingly.</p> <p>Final draft agreed by CIM WG.</p>

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INTRODUCTION

This document is drafted based on IEC 62325 series. In particular, the IEC 62325-450 methodology was applied to develop the conceptual and assembly models.

This methodology is described in the following document: *ENTSO-E Common information model (CIM) European style market profile User guide*.

Scope

The objective of this implementation guide is to make it possible for software vendors to develop an IT application for market players to exchange information relative to critical network elements used for interconnection capacity determination process.

The implementation guide is one of the building blocks for using UML (Unified Modelling Language) based techniques in defining processes and messages for interchange between actors in the electrical industry in Europe.

Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC TS 61970-2, *Energy management system application program interface (EMS-API) – Part 2: Glossary*

IEC 62325-301, *Framework for energy market communications – Part 301: Common information model (CIM) extensions for markets*

IEC 62325-351, *Framework for energy market communications – Part 351: CIM European market model exchange profile*

IEC 62325-450, *Framework for energy market communications – Part 450: Profile and context modeling rules*

IEC 62325-451-1, *Framework for energy market communications – Part 451-1: Acknowledgement business process and contextual model for CIM European market*

IEC 62325-451-3, *Framework for energy market communications – Part 451-3: ENTSO-E Capacity Allocation and Nomination business process and contextual model for CIM European market*

This implementation guide assumes the use of the Critical Network Element Market Document contextual and assembly model (also referred to as XSD or schema) with version urn:iec62325.351:tc57wg16:451-n:cnedocument:2:5.

Terms and definitions

3.1 constraint situation

It is a network configuration, corresponding either to the expected nominal state, or to an hypothetical degraded state where one or several contingencies occur. In both cases, associated remedial actions can be included in the network configuration.

3.2 critical network element

A network element either within a bidding zone or between bidding zones taken into account in the capacity calculation process, limiting the amount of power that can be exchanged.

116 Depending on the chosen implementation, there may be only one or several critical network
117 elements which will be monitored in a given constraint situation.

118 **3.3**
119 **final adjusted margin value**
120 **FAV**

121 This is the amount of MW that is manually added or subtracted to the capacity of the critical
122 network element. A negative value for FAV simulates the effect of an additional margin due to
123 complex remedial actions which cannot be modelled and so calculated in the flow-based
124 parameter calculation. A positive value for FAV, as a consequence of the verification phase of
125 the flow-based domain, leads to the need to reduce the margin on one or more critical network
126 elements for system security reasons.

127 **3.4**
128 **flow**

129 This is the computed physical flow, resulting from a load flow calculation, corresponding to the
130 critical network element in the constraint situation ("N Situation", "N-1 Situation" ...) after the
131 capacity calculation. The flow is expressed in A, %, or MW.

132 **3.5**
133 **flow based remaining available margin**
134 **RAM**

135 This is the remaining available margin (RAM) for one critical network element in a constraint
136 situation. This is the amount of MW or A that is left for the limiting element in a computed
137 constraint situation, i.e. the amount that can be traded or used.

138 **3.6**
139 **flow based study domain**

140 This is the area for which the flow-based study is carried out.

141 **3.7**
142 **flow reliability margin**

143 This is the flow reliability margin for a given critical network element in each considered
144 constraint situation. The amount of MW or A that is reserved for this critical network element
145 and shall not be used for the computed outage situation, in order to secure the power network.

146 **3.8**
147 **long term allocation margin**

148 This is the amount of MW that is added to the capacity of the critical network element in order
149 to automatically include the long-term allocation domain into the flow based domain.

150 **3.9**
151 **market coupling domain**

152 This is the market coupling area or a part of the market coupling area for which the social
153 welfare impact due to the critical network element is computed.

154 **3.10**
155 **monitored registered resource**

156 This is the critical network element of the power network in the constraint situation. Some
157 analog measurements are of interest in order to provide information about the limitation and the
158 physical impact on this element in such a constraint situation.

159 **3.11**
160 **outage registered resource**

161 This is one of the network elements which are in outage for the studied constraint situation.

162 **3.12**
163 **power transfer distribution factor**

164 This is a factor (PTDF) representing the impact of 1 MW variation of the net position of the
165 corresponding bidding zone on the critical network element.

- 166 **3.13**
167 **PTDF domain**
168 This is a bidding zone of the market coupling region which may be impacted by the critical
169 network element.
- 170 **3.14**
171 **remedial action registered resource**
172 This is one of the network elements on which remedial action are carried out to improve the
173 constraint situation. Those elements are used to alleviate the constraints induced by the
174 constraint situation. The remedial actions may be identified as automatic, preventive or curative.
175 The type of the remedial action includes generation, load and/or topology changes.
- 176 **3.15**
177 **shadow price**
178 This is the price variation of the market welfare for the variation of 1 MW or A on this particular
179 critical network element. This identifies the impacts of the limiting element on the market
180 coupling welfare.
- 181 **3.16**
182 **spanning margin value**
183 **SMV**
184 This is the margin that is taken into account when spanning is applied. SMV is an historical
185 based parameter which specifies the amount of MW that reduces the RAM when spanning is
186 applied.
- 187 **3.17**
188 **Special Protection Scheme (SPS)**
189 A remedial action consisting in an automatic device triggered after contingency.

The critical network element calculation and publication process

4.1. Overall business context

The business process described in this document is related to the determination of the critical network elements and their publication for capacity allocation purposes.

The critical network elements determination process is based on a set of inputs data that are out of the scope of this document.

The focus is put on the results of the critical network elements calculation which is provided to TSOs for operational and publication purposes and market operator, such as power exchanges (PXs), for market coupling allocation process.

This document describes for the flow-based process or the capacity coordinated determination process the necessary set of results on the critical network elements.

The critical network elements are determined based on a set of operational input data which are out of the scope of this document, such as:

- DACF
- D-2CF
- GSK
- Available preventive remedial actions
- Potential outage cases

Those operational input data are called “network data” in this document. In a first step the input data are given in individual models; in a second step they will respect the Common Grid Model (CGM).

These steps are the identified use cases for the critical network elements determination process and are to be carried out by the TSOs on day ahead (D-1). Figure 1 provides the use case for the critical network element process.

Each TSO sends firstly their network data to the capacity coordinator. The data that are sent are out of the scope of this document as considered of operational concerns.

Based on the network data of all the TSOs, the capacity coordinator performs a merge of these data and computes the critical network elements. This part of the process refers directly to guidelines CACM and CGMES. The calculation basically enables to identify which are the most important limiting elements of the power network in several studied constraint situation, i.e. outages. Once the calculation performed, the capacity coordinator provides the TSOs with a list of critical network elements for internal process. The critical network elements are provided in day ahead for a specific period of time.

The critical network elements enable to define then the net transfer capacity (NTC) on day ahead to be used for daily allocation process. This part of the process refers directly to IEC 62325-451-3 business process.

The critical network elements may be provided, complemented by flow-based parameters in case flow-based calculation is run instead of NTC determination. Those flow-based parameters will include the influence of the critical network elements on the market coupling process. The critical network elements with flow-based parameters define the so-called flow-based domain. The details of the flow-based domain calculation process are out of the scope of this document.

This flow-based domain is provided by the capacity coordinator to the TSOs. An “anonymous” version of the flow-based domain (without identifying precisely the limiting elements of the network) is sent to the market operator in order to be used for the market coupling calculation process.

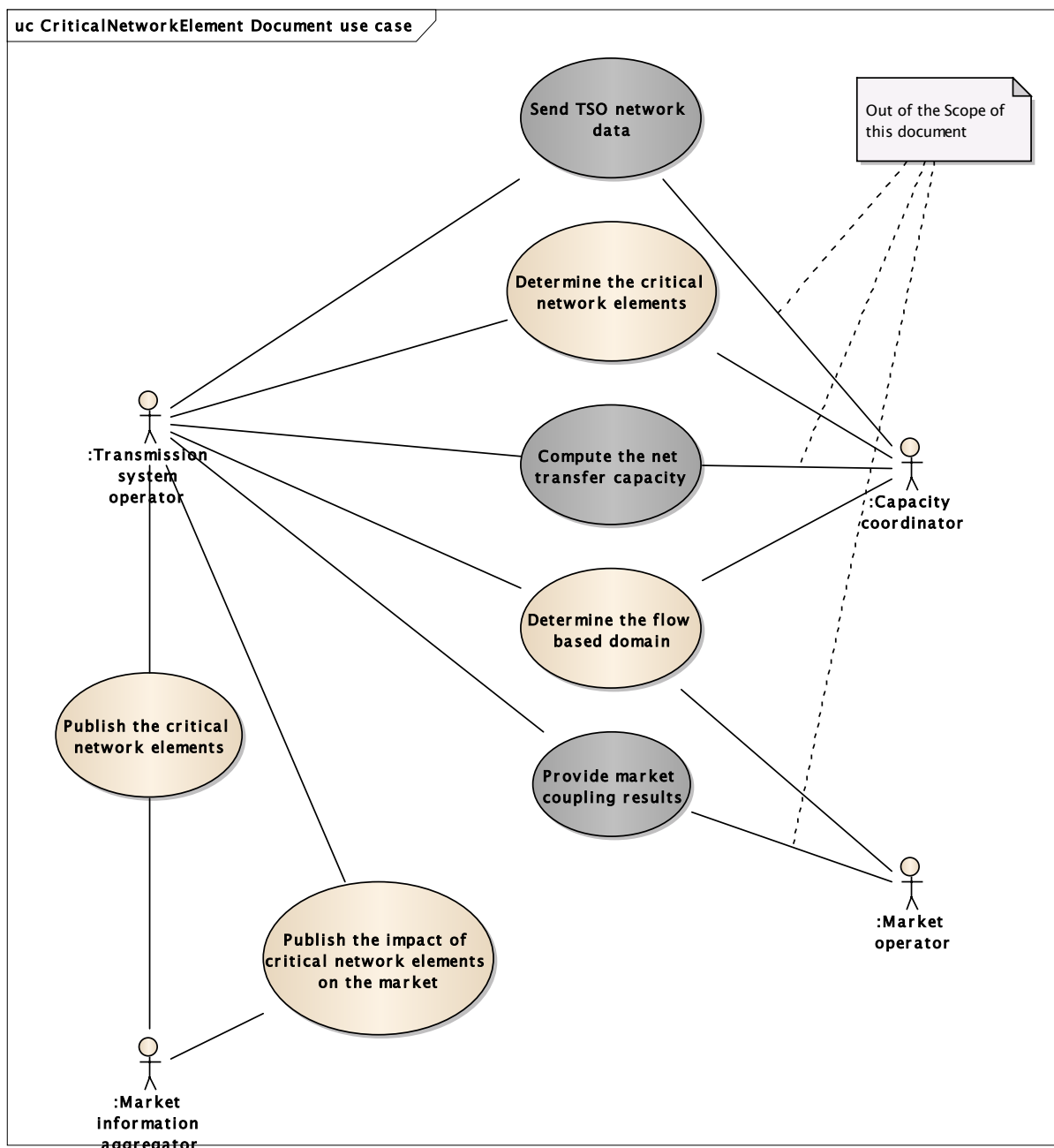


Figure 1 – Use case of the critical network elements process

The market coupling process itself is out of the scope of this document.

However, the market coupling results enable to identify the impact of the previously identified critical network elements on the social welfare of the flow-based market coupling area. This impact is identified by the shadow price of the critical network element.

Finally, the shadow prices are published with the flow-based domain to the market information aggregator.

In case of NTC determination process, the critical network elements which effectively constrained the allocation market position (market coupling or explication auction) are published to the market information aggregator.

4.2 Critical network elements determination and publication

In a context of regional coordinated capacity calculation, it is of interest to perform a capacity calculation on a common grid model (merge of each TSO network model) to identify the main

249 critical network elements of the region which will limit the net transfer capacity for the allocation
250 market.

251 The details of such a process are out of the scope of this document and those are summarized
252 by the two steps:

253 - Sending of TSOs network data to the capacity coordinator

254 - Critical network elements determination

255 Once the critical network elements determination process is performed in day ahead, the
256 capacity coordinator sends the list of identified critical network elements that constraint the
257 power network and induces congestions. Those critical network elements are identified for one
258 specific point of time hour of a delivery day.

259 There may be one or several constraint situations identified on the power network for one
260 specific point of time. Per constraint situation, one or several critical network elements may be
261 identified. It is of TSOs' responsibility to monitor each critical network element. In this condition,
262 threshold values are provided as "monitored analog measurements" of the "monitored elements"
263 for TSOs internal process.

264 The net transfer capacity (NTC) will be calculated based on the critical network elements
265 determined by the capacity coordinator. The related oriented border associated to the critical
266 network elements calculation is provided in the critical network elements results. This
267 information is needed as an input for NTC determination. For instance, the critical network
268 elements identified in the calculation of the full export situation (from France to Italy) will be
269 used as inputs for NTC calculation on France-to-Italy border.

270 The details of the NTC calculation are out of the scope of this document. The publication of
271 NTC is out of the scope this document since for NTC, as described in IEC 62325-451-3, the
272 information is provided by using Capacity_MarketDocument.

273 The critical network elements results are published by the TSOs to the market information
274 aggregator without the monitored measurement information.

275 The NTC is then used for capacity allocation as described within IEC 62325-451-3. After
276 allocation, the critical network elements which effectively impacted the market position are sent
277 to the market information aggregator.

278 Figure 2 provides the sequence diagram for the critical network elements determination and
279 publication process.

280 The capacity coordinator sends the list of critical network elements to TSOs by using the
281 CriticalNetworkElement_MarketDocument.

282 The TSOs are using the CriticalNetworkElement_MarketDocument to publish the critical
283 network elements. The information about the limiting TSO and the location of the critical network
284 element is also of publication interest.

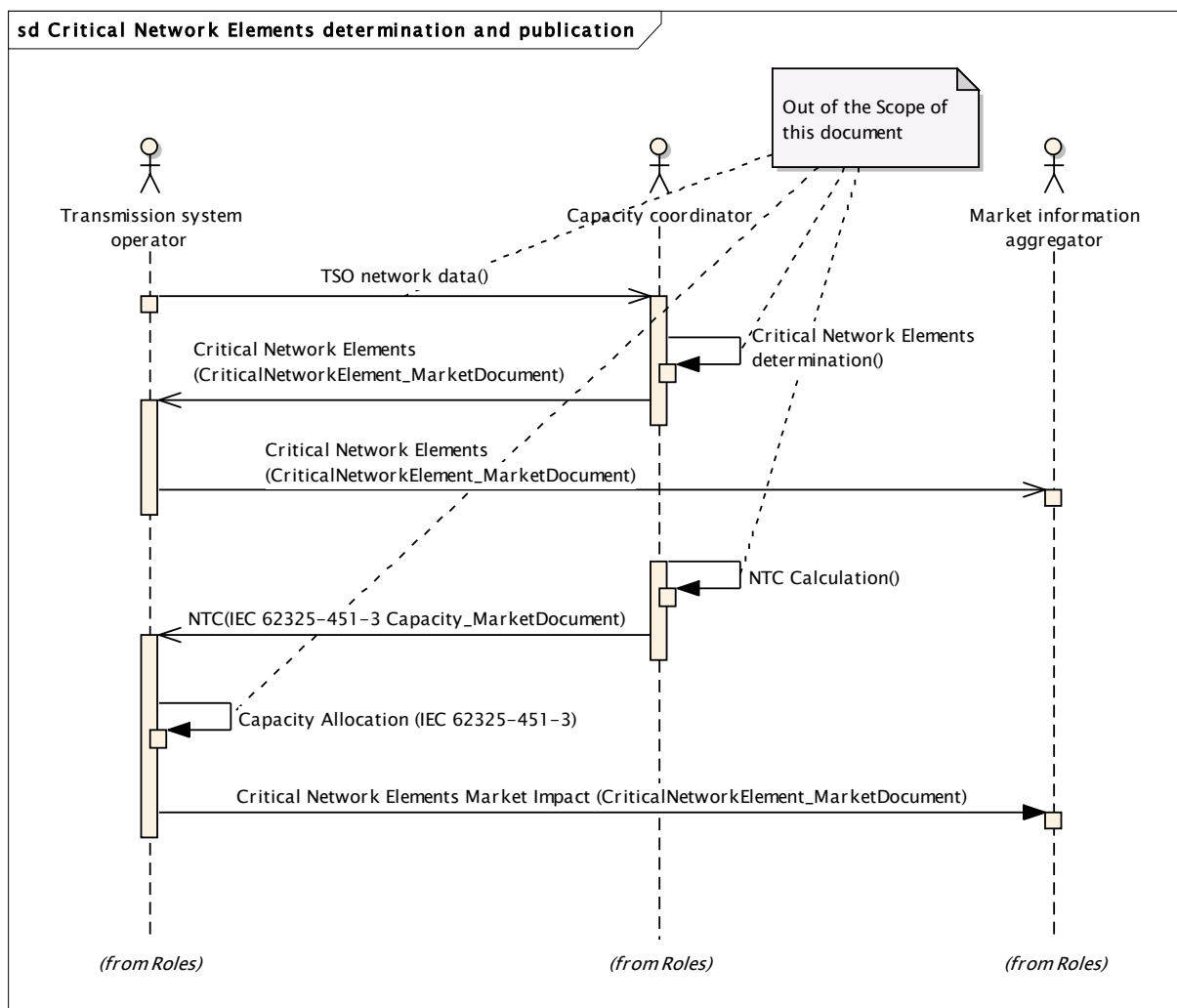


Figure 2 – Critical network elements determination and publication

4.3 Flow based domain determination and publication

In the context of flow-based capacity calculation, once the critical network elements determination process is performed in day ahead, the capacity coordinator sends the defined flow-based domain to TSOs.

The flow-based domain identifies the domain where the power system is safely operated depending upon commercial exchanged flows and congestion management on the borders. The flow-based domain is identified per point of time by a set of critical network elements influencing the allocation market with given weighting factors defined by the PTDF factors and their associated RAM. Those critical network elements are identified for one specific point of time of a delivery day.

There may be one or several constraint situations identified on the power network for one specific point of time. Per constraint situation, only one critical network element is identified by the flow-based calculation. It is of TSOs' responsibility to monitor each critical network element. In this condition, threshold values are provided as "monitored analog measurements" of the "monitored elements" for TSOs internal process.

The flow-based domain is sent by the capacity coordinator to the market operator to take into account the critical network elements with their PTDFs and RAM in the market coupling calculation process. In this case, the critical network elements are sent in an anonymous way and the analog measurements are not sent.

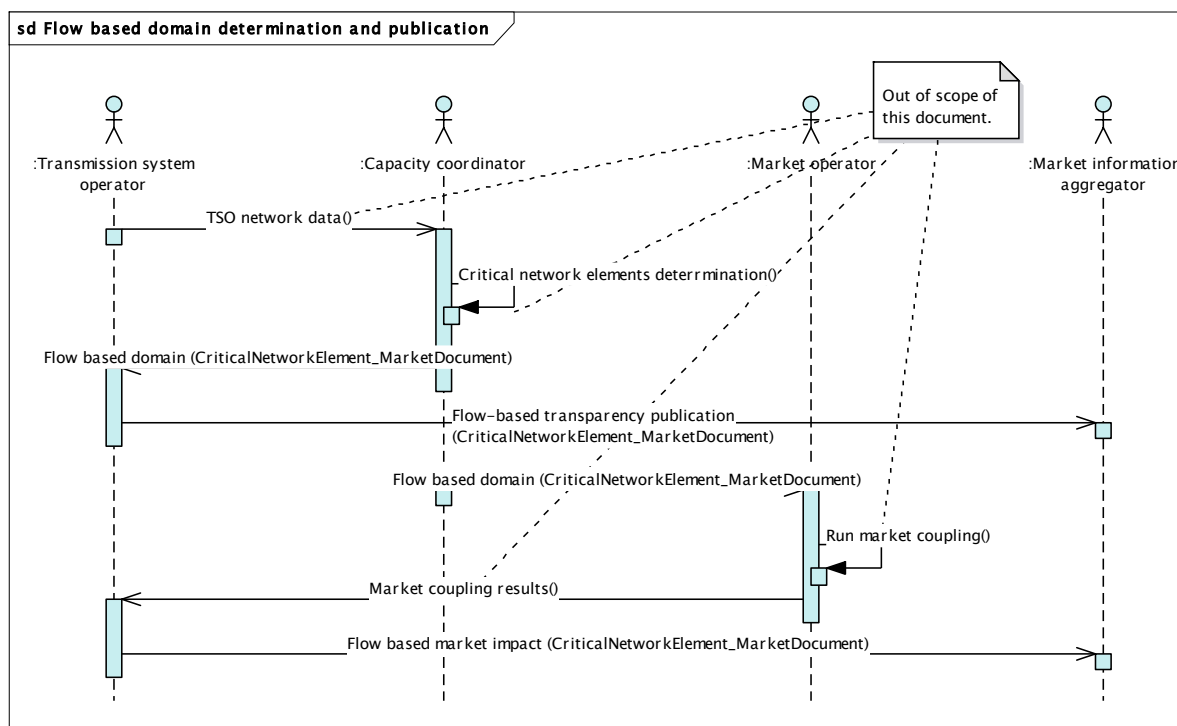
The same flow-based domain result as for the market operator is also sent to the market information aggregator.

308 Then, once the market coupling process is performed and the calculation done, the impact of
309 each critical network element of the flow-based domain on the social welfare of the flow-based
310 market coupling region is available.

311 This impact is published as the shadow price of the critical network elements of the flow-based
312 domain.

313 Figure 3 provides the sequence diagram for the critical network elements determination and
314 publication process.

315



316

317 **Figure 3 – Flow based domain determination and publication**

318 The capacity coordinator sends the flow-based domain to TSOs by using the
319 CriticalNetworkElement_MarketDocument.

320 The TSOs are using the CriticalNetworkElement_MarketDocument to publish the relevant flow-
321 based parameters as required by transparency regulation article 11.1.b. The information about
322 the limiting TSO and the location of the critical network element is also of a publication interest.

323 When the market coupling process is over, the TSOs are using the
324 CriticalNetworkElement_MarketDocument to publish the flow-based domain with the shadow
325 prices.

326 4.4 Business rules for the critical network element determination process

327 4.4.1 General rules

328 The generic rules defined in IEC 62325-351 applied to all the documents described in this part.
329 In particular, IEC 62325-351 describes the concept of curve type that is to be used to define
330 the pattern of the critical network elements for a day.

331 For each electronic data interchange defined in this document, an application acknowledgement
332 is required as defined in IEC 62325-451-1.

333 When a document is received, it shall be checked at the application level to ensure that there
334 are no faults in it that could prevent its normal processing. After this check, an
335 acknowledgement document, as defined in IEC 62325-451-1, shall be generated either
336 accepting in its entirety the document in question or rejecting it.

4.4.2 Dependencies governing the CriticalNetworkElement_MarketDocument

The following rules applied to the CriticalNetworkElement_MarketDocument:

- A CriticalNetworkElement_MarketDocument may contain for a specific position several Constraint_Series.
- For each position, a set of Border_Series can be used to describe different “corner” situation which has been studied depending on the code specified in the businessType attribute (e.g. maximum flow or maximum flow after remedial actions on an oriented border, or maximum Net Position of a zone).
- A Border_Series class may contain for a specific position several ConnectingLine_RegisteredResource
- In case of NTC Determination process, the TimeSeries of the CriticalNetworkElement_MarketDocument provides the main related oriented border of the calculation study used for NTC calculation:
 - In_Domain.mRID: the area of the related oriented border study where the energy flows into.
 - Out_Domain.mRID: the area of the related oriented border study where the energy comes from.
- There are two types of Constraint_Series. The BusinessType is used to distinguish between both types:
- The studied constraint situation identified by a constraint situation and the associated critical network elements:
 - The Constraint_Series contains:
 - A mRID which identifies a constraint situation. If a business process used a coding scheme to identify the constraint situation (for example a Critical Network Element and Critical Outage (CBCO) code), the mRID can bring this information.
 - A BusinessType which identifies the case: Critical Network Element, Red flag, etc.
 - A Name which maybe use to provide the outage situation name.
 - A ReferenceCalculation_DateAndOrTime that can be used to provide the reference date and time that were used within the capacity calculation process to determine the constraint situation.
 - An Optimization_MarketObjectStatus which allows to describe the status of the constraint situation for a Remedial Action Optimization process (branch which margin must be optimized, constraint for the optimization...).
 - A list of AdditionalConstraint_Series which identify additional constraints which limited flows in the studied case, like an imposed bilateral exchange or a net position for a given area.
 - The business type identifies the nature of the additional constraint (TTC, NTC, Net Position, or Phase Shift Angle).
 - If the additional constraint is an exchange or a net position constraint, In_Domain and Out_Domain shall identify the direction of the exchange or the area concerned by a net position.
- If the additional constraint is a phase shift angle, the AdditionalConstraint_Series is associated with AdditionalConstraint_RegisteredResource elements, which describe the elements between which a maximum phase shift angle must not be exceeded. Within the AdditionalConstraint_RegisteredResource, the direction of the phase shift angle is provided by the MarketObjectStatus.status attribute.
- A list of Contingency_Series which identify the network elements in outage for this studied case:
 - There are as many Contingency_Series as contingencies simulated in the studied case.

- 388 • In case of N Situation studied case, there is no Contingency_Series present
- 389 in the Constraint_Series.
- 390 • Each Contingency_Series is associated with one or several
- 391 Contingency_RegisteredResource elements, which describe the network
- 392 elements in fault. The Contingency_RegisteredResource are identified by
- 393 their EIC code.
- 394 • The name of the Contingency_Series may be provided.
- 395 • The location of a Contingency_RegisteredResource is provided by In_Domain
- 396 and Out_Domain, using EIC code.
- 397 – A list of RemedialAction_Series, identifying the Remedial Actions which are
- 398 performed to relieve the constraints for the studied case. Each
- 399 RemedialAction_Series is associated with one or several
- 400 RemedialAction_RegisteredResource which identify the network elements on
- 401 which the remedial action is performed:
- 402 • In case no remedial action is performed, there is no RemedialAction_Series
- 403 present in the Constraint_Series.
- 404 • The RemedialAction_RegisteredResource is identified by its EIC code.
- 405 • The name of the RemedialAction_Series or of the
- 406 RemedialAction_RegisteredResource may be provided.
- 407 • The location of the RemedialAction_RegisteredResource is provided by
- 408 In_Domain and Out_Domain, using EIC code.
- 409 • For orientation purpose, In_AggregatedNode and Out_AggregatedNode,
- 410 using EIC code, may be used.
- 411 • The remedial action type shall be provided as Tieline, Line, Generation, Load,
- 412 Redispatching, etc.
- 413 • The remedial action status shall be provided as automatic, preventive or
- 414 curative action.
- 415 – A list of Monitored_Series which identifies the sets of limiting network elements
- 416 (so-called Critical network elements) in the studied case. Each Monitored_Series
- 417 is associated with one or several Monitored_RegisteredResource which identify
- 418 the network elements monitored for a given set
- 419 (ConnectingLine_RegisteredResource follows the same rules that
- 420 Monitored_Series):
- 421 • There are as many Monitored_Series as sets of critical network elements
- 422 identified in the studied case.
- 423 • There is at least one Monitored_Series present in the Constraint_Series. The
- 424 Monitored_RegisteredResource is identified by its EIC code.
- 425 • The name of the Monitored_RegisteredResource may be provided.
- 426 • The location of the Monitored_RegisteredResource is provided by In_Domain
- 427 and Out_Domain, using EIC code.
- 428 • For orientation purpose, In_AggregateNode and Out_AggregateNode, using
- 429 EIC code, may be used.
- 430 • A list of measurements of interest for the Monitored_RegisteredResource may
- 431 be provided through the usage of the class Analog.
- 432 • In case of Flow Based, a set of flow Based Parameters may be provided for
- 433 the Monitored_RegisteredResource. In this case:
- 434 The Flow Based Remedial available Margin shall be provided for the studied
- 435 flow based Studied Area (using EIC code).
- 436 The shadow price may be provided for the market coupling area (using EIC
- 437 code).

- 438 A set of PTDF factors shall be provided. One PTDF factor shall be provided
439 per bidding zone (using EIC code).
- 440 • The class Analog shall be used to provide the measurements of interest for the
441 Monitored_RegisteredResource of the Constraint_Series:
 - 442 – There are as many Analog as measurements of interest for the
443 Monitored_RegisteredResource.
 - 444 – For one Monitored_RegisteredResource, the Analog contains:
 - 445 • A measurementType which defines the nature of the monitored
446 measurement. The list of authorized measurementType is: flow, maximum
447 flow, reference flow, flow reliability margin, spanning margin value, long term
448 allocation margin, final adjustment margin value.
 - 449 • A unitSymbol which identifies the unit of the measurement.
 - 450 • A positiveFlowIn which identifies on which direction the
451 Monitored_RegisteredResource element is monitored.
 - 452 – For each measurement, the values shall be provided by AnalogValues:
 - 453 • There is one AnalogValue per Analog measurement.
 - 454 • For each AnalogValues:
 - 455 – The value of the measurement shall be provided.
 - 456 – The constraint duration of such a measurement may be provided.
 - 457 – The condition description of such a measurement may be provided as
458 “Before Outage”, “After Outage”, “After curative action”, etc.
 - 459 – The external constraint identified by a global capacity constraint as a total transfer
460 capacity (TTC) or a net position limitation (bidding zone import or export) for instance.
461
 - 462 • The Constraint_Series contains:
 - 463 – A BusinessType which identifies the External Constraint. The external constraint
464 may be of TTC (Total Transfer Capacity), NTC (Net Transfer Capacity), ATC min,
465 net position, etc.
 - 466 – A Name may be used to provide the external constraint name.
 - 467 – The external constraint quantity shall be used to provide the quantity
468 BusinessType-related constraint.
 - 469 • In case of external Constraint_Series, the Contingency_Series,
470 RemedialAction_Series, Monitored_Series classes shall not be used.
 - 471 - Two types of document are identified depending on the two processes of critical network
472 elements calculation:
 - 473 – The critical network elements determination document that is used for a coordinated
474 NTC calculation process.
 - 475 – The flow-based domain document that replaces the ATC in usual IEC 62325-451-3
476 process and is used directly for Flow Based capacity allocation.
 - 477 - Specific types of document for publication are also identified:
 - 478 – The critical network elements publication which is used to provide only relevant
479 information to market information aggregator.
 - 480 – The critical network elements market impact publication which is used to provide the
481 critical network elements which effectively impacted the allocation market.
 - 482 – The flow-based domain publication which is used to publish only the relevant information
483 to market information aggregator.
 - 484 – The flow-based market impact document which is used to publish the shadow prices of
485 the critical network elements to market information aggregator.

- 486 - As defined previously, there shall be at least one monitored element per
487 Constraint_Series of constraint situation type:
- 488 - For flow based, only one critical network element shall be identified per constraint
489 situation.
- 490 - For coordinated NTC calculation, several critical network elements may be identified per
491 constraint situation.
- 492 - In case no constraint situation can be provided for one specific position of time, the
493 point shall not provide any Constraint_Series:
- 494 - The reason class associated to the class Point shall be used to inform that no constraint
495 situation is provided.
- 496 - In case no constraint situation can be provided for the whole delivery period, document
497 shall not provide any TimeSeries:
- 498 - The reason class associated to the class MarketDocument shall be used to inform that
499 no constraint situation is provided for the whole delivery period.
- 500 The dependencies are listed in:
- 501 - Table 1: Flow Based Domain
- 502 - Table 2: Flow Based Transparency Publication
- 503 - Table 3: Flow Based Market Impact Publication
- 504 - Table 4: Critical Network Element Determination
- 505 - Table 5: Critical Network Element Publication
- 506 - Table 6: Critical Network Element Market Impact Publication

507

Table 1 – Flow based Domain dependency

Class	Attribute	Flow Based Process
CriticalNetworkElement MarketDocument	type	B08 = Flow Based Domain
	process.processType	A43 = Flow Based domain constraint Day Ahead A44 = Flow Based domain constraint Intraday
	sender_MarketParticipant.marketRole.type	A36 = Capacity Coordinator
	receiver_MarketParticipant.marketRole.type	A04 = TSO
	docStatus	A40: Proposed A37: Confirmed A34: Rejected
	received_MarketDocument.mRID	mRID of the received document in case of a CNE anomaly report
	received_MarketDocument.version	version of the received document in case of a CNE anomaly report
	Related_MarketDocument.mRID	mRID of a related MarketDocument within a given process
	Related_MarketDocument.RevisionNumber	RevisionNumber of a related MarketDocument within a given process
	domain.mRID	used as EIC code of the Flow Based Study Area
Time Series	mRID	used to identify the TS
	businessType	B37 = Constraint Situation B38 = Initial Domain B39 = Flow based Domain Adjusted to Long Term schedules
	In_Domain.mRID	not used
	Out_Domain.mRID	not used
	CurveType	used
Series_Period		
Point		

508

		Constraint Situation Type	External Constraint Type
Border_Series	mRID	used to identify a given maximum flow situation	not used
	businessType	Used C12 = Maximum power exchange	not used
	In_Domain.mRID	used to identify the inArea of the flow	not used
	out_Domain.mRID	used to identify the OutArea of the flow	not used
	flow_Quantity.quantity	used to identify the maximum flow value	not used
Constraint_Series	mRID	used to identify the Constraint_Series	used to identify the Constraint_Series
	businessType	used B40 = Network Element Constraint B41 = Calculation opposition (Red Flag)	used B09 = Net position
	name	may be used To provide a Name to the Constraint Situation	may be used To provide a Name to the External Constraint
	Quantity_Measurement_Unit.name	used for the Flow Based Margin	used for External Constraint (= MW)
	ExternalConstraint_Quantity.quantity	not used	used to provide External Constraint Quantity
	pTDF_Measurement_Unit.name	used for PTDF	not used
	shadowPrice_Measurement_Unit.name	not used	not used
	currency_Unit.name	not used	not used
	Party_MarketParticipant.mRID	used to identify the limiting TSOs	used to identify the limiting TSOs
	Optimization_MarketObjectStatus.status	used to identify the status of the Series for a Remedial Action optimization process	not used

		Constraint Situation Type	External Constraint Type
AdditionalConstraint_Series	mRID	Used to identify the additional constraint	not used
	Business Type	A81 : TTC B09 : Net position A27 : NTC B87 : Phase Shift Angle	not used
	name	Used as the name of the Additional Constraint	not used
	Party_MarketParticipant.mRID	Used to identify the owner of the Additional Constraint	not used
	In_Domain.mRID	If the additional constraint is an exchange or a net position constraint: used to identify area where the energy flows into	not used
	Out_Domain.mRID	If the additional constraint is an exchange or a net position constraint: used to identify area where the energy comes from	not used
	Measurement_unit.name	The measurement unit of the additional constraint	not used
	Quantity.quantity	The value of the additional constraint	not used
RegisteredResource	mRID	used as the EIC or CGMES code of one of the registered resources between which there is a maximum phase shift angle	not used
	name	not used	not used
	In_Domain.mRID	not used	not used
	Out_Domain.mRID	not used	not used
	marketObjectStatus.status	Used to provide the direction of the phase shift angle A46: Importing element A47: Exporting element	not used
Contingency_Series	mRID	Used to identify a given contingency	not used
	name	Used as the name of the contingency to be simulated	not used
	Party_MarketParticipant.mRID	Used to identify the owner of the contingency	not used
Contingency_Registered_Resource	mRID	used as EIC code of the Outage element	not used
	name	used as the name of the Outage element	not used
	In_Domain	used to identify InArea	not used
	Out_Domain	used to identify OutArea	not used
Monitored_Series	mRID	Used to identify a given set of monitored elements	not used
	name	Used as the name of the set of monitored elements	not used
	Party_MarketParticipant.mRID	used to identify the owner of the set of monitored elements	not used
Monitored_RegisteredResource	mRID	used as EIC code of the Monitored element	not used
	name	used as the name of the Monitored element	not used
	In_Domain	used to identify InArea	not used
	Out_Domain	used to identify OutArea	not used
	In_AggregateNode	used to identify InAggregateNode for element orientation	not used
	Out_AggregateNode	used to identify OutAggregateNode for element orientation	not used
	flowBasedStudy_Domain.mRID	used as EIC code of the Flow Based Study Area	not used
	flowBasedStudy_Domain.flowBasedMargin_Quantity.quantity	used for the RAM	not used

		Constraint Situation Type	External Constraint Type
Analog	marketCoupling_Domain.mRID	not used	not used
	marketCoupling_Domain.shadow_Price.amount	not used	not used
	measurementType	used to identify the monitored measurements A01 = Flow A02 = Maximum Flow A03 = Flow Reliability Margin A04 = Spanning Margin Value A05 = Long Term Allocation Margin A06 = Final adjustment margin value	not used
	unitSymbol	used to identify the unit of the measurement "A", "MW", "%"...	not used
	positiveFlowIn	may be used to identify on which direction the element is monitored A01 = Direct A02 = Opposite Not used = Double	not used
	analogValues.value	used to provide the measurement value	not used
RemedialAction_Series	analogValues.timeStamp	may be used to provide the constraint duration	not used
	analogValues.description	may be used to identify the situation of the measurement point "Before Outage", "After Curative Action"...	not used
	mRID	Used to identify the set of remedial actions	not used
	name	used as the name of the element on which a remedial action is carried out	not used
	BusinessType	B58 ; Busbar B59 : Network Element A60 : SPS A27 : NTC A81 : TTC	not used
	ApplicationMode_marketObjectStatus.status	Used to identify the status of the remedial action A18 = Preventive A19 = Curative A27 = Curative or preventive A20 = Automatic	not used
	Party_MarketParticipant.mRID	used to identify the owner of the set of remedial actions	not used
	In_Domain.mRID	If Business Type = TTC or NTC, used to identify the area where the energy is going to	not used
	Out_Domain.mRID	If Business Type = TTC or NTC, used to identify the area where the energy comes from	not used
	Measurement.unit.name	If Business Type = TTC or NTC, the measurement unit of the quantity	not used
RemedialAction_RegisteredResource	Quantity.quantity	If Business Type = TTC or NTC, the value of the new bilateral exchange	not used
	mRID	used as EIC code of the element on which a remedial action is carried out	not used
	name	used as the name of the element on which a remedial action is carried out	not used
	pSRType.psrType	used to identify the type of the remedial action A01 = Tieline, A02 = line, A04 = Generation, A05 = Load	not used
	In_Domain	used to identify InArea	not used
	Out_Domain	used to identify OutArea	not used
	In_AggregateNode	may be used to identify InAggregateNode for element orientation	not used

		Constraint Situation Type	External Constraint Type
	Out_AggregateNode	may be used to identify OutAggregateNode for element orientation	not used
	marketObjectStatus_status	Used to identify the status of the remedial action A18 = Preventive A19 = Curative	not used
	resourceCapacity.maximumCapacity	If marketObjectStatus_status = Relative or Absolute : Used to identify the maximum variation or the maximum target value of tap, generation or load	not used
	resourceCapacity.minimumCapacity	If marketObjectStatus_status = Relative or Absolute : Used to identify the minimum variation or the minimum target value of tap, generation or load	not used
	resourceCapacity.defaultCapacity	If marketObjectStatus_status = Relative or Absolute : Used to identify the variation or target value of tap, generation or load	not used
	resourceCapacity.unitSymbol	If marketObjectStatus_status = Relative or Absolute : Used to identify the unit of the target values described	not used
Shared_Domain	Shared_Domain.mRID	EIC code of the area which can use the remedial action	not used
PTDF Domain	mRID	used to identify the impacted bidding zone	not used
	pTDF_Quantity.quantity	used to provide the PTFD factor for the Bidding zone	not used

510 **Table 2 – Flow-based transparency publication dependency table**

511

Class	Attribute	Values
CriticalNetworkElement MarketDocument	mRID	Identification of the document
	revisionNumber	Version of the document
	type	B09 = Flow based domain publication
	process.processType	A33 = Year ahead A32 = Month ahead A43 = Flow based domain constraint day-ahead A44 = Flow based domain constraint intraday
	sender_MarketParticipant.mRID	EIC X code of the sender
	sender_MarketParticipant.marketRole.type	A04 = System Operator A07 = Transmission Capacity Allocator
	receiver_MarketParticipant.mRID	EIC X code of the receiver (Transparency Platform)
	receiver_MarketParticipant.marketRole.type	A32 = Market Information Aggregator
	createdDateTime	UTC time when the document is created in the sender application
	docStatus	May be used. A13: Withdrawn
	received_MarketDocument.mRID	not used
	received_MarketDocument.revisionNumber	not used
	related_MarketDocument.mRID	not used
	related_MarketDocument.RevisionNumber	not used
	time_Period.timeInterval	Delivery period covered by the document.
	Domain.mRID	used as EIC code of the Flow Based Study Capacity Calculation Region
Time Series	mRID	used to identify the TS
	businessType	B39: Flowbased Domain Adjusted to Long Term schedules
	In_Domain.mRID	not used
	Out_Domain.mRID	not used
	curveType	A01: Sequential fixed size block
Series_Period	Attribute	Values
	timeInterval	Start and end time of the period EG: <start>2018-03-16T00:00Z</start><end>2018-03-16T00:30Z</end>
	resolution	P1Y P1M PT60M
Point	Attribute	Values
	point	used
	Reason.code	Not used:
	Reason.text	Not used

512

513 Note: Within this Business Process, a constraint consists of exactly one critical branch and
514 optionally a single outage. Therefore, exactly one instance of monitored time series and
515 monitored registered resource shall be provided per constraint series and not more than one
516 Contingency_Series instance shall be provided per Constraint_Series.

517 In case that there were no available results or no constraints for a given point, no instance of
518 Constraint_Series will be provided.

Class	Attribute	Values
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Constraint_Series	mRID	used to identify the Constraint_Series
	businessType	B37: Constraint situation → May be used to identify an external constraint situation C90 = combined dynamic constraint C91 = anonymous constraint B40 = Network Element Constraint
	name	not used
	referenceCalculation_DateAndOrTime.Date	not used
	referenceCalculation_DateAndOrTime.Time	Not used
	quantity_Measurement_Unit.name	MAW
	externalConstraint_Quantity.quantity	not used
	externalConstraint_Quantity.quality	not used
	pTDF_Measurement_Unit.name	MAW
	shadowPrice_Measurement_Unit.name	not used
	currency_Unit.name	not used
	Optimization_MarketObjectStatus.status	not used
	ConstraintStatus_MarketObjectStatus.status	Used only when the constraint is pre-solved A54: Presolved
	Reason.code	Not used
	Reason.text	Not used

519
520 At least one and not more than two instances of Party_MarketParticipant shall be associated
521 with Constraint_Series to indicate the TSO(s) that introduced the constraint.
522

Party_MarketParticipant	mRID	EIC of TSO introducing the constraint
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523
524 Note: There shall not be any instance of contingency_Series when the constraint is external,
525 anonymised or combined dynamic
526

Contingency_Series	mRID	Used to identify the contingency series
	name	Not used
	Party_MarketParticipant.mRID	Not used

527
528 Note: The location and PSRtype of network elements in contingency/outage are recorded in
529 transparency platform's master data and will be populated when downloading publications from
530 transparency platform, but not when data provider submits the flow-based parameters to the
531 transparency platform.
532 There shall be exactly one instance of contingency_RegisteredResource associated with every
533 Contingency_Series
534

Contingency_RegisteredResource	mRID	EIC code of the Outage element
	name	used in download only (Master data)
	in_Domain	used
	out_Domain	used
	pSRType.psrType	used in download only (Master data)
	location.type	used in download only (Master data)
Monitored_Series	mRID	Used to identify a given set of monitored elements
	name	not used
	Party_MarketParticipant.mRID	not used

536 Note: The location and PSRtype of network elements in critical branch are recorded in
537 transparency platform's master data and will be populated when downloading publications from
538 transparency platform, but not when data provider submits the flow-based parameters to the
539 transparency platform.
540

Monitored_RegisteredResource	mRID	EIC code of the monitored element Populated with a dummy EIC code when the monitored_RegisteredResource is associated with an external, anonymous or combined dynamic constraint
	Name	used in download only (Master data)
	In_Domain	Not used when anonymous constraint. Used in all other cases.
	Out_Domain	Not used when anonymous constraint. Used in all other cases.
	In_AggregateNode	Not used
	Out_AggregateNode	Not used
	pSRType.psrType	used in download only (Master data)
	location.type	used in download only (Master data)
	flowBasedStudy_Domain.mRID	not used
	flowBasedStudy_Domain.flowBasedMargin_Quantity.quantity	used to provide the remaining available margin (RAM)
	flowBasedStudy_Domain.flowBasedMargin_Quantity.quality	not used
	marketCoupling_Domain.mRID	not used
	marketCoupling_Domain.shadow_Price.amount	not used
	Reason.code	not used
	Reason.text	not used
Analog	measurementType	A02 = Permanent admissible transmission limit (PATL) → Used to specify the maximum allowable power flow (Fmax) A03 = Flow reliability margin A18 = Adjustment for minimum RAM → (AMR) A22 = Reference Flow → Used to specify the reference flow (Fref) A41 = negative Fref A24 = I _{max} A25 = IVA The following measurements are applicable to long-term allocations only: A37 = U A38 = cos phi The following measurements are applicable to Core region only: A27 = F _{0_wce} A28 = F _{0_all} A32 = Ramr The following measurements are applicable to day-ahead and intraday allocations in the Core region only: A29 = F _{nrao} A42 = negative F _{nrao} A30 = F _{LTN} A31 = CVA A35 = F _{uaf} A36 = minRAM_targetThe following measurements are only applicable to Nordic region: A26 = F ₀ A34 = FRA The following measurement is only applicable to day-ahead and intraday allocations in the Nordic region and to long-term allocations in both regions: A33 = Faac
	unitSymbol	AMP when measurementType = A24 P1 when measurementType = A32, A38 or A36 KVT when measurementType = A37 MAW in all other instances.
	positiveFlowIn	Not used
	analogValues.value	used to provide the measurement value.

		This value is always zero or positive.
	analogValues.timeStamp	not used
	analogValues.description	not used
PTDF Domain	mRID	Used as PTDF domain/hub EIC code of the bidding zone
	pTDF_Quantity.quantity	Used The PTDF factor for the bidding zone. The value may be positive or negative

541

542

543

Table 3 – Flow based Market Impact Publication dependency

Class	Attribute	Flow Based Process
CriticalNetworkElement MarketDocument	type	B10 = Flow Based domain Market Impact Publication
	process.processType	A43 = Flow Based domain constraint DayAhead A44 = Flow Based domain constraint Intraday
	sender_MarketParticipant.marketRole.type	A36 = Capacity Coordinator or A04 = TSO
	receiver_MarketParticipant.marketRole.type	A32 = Market Information Aggregator or A11 = Market Operator
	docStatus	not used
	received_MarketDocument.mRID	not used
	received_MarketDocument.version	not used
	Related_MarketDocument.mRID	mRID of a related MarketDocument within a given process
	Related_MarketDocument.RevisionNumber	RevisionNumber of a related MarketDocument within a given process
	domain.mRID	used as EIC code of the Flow Based Study Area
Time Series	mRID	used to identify the TS
	businessType	B39 = Flow based Domain Adjusted to Long Term schedules
	In_Domain.mRID	not used
	Out_Domain.mRID	not used
	CurveType	used
Series_Period		
Point		

544

		Constraint Situation Type	External Constraint Type
Border_Series	mRID	used to identify a given maximum flow situation	not used
	businessType	Used C12 = Maximum power exchange	not used
	In_Domain.mRID	used to identify the inArea of the flow	not used
	out_Domain.mRID	used to identify the OutArea of the flow	not used
	flow_Quantity.quantity	used to identify the maximum flow value	not used
Constraint_Series	mRID	used to identify the Constraint_Series	used to identify the Constraint_Series
	businessType	used B40 = Network Element Constraint B41 = Calculation opposition (Red Flag)	used B09 = Net position
	name	may be used To provide a Name to the Constraint Situation	may be used To provide a Name to the External Constraint
	Quantity_Measurement_Unit.name	used for the Flow Based Margin	used for External Constraint (= MW)
	ExternalConstraint_Quantity.quantity	not used	used to provide External Constraint Quantity
	pTDF_Measurement_Unit.name	used for PTDF	not used
	shadowPrice_Measurement_Unit.name	not used	not used
	currency_Unit.name	not used	not used
	Party_MarketParticipant.mRID	used to identify the limiting TSOs	used to identify the limiting TSOs
	Optimization_MarketObjectStatus.status	used to identify the status of the Series for a Remedial Action optimization process	not used
Additional			
Additional	mRID	Used to identify the additional constraint	not used

		Constraint Situation Type	External Constraint Type
	Business Type	A81 : TTC B09 : Net position A27 : NTC B87 : Phase Shift Angle	not used
	name	Used as the name of the Additional Constraint	not used
	Party_MarketParticipant.mRID	Used to identify the owner of the Additional Constraint	not used
	In_Domain.mRID	If the additional constraint is an exchange or a net position constraint: used to identify area where the energy flows into	not used
	Out_Domain.mRID	If the additional constraint is an exchange or a net position constraint: used to identify area where the energy comes from	not used
	Measurement_unit.name	The measurement unit of the additional constraint	not used
	Quantity.quantity	The value of the additional constraint	not used
RegisteredResource	mRID	used as the EIC or CGMES code of one of the registered resources between which there is a maximum phase shift angle	not used
	name	not used	not used
	In_Domain.mRID	not used	not used
	Out_Domain.mRID	not used	not used
	marketObjectStatus.status	Used to provide the direction of the phase shift angle A46: Importing element A47: Exporting element	not used
Contingency_Series	mRID	Used to identify a given contingency	not used
	name	Used as the name of the contingency to be simulated	not used
	Party_MarketParticipant.mRID	Used to identify the owner of the contingency	not used
Contingency_Registered_Resource	mRID	used as EIC code of the Outage element	not used
	name	used as the name of the Outage element	not used
	In_Domain	used to identify InArea	not used
	Out_Domain	used to identify OutArea	not used
Monitored_Series	mRID	Used to identify a given set of monitored elements	not used
	name	Used as the name of the set of monitored elements	not used
	Party_MarketParticipant.mRID	used to identify the owner of the set of monitored elements	not used
Monitored_RegisteredResource	mRID	used as EIC code of the Monitored element	not used
	name	used as the name of the Monitored element	not used
	In_Domain	used to identify InArea	not used
	Out_Domain	used to identify OutArea	not used
	In_AggregateNode	used to identify InAggregateNode for element orientation	not used
	Out_AggregateNode	used to identify OutAggregateNode for element orientation	not used
	flowBasedStudy_Domain.mRID	used as EIC code of the Flow Based Study Area	not used
	flowBasedStudy_Domain.flowBasedMargin_Quantity.quantity	used for the RAM	not used
	marketCoupling_Domain.mRID	not used	not used
	marketCoupling_Domain.shadow_Price.amount	not used	not used
Analog	measurementType	used to identify the monitored measurements A01 = Flow	not used

		Constraint Situation Type	External Constraint Type
		A02 = Maximum Flow A03 = Flow Reliability Margin A04 = Spanning Margin Value A05 = Long Term Allocation Margin A06 = Final adjustment margin value	
	unitSymbol	used to identify the unit of the measurement "A", "MW", "%"...	not used
	positiveFlowIn	may be used to identify on which direction the element is monitored A01 = Direct A02 = Opposite Not used = Double	not used
	analogValues.value	used to provide the measurement value	not used
	analogValues.timeStamp	may be used to provide the constraint duration	not used
	analogValues.description	may be used to identify the situation of the measurement point "Before Outage", "After Curative Action"...	not used
RemedialAction_Series	mRID	Used to identify the set of remedial actions	not used
	name	used as the name of the element on which a remedial action is carried out	not used
	BusinessType	B58 ; Busbar B59 : Network Element A60 : SPS A27 : NTC A81 : TTC	not used
	ApplicationMode_marketObjectStatus.status	Used to identify the status of the remedial action A18 = Preventive A19 = Curative A27 = Curative or preventive A20 = Automatic	not used
	Party_MarketParticipant.mRID	used to identify the owner of the set of remedial actions	not used
	In_Domain.mRID	If Business Type = TTC or NTC, used to identify the area where the energy is going to	not used
	Out_Domain.mRID	If Business Type = TTC or NTC, used to identify the area where the energy comes from	not used
	Measurement.unit.name	If Business Type = TTC or NTC, the measurement unit of the quantity	not used
	Quantity.quantity	If Business Type = TTC or NTC, the value of the new bilateral exchange	not used
RemedialAction_RegisteredResource	mRID	used as EIC code of the element on which a remedial action is carried out	not used
	name	used as the name of the element on which a remedial action is carried out	not used
	pSRType.psrType	used to identify the type of the remedial action A01 = Tieline, A02 = line, A04 = Generation, A05 = Load	not used
	In_Domain	used to identify InArea	not used
	Out_Domain	used to identify OutArea	not used
	In_AggregateNode	may be used to identify InAggregateNode for element orientation	not used
	Out_AggregateNode	may be used to identify OutAggregateNode for element orientation	not used
	marketObjectStatus_status	Used to identify the status of the remedial action A18 = Preventive	not used

		Constraint Situation Type	External Constraint Type
		A19 = Curative	
	resourceCapacity.maximumCapacity	If marketObjectStatus_status = Relative or Absolute : Used to identify the maximum variation or the maximum target value of tap, generation or load	not used
	resourceCapacity.minimumCapacity	If marketObjectStatus_status = Relative or Absolute : Used to identify the minimum variation or the minimum target value of tap, generation or load	not used
	resourceCapacity.defaultCapacity	If marketObjectStatus_status = Relative or Absolute : Used to identify the variation or target value of tap, generation or load	not used
	resourceCapacity.unitSymbol	If marketObjectStatus_status = Relative or Absolute : Used to identify the unit of the target values described	not used
Shared_Domain	Shared_Domain.mRID	EIC code of the area which can use the remedial action	not used
PTDF Domain	mRID	used to identify the impacted bidding zone	not used
	pTDF_Quantity.quantity	used to provide the PTDF factor for the Bidding zone	not used

545

546

Table 4 – NTC Coordinated Determination dependency

Class	Attribute	Flow Based Process
CriticalNetworkElement MarketDocument	type	B06 = Critical Network Element Determination
	process.processType	A15 = Capacity Determination or A40 = Intraday Process
	sender_MarketParticipant.marketRole.type	A36 = Capacity Coordinator
	receiver_MarketParticipant.marketRole.type	A04 = TSO
	docStatus	A40: Proposed A37: Confirmed A34: Rejected
	received_MarketDocument.mRID	mRID of the received document in case of a CNE anomaly report
	received_MarketDocument.version	version of the received document in case of a CNE anomaly report
	Related_MarketDocument.mRID	mRID of a related MarketDocument within a given process
	Related_MarketDocument.RevisionNumber	RevisionNumber of a related MarketDocument within a given process
	domain.mRID	used as EIC code of the Flow Based Study Area
Time Series	mRID	used to identify the TS
	businessType	B37 = Constraint Situation
	In_Domain.mRID	used as EIC code of the InArea of the oriented border study impacted by the listed Critical network elements
	Out_Domain.mRID	used as EIC code of the OutArea of the oriented border study impacted by the listed Critical network elements
	CurveType	used
Series_Period		
Point		

547

		Constraint Situation Type	External Constraint Type
Border_Series	mRID	used to identify a given maximum flow situation	not used
	businessType	Used C12 = Maximum power exchange	not used
	In_Domain.mRID	used to identify the inArea of the flow	not used
	out_Domain.mRID	used to identify the OutArea of the flow	not used
	flow_Quantity.quantity	used to identify the maximum flow value	not used
Constraint_Series	mRID	used to identify the Constraint_Series	used to identify the Constraint_Series
	businessType	used B40 = Network Element Constraint B41 = Calculation opposition (Red Flag)	used B09 = Net position
	name	may be used To provide a Name to the Constraint Situation	may be used To provide a Name to the External Constraint
	Quantity_Measurement_Unit.name	used for the Flow Based Margin	used for External Constraint (= MW)
	ExternalConstraint_Quantity.quantity	not used	used to provide External Constraint Quantity
	pTDF_Measurement_Unit.name	not used	not used
	shadowPrice_Measurement_Unit.name	not used	not used
	currency_Unit.name	not used	not used
	Party_MarketParticipant.mRID	used to identify the limiting TSOs	used to identify the limiting TSOs
	Optimization_MarketObjectStatus.status	used to identify the status of the Series for a Remedial Action optimization process	not used

		Constraint Situation Type	External Constraint Type
AdditionalConstraint_Series	mRID	Used to identify the additional constraint	not used
	Business Type	A81 : TTC B09 : Net position A27 : NTC B87 : Phase Shift Angle	not used
	name	Used as the name of the Additional Constraint	not used
	Party_MarketParticipant.mRID	Used to identify the owner of the Additional Constraint	not used
	In_Domain.mRID	If the additional constraint is an exchange or a net position constraint: used to identify area where the energy flows into	not used
	Out_Domain.mRID	If the additional constraint is an exchange or a net position constraint: used to identify area where the energy comes from	not used
	Measurement_unit.name	The measurement unit of the additional constraint	not used
	Quantity.quantity	The value of the additional constraint	not used
RegisteredResource	mRID	used as the EIC or CGMES code of one of the registered resources between which there is a maximum phase shift angle	not used
	name	not used	not used
	In_Domain.mRID	not used	not used
	Out_Domain.mRID	not used	not used
	marketObjectStatus.status	Used to provide the direction of the phase shift angle A46: Importing element A47: Exporting element	not used
Contingency_Series	mRID	Used to identify a given contingency	not used
	name	Used as the name of the contingency to be simulated	not used
	Party_MarketParticipant.mRID	used to identify the owner of the set of monitored elements	not used
Contingency_Registered_Resource	mRID	used as EIC code of the Outage element	not used
	name	used as the name of the Outage element	not used
	In_Domain	used to identify InArea	not used
	Out_Domain	used to identify OutArea	not used
Monitored_RegisteredResource	mRID	used as EIC code of the Monitored element	not used
	name	used as the name of the Monitored element	not used
	In_Domain	used to identify InArea	not used
	Out_Domain	used to identify OutArea	not used
	In_AggregateNode	used to identify InAggregateNode for element orientation	not used
	Out_AggregateNode	used to identify OutAggregateNode for element orientation	not used
	flowBasedStudy_Domain.mRID	not used	not used
	flowBasedStudy_Domain.flowBasedMargin_Quantity.quantity	not used	not used
	marketCoupling_Domain.mRID	not used	not used
	marketCoupling_Domain.shadow_Price.amount	not used	not used
Analog	measurementType	used to identify the monitored measurements A01 = Flow A02 = Maximum Flow A03 = Flow Reliability Margin A04 = Spanning Margin Value	not used

		Constraint Situation Type	External Constraint Type
		A05 = Long Term Allocation Margin A06 = Final adjustment margin value	
	unitSymbol	used to identify the unit of the measurement "A", "MW", "%"...	not used
	positiveFlowIn	may be used to identify on which direction the element is monitored A01 = Direct A02 = Opposite Not used = Double	not used
	analogValues.value	used to provide the measurement value	not used
	analogValues.timeStamp	may be used to provide the constraint duration	not used
	analogValues.description	may be used to identify the situation of the measurement point "Before Outage", "After Curative Action"...	not used
RemedialAction_Series	mRID	Used to identify the set of remedial actions	not used
	name	used as the name of the element on which a remedial action is carried out	not used
	BusinessType	B58 ; Busbar B59 : Network Element A60 : SPS A27 : NTC A81 : TTC	not used
	ApplicationMode_marketObjectStatus.status	Used to identify the status of the remedial action A18 = Preventive A19 = Curative A27 = Curative or preventive A20 = Automatic	not used
	Party_MarketParticipant.mRID	used to identify the owner of the set of remedial actions	not used
	In_Domain.mRID	If Business Type = TTC or NTC, used to identify the area where the energy is going to	not used
	Out_Domain.mRID	If Business Type = TTC or NTC, used to identify the area where the energy comes from	not used
	Measurement.unit.name	If Business Type = TTC or NTC, the measurement unit of the quantity	not used
	Quantity.quantity	If Business Type = TTC or NTC, the value of the new bilateral exchange	not used
RemedialAction_RegisteredResource	mRID	used as EIC code of the element on which a remedial action is carried out	not used
	name	used as the name of the element on which a remedial action is carried out	not used
	pSRType.psrType	used to identify the type of the remedial action A01 = Tieline, A02 = line, A04 = Generation, A05 = Load	not used
	In_Domain	used to identify InArea	not used
	Out_Domain	used to identify OutArea	not used
	In_AggregateNode	may be used to identify InAggregateNode for element orientation	not used
	Out_AggregateNode	may be used to identify OutAggregateNode for element orientation	not used
	marketObjectStatus_status	Used to identify the status of the remedial action A18 = Preventive A19 = Curative	not used
	resourceCapacity.maximumCapacity	If marketObjectStatus_status = Relative or Absolute :	not used

		Constraint Situation Type	External Constraint Type
		Used to identify the maximum variation or the maximum target value of tap, generation or load	
	resourceCapacity.minimumCapacity	If marketObjectStatus_status = Relative or Absolute : Used to identify the minimum variation or the minimum target value of tap, generation or load	not used
	resourceCapacity.defaultCapacity	If marketObjectStatus_status = Relative or Absolute : Used to identify the variation or target value of tap, generation or load	not used
	resourceCapacity.unitSymbol	If marketObjectStatus_status = Relative or Absolute : Used to identify the unit of the target values described	not used
Shared_Domain	Shared_Domain.mRID	EIC code of the area which can use the remedial action	not used
PTDF Domain	mRID	not used	not used
	pTDF_Quantity.quantity	not used	not used

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Table 5 – Critical Network Element Publication dependency

Class	Attribute	Flow Based Process
CriticalNetworkElement MarketDocument	type	B07 = Critical Network Element Publication
	process.processType	A15 = Capacity Determination or A40 = Intraday Process
	sender_MarketParticipant.marketRole.type	A36 = Capacity Coordinator or A04 = TSO
	receiver_MarketParticipant.marketRole.type	A32 = Market Information Aggregator
	docStatus	not used
	received_MarketDocument.mRID	not used
	received_MarketDocument.version	not used
	Related_MarketDocument.mRID	mRID of a related MarketDocument within a given process
	Related_MarketDocument.RevisionNumber	RevisionNumber of a related MarketDocument within a given process
	domain.mRID	used as EIC code of the Flow Based Study Area
Time Series	mRID	used to identify the TS
	businessType	B37 = Constraint Situation
	In_Domain.mRID	used as EIC code of the InArea of the oriented border study impacted by the listed Critical network elements
	Out_Domain.mRID	used as EIC code of the OutArea of the oriented border study impacted by the listed Critical network elements
	CurveType	used
Series_Period		
Point		

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		Constraint Situation Type	External Constraint Type
Border_Series	mRID	used to identify a given maximum flow situation	not used
	businessType	Used C12 = Maximum power exchange	not used
	In_Domain.mRID	used to identify the inArea of the flow	not used
	out_Domain.mRID	used to identify the OutArea of the flow	not used
	flow_Quantity.quantity	used to identify the maximum flow value	not used
Constraint_Series	mRID	used to identify the Constraint_Series	used to identify the Constraint_Series
	businessType	used B40 = Network Element Constraint B41 = Calculation opposition (Red Flag)	used B09 = Net position
	name	may be used To provide a Name to the Constraint Situation	may be used To provide a Name to the External Constraint
	Quantity_Measurement_Unit.name	used for the Flow Based Margin	used for External Constraint (= MW)
	ExternalConstraint_Quantity.quantity	not used	used to provide External Constraint Quantity
	pTDF_Measurement_Unit.name	not used	not used
	shadowPrice_Measurement_Unit.name	not used	not used
	currency_Unit.name	not used	not used
	Party_MarketParticipant.mRID	used to identify the limiting TSOs	used to identify the limiting TSOs
	Optimization_MarketObjectStatus.status	used to identify the status of the Series for a Remedial Action optimization process	not used

		Constraint Situation Type	External Constraint Type
AdditionalConstraint_Series	mRID	Used to identify the additional constraint	not used
	Business Type	A81 : TTC B09 : Net position A27 : NTC B87 : Phase Shift Angle	not used
	name	Used as the name of the Additional Constraint	not used
	Party_MarketParticipant.mRID	Used to identify the owner of the Additional Constraint	not used
	In_Domain.mRID	If the additional constraint is an exchange or a net position constraint: used to identify area where the energy flows into	not used
	Out_Domain.mRID	If the additional constraint is an exchange or a net position constraint: used to identify area where the energy comes from	not used
	Measurement_unit.name	The measurement unit of the additional constraint	not used
	Quantity.quantity	The value of the additional constraint	not used
RegisteredResource	mRID	used as the EIC or CGMES code of one of the registered resources between which there is a maximum phase shift angle	not used
	name	not used	not used
	In_Domain.mRID	not used	not used
	Out_Domain.mRID	not used	not used
	marketObjectStatus.status	Used to provide the direction of the phase shift angle A46: Importing element A47: Exporting element	not used
Contingency_Series	mRID	Used to identify a given contingency	not used
	name	Used as the name of the contingency to be simulated	not used
	Party_MarketParticipant.mRID	Used to identify the owner of the contingency	not used
Contingency_Registered_Resource	mRID	used as EIC code of the Outage element	not used
	name	used as the name of the Outage element	not used
	In_Domain	used to identify InArea	not used
	Out_Domain	used to identify OutArea	not used
Monitored_Series	mRID	Used to identify a given set of monitored elements	not used
	name	Used as the name of the set of monitored elements	not used
	Party_MarketParticipant.mRID	used to identify the owner of the set of monitored elements	not used
Monitored_RegisteredResource	mRID	used as EIC code of the Monitored element	not used
	name	used as the name of the Monitored element	not used
	In_Domain	used to identify InArea	not used
	Out_Domain	used to identify OutArea	not used
	In_AggregateNode	used to identify InAggregateNode for element orientation	not used
	Out_AggregateNode	used to identify OutAggregateNode for element orientation	not used
	flowBasedStudy_Domain.mRID	not used	not used
	flowBasedStudy_Domain.flowBasedMargin_Quantity.quantity	not used	not used
	marketCoupling_Domain.mRID	not used	not used
	marketCoupling_Domain.shadow_Price.amount	not used	not used
Annotation	measurementType	used to identify the monitored measurements	not used

		Constraint Situation Type	External Constraint Type
		A01 = Flow A02 = Maximum Flow A03 = Flow Reliability Margin A04 = Spanning Margin Value A05 = Long Term Allocation Margin A06 = Final adjustment margin value	
	unitSymbol	used to identify the unit of the measurement "A", "MW", "%"...	not used
	positiveFlowIn	may be used to identify on which direction the element is monitored A01 = Direct A02 = Opposite Not used = Double	not used
	analogValues.value	used to provide the measurement value	not used
	analogValues.timeStamp	may be used to provide the constraint duration	not used
	analogValues.description	may be used to identify the situation of the measurement point "Before Outage", "After Curative Action"...	not used
RemedialAction_Series	mRID	Used to identify the set of remedial actions	not used
	name	used as the name of the element on which a remedial action is carried out	not used
	BusinessType	B58 ; Busbar B59 : Network Element A60 : SPS A27 : NTC A81 : TTC	not used
	ApplicationMode_marketObjectStatus.status	Used to identify the status of the remedial action A18 = Preventive A19 = Curative A27 = Curative or preventive A20 = Automatic	not used
	Party_MarketParticipant.mRID	used to identify the owner of the set of remedial actions	not used
	In_Domain.mRID	If Business Type = TTC or NTC, used to identify the area where the energy is going to	not used
	Out_Domain.mRID	If Business Type = TTC or NTC, used to identify the area where the energy comes from	not used
	Measurement.unit.name	If Business Type = TTC or NTC, the measurement unit of the quantity	not used
	Quantity.quantity	If Business Type = TTC or NTC, the value of the new bilateral exchange	not used
RemedialAction_RegisteredResource	mRID	used as EIC code of the element on which a remedial action is carried out	not used
	name	used as the name of the element on which a remedial action is carried out	not used
	pSRType.psrType	used to identify the type of the remedial action A01 = Tieline, A02 = line, A04 = Generation, A05 = Load	not used
	In_Domain	used to identify InArea	not used
	Out_Domain	used to identify OutArea	not used
	In_AggregateNode	may be used to identify InAggregateNode for element orientation	not used
	Out_AggregateNode	may be used to identify OutAggregateNode for element orientation	not used
	marketObjectStatus_status	Used to identify the status of the remedial action	not used

		Constraint Situation Type	External Constraint Type
		A18 = Preventive A19 = Curative	
	resourceCapacity.maximumCapacity	If marketObjectStatus_status = Relative or Absolute : Used to identify the maximum variation or the maximum target value of tap, generation or load	not used
	resourceCapacity.minimumCapacity	If marketObjectStatus_status = Relative or Absolute : Used to identify the minimum variation or the minimum target value of tap, generation or load	not used
	resourceCapacity.defaultCapacity	If marketObjectStatus_status = Relative or Absolute : Used to identify the variation or target value of tap, generation or load	not used
	resourceCapacity.unitSymbol	If marketObjectStatus_status = Relative or Absolute : Used to identify the unit of the target values described	not used
Shared_Domain	Shared_Domain.mRID	EIC code of the area which can use the remedial action	not used
PTDF Domain	mRID	not used	not used
	pTDF_Quantity.quantity	not used	not used

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Table 6 – Critical Network Element Market Impact Publication dependency

Class	Attribute	Flow Based Process
CriticalNetworkElement MarketDocument	type	B12 = Critical Network Element Market Impact Publication
	process.processType	A15 = Capacity Determination or A40 = Intraday Process
	sender_MarketParticipant.marketRole.type	A36 = Capacity Coordinator or A04 = TSO
	receiver_MarketParticipant.marketRole.type	A32 = Market Information Aggregator
	docStatus	not used
	received_MarketDocument.mRID	not used
	received_MarketDocument.version	not used
	Related_MarketDocument.mRID	mRID of a related MarketDocument within a given process
	Related_MarketDocument.RevisionNumber	RevisionNumber of a related MarketDocument within a given process
	domain.mRID	used as EIC code of the Flow Based Study Area
Time Series	mRID	used to identify the TS
	businessType	B37 = Constraint Situation
	In_Domain.mRID	used as EIC code of the InArea of the oriented border study impacted by the listed Critical network elements
	Out_Domain.mRID	used as EIC code of the OutArea of the oriented border study impacted by the listed Critical network elements
	CurveType	used
Series_Period		
Point		

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		Constraint Situation Type	External Constraint Type
Border_Series	mRID	used to identify a given maximum flow situation	not used
	businessType	Used C12 = Maximum power exchange	not used
	In_Domain.mRID	used to identify the inArea of the flow	not used
	out_Domain.mRID	used to identify the OutArea of the flow	not used
	flow_Quantity.quantity	used to identify the maximum flow value	not used
Constraint_Series	mRID	used to identify the Constraint_Series	used to identify the Constraint_Series
	businessType	used B40 = Network Element Constraint B41 = Calculation opposition (Red Flag)	used B09 = Net position
	name	may be used To provide a Name to the Constraint Situation	may be used To provide a Name to the External Constraint
	Quantity_Measurement_Unit.name	used for the Flow Based Margin	used for External Constraint (= MW)
	ExternalConstraint_Quantity.quantity	not used	used to provide External Constraint Quantity
	pTDF_Measurement_Unit.name	not used	not used
	shadowPrice_Measurement_Unit.name	not used	not used
	currency_Unit.name	not used	not used
	Party_MarketParticipant.mRID	used to identify the limiting TSOs	used to identify the limiting TSOs
	Optimization_MarketObjectStatus.status	used to identify the status of the Series for a Remedial Action optimization process	not used

		Constraint Situation Type	External Constraint Type
AdditionalConstraint_Series	mRID	Used to identify the additional constraint	not used
	Business Type	A81 : TTC B09 : Net position A27 : NTC B87 : Phase Shift Angle	not used
	name	Used as the name of the Additional Constraint	not used
	Party_MarketParticipant.mRID	Used to identify the owner of the Additional Constraint	not used
	In_Domain.mRID	If the additional constraint is an exchange or a net position constraint: used to identify area where the energy flows into	not used
	Out_Domain.mRID	If the additional constraint is an exchange or a net position constraint: used to identify area where the energy comes from	not used
	Measurement_unit.name	The measurement unit of the additional constraint	not used
	Quantity.quantity	The value of the additional constraint	not used
RegisteredResource	mRID	used as the EIC or CGMES code of one of the registered resources between which there is a maximum phase shift angle	not used
	name	not used	not used
	In_Domain.mRID	not used	not used
	Out_Domain.mRID	not used	not used
	marketObjectStatus.status	Used to provide the direction of the phase shift angle A46: Importing element A47: Exporting element	not used
Contingency_Series	mRID	Used to identify a given contingency	not used
	name	Used as the name of the contingency to be simulated	not used
	Party_MarketParticipant.mRID	Used to identify the owner of the contingency	not used
Contingency_Registered_Resource	mRID	used as EIC code of the Outage element	not used
	name	used as the name of the Outage element	not used
	In_Domain	used to identify InArea	not used
	Out_Domain	used to identify OutArea	not used
Monitored_Series	mRID	Used to identify a given set of monitored elements	not used
	name	Used as the name of the set of monitored elements	not used
	Party_MarketParticipant.mRID	used to identify the owner of the set of monitored elements	not used
Monitored_RegisteredResource	mRID	used as EIC code of the Monitored element	not used
	name	used as the name of the Monitored element	not used
	In_Domain	used to identify InArea	not used
	Out_Domain	used to identify OutArea	not used
	In_AggregateNode	used to identify InAggregateNode for element orientation	not used
	Out_AggregateNode	used to identify OutAggregateNode for element orientation	not used
	flowBasedStudy_Domain.mRID	not used	not used
	flowBasedStudy_Domain.flowBasedMargin_Quantity.quantity	not used	not used
	marketCoupling_Domain.mRID	not used	not used
	marketCoupling_Domain.shadow_Price.amount	not used	not used
Annotation	measurementType	used to identify the monitored measurements	not used

		Constraint Situation Type	External Constraint Type
		A01 = Flow A02 = Maximum Flow A03 = Flow Reliability Margin A04 = Spanning Margin Value A05 = Long Term Allocation Margin A06 = Final adjustment margin value	
	unitSymbol	used to identify the unit of the measurement "A", "MW", "%"...	not used
	positiveFlowIn	may be used to identify on which direction the element is monitored A01 = Direct A02 = Opposite Not used = Double	not used
	analogValues.value	used to provide the measurement value	not used
	analogValues.timeStamp	may be used to provide the constraint duration	not used
	analogValues.description	may be used to identify the situation of the measurement point "Before Outage", "After Curative Action"...	not used
RemedialAction_Series	mRID	Used to identify the set of remedial actions	not used
	name	used as the name of the element on which a remedial action is carried out	not used
	BusinessType	B58 ; Busbar B59 : Network Element A60 : SPS A27 : NTC A81 : TTC	not used
	ApplicationMode_marketObjectStatus.status	Used to identify the status of the remedial action A18 = Preventive A19 = Curative A27 = Curative or preventive A20 = Automatic	not used
	Party_MarketParticipant.mRID	used to identify the owner of the set of remedial actions	not used
	In_Domain.mRID	If Business Type = TTC or NTC, used to identify the area where the energy is going to	not used
	Out_Domain.mRID	If Business Type = TTC or NTC, used to identify the area where the energy comes from	not used
	Measurement.unit.name	If Business Type = TTC or NTC, the measurement unit of the quantity	not used
	Quantity.quantity	If Business Type = TTC or NTC, the value of the new bilateral exchange	not used
RemedialAction_RegisteredResource	mRID	used as EIC code of the element on which a remedial action is carried out	not used
	name	used as the name of the element on which a remedial action is carried out	not used
	pSRType.psrType	used to identify the type of the remedial action A01 = Tieline, A02 = line, A04 = Generation, A05 = Load	not used
	In_Domain	used to identify InArea	not used
	Out_Domain	used to identify OutArea	not used
	In_AggregateNode	may be used to identify InAggregateNode for element orientation	not used
	Out_AggregateNode	may be used to identify OutAggregateNode for element orientation	not used
	marketObjectStatus_status	Used to identify the status of the remedial action	not used

		Constraint Situation Type	External Constraint Type
		A18 = Preventive A19 = Curative	
	resourceCapacity.maximumCapacity	If marketObjectStatus_status = Relative or Absolute : Used to identify the maximum variation or the maximum target value of tap, generation or load	not used
	resourceCapacity.minimumCapacity	If marketObjectStatus_status = Relative or Absolute : Used to identify the minimum variation or the minimum target value of tap, generation or load	not used
	resourceCapacity.defaultCapacity	If marketObjectStatus_status = Relative or Absolute : Used to identify the variation or target value of tap, generation or load	not used
	resourceCapacity.unitSymbol	If marketObjectStatus_status = Relative or Absolute : Used to identify the unit of the target values described	not used
Shared_Domain	Shared_Domain.mRID	EIC code of the area which can use the remedial action	not used
PTDF Domain	mRID	not used	not used
	pTDF_Quantity.quantity	not used	not used

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