OFFSHORE INTEGRATION DESIGN NOTE

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1. Executive summary

By 2020, ELIA expects a significant increase of the Belgian offshore wind production. Once all offshore parks will be fully operational the total installed capacity will reach 2300 MW.

Furthermore, because all Belgian offshore wind parks are situated close to each other in the North Sea, ELIA observes a similar behaviour in front of a **storm event**, the only difference coming from the technical characteristics of installed wind turbines (a.o the **wind speed cut out**; which corresponds to the technical limit from which a wind turbine stops producing because of too high wind speeds).

To better understand the storm phenomenon, ELIA and consultant 3E realized and published a dedicated study early 2018[1]. Results were discussed with market parties in WG balancing on 30/11/2017 and following action plan was put forward:

1) Develop **dedicated storm forecast tools** to improve the forecast accuracy of these specific events. Indeed - even though ELIA and 3E observed that most important storm events could already be anticipated in day-ahead and predicted in intraday based on current wind power forecasts and wind speed forecasts available for the North Sea area – more accurate predictions will be available when specific weather models that calculate wind speed forecasts at exact turbine height and localisation are calibrated and implemented;
2) Develop **specific operational procedures** between ELIA and BRP's responsible for offshore production to coordinate actions and communication when a storm event is detected. In this context, ELIA makes the difference between two specific procedures:
    a. The "standard**" procedure**;

    This procedure foresees information exchange between BRPs, outage planning agent, scheduling agent and Elia enabling Elia to make an assessment whether the BRPs will manage correctly its balancing responsibilities during each **forecasted storm** event;

    b. The "**fall-back" procedure**;

    This last resort procedure will be used in case a non-mitigated balancing risk is identified based on the standard procedure and consists in ex-ante activation of incremental flexibility that cannot be used within balancing time frame of 15 minutes (a.o: start-up of slow start units) compensated by decremental activations following the usual balancing merit order.

To implement the above mentioned action plan, the following milestones were detailed to market parties, as illustrated in the *Figure 1* below:

1) Development of dedicated storm forecasting tools;
2) Discussion and validation of operational procedures with market parties by end 2018;
3) Realization of a **test phase** on winter 2018 / 2019 to validate and further improve the storm forecast tools accuracy and proposed operational processes practicability.;
4) Integration into operational tools and concerned contracts (a.o: CIPU offshore contract, BRP contract…) by end 2019.

[1] http://www.elia.be/~/media/files/Elia/users-group/Working-Group-Balancing/Projects%20and%20publications/offshore%20integration%20study%20final%20version.pdf

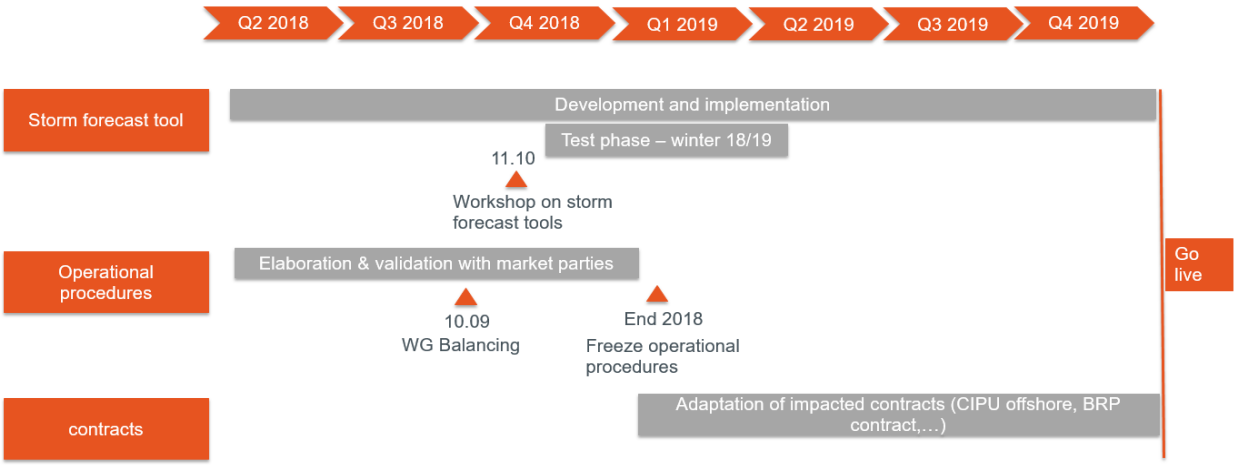


Figure 1 – Offshore integration implementation plan

Disclaimer

The solution presented in this document is valid for the expected 2020 offshore installed capacity (2300 MW). The consideration of possible future offshore configurations (with additional capacity being installed after 2020) and their influence on the system imbalance and the operational processes presented hereafter is not in the scope of this document and requires additional analyses.

1.1. Scope and structure of the present design note

The present design note focuses on the detailed description of the operational processes that are specifically designed to cover storm situations. To do so, the document is organized in 4 specific sections:

1) **Storm forecasting tools**: the storm forecasts provided by the external forecast suppliers will – when a storm risk is identified – trigger the standard procedure and when required the fall back procedure. Seen the importance of storm forecast in the proposed operational procedures, a description of model's key characteristics is provided in this section.

2) **Interactions with ongoing projects, legal and regulatory framework**: Considering the numerous interactions with other projects – which have been or will be discussed with market parties in relevant work groups – ELIA summarizes in this section aspects already implemented (or announced) and from which the procedures ("standard" and "fall back") have been elaborated. Whenever relevant, references to related documents, regulation or legal framework are provided by ELIA.

3) **Standard procedure**: In this section, ELIA describes the different steps applicable from the moment a storm is forecasted by the storm forecasting tools (starting in day ahead). This procedure foresees an information exchange between BRPs and Elia enabling Elia to make an assessment whether the BRPs will manage correctly its balancing responsibilities during each **forecasted storm** event. Furthermore, roles

and responsibilities of both ELIA and key market parties (BRP offshore, the scheduling agent and the outage planning agent in the future) are detailed for each step.

Finally, examples are provided to clarify the most probable scenarios that could occur in reality (a.o: related to forecasts errors).

4) **Fall-back procedure**: In addition to the standard procedure detailed in the third section of the present document, this last resort procedure will be used in case a non-mitigated balancing risk is identified based on the standard procedure. Possible actions as well as conditions under which ELIA applies this procedure are fixed in this section.

1.2. Out of scope

Two issues were studied in the offshore integration study ELIA and consultant 3E presented in 2017: the power fluctuation caused by storm events and those generated because of sudden wind variation (also named “ramps”).

As additional analyses are required before being able to elaborate dedicated solutions to cover the ramp issue, this topic is not considered in this document.

1.3. Definitions

Storm event: a storm event is defined by ELIA as a measured decrease of at least 30 % of offshore production during at least 2 quarter-hours while average 10 minutes wind speed measurements remains above a pre-determined threshold. This threshold varies for each wind park in function of the wind turbine technology and its related cut-out wind speed limit[2]. ELIA considers an event as “storm” from the moment one wind park respects the above mentioned criteria.

Important remark

The definition of storm event used in this document is based on MW offshore measurements and wind speed measurement of each wind parks and serves as input for the storm forecast supplier to detect storm events. Prior to the entry into force of the operational procedures described in this document (and the related settlement process), additional criteria will be fixed (a.o: to include forecast errors in timing of cut-out phase). These criteria’s will be determined from the results of the test phase and discussed with market parties in Q2 2019.

Cut-out phase: the decremental phase of a storm event; being the power loss observed on offshore wind park production caused by wind speeds above the turbine’s technical threshold.

[2] Information on cut-out wind speed limit of offshore wind turbines is essential input to the storm forecast model as it allows ELIA to receive the most accurate and close to reality forecasts. **However, procedures described in section 4 and 5 are applicable independent of the wind turbine installed cut-out technology**.

Cut-in phase: the incremental phase of a storm event; being the power production observed consecutive to the cut-out phase.

Storm impact: taking available technical information into consideration (e.g: wind speed at altitude of wind turbine; technical wind turbine characteristics…), the estimated impact (in MW) of the storm event (both cut out and cut in phases) for a specific offshore wind park.

An example of the 4 above mentioned definitions is given in Figure 2 below.

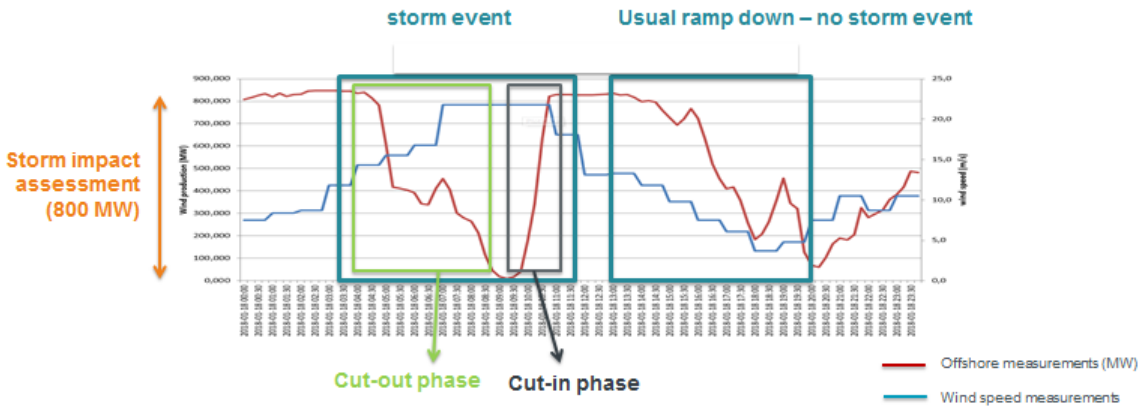


Figure 2: Example of storm event observed previous winter (18.01.2018). Please note imprecision is caused by the fact that the wind speed measurements (blue line on the graph) used in this example are not exactly taken at the offshore parks localisation.

Offshore BRP's: the BRP's of offshore parks; hereafter "offshore BRP's".

Mitigation measures: the actions the offshore BRPs undertake in order to balance their portfolio in case of storm events. These measures cover both the decremental (being a coordinated reduction of the offshore production) and the incremental (BRP's solution to compensate the expected offshore production loss for the storm event duration) directions.

Residual storm impact risk: the residual storm risk corresponds to the initially forecasted storm impact reduced by the mitigation measures which have been communicated by the BRP to Elia via a dedicated interface and confirmed (whenever possible) via the existing nomination processes.

Available mFRR balancing means: all balancing energy that can be activated within the quarter hour as clarified by EB GL in art. 32 and that is confirmed available for the concerned delivery period(s), being:

- mFRR energy bids resulting from the contracted balancing capacity;
- Non contracted mFRR energy bids and;
- Cross border balancing energy accessible through sharing agreements with other TSOs.

NB**:** For the avoidance of doubts, aFRR bids are not included in the above mentioned definition.

2. Storm forecast tools

As introduced earlier in this document, one recommendation of 3E storm risk study is to **develop a dedicated storm forecast tool** to forecast more accurately the magnitude and timing of storm events. Based on the outcome of this tool, operational processes will be initiated.

Consecutive to 2018 offshore integration study, ELIA selected 2 forecast suppliers to model and support the implementation of this specific service. As detailed in the implementation plan presented above, ELIA's objective is to have these models ready by Q3 2018 in order to run a 6 month period of test (Nov. 2018 – April 2019). Thanks to this test period, valuable information on the storm forecasts accuracy will be collected (e.g: storm detection; cut out start and end time; cut in start and end time...) and used as input[3] to improve the operational processes described in section 4 and 5 and to fix key parameters (definitions, timing,…).

In this section, key characteristics of these models (as currently foreseen by ELIA for the delivery in test period) are summarized to help understand how and based on which information ELIA will trigger the operational processes described below. In addition to the information provided below, ELIA organized on 11 October 2018 a dedicated workshop with market parties (BRPs and concession holders) and its storm forecast supplier with the objective to share knowledge on the weather and statistical models used as input to the storm forecasts. By involving market parties, ELIA also hopes to gather useful improvement suggestions (ex: based on additional data not available to ELIA such as the wind speed forecasts on each wind parks) in order to have to most accurate possible tool at disposal.

Disclaimer

Please keep in mind that:

1) These storm forecast models are currently in development. In this way, it is possible that changes – compared to the information presented below - will be introduced by the time these tools are effectively implemented;

2) The storm forecasts will not be included in publication on ELIA's website before the end of the test period. Once a stable storm forecasting tool is available Elia will publish the results on its website (Q4 2019).

3) Just like other publications regarding forecasting (wind, solar) ELIA cannot be held responsible for the published data (accuracy, forecast error, temporary failure in the publications ;..) In the framework of its legal obligation to be balanced BRPs should develop its own tools and processes.

[3] The results of ELIA's analysis on the accuracy of storm forecasts will be presented to market parties in WG balancing in Q2 2019. Consecutive to this analysis and once the identified improvements will be implemented, ELIA will publish storm related information on its website (expected for Q4 2019)

2.1. Storm forecast model delivered by external suppliers

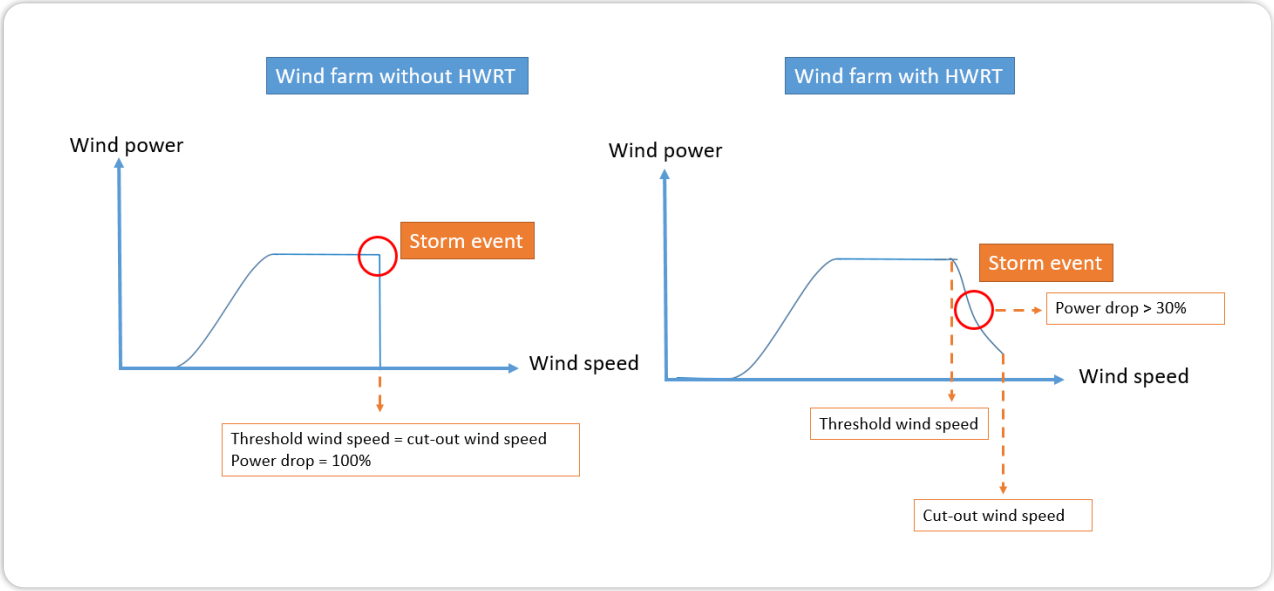
ELIA defines the following two main objectives for its storm forecast model:

1) Forecast the occurrence of storms and;
2) Assess the impact (in MW) of the detected storm event on each offshore wind park.

2.1.1. Forecast storm occurrence

A **storm event** is currently[4] defined by ELIA as a measured decrease of at least 30 % of offshore production during at least 2 quarter-hours while average 10 minutes wind speed measurements remains above a pre-determined threshold. This threshold varies for each wind park in function of the wind turbine technology and its related cut-out wind speed limit. ELIA considers an event as "storm" from the moment one wind park respects simultaneously the above mentioned criteria.

The wind speed threshold used in this definition is different for each wind park and is defined in the technical specifications of the wind turbines[5]. For some wind parks, this threshold corresponds to the cut-out wind speed. For offshore parks equipped with special wind turbine technology, such as the High-Wind Ride Through, the wind speed threshold considered in this definition is the speed at which the power starts to decrease. For these specific wind parks, the combination of both decrease of offshore production **and** wind speed higher than the threshold is considered for Elia to consider an event as a storm.



Based on a combination of weather and statistical models and calibrated from historical measurement available at ELIA (on top of the additional data provided by market parties

[4] The definition of storm risk shall be updated in the future in function of return of experience and after discussion with CREG and stakeholders

[5] In function of return of experience following storm events, Elia reserves the right to modify these thresholds after discussion with the wind parks.

during the test phase such as wind speed measurements), the storm forecast models will provide information for each wind park on:

- The expected timing of concerned storm event (both for cut-out and for cut-in phase);
- The expected duration of each phase;
- Statistical indicators to indicate the forecast certainty (on both the expected impact in MW and the timing of cut-out / cut-in phases);

Updated forecasts will be sent to ELIA on **hourly basis** and cover a **36 hour** period of time.

2.1.2. Storm impact

An **impact assessment (in MW)** – taking into consideration ELIA's available information on wind turbine localisation and technical characteristics – will be provided for each offshore wind park, per quarter hour and over the next 36 hours. When computing the storm impact, the model considers also partial cut-out for offshore wind parks equipped with new wind turbines technologies such as High Wind Ride Through. ELIA will use this information as input to the operational procedures described in section 4 and 5 below.

Important remark

Once stable results can be guaranteed, ELIA foresees to publish storm related information on its website and via a RSS feed. The total storm impact (aggregated for all wind parks) and the timings of the storm will be available in the publications

2.2. Additional storm related requirements identified by ELIA

On top of the requirements presented above for which the support of external expertise is needed, ELIA identifies the need to implement a dedicated monitoring of offshore wind park production in order to be able to detect the **occurrence of an unexpected storm event**.

Indeed, ELIA and 3^{E} observed in 2018 offshore integration study that not all the wind parks subject to the storm event disconnected at the same time (the average cut-out duration was 2 hours 16 minutes).

Furthermore, considering that the installation of additional offshore wind capacity will extend the geographical zone to be analysed for each storm situation, the average cut-out duration is expected to increase accordingly.

In this way - if a cut out on a specific wind park can be quickly detected - this concretely signifies that **coordinated actions can still be aligned between ELIA and the offshore BRPs** responsible for offshore parks with similar technical cut-out characteristics and which have not been influenced yet by this storm.

On top of the need to coordinate actions for the ongoing cut-out phase, the real time detection of storm occurrence will also allow ELIA to apply specific actions applicable to the cut-in phase as detailed in section 4.5 of this document.

3. Interactions with ongoing projects, legal and regulatory framework

Before detailing the operational procedures foreseen by ELIA to cover storm situations (in section 4 and 5 below), the relevant Belgian and European regulations as well as the interactions with other ongoing project's (a.o : ICAROS) are highlighted in this section.

3.1. Relevant Belgian and European regulations

3.1.1. Federal grid code (19.12.2002)

In the federal grid code, several articles refer to the obligation of balancing responsible parties to respect the balance between injection and offtake at several time horizons. In this way, art. 157, 214 and 216 apply.

Related to the above mentioned obligations, ELIA reminds that the management of a predictable storm event having an impact on the offshore wind production is inherent to the BRP's legal obligation to balance its portfolio. Therefore, the BRP's have the obligation to consider storm events when balancing their position in day ahead and intraday.

3.1.2. New federal grid code (final proposal – officially submitted by ELIA on 17.05.2018)

In the federal grid code proposal (submitted on 17.05.2018[6]), **article 201** (paragraph 3) details the possibility for the TSO to impose to the balance responsible party means or procedures aiming to allow anticipation and preparation to forecasted storm events.

In parallel**, art 252** details the obligation for the scheduling agent to inform ELIA as quickly as possible about partial or full interruption of offshore production due to forecasted or ongoing weather phenomenon.

Disclaimer

The federal grid code is currently being reviewed and discussed by relevant market parties (a.o: FOD, SPF, regulator, ELIA and market parties). The references and content of the above mentioned articles may therefore be subject to changes in future grid code versions.

3.1.3. BRP contract

As introduced earlier in this document, the BRP contract will be adapted in 2019 – once the offshore integration design has been discussed with market parties – to reflect the obligations

[6] http://www.elia.be/en/users-group/Working-Group-Belgian-Grid/Proposal-Federal-Grid-Code-and-General-Requirements

and expected actions of offshore BRP's in storm situations as well as the additional requirements introduced in the new federal grid code proposal.

3.1.4. Market functioning rules with regards to compensation of quarter-hour imbalances (balancing rules) and LFC Bloc Operational agreement

In the standard and the fallback procedures described in sections 4 and 5, ELIA applies its right to activate units unable to deliver the required power within 15 minutes or units subject to technical constraints in function of the operational needs. This principle is described in chapter 8.9[7] of the market functioning rules with regards to compensation of quarter-hour imbalances as well as in the LFC Bloc Operational agreement (article 5 – section 3 and article 11).

3.1.5. Reserve needs dimensioning – dossier volume

Historically and until 2017 (included) storm events were considered by ELIA in its dimensioning methodology the same way than a production unit. Therefore, offshore wind production influenced the determination of ELIA's volume of reserves in two different ways:

- Being considered as one of the production unit determining the dimensioning incident and;
- Via the historical system imbalance data used as methodology's input. Indeed, this data includes the system imbalance caused by wind forecasts errors.

However, based on the results of offshore integration study realized in 2018, ELIA stopped to consider offshore wind production as a classic production unit subject to a forced outage risk. There were two reasons for this evolution:

- The System Operation Guideline defines in **Art. 157** the FRR dimensioning rules to be respected by TSOs when implementing their dimensioning methodology. In this way, "*the TSO of a LFC block shall determine the size of the reference incident which shall be the largest imbalance that may result from an **instantaneous change** of active power of a single power generating module, single demand facility or single HVDC interconnector*". Offshore production does not fall into this definition as a cut-out phase takes several quarter hours;
- A majority of storm events are **predictable**. This signifies that solutions can be elaborated by the responsible BRPs. Therefore, the related imbalances can be anticipated and mitigated appropriately.

As a consequence, ELIA assumes that an outage of offshore wind production due to storm event shouldn't affect the parameters influencing the determination of the reserve needs.

[7] www.elia.be/~/media/files/Elia/Products-and-services/Balancing/Balancing%20mecanism/20180401%20Balancing%20Rules%20FR.pdf

3.2. Roles and responsibilities

Key tasks regarding system operations and market procedures for large production units are currently organised with BRPs via the CIPU contract. With the entry into force of European electricity guidelines, a complete reorganization of the current roles and responsibilities along with the creation of new roles (scheduling agent, outage planning agent) is foreseen. To achieve this objective, ELIA created the "ICAROS" project and published specific design documents end 2017[8].

When looking more specifically at the offshore integration topic, ELIA identifies two major differences between current and future organization related to the entities responsible for the introduction of schedules and outage planning. So far, the balance responsible party is also responsible for the introduction of schedules and outage planning (via the CIPU contract) while from the entry into force of the ICAROS project these might differ.

In this document, ELIA highlights the actions and obligations related to each one of these three roles (outage planning agent; scheduling agent and balance responsible party). As long as ICAROS is not implemented, these actions and obligations will be still coordinated by the BRP.

3.2.1. Balance responsible party obligation

As introduced earlier in this document, ELIA reminds that the management of a predictable storm event having an impact on the offshore wind production is inherent to the BRP's legal obligation to balance its portfolio. Therefore, the BRP's have the obligation to consider storm events when balancing their position in day ahead and intraday. Because of the magnitude of the impact of such storm events on the power production and the potential consequences on balance of the Belgian control area in case this is not properly managed by the BRP, they will need to inform ELIA about the foreseen mitigation measures and their related timing. Specific interfaces will be implemented by ELIA to facilitate the exchange of information required because of the operational procedures described in section 4 and 5 of this document.

The mitigation measures are proposed by the BRPs without approval from ELIA and **must be reflected in the existing processes** and nomination platforms (whenever possible). Whenever required, **related contracts (e.g: BRP contract) will be adapted accordingly to reflect these obligations**.

A cut-out risk for which announced mitigation measures are not communicated and reflected in existing processes (at least an updated schedule and outage planning of the wind parks for the decremental direction) **will not be considered by ELIA as covered in its residual storm impact risk assessment**. If – as consequence – the fall-back procedure is activated, ELIA will require **justification from the BRPs** who did not follow published storm forecasts and ELIA's warnings (in the preparation phase) and **might decide to trigger the termination procedure** detailed in BRP contract.[9]

[8] http://www.elia.be/en/about-elia/publications/Public-Consultation/Archives/New-eu-guideline-compliant-approach-for-the-coordination

[9] Such a termination procedure might be also started up in case it appears that BRPs have communicated wrong information on purpose during the standard procedure

3.2.2. Scheduling obligation and Outage planning obligations

According to Art. 245 of the Federal Grid Code, the outage planning agent (OPA) of an asset has the obligation to inform ELIA as quickly as possible about any partial or full unexpected unavailability of this asset.

According to the Art. 252 §1 of the Federal Grid Code, the scheduling agent (SA) has the obligation to inform ELIA as quickly as possible about partial or full interruption of offshore production due to forecasted or ongoing weather phenomenon. The §2 of the Art.252 defines also that any restart of the offshore production following the situation described in the §1 has to be agreed and coordinated by the SA with Elia. Elia can impose conditions on the restart profile if required.

Art. 253 of the Federal Grid Code imposes also that the data coming from the different parties for the same asset (outage planning, schedules and nominations from BRP) have to be coherent.

3.2.2.1. Outage planning obligation

The outage planning agent is required to inform Elia as quickly as possible about any change in the outage planning status and/or “Pmax” available due to forecasted or ongoing storm events. To do so, he will request an outage planning amendment to ELIA to update the outage planning status and/or the “Pmax” available depending on the expected impact of the storm (partial or full cut-out). The outage planning amendment is subject to ELIA’s approval in order to safely coordinate the cut-in phase.

With regard to storm events covered by the BRP with adequate mitigation measures and correctly reflected in the schedules, the outage planning agent will update the outage planning status and/or the information on the “Pmax” available for the storm duration. Any update of this information (higher/lower storm impact, updated start/end time) resulting from the real-time situation during an ongoing storm has to be communicated as quickly as possible to Elia.

ELIA might observe in real time cut-out on wind parks for which the BRP had not foreseen any mitigation measures and/or the scheduling agent had not updated the schedules accordingly. In such circumstances, and if a new outage planning is not provided by the outage planning agent after the cut-out occurs, **ELIA will adapt the outage planning** and/or the information on the “Pmax” available of the concerned wind park(s) for the rest of the day. Depending on the type of cut-out detected in real-time (partial or full cut-out), Elia will adapt the Pmax available and/or the outage planning status. Elia will use the minimum value of the observed power during the last hour to adapt the Pmax available. Consequently, the reference schedule has to be updated to be in link with the real time situation. The outage planning agent is then required to update the information as quickly as possible (assuming that on the same day the storm will pass and therefore an update is required) as described above.

3.2.2.2. Scheduling obligation

The scheduling agent is required to inform Elia as quickly as possible about any change in the schedules due to forecasted or ongoing storm events according to Federal Grid Code. As the Art. 253 imposes the coherency of data, any change in the outage status and “Pmax” available must be reflected in the schedules. As described in Art. 252 §2 of the Federal Grid Code, the schedule amendment is subject to ELIA’s approval in order to safely coordinate the cut-in phase.

Schedules must respect the outage status of the asset. In this way, as detailed previously in the case in which Elia adapts the outage status and/or "Pmax" available, it has to be automatically adapted for the rest of the day to be consistent with the updated outage planning. .

In the ICAROS design note on scheduling and redispatching[10], the **obligation to respect schedules** in situation when the deviation from schedule aggravates or causes a congestion risk is reinforced with the set-up of a dedicated **monitoring and penalty mechanism**. This logic is extended to offshore wind parks to cover storm situations and is in line with the rule presented in art. 209 of Federal Grid Code amendment proposal.

This concretely signifies that – independent of the congestion risk identified for the offshore area – **scheduling agents (currently via the CIPU contract the same entity as the BRP**) **have the obligation to respect their last validated offshore schedule from the moment a storm risk is detected** (see more information on storm detection in section 4.1). ELIA will monitor this obligation is respected and **will apply related penalties** defined in ICAROS if this is not the case.

The detailed settlement rules around this specific obligation are being further elaborated via the ICAROS project and are therefore not presented in this document.

3.3. Incentives

As introduced above in this document, ELIA does not foresee additional volume of reserves to cover the cut-out of wind parks because of a storm event. This signifies that the available balancing means at the storm occurrence should not specifically be activated to solve storm related imbalances.

To make sure offshore BRP's respect their balancing responsibilities and coordinate by themselves the **cut out and cut in of offshore parks** along with the related incremental compensation (and therefore limit the use of balancing means to cover storm related imbalances) ELIA will make sure the **adequate financial incentives are given via the imbalance pricing mechanism**. To do so, ELIA proposed an adaptation of the imbalance formula currently used for the 'alfa' component[11] in the framework of the tariff proposal 2020-2023.

Specifically related to offshore procedures described in this document, ELIA takes the assumption BRPs shall be exposed to adequate incentives via the imbalance prices.

3.4. Conclusion of sections 2 and 3

ELIA is working – with support of external providers – on the development of two separate and dedicated storm forecasting models to have access to the most accurate information possible. These forecasts will serve as trigger (from day-ahead) for the application of two distinct operational procedures: the standard procedure and the fall-back procedure.

[10] http://www.elia.be/en/about-elia/publications/Public-Consultation/Archives/New-eu-guideline-compliant-approach-for-the-coordination

[11] http://www.elia.be/en/about-elia/publications/Public-Consultation/20190212_Public-consultation-tariff-proposal-for-the-period-2020-2023

These procedures are based on existing regulations and current market organisation. Three market parties play a role in their application: the scheduling agent, the balance responsible party and the outage planning agent. However, as long as ICAROS project is not implemented, these 3 roles are held by the Balance Responsible Party.

In this way, the balance responsible parties have the obligation to consider storm event when balancing their position in day-ahead and intraday and will inform ELIA about the foreseen mitigation measures to compensate the expected impact of the cut-out of offshore production because of the storm event.

In parallel, outage planning (and Pmax) and schedules must be adapted to reflect the impact of the storm event.) These amendments require ELIA's approval and a dedicated monitoring and penalties (as foreseen in design notes ICAROS) will be applied to make sure theyare respected.

Finally, as no additional reserves are contracted to cover the cut-out effect of a storm event and considering the potential impact above 2 GW once the entire offshore installed capacity is effectively there (2020), ELIA foresees a specific "fall-back" procedure to be applied as last resort and relies on an adapted imbalance tariff formula to make sure right incentives are provided to BRPs in such situations.

4. Standard procedure

The standard procedure is the core of ELIA's answer to offshore integration problematic. It starts from the moment a storm is detected and consists in 5 steps. For each of these steps, the distinction between ELIA's actions and expected actions from market parties is made to better understand each one's roles and responsibilities.

The key objective of this procedure is to perform – based on the information made available by the storm forecast supplier and the BRPs – a residual storm impact assessment which will support any decision to launch the fall back procedure detailed in section 5.

Finally, 4 examples are given to illustrate concrete application of the standard procedure.

The structure of this section is illustrated in the figure 3 below and will be reminded at each step to facilitate the reader's understanding.

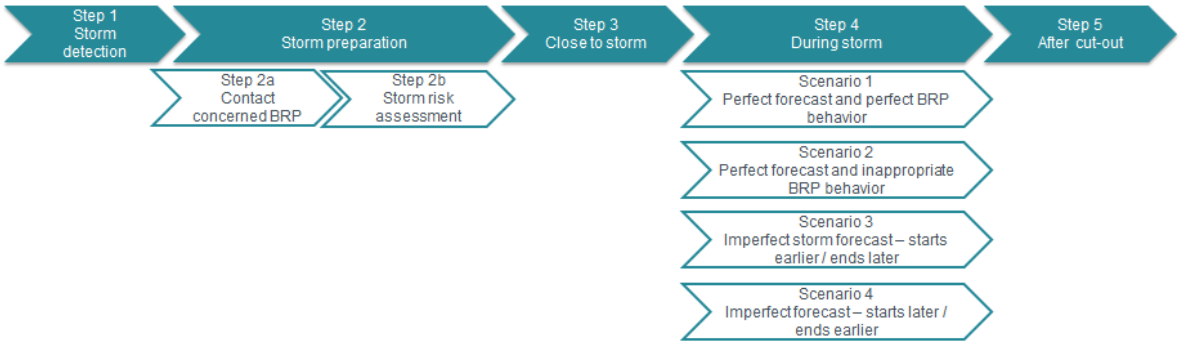


Figure 3 – structure of standard procedure

Important remark

As already explained in this document, ELIA will adjust – whenever needed – the operational processes described in those sections based on experience gathered once the storm forecast tools and the operational processes are functional.

4.1. Step 1 - storm detection

The first step of the standard procedure starts from the moment the storm risk is detected via the storm forecasts in the next 36h. Actions from both ELIA and BRPs are summarized in this section.

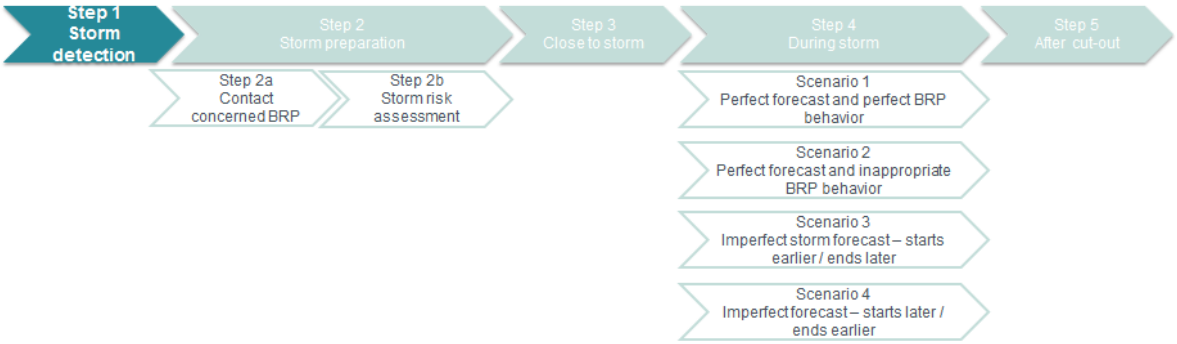


Figure 4 – structure of standard procedure

4.1.1. ELIA's actions

As detailed in section 2 above, ELIA will have access to accurate storm forecasts (with hourly updates) coming from two distinct external suppliers. These forecasts will provide information on expected impact per wind park (in MW) as well as timing (hh:mm) of both cut out and cut in phase.

As soon as **a storm risk[12] is detected for one (or several) offshore wind parks** in the next 36h ELIA will **publish for information a storm alert on its website[13]**and via a RSS feed. The total impact of the storm per quarter-hour and the timings of the event will be available in this publication.

On top of this automatic publication, a specific message is sent to the BRP responsible for offshore parks subject to the identified cut-out risk.

4.1.2. Impacted BRP's actions

In answer to ELIA's notification and based on its own data, the BRP's impacted by the identified cut-out risk will prepare its analysis to determine its most optimal solution to cover the identified risk.

It might happen that a BRP detects a storm risk - based on its own information - while ELIA has not notified any storm detection yet. In those situations, BRP takes contact with ELIA to share any relevant information (expected impact, timing...). Based on this data, ELIA will contact its storm forecast suppliers to confirm / infirm the storm risk situation and take appropriate actions if needed.

The *Figure 5* below illustrates all actions undertaken in the 1st step of this procedure.

[12] The detection of a storm event is performed according to the storm definition described in section 2.1.1

[13] The publication will only occur once the results of the test phase have been presented to market parties and integrated into operational processes accordingly (expected by S2 2019)

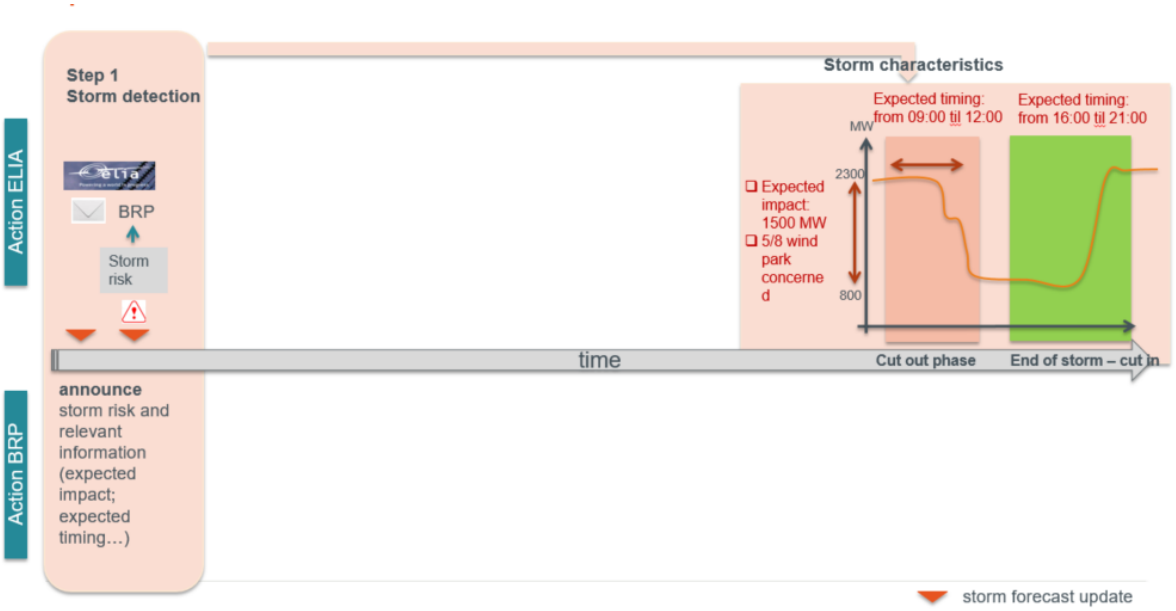


Figure 5 – 1st step of the standard procedure

4.2. Step 2 - before the storm

Between 24h and some hours before the identified storm[14], and if the total storm impact is larger than the available mFRR reserves, ELIA enters in the storm preparation phase and starts the storm mitigation process. It concretely consists in 2 sets of actions: contact the concerned BRP's (see section 4.2.1) and run a dedicated risk assessment based on the information collected from the BRP's (see section 4.2.2).

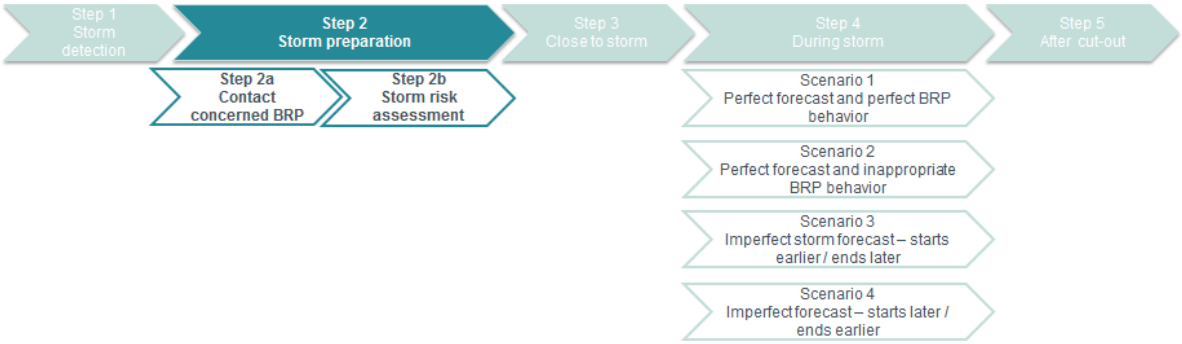


Figure 6 - structure of standard procedure

[14] At the time this design note is published, this timing is fixed at about 16h. This timing could evolve depending on the feedback from the application of the procedure.

4.2.1. Step 2.a: contact concerned BRPs

4.2.1.1. ELIA's actions

In addition to the warning sent as soon as a storm event is detected, **ELIA takes contact with the BRPs** responsible for offshore parks subject to storm risk[15] in order to:

A. **Confirm the occurrence** of storm event (compared to BRP's own forecasting model or additional source of information);

B. Gather information from the BRP on **its planned mitigation measure to cover the risk** to cause system imbalance because of an uncontrolled cut-out of the wind production for which he is responsible and;

C. **Gather information on the timing** of BRP's planned mitigation measures.

Important remark

A **specific interface** will be developed by ELIA to gather and centralize information related to these mitigation measures (timing; proposed solution ;...).

4.2.1.2. Impacted BRP's actions

The BRP has the legal responsibility to balance of its portfolio - which includes the offshore parks - and will bear a financial risk for any imbalance via the imbalance settlement. In terms of operational processes applicable to storm situation, this concretely signifies:

➔ BRP has the **freedom to select the solution** to cover the expected loss of MW of its offshore parks because of the coming storm. **ELIA will not impose one sort of mitigation measure** (a.o possible solutions: day ahead and intraday trades, HUB deals, flexibility from BRP's own portfolio...)

➔ BRP has the freedom to **determine by himself the timing** of its mitigation measures.

In this way, the only actions the BRP must do in this step are:

- To indicate via the dedicated interface as well as in the usual processes (if any) the information related to the chosen mitigation measures;
- To make sure the outage planning is adapted accordingly (status unavailable set for the storm period);
- To make sure the schedules are adapted accordingly and in line with the most recent outage planning.

As a BRP must be balanced it is expected that production schedules of the offshore parks will be modified in function of the mitigation measures. ELIA **must at least** see a modification

[15] The identification of offshore parks concerned by storm event is made automatically by the storm forecast provider as the model's output is delivered to ELIA per wind park and per quarter hour.

of the production schedule for the concerned parks in line with the announced mitigation measures. This must be introduced via the usual scheduling processes.

Important remark

First results provided by ELIA's storm forecast supplier show that storm events can be anticipated as of 36h ahead. This gives the opportunity to BRPs to cover the storm impact via day-ahead deals where price volatility is expected to be lower than on intraday markets.

4.2.1.3. Example

In the example below, storm forecast supplier provides the following information:

- A full **cut-out phase** is forecasted later on that day at 9 AM for an expected impact of **1500 MW**.
- The storm forecast concerns 2 BRPs ; which are responsible for 5 offshore parks:
  - BRP 1 is responsible for 900 MW and;
  - BRP 2 is responsible for 600 MW.

Following this first contact with ELIA, BRP1 proposes as mitigation measure flexibility from its own portfolio (as already mentioned in this document, other solutions can be proposed by the BRP's). In the meantime, BRP 2 decides to wait for the next forecast update before taking its decision.

ELIA receives therefore an updated schedule, in which (in yellow in the graph):

- A coordinated reduction of its offshore production to 0 MW as of 8 AM; valid for the forecasted storm event duration and;
- Updated production program to reflect the incremental compensation of 900 MW as of 8 AM.

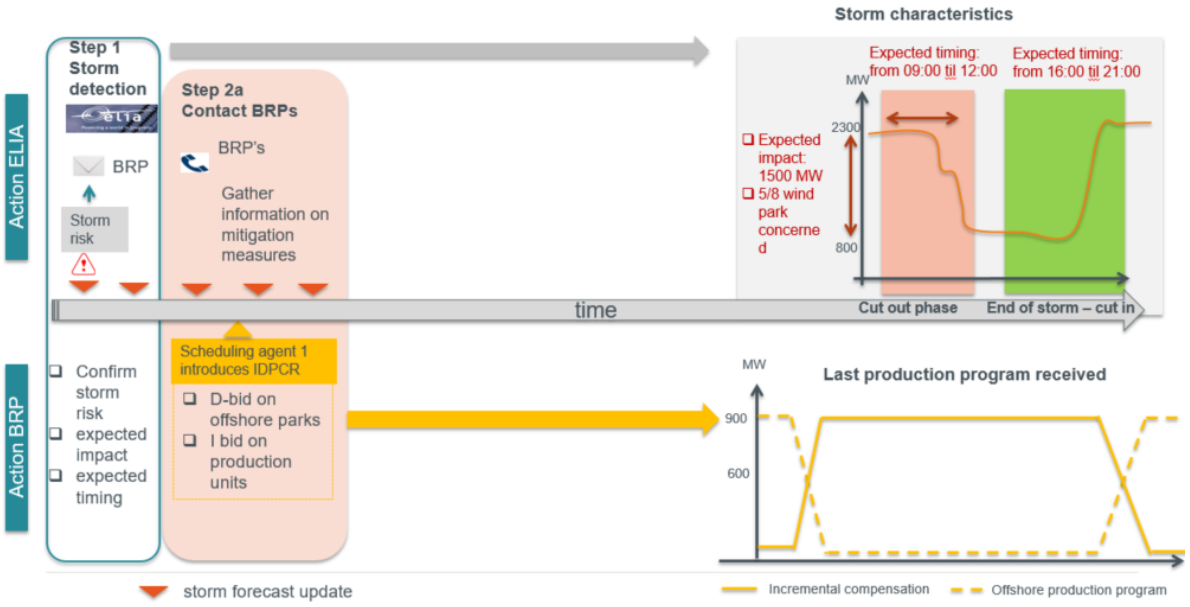


Figure 7 – example of step 2a of standard procedure

In parallel, the outage planning and/or available "Pmax" and schedules of the concerned wind parks are updated accordingly[16].

4.2.2. Step 2.b: storm risk assessment

4.2.2.1. ELIA's actions

In this step, no actions from BRP are expected. ELIA assesses the risk to have system imbalance caused by uncontrolled cut-out of wind production based on the following two source of information:

A. The **storm impact (MW)** per wind park and per quarter-hour provided by the storm forecast provider and;

B. Consecutive to the action undertaken as described in paragraph 4.2.1, the mitigation measures communicated by the BRP to ELIA.

The output obtained from this storm risk assessment is the residual storm impact risk and corresponds to the volume (MW) that can be lost and for which no mitigation measure has (have) been foreseen by the concerned BRP(s).

The storm risk assessment is automatically realized by ELIA each time an updated information is available (being an updated storm forecast or a new mitigation measure communicated by a BRP via the dedicated interface).

[16] In case a partial cut-out is detected, only the available "Pmax" and the schedules have to be adapted

4.2.2.2. Example

Going on with the example presented in section 4.2.1.3 above, the risk assessment realized by ELIA at that time will consist in:

- The consideration of expected storm impact (as provided by storm forecast providers): 1500 MW and;
- The analysis of the introduced mitigation measures of BRP 1; for a volume of 900 MW.

The residual storm risk corresponds to 600 MW (**in blue**)**,** being the production (concerned by the storm event) for which BRP 2 is responsible but has not announced mitigation measures yet.

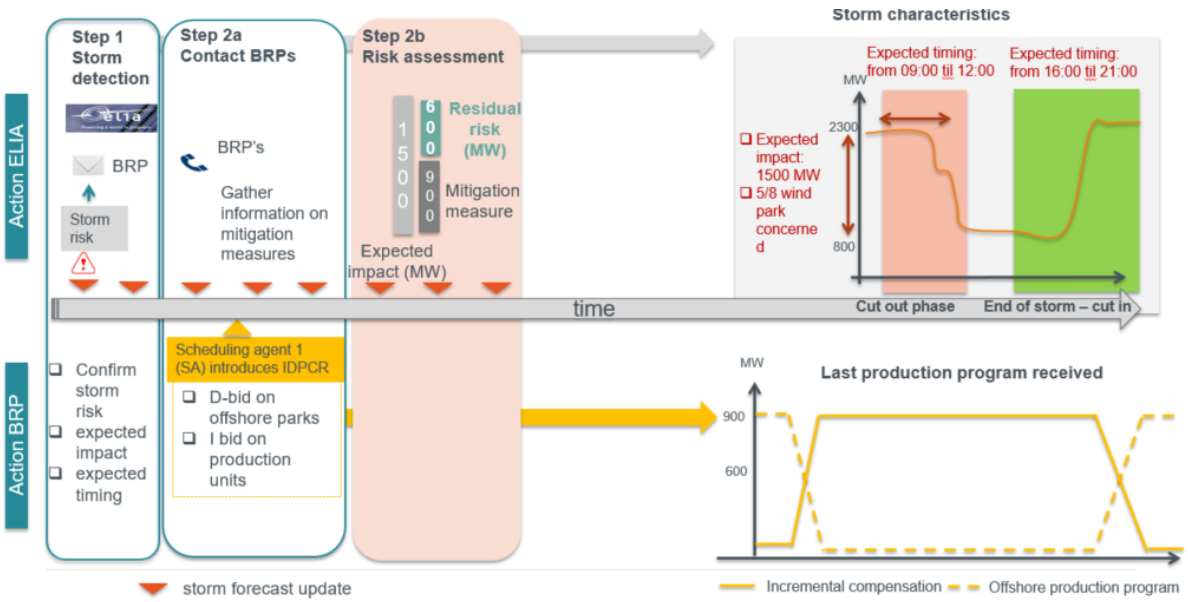


Figure 8 – example of step 2b of standard procedure

4.3. Step 3 - close to storm

This step summarizes additional actions organized by ELIA (and expected from the concerned BRPs) from the moment the storm event is expected, based on the most recent storm forecasts available, to begin in the coming hours. The logic is similar to the actions presented previously in step 2.

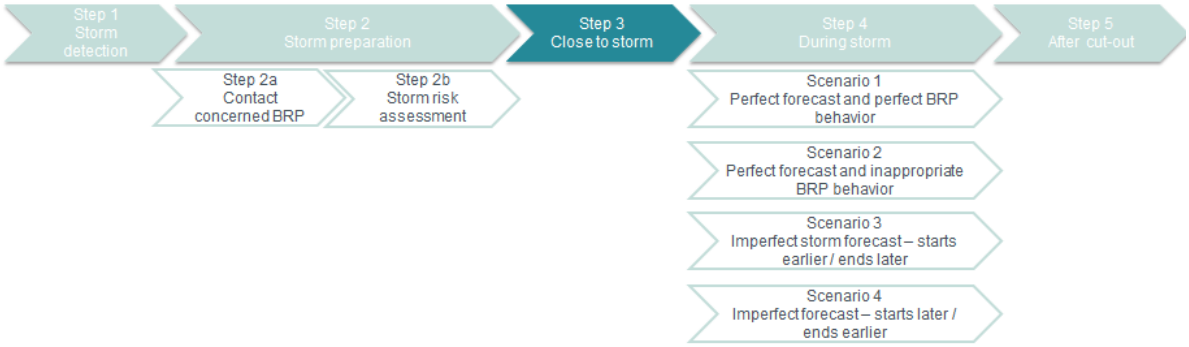


Figure 9 – structure of standard procedure

4.3.1. ELIA's actions

In this step, an **additional contact with BRP's** for which ELIA has not received mitigation measures yet and which are expected to cover the individual imbalance risk due to the storm event. This contact will happen – based on the information provided by the latest storm forecast made available – close to the expected start of the cut-out phase[17].

Consecutive to this additional contact; an **updated risk assessment** is performed by ELIA.

4.3.2. Impacted BRP's actions

In line with the possible actions from BRP described in second step of this standard procedure, the BRPs have the right to update their mitigation measure proposal to consider latest information provided by storm forecasts or recent evolution in their portfolio. These updates have to be communicated to Elia.

4.3.3. Example

Going on with the example initiated above in the document, ELIA observes:

- A confirmation of storm risk with the most recent storm forecasts received : no significant changes in expected impact (MW) nor timing are identified;
- Mitigations measures have been announced by BRP 1 to cover the 900 MW of offshore production which falls under his balancing responsibility ;
- No actions have been taken yet by BRP 2, responsible for 600 MW.

Consequently, ELIA contacts BRP 2 to discuss about his mitigation measures. Consecutive to this exchange, BRP 2 introduces an updated schedule for the 600 MW of offshore production he is responsible for. Finally, the outage planning and/or the "Pmax" available and schedules are modified accordingly.

[17] The exact timing is dependent on technical characteristics of available solutions (a.o : slow start units) in case an ex-ante action is required from ELIA (see following section for more information) but will happen at least 4h before the storm event. The last call for mitigation measures could occur 30 min before starting ex-ante actions.

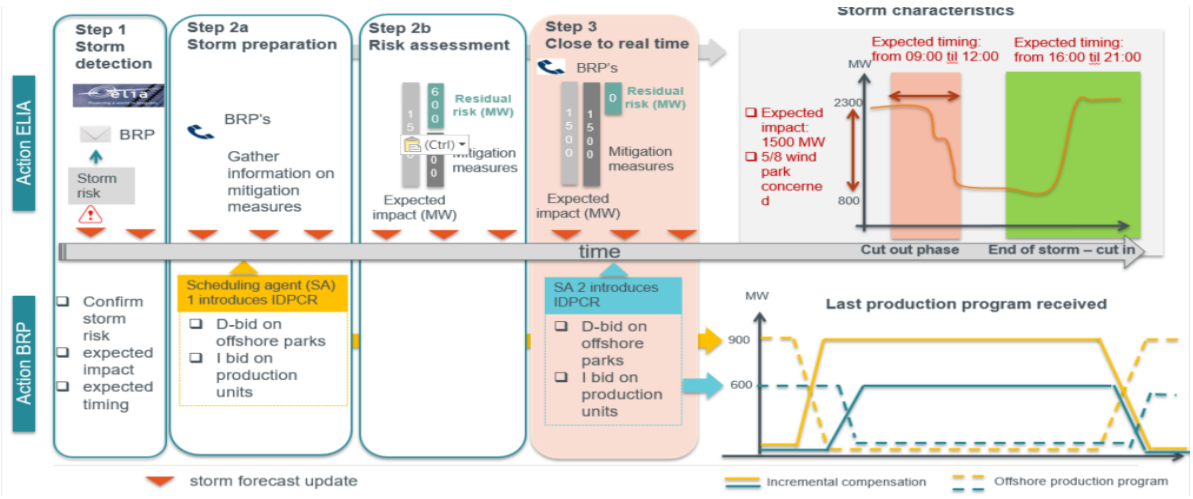


Figure 10 – illustration of actions required during step 3 of standard procedure

4.4. Step 4: during storm

To efficiently explain the possible actions during the storm event, several scenarios are elaborated to cover the most realistic possibilities (due to the possible errors in storm forecasts or imperfect BRP's behaviour) and clarify roles and responsibilities of each market party for each situation.

Two dimensions are studied in each scenario: storm forecast uncertainty and BRP's behaviour.

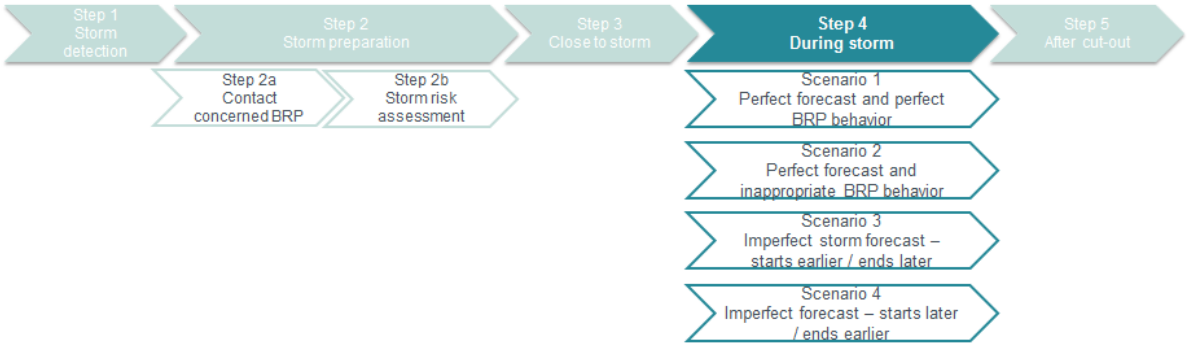


Figure 11 – structure of standard procedure

Important Note

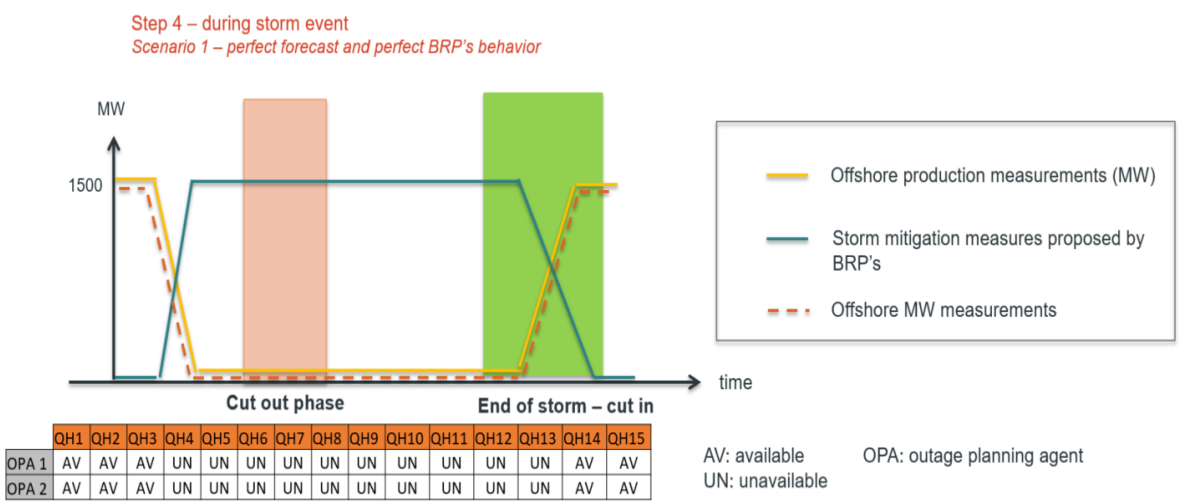
In these scenarios, a full-cut-out of the wind parks is considered requiring a change of the outage planning status. In case of partial cut-out, only the "Pmax" available and the schedules have to be adapted.

4.4.1. Scenario 1 - perfect storm forecast and perfect BRP's behaviour

Scenario's description

The storm event is detected several hours in advance (in DA or ID) and confirmed by each hourly forecast update. In reaction to the identified cut-out risk, the concerned BRP's (BRP1 and BRP2) have communicated mitigation measures to ELIA, covering both the expected impact (MW) and timing (HH:MM) of the storm event, and adapted their outage planning and schedules accordingly.

As illustrated below, in this configuration both BRP's will coordinate the offshore wind park power reduction with adequate mitigation measures (DA/ID deals, bilateral trades, modifications of production program…) and make sure the outage planning and schedules are adapted accordingly (with status "unavailable" for the entire storm duration and schedules at 0 MW). By doing so, **no imbalance will be caused** by the storm event and therefore **no specific actions are expected from ELIA** in real time.



	QH1	QH2	QH3	QH4	QH5	QH6	QH7	QH8	QH9	QH10	QH11	QH12	QH13	QH14	QH15
OPA 1	AV	AV	AV	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	AV	AV
OPA 2	AV	AV	AV	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	AV	AV

Figure 12 – Example of scenario 1

4.4.2. Scenario 2 – perfect storm forecast and inappropriate BRP's behaviour

Scenario's description

The storm event is detected several hours in advance (DA or ID) and confirmed by each hourly forecast update. However, BRP2 decides – based on his own information – that the identified storm risk will not impact the offshore parks for which he is responsible.

NB: actions described hereunder are the same for a scenario where a storm is not forecasted.

In this configuration, the offshore production is proactively reduced by 900 MW (responsibility of BRP1) and compensated by mitigation measures (action 1 in the example below). Consequently, the outage planning and the schedules are adapted to reflect the storm (status unavailable).

The residual storm impact risk corresponds therefore to the 600 MW of BRP2; for which no mitigation measure has been foreseen.

In real time; ELIA observes an effective cut out of BRP2's offshore production caused by the storm event (action 2 in the *Figure 13* below). As **a consequence the system imbalance is impacted in real time and actions from ELIA are required**.

4.4.2.1. ELIA's actions

ELIA will activate its available balancing means – respecting the usual activation merit order – to resolve or reduce the observed system imbalance.

In parallel to these activations ELIA may use its right to activate units unable to deliver the required power within 15 minutes or subject to technical constraints as foreseen in the Balancing rules (see section 3.1.4) and in ELIA's LFC Bloc operational agreement proposal.

Indeed, ELIA's operational need in such example is to desaturate the activated balancing means and by doing so to make sure enough reserve remains available to cover the imbalance risks for which they are dimensioned (e.g: outage of nuclear unit).

This is illustrated in the example below (action 3) with the activation of slow start units, whose technical constraints (start-up time, Pmin…) have been taken into account by ELIA in the activation decision. These real time activations will set the imbalance tariff following the usual procedures.

Finally, if new outage planning and schedules have not been provided by the relevant parties, ELIA will update the outage planning of the concerned wind parks to consider them as "unavailable" for the rest of the day and the schedules have to be set to 0 MW for the same period of time.

4.4.2.2. Impacted BRP's actions

No actions are required from BRP1 in real time as he already reduced its offshore production and neutralized the effect with incremental capacity before the start of the storm event cut-out phase while the outage planning and schedules were updated accordingly.

On the contrary, BRP 2 did not initiate preventive action as he believed the storm event would not influence the wind production for which he is responsible. **As a consequence, BRP2 will be in imbalance from the moment the 600 MW offshore parks cut-out** (action 2 in the example below) **and exposed to the imbalance tariff**. In this example, BRP 2 will therefore be subject to significant financial penalties.

Furthermore, if new outage planning and schedules have not been provided by the relevant parties, ELIA will adapt the outage planning of the concerned wind park(s) and consider them as "unavailable" for storm reasons for the end of the day. Consequently, the schedules have to be adapted to 0 MW in correspondence to the real time situation.

An outage planning amendment needs to be sent to ELIA, setting the status back to “available” after the storm. Once it has been approved, the schedules need to be adjusted accordingly if the offshore park is planned to restart production.

Consecutive to this approval; ELIA can coordinate the end of the activation of the slow start unit with the come back to full production of the offshore parks to make sure system imbalance is not affected (action 5 in the example below).

On the contrary, if an outage planning amendment and new schedules have been sent to Elia directly after the cut-out occurs (as required by the Federal Grid Code), these updates are subject to ELIA’s approval in order to safely coordinate the cut-in phase as foreseen in Art. 252 of the Federal Grid Code. If required, Elia can impose a profile on the restart of the offshore production.

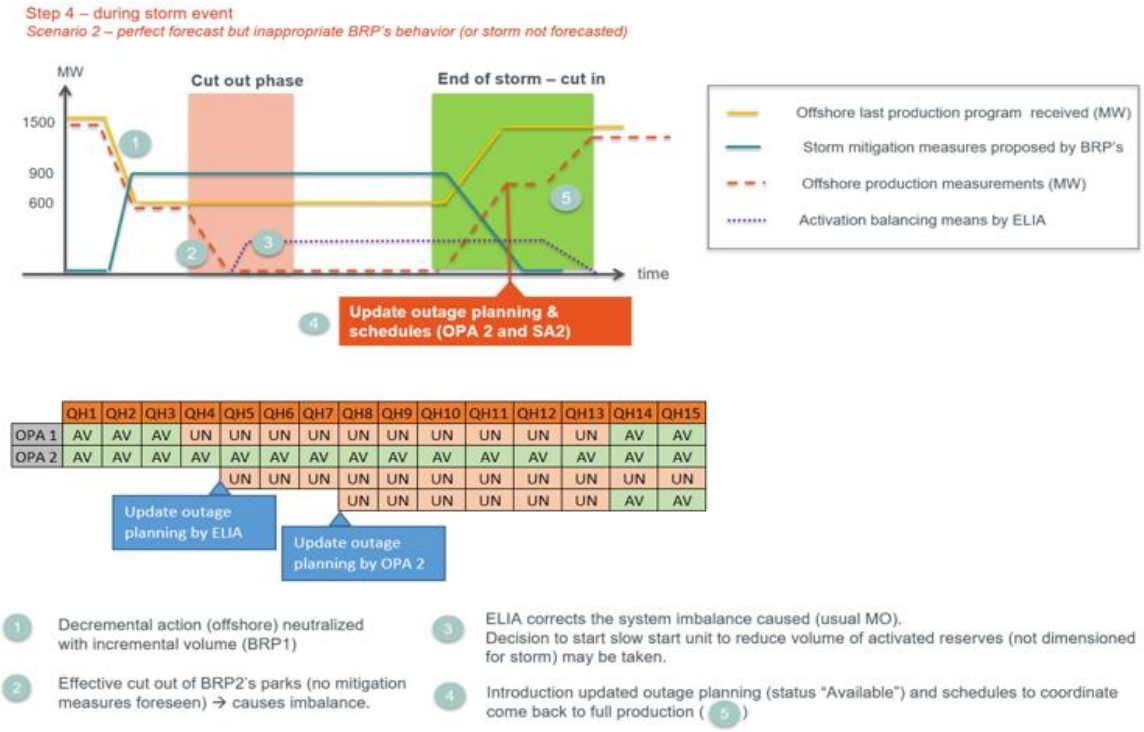


Figure 13 – Example of scenario 2

Important remark

In current general framework for tertiary control by CIPU technical units, the supplier gets the right to activate at his own expense all or some of the CIPU units made available as tertiary power control if the following criteria's are met simultaneously:

1) The activation is to compensate for active power that was lost as the result of a forced outage which occurred on another production unit for which the supplier is the BRP responsible;

2) The other resources of the supplier are exhausted at that moment and;

3) ELIA has granted permission.

This rule is not applicable to offshore storm events (forecasted or not) because of 2 major differences:

1) Offshore storm events are not considered as "Forced Outages" and

2) Tertiary reserve is not dimensioned to cover cut-out impact on system imbalance while outage of production units are taken into consideration.

4.4.3. Scenario 3 – imperfect storm forecasts – start later and / or ends later than expected

Scenario's description

The storm event is detected several hours in advance (DA/ID) and confirmed by each hourly forecast update. However, in real time ELIA observes a delayed start of the cut-out phase compared to its initial forecasts (irrespective of BRP's behaviour)

In this scenario, **no system imbalance is caused by the forecast error** as the production of both BRP 1 and BRP 2's parks have already been reduced (action 1 in the example below).

From the BRPs perspective, the consequences of this kind of error are the upholding of the offshore production to 0 MW as long as the storm is not over (based on the new forecasts received) and the taking of additional mitigation measures. In terms of operational processes, it is reflected with updated outage planning and schedules, as illustrated in the example below:

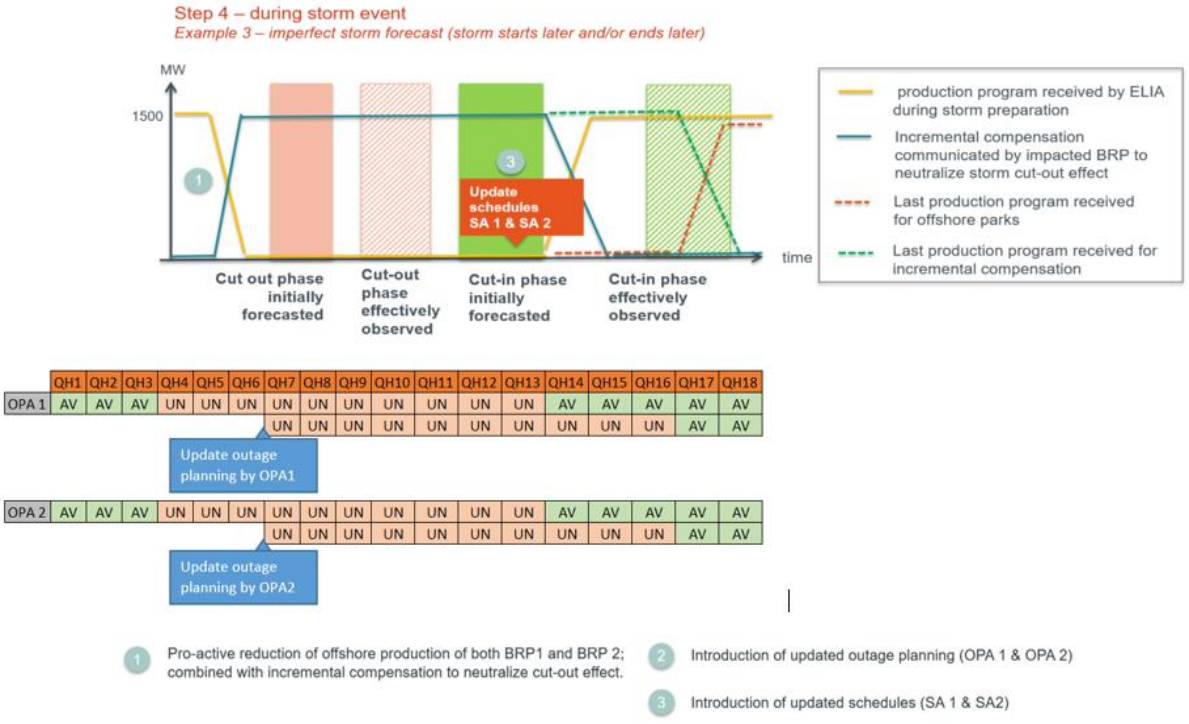


Figure 14 – Example of scenario 3

4.4.4. Scenario 4 – imperfect storm forecast – starts earlier and/or ends earlier than expected

Scenario's description

The storm event is detected several hours in advance (DA/ID) and confirmed by each hourly forecast update. However, ELIA observes in real time cut-out of wind parks before the forecasted start of cut-out phase, independently of BRP's behaviour.

In this configuration, BRP 1 and BRP 2 prepared the storm event with ELIA by introducing mitigation measures based on the expected timing of storm event's cut out phase (action 1 in the example below) and adapting outage planning and schedules accordingly.

In real time, ELIA observes cut-out of wind production before the forecasted timing (action 2 in the example below). As a consequence, it generates system imbalance while BRP1 and BRP2's position are in imbalance and therefore subject to imbalance tariff.

To solve this system imbalance, ELIA will apply the rules described above in section 4.4.2.1.

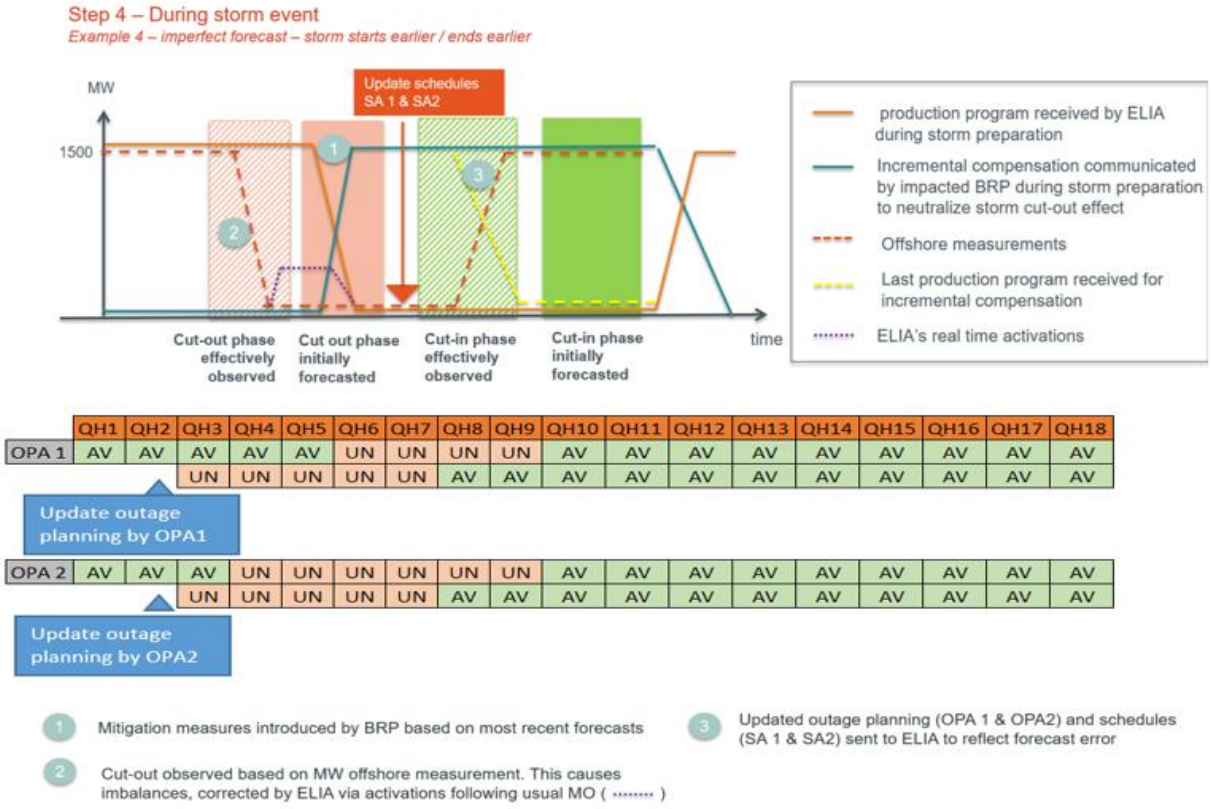


Figure 15 – Example of scenario 4

Important remarks

1) In this example, ELIA will probably not start slow start units as the BRPs have indicated mitigation actions on offshore parks and as those measures are reflected in the last validated schedules.

2) As already mentioned in this document and just like other publications regarding forecasting ELIA cannot be held responsible for the published data (accuracy, forecast errors, temporary failure of the publication tool,…). In the framework of its legal obligation to be balanced, BRP should develop their own tools and processes.

4.4.5. Additional clarification – temporary come back

In the "offshore integration study" realized by ELIA and 3^E in 2018, a specific phenomenon was observed during the cut-out phase of some storm events: **the temporary come-back**. Triggered by a brief wind speed drop below the technical cut out of the wind turbines, it causes a temporary comeback to production (usually not the initial level before the storm event) before being cut-out again.

This phenomenon was observed for some wind parks in the storm event on 18/01/2018 illustrated in the graph below (each coloured line represents a wind park).

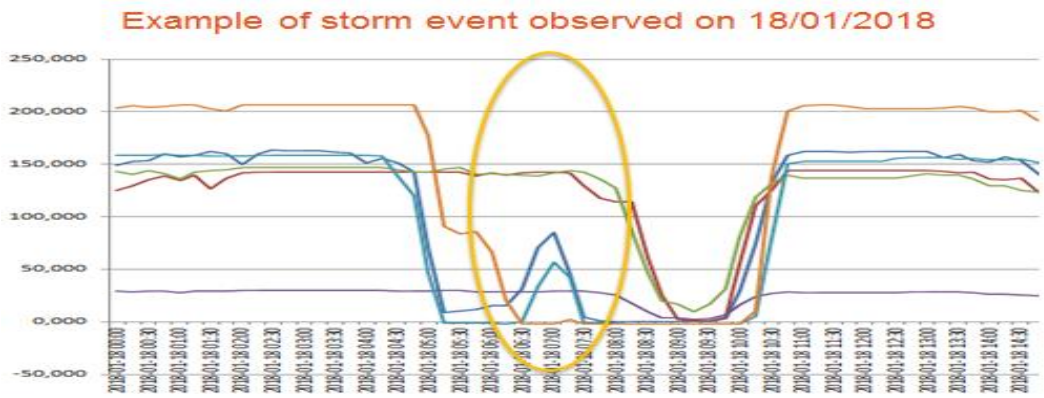


Figure 16 – Example of "temporary come back" phenomenon

These fluctuations are very difficult to predict. Therefore, the BRP will have limited possibilities to neutralize their impact and ELIA will have to resolve in real time the system imbalance it will cause (in both upward and downward directions) while the BRP will be penalized via the imbalance tariff.

In application of principles detailed this document**,** ELIA imposes the respect of last schedule introduced to ELIA. If those fluctuations were not forecasted and reflected in those schedules, offshore production will remain cut-out (partially or totally) for the entire storm duration.

4.5. Step 5 - after cut-out phase (cut in phase)

The cut-in phase is characterized by the comeback of offshore production to production level similar to those measured before the storm occurrence. Similar to the cut-out phase, the cut-in phase can significantly influence the system imbalance if not coordinated appropriately.

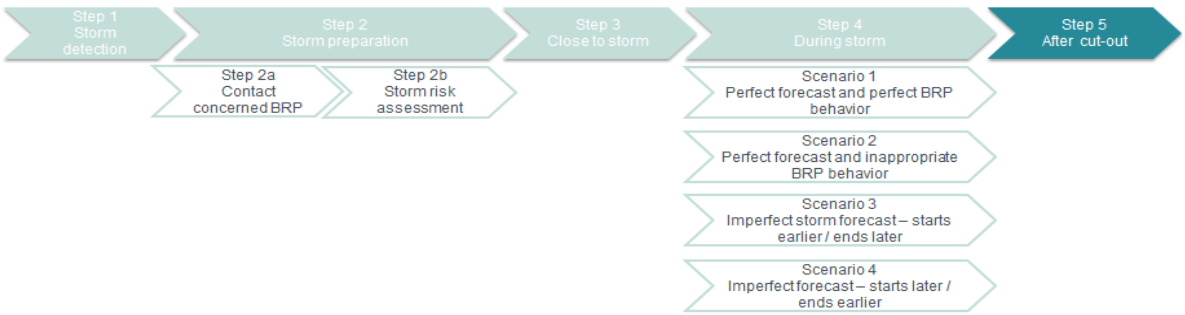


Figure 17 – structure of standard procedure

In this way, ELIA expects from its offshore BRP that their mitigation measures also cover the cut-in phase. Based on scenarios presented in section 4.4, two specific situations are distinguished below: the ones which did not require ELIA's actions in real time and those in which ELIA activated balancing means.

4.5.1. No actions from ELIA triggered in real time

This situation corresponds to scenarios 1 and 3 presented in section above. In those scenarios, **no system imbalance is caused by the storm event** as the impacted market parties have introduced and applied appropriate mitigation measures.

Those introduced mitigation measures also cover the cut-in phase as the BRPs need – to maintain their position balanced and avoid exposure to imbalance tariff - to coordinate the comeback to full production of offshore parks along with the end of the storm-related incremental actions. In this way, **the last schedule received and validated by ELIA indicates the moment the offshore production is planned to produce again.**

No additional actions are expected from ELIA in those scenarios.

4.5.2. Actions taken by ELIA in real time

This situation corresponds to scenarios 2 and 4 presented in section above. In those scenarios, because of inappropriate actions from BRP (scenario 2) or forecast errors (scenario 4), system imbalance is caused by the storm event. As a consequence, ELIA activated balancing means while updating the related outage planning to “unavailable” (with the schedule to 0 MW) for the rest of the day. **The end of activation of those means must therefore be coordinated with the offshore production’s comeback**. To do so, ELIA must receive and validate updated outage planning and schedules. These will be used as reference to coordinate the end of the ELIA’s activated means (including the possible use of slow start units as described earlier in this document).

4.5.3. End of storm event

Once ELIA receives the confirmation that the storm event is over (via the storm forecast tools), the information is officially notified to market parties (via ELIA’s website). All storm related obligations are suspended at that time.

5. Fall-back procedure

The operational procedure described in section 4 is organized around the BRP's balancing responsibility. Indeed, starting from the statement that a majority of storm events can be anticipated in day-ahead and forecasted in intraday, it was concluded that the BRP can take actions to neutralize the expected loss of production caused by the storm event cut out phase (mitigations measures).

In parallel and as described in section 2 and 3, ELIA is working – with the help of external suppliers – on the elaboration of dedicated storm forecast tools to support storm related operational decision. These forecasts will also be shared by ELIA on its website and made accessible to market parties. Finally, financial incentives (a.o the imbalance tariff formula) and operational procedures are being reinforced to make sure the adequate tools and incentives are implemented and applicable to concerned market parties.

However - independent of the incentives implemented by ELIA and based on the information gather via the procedure described in section 4 above – ELIA can face situations where the outcome of the residual storm impact assessment is significantly higher than the volume of available mFRR balancing means for the concerned delivery period(s). Operationally, this is a risk ELIA cannot accept. In such circumstances, ELIA may therefore decide to apply the "fall-back" procedure described in the section hereunder.

5.1. Trigger criteria of the fall-back procedure

The fall-back procedure frames the possible actions (and under which conditions) ELIA may take **before the start of the cut-out storm event**. By initiating these ex-ante actions, ELIA ambitions **to increase balancing means activable within 15 minutes in order to match the residual storm risk for the concerned delivery period.**

By doing so ELIA makes sure t**he potential impact on system imbalance is limited to a volume manageable in real time with the available mFRR balancing means.**

Electricity Balancing Guidelines (art. 32) lists 3 possibilities of mFRR balancing means:

- Non-contracted balancing energy (free bids);
- Sharing agreements;
- Balancing energy resulting from contracted capacity obligations (reserves).

For each one, ELIA will consider – based on the information available at the time of the risk assessment – their expected availability. For example, if R3 flex was just activated when the storm impact assessment is done, ELIA will consider for the neutralization time the related volume "unavailable".

The illustration below summarizes the trigger's criteria of the ex-ante procedure:

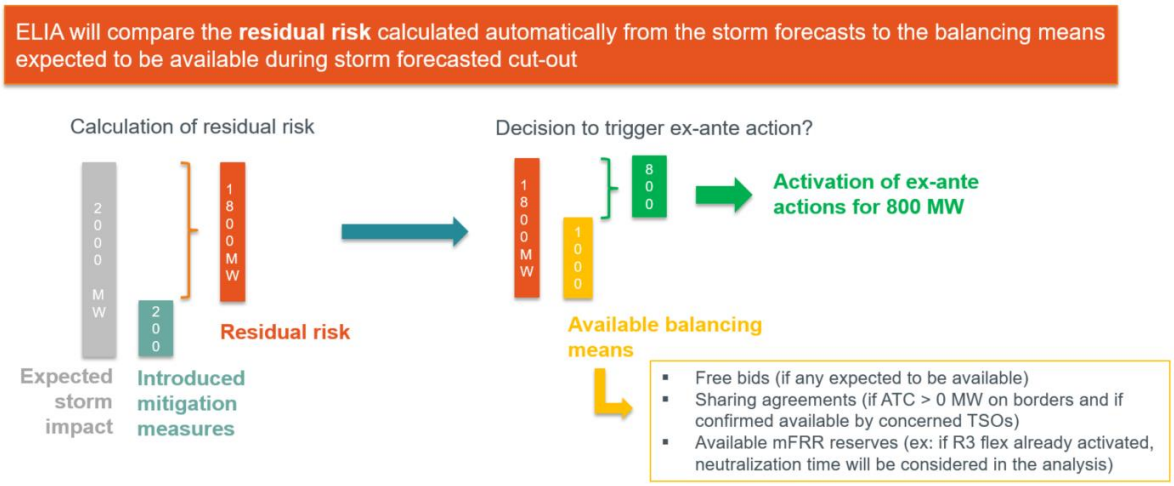


Figure 18 – activation criteria's of ex-ante actions in application of fall-back procedure

Important remarks

ELIA will only take the decision to initiate ex-ante actions if no sufficient mitigation measures have been communicated by the BRPs in answer to an identified storm risk.

As mentioned in article 5 of LFC Bloc Operational agreement, each ex-ante action triggered by ELIA in application of this fall-back procedure will be subject to an ex-post analysis with a specific report submitted to regulator within 30 days.

5.2. Timing and additional actions of fall-back procedure

The decision to trigger the fall-back procedure is taken at the third step of the standard procedure described above. At that time, based on the latest information available, the storm impact risk assessment is updated and used as input to take the decision to activate ex ante actions (according to the criteria's described above).

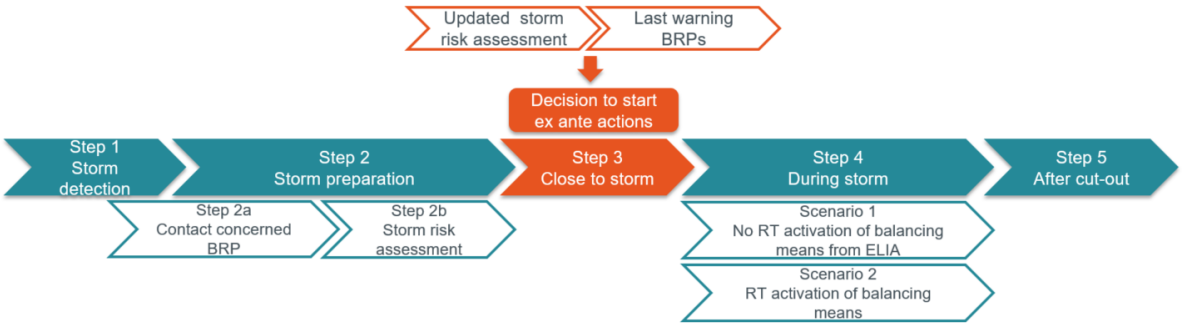


Figure 19 – Fall-back procedure

5.2.1. Third step – close to storm

In the third step of the procedure (close to storm), 2 specific actions are foreseen and illustrated in the example below:

1) ELIA updates its risk assessment based on most recent information available. 2 sources of information are used as input of the risk assessment: the expected impact (MW) provided by the storm forecasts and the mitigation measures announced by the concerned BRPs (if any).

   In some situation, the **residual storm impact risk** remains higher than the available balancing means. If no additional actions are taken by responsible BRPs, **Elia might start ex-ante slow starting units in order to mitigate this risk.**

   Consecutive to this updated risk assessment, ELIA contacts once more the concerned BRPs to announce the risk assessment results, being a need for ELIA to take preventive actions for a dedicated volume (in the example below : 500 MW). By doing so, ELIA gives the BRP a clear signal and a **last chance to introduce an updated version of its mitigation measures in the relevant tools.**

2) As a next step, ELIA will run an ultimate risk assessment in which – consecutive to the warning signal communicated to concerned BRPs – last updated mitigation measures (if any) are included. If the need to initiate the fallback procedure is confirmed, ELIA starts immediately after its activation.

3) Finally, as already foreseen in current procedures, ELIA will publish a balancing warning on its website.

Important remark

The exact timing around the step 3 of the procedure (a.o: how close to real time can ELIA wait before initiating the actions of these step) is dependent on technical characteristics of available solutions (e.g: if only slow start units which take 6 hours to start are available)but will happen at least 4h before the storm event. The last call for mitigation measures could occur 30 min before starting ex-ante actions.

5.2.2. Example

Starting again with the example presented in section 4 of the document:

- ELIA detects a storm risk (**step 1)** with an impact of 1500 MW impact;
- After a first contact with concerned BRPs, no mitigation measures are introduced as they believe the risk detected does not concern the offshore parks for which they are responsible **(step 2a).**
- The risk assessment gives a residual risk **(step 2b)** of 1500 MW;
- The expected available balancing means for the concerned period is 1000 MW;
- In step 3; ELIA runs an updated risk assessment. The results are identical to the one realized previously and confirm the **need for ELIA to take ex-ante actions for 500 MW** (difference between storm impact of 1500 MW and mFRR need of 1000 MW).

- ELIA takes another contact with BRPs to inform them on the risk assessment results and give them one last chance to update their mitigation measures **(action 1 in step 3)**;
- ELIA does a final risk assessment (latest moment possible before start of storm cut-out) which confirms (no additional action introduced by BRPs) the need to trigger ex-ante actions for 500 MW **(action 2 in step 3).**

➔ **ELIA initiates ex-ante actions following procedure described in section 5.3 below.**

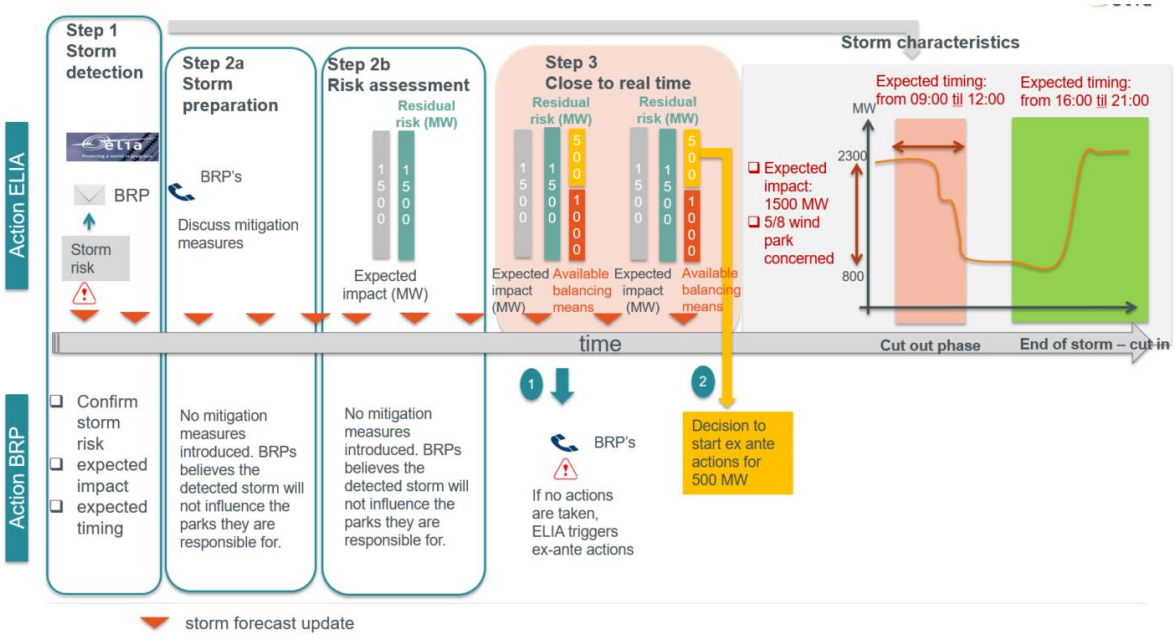


Figure 20 – example of decision to trigger ex-ante actions

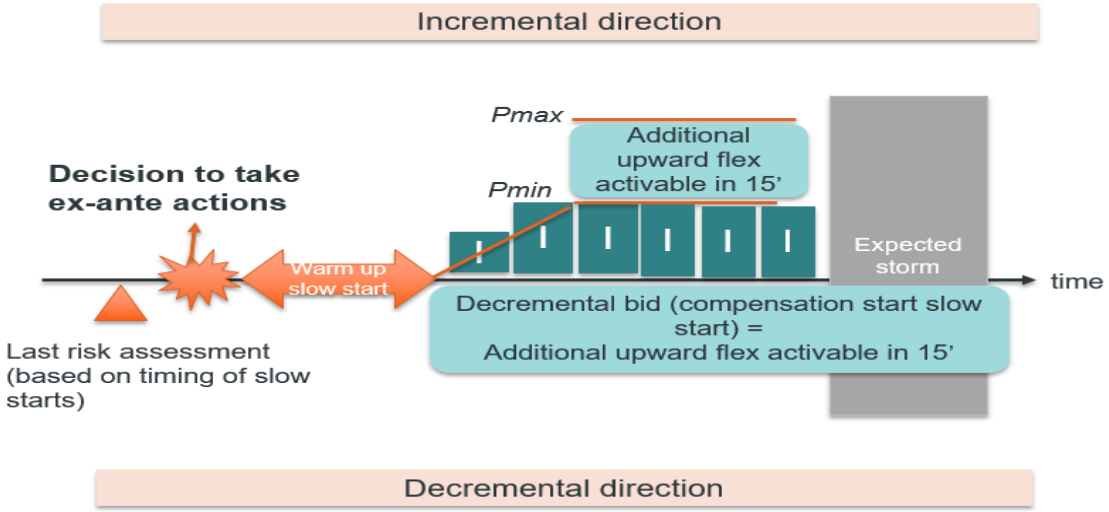
5.3. Ex-ante activation process

Once the decision to activate ex-ante is taken by ELIA, the activation process is initiated. It consists in:

- **Incremental activations on flexibility which cannot be activated within balancing time frame of 15 minutes (e.g:** start of slow start units)

- **Decremental bids** following the usual balancing merit order and;

The example below illustrates the activation of ex-ante solution by ELIA in application of fall-back procedure described in this section.



5.4. Settlement of fall-back mechanism

As soon as ELIA initiates ex-ante actions, costs for both the decremental and the incremental activations are generated. In this section, ELIA clarifies the settlement principles related to the fall-back mechanism.

1) Cost of ex-ante actions are not considered in the set-up of the tariff imbalance;
2) BRP's perimeters are corrected to avoid an impact on their balancing position because of ELIA's activation;
3) Costs of ex-ante actions are covered by the imbalance margin. These costs are expected to be limited as:
    a. The volume concerned by ELIA's ex-ante actions is limited to the difference between the residual storm risk and the available balancing means;
    b. The number of QH during which ELIA activates these volumes in both directions is limited as ELIA will wait the closest possible to real-time (taking into consideration technical characteristics such as warm up time of available slow start units as well as the accuracy of storm forecasts) before triggering the ex-ante procedure;
    c. ELIA takes ex-ante actions in a context of forecasted storm event where BRP's have not taken enough mitigation measures. As a consequence, significant imbalances are expected in real-time (at storm occurrence). As the fall back mechanism is only used to deal with the imbalance risk not covered by available reserves, it is expected that ELIA will still activate significant volume of balancing means during the normal balancing procedure in real time. This will bring the imbalance tariff to a very high level as expensive means will be activated and provide the right incentive for BRP's to take preventive mitigation measures.

6. Conclusion

By 2020, ELIA expects a significant increase of the Belgian offshore wind production. In this way - once all offshore parks will be fully operational - the total installed capacity will reach 2300 MW. Over the last years ELIA observed a common behaviour of these parks in front of a storm event, the only difference coming from their technical characteristics (wind speed cut-out). This is explained by their geographical localisation and introduces a new risk – if not managed properly - to cause significant impact on the system imbalance.

In answer to this identified risk, ELIA proposed – based on the conclusions of the dedicated study realized in 2017 with the help of 3^E – an action plan built around 2 axes: the development and implementation of dedicated storm forecast models and the elaboration of specific operational processes applicable from the moment a storm is detected.

Regarding the storm forecast models, 2 external suppliers have been selected by ELIA to implement and develop a tailor-made model; taking into consideration all available and relevant information (wind turbine technical characteristics, geographical localisation, height of the turbine, wind speed measurements…).

In this way, ELIA will receive as output of these models the estimated impact (in MW) per quarter hour and per wind park; for a period of 48 hours and updated each hour. In addition to these; information on each phase timing (cut-out and cut-in) will also be provided. **These data will trigger ELIA's two operational processes (standard procedure and fall-back procedure) dedicated to storm management**.

The **standard procedure** is based on the BRP's responsibility and obligation to include forecasted storm events in the balancing of their perimeter from the moment the storm is detected. Furthermore, seen their potential impact, BRPs are obliged to inform ELIA about the solutions they foresee to neutralize the cut-out impact and avoid causing imbalances.

ELIA does not impose a specific solution to cover storm risk. It is up to the BRP to determine by himself the most optimal proposal and the timing for its application. However, ELIA reinforces and extends existing principles to make sure the right incentives are implemented and cover storm situations.

Looking at 2020 offshore installed capacity and considering the fact that dimensioning's methodology does not include storm situation, a **fall-back procedure** (applicable as last resort) is elaborated by ELIA to frame possible ex-ante actions aiming at reducing the detected balancing risk in situations where BRPs do not foresee any mitigation plan.

The two storm related operational procedures can be summarized around the following key milestones:

1) M**arket parties are informed** (ELIA's website and ad hoc notification to concerned BRPs) from the moment a storm risk is detected;
2) Contacts with BRPs are taken to **confirm the problematic and gather information on BRP's identified solutions**;
3) A **storm risk impact assessment** is realized as soon as updated information (from forecast tools and/or BRPs) is made available to ELIA. The risk assessment's output

(the residual risk) corresponds to the possible impact of storm event on system imbalance;

4) In the specific situation where the residual risk exceeds the volume of available balancing means, **ex ante actions may be triggered by ELIA** to increase the volume of flexibility activable within 15 minutes and by doing so making sure it matches the residual storm risk;

   These ex ante activations from ELIA must be seen as “last resort” measures and will only be used in exceptional circumstances;

5) In every other situation, ELIA waits for the storm to occur in reality, solves imbalances by activating usual means and might applies additional actions to restore activated means (e.g activation of slow start units);

6) Finally, ELIA notifies market parties as soon as the storm event is considered as over.