

**Memo to:**  
Mr. Matthew Magill, National Grid ESO

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**From:** DNVGL  
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## Executive Summary - Summer Operability Review

DNV GL has independently reviewed the precautions and actions taken by National Grid ESO (ESO) to ensure security of supply on the Great Britain (GB) electricity system for the summer 2020, taking into account the uncertainties caused directly and indirectly by the COVID-19 pandemic. The review has been focused on models, assumptions and calculations, processes and procedures, as well as on the substantiation of operational measures.

DNV GL has found ESO well prepared to meet a probable extremely low demand scenario, in combination with a high level of renewable generation and reduced traditional synchronous generation. By building on existing approaches and ways of working and thinking around the operability challenges to tackle the unprecedented COVID-19 scenario, ESO has and is able to react in an agile fashion and bring about an approach to deliver analysis and requirements for this extreme situation. To manage the situation ESO relies on effective and accurate tools for forecast, power system analysis and simulations; highly ranked commercial products as well as inhouse developed applications and methodologies. The 'Obeya' process has been established to ensure efficient work processes and flows of information, which is unique among European TSOs.

To further increase system flexibility, an additional service for reducing embedded generation output has been introduced together with an increased margin of negative reserves. Also, an agreement has been made with the largest unit to reduce its power output. To ensure the transparent mitigation of identified & unidentified risks, ESO has established effective communication channels with stakeholders, such as TOs, DNOs, providers, and industry, with frequent information exchange and weekly webinars.

An international comparison with other TSOs, and against Cigré assessments of COVID-19 impacts has also been conducted with ESO being found to be aligned with best practice, and far ahead of most TSOs in their work of preparing for the extremely low demand levels caused by Covid-19, in combination with high levels of renewable generation.

Whilst a small number of areas for improvement have been identified, DNV GL's review has highlighted no 'red flags' that would impact ESO's ability to maintain security of supply and/or system operability.

To the best of DNV GL's knowledge, based on our role as outlined above, including independent review and analysis of underlying data, tool, and methodologies, combined with in-depth interviews, we believe that the preparation and precautions taken by ESO are diligent and robust. We therefore support the strategy and procedures applied to adequately operate the GB power system throughout the coming low demand summer period, significantly affected by the COVID-19 situation.

## Review context and approach

The COVID-19 pandemic has had an unprecedented impact on the electricity demand patterns on the GB electricity system. These historically low demand patterns have also coincided with periods of high renewable generation which has presented ESO with very significant challenges in operating the GB transmission system and ensuring security of supply. Indeed, through the period between April to June, it has had to take unprecedented actions to ensure the operability of the transmission system. ESO expects that these challenges will continue through the summer of 2020, and possibly beyond, with the increased likelihood of 'exceptional' days, characterised by low and uncertain demand forecasts, high levels of renewable generation, and many synchronous units that were not running due to market prices.

Although the GB electricity transmission system has been operating in a normal state, ESO wants to assure that the extraordinary measures it has taken to operate the transmission system during the exceptional period of the COVID-19 pandemic have been (and are) appropriate and proportionate.

DNV GL was engaged to undertake a third-party assurance of ESO's assumptions, analysis and processes during the COVID-19 period and a review of the tools used by ESO and the approaches that will be taken to operate the system during the forthcoming summer period.

The key areas that have formed the basis for the DNV GL review are:

- Models, assumptions and calculation results for all operational and system planning calculations related to the operation of the system.
- Process flows and logic steps taken by ESO in developing its assumptions and resulting actions.
- Operational procedures in emergency and blackout situations.
- Substantiation of the operational measures.
- Investigation of different low demand & challenging scenarios and mitigation approaches.

Below we present the key questions that have formed the basis for the DNV GL review with short summaries of our findings:

- *To what extent are the existing tools suitable for planning and operation of the power system during normal and exceptional conditions?*
  - The existing tools, models and methodologies have been found to be appropriate and effective for this extreme situation, since we are dealing with the same phenomena, however, at a different point of operation.
- *Are the balancing mechanism and associated balancing services, including new sources of flexibility, robust enough to cope with a situation characterised by a significant decrease in demand, a decrease in system inertia due to renewable generation, and the lack of a reliable overview of the embedded generation?*
  - New problems like lack of inertia and reactive power surplus are emerging at extreme situations. However, ESO has quickly recognized these challenges and expanded its mix of commercial and mandatory tools, which now can be considered appropriate to plan for the extreme situations and to act in even worse situations.
- *Is the range of balancing tools the control room has at its disposal good enough to handle low demand period in the summer?*
  - The balancing tools have been found to be appropriate.
- *To what extent do the COVID-19 measures influence the quality of the balancing services of service providers?*

- The balancing services of service providers is not found to be significantly influenced by the specific COVID-19 measures.
- *How certain is ESO that the Optional Downward Flexibility Management (ODFM), a newly developed balancing service, will turn out to be as effective as expected?*
  - The ODFM has been tested several times, the design is robust with respect to response, and we are confident that it is well designed and dimensioned for its purpose.
- *What precautionary measures have ESO taken to prevent a power outage, similar to that of August 2019, during the summer period?*
  - The response margins have been increased and actions are ongoing to ensure that large generation units comply with the fault-ride-through requirements.

To address these topics and questions, ESO has made available to DNV GL very significant amounts of written and analytical material to facilitate our review. We have also been given access to its key analytical tools. In addition, a large number of in-depth interviews have been carried out with ESO personnel representing key functions, from long term demand forecasting all the way into the control actions taken in real time at the control room.

An international comparison with other TSOs practices, and against Cigré assessment of COVID-19 impacts has also been conducted. It should be noted that in all instances, ESO management and staff have been open and forthcoming with information, which has contributed significantly to the review work.

## Key review findings

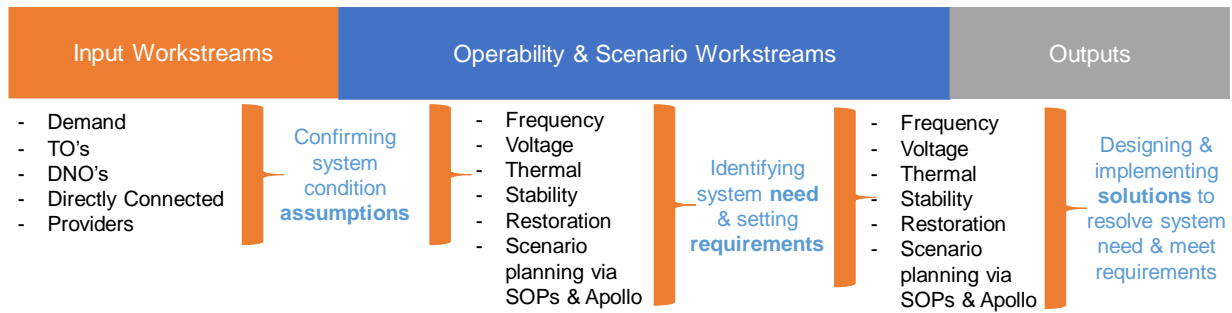
In the review of how the COVID-19 situation has affected the reliability of the GB power system, and its ability to robustly meet demand at adequate margins and reasonable costs, DNV GL has concluded that the COVID-19 situation has had a direct and material impact on demand.

### Organisation and process

COVID-19 has required an extraordinary approach from ESO to cope with an extremely low demand situation coupled with high renewable output and uncertainty regarding embedded generation output. Therefore, DNV GL focused on what ESO has done differently to 'business as usual' to ensure security of supply in the new scenario. DNV GL has noted that no organisational changes or modifications (in methodology or tools) have been made to specifically address the low demand situation caused by COVID-19 apart from the 'Obeya' to co-ordinate the work. The approach has been to include COVID-19 as an add-on condition to the normally applied tools and working practices.

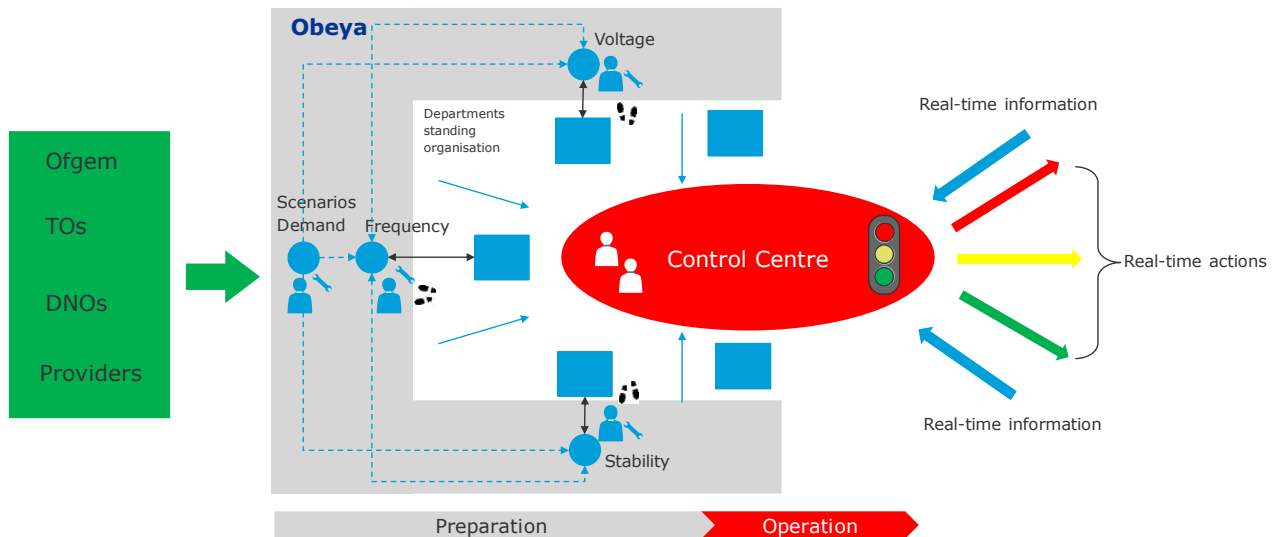
In addition to the standing organisation, ESO has created the Short Term Obeya (Obeya), which is designed to facilitate the interaction of experts from various ESO departments. The intention is close cooperation of those experts, not hindered by the walls that are a characteristic of departments within an organization. The integrated approach of the Obeya is designed to prevent sub-optimization in operations. DNV GL strongly supports this approach, which is in line with the strategy to use the same staff and tools during crises, as during normal conditions. This is a well proven and successful strategy.

Obeya has defined the following workflows for the purpose of its engagement (Figure 1): Frequency, Voltage, Thermal, Stability, Restoration, and Scenario planning.



**Figure 1** *Obeya's purpose: how to design and implement solutions to resolve system needs and meet requirements.<sup>1</sup>*

Figure 2 shows how DNV GL sees the interrelationship between these areas which have given their name to the corresponding Obeya workstreams.



**Figure 2** *How Obeya relates to operability*

DNV GL has identified a possible COVID-19 risk for the availability of key personnel involved in ESO's processes, i.e. the possibility of a critical person being incapacitated by the virus. In some areas we have identified a centralization of knowledge on single key individuals within ESO raising possible delays in delivering some aspects of the work, if they become unavailable for whatever reason (such as falling ill during the current pandemic).

### Operations and technical

DNV GL has focused the review on three of the Obeya workflows, Frequency, Voltage and Stability, to assess ESO's summer operability preparedness. The workflow Scenario Planning has also been considered due to its relevance to the current extreme system scenarios.

<sup>1</sup> The Obeya scheme has been provided by ESO

Having assessed these aspects, DNV GL considers that ESO has effectively addressed the key elements needed to ensure the operability of the power system through the summer of 2020 in which COVID-19 measures are likely to remain in place.

Models and tools used for operational planning: forecasting, power system analysis, scenarios analysis, frequency response and reserve analysis are a combination of well-established commercial software (such as DIGSILENT Power Factory) and in-house developed bespoke tools (such as Apollo and the Frequency Simulation Engine). The control room receives demand forecasts both from in-house developed tools and from a commercial tool. Further, forecasts are also adjusted based on historical data from days with similar characteristics, meaning decisions by the control room operators are made robustly. We also note that, when developing scenarios to prepare for what might come, tools which have recently been superseded by newer versions or new modelling products have been used to check and give confidence to the results. There are established procedures for specialists from different departments to look at the results provided from a tool or analyses and provide input that might have an impact.

In the Obeya process, results from analyses are distributed to various specialists in the organization to get their opinion. Numerous different tools are used throughout the process within the different workstreams. Several tools perform long term studies well in advance and hands over the outcomes to control room. Real-time studies or configurations for standard studies are performed regularly alongside ad-hoc analysis of specific situations that needs to be addressed. DNV GL's view is that ESO has the necessary means to undertake robust analysis and take well informed decision. ESO is also found to be aware of areas in which there may be potential to improve and has shown aptitude to continuously work towards better performance and higher efficiency.

Regarding the network capability effects arising from COVID-19, these are focused on voltage and reactive power issues associated with low demand and high levels of renewable embedded generation, while thermal aspects at low demand is not a characteristic issue.

DNV GL was also specifically asked by ESO to review ESO's assumptions concerning COVID-19 impacts on the Black Start system restoration service. Having reviewed the assumptions and arrangements for Black Start, we are content that the only effect from COVID-19 is the reduced number of service provider tests, due to travel restrictions.

### *Recent Operational Experience*

ESO continually monitors its forecasting performance, where outturn actual demand is compared with the forecast.

In May the ESO indicative performance was within the benchmark of 546 MW. Increased uncertainty around the impact of COVID-19 persists. With many people staying at home, their responses to the weather are more pronounced compared to "normal" times. Hence, the element of the underlying demand that is driven by human behavior is more impactful during the pandemic and less predictable. Even with these challenges, ESO has so far managed to outperform the indicative performance benchmarks.

A number of low demand records have been scored during the lockdown period.

- Record low Easter National Demand of 15,167MW occurred on Monday 13 April at 05:00.
- Record low National Demand occurred on Sunday 24 May 2020 at 06:00. National Demand registered at 14,500MW with ~800MW of ODFM being used; National Demand would otherwise have been 13,700MW.
- Record low afternoon demand of 15,267 MW occurred on Saturday 30 May at 15:00.
- New record low National Demand of 13.4GW seen on Sunday 28 June.

DNV GL noted that in conjunction with the demand forecasts prepared for the expected lockdown situation the ESO prepared an absolute worst-case scenario. This scenario assumed conditions far worse than the restrictions associated with the expected lockdown and assumed far more demand reductions due to much greater impacts on industrial and commercial businesses. This worst-case was estimated (8 April) to be 9.8 GW. During the ESO's preparations to manage expected low demands this worst-case scenario was seen as highly unlikely. As such and although it was acknowledged as a risk, all preparations were made using an expected low demand of 12.9 GW.

### *International Comparison*

Furthermore, DNV GL has made a high-level comparison with the way several European TSOs, including Red Electrica, Terna, RTE, and Svenska Kraftnät, have carried out their summer operability preparedness. None of these TSOs has taken such serious precautions as ESO. Most of the TSOs consider the impact of COVID-19 to be smaller than many other uncertainties. The TSOs in Spain, Italy and France rely very much on the wider interconnected European system, and Sweden has been much less affected by COVID-19 due to its relatively light 'lock down'.

The Cigré report<sup>2</sup>, addressing the operations impact of COVID-19 on electricity transmission system operation has also been reviewed. In the report, a number of common and national aspects are given, but the main part is focused on the COVID-19 impact on the demand in France, Germany, Italy, and Spain. Some very brief market impacts are also pointed out. All of the four countries experienced a demand reduction in the range of 10 to 20% due to COVID-19. Due to the demand reduction and good weather conditions, renewable generation covered up to and above 50% of total generation, which is higher than ever before. Additional issues like inertia, frequency control, voltage control, etc., were then emphasized. It is our view that all issues described in the Cigré report, that could have a tentative impact on the GB system, have already been properly taken care of by ESO.

### *Improvement Potential*

DNV GL has identified some minor concerns with respect to the ESO's approach that, if addressed, will help ensure continued security of supply.

- 1) During interviews, DNV GL received some indication that the specialization in dedicated workstreams and inputs might lead to a narrow focus, with high requirements on handshaking at the interfaces between workstreams. In such situations there is a risk that some important issues, inputs, facts or conditions, fall between gaps and are overlooked. That said, our interview with the Control Room Engineer gave a strong impression that the control room personnel have a very good understanding of the different inputs used to set the final balance and reserve allocation.
- 2) During interviews, DNV GL also got the impression that engineers working with the different inputs are somewhat specialised and that redundancy and backup, with respect to personnel, could be improved. Again however, when we stressed the Control Room Engineer on the issue of personnel redundancy, we received assurance that the control room organisation is robust.

<sup>2</sup> Carlini, et. Al; System Operations impact of COVID-19: European Perspective; Cigré, ELECTRA, No. 310, June 2020.