

## THE DEVELOPMENT OF DNO FLEXIBILITY SERVICES TO FIT WITHIN THE EXISTING UK MARKET FOR ANCILLARY SERVICES.

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### ABSTRACT

*This paper describes the development of Distribution Network Operator (DNO) flexibility services to fit within the UK market for ancillary services developed as part of Western Power Distribution's (WPD) Entire [1] Network Innovation Allowance (NIA) project. The paper covers the development on the network use-cases; the development of commercial services, the systems deployed, the participant recruitment process, and the operational trials to date. These sections show services which have been well received, with high interest and good reliability. However the conversion of interest into contracted units proved difficult due to the level of change in the UK ancillary service market as well as trial fatigue from previous DNO trials which have not been carried forward. As such WPD has committed to the continuation of such services beyond the trial as well as the provision of improved information to the market.*

### INTRODUCTION

This paper is one of the outputs from WPD's Entire project. Funded under the NIA, the project followed on from previous trials (FALCON [2], Low Carbon London [3], Customer Led Network Revolution [4]) which had shown the technical capability of third parties to provide services to help manage the distribution network and aimed to translate such technical capabilities into commercial viability. The project focussed primarily on the ability of participants to stack potential revenue alongside the existing market for flexibility services ensuring the services are commercially viable for both the DNO and the participants.

### NETWORK USE CASES

The starting point for the development of the services was the identification of the network use cases the services would mitigate. These fell broadly into three categories.

#### Pre-fault intervention

Most of WPDs 132kV and primary networks are built to n-1 redundancy allowing them to provide the security of supply required as part of Engineering Recommendation (ER) P2/6 [5]. A typical example would be a Bulk Supply Point fed by two 132/33kV transformers. Traditional design would ensure that the total site loading did not exceed the rating of a single transformer preventing any assets from being overloaded if a transformer faults and allowing supplies to be maintained.

Where the loading on the site could potentially exceed the rating of a single transformer, flexibility services could be used to reduce loading back below the rating to ensure n-1 compliance. In such mode of operation actions are taken ahead of any event to ensure network integrity.

#### Post-fault intervention

As the loading on a network group increases, the requirements in ER P2/6 increase to also cover second circuit outages. As such, during an outage on one asset (but not a fault), there are requirements on the DNO to restore load following a subsequent fault. For a class D network this would be the smaller of group demand minus 100MW or a third of group demand within 3 hours.

Under such a scenario, supplies are lost to the group; hence pre-fault intervention is not appropriate. Flexibility service could provide value following the fault as part of a restoration plan. For example generation could be used to reduce the loading on an interconnector and maintain supplies to a wider group of customers whilst the circuit under outage is returned to service.

#### Restoration

The final use case identified was that of value beyond the minimum security standards identified in ER P2/6 such as the mitigation of WPD's Interruption Incentive Scheme liabilities. Whilst the minimum security standard might be to secure load under an outage followed by a fault, there is still a risk of lost load under a double fault. Flexibility services could help the management of such a network during restoration. In such a scenario, the value per MW is linked directly to the avoided customer minute lost liability which in turn is linked to the average kW/Customer on the network. This is a high value, but very low likelihood event.

### SERVICE DESIGN

The translation of the network use cases into commercial services aimed to deliver products that were beneficial to both DNO and participant. Throughout the process, various trade-offs were made. These generally erred towards simplicity and ease of participation, maintaining low barriers to entry to help develop the new markets.

#### Weekly process

The starting point for the service design was to adjust the advanced-notice services developed as part of the FALCON project and adapt them to fit within the existing marketplace. The design focused primarily on

accommodating an existing flexible STOR [6] contract offered by National Grid. This service has a flexible participation option offered on a weekly acceptance and rejection process. Participants submit their pre-agreed capacity for acceptance by midnight on Thursday evening with National Grid accepting or rejecting requirements by 12.00 on the Friday. A similar weekly process was developed with participants declaring capacity by Wednesday at midnight with the DNO accepting or rejecting capacity by 12.00 on the Thursday. This advanced warning would give participants certainty over revenue and allow them to participate in multiple markets.

**Services**

Within the weekly process, 3 services were designed to align with the three use cases identified. These were called Secure, Dynamic and Restore.

These are summarised in Table 1.

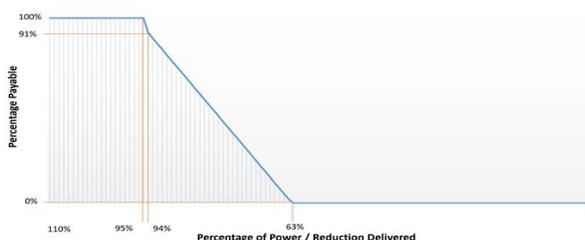
The Secure service was based on the pre-fault intervention and the week-ahead commitment to requirements trialled in the FALCON project. As such

**Table 1: Services Designed**

	Secure	Dynamic	Restore
<b>Original Use case</b>	Pre-fault intervention	Post-fault intervention	Post-fault network restoration
<b>Advanced payment</b>	Yes, an arming payment for the declared run time £75-118/MW/h	Yes, an availability fee for the duration of potential requirement £5/MW/h	No
<b>Utilisation payment</b>	£150/MWh	£300/MWh	£600/MWh
<b>Dispatch Notice</b>	Week Ahead, on acceptance of availability	15 minutes ahead of requirement.	15 minutes ahead of requirement.

**Payment mechanisms**

A detailed payment mechanism was designed to incentivise reliable delivery of service [7]. Previous trials had utilised linear relationships between utilisation payments and delivery. However this does not incentivise the accurate declaration of capacity by participants. As such a new mechanism was developed which included a small grace factor for delivery (5%) followed by a 3% reduction in payment for every 1% of under delivery below the grace factor (in addition to a linear reduction for non-delivery within the grace factor).



**Figure 1: Utilisation Payments for the Secure service**

the DNO would indicate at the week-ahead stage exactly when the participant is required to run. This aimed to give both participant and the DNO maximum notice to maximise possible reliability. Payments were split between an advanced “arming” payment and a utilisation payment.

The Dynamic service acknowledged that for certain post-fault interventions week-ahead notification of the specific running requirements were not appropriate. However the times of heightened risk (outages) could be identified. As such an advanced “availability” fee was proposed to ensure flexibility is available, with actual utilisation triggered by a real time signal.

The Secure and Dynamic were designed as the main services, with every zone having either a Secure or a Dynamic service.

In addition all zones had a Restore service. As this is to mitigate general risk on the network, there is no period of heightened requirement and hence no advanced fee was made. However as utilisation would offset customer minutes lost, a premium utilisation price could be offered.

This was recorded on a minute by minute basis. In addition total volumes of energy delivered are recorded with clawbacks on participant availability if any under-delivery occurs.

A less punitive payment mechanism was developed for the utilisation only Restore service with a linear relationship between utilisation payment and delivery between 80 and 110% and a 2% ratchet below 80%.

In each of these mechanics, delivery must be assessed against a baseline. For the trial a simple baseline was developed as the average of output between 3-8PM for the first 3 weeks of the previous month. This represented a reasonable option to balance simplicity and establishing a methodology that would be inclusive for all site types.

**SYSTEMS**

To trial these services, new systems were deployed. These were split into new systems and integrations into the wider DNO systems. These are highlighted in figure 2.

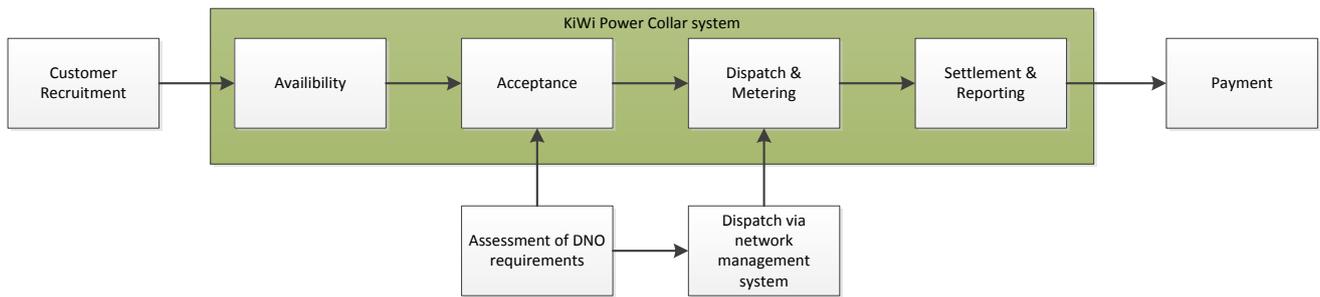


Figure 2: Systems Required

**New Systems**

Once the functional requirements for the new systems were established, delivery was put to competitive tender and won by Kiwi Power who developed the required functionality with their Collar system. It covered the following functions.

**Availability**

The Availability functionality facilitated the submission of participant availability to WPD on a weekly basis. This was carried out via a web based portal [8] which accommodated a calendar. Participants also specified their key operating parameters including, available MW and maximum and minimum run times.

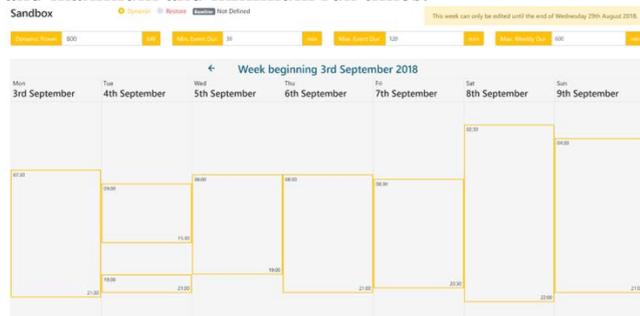


Figure 3: Availability Portal

**Acceptance**

The Acceptance calendar also allowed WPD to accept the capacity made available by participants within the portal.

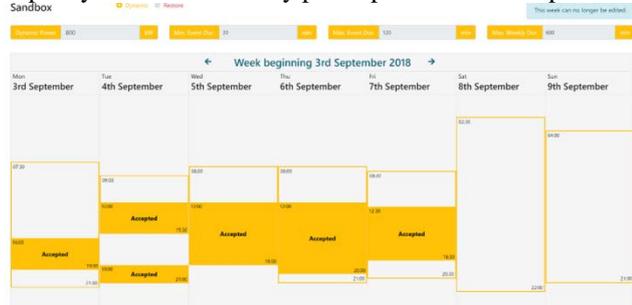


Figure 4: Acceptance Portal

**Dispatch and Metering**

Dispatch and Metering was carried out via a simple Application Program Interface (API) which enabled participants to submit minute by minute usage data well

as receive start and stop signals for dispatch. The information was fed into a monitoring view to allow the DNO operator to see the response received.

**Settlement and Reporting**

The Settlement and Reporting processes allowed the system to log the metered output for each zone and assess both the baseline and the actual performance of participants.

Performance was then highlighted in both an operational view (based on kW and kWh) in a performance report and also in a monetary perspective in an earning statement. Finally invoices were produced to facilitate the payment process.

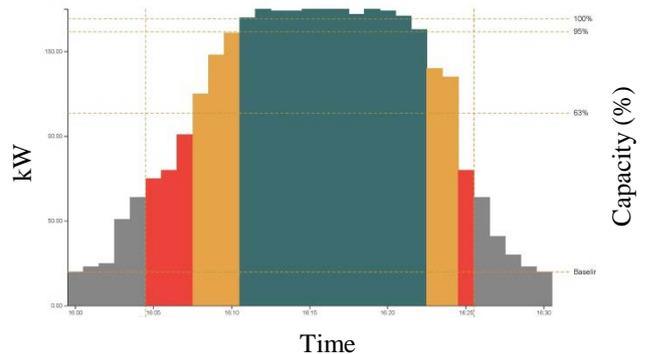


Figure 5: Performance report excerpt for an event

**Additional Integrations**

Further systems and integrations were also required to facilitate the services. These include the development of:

- A website [9]
- A customer relationship management tool
- Operations Support tools
- Links to the Network Management System
- Contract management tools
- Processes for the payment of participants

**PARTICIPANT RECRUITMENT**

**Location**

The trial took place in the East Midlands as shown in Figure 6. The wider area was split into 14 zones based on differing constraints. The area was chosen due to the high expected load growth.

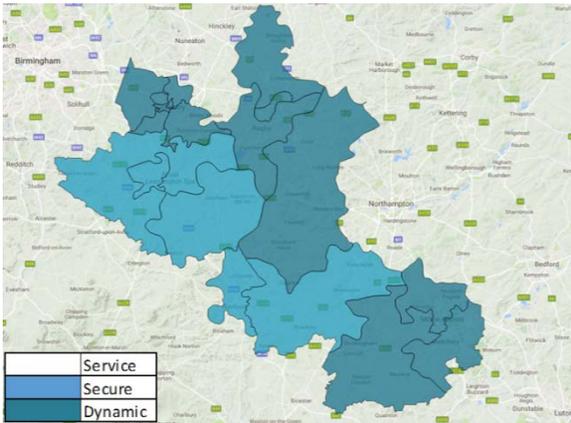


Figure 6: Trial location

**Process**

Participant recruitment was split into 4 phases. The whole process was designed to be as simple as possible to limit the cost of participation. This was all done through a new brand called Flexible Power to create a clear distinction between the requirement for flexibility services and the wider work of WPD in the provision on connections.

**Participant Engagement**

Initial engagement focussed on building relationships with potential participants and highlighting the service requirements. This involved proactively engaging with all the aggregators in the UK as well as speaking at conferences, utilising WPD mailing lists, and promoting heavily on the website.

**Expression of Interest**

The Expression of Interest (EoI) element of the process was designed to develop an understanding of the high level viability of a zone. By collecting limited information from potential participants it allowed judgments to be made on the total potential volume in a target area with minimal effort from participants. The EoI permitted zones with very limited potential capacity could be filtered out limiting the follow up resource required for all parties.

**Procure**

Procurement consisted of collecting more detailed information on the sites and getting contracts signed. Within the trial there were no volume limitations, as such all compliant volume was awarded a contract.

**Build**

The final stage consisted of building and commissioning the API as well as providing participant payment details.

**OPERATIONS**

Once participants were operational, trials commenced. These aimed to test the operational behaviour and the reliability of response provided by participants. This

included testing short and long duration calls to build operational experience of a variety of situations.

**RESULTS**

**Service design**

In general the design of the services was received with positive feedback. Participants were particularly pleased with the simplicity provided by the simple pricing strategy. Minor changes were made to the process including bringing forward the weekly process by a few hours to provided stackable services across a wider pool of services (helping participants access frequency response markets).

Key future developments were also identified such as the production of better information on how much services would be called allowing participants to estimate a clear £/kW/year value for participation.

**Systems**

The systems developed were also well received, by both participants, but also other industry professionals such as the other DNOs. The simplicity of interface and set up were praised as well as the integrated approach taken from dispatch to settlement. The systems will be further developed as additional functionality and scale are added to DNO services.

**Recruitment**

The services offered attracted lots of interest with many positive conversations with potential participants as highlighted by the high volume of responses to the EoI phase (as shown in Table 3).

Table 2: Expression of Interest results

	Total	Compliant	Potential	Non-Compliant	Out of Zone
Sites	69	34	23	4	8
MW	121.47	41.46	17.95	41.0	21.06

However the gap between interest and tangible ability to provide services proved large. The EoI stage showed a large volume of MWs interested but not in the correct target areas, or even from providers who could not provide the technical service required.

Progression through the procurement phase was also very challenging with a significant drop off between interest and commitment. In total 6 contracts were signed with 3 sites and 2.299 MW active to date. The drop off between contracts signed and sites active highlights the challenge involved with bringing volume live. Participant feedback highlighted a variety of reasons:

- Busy marketplace. There are currently a number of significant changes happening within the UK

market for flexibility services. These included changes to schemes such as the reduction of embedded benefits, wider access to the Balancing Mechanism or the mergers and acquisitions of several firms. This limited the available resource that could be devoted to DNO services.

- Trial fatigue. There have been a number of DSR trials by DNOs within the UK, with limited roll out to business as usual. Such experience has created a reticence for participation, as participants saw limited scope for the return of the time investment necessary to operate within the innovation trials.
- Limited Value. A minority of potential participants highlighted that at the current scale, participation did not present enough value to warrant interest.

### Operations

The operational phase of the project is still underway; however initial results are available on the operation of the trial.

Table 3: Operation Trials

Event Number	kWh contracted	Volume delivered	Comments
S1	512	104%	
S2	1000	100%	
S3	512	207%	
S4	2280	48%	Site operational incident
S5	942	115%	
S6	658	233%	
S7	470	0%	No response due to WPD system error
S8	940	0%	No response due to participant system error
S9	470	100%	
S10	940	102%	
S11	940	103%	
S12	829	-184%	Significant plant failure
S13	2487	110%	
S14	940	103%	
S15	800	102%	
S17	500	115%	
S18	470	100%	

Due to the limited participation in the trial, this does not provide a significant sample size. The high-level results of the operations to date are covered in Table 3 which

shows a wide range of responses from significant under-delivery to significant over delivery. Most events however clustered around full delivery of volume. Once system issues have been removed from the sample, the average delivery volume was 97% of expected output. In one event of note (S12), the period of the WPD call coincided with significant plant failures on site, resulting in a very large under-delivery of capacity.

### CONCLUSION

The Entire trial has shown the potential to develop as DNO flexibility service that can fit within the existing UK market for ancillary services. With positive feedback and significant interest in the services developed there is clearly an appetite in the UK market for such a service. The operational trials to date have developed basic systems and processes which have provided reliable responses for participants. However the testing to date has been limited due to the available volume in the service. The difficulty in recruitment is similar to that encountered in previous DNO flexibility trials in the UK. To continue the development of such services WPD has implemented several measures to transition the services into business as usual. These include a long term commitment to the use of such services as well as the publication of enhanced information on potential usage. This should mitigate the primary reasons stated for non-participation and show whether DNO led flexibility can be used as a reliable alternative to reinforcement in the current UK electricity market.

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