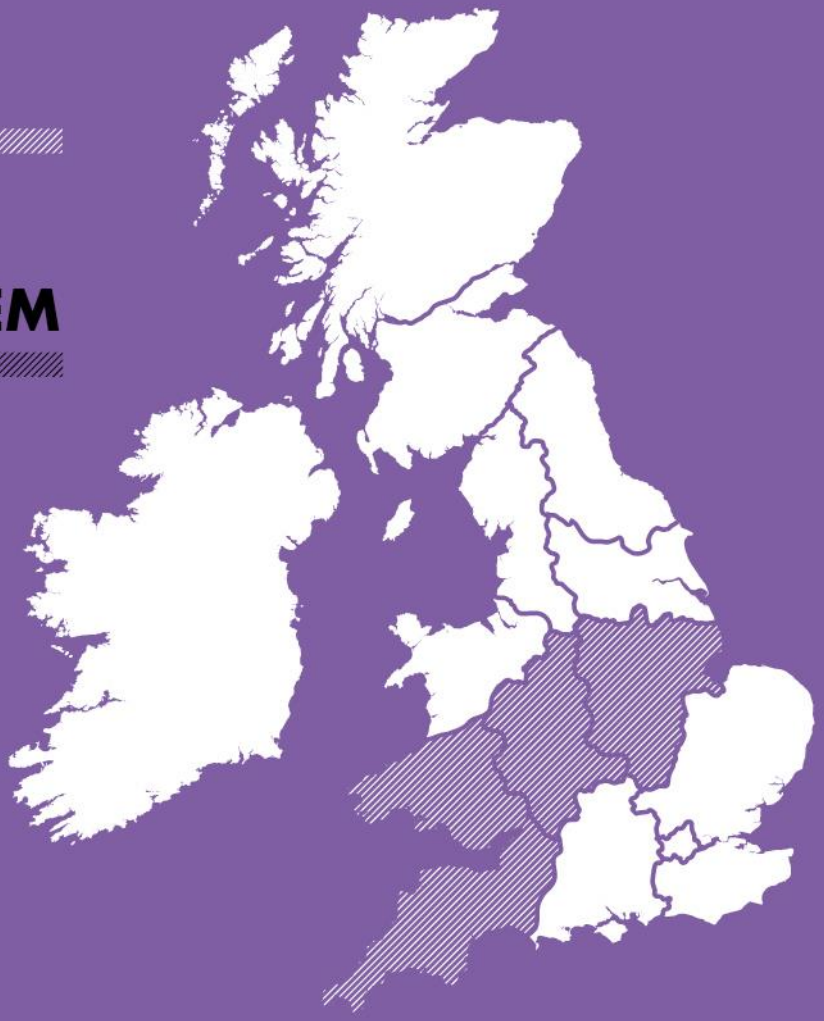
WESTERN POWER DISTRIBUTION

EFFS

ELECTRICITY FLEXIBILITY AND FORECASTING SYSTEM

EFFS
WPD_EN_NIC_003

NIC MAJOR PROJECT
System Design: Service Management



RIIO NIC NETWORK INNOVATION COMPETITION

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Contents

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1 Purpose of this document

The purpose of this design document is to specify how the service management requirements defined in the EFFS project's DSO Requirements Specification will be delivered from a functional perspective. This design document forms one of eight system design documents (listed below), namely the service management design document. The system design documents complement the System Design Summary Report, which contains an overview each functional area and the relationships between them.

- Forecasting**;**
- Capacity Engine;
- **Service Management**;
- Optimisation;
- Scheduling;
- Conflict avoidance and synergy identification;
- Market Interface;
- Reporting and Reconciliation.

In accordance with the EFFS Project Direction, this document forms part fulfilment of the project's fourth deliverable to Ofgem, the 'EFFS system design specification'.

2 Executive summary

Service management takes the output of the capacity engine and transforms that into a number of flexibility requirements to be fulfilled by the market. These are created as service instances and their following lifecycle and associated statuses are managed by the service management module in the AMT-SYBEX Affinity Networkflow[1] product.

Also, service management stores all default parameters associated to the service types supported by EFFS (e.g. minimum bid size, maximum bid duration etc) and will validate that what is offered by the Flexibility Platforms is a valid service instance and adheres to the defined characteristics.

During Workstream 1 (forecasting evaluation and requirements gathering), the project decided to support the 4 DSO service types as defined by the ENA ON (scheduled constraint management, pre-fault constraint management, post fault constraint management and restoration). However, the scheduled constraint management use case has lead times of at least a year prior to the curtailment event, which does not align with the EFFS forecasting timelines (maximum of 6 months prior to the curtailment event). For this reason, the scheduled constraint management service type has been removed from the scope of the design and the EFFS trials.

[1] https://www.amt-sybex.com/networkflow/

3 Glossary

Term	Definition
AFctivation period	Defined by the ENA in "Open Networks Project DSO Service Requirements: Definitions", in the EFFS process and terminology this is "minimum dispatch response lead time"
ANM	Active Network Management
API	Application Programming Interface
BSP	Bulk Supply Point (132kV Network)
Contingency scenario	These are scenarios to consider when modelling the network in order to identify constraints (for example an N-1 or N-2 scenario) As per current WPD policy this will be every combination of the following for the relevant part of the network to define the next credible fault: • Each circuit fault • Each busbar fault
Constraint	For EFFS purposes this refers to thermal network constraints (as opposed to voltage constraints)
DER	Distributed Energy Resources
DNO	Distribution Network Operator
DSO	Distribution System Operator
EFFS	Electricity Flexibility and Forecasting Systems
ENA	Energy Networks Association (specifically the Open Networks Project)
ESO	Electricity System Operator, i.e. the role carried out by National Grid ESO that includes national system balancing and frequency control
Flexibility platform	See Appendix 2 for details.
Flexible Power	WPD branding for flexibility services and the name used to refer to the platform to deliver the procurement of flexibility services
HH	Half Hourly electricity metering
kV	Kilovolt
kW	Kilowatt
MPAN	A Meter Point Administration Number is a 21-digit reference used in Great Britain to uniquely identify electricity supply points such as individual domestic

Term	Definition
	residence
Networkflow	Proprietary software suite developed, licenced and maintained by AMT-SYBEX relating to the management of flexibility services for electricity networks.
MVA	Mega volt ampere
MW	Megawatt
Network hierarchy	The relative configuration of the key locations of the network by voltage level. This is simpler than the integrated network model but would allow an understanding of how actions at a particular primary, for example, would impact on 33kV feeders, bulk supply points, 132kV feeders and GSPs.
Network model	An electronically held network arrangement that may be used to simulate the impact of load-flows or perform other analysis of the network under different scenarios. Some further definition related to network models: • Switch level = a network model that contains switchgear details to allow for contingency modelling; • As built = the current network model; • Committed = As built amended for future network changes that are confirmed (i.e. not proposed).
Ofgem	Office of Gas and Electricity Markets
Power On	WPD's Distribution Management System provided by GE
Primary Substation	11kV and 33kV substations
PSS®E	Transmission planning and analysis software provided by SIEMENS
Service Instance	A service instance is an instance of a service type for the purpose of procuring and mastering service management data. In essence a service instance the record in the system of the service, what type it is, what status it is at and what parameters it uses.
Service types	Types of peak shaving flexibility services that will be supported by EFFS (namely, pre-fault constraint management, post-fault constraint management, restoration support.)
SLA	Service Level Agreement
T.E.F.	TRANSITION, EFFS, FUSION
User	Users of the EFFS system are anticipated to be: • **Forecaster and flexibility co-ordinator** up until the real time management, dispatch and monitoring. Note: both these roles do not currently exist but are required, as they do not map onto an existing business function. The flexibility co-ordinator role will have a very

Term	Definition
	similar skill set to that of an outage planner, whereas the forecaster role will require individuals with a mathematical / statistical background and possibly some programming experience. • **Control engineer** for real time dispatch and monitoring of the network. • **System administrator** system and interface support, maintenance of master data, data cleansing.
Utilisation Payment	A payment made for the dispatch of flexibility services
WPD	Western Power Distribution

4 Related documents

Ref	Document title	Version	Date issued	Prepared by	Location
1	Revised_EFFS_FSP_Redacted_v2	2.0	06/07/2018	EFFS	Link
2	WPD_EFFS_DSO Requirements Specification_v1.0	1.0	24/05/2019	EFFS	Link
3	System Design Summary Report	2.0	25/10/2019	EFFS	Link

5 System overview

5.1 Core functions overview

Figure 1 below is a diagrammatic representation of the functional areas within the EFFS project. The functional area that is subject of this document is circled in red.

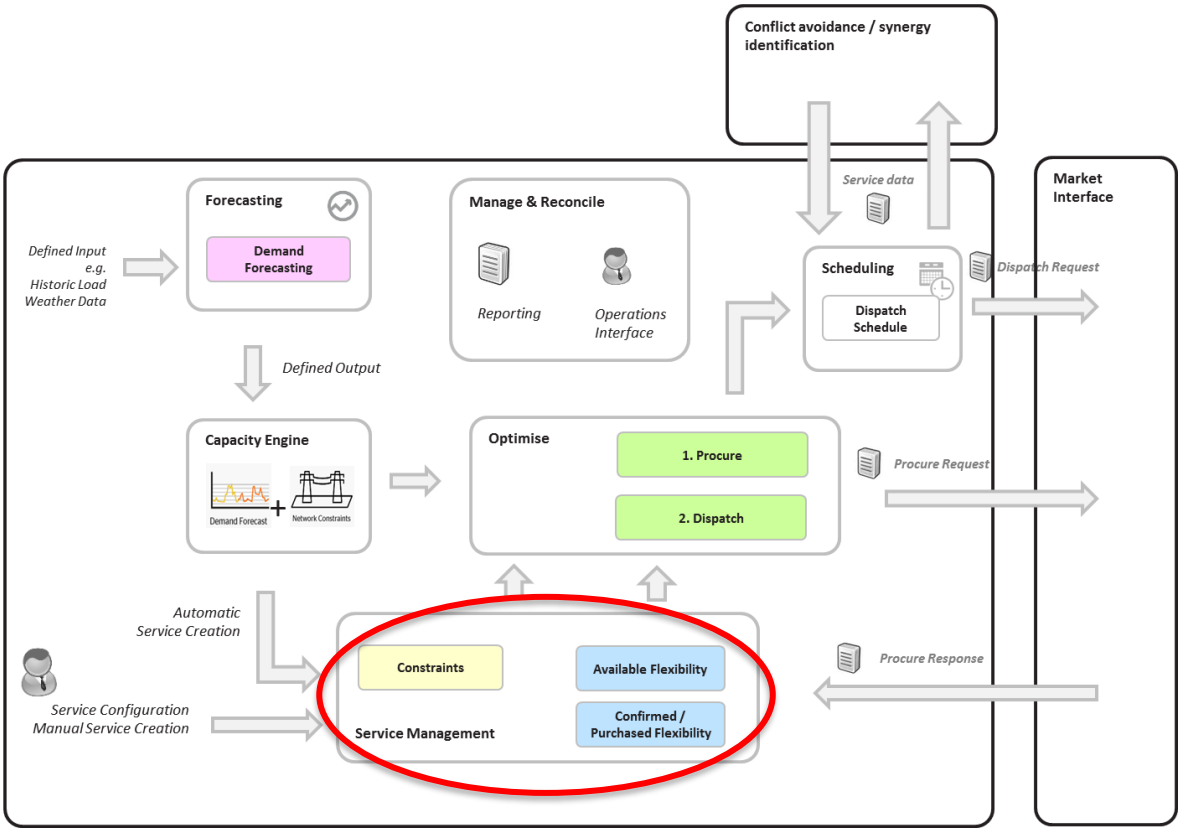

Figure 1: EFFS core functions

6 Service management

6.1 Scope

Table 1 defines the scope of the service management solution to be implemented within the EFFS project.

In scope	Out of scope

• Automatic creation of services from capacity engine process;
• Manual creation of services; and
• The following service types (which are a sub-set of market services) to be supported as per ENA Open Networks workstream 1 product 2:
  ○ Pre-fault constraint management (Secure);
  ○ Post-fault constraint management (Dynamic); and
  ○ Restoration support (Restore).
	• Definition and creation of new service types.

Table 1: Scope for service management

6.2 Description

The service management function in EFFS will be triggered via two methods to create a Service Instance. Firstly, through a user manually creating it, for example in a post-fault scenario and, secondly, via a forecast triggered in the system either manually or automatically, for example in a pre-fault scenario.

Before a Service Instance is created, the system or a user shall have conducted a power flow analysis, which will create a number of contingency scenarios, for which the capacity engine process will provide the appropriate constraint data such as the Half Hourly (HH) profile of the thermal constraint to be resolved. The service management process will convert the constraint data into a flexibility requirement to procure flexibility for the respective Bulk Supply Point (BSP) or Primary Substation and create the service type based on the power flow analysis output.

Services will be mastered in Networkflow and constructed by defining the various service types and service parameters associated to those types. These will be preconfigured within the solution reflecting asset holder and relevant DSO requirements (see section 6.3.4.3 for further details). The ability to modify and add new service types and parameters will also be included within the administration function of the service repository. Once the service types and parameters have been defined, it is possible to associate defined parameters to various service types allowing for a highly flexible and future proof solution.

6.3 Solution

6.3.1 Pre-requisites

- Creation of service types configured in system; and

- An interface to flexibility platforms to request and accept bids as defined in the latest 'WPD EFFS_System Design_Market Interface' specification.

6.3.2 Input

- The HH profiles of thermal network constraints at the aggregated level for procurement.

6.3.3 Output

- Service requirements for flexibility platforms to acquire flexibility services; and
- Confirmation of services procured, cancelled and dispatched.

6.3.4 Procurement process

6.3.4.1 Service Instance creation

In order for procurement to take place, a service instance must be created in Networkflow. Service requirements will be captured in a service instance and will master the data for the lifecycle of a service such as the service parameters and power and energy profile data required for procurement. The system will trigger the creation of a service instance when the capacity engine has created a HH profile of the flexibility required or when a user manually creates it see section 6.3.4.2 on the user method. When a service is created the status of the service will be 'New' and will proceed to determine the service type required. This is achieved by the following criteria received from the power flow analysis:

Contingency Type	Service Type
First Circuit Outage	Pre-Fault Constraint
Second Circuit Outage	Post-Fault Constraint
Multiple Outages	Restoration Support

Table 2: Power flow analysis criteria

The solution will then create a skeleton Service Instance with associated standing data and default parameters as defined in the following sections.

6.3.4.2 User creation of services

A user will be able to create a service in the system, this will create a new Service Instance using the system defaults. A user can then add, edit and amend service parameters and other data associated to the service such as the below section 6.3.4.4. This will enable an experienced user to create a service with specific requirements to mitigate a constraint like in a restoration support scenario.

6.3.4.3 Service Instance generic/standing data items

The Service Instance data items are standard components that will exist in every Service Instance, where no values are present then they will contain NULL. The indicative data items are presented in Table 3.

Name	Notes
Service Instance ID	Unique ID to identify a Service Instance.
Service Type	Permissible values: 'Scheduled Constraint'

	'Pre-Fault Constraint' 'Post-Fault Constraint' 'Restoration Support'
Service Status	Please see section 4.2.3.4.2.2 below
MPAN/s	Our working assumption is that MPAN's can only be supported by non-aggregator customers and depending on the flexibility will provide either an import or export MPAN.
Asset ID/s	This value will be the unique Asset ID for the flexibility asset, and we assume this can only be supported by non-aggregator customers.
Network Location	The network Location will be the BSP or Primary Substation WPD Site ID and will match the published list of names given to the flexibility platforms'
Power/Energy Requirement	Total amount of Power/Energy required for a service instance.
Power/Energy Available	Total amount of Power/Energy available for a service instance.
Actual Procurement Payment	Payment (£/kWh) for procuring services
Actual Utilisation Payment	Payment (£/kWh) for scheduling services
Availability Windows	HH values for the service duration

Table 3: Data items for service management

6.3.4.4 Service parameters

Table 4 states the service parameters to support the service management function in EFFS. It advises the following:

Parameter ID	Parameter	Spec Used	Data Type	Units	Mandatory Parameter	Pre-Fault Constraint	Post-Fault Constraint	Restore	Notes and initial values
PAR-01	Reservation payment	Service/ Optimisation	NUMBER(4)	£/MW per HH	Y	Y	Y	N	Initial value '0'. Due to the uncertainty around how procurement and payments will operate this value has been initially set to zero until such times as there is clarity to how procurement payments will operate in the market.
PAR-02	Utilisation payment	Service/ Optimisation	NUMBER(4)	£/MWh	Y	Y	Y	N	Initial value £999 this is a maximum value per MWh. The utilisation payment is the price per MWh of delivery.
PAR-03	Bids for less than the full contiguous required period of flexibility services are permissible	Service/ Optimisation	Boolean	Boolean	N	Y	Y	Y	
PAR-04	Bids for less than or more than the energy offered in each HH period	Service/ Optimisation	Boolean	Boolean	N	Y	Y	Y	

Parameter ID	Parameter	Spec Used	Data Type	Units	Mandatory Parameter	Pre-Fault Constraint	Post-Fault Constraint	Restore	Notes and initial values
	within the full contiguous required period								
PAR-05	Non-contiguous bids are permissible	Service/ Optimisation	Boolean	Boolean	N	Y	Y	Y	
PAR-06	Cherry pick only some HH and/or portion of capacity	Service/ Optimisation	Boolean	Boolean	N	Y	Y	Y	This parameter enables cherry picking of the HH, which a DSO perceives to be better suited to their requirements. All service instances of the relevant type will be validated against this criterion.
PAR-07	Minimum bid size	Service/ Optimisation	NUMBER(4)	MW	Y	Y	Y	Y	Pre-Fault Constraint Management = 0.1MW. Post-Fault Constraint Management = 0.1MW. Restoration Support = 0.1MW. Enables the DSO to have the ability to limit bids to those received are of practical use in terms of size. All service instances of the relevant type will be validated against this criterion.

Parameter ID	Parameter	Spec Used	Data Type	Units	Mandatory Parameter	Pre-Fault Constraint	Post-Fault Constraint	Restore	Notes and initial values
PAR-08	Maximum bid size	Service/ Optimisation	NUMBER(4)	MW	Y	Y	Y	Y	Pre-Fault Constraint Management = 49. Post-Fault Constraint Management = 49. Restoration Support = 49. Initial value set to 49MWh as this is the largest theoretical generation on the network. All service instances of the relevant type will be validated against this criterion.
PAR-09	Minimum bid duration	Service/ Optimisation	NUMBER(4)	Minutes	Y	Y	Y	Y	Pre-fault constraint Management = 30 minutes. Post-Fault Constraint Management = 30 minutes. Restoration Support = 30 minutes. This enables a DSO to have the ability to limit bids to those received are of practical use in terms of duration. All service instances of the relevant type will be validated against this criterion.

Parameter ID	Parameter	Spec Used	Data Type	Units	Mandatory Parameter	Pre-Fault Constraint	Post-Fault Constraint	Restore	Notes and initial values
PAR-10	Maximum bid duration	Service/ Optimisation	NUMBER (4)	Minutes	Y	Y	Y	Y	Pre-Fault Constraint Management = 1439 minutes. Post-Fault Constraint Management = 1439 minutes. Restoration Support = 1439 minutes. Initial value set to 1439 minutes (or 23hrs and 59 minutes) as this is the longest theoretical time generation can deliver in a day. All service instances of the relevant type will be validated against this criterion.
PAR-11	Minimum procurement response lead time	Service/ Optimisation	NUMBER (4)	Minutes	N	Y	Y	Y	Initial value 30 minutes. This is the minimum amount of time a bid response can be received back. All service instances of the relevant type will be validated against this criterion.
PAR-12	The system will capture minimum dispatch response lead time	Service/ Optimisation	NUMBER(5)	Minutes	N	Y	Y	Y	Pre-Fault Constraint Management = closer to real time (15mins) Post-Fault Constraint Management = real time (postfault; 15mins). Restoration Support = real time

Parameter ID	Parameter	Spec Used	Data Type	Units	Mandatory Parameter	Pre-Fault Constraint	Post-Fault Constraint	Restore	Notes and initial values
									(postfault; commencement of service). The minimum time a provider requires notification to dispatch flexibility. All service instances of the relevant type will be validated against this criterion.
PAR-13	Maximum ramping period	Service/ Optimisation	NUMBER(5)	Minutes	Y	Y	Y	N	Pre-Fault Constraint Management <= 15 minutes. Post-Fault Constraint Management <= 15 minutes. Restoration Support = NULL. This is the maximum amount of time a provider requires to ramp up the asset/s to deliver the required flexibility. All service instances of the relevant type will be validated against this criterion.
PAR-14	Minimum full activation period (i.e. the minimum continuous block of HH services an asset must	Service/ Optimisation	NUMBER(4)	Minutes	Y	Y	Y	Y	Pre-Fault Constraint Management = 30 minutes. Post-Fault Constraint Management = 30 minutes. Restoration Support = 30 minutes Initial values set to 30 as the is timing of a HH period.

Parameter ID	Parameter	Spec Used	Data Type	Units	Mandatory Parameter	Pre-Fault Constraint	Post-Fault Constraint	Restore	Notes and initial values
	provide)								All service instances of the relevant type will be validated against this criterion.
PAR-15	The system will capture maximum number of activations (per day, per week)	Service/ Optimisation	NUMBER(3)	Numeric	Y	Y	Y	Y	Initial Value per day '12' and per week '48'. This limits the number of times a provider is called per day. All service instances of the relevant type will be validated against this criterion.
PAR-16	Minimum number of participants to fulfil power / energy requirement per event as a service parameter.	Service/ Optimisation	NUMBER(1)	Numeric	N	Y	Y	Y	Initial Value = '1' This allows the DSO to spread the risk of non-delivery by ensuring no single party has responsibility to deliver all the flexibility in a half hourly period. This parameter would be used by the optimisation process. All service instances of the relevant type will be validated against this criterion.
PAR-17	Maximum number of participants to fulfil power / energy requirement per event as a	Service/ Optimisation	NUMBER(2)	Number	N	Y	Y	Y	Initial Value = '99' This would allow the optimisation process to limit the number of providers contributing towards the flexibility in a half hourly period. If this is not required, setting this to a high value will

Parameter ID	Parameter	Spec Used	Data Type	Units	Mandatory Parameter	Pre-Fault Constraint	Post-Fault Constraint	Restore	Notes and initial values
	service parameter.								remove its impact on the optimisation process. All service instances of the relevant type will be validated against this criterion.
PAR-18	Minimum percentage of energy in the HH sourced from 1 asset to fulfil energy requirement	Service/ Optimisation	NUMBER(1)	Numeric	N	Y	Y	Y	Initial Value = '0' This would allow the optimisation process to limit the number of providers contributing towards the flexibility in a half hourly period. A similar effect could be achieved by specifying larger values for the minimum bid size, so it may be that this field is not used in practice. If this is not required, setting this to a low value will remove its impact on the optimisation process. All service instances of the relevant type will be validated against this criterion.
PAR-19	Maximum percentage of energy in the HH sourced from 1 asset to fulfil energy requirement	Service/ Optimisation	NUMBER(1)	Numeric	N	Y	Y	Y	Initial Value = '1' equals 100%
PAR-20	Availability	Service/	TBC	N/A					Included for future proofing. Not

Parameter ID	Parameter	Spec Used	Data Type	Units	Mandatory Parameter	Pre-Fault Constraint	Post-Fault Constraint	Restore	Notes and initial values
	windows (i.e. actual HH values for which the service is available)	Optimisation							expected to include in EFFS may be reviewed in the trials.
PAR-21	Reliability factor for an organisation	Service/ Optimisation	TBC	N/A					Included for future proofing. Not expected to include in EFFS may be reviewed in the trials.
PAR-22	Reliability factor for an asset	Service/ Optimisation	TBC	N/A					Included for future proofing. Not expected to include in EFFS may be reviewed in the trials.
PAR-23	Reliability factor for a market	Service/ Optimisation	TBC	N/A					Included for future proofing. Not expected to include in EFFS may be reviewed in the trials.

Table 4: Parameters for service management

6.3.4.5 Validating flexibility procurement request

After power flow contingencies have been processed as described above, an assessment is carried out by an outage planner to assess if the constraint can be managed by network solutions. Once the assessment has been completed the system will be updated to a status 'Handled' as it can be managed by the DSO without the use of market solutions. Where the constraint cannot be managed using on network solutions the DSO operator will update the system to 'Awaiting Procurement' to proceed to the procurement stage.

6.3.4.6 Validating flexibility procurement requirements

Prior to sending procurement messages via the market interface, the system will assess that the service requirements meet and/or do not exceed or conflict with the service parameters or duplicate service This is to ensure that the flexibility procured is valid and does not conflict. To determine this the following rules will be applied:

- Flexibility required is >= the procurement request
- Flexibility required is <= the maximum procurement request
- Flexibility period is >= the minimum service duration
- Flexibility period is <= the maximum service duration
- Flexibility Start Datetime >= the procurement requested start datetime
- Flexibility Start Datetime <= the procurement requested start datetime
- No other service instance exists for the same network location and requesting an opposite type of power i.e. existing services requesting demand turn down and procurement request for buying power.

Power flow analysis will also be carried out in order to validate that the proposed flexibility requirements resolve the constraint and also do not create / exacerbate overloads elsewhere on the network. This is especially important for heavily interconnected areas of the network. See 'WPD EFFS_System Design_Capacity_Engine' for details.

Where there is a conflict in the parameters an exception will be created for a user to manage. This may require a rerun of the process to correct the error therefore the status of the service instance will be updated to 'Cancelled'.

6.3.4.7 Flexibility procurement submission

If no conflicts have been identified, then the requirement/s from the service instance will be submitted to the respective flexibility platform/s via the market interface. This will be submitted in power as MWs for positive or negative values required for each HH period for the respective BSP or primary substation**Error! Bookmark not defined.**.

The way in which requests for flexibility services are sent to the various market platforms depends on the degree of interoperability between market platforms and the approach taken to optimisation. If market platforms are operating to agreed standard processes, timescales, interfaces etc. then it would be possible to optimise the selection of flexibility service offers from a combination of market platforms. i.e. that the same request for flexibility could be sent to multiple platforms at the same time and responses would be received in the same format from the various platforms by the same deadline. This would then allow optimisation on the combined responses and finally for notifications to be sent to the relevant platforms following the output of optimisation.

However, if market platforms are not interoperable, then another approach must be taken to ensure

the DNO does not favour one market platform over another. It is suggested that an apportionment approach is taken where metrics for each platform in a particular area are stored so that they can be used to set an apportionment target for each platform. When a new request needs to be sent to a platform, the actual share of business is compared against these targets to determine which platform should be selected.

The table used to set apportionment target will need to set values for different areas. The areas may reflect:

- DNO licence area; or
- Flexibility Management Zone.

The metrics to assess flexibility procurement submission should include:

1. The connected capacity of flexibility services for each platform in each area. This will be a manual input taken from data provided by a centralised register of flexibility assets or if that is not available from values provided by the market platforms themselves. Each platform's target apportionment will be equal to their market share of the total market in each area as shown in the worked example in Table 5.

	Capacity MW	Market share %	Apportionment target %
Platform A	50	3%	3%
Platform B	300	19%	19%
Platform C	400	26%	26%
Platform D	200	13%	13%
Platform E	600	39%	39%
Total	1550	100%	100%

Table 5: Worked example of target apportionment for each platform

2. The historic average price of flexibility services for each platform in each area. This will be calculated by one of the standard reports set up in EFFS. If this metric were selected, EFFS would expect to purchase more from those platforms that were generally cheaper than average and less from platforms that were more expensive in proportion to their variation from the average. This will ensure that no platforms are avoided completely and help ensure costs to customers is kept low. See Table 6 for a worked example.

	Average £/MWh	Price compared to average	1/price compared to average	Apportionment target %
Platform A	300	1.00	1.00	20%
Platform B	280	0.93	1.07	21%
Platform C	260	0.87	1.15	23%
Platform D	350	1.17	0.86	17%
Platform E	310	1.03	0.97	19%
Average	300		5.05	100%

Table 6: Worked example of cost comparisons across platforms

Actual apportionment of services should be measured as a share for each platform of services from a defined calculation start dated by contracted utilisation in MWh. The calculation start date should be user configurable, so that it can be reset if there is a significant change to the market rules, players in the market etc.

The selection of the market platform is then made according to the difference between the target apportionment value and the actual apportionment value i.e. the platform that was most below its target apportionment should be selected. Where more than one platform has the same maximum gap between actual and target apportionment then the selection should be made randomly between those platforms.

6.3.4.8 Flexibility procurement no response

If no response is received within the configured timescale the request expires as no longer valid such as the service start date and time has subsequently passed. This will result in the status of the service instance to be updated to 'Cancelled'.

6.3.4.9 Flexibility bid validation

Where a bid/s have been received from one or more flexibility platforms, the solution will perform a validation to ensure the bid/s meet the minimum or do not exceed the maximum service type criterion prior to optimisation. These shortlisting parameters are expressed in Table 7 and have the detailed business rules defined in section 6.3.4.3.

Parameter ID	Parameter name
PAR-02	Utilisation payment
PAR-03	Bids for less than the full contiguous required period of flexibility services are permissible
PAR-04	Bids for less than or more than the energy offered in each HH period within the full contiguous required period
PAR-07	Minimum bid size
PAR-08	Maximum bid size
PAR-09	Minimum bid duration
PAR-10	Maximum bid duration
PAR-11	Minimum procurement response lead time
PAR-12	The system will capture minimum dispatch response lead time
PAR-13	Maximum ramping period

Table 7: Shortlisting parameters for flexibility bid validation

After the above assessment has been conducted any bids that do not meet the service will have the reason it did not meet the requirement/s recorded and withdrawn from further processing. If no bids received meet the service criteria resulting in no flexibility being able to be purchased, then an exception will be raised to a user to resolve.

Bids received that meet the criteria and are compliant with the service requirements will then be passed for optimisation to define what bids are best to select for procurement. After the bids have been optimised the statuses of each bid will be updated to 'Optimised' and declare which bids should be procured and what should be disregarded.

6.3.4.10 Flexibility bid approval

Where the system is parameterised to manually approve the bids the system will notify the user of approval. If no user updates the approval, the approval will timeout based on a configurable time limit and will update the service status to 'Cancelled'. Where a user reviews the approval, they will have the ability to accept all or some of the optimised bids.

If a bid does not require user approval or a user has approved the bid/s, the approved bids will be reassessed through power flow analysis to ascertain the impacts of the new flexibility procured. As with the start of the process, a procurement process parameter will define if the output of the power flow analysis requires manual intervention or can be automatically approved.

In the instances the contingencies produced by the new power flow analysis is acceptable and does not invoke any new constraints then the solution will proceed to confirm the bids from the flexibility service provider/s. Once a bid has been accepted in the system the solution will update the status to 'Procured'.

In the instances the revised power flow analysis show further constraints then it will follow the same processed as outlined above, it will be assessed whether it can be managed internally or further procurement of flexibility maybe required, in this case the solution will review if the bids received pre or post optimisation would meet the new contingencies if they do not then the process will loop as described above until the flexibility meets the constraint and is procured or will be cancelled as subsequent events have taken place.

6.3.5 Dispatch process

The dispatch process begins after procurement has concluded. Dispatch is only actioned when the DSO has confidence that they will require the services previously procured. Following procurement confirmation, the system will submit a dispatch message to the flexibility platforms for procured flexibility. If no response is received within the configured timescale, the request raises an exception for a user to review. Where a dispatch message is returned within the timescales then the system will update the service status to 'Dispatched'.

6.3.5.1 Service statuses

Table 8 defines the service statuses that will be used to track the status of a Service Instance:

Status	Status description	Reference
New	Service has been created.	Service Management, section 5.3.5.1 Service Instance creation
Handled	Service resolved internally via not using flexibility.	Service Management, section 5.3.5.4 Validating flexibility procurement request
Optimised	The procurement has been optimised and is awaiting decision/approval to proceed to the next stage.	Service Management, 5.3.5.8 Flexibility bid validation
Delivered	Service has been delivered.	Service delivery monitored outside of EFFS; status will be assumed
Cancelled	Service cancelled as no longer required.	Service Management, sections 5.3.5.5/7/9
Awaiting Procurement	Procurement is required to purchase energy/power and awaiting system/user	Service Management, section 5.3.5.4 Validating flexibility

	to initiate procurement process.	procurement request
Procured	Service has procured flexibility.	Service has procured flexibility
Dispatched	Service has dispatched the flexibility.	Service Management, section 5.3.5.10 Dispatch

Table 8: Service statuses

Figure 2 depicts the control flow of how the statuses should be updated by a user in Networkflow. The logic to drive the statuses can be found in the above table however, the below gives a representation of the order in which the statuses should be updated. Please note that a service status can be cancelled anytime by a user in the event it is no longer required.

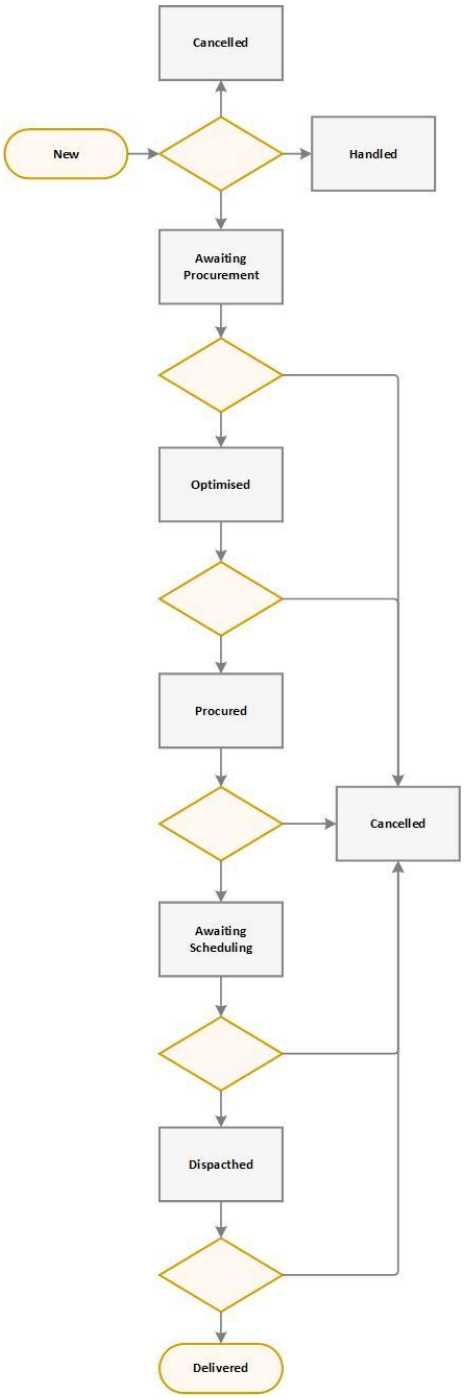

Figure 2: Control flow for service management

6.4 Changes since DSO requirements document baselined

Uniform interfaces to flexibility platforms have yet to be defined at an industry level. Therefore, within EFFS the decision was made in the previous phase to define a default set of instructions between EFFS and flexibility platforms that it was assumed that any flexibility platform integrating to EFFS will use this standard. i.e. there will be no requirement to develop customised interfaces for EFFS to interface with platforms. The instructions and associated data items were derived from the service types defined by the ENA ON (see Appendix 1 for more details) and the operational procurement, arming and dispatch processes defined in this document. However, in practice the flexibility platforms EFFS is interacting with are not yet interoperable in terms of service types and signals supported, therefore separate interfaces and service types have been specified per platform (taking advantage of any synergies between the respective platforms design where possible).

Within the ON working group there has been a common set of use cases / services developed for 'Active Power Flexibility'. The DNOs are now looking to adopt these services as standard and to use consistent terminology to refer to these services in future tenders. We have therefor mapped the procurements that will take place within EFFS to the standard service characteristics as show below and extracted from the Open Networks Project – 2018 Review document.

Service characteristics	Scheduled constraint management	Pre-fault constraint management	Post-fault constraint management	Restoration support
When to act	Pre-fault	Pre-fault	Post-fault	Post-fault
Triggering action	Time	DSO forecast; or asset loading	Network fault	Network fault
Certainty of utilisation	Very certain	Uncertain	Uncertain	Very uncertain
Efficiency of utilisation	Low	Medium	High	Low
Risk to network assets	Low	Medium	High	Low
Frequency of use	High	Medium	Low	Low

Figure 3: ENA defined DSO service characteristics

Based on the parameters set out above, the principles detailed within 'Scheduled Constraint Management' it precedes the DSO forecasting timescales and is therefore deemed out of scope for the EFFS project. WPD have previously employed such a service to manage network conditions for pre-fault purposes from as early as 2011 and established a 20 year agreement with a generation site to guarantee their operating state would be such as to support alleviation of a demand constraint. There is a number of methods in which it may be possible to procure such services, including conditions associated with a new connection offer, rather than solely as service requirement purchased through a flexibility market platform. We therefore recognise the importance of having such services included within the options framework, but it is unlikely to impact the outcomes of the EFFS trial. In fact, where such scheduled services are operated for at least a year in advance of the EFFS forecasting commencing, it is likely that the operation of such scheduled services will be reflected in the background behaviour and baseline from which a shorter flexibility need is assessed.

7 Interfaces

The service management function has no direct system interfaces.

8 Contact

If you have any questions relating to this document, please use the following points of contact:

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Appendix 1 – Service Definitions

Below are the definitions of the initial services types to be supported in accordance with the ENA ON workstream 1 product 2, 'DSO Service Requirements: Definitions':

"***Scheduled Constraint Management*** *- The DSO procures, ahead of time, a pre-agreed change in input or output over a defined time period to prevent a network going beyond its firm capacity (thereby ensuring all load remains secure following the next fault). For example, a reduction in demand is procured over an evening peak period to mitigate risk of overload that might result should a fault occur on one of two in-feeds to a group*[2]*.*

Pre-fault Constraint Management *– The DSO procures, ahead of time, the ability to access a pre-agreed change in Service Provider output based on network conditions close to real-time. Utilisation is then delivered by different mechanisms, depending on whether the DSO wishes to manage network risk manually, or automatically: a. Utilisation may be instructed manually, ahead of real-time, to prevent a network going beyond its firm capacity. This will generally be a manual call based on circuit loading forecasts. For example, a Service Provider is contracted to be available to the DNO over winter evening peaks. The DNO then calls the Service Provider on days forecast to have the worst predicted loadings; or b. Utilisation may be initiated through an automated DSO system. For example, a Service Provider is contracted to be available to the DSO over winter evening peaks. The DSO system then triggers the service when the loading reaches the firm capacity.*

Post-fault Constraint Management *– The DSO procures, ahead of time, the ability of a Service Provider to deliver an agreed change in output following a network fault. Utilisation is then instructed when the fault occurs on the network (but only if loading is beyond the post-fault rating of the remaining assets). This will generally be instructed through an automated system and will utilise the short-term ratings of the assets, such that a sustainable post-fault flow can be achieved. For example, a Service Provider is contracted to be available to the DSO over winter evening peaks. The DSO system instructs the Service Provider to deliver the contracted change in output when the fault occurs.*

Restoration Support *– Following a loss of supply, the DSO instructs a provider to either remain off supply, or to reconnect with lower demand, to support increased and faster load restoration under depleted network conditions. For example, a Service Provider may be restored at minimal load to allow for other (perhaps less flexible) customers to be restored."*

Table 9 summarises these service characteristics:

Service Characteristics	Scheduled Constraint	Pre-fault Constraint	Post-fault Constraint	Restoration Support

[2]This service is characterised by operating on a scheduled manner and is therefore simpler to manage and does not require sophisticated forecasting to support decision-making.

	Management	Management	Management	
When to act	Pre-fault	Pre-fault	Post-fault	Post-fault
Triggering action	Time	DSO forecast; or Asset Loading	Network fault	Network fault
Certainty of utilisation	Very certain	Uncertain	Uncertain	Very uncertain
Efficiency of utilisation	Low	Medium	High	Low
Risk to network assets	Low	Medium	High	Low
Frequency of use	High	Medium	Low	Low

Table 9: Service characteristics

Appendix 2: Definition of Flexibility Platform

'Flexibility Platform' is a term used throughout this document and is deliberately generic due to the current lack of cross-industry consensus on what this role entails and the differences between the existing platforms. Whilst it is not the purpose of EFFS to specify how these platforms will operate, the project makes various assumptions about what functions they will perform throughout the document. For ease of reference these are collated in the table below. Please note that this list is not an exhaustive; it is an overview of assumed flexibility platform capabilities and their relationship to EFFS.

Function	Carried out by flexibility platform?	Required by EFFS?
Interface for registering flexible resources	Yes	Yes
Allows buyers and sellers to match their requirements	Yes	Yes
Communication with flexibility resources	Yes	Yes
Dispatch of flexibility resources	Yes	Yes
Commercial optimisation	Yes	No, as EFFS will use multiple platforms therefore needs a cross platform view
Conflict avoidance with other parties	Yes	No, as EFFS will use multiple platforms therefore needs a cross platform view
Synergy identification with other parties	Yes	No, as EFFS will use multiple platforms therefore needs a cross platform view
Settlements (payment of flexibility providers)	Yes	Yes
Measurement of flexibility providers performance	Yes	Yes

Table 10: Flexibility platform functions

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