

Stability Pathfinder Phase 2: Expressions of Interest Final Assessment Methodology (v3)

Final version (v3), published May 2021

Changes Draft (v2) to Final (v3)

- Further clarification on how the costs of tenders starting on different dates are accounted for, both for tendered options and for options submitted by TOs
- More information on how the counterfactual of the Balancing Mechanism works
- Explanation of linked offers (example 5)
- Please note an update on TO capital costs in section 5.1

Changes Draft Version 1 to Draft Version 2

- Added detail on how infrastructure costs are provided and checked
- Added detail on our approach to assessing tenders that do not meet the latest in-service date of April 2024
- Added detail on how we will consider the cost of energy losses in any TO submissions
- Added detail on re-evaluating the solution in the case of tenders not progressing

Feedback

Thank you for your feedback on the draft versions of this document. This document is now 'final' and we will not change the methodology unless there is an exceptional reason to. You may still contact box.networkdevelopment.roadmap@nationalgrideso.com with queries, please also refer to the latest FAQ document in case your query has already been addressed there.

1. Principles

This document sets out the approach National Grid ESO intends to take in assessing options submitted to manage stability in Scotland as part of the Stability Pathfinder Phase 2 tender process.

Our aim is to ensure our Short Circuit Level (SCL) requirements in Scotland are met at the lowest overall cost to consumers on a £/SP basis, while also considering the additional value of options which reduce our national inertia need. This could be through contracting with commercial providers, asking a Network Owner to build a regulated asset, by managing the issue through Balancing Mechanism (BM) actions, or some combination of these.

2. Information required for the assessment

From the information to be submitted by participants as part of the tender process, the following will be used in the economic assessment of our preferred solution:

- A price in £ per settlement period (£/SP), in a 2021 price base, which should be inclusive of all costs faced by the provider, for example all applicable network / use of system charges, levies & losses. The value should be in 2021 prices.

- Short circuit current contribution in kA at the point of stability ¹at 100ms after a 3-phase symmetrical fault at 8 ESO locations of need. These values need to be demonstrated in the technical feasibility study and should be the additional capability only, as defined in slide 16 of the tender pack.
- Their contribution to inertia in MJ ², as stated in the technical specification. This should be the additional capability only, as defined in slide 16 of the tender pack. Their availability to provide inertia, as a percentage of settlement periods over the course of a year.
- Transmission substation name and voltage level at the point of stability
- Where a provider submits multiple options, they should indicate if any options are mutually exclusive to each other or part of an 'all or nothing' group.

3. What we are procuring

We are looking to meet a requirement for 8400 MVA of SCL across eight locations, with the minimum requirement at each location detailed in **Table 1**. We are also setting an inertia requirement for at least 6000 MVA.s of inertia, which will contribute towards our national need for inertia. We will not be valuing static / steady state reactive range.

For SCL, a contribution at any single point will reduce the requirement across all eight locations to different amounts, depending on the effectiveness for each location. Therefore, it is expected that the total SCL capability procured may be less than 8400MVA.

For inertia, we will seek to meet a minimum requirement of 6000 MVA.s and will stop selecting pathfinder or TO options either when this requirement is met or when it becomes cheaper to meet the requirement using alternative actions (i.e. the balancing mechanism).

We will seek an overall solution that minimises our net costs allowing us to meet these requirements. Tendered options will be compared to each other, TO assets, and to our counterfactual costs of using Balancing Mechanism (BM) actions. We may therefore procure less than our requirements through the pathfinder process if it is cheaper to meet the requirements in other ways.

Once we have selected the most effective options to meet the minimum requirements, the ESO reserves the right to procure additional options if we consider that particular areas could benefit from increased resilience. This could be due to the lack of alternative options to manage SCL in the area in the case of unplanned outages.

Table 1: Requirements at each location

Location	Ref	SCL Requirement (MVA)
Spittal	1	600
Blackhillock	2	1,300
Peterhead	3	1,300
Longannet area	4	600
Hunterston	5	1,200
Mark Hill/Coylton area	6	400
Moffatt/Elvanfoot area	7	1,800
Eccles area	8	1,200
Total SCL		8,400
Inertia	9	6000 MVA.s

¹ Point of Stability is defined in the technical specification.

² 1 MJ = 1 MVA.s

4. Parts of the Assessment

4.1 Effective SCL Contributions

Each solution will be assessed using its effective SCL contribution in MVA. The effective MVA of a solution is the contribution toward the SCL at the 8 requirement nodes for a fault at each of those 8 nodes. There will be two factors that contribute to this effectiveness:

1. The network impedance between the point of stability and the 8 requirement nodes. These are published by the ESO as the effectiveness factors.
2. The solution's short circuit current contribution for faults at the 8 requirement nodes. This is to be given by the provider and demonstrated for each solution at the feasibility study stage.

At the feasibility stage the ESO will provide a figure for the retained voltage (voltage dip seen during a fault) at a solution's point of stability for a fault at each of the 8 requirement nodes. The provider will then be required to calculate the reactive current output of their solution for these 8 faults. This is defined here as the short circuit current contribution in kA.

To get the effective short circuit level for each of the 8 locations, the ESO will multiply the 8 short circuit current contributions in kA by the effectiveness factors relevant to each location for that solution. We will convert these into MVA by multiplying the 'effective kA' by the phase voltage of the requirement node. This will result in a set of 8 'effective SCL' figures in MVA, which are then used in the assessment.

For a full worked example, please see Example 1.

4.2 Inertia

Based on feedback from the RFI, we are also setting an inertia requirement. We will buy inertia where the costs of doing so are less than our counterfactual option, for a requirement of 6000 MVA.s and subject to being technically feasible. If the full inertia requirement is met, there will not be any value associated with inertia above this limit.

If you are proposing a solution which could have more inertia added to it for an additional cost, we strongly recommend that you submit at least two mutually exclusive options with a cost for each different level of inertia. Once the inertia requirement has been reached, there will in effect be no value to buying any additional inertia, so putting forward a cheaper but lower inertia option raises the likelihood of being part of the solution to the SCL requirement.

For a worked example that shows how high and low inertia options might interact in the assessment, see Example 3.

4.3 Availability

SCL

We are looking for options with an availability of over 90% for SCL. Unless there are a significant number of options which cannot meet this availability requirement, options with lower availability will not be considered in the assessment. However, if we cannot meet our SCL requirements using only options with >90% availability, or to do so is more expensive than our counterfactual costs, then we may consider reducing the availability requirement and bringing these less available options into the assessment.

Inertia

As detailed in the EOI slide pack and Heads of Terms, providers will be able to specify their availability for providing the inertia service. In the assessment, we will multiply the stated availability % by the amount of inertia provided and compare bids on this basis. For example, a unit providing 500MVA.s with 100% availability would be valued the same as a 1000MVA.s unit with 50% availability. Inertia contributions should be a single number, where the availability is the proportion of settlement periods for which your inertia will be at or above this level.

4.4 Start Date

For contracts starting between 1st April 2022 and 31st March 2024, solutions will be compared on the same £/SP basis. This means that two options which both have the same availability price (£/SP) but connect on different dates within the above range will perform equally in the assessment, assuming all else (capability, location, infrastructure costs, etc.) is equal. The earlier starting option will however benefit from receiving availability payments from an earlier date as it can start to provide the service sooner.

The latest start date is driven by system needs, which is why we wish to procure options that can connect before this date. However, we will not fail an option at the EOI stage based on the connection date, allowing it to take part in the TO connections review. At this stage we will receive a better view of all options' start dates and may find it beneficial to select options which start later than 31st March 2024 if there are a limited number of options which can meet this start date.

After 31st March 2024, we will start to include an additional cost which is associated with options arriving late – the cost to manage the SCL and/or inertia by using units in the Balancing Mechanism (BM), where applicable.

When comparing options which connect before and after April 2024, we will include additional costs in those which connect after 31st March 2024 representing the incremental cost of using the balancing mechanism to manage an amount of SCL and inertia equivalent to what that option provides. This will mean that those who connect 'on time' will perform better than those who do not meet the deadline in an otherwise equal bid, for example a connection in May 2024 would be better than one in January 2025. This does mean that a 'late' option may beat an 'on time' option in the case where the earlier option is more expensive than the sum of the late option's costs plus the cost to manage its contribution in the BM for the period from April 2024 to its connection date. This avoids a hard cut off whereby options connecting before April 2024 would win at any cost over those who connect even a week beyond the deadline, while encouraging delivery before April 2024 where possible, especially for those locations with the most pressing needs.

4.5 MW Export

This tender is open to solutions which are not 0MW, however if the provision of the service is dependent on exporting **additional** active power to what would usually be expected, we will make an adjustment for increased balancing costs in our assessment. For example, if additional capability is added to a gas generator, but providing this capability requires the generator to run when it would be out of merit, this would cause additional costs to bid off a generator elsewhere on the system.

To do this, we will estimate the costs to re-balance the system to accommodate the active power export using our market modelling tool (BID3), Future Energy Scenarios, and assumptions on alternative generation. If a proposed solution must export additional MW to provide the service, then we may need to turn off generation elsewhere to maintain a balanced system. In this case, the generation that can be turned off may be limited to units that are not also providing a service such as inertia or SCL, leading to higher balancing costs than if the action were taken for thermal reasons.

4.6 Infrastructure Costs

When a user connects to the network, there are costs associated with assets for the new connection. Some of these will be connection assets where the cost is recovered from the connecting party through a connection charge. Others will be infrastructure assets, where the cost is socialised and recovered through TNUoS.

For solutions owned by TOs, the capital costs we receive will include the costs for assets which, for a user connection, would be infrastructure assets. Therefore, these costs are already part of the TO's costs as submitted for the assessment, while they do not form part of a commercial provider's tender bid price.

Commercial providers will have infrastructure costs added on to the cost of their contract for the assessment. The costs used will be provided as part of the connections review stage, or if a connection has a connection agreement then the costs in that agreement will be used. If the connection is not new, i.e. it already had TEC on the July 2019 TEC register, then the infrastructure costs of their connection will not be included. Costs from the connection review will be checked against the ESO's cost book to ensure accuracy, and we will also check that costs are consistent between connections. The costs we use will be specific to the location and connection type of each solution, and independent of any other proposed options at that site. It may be necessary to re-visit these costs if two options are selected at the same site and it is technically feasible to connect them both.

We are aware that some providers may plan to use their connection for the provision of other services. It is not possible to portion the costs up and reduce the infrastructure cost the project is assessed on as this would require us to make a judgement on the viability of future projects. If in the future you use the same connection to provide another service to the ESO, we will not count the infrastructure cost again for the assessment of that service as it will no longer be a "new" connection.

4.7 Availability Price

Each option should have an availability price per settlement period which should be inclusive of all costs faced by the provider. It will not be possible to change or negotiate the price after the commercial tender period closes. Depending on your solution these may include:

- Cost to build the asset
- Ongoing operating and maintenance costs, including
 - Energy costs, including all relevant levies and charges, e.g. Final Consumption Levies, TNUoS, BSUoS
 - Connection charges, as faced by the user (i.e. not infrastructure asset costs, which are socialised and accounted for separately)

It should not include:

- Additional costs associated with reactive power utilisation, which will be covered by an ORPS payment.

An estimate of connection costs will be provided by the connections review and these should be used to inform your bid if you do not have a connection agreement.

5. TO proposed options

Network Owners, i.e. Scottish Power Transmission (SPT) and Scottish Hydro Electric Transmission (SHET) for Scotland, will be invited to propose options for inclusion in this assessment via the regulated SRF route. Because of differences in how TOs are regulated, the way they recover their costs and the charges that apply to them, the methodology that applies will be different. We will aim to reflect the cost to the consumer of any option to allow for a fair comparison with commercial solutions.

A £/SP figure for comparison to commercial providers will be obtained by dividing the cost of TO options by the number of settlement periods for which they would be present. This means that TO options connecting earlier will be preferred over those connecting later. As with commercial options, we will also add BM costs to any TO option which is expected to be delivered after 1st April 2024.

5.1 Capital Cost and Operating and Maintenance Costs

TOs will provide us with a capital spend profile to build a given asset along with costs for ongoing operating and maintenance and the amount of energy it consumes. We will calculate a present value representing the cost to consumers of proceeding to build and operate the option, following the Spackman methodology and using the relevant TO's weighted average cost of capital (WACC) as agreed in the RIIO-T2 price control framework.

The approach that TOs should use when submitting the costs of their options, and if this should or should not consider any residual value after the tender period, is currently under discussion with Ofgem. Appreciating the importance of this information for informing the pricing strategies of other participants, we will provide an update on this as soon as possible and no later than two weeks prior to the deadline to receive commercial bids.

As TOs are not paid ORPS for reactive power, any costs associated with reactive utilisation should be included in the operating and maintenance costs. TO costs will be checked against the ESO's cost book for accuracy.

5.2 Adjustment for Losses

The cost of energy losses from TO owned assets are passed onto consumers, not paid by the TO. However, commercial providers will have to pay for the energy their solutions use and are asked to build this cost into their bid. We will include an estimate of the cost of energy losses to consumers for TO solutions and add this onto a TO's assessment cost. TOs will provide details of their solution's energy consumption and using FES electricity price forecasts we will calculate an estimated cost for losses. We will assume 24/7 operation (8760 hours per year).

The four FES scenarios include different assumptions on the future price of energy, and consumers will be exposed to changes in this price. If we find that the solution is sensitive to the scenario used (i.e. that using the cheapest cost of energy leads to a TO option being selected, while the more expensive scenario does not) then we will perform a least-worst regrets analysis on the competing options. The tendered option's cost will remain the same in each scenario,

while the TO's will differ with the energy price assumption. If choosing the TO in the most expensive energy scenario carries less regret than choosing the alternative in the least expensive energy scenario, the TO will be preferred. See Example 4.

6. Further Notes on Assessment

Costs that are incurred across future years will be discounted back to a single year in line with the recommendations of the Treasury Green Book (i.e. a discounting rate of 3.5% for the first 30 years). Any spending by Transmission Owners, including infrastructure costs and any TO proposed solutions will be converted into a present value according to the Spackman methodology, using the TO's Weighted Average Cost of Capital.

Providers are allowed two weeks per year in which outages can be taken without an impact on their availability payments and availability performance figures (see Contact Terms). We will not be costing outages in the assessment.

6.1 BM Counterfactual Option

To ensure consumer value the options submitted through this pathfinder will be compared to this counterfactual cost. The balancing mechanism (BM) can be used to meet SCL and inertia requirements by bringing generators online which contribute to those requirements.

To value BM costs we need to match the SCL requirement in each location and settlement period with available generation, which is a function of the scenario's generation background and availability to spin up. A Linear Programming (LP) optimisation algorithm is utilised to find the lowest cost solution for each hour, while meeting constraints such as the requirement. The BM costs are determined by combining the cost of accepting offers on the available generators up to their stable export limit (SEL). We need to maintain the balance of generation and demand, so the cost of bidding off an equal amount of generation elsewhere is also included.

This model is run across the whole pathfinder period and will be used both to calculate the cost impact of accepting options which start beyond April 2024 and in comparing the cost of tendered options with the alternative of not procuring that capability and instead using the BM to manage the requirement. If it is cheaper to manage some level of requirement using BM units than to use tendered options, we may buy less than our requirements through the pathfinder. The BM costs will vary based on location and the size of the requirement, and there may not always be a BM alternative due to a lack of generation in a given area. The BM units used are informed by the ESO's view from the Future Energy Scenarios of the likely future generation in the area over the whole tender period.

6.2 Finding the Optimal Solution

We will use a linear optimisation tool to find the most cost-effective solution to our requirements. It will be set up to minimise cost, subject to meeting all eight SCL requirements and the inertia requirement, and constraints such as mutually exclusive options. Mutually exclusive and 'all or nothing' constraints will be added based on the information in individual tender submissions, as well as to reflect any constraints that prevent multiple solutions from different providers from connecting. For example, if two options are proposed on the same piece of land, such that only one could be built.

Each option will have a set of eight effective SCL contributions, one for each node where we have set the requirement. They will also have an inertia contribution. Their cost will be the total present value over eight years (with options that start late having costs calculated as if they arrived in April 2022).

In addition to the options submitted by tender parties and TOs, there will be options that represent the cost of buying different amounts of SCL and inertia using balancing mechanism units. This may mean that the full requirement is not bought from the pathfinder solutions if the cost would be excessive and there are alternative actions we could take to meet the requirement.

Option	Cost	SCL_1	SCL_2	SCL_3	SCL_4	SCL_5	SCL_6	SCL_7	SCL_8	Inertia
A										
B										
C										
...										
[Costs for BM actions]										

Once a solution is found, we will check that it is feasible technically, and that there are no interactions between the selected options.

6.3 Re-evaluating the solution

Whilst we expect that all options proffered in the tender will progress to a signed contract if selected as part of the optimal solution, there may be circumstances in which an accepted option does not progress to contract as expected³.

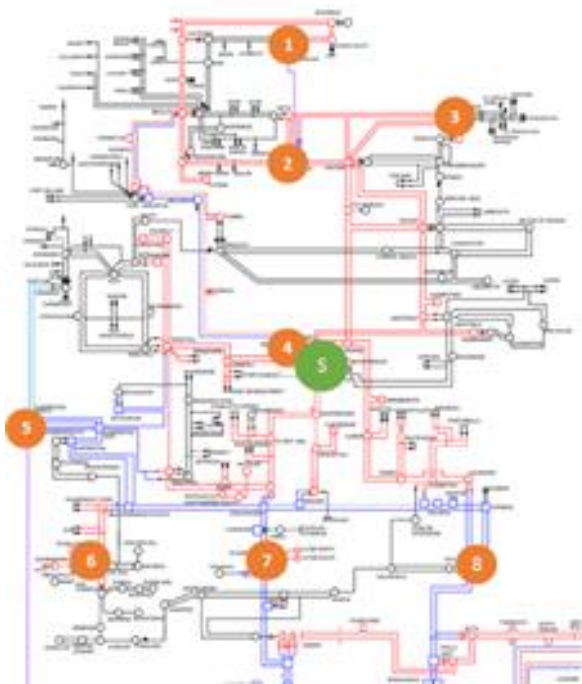
When communicating the results, we will make clear if any offer is linked to another party also signing their offer. There will be a period of time, specified in the invitation to tender, after we make the offers for all parties to sign them. If any of the linked offers are not signed, we reserve the right to reconsider all the linked offers in this period. Once all the linked offers are signed, we will not remove any as a result of other unlinked offers failing to progress.

If we need to re-evaluate the solution after this period then we may procure the most economic replacement(s) for the option(s) which have not progressed only, while keeping previously accepted options as part of the solution. The replacement(s) could be chosen from the previously unsuccessful tendered options (if tenders are still valid), managing the system through the Balancing Mechanism, or re-tendering for the remaining requirement if necessary.

7. Examples

7.1 Calculating Effective MVA values for SCL requirements

Note: Numbers are illustrative in order to demonstrate the process. This example has been also been reproduced in excel form as part of the Effectiveness Figures (v3) spreadsheet.



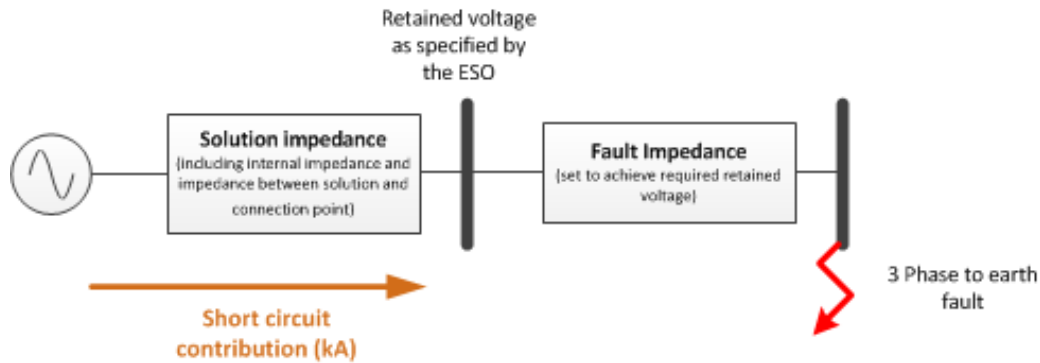
In the example a solution is proposed at Longannet 275kV substation. At the feasibility stage, the ESO will provide the retained voltage at Longannet 275kV substation for a fault at each of the 8 requirement nodes, as below:

Fault at:		Blackhillock	Eccles	Hunterston	Logannet	Peterhead	Spittal	Mark Hill	Moffatt
Retained voltage (P.U.)	Point of stability: Longannet 275kV	0.9	0.3	0.7	0	0.5	0.6	0.3	0.3

Note: figures for illustration only

³ See contract terms for details on our approach to assurance

Using this data, providers will be expected to provide the fault contribution at their point of stability for a remote fault causing the given retained voltage. Further guidance on how to provide this is given in the feasibility study guidance.



The information returned by the provider is expected to look like:

Fault at:		Blackhillock	Eccles	Hunterston	Logannet	Peterhead	Spittal	Mark Hill	Moffatt
SCL contribution (kA)	Point of stability: Longannet 275kV	0.06	2.02	2.02	3.36	1.34	0.67	0.33	2.02

Note: figures for illustration only

To get the effective SCL the above numbers are multiplied by the published effectiveness values and converted into MVA using the equation:

$$S_n = \sqrt{3}VI_sE_n$$

Where;

S_n is the effective SCL (in MVA) at point n, each of the eight nodes where the requirement is defined

V is the line voltage of the substation where the requirement is defined.

I_s is the Short circuit current contribution from the solution

E_n is the effectiveness factor of the solution from the solution’s location to node n, the substation where the requirement is defined

The effectiveness factors for Longannet 275kV are:

Fault at:		Blackhillock	Eccles	Hunterston	Logannet	Peterhead	Spittal	Mark Hill	Moffatt
Effectiveness factor	Point of stability: Longannet 275kV	12%	13%	23%	100%	15%	2%	13%	23%

Therefore, the effective MVA of the solution will be:

Fault at:		Blackhillock	Eccles	Hunterston	Logannet	Peterhead	Spittal	Mark Hill	Moffatt
Effective SCL (MVA)	Point of stability: Longannet 275kV	5	182	322	1600	96	6	20	322

7.2 Submitting 'bundled' options

If a provider would like to offer a range of prices depending on the total size of a solution, i.e. to reflect incremental costs associated with adding extra capability, or savings associated with taking forward multiple options, they can do so through a series of mutually exclusive options.

Example: Provider A would like to offer a 100MVA option for £1 /SP and a 150 MVA option for £1.50 /SP. However, it is possible to build both and if so they can offer a discounted price for the combined solution of £2 / SP.

The best way to present this information is to submit three options with different prices, as below.

Option A1, 100 MVA, £1/SP

Option A2, 150 MVA, £1.50/SP

Option A3, 250MVA, £2/SP.

Options A1, A2, A3 are mutually exclusive.

7.3 Worked example on Inertia Options

This example aims to show how submitting both smaller and larger options for inertia is beneficial where the provider is able to offer a choice on the amount of inertia, and how options with lower levels of inertia may still be beneficial in the tender.

	Cost	SCL_1	SCL_2	Inertia
A	160	180	30	800
B	105	10	90	110
C	105	15	100	110
D	100	160	60	250
E	140	40	140	400
E1	90	40	140	110

In this simplified example, we need 200 MVA of SCL at nodes 1 and 2, and 2000 MVA.s of inertia. Note that E1 is an option mutually exclusive to E, providing the same amount of SCL but lower inertia. The optimal solution is A + D + E1, costing £350.

If provider E had only submitted their higher inertia option E, the optimal solution would have been A+B+C, as this meets the SCL and inertia requirements at a lower cost than a solution involving E.

In this case, buying most of the inertia from larger providers and using cheaper, lower inertia, SCL providers proved to be the overall lowest cost option. In the pathfinder assessment, the additional cost of options with more inertia will also have to be competitive against using the BM.

7.4 Least Worst Regret Analysis

In these examples, two options' costs are compared across the four FES scenarios. The non-TO option, Option A, costs the same no matter the scenario as the availability fee they are paid is fixed. The TO option's cost will change depending on the energy prices assumed in each scenario. The below examples show the possible outcomes.

	LW	CT	ST	SP
Option A	100	100	100	100
Option TO	105	99	103	96

min cost	100	99	100	96
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Regrets	Worst Regret				
Option A	0	1	0	4	4
Option TO	5	0	3	0	5

The non-TO option is chosen.

	LW	CT	ST	SP
Option A	101	101	101	101
Option TO	104	98	102	95
min cost	101	98	101	96

Regrets	Worst Regret				
Option A	0	3	0	6	6
Option TO	3	0	1	0	3

The TO option is chosen.