Stability Pathfinder

Technical Request for Information

Interactive Guidance Document

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Version Control

Version	Date published	Page No.	Comments
1.0	19/07/2019		

How to use this guide

- A menu button on each page allows access back to the main menu, or section menu where required:

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A toolbar runs along the bottom of every page, allowing for quick navigation to section menus. Coloured icons allow navigation to relevant sections of the document**.**

1. Context & Market Information | 2. Stability Overview | 3. Technical & Assessment Criteria | 4. How to Participate | 5. Next Steps

- Sections of the guidance are colour coded, for ease of use.

- Please contact box.networkdevelopment.roadmap@nationalgrideso.com if you have any questions or feedback.

Note: icons on this page are for illustration only - links do not work.

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1.1. Context

Why are we doing this?

- The System Operability Framework (SOF) has highlighted the operability risks expected due to the decline in transmission connected synchronous generation over the next decade.
- As part of our Network Development Roadmap, we want to explore benefits and practicalities of applying a Network Options Assessment (NOA)-type approach to the operability aspects of system stability.
- This Request for Information (RFI) is the next step in expanding the process for stability solutions to be included in the assessment of market-based solutions against Network Owner solutions.
- The outcome of the stability pathfinder will be a recommendation of the most economic & efficient solution, which should be taken forward.
- The recommended solution could consist of market-based options, Network Owner options or a mix of market based and Network Owner options.
- For the avoidance of doubt, an outcome could be that we accept no market tender and/or no Network Owner options if none of the options considered in the process provide benefits against forecast Balancing Mechanism (BM) cost to otherwise maintain stability.

1.1. Context

Aims

We would like to understand through this RFI:

- The ability of all interested parties to provide solutions to meet the identified stability needs
- Level of interest to provide a stability product to meet the identified needs
- Delivery timescale of options
- Potential framework restrictions

We would also like to seek feedback on:

- Assessment principles
- Preferred contract structure

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1.2. Wider Activities Impacting Stability

There are a number activities that have potential interaction with stability pathfinder.

Some are noted below.

- Grid Code VSM Expert Working Group
- Applying a ‘Network Options Assessment’ to Voltage
- Black Start Tender
- EU Code Implementation
- EFCC NIC Project
- Phoenix NIC Project
- NOA Voltage Methodology

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1.3. Pathfinders

As part of our network development roadmap, we are undertaking various pathfinder projects. These pathfinder projects are a way for us to 'trial and test' a new process. For more information on pathfinders, please see our Network Development Roadmap page.

For the stability pathfinder, we are looking at Scotland in detail as explained in our recent SOF report on 'Impact of declining short circuit levels'.

High Voltage Pathfinders	Constraint Management Pathfinder	Commercial Solutions Pathfinder	Thermal Probabilistic Pathfinder	Stability Pathfinder
Mersey	Selected ETYS* boundaries	Selected ETYS boundaries	Selected ETYS boundaries	Scotland detailed analysis
Pennine				England & Wales high-level analysis

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*ETYS- Electricity Ten Year Statement

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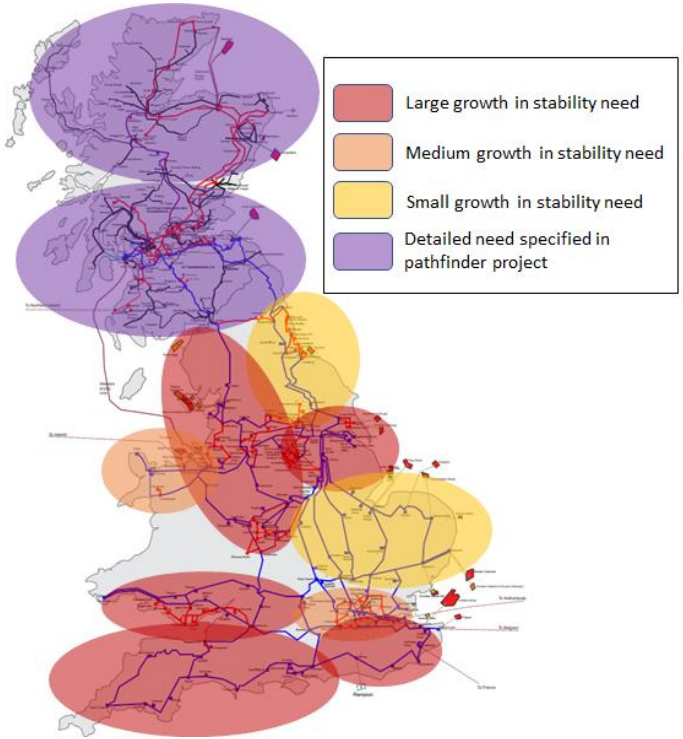
1.4. GB Areas of Stability Focus

- Our assessment shows that our need for stability products is different across the country.
- High-Voltage pathfinders in Mersey and Pennine are addressing static high voltage requirement which is separate to our stability needs in these areas.
- For Stability Pathfinder, we have carried out detailed assessment of Scotland and high-level assessment of England & Wales (E&W)
  - Scotland solutions are our priority and we set out timeline proposals for these later in this pack.
  - For E&W, we will set out priority areas for solutions based on RFI responses and our needs for stability growth. We will set out next steps for E&W post RFI feedback.



1.4. What are we looking for across GB in this RFI

	E&W short term	E&W long term	Scotland short term	Scotland long term
Technology Readiness Level (TRL)	7-9	≥5	7-9	≥5
Solution years	2020-2022	2023-2030	2020 - 2022	2023 - 2030
Next steps	Tender for 2020*	Prioritisation based on RFI feedback	Tender for 2020*	Timeline proposed

*Based on RFI feedback, we will publish next steps

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1.5. How information will be used

We will use the information received to inform our decision on next steps and shape our:

- Contract structures
- Assessment criteria and principles

We will publish an anonymised summary of the findings of the RFI. At this stage, no commercial sensitive information will be published.

1.6. Market information for 2020 to 2030

Information is being primarily sought on the potential of service provision from 2020/21 financial year onwards. We do not however preclude consideration of earlier services offered both in the principle analysis area and outside of it.

Long-term requirement is sensitive to uncertainty over future assumptions. At this point in time we will consider procurement for the following:

- Procurement options will be considered for a maximum of 10 years between 2020/21 and 2030/31
  - We are interested in solutions that can be delivered at any time between 2020/21 and 2030/31
  - The procurement could be yearly or longer based on system needs and cost benefit analysis
- We would require a minimum level of availability year-round between 30 March 2020 and 30 March 2031 – this is also specified in our minimum technical criteria (Refer to RFI Attachment 1)
- Our analysis tells us that solutions become significantly more effective as their connection voltage increases (Refer to SOF report on Whole system short circuit levels). This is consistent with our expectation that effectiveness increases as network impedance reduces and means that we are very much focussed on transmission connected solutions in this exercise. We welcome engagement from all providers, including those who see an opportunity to connect at distribution voltages, but would ask interested parties to note that we believe it is unlikely that solutions based on a connection below transmission voltages will deliver best value for consumers.

RFI Feedback Questions -1

1. What is the current status of your solution(s)? (built, concept, in delivery, other)
2. What is the Technology Readiness Level of your solution(s)?
3. How long will it reach to get to TRL 9?
4. What location(s) are you interested in? Give indications of substation site/ voltage level
5. What is the earliest in service date possible for your proposed solution(s)?
6. What is the minimum contract length you are looking for and why?
7. What indicative prices per year are you expecting (£/year)?
8. What key milestones/ steps would need to be addressed to achieve your solution? (flag dependencies)
9. When the proposed solution(s) will be available for connection?

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2. Stability Overview

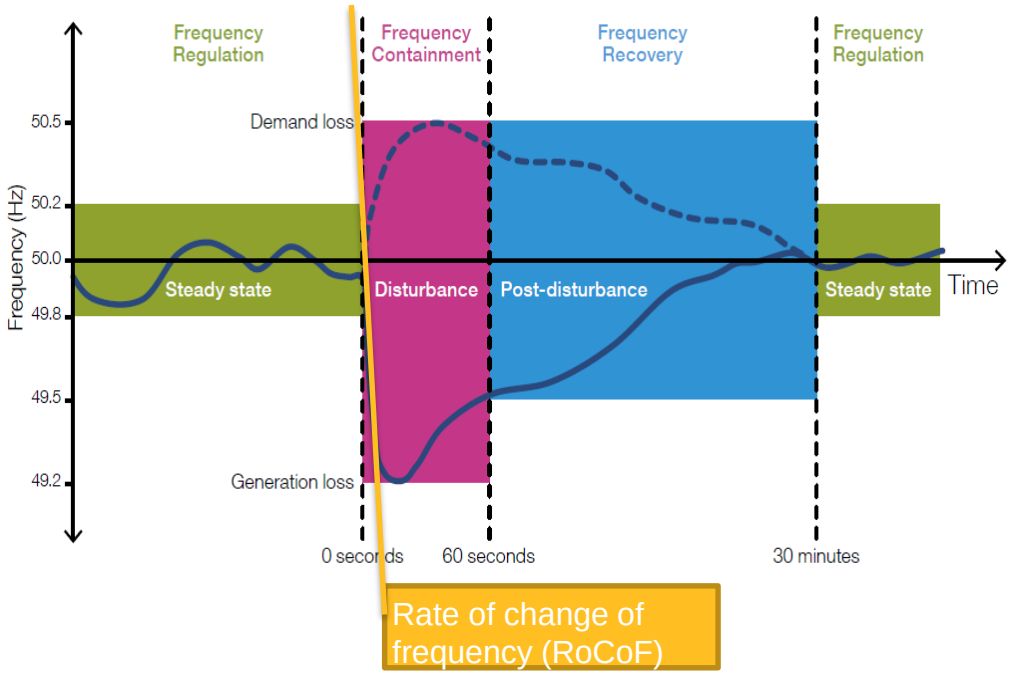
2.1. Stability Context

System Operator Obligations	■ The System Operator has a statutory obligation to ensure a safe, secure and economic system. ■ The System Operator is required to maintain frequency within statutory limits and ensure safe, stable and economic operation of the transmission network. ■ The System Operator is required to maintain voltage within within statutory limits and ensure safe, stable and economic operation of the transmission network.
Stability Context	■ By stability, we mean the stability of frequency and voltage, and the ability of a user to remain connected to and to act to support the system during normal operation, during a secured fault or after a secured fault, without any restriction in doing so that would relate to the strength of the system at that time. ■ Properties of synchronous generators such as short circuit level, fast fault current injection and inertia mean that decline in availability may impact stability of system voltage and frequency. ■ With decline of synchronous assets and increase of non-synchronous generation on both transmission and distribution networks, stability needs are evolving.

2.1. Stability Context

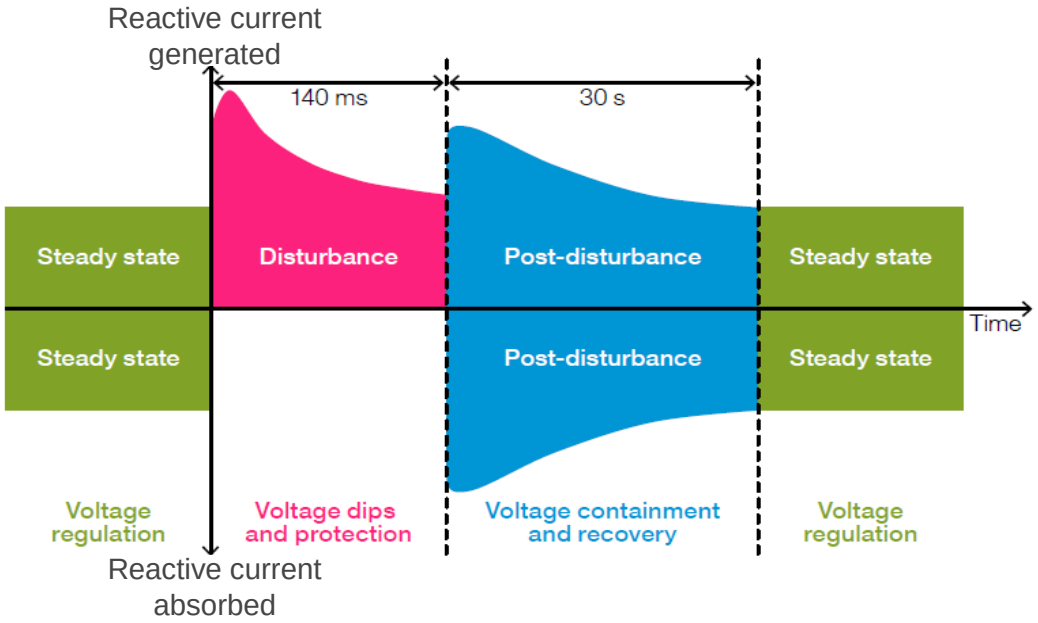
Stability Context – National	■ At national level, frequency is maintained within limits by consideration of frequency response/reserve market products. ■ At national level, Rate of Change of Frequency(RoCoF) is maintained within limits by consideration of largest generation/demand loss on the system and planning for national levels of inertia.
Stability Context – Regional	■ Based on the conditions at the time, regional levels and the distribution of regional inertia across GB has the potential to influence the scale of regional variations in RoCoF, or regional frequency variations- such that regional impacts could be beyond established National limits. ■ Voltage is a regional characteristic and it is maintained within limits by consideration of the balance of local/regional reactive power support both through TO assets or market products. ■ Voltage support must be provided across all times of regulation, the period of the fault/ disturbance, and the recovery period immediately following it. Whilst voltage can be supported statically as well as dynamically, only dynamic support can be provided across all periods of a disturbance. Support approaches may be unique, or layered across a variety of solutions to achieve this. ■ Short circuit level is a regional characteristic, influenced by local network elements (demand, generation) and is important in ensuring local voltage, frequency stability and control system integrity.

2.2. Frequency Stability Overview



- Figure illustrates frequency management at different network states.
- RoCoF, calculated in Hz/s, is a local measure of how fast frequency is changing following a network disturbance. This measure may be influenced regionally by the effect of the disturbance itself. Containing RoCoF contains the risk of embedded generation disconnection subject to disconnection under loss of mains relays.
- Synchronous machines and motor demand provide instantaneous energy or inertia in case of a network event which limits the rate at which frequency changes.
- During a disturbance, regional frequency can be different to national average, as explored in our NIC EFCC project.

2.3. Voltage Stability Overview



- Figure illustrates voltage management at different network states.
- Voltage requirements vary regionally across different periods of a fault/disturbance.
- With more non-synchronous penetration in the electricity network
  - There is increased need of immediate reactive support during a disturbance and immediately after.
  - There is increased risk of combined voltage and frequency events. (Highlighted this in our SOF report on Voltage and frequency dependency)
- High voltage pathfinders in Mersey and Pennine are considering voltage regulation requirements during the steady state period.

2.4. Impact of Short Circuit Levels

Short circuit level (SCL)	■ Short circuit level is a measure of system strength. It is a measure of how extensive a disturbance is, and how quickly the system recovers following a disturbance. (Refer to SOF 2016 Document) ■ Transmission system SCL currently dominated by synchronous generators is declining. ■ Devices/equipment which provide short circuit level can provide support to the resilience of: • Network protection • Stability of PLL based converters • Retained voltage levels • Voltage angle change and withstand
Protection	■ Transmission system protection systems are designed and configured to meet a certain level of SCL.
Phase locked loop (PLL)	■ Inverter based plant such as HVDC links and wind farms are configured to track AC transmission system phase reference assuming quality performance at a certain level of SCL. ■ For low SCL, PLL based plant could be at risk of losing system reference. (Refer to SOF 2017 PLL Report)

2.4. Impact of Short Circuit Level on Stability

Retained voltage	■ Retained voltage is referring to the voltage across the network during a disturbance/fault. ■ Areas with high SCL benefit from higher fast fault current injection which means higher retained voltages within the transmission and distribution systems away from the fault. ■ If the retained voltages drop below specifications in Grid Code, generation is at risk of tripping. ■ In SOF, in Grid Code modification GC0100 and the VSM expert working group, we highlighted the need for fast fault current injection to support retained voltages during a fault, as SCL declines.
Voltage angle change withstand and support	■ Voltage angle of the system is defined by the action of generators to support an acceptable voltage profile across the system to support power flow. During a fault or disturbance, this is supported immediately by synchronous generators. ■ Decline in synchronous generators means that voltage angles will move to a greater extent, and more rapidly during a disturbance. ■ Existing inverter based plant, deliver active and reactive power by measuring and predicting movement of voltage angle. In low SCL, these plants will be at risk of losing system phase reference due to a volatile voltage angle movement- a potential risk that either they will trip or behave in an unexpected/ unhelpful manner.

2.5. New Stability Support Product

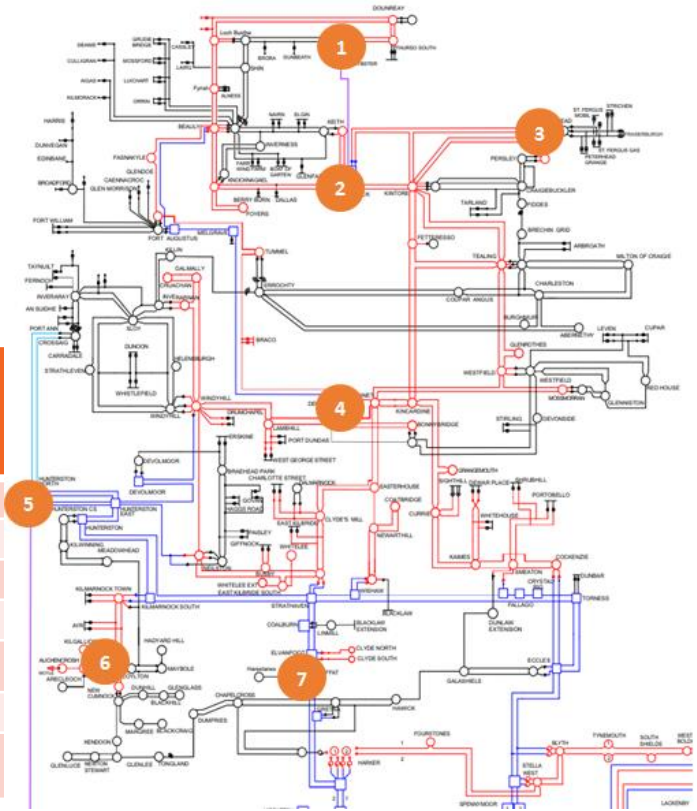
Stability support product description
Transient voltage dip, short circuit level and inertial support. Immediate post fault response to limit voltage deviation, and contain voltage angle movement.

2.7. Scotland Locations

- The total requirement across these 7 sites we want to procure for is 6000 MVA (at 1.5 p.u.).
- Each MVA of the potential solution is expected to meet and demonstrate technical performance criteria in Attachment 1.
- Solutions at sites other than listed will be assessed individually for their effectiveness.

Numbers are indicative of the scale of potential solutions and will be reviewed as the pathfinder progresses.

Ref	Location of 100% effectiveness	Requirement (MVA at 1.5 p.u.)
1	Spital	1000
2	Blackhillock	1000
3	Peterhead	300
4	Longannet	800
5	Hunterston	1500
6/7	Mark Hill / Moffat	1400
	Total	**6000**



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3. Technical and Assessment Criteria

3.1. Technical Specification

3.2. Assessment Criteria

3.1. Technical Specification

Potential providers are expected to meet the technical specification criteria specified in the Technical and Assessment Criteria document.

Refer to Attachment 1 of this RFI pack for details.

3.2. Assessment Criteria

Refer to Attachment 1 of this RFI pack for details.

Pass/Fail	Minimum technical criteria across all time periods
Commercial 100%	Cost Benefit Analysis (CBA) *Considering cost, effectiveness of solutions and the ability to provide support without impacting the energy market (MW)*
Technical additional consideration between otherwise equivalent value commercial solutions	Connection diversity
	Resilience of support
	Enhanced capability for stability support

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4. How to Participate

Please use the Feedback template in Attachment 2 of this RFI pack to respond.

The deadline for submission of information is 13th September 2019. Please send your responses via email to box.networkdevelopment.roadmap@nationalgrideso.com

For any queries, please tell us if you consider a query to be confidential and if yes, please explain why.

Webinar will be held on 6th August 2019

Webinar sign up

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5. Next Steps

5.1. Next Steps

5.2. Timescales Proposal

5.3. Feasibility Process

5.4. Technical Model Requirements

5.1. Next Steps

Subject to RFI feedback

- Prioritise GB areas for stability tender (e.g. Scotland being high priority due to the level of detailed analysis, but where options emerge elsewhere, further investigation may also be prioritised)
- Publication of short term tender steps
- Expression of Interest submission for Scotland

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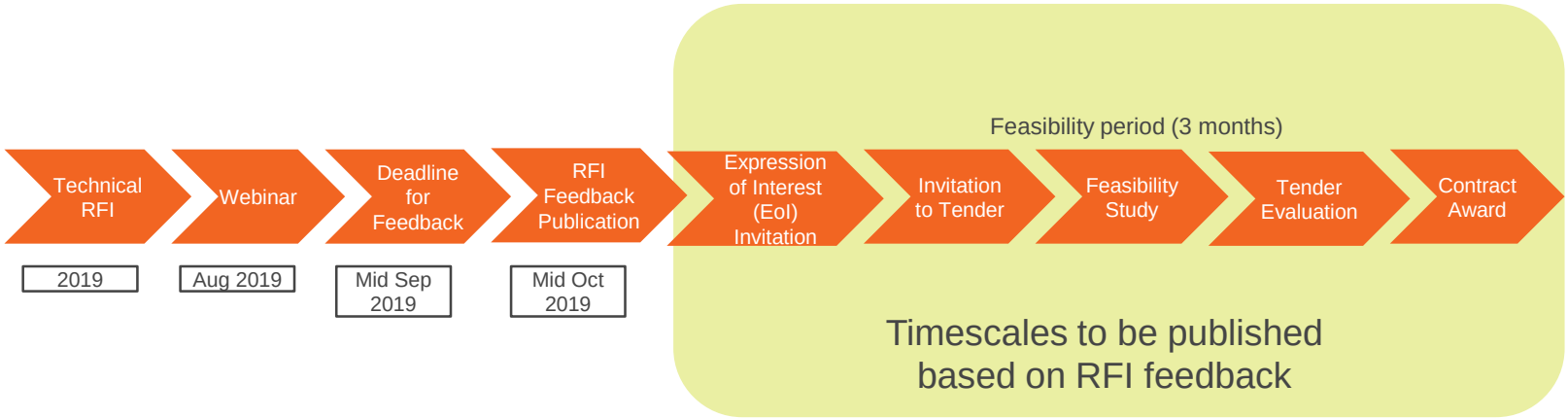
5.2. Timescales Proposal for Scotland

This proposal is for Scotland solutions for 2023 onwards



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5.3. Feasibility Process

- We will invite potential providers to submit their Expression of Interest (EoI)
- After submission of EoI, we will assess proposed solutions against the technical criteria.
- A pass/fail outcome of this step will be bilaterally communicated. The outcome of that first assessment step will result in an invitation to tender for successful parties.
- As part of the tender process, solution providers will be required to demonstrate meeting technical criteria during a feasibility study stage.
- We will prioritise the programming of these feasibility studies, based on:
  - the intended delivery timeframes of these solutions
  - their need and location
  - solution complexity and analysis requirements
  - mutual resource availability of solution providers and ourselves to support investigation

Whilst maintaining the viability of all solutions being taken forward.

5.4. Technical Model Requirements

- In Appendix A of Technical and Assessment Criteria document, we set out our views on technical modelling requirements from the potential solutions providers.
- As part of this RFI, we want to get your feedback on these aspects.

RFI Feedback Questions -2

10. Appendix A of attachment 1 describes our proposed modelling and compliance expectations,
    a. What other requirements do you suggest?
    b. What format of models (EMT/RMS) could you provide, on what basis and timeframes?
    c. What information could you provide that would allow models to be validated?

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RFI Feedback Questions -3

11. Any comments on the proposed timelines
12. Any comments on technical performance specification
13. Any comments on general assessment principles
14. How long or short you expect feasibility stage to be and why?
15. What contract structures/terms would be important to you?
16. Are there any other code/ frameworks/ other clarifications important to progressing these solutions?
17. Any other comments or feedback.

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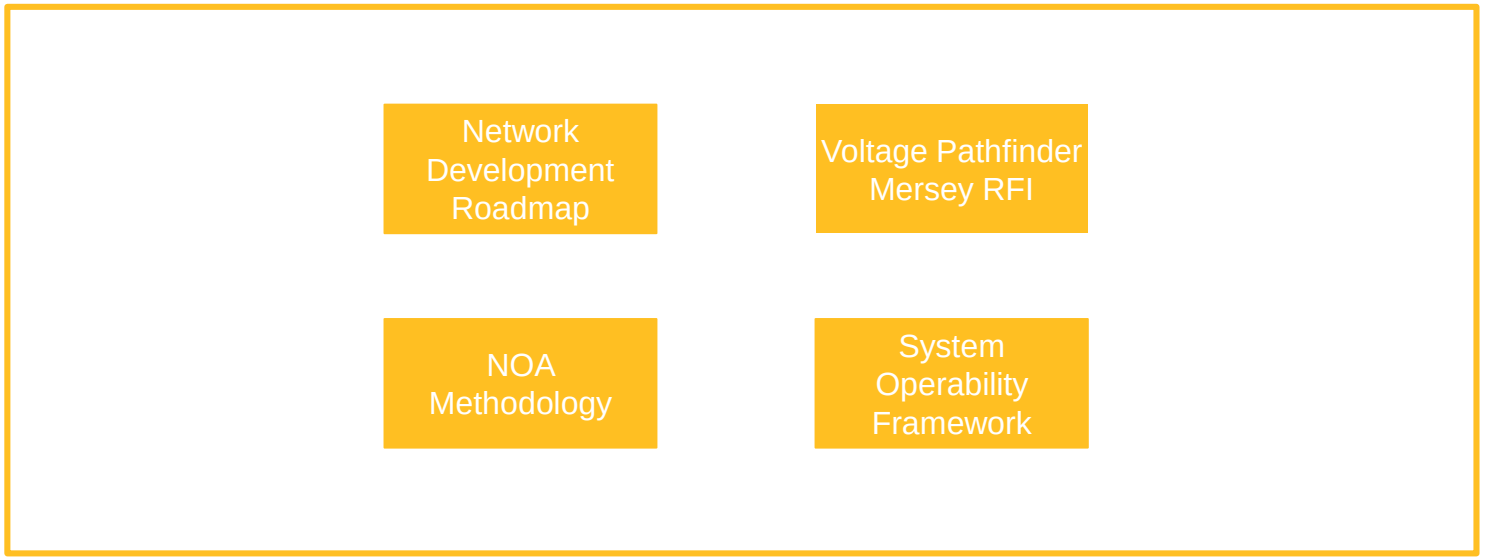
Key documents



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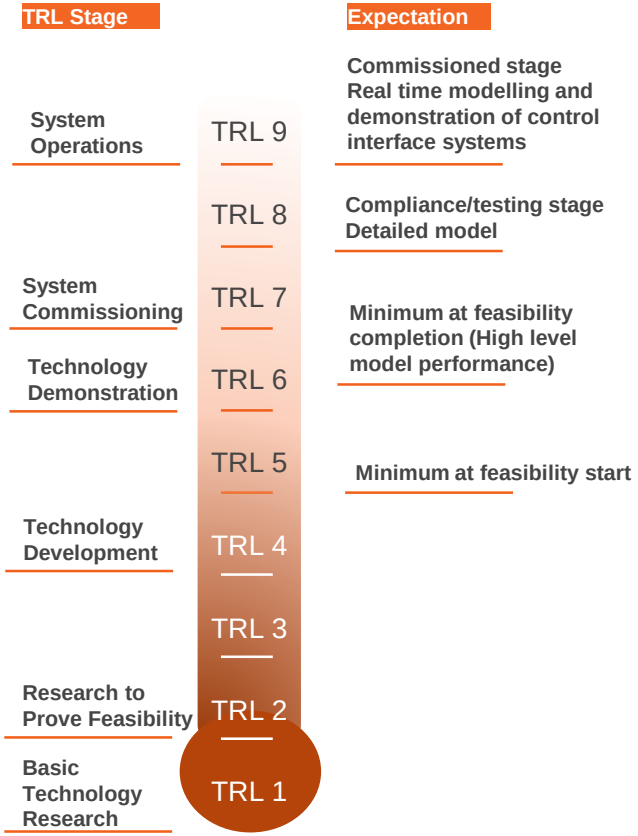
Technology Readiness Level (TRL)



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RFI Attachments

Attachment 1: Technical Performance and Assessment Criteria

Attachment 2: RFI Feedback Template

Attachment 3: TRL Description

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