

Guide

Non-Firm Access Connections for Distribution Connected Distributed Generators

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Introduction

The purpose of this document is to outline ESB Networks' plan for the introduction and development of Non-Firm Access (NFA) for connection of distributed generators (DG) to the distribution system.

In general, the principle of NFA is to enable the connection of further DG connections to the distribution system, and to enable those distributed generators to remain connected, as long as the distribution system is in a particular configuration. Any event which alters that configuration (e.g. a planned or fault related outage) will require the DG to disconnect from the distribution system or may, in future approaches to be developed, to reduce output appropriately as an alternative.

ESB Networks is committed to introduce NFA connections during the Price Review 5 (PR5) period (2021-2025), and to develop these and other approaches further over time. The introduction and development of NFA will enable the connection of further distributed generation to the distribution system, and in conjunction with other measures, assist in achieving the targets set out in the Climate Action Plan 2019¹ with respect to generation of electricity from renewable sources.

The initial introduction of NFA will be based on non-firm transformer access, where network access upstream is treated as secure, and the current technical criteria apply.

This application represents the initial introduction of NFA, however further developments will be considered in the future.

Future developments may include:

- Development of robust means for signalling and communication to a DG incorporating a proof of concept trial to utilise an agreed reduced Maximum Export Capacity (MEC) for the DG for specified planned or fault related outages, rather than reducing to zero or disconnecting
- Trial of NFA for a more variable MEC for specified planned or fault related outages
- Development of further active management approaches

It is intended to hold a public consultation later in 2020 on the further development of NFA proposals, including further consideration of:

- The impact of microgeneration
- Treatment of NFA connections where load related reinforcement is required
- The order in which NFA connections are affected in future development or in the event of future interactions, e.g. pro-rata, last-in-first-out (LIFO), curtailment, etc.
- Interaction of NFA and other operational aspects of system operation such as flexibility, DS3, etc.
- How the presence/absence of constraint payments affects switching order and criteria
- Other related issues

A timeline for the development and enhancement of the NFA process is also included.

¹ https://www.dccae.gov.ie/en-ie/climate-action/publications/Documents/16/Climate_Action_Plan_2019.pdf

i. Scope

This document outlines ESB Networks plan for the introduction of Non-Firm Access (NFA) for distribution connected DG connections.

Firmness of access to the transmission system is not covered by this document.

The document is structured as follows:

- Section 1 sets out general principles applied in the consideration of NFA by ESB Networks.
- Section 2 outlines the initial proposal for introduction of NFA.
- Section 3 overviews potential developments for NFA and highlights increasing complexities and areas for consideration.
- A roadmap showing the development and enhancement of the Flexibility services over PR5 (2021-2025) and into PR6 (2026-2030) is detailed in Annex B.

ii. Mandatory References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies.

Table 1: Mandatory References

| Document No. | Title |
|--------------------------------|---|
| DOC-170220-FOM | The Distribution System Security and Planning Standards |
| - | Climate Action Plan 2019, Department of Communications, Climate Action & Environment |
| DOC-041119-FFN | Public Consultation on Smarter HV and MV Customer Connection Project - New Approaches to Distribution Planning and Security of Supply Standards |

1. Non-Firm Access General Principles

Implementation of NFA requires the identification of the limitations that restrict access for further DG connections and then the constraining of the DG so that the limitation is not breached.

The methods by which the limitations can be identified, and the generator constrained, vary from simple, involving an absolute constraint on generation when a limitation is expected to be breached, to complex, involving constraining off generation in proportion to what is required to ensure that the limitation is not breached. In the simplest case the DG is disconnected from the distribution system, and in the complex case the output is constrained to ensure a limit is not breached.

It must also be realised that more than one generator may wish to have NFA to the same network, and this could lead to excessive complexity and deterioration in the reliability of the network.

Furthermore, the risk associated with operating networks at their limits increases the likelihood that a maloperation of the scheme could result in extensive damage to the network and disruption to demand customers and other generators. This is because NFA involves the connection of generation in excess of the firm network capacity available, so that the system is operating at the margin and any default could affect the correct operation of the associated network.

Costs, including those associated with the day to day operation of such schemes, should be allocated appropriately amongst those using the distribution system.

The implications of the above are that:

- a) NFA schemes should not unduly infringe on rights of existing generators, i.e. existing connected generators or those with signed connection agreements.
- b) NFA schemes should not initially require centralised control and should operate automatically with fail safe procedures from a local HV station controller.
- c) NFA should be initially applied in simple schemes and should be limited so that interactions between different schemes do not occur, e.g. application at 38kV and above would be simpler than at lower voltages.
- d) Risk and costs associated with the implementation of NFA schemes should not be borne by demand users or generators not associated with the NFA scheme.
- e) NFA schemes should be designed in such a way that they facilitate the future development of more complex schemes (e.g. by ramping export down to a reduced level) which would provide increased benefits to the system.
- f) A feature of an NFA scheme is that in the event of planned maintenance on a particular network component or circuit, the generator will be impacted for the duration of the works, and this time period may be extensive, up to several months.

2. Initial Non-Firm Access Offering

2.1 General

Non-firm second transformer access will be available for HV/MV transformer capacity from the second HV station transformer, utilising a hard-intertripping / special protection scheme arrangement within the HV station, subject to limitations as set out in Section 2.2.

This is the first such ‘non-firm access’ initiative and as such a simplified regime has been utilised as this ensures that it can be implemented successfully and also that it is unlikely to limit or interfere with other future NFA initiatives.

A non-firm access DG connection will be treated as secure on the network for upstream circuits and transformers on the distribution system (i.e. above the immediate connection voltage). In order to provide secure access from the upstream networks, additional reinforcements may be required. Transmission system reinforcements may also apply, and this would be specified by the TSO.

Figure 1: Simplified HV station example

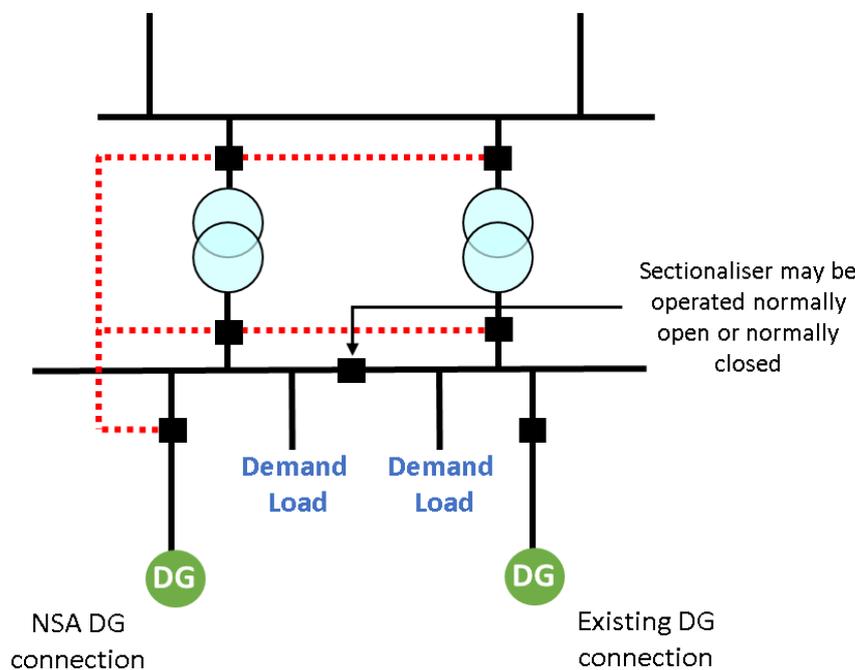


Figure 1 represents a typical two transformer HV/MV station (38/MV or 110/38/MV or 110/MV); there are two transformers in service and a demand load connected to the station.

An existing firm access DG is connected, the available capacity for which is based on the criteria as set out in section 7.3 of the Distribution System Security and Planning Standards document. This allows for a planned or fault related outage of a transformer, without causing an overload on the remaining plant. However no further DG can be accommodated at the station without causing an overload on the remaining plant, and therefore requiring a reinforcement.

In the NFA arrangement, the available capacity will be based on the capacity of a single (second) transformer, taking into account that all the firm DG capacity has full standby cover in the event of a transformer unavailability. This means that under normal system conditions, further DG can be accommodated at the station.

However, in order that the remaining plant is not overloaded in the event of a planned outage of a transformer, the NFA DG would be disconnected from the system in advance of the planned outage. It may additionally be possible for the DG affected by a transformer outage associated with the connection of new DG, to apply for outage mitigation

measures, subject to limitations conditions and technical acceptability². This may facilitate a reduced MEC for the duration of the outage. Otherwise the connection will not be restored until the transformer is reconnected.

In the event of a fault related outage the NFA DG would have its output restricted immediately by an intertripping scheme with the transformer circuit breakers (CB) with the signal paths shown by the dotted red lines.

2.2 Assessment Criteria

All of the technical connection assessment criteria set out in The Distribution System Security and Planning Standards apply in the consideration of an NFA connection for a DG.

In addition, a number of other factors need to be accounted for in the calculation of available capacity for an NFA connection.

2.2.1 Operational considerations

The NFA connection shall only be considered where practically implementable and operationally feasible and acceptable.

2.2.2 Busbar configuration

To avoid potential overload of the busbar, the NFA connection may have to be made to a different busbar section than any existing DG. Depending on the layout of the station, some reconfiguration of existing circuits may be required, which will form part of the connection requirements.

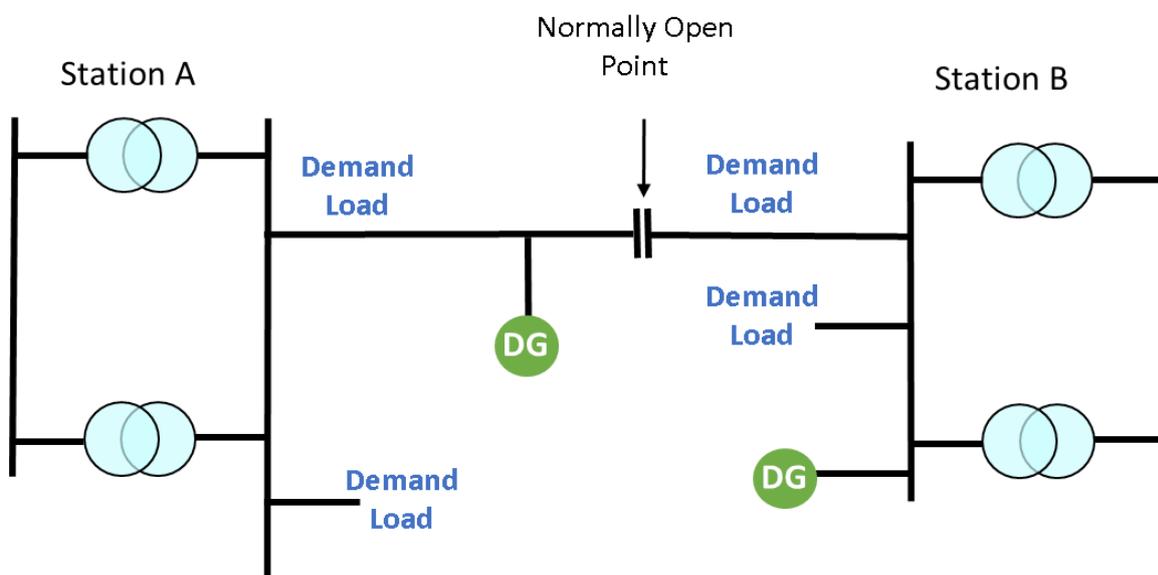
2.2.3 HV Transformer Circuit Breakers (CBs)

As an inter-tripping arrangement will be required, the HV transformers in the station must be connected through protected CBs³. Any required installation of CBs will form part of the connection requirements.

2.2.4 Existing DG connection arrangements

Any existing firm access DG connection will be accounted for in the calculation of available NFA capacity, e.g. where DGs are transferred to another station on a standby feeding arrangement.

Figure 2: Simplified operational consideration example



² <http://www.cru.ie/wp-content/uploads/2019/04/CRU19044e-GCLG-No.-50-Outage-mitigation-when-connecting-new-generation-ESBN.pdf>

³ Fault make-fault break duty with associated relays.

The existing DGs normally connected to Station A can transfer to Station B on standby, through closing of the normally open point shown. Their capacity will be accounted for when assessing capacity for an NFA connection to Station B, and will not be available for an NFA connection at Station B.

2.2.5 DG Connection Arrangement

As the NFA connection will utilise inter-tripping within the station, the NFA connection circuit must be connected directly to the busbar of the HV station via a dedicated and direct circuit.

2.2.6 Impact of microgeneration

A provision is made for the expected future growth in the connection of microgeneration, see Section 2.4

2.2.7 Eligibility for NFA

The aim of NFA is to facilitate access to the network for further DG, while the distribution system is in normal configuration. An energy storage facility cannot be considered as a DG for a non-firm connection.

2.2.8 Increase in fault level

With increased DG connection to a HV station under normal configuration, fault levels may increase and may be a limiting factor to available capacity. This will be assessed as part of the technical study, and an associated reinforcement may form part of the connection requirements.

2.2.9 Voltage fluctuations

Voltage fluctuations may be caused by switching NFA connected DG, and this will be assessed as part of the technical study. Future developments in reducing MEC (e.g. by ramping down to a reduced level) may mitigate such fluctuations.

2.3 Interactions within a Batch

Where there are interactions of DG applications within the same Enduring Connection Policy (ECP)⁴ batch and more than one applicant may be eligible for an NFA connection, the existing principles already in use will be applied, i.e. Least Cost Technically Acceptable (LCTA) connection method for the sub-group as a whole within the batch will determine the connection methods offered.

2.4 The Impact of Microgeneration

Microgeneration in Ireland is defined as generation connected at Low Voltage (LV), having a MEC of:

- 25A / 6kW, at single phase LV (230V)
- 16A/phase / 11kW, at three phase LV (400V)⁵

Distributed generators in excess of the microgeneration limits above are processed under the approved connection offer policy, currently ECP Non-Batch ($\leq 500\text{kW}$), and ECP Batch ($>500\text{kW}$).

The current approved ESB Networks policy for the connection of microgeneration is on an 'inform and fit' basis⁶, which facilitates the connection of microgeneration installations through a 'fast track' approach which generally does not

⁴ Enduring Connection Policy; ECP-1 is in effect at time of writing; ECP-2 is under consideration at time of writing; www.cru.ie/document_group/electricity-connection-policy-2/

⁵ www.cru.ie/wp-content/uploads/2007/07/cer07208.pdf

⁶ www.esbnetworks.ie/docs/default-source/publications/conditions-governing-connection-and-operation-of-micro-generation-policy.pdf

require a formal network study⁷. ESB Networks is currently assessing future developments under its Microgeneration Framework Project.⁸

The impact of microgeneration at LV (e.g. rooftop photovoltaic (PV) generation) is not considered material at present, but its prominence has increased since the ‘Smarter HV and MV Customer Connection Project - New Approaches to Distribution Planning and Security of Supply Standards’ Public Consultation⁹ in late 2019, and under the Climate Action Plan 2019¹⁰, the connection of further microgeneration is strongly supported, including the formalisation of a scheme for payment for electricity exports.

It is likely therefore that the penetration levels of microgeneration on the distribution system will increase. This expected growth in microgeneration may be to an aggregated level which is material on MV and HV capacity.

Accordingly, and as an interim measure for the initial offering of NFA, given the uncertainty on timing of microgeneration installations and overall penetration, it is prudent to reserve a provision in the available capacity proposed for NFA, for the expected future growth in microgeneration connections at HV stations and possibly also on some circuits. This interim measure provides certainty in terms of capacity for both larger DG and microgeneration customers.

A provision of 30% of uncommitted HV transformer capacity will be allocated to the expected future growth in microgeneration connections, in a HV station where an NFA connection is considered.

It is intended to review this interim measure later in 2020, and seek input via a public consultation, which will outline alternative approaches to account for the impact of microgeneration for which there are a variety of possible approaches (e.g. including basing a provision on the number of existing or planned houses or commercial/industrial units in an area or connected to a particular HV station, adopting a flexibility approach, potential for constraining of generation output, etc.).

Any further information or greater certainty which may be available through the Climate Action Plan 2019 microgeneration working groups or other sources will be accounted for in the consultation.

⁷ Certain limitations apply, as set out in the policy document.

⁸ A public consultation on the Microgeneration Framework was held in mid-2020; https://www.esbnetworks.ie/docs/default-source/publications/microgeneration-framework-consultation---may-2020-final.pdf?sfvrsn=591d07f0_0

⁹ www.esbnetworks.ie/docs/default-source/publications/public-consultation-on-the-smarter-hv-and-mv-customer-connections-project-0811195792622d46d164eb900aff0000c22e36.pdf?sfvrsn=f64306f0_0

¹⁰ https://www.dccae.gov.ie/en-ie/climate-action/publications/Documents/16/Climate_Action_Plan_2019.pdf

3. Future Non-Firm Access Developments

An example of the wider application of NFA was set out in Section 6.6 of the Public Consultation on the 'Smarter HV and MV Customer Connection Project - New Approaches to Distribution Planning and Security of Supply Standards'¹¹ document. This is re-presented in this document in Annex A.

As described, the level of complexity involved in a widescale implementation of NFA can increase exponentially, and as such any future developments are likely to be limited to trials in certain areas or zones of the distribution system, before any wider network implementation could be considered.

This is likely to form the basis of a future innovation project, under ESB Networks' Innovation Strategy.

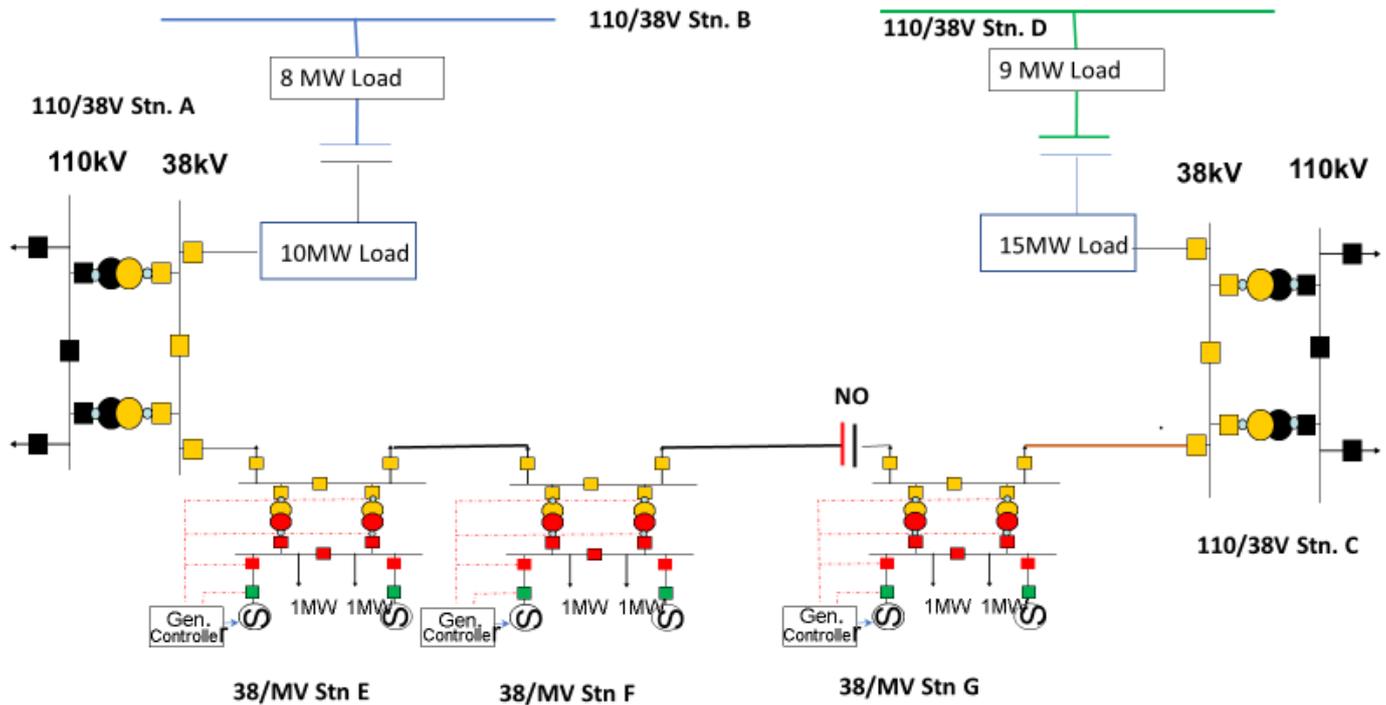
¹¹ www.esbnetworks.ie/docs/default-source/publications/public-consultation-on-the-smarter-hv-and-mv-customer-connections-project-0811195792622d46d164eb900aff0000c22e36.pdf?sfvrsn=f64306f0_0

Annex A. Future Wider Application of Non-Firm Access

A.1. Non-Firm Access under ‘real world’ considerations:

In more complex arrangements with multiple generators available capacity will have to be allocated on an agreed basis amongst all NFA Generators, so that operation of the system is simplified, and more generator capacity can be connected.

Figure 3: Implementation of NFA in actual Network conditions



In Figure 3, a more complete description of a typical network is provided.

There is a 38kV circuit shown between 110/38kV stations A and C, on which three 38/MV Stations are looped, with 38/MV stations E and F fed from 110kV Station A, and 38/MV Station G fed from 110/38kV Station C. There is a Normally Open Point on the 38kV circuit between the 38kV stations F and G.

Each of the 38/MV Stations also has an NFA Generator connected.

Additionally, 110/38kV Station A has another 38kV circuit feeding 10MW of load/generation with standby from 110/38kV Station B via a 38kV Station carrying 8MW of load/generation.

There are similar arrangements between 110/38kV stations C and D which are interconnected by a 38kV circuit carrying 15 and 9MW of Load/Generation.

Next consider the situation where the Customers described as ‘Load’ on the diagram are actually Generation.

So, the additional issues now arising are as follows:

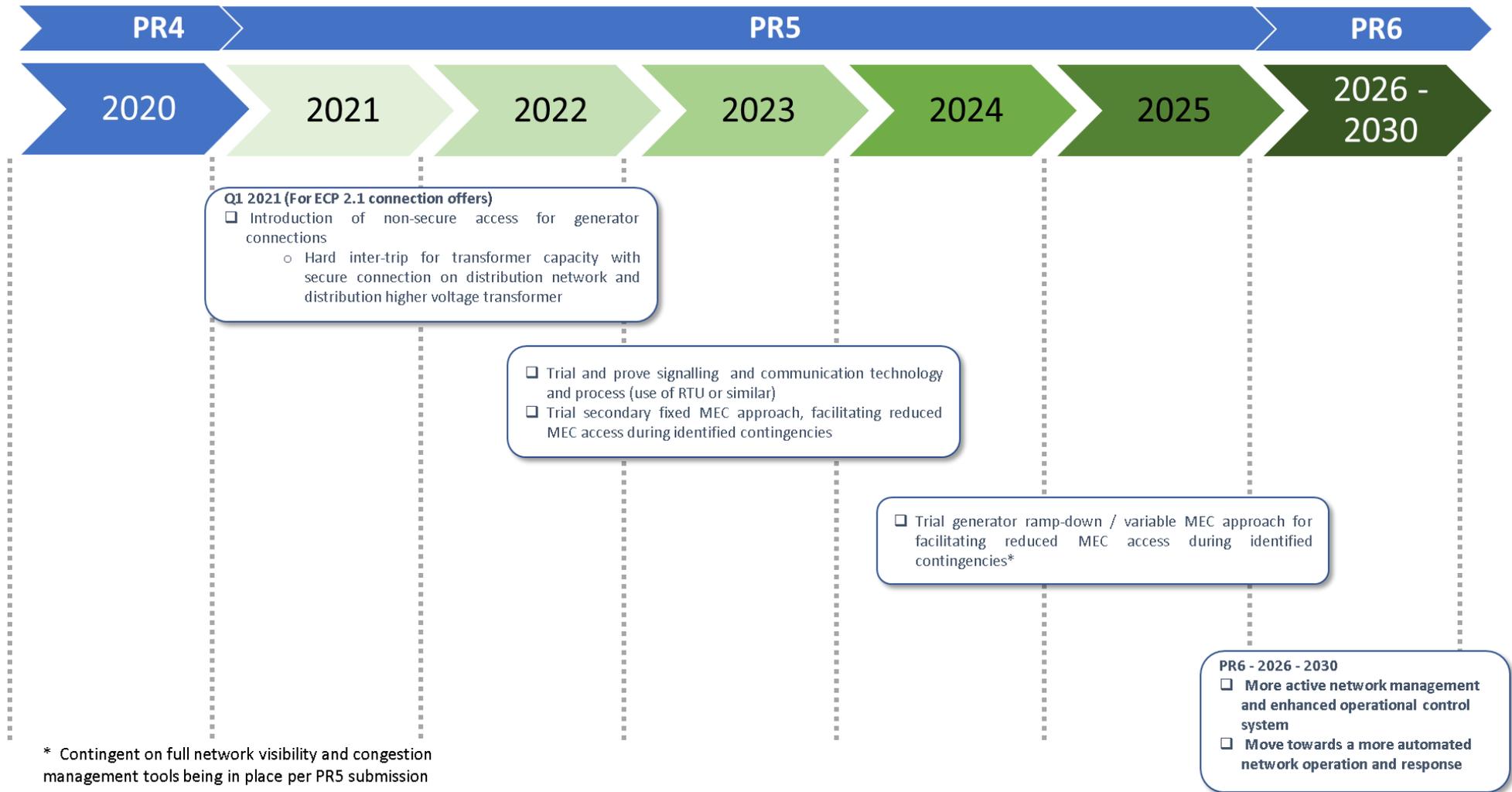
- If there is a fault on either of the first sections of the 38kV Circuit between 110kV Stations A and C, then all the 38kV Stations and their associated NFA Generation will now be transferred to either 110kV Station A or 110/38kV Station C, and the associated 38kV Circuit will carry the full amount of normal and NFA generation connected to 38kV Stations E, F and G.

- If the 38kV Circuit is then overloaded, then NFA generation must be reduced, so that communications are required between the 38kV Feeders at 110/38kV Stations A and C and every NFA Generator & 38kV Station on the full 38kV Circuit (Station's E, F & G), both normal and standby.
- If there is a fault on the 38kV Circuits between 110kV Station A and B, or between 110kV Stations C and D, then extra generation will be added to the 110/38kV Transformers in these Stations and if the 110/38kV Transformers are overloaded then the NFA Generators on any 38kV circuits fed from the 110/38kV Station must be restricted.
- This requires communication between 110kV Stations A and every 38kV Station with NFA Generation on every 38kV Circuits fed from 110kV Station A. Similar requirements are required for 110kV Station B.

As can be appreciated from the above example, the level of complexity has increased exponentially and as failure to respond to such scenarios will cause overloading and damage to plant (as well as associated safety issues) all such eventualities must be addressed by the system installed.

Furthermore, it can be seen that attempting to apply any disconnection order is increasingly complex as the NFA Generators involved may now be fed from circuits and transformers to which they were not normally connected.

Annex B.(Informative) Indicative Non-Firm Access Roadmap over PR5 (2021-25) / PR6 Period (2026-30)



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