

# DC0079 Implementation

Recommended Approach for the Implementation of  
Retrospective Loss of Mains Protection Changes

28 January 2019

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## 1 Executive Summary

This document sets out a recommendation for a multi-year project that will ensure that the existing fleet of distributed generation complies with the most recent requirements on Loss of Mains (LoM) protection as defined in the Distribution Code and the associated documents.

A significant number of distributed generation sites have LoM protection of type and settings that make them susceptible to inadvertent tripping following faults on the transmission system or loss of load or infeed. The costs of managing some of these risks was £59m in 2017/18 and is over £100m to date in 2018/19.

Pending the approval of The Authority to the modifications to the Distribution Code, proposed by the DC0079 Workgroup, a significant number of distributed Generators that are currently connected to the distribution system need some modification to their LoM protection. The responsibility to implement these modifications lies with Generators.

We propose that these modifications to the LoM protection are coordinated through a dedicated project. This will accelerate the delivery and will maximise the value delivered.

The project will deliver its output through a combination of up to three delivery programmes;

1. A **Payment Programme** will incentivise a coordinated and rapid implementation by assisting in removing financial barriers that might prevent Generators from implementing the modification.
2. Various forms of assistance will be made available via an **Assistance Programme** for Generators throughout the project, including providing Generators with a view of potential service providers able to administer the requisite protection changes.
3. Finally, and if required, an **Enforcement Programme** will tackle the sites that consistently fail to respond to the support offered and do not make the changes.

It is anticipated that the Payment Programme will drive the most significant proportion of the required work, based on the successful experience of this type of programme in making the required Vector Shift changes during the early Summer of 2018.

The project will be administrated through two management phases;

1. The Framework Setup phase that will run at the beginning of the project.
2. The Continuous Review phase which will run through the entire project to monitor delivery, refocus priorities, develop new actions and mitigations if appropriate, and trigger project closure when appropriate.

The project will also require four specific workstreams to be established, with one workstreams focusing on stakeholder engagement, another workstreams coordinating customer support activities, a third workstreams providing delivery assurance, and the fourth workstreams providing value assurance. A project steering group will provide direction to the four workstreams and will report on delivery to the Distribution Code Review Panel and will give affected parties a meaningful influence over the project.

## 2 Background

There has been a series of modifications to the Distribution Code that aimed to reduce the potential of inadvertent tripping of distributed generation by LoM protection. The analysis by the DC0079 working group has demonstrated that there are considerable system operation cost savings to be made by desensitizing existing Rate of Change of Frequency (RoCoF) protection, and by replacing vector shift LoM protection with RoCoF, in distributed generation installations.

To comply with the latest requirements, it will be necessary to revise the LoM protection settings for all the existing non-type tested distributed generation fleet to;

1. Ensure that where rate of change of frequency (RoCoF) protection relays are used, as part of Loss of Mains protection, the applied setting should be  $1\text{Hzs}^{-1}$  with a definite time delay of 500ms.
2. Ensure that vector shift (VS) protection technique should be removed where it is in use as Loss of Mains protection.
3. Remove LoM protection from all generation except synchronous and Double Fed Induction Generator (DFIG) where a suitable RoCoF setting cannot be made without additional investment.

Earlier work by GC0035 recommended in 2014 that the RoCoF (not VS) setting changes should be made to all distributed generation >5MW within a period of two years. At the time the recommendation was made there were less than 300 sites in the 5 to 50MW size range in GB, and the programme to complete the retrospective changes took twice as long as the intended two years. That programme was initiated by the distribution network operators (DNO) requesting the owners of generation to make the necessary changes, at the owners' expense. Owners had a number of challenges in completing the programme including lack of understanding of the need, lack of recompense for the costs of making the changes, and in many cases a lack of expertise in both understanding the technicalities of what was being asked of them and the ability to make the physical changes.

Another programme to update the protection settings at approximately 70 sites, with total capacity of about 800MW, that used VS relays as means of LoM protection was completed in 2018. The programme was initiated by the National Grid Electricity System Operator (NGESO), UK Power Networks, Scottish and Southern Power Distribution and West Power Distribution to carry out a procurement process whereby distributed generation owners offered to change their VS protection settings for a fee. DNOs were actively engaged with their customers to market the opportunity and support the change. Funding was facilitated by the NGESO and delivered the required change within a month in summer 2018.

This most recent modification proposal requires protection modification at up to 50,000 sites with the majority of sites requiring only a change of settings. Some sites will require additional works. A very high degree of compliance with the new requirements are needed to achieve the benefits envisaged by the workgroup recommendations, the actual volume of changes will be determined by continuous cost benefit analysis.

In order to ensure timely compliance with the new requirements and to guarantee value delivery for the end consumer, it is proposed to set up a dedicated project team to provide the right level of transparency, stakeholder engagement, incentive to act, assistance as required, and where necessary eventually enforce compliance with Distribution Code obligations.

### 3 Implementation Approach Options and Recommendation

There are a number of approaches and experience from Great Britain and internationally which could be applied to this project. The recommended approach has been developed by evaluating the advantages and disadvantages of four high level models which underpin the four phases of the project.

The four models considered were:

- Engagement with Generators – essentially briefing of the issues, and requirement for compliance with the revised Distribution Code, and exhortation of Generators to comply.
- Payment Based Model – where a financial incentive is offered to Generators for them to make the changes.
- Assistance Based Model – where DNOs undertake the necessary work on behalf of Generators, at no, or low, cost to the Generators
- Enforcement Model – Where compliance is enforced – at the Generators' own costs.

From analysis of the models it has been concluded that most rapid progress would be made by using the Payment Based Model.

Appendix 1 (Section 9) analyses the four models in more detail.

#### 3.1 Recommended Model

It is unlikely that a single pre-determined and static model will deliver the volume of change required and satisfy the need to control costs appropriately. Therefore, an iterative model is proposed which can flex and adapt in response to defined performance measures as the programme proceeds. Within this model, it is expected that the most effective way to get the necessary work done will be to offer payment to generators who take the necessary responsibility for and organise their own changes. This will distribute the work to the parties best able to manage costs, risks and liabilities.

The success of this model relies on widely communicating the arrangements under which generators would receive payment once they have made and certified the changes within agreed timescale, along with a clear requirement to have made the changes within a defined (3 year) period.

There is good evidence that the proposed approach can be effective from the accelerated VS relay change programme procured by the ESO and delivered by DNOs in summer 2018 when VS relays at approximately 70 sites were changed over a period of a month. The difference is that standardized payment opportunities will be offered to significantly more distributed generators to achieve a very high degree of compliance. A staged framework will be used to incentivise the early completion.

There is a risk that payment model will not incentivise all affected Generators to make the necessary changes. Some will feel the payment is immaterial and others will fail to engage due to lack of capability to understand and carry out the changes or the desire to do so. Hence it will be necessary to monitor measured performance throughout the project and adapt the approach if required.

## 4 Overall Project Implementation

This section describes what the project is going to do in order to achieve its objectives. The aim is to deliver as high a proportion of the modifications required as is possible through offering payment for Generators undertaking the works before the implementation deadline.

For the project to be successful, it will be necessary to run a comprehensive stakeholder engagement programme and identify appropriate enforcement actions to be taken (should these be required) with Generators who fail to take advantage of the support available and remain non-compliant.

This will be delivered within a framework that governs the interactions between the different parties involved and will be subject to a continuous assessment and review of the criteria and methodologies applied.

### 4.1 Framework Setup

This will take place at the beginning of the project with the aim to;

- specify the commercial and legal terms between NGESO and DNOs,
- agree contracts and indemnities,
- set up the project team and allocate resources for the four workstreams,
- specify the governance, processes, and documentation, and
- define and publish the procurement methodology.

#### ***4.1.1 Specifying and Communicating the payment mechanism***

At the launch of the programme, NGESO will publish a procurement methodology to make it clear how NGESO and the distribution network operators, will be procuring the expedited relay settings changes. This will include how NGESO intends to assess the value based on capacity, current type of loss of mains protection, load factor during effective periods and how soon the Generator can make the change. This will outline the procurement principles, assessment principles, the relationship between the generators, DNOs and NGESO, audit requirements and how to participate.

NGESO will review this procurement methodology after twelve months and if during the first year the process has not delivered on the volume required it will review the methodology and update it to make any necessary improvements.

#### ***4.1.2 Contract terms***

To facilitate the payment of generators NGESO will enter into a balancing services contract with the DNOs to provide a stability constraint management service, through coordinating the delivery of the requisite Generator protection changes. NGESO will agree the cost model with the DNOs up front, including the level of payment to generators.

#### ***4.1.3 Cost recovery***

Recovery of Generator and DNO cost - As NGESO will be entering a balancing services contract with the DNO the Generator and DNO costs will be funded via Balancing System Use of System (BSUoS).

#### ***4.1.4 Assurance***

To provide assurance that the project is appropriately implemented NGESO will arrange for audits to be carried out during the process to supplement the assurance provided by DNOs that changes have been implemented:

- **Procurement methodology:** NGESO will request independent feedback on the Procurement Methodology at the start of the process to ensure that NGESO are using appropriate best practice where possible in the timescales.

- **Confirmation of data:** NGESO will instruct an independent audit of a proportion of the sites to demonstrate that the changes have been delivered in line with the information that the DNOs have been provided. This will give the NGESO confidence that it can use the data provided to change its operational policy.

## 4.2 Engagement

The project will include a comprehensive Engagement Programme which will deliver general information and messaging about the project, facilitate targeting specific audiences, and provide monitoring and assurance on delivery to stakeholders.

### 4.2.1 General Engagement

The stakeholders whose actions have the biggest influence on the success of this project are owners and operators of distributed Generators. However, in order to ensure that the message is widely communicated, it will be necessary to include a wider range of stakeholders who would be able to cascade the message to the main audience.

The stakeholders that have been identified are:

- Contractors who have the technical capacity to carry out the modifications required,
- Consultancies,
- Suppliers,
- Site operators,
- Aggregators,
- Investors,
- Utilities,
- Community energy associations,
- Trade associations
- Other large organisations who own distributed Generators (NHS etc.)

The General Engagement programme will run continuously over the duration of the project with an objective to ensure that stakeholders are fully aware of both the change to the Distribution Code and of this implementation project. The messages delivered about the changes to the Distribution Code will include the scope of change of requirements on LoM protection, the reasons behind this change, the works necessary for compliance, parties responsible to carry out these works, the timescales by which compliance will need to be achieved, and the consequences of non-compliance. The messages delivered about the project will include sufficient information about the project, assistance offered, payment offered, the process to apply for such payment, the criteria that would be used to assess whether payment will be offered or not, and the backstop enforcement options.

To be effective, publicity should take place in various forums and through a wide range of media. Open letters addressing the industry and/or specific stakeholder groups will be published, seminars and workshops will be organised to raise awareness of the project, regular updates will be provided in code panel meetings and other relevant industry events. Online communications through ENA, NGESO, and DNO websites; through social media; and through mailing lists will also play a major role in the communications.

It is proposed to launch the project early in 2019 with an open letter aimed at all the above stakeholders and promoted through electronic means. Additionally, physical briefings will commence with a meeting will be held in London in March 2019, an invite to which will be included in the open letter. The future programme of publicity will be managed via the Stakeholder Workstream (see 5.2.4 below) and build on the experience of the responses to the first open letter, the briefing meeting in March 2019, and DNOs' experiences of publicity effectiveness.



### 4.2.2 Targeted Engagement

Targeted Engagement will comprise two elements. The first element is to be delivered by each DNOs individually to its own customers, ie through direct communication between the DNO and Generators. This element is illustrated by the flowchart in Figure 1 and will be driven by the value assessment set out in the payment mechanism procurement methodology. The second element is to be delivered collectively by the Project through targeting specific stakeholder groups. This element is illustrated by the flowchart in Figure 2. Both elements will run in quarterly waves, with the targeting of sites following the general publicity for each wave. This will allow time for Generators to proactively engage with project and thus minimize cost of additional administration. The aim will be to maximise the value delivered by targeting specific stakeholder groups.

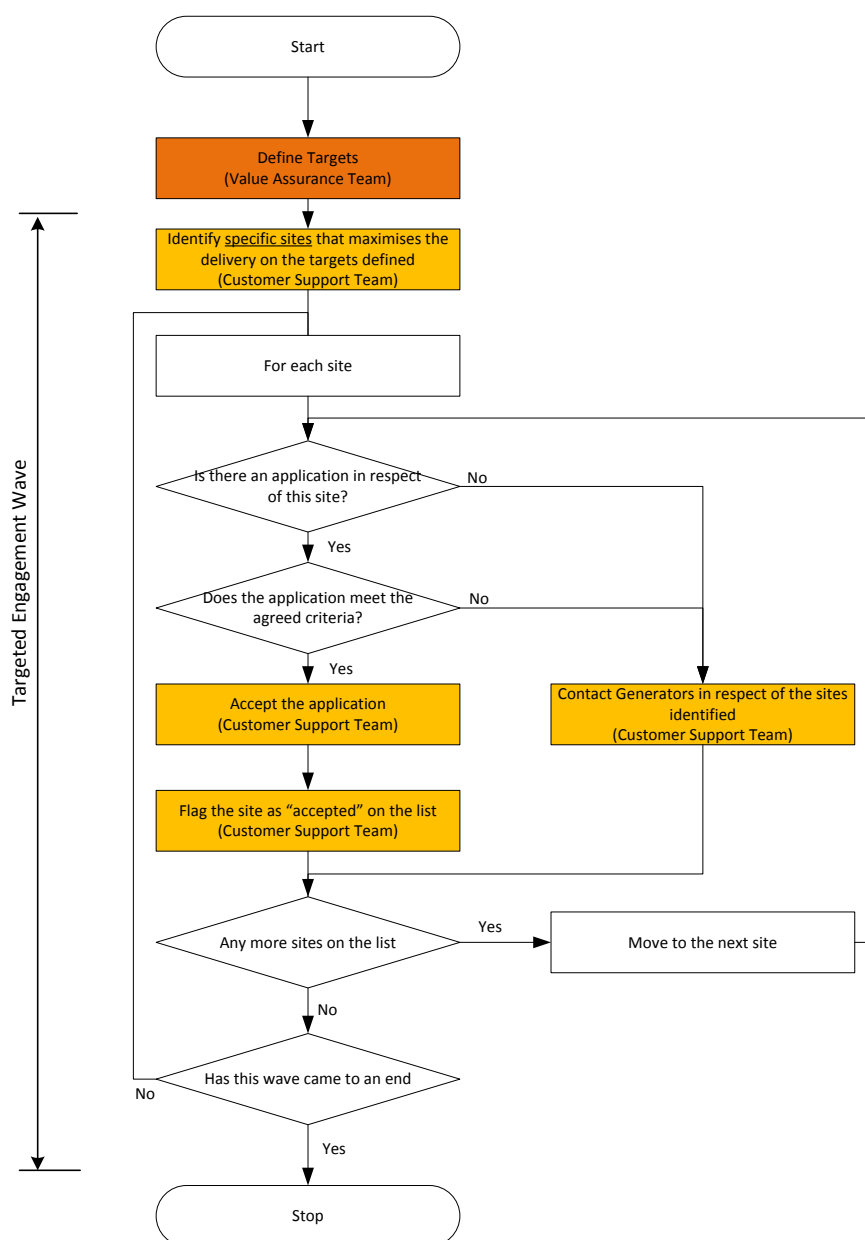


Figure 1: Targeted Engagement Phase: Delivered by individual DNOs

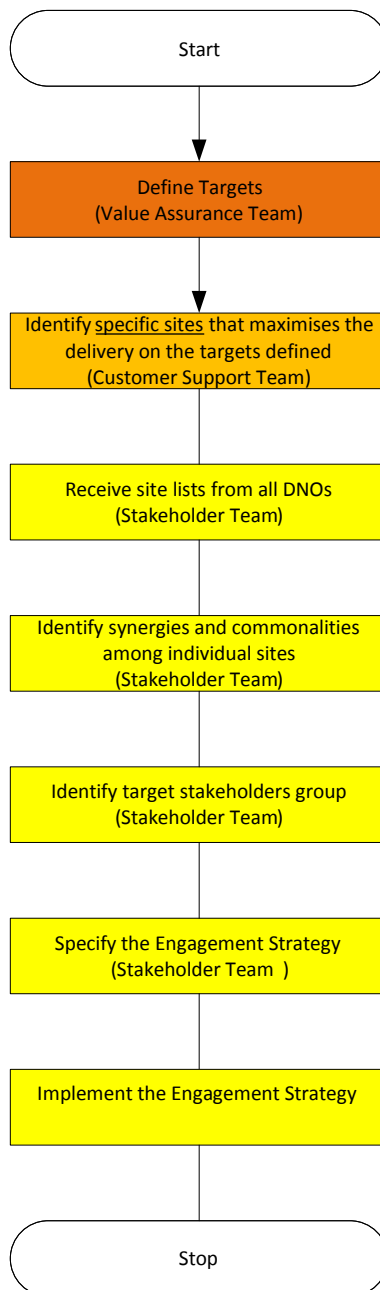


Figure 2: Targeted Publicity: Lead by the project Stakeholder Engagement Workstream

#### 4.2.3 Reporting

This project will improve the security of supply through reducing the risk of inadvertent tripping of LoM protection and reduce balancing service costs spent on managing the risk of inadvertent tripping of RoCoF and VS relays. However, the costs incurred in this process will be significant and will be paid for through BSUoS. Therefore, it will be necessary to provide sufficient information throughout the project duration to allow

- BSUoS Payers;
- Ofgem; and
- all other stakeholders identified previously;

to track the costs and the benefits of the project. Items to report will include costs incurred, projected future costs, projected impact on BSUoS charge, projections of future RoCoF constraints costs, and other performance measures monitoring the project progress.

The same forums and methodologies used for General Engagement will be used for reporting. In addition, Transmission Charging Forums and direct engagement with both Ofgem and BEIS will play a major role.

### 4.3 Payment Programme

The Payment Programme is intended to encourage the provision of information and the protection settings update by providing an offer of payment for generators who notify their ability to modify the protection settings within a specific time window. This financial support will be independent of how generators get the work done.

The Payment Programme will run in waves with expenditure in each wave capped to a declared amount. This will provide BSUoS payers confidence over the maximum exposure to costs, will manage the ramp up of workload for DNOs and will encourage early declaration of intent.

Generators will be required to submit application for payment. These will be processed within the time window for each wave. Once application is assessed and approved by network licensees, Generators should complete the necessary changes within the agreed timescale, cooperate the witness testing if required, then submit claims and supporting evidence of the initial LoM protection settings, the modified LoM protection settings, and the date at which these were modified DNOs will verify the evidence submitted and administer the payment if successful changes are made.

The success of this programme depends on a number of parameters (eg payment level, number of waves) some of which will be published prior to the programme starting and the knowledge that all affected generators will ultimately have to make the change to compliance with the Distribution Code. Hence, communication of the payment scheme design in formal and informal channels is critical to its success.

#### 4.3.1 The Principles

- Generators to apply to be eligible for payment:

Generator will be required to submit an application to be considered in the Payment Programme. The application will contain sufficient information about the plant, its protection settings, and the changes required, and the lead time for delivery. Only Applications that meet the agreed criteria will be offered payment. This is to facilitate data collection at the beginning of the Payment Programme, guarantee control over the process, and allow DNOs to arrange to check the protection updates at some sites.

- Generators may submit applications at any time for as long as the Payment Programme is running:

Once the application window opens, any Generator whose plant is affected will be eligible to apply. This is to give an equal opportunity for everyone and to facilitate that those who wish to apply as early as they can.

The application window will remain open for all Generators for the whole duration of the Payment Programme with no deadlines for specific plant capacity, technology, location or protection type. This is to maximise the opportunity for everyone to do the work required and get their payment.

- The Payment Programme will continue to run till it ceases to deliver value:

The Payment Programme will run for twelve months. Any extension will be agreed based on an assessment of the expected value to be delivered. The assessment would look at the expected change to be delivered and on the balance between the cost of this change and the benefit it achieves. Once the Payment Programme ceases to deliver value, no further payment applications will be accepted.

A Generator's best opportunity to remove any uncertainty over the availability of payment is to apply early.

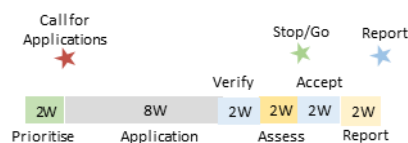
Applications will be addressed based on value. Continuous valuation will be carried out during the whole Payment Programme. Payment is independent of implementation timescales although early implementation will be factored in to the valuation process.

The payment sum for each change will be defined upfront and will be offered to those whose application have been approved provided they do the work within the timescales agreed. This sum will be kept constant throughout the Payment Programme irrespective of when the agreed dates are.

#### **4.3.2 The Application Process**

In order to manage the workload and facilitate prioritisation whilst keeping the application window open continuously, it is proposed that the Payment Programme will be run in waves of 18 weeks each.

Each wave will comprise three windows: a priority definition window, an application window, and a processing window. There are three milestones in each wave. The first is when applications are invited, the second is when the decision to run another wave is decided, and the third is when progress is reported. This is illustrated by Figure 3.



*Figure 3: The timeline of a Payment Application Wave*

Engagement priorities will be defined in the first two weeks of each wave. These priorities will be used to agree the Targeted Engagement strategy. Each DNO will determine their own priorities in line with the valuation criteria and will identify a set of sites that allows them to deliver these priorities at minimum cost. DNOs will then communicate with these sites to encourage them to submit their application over the next few weeks, if not already received. Once a DNO receives an application in relation to any of these sites, the DNO will be able to approve this application with no reference to NGESO.

Prior to the first day of the first Application Window, an open letter will be published to invite interested parties to submit their applications. An updated version of that letter will be sent at the beginning of each new Application Window as part of the regular communications and reporting the project team will be used to keep stakeholders informed and involved.

The open letter will invite interested parties to apply to join the Payment Programme. It will clarify:

- that applications could be submitted at any time up until further notice;
- timescales for assessment;
- treatment of 'late' applications;
- criteria and timescales for payment programme closure.

At the end of the three-month period an assessment will be made to decide whether the Payment Programme is not delivering material change, is delivering material change but further change is required; or has delivered the change necessary. Based on this assessment, the decision to reevaluate the strategy, run another wave, or close the project will be taken.

By the end of the Processing Window, all Generators who applied prior to the deadline specified will be notified that their application have either been accepted or, in the event that a cap has been exceeded, they are in a queue to be reassessed in the next round.

#### **4.3.3 The Application Timeline**

The Payment Programme will comprise a number of overlapping waves. Each wave will start three months after the previous wave. This is to ensure that an Application Window is always open at any time during the Payment Programme.

Figure 4 demonstrates how the first four waves of the Payment Programme are aligned and the corresponding timeline.

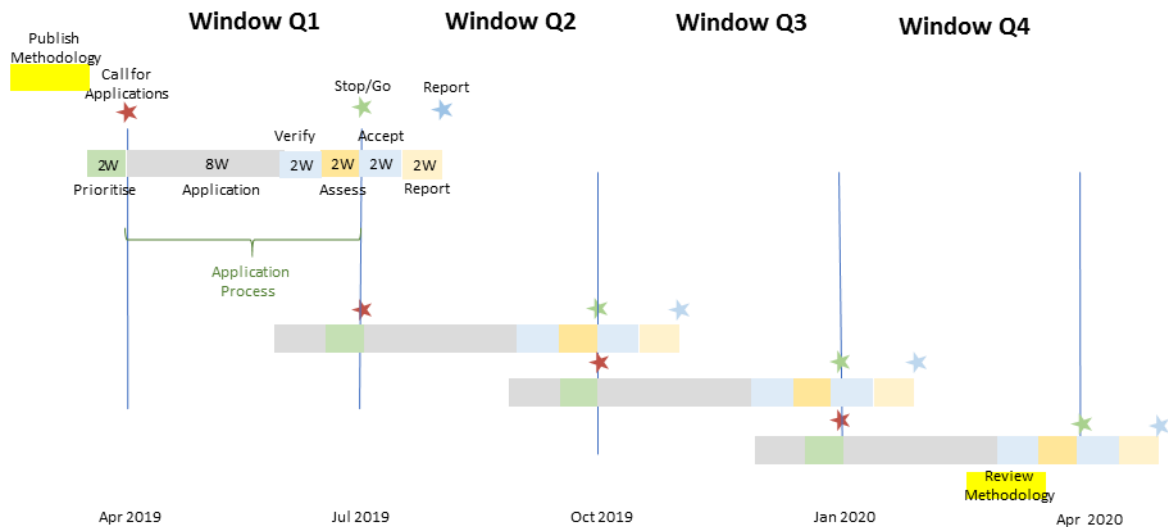


Figure 4: The first four waves of the Payment Application Programme and the corresponding timeline

#### 4.3.4 Implementation and Assurance Process

Once an application is approved, and prior to sending confirmation, the relevant DNO will apply agreed criteria to determine whether there will be a need to witness or check the implementation. The proportion of sites chosen for witness testing or checking will be specified at the start of the project and, if necessary, adapted in response to success rates.

Sites that do not require witnessed implementation may be required to allow a site visit to confirm the successful implementation. This will allow for an independent check to be made as part of an annual audit of the end to end process.

Figure 5 illustrates the implementation process.

#### 4.3.5 Site visits

It will be necessary that DNOs visit some of the sites as a part of this project. This is to witness the protection change or to verify that the change has been done.

An initial sample size will be agreed at the beginning of the project. Performance will be monitored throughout the project and the sample size may be revised based on the outcome of these visits.

The DNOs will determine the sites chosen for visits based on

- the materiality of the change required at any specific site,
- whether a site is representative for a portfolio of sites owned or operated by the same entity,
- randomly



Figure 5: The implementation Process

#### 4.4 Continuous Review

The programme will run in waves and will evaluate and report regularly in order to:

- Show the value of project performance against the success criteria agreed;
- provide visibility of progress, costs incurred, value delivered and potential future costs;
- identify particular problem groups of Generators or individual sites that may need specific consideration;
- assist the steering group in determining if it is appropriate or necessary to invoke the Assistance Programme or the Enforcement Programme;
- provide assurance of delivery by reporting on success rates.

The programme will also regularly review its assessment criteria and refocus the priorities for the next phase of the engagement programme and assistance as necessary.

#### 4.4.1 Value Delivery

The ESO spends a significant amount of money on ensuring that following a secured event that results in the largest infeed<sup>1</sup>, or demand, loss, the RoCoF does not exceed  $0.125\text{Hzs}^{-1}$ . This is to avoid consequential tripping of distributed generation. The cost of enforcing this constraint is independent of the capacity, or the output, of any generation on RoCoF risk. This is illustrated by the green line in Figure 6.

An alternative solution would be to carry additional frequency response to ensure that, following the generation loss and any consequential tripping of distributed generation by their LoM relays, the frequency remains within acceptable limits. This solution is currently infeasible due to the large capacity of generation on LoM relays. However, as the project progresses, the amount of additional frequency response will no longer be prohibitive and the cost of this service will drop. This is illustrated by the orange line in Figure 6.

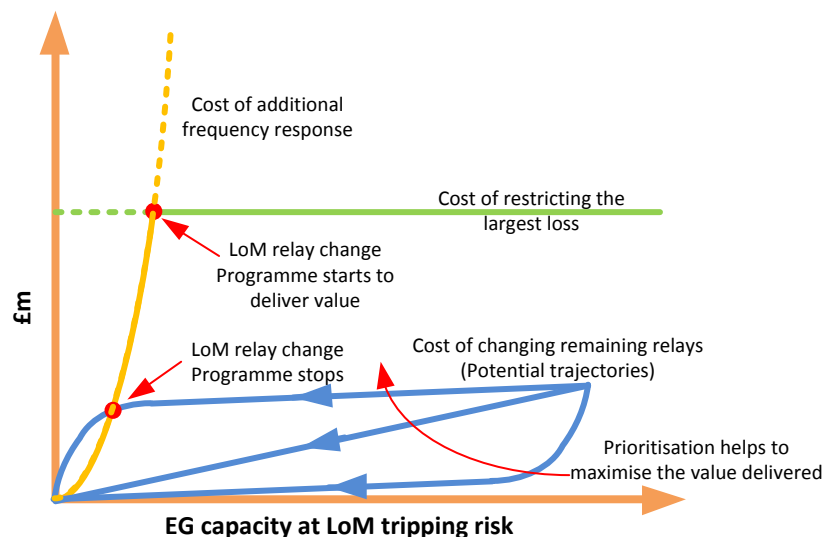


Figure 6: Value Delivery

There will be a breakeven point when the cost of additional frequency response services drops below the cost of constraining the largest loss. Once this breakeven point is reached, the project will start delivering value to consumers. Beyond this point, any further reduction to the risk of LoM protection would result in a reduction in the cost of frequency response service.

The cost required to modify the LoM protection for the entire fleet of distributed generation covered by the scope of this project is driven by the number of sites. However, the trajectory by which this cost will be incurred is dependent on the order by which the modification is implemented. Three trajectories are shown by the blue curves in Figure 6.

Depending on which trajectory takes place, there could be another breakeven point at which the cost of continuing this protection modification project exceeds the benefit achieved from it.

Accurate distributed generation information is the key for the programme to calculate the value delivered and make the recommendation on whether to continue the implementation. This programme will enable the DNOs to provide the ESO with data related to each distributed

<sup>1</sup> The largest infeed loss will include distributed generation equipped with VS relays tripped by the event.

Power Station in scope, detailing its size, technology, , type of LoM protection and its protection settings. The ESO will then use this data to estimate the baseline risk level and inform the prioritisation process.

In the absence of such data for some, or many, generation sites it may be necessary to make some assumptions. In order to ensure that the risk of LoM inadvertent tripping is sufficiently mitigated, the assumptions made are likely to be risk-averse and may result in the project having to run longer than is necessary.

#### ***4.4.2 Value assessment and prioritisation***

The RoCoF relay change programme aims to reduce, and eventually eliminate, the costs incurred in securing the system against the risk of the tripping of such relays following a large generation loss. Value assessment for the RoCoF relay change programme will be based on

1. the existing relay settings – priority given to power stations with RoCoF relays set to  $0.125\text{Hz/s}^{-1}$ ;
2. the operational regime of the distributed power station – priority given to power stations that are likely to run when a RoCoF constraint is active; and
3. the capacity of the distributed power station – priority given to power stations with high MW capacity.

The VS relay change programme aims to reduce, and eventually eliminate, the risk of inadvertent generation tripping leading to unacceptable frequency condition following a secured event. Priorities for the VS relay change programme will be based on

1. proximity to large power stations;
2. susceptibility to high probability faults (eg single circuit fault); and
3. the capacity of the distributed power station.

The value assessment approach will be a key part of the published methodology and will be used to assess applications, define value measures and to prioritise engagement.

#### ***4.4.3 Operational Management of LoM Risk***

Today, the ESO manages RoCoF to ensure it does not exceed  $0.125\text{Hz/s}^{-1}$ . Once the first breakeven point is reached, the operational policy will be updated to allow the choice between

- managing RoCoF to  $0.125\text{Hz/s}^{-1}$ ;
- managing RoCoF to an interim level, eg  $0.2\text{Hz/s}^{-1}$ , and contracting additional frequency response;
- not managing RoCoF and contracting additional frequency response; or
- do nothing as the risk becomes immaterial. The project

The logic that will be applied to allow this is contained in the Operational Flowchart shown in Figure 7 below.



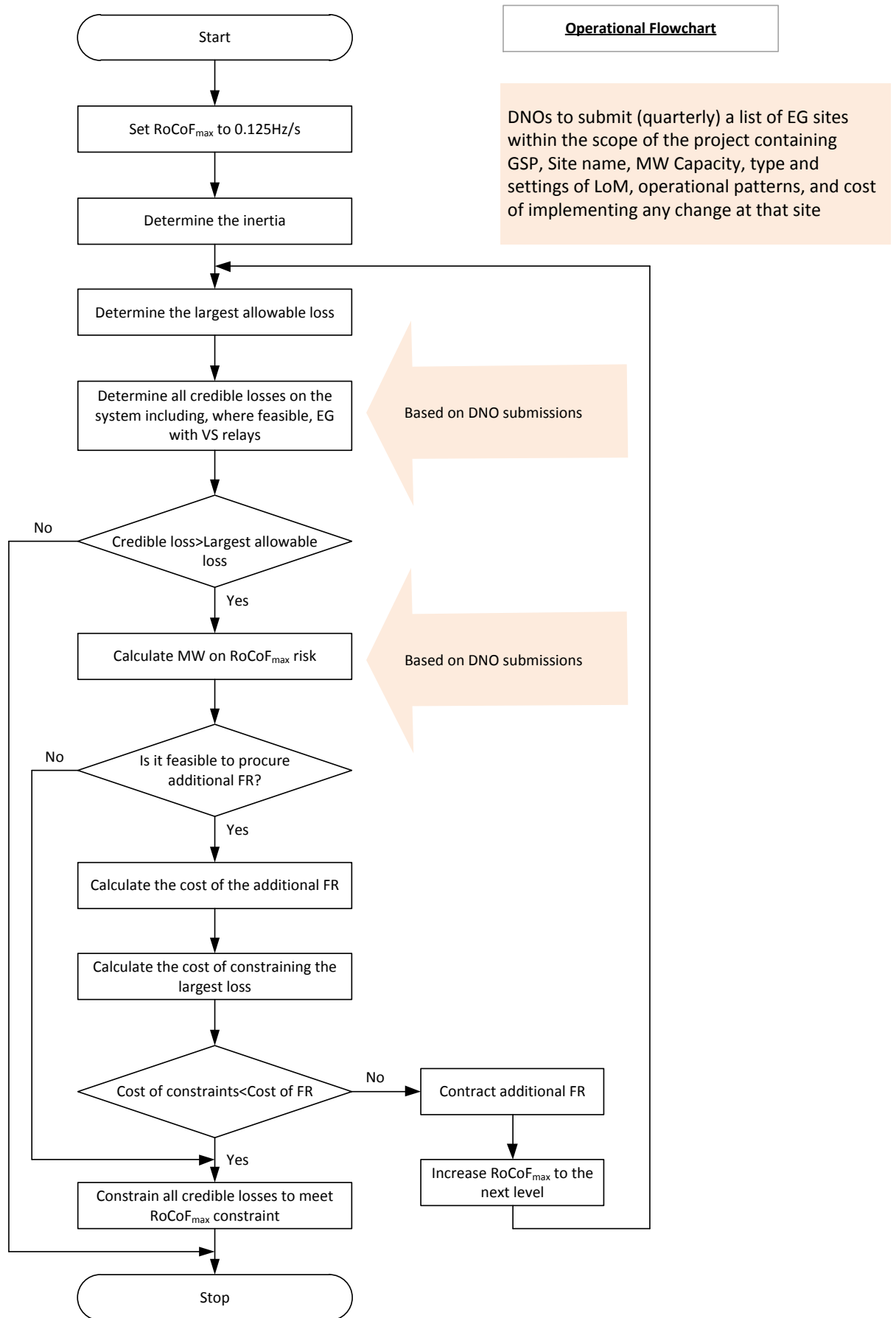


Figure 7: Operational Flowchart

To facilitate this decision making, it will be necessary that DNOs provide sufficient information about all distributed power stations within the scope of the project. This includes their location, technology, MW capacity, type and settings of their LoM relays, and estimated cost of updating their LoM settings. This information will be supplemented and improved by the applications submitted for generators to receive payment.

#### **4.5 Assistance to Generators**

Assistance will be offered to Generators in three forms:

- Lists of contractors who are willing to offer the service of updating the LoM protection at affected sites, to meet the new requirements, will be compiled and made available. Generators will be able to directly, and at their own risk, employ those contractors if they wish to use their services;
- Comprehensive guidance documents and clear process diagrams will be published to support Generators;
- Where necessary, Generators may ask the DNO for network data to assist with the risk assessment; and
- Where necessary, Generators will be able to seek guidance directly from the DNOs.

Further assistance may be made available for Generators who fail to or cannot engage with contractors. The extent to which this is provided will be determined in response to performance: a significant shortfall in planned protection changes will give a clear justification to considering an alternative approach.

#### **4.6 Enforcement Programme**

The Enforcement Programme will target Generators who failed to respond to the Payment Programme and have not taken advantage of any assistance offered throughout the project. The aim of this programme is to achieve compliance through progressive engagement with the appropriate enforcement option being a last resort and probably subject to direction of the Authority.

This phase would only run, if necessary, towards the end of the project. It will have the potential of delivering the remaining value to be delivered by the project.

Each DNO would be responsible for delivering this programme for the relevant Generators connected to their networks.

#### **4.7 Project Closure**

The simplified diagram in Figure 6 tells us that, depending on how Generators respond to the project, there could be a situation when the cost of continuing the project exceeds the benefit delivered by it. Therefore, it will be necessary to reassess the situation on regular basis to ensure optimal cost and resource allocation. The assessment should evaluate:

- the overall costs of managing the LoM risk over future years taking into account credible operational conditions, and
- the costs of changing the relays at the remaining sites (as advised by DNOs)

Once the cost of continuing the protection modification project exceeds the costs of managing the LoM risk, the project should be closed as any further work will not deliver any additional value.

The project progression flow chart flowchart is shown in Figure 8.

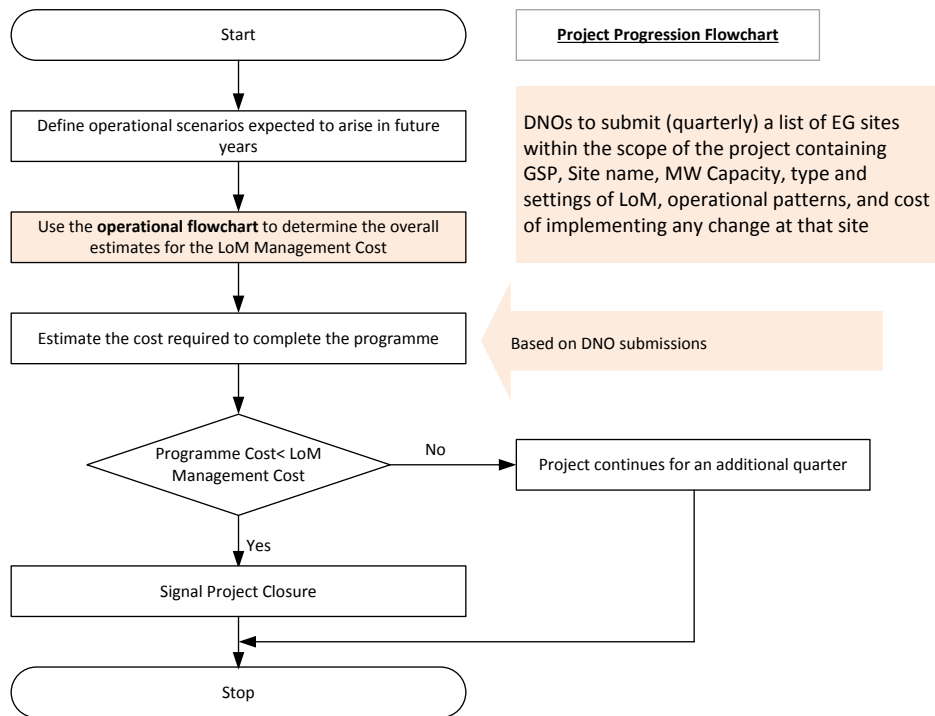


Figure 8: Project Progression Flowchart

## 5 Delivery

This section describes who the project will be organised.

### 5.1 Project Steering Group

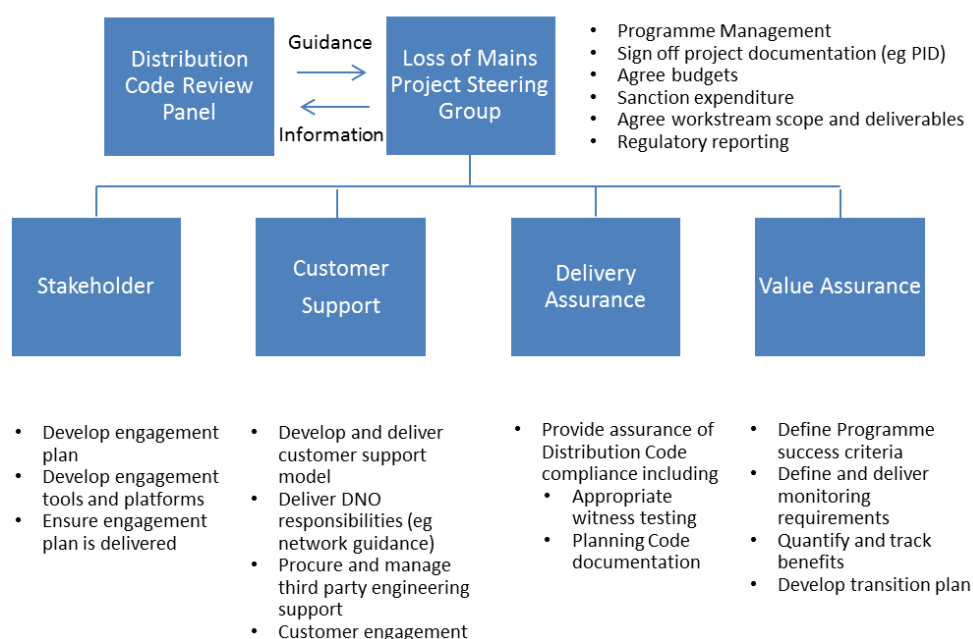
#### 5.1.1 Constitution

The membership of the Project Steering Group and the four project workstreams will include members of all network licensees and the relevant stakeholder group representatives. The constitution and the leadership are expected to reflect the tasks appointed to each of the workstreams with the Value Assurance Workstream expected to have more representation from the Electricity System Operator than from DNOs and with the Delivery Assurance and Customer Support Workstreams expected to have significant representation from DNOs.

#### 5.1.2 Governance

The Project Steering Group will be appointed by and will report to the Distribution Code Review Panel. Affected stakeholders, including affected generators and BSUoS payers will be represented. The four project workstream will be appointed by and will report to the Project Steering Group.

### 5.2 The Project's Team



A dedicated project team will be established that comprises members of all network licensees. The project team will be responsible for:

1. the implementation of the necessary protection setting changes in a coordinated manner that maximises the value delivered; and
2. sharing best practice amongst participating licensees.

The Project Team will comprise four workstreams as follows.

#### 5.2.1 Value Assurance Workstream

This workstream will define the project success criteria and the key performance indices required to monitor them. It will monitor the implementation progress, and quantify and track the value delivered including specifying and performing the value assessment. It will also develop a

transition plan to ensure all part of the system including the generators be ready for the higher RoCoF operation.

#### ***5.2.2 Delivery Assurance Workstream***

This workstream will define the process, the documentation, and any tests or site visits required to ensure that the protection change at a specific site has been implemented in a satisfactory manner. It will also monitor the delivery on these requirements.

#### ***5.2.3 Customer Support Workstream***

This workstream will sit at the heart of the project as it will develop and deliver the customer support model, deliver DNO actions required by the project, and procure and manage third party activities where such activities are necessary. It will respond to queries from Generators, process their claims, and pay them for the work done in line with the agreed payment criteria.

#### ***5.2.4 Stakeholder Engagement Workstream***

This workstream will be responsible for Stakeholder Engagement activity planning and performance monitoring required to ensure the success of the protection change programme. It will develop the engagement plans including the activities, tools, and platforms required for their implementation. It will also oversee the delivery of these engagement plans.

The four project workstreams will report to the Project Steering Group which will manage the delivery of the protection change programme. The Steering group will sign off the project documentation, eg the Project Initiation Document, agree the budget, sanction expenditure, and agree the accountabilities and the deliverables of each of the project workstreams. The Project Steering Group will be responsible for Regulatory Reporting as and when required.

## 6 Plan and Timeline

The project is expected to run over a period of 36 months with delivery, performance, and project direction being reviewed quarterly in order to refocus the priorities as required to maximise the benefit.

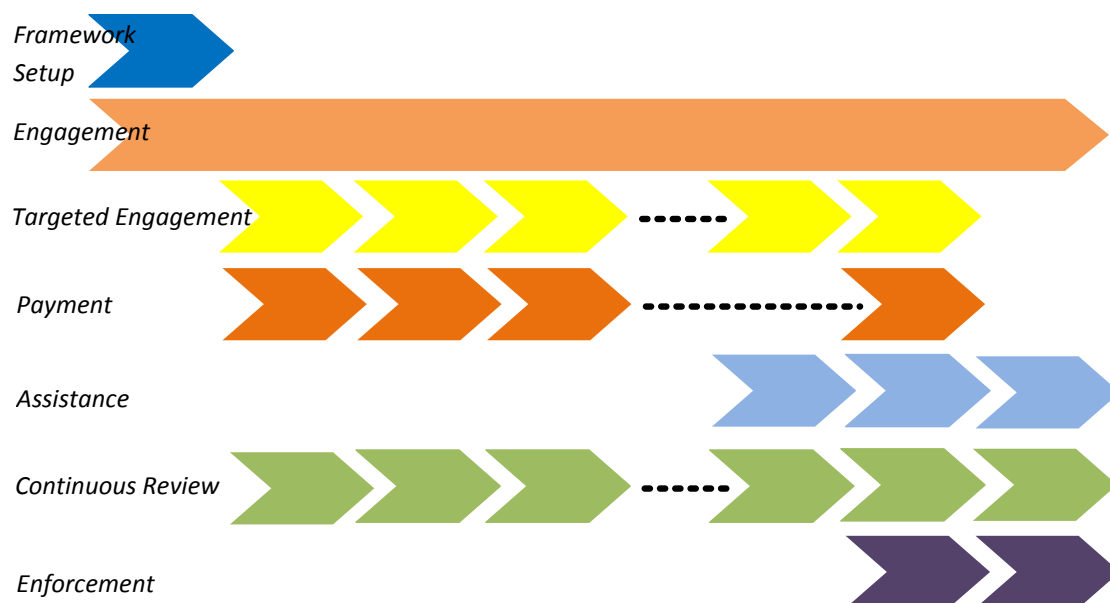


Figure 9: Plan and Timeline

Framework will be set up in the first quarter:

This actions required for this and the implementation timeline are in Table 1.

Table 1

Task	Jan	Feb	Mar	Apr
set up the project team;				
agree the commercial and legal terms;				
agree contracts and indemnities;				
agree the governance;				
set a clear project objective, define success criteria, and clear key performance indices;				
agree the criteria to determine which sites are to be prioritised for replacement;				
define a verification process for DNOs to follow in order to ensure that any generator-led change of protection settings and/or relay replacement is done up to the required standard;				
define the Customer Support model that DNOs will deliver to the generators;				
draft all the relevant documentation and guidance necessary for the delivery of the project;				
draft all the relevant guidance for Generators;				

identify contractors who have the competency to implement the modifications on behalf of the Generators	Jan	Feb	Mar	Apr
identify all the relevant forums in which the Project Team could engage with the affected stakeholders;	Jan	Feb	Mar	Apr
agree the backstop actions relevant to Generators who fails to comply with the new requirements by the end of the programme;	Jan	Feb	Mar	Apr
devise a stakeholder engagement programme to run over the whole period of the project to ensure continuous engagement and outreaching communications; and	Jan	Feb	Mar	Apr
start the implementation of the stakeholder engagement programme.	Jan	Feb	Mar	Apr
apply the prioritisation criteria to determine the sites to be focused on in the second quarter	Jan	Feb	Mar	Apr
devise a focused engagement programme for the second quarter;	Jan	Feb	Mar	Apr
agree priorities for each DNO's Customer Support plan	Jan	Feb	Mar	Apr

#### Agree the focus for the second quarter

This actions required for this and the implementation timeline are in Table 2.

Table 2

Task	Jan	Feb	Mar	Apr
apply the prioritisation criteria to determine the sites to be focused on in the second quarter				
devise a focused engagement programme for the second quarter;				
agree priorities for each DNO's Customer Support plan				

In the subsequent quarters, we intend to

#### Implement the agreed plans

- continue the implementation of the stakeholder engagement phase;
- implement the quarterly focused engagement and payment phases;
- coordinate the implementation of the Customer Support plans for different DNO; and
- pay Generators who successfully carried out the protection change programme;

#### Monitor progress and delivery and refocus the priorities as required

- update records and monitor the KPIs as required;
- assess the project progress against the project success criteria;
- initiate project closure once the success criteria are met.
- estimate the value delivered to consumers through the actions implemented so far;
- report progress to the Distribution Code Review Panel
- use input from the ESO to revise the priorities for the subsequent quarter;
- apply the prioritisation criterion to determine the sites to be focused on in the second quarter;
- devise a focused engagement programme for the second quarter; and

- agree priorities for each DNOs Customer Support plan;

Twelve months through the project, we intend to

- assess the need to develop and enhance an Assistance Programme; and
- if necessary, scope and develop this programme.

At least One year ahead of target project closure, we intend to

- coordinate the implementation of the backstop actions agreed at the beginning of the programme.



## 7 Roles and Responsibilities

### 7.1 Generators

Generators have the responsibility to ensure their compliance with the Distribution Code. The ability to carry out the changes required, and the timescales in which this can be achieved will vary from one Generator to another. Generators who respond positively are expected to undertake the following actions.

*Table 3: Typical actions undertaken by a Generator in response to the Engagement Programmes or the Payment Programme*

Identify	Identify whether its existing protection scheme complies with the new requirements or not
	Identify the changes required to meet the new requirements. This could include changing the relay settings, changing the relay, or disabling the relay.
Mitigate any risks	Form a view of whether the generic risk assessment carried out by the workgroup is sufficient or whether a site specific risk assessment would be necessary
	Where necessary, contact the DNO to provide the information required for the site specific risk assessment
	Carry out the risk assessment
	Inform the DNO of the outcome including the details of any actions that they need DNOs to undertake to mitigate any risk.
	Await confirmation from DNOs on the implementation of the actions identified
Implement action	Change the relay settings, replace the relay, or disable the relay as necessary
Notify	Notify the DNOs that the relay settings are compliant with the new settings
	Notify the DNOs with the scope of works that were required to achieve that compliance
	Await for acknowledgement and, where necessary, details of any testing required by the DNOs

### 7.2 DNOs

For the successful and timely completion of this protection change project, DNOs will have to play a major role in all the project programmes. Each DNO will be responsible for the actions listed in Table 4 within their Licensed Area. Each of these actions will fit under one of the main Programmes of this project and will be coordinated by one of the Project Workstreams.

*Table 4: Typical DNO actions*

Prepare	- Identify the relevant distributed generators and share the data with the ESO	Framework Setup	Stakeholders workstream
	- Notify all the generators with the changes to the Distribution Code; provide generic guidance on implementation; and provide information about the Payment, Assistance, and Enforcement Programmes.	Engagement Phase	Stakeholders workstream
Respon	- Receive updates from generators on their protection settings and any actions undertaken to meet the new requirements.	Payment Phase	Delivery Assurance workstream

	- Respond to requests for data to facilitate site specific risk assessment.	Payment Phase	Customer Support workstream
	- Implement the verification process, including any random site visits, as agreed.	Payment Phase	Delivery Assurance workstream
	- Update site records as necessary notifying the ESO on regular basis	Continuous Review	Value Assurance workstream
	- Provide appropriate assistance to generators	Assistance Phase	Customer Support workstream
Pay	- Identify the level of payment suitable for each generator	Payment Phase	Customer Support workstream
	- Request funds from the ESO to cover payment for tranches of Power Stations and pay Generators as agreed.	Payment Phase	Customer Support workstream
Assist	- Create a list of contractors who are willing to offer the service of updating the LoM protection at affected sites.	Assistance Phase	Customer support workstream
	-		
	- Provide comprehensive guidance documents and clear process diagrams to support Generators	Assistance Phase	Value Assurance workstream
Enforce	- Provide further assistance to generators	Assistance Programme	Customer Support workstream
	- After the backstop date, consider the enforcement options for sites that have not updated their protection settings	Enforcement Phase	Customer Support workstream

### 7.3 National Grid ESO

The ESO will play a supervisory role in this project. This reflects that the risks mitigated by this project are mainly affecting the National Electricity Transmission System and that the funding for the project is from the ESO BSUoS budget. The ESO will lead on the specification of engagement strategies and on the delivery of a significant part of the Engagement Programmes. The ESO will also be fully responsible for the specification and the delivery of the value assurance programme. The ESO actions, listed in Table 4, will focus on stakeholder engagement, continuous quantification of the risks, providing input to the prioritisation process, and funding the necessary works.

Table 5: Typical ESO actions

Engage	- Agree the message about the in the relevant forums and media	Framework Setup	Stakeholders workstream
	- Receive lists compiled by the DNOs for the affected generators	Framework Setup	Value Assurance workstream
Monitor	- Update the lists as advised by the DNOs	Continuous Review	Value Assurance workstream
	- Monitor the VS Risk	Continuous Review	Value Assurance workstream

	- Monitor the RoCoF Risk	Continuous Review	Value Assurance workstream
<b>Prioritise</b>	- Inform the prioritisation processes for VS risk (MW Capacity at Targeted Locations)	Continuous Review	Value Assurance workstream
	- Lead the prioritisation processes for RoCoF risk (Mostly MW Capacity)	Continuous Review	Value Assurance workstream
<b>Fund</b>	- Fund DNOs to pay generators	Payment Phase	Customer Support workstream
	- Pay DNOs for the work done	Assistance Phase	Customer Support workstream
<b>Operate</b>	- Update the policy on managing RoCoF/VS risks as the project progresses	Continuous Review	Value Assurance workstream

## 8 Risks and Mitigations

Some high-level project risks and their mitigations have been captured in the active risk register which will be reviewed and refined to ensure that it represents a fully comprehensive, accurate and up-to-date list of project risks and planned mitigations.

*Table Risk Register*

<b>Risk Description</b>	<b>Mitigation</b>
Generators are not informed of the change necessary	An extensive and outreaching engagement programme that runs for the whole duration of the project and a series of focused publicity programmes aimed at targeted audience.
Generators do not understand the changes required at their plants	Generic guidance produced by the Customer Support Workstream and disseminated by through the Publicity Programme
Generators are concerned about potential risks to their plant if they implement the changes required.	Guidance to clarify the outcomes of the generic risk assessment conducted by the workgroup as a part of this code modification. Provide information for site specific risk assessment if required.
Generators are not satisfied with the generic risk assessment conducted by the workgroup.	Option to request data from DNOs to enable Generators to conduct their site-specific risk assessment.
Generators have no technical capability to implement the change	A list of potential contractors will be made available to Generators throughout the project and an option that DNOs provide further support could be made available towards the end of the project.
Costs of implementation are prohibitive for some Generators	Generators who implement the protection modification will be paid for the work done
Lack of engagement from Generators	A comprehensive Publicity programme with a backstop enforcement programme
Generators implement the change but not to an acceptable standard	A Delivery Assurance Workstream will look at streamlining the delivery with documentation, checks, and site visits to ensure the changes delivered are acceptable.
The Programme does not deliver the value expected	Quarterly evaluation of the change delivered, revaluation of the benefits, and refocusing of priorities to maximise value delivered
Costs are higher than is acceptable to BSUoS payers	Quarterly reporting of agreed performance measure to Steering Group with appropriate representation and influence over stop/go criteria
The remaining LoMs risk can't be accurate assessed due to lack of quality distributed generation LoMs information	Agree appropriate assumptions based on the LoMs change completed
Generators get paid but have not made the necessary change	Two layers of checks: firstly, directly by DNOs and secondly independently at an agreed proportion of sites

## **9 Appendix 1 – Implementation Approach Options Analysis**

### **9.1 Engagement Based Model**

Under this model, network licensees will engage extensively with generators to clarify the changes required and the responsibility of the generators to ensure continuous compliance with the Distribution Code. Generators will then modify their LoM relay settings as required at their own cost..

This approach replicates the approach used for implementation of the GC0035 modification which covered approximately 300 sites. During this programme, Generators encountered several technical and commercial issues and the programme over ran by 2 years. This approach was only successful when backed up by the obligation to comply with the Distribution Code.

A significant but small subset of Generators are expected to respond to this model. These are likely to be parties that have had issues with protection systems or have significant enthusiasm for a move away from Loss of Mains approaches. Therefore, this model on its own would provide neither timely nor complete implementation of the change required.

### **9.2 Payment Based Model**

This replicates the Engagement Based Model with the difference that generators would receive payment once they have made and certified the changes within agreed timescale.

This has some similarities to the accelerated VS relay change programme procured by the ESO and delivered by DNOs in summer 2018 when VS relays at approximately 70 sites were changed over a period of a month. The difference is that standardized payment opportunities will be offered to all relevant distributed generators to achieve a very high degree of compliance. A staged framework can be designed to incentivise the early completion. .

This approach would accelerate the implementation and would increase the number of generators implementing the change as it will remove or at least reduce the cost barrier.

This model is likely to be more effective and quicker to implement than the Engagement Based Model. However, this model will not be likely to affect the Generators who feel the payment is immaterial or fail to engage due to lack of capability to understand and carry out the changes or the desire to do so; hence it is not likely to complete implementation on its own.

### **9.3 Assistance Based Model**

There are different options on what assistance based model could be developed;

One option is for network licensees to provide direct assistance for generators, undertaking, with the generators' permission and effectively as the generators' agents, the necessary protection changes.

This would solve the problem of the lack of technical capability and lack of engagement of some generators. However, changing the relay settings at 50,000 sites over a period of three years would require that approximately 70 are retrofitted every working day. The programme necessary to achieve that would take significant time and resource to prepare and establish the dedicated delivery agencies which would slow the overall programme. Procurement for such a large programme also needs consideration, including whether DNOs should tender the work collectively or individually; which could further complicate and slow the programme. In addition, it will be necessary to manage liabilities associated with DNOs working on Generators' equipment. Based on the issues identified, it becomes clear that a simpler assistance model is more appropriate.

A simpler variant of the approach above, particularly taking into account the setup costs, setup timescales, resource implications, and DNO liability resolution, can be envisaged. Under this simpler model, DNOs would make available a list of contractors who could undertake the works, publish comprehensive guidance, and respond to queries from Generators as and when necessary.

This would avoid the significant risks to the delivery of the project from the costs and complexities of the full Assistance model. Features which present a significant risk to delivery are the need to:

1. Source appropriate resource centrally;
2. Get consent from the responsible party to enter premises;
3. Get consent for the responsible party to modify their equipment, including the shut down and restart of generation equipment;
4. Plan and execute a programme of site visits, with a dependency on a representative of the responsible party being present; and
5. Agree how to manage risks and liabilities associated with working on third party equipment.

The option remains open for a more comprehensive Assistance Model would remain open to run if and when necessary.

#### 9.4 Enforcement Based Model

This replicates the Engagement Based Model with the difference that Generators that do not carry out the modifications required to their plant would be subject to the agreed compliance enforcement process.

The Enforcement Model is likely to be the last resort to address a small population of distributed generation that fail to respond to the change programme.

This model, if implemented on its own, is likely to need significant time to implement and would probably face several challenges by Generators.

#### 9.5 Summary of Models

<b>An Engagement Model</b>	<b>A Payment Model</b>	<b>An Assistance Model</b>	<b>An Enforcement Model</b>
<b>Generators implement the change at their own cost</b>	<b>Generators implement the change and get paid for the work</b>	<b>DNOs provide assistance</b>	<b>Generators implement the change at their own cost otherwise they are penalised</b>
<ul style="list-style-type: none"> <li>- Easy to setup project</li> <li>- Low set-up cost £1ks</li> <li>- Immediate start</li> <li>- Low delivery cost £10ks</li> <li>- Low resource required</li> <li>- No risk to DNOs</li> <li>- Long implementation time</li> <li>- Some Generators may not have the capability to undertake the works required</li> <li>- Most Generators wouldn't see the need</li> <li>- Unlikely to deliver sufficient change</li> <li>-</li> </ul>	<ul style="list-style-type: none"> <li>- Low set-up cost £10ks</li> <li>- Start once design is complete</li> <li>- High delivery cost £20m to £50m</li> <li>- Medium resource required</li> <li>- No risk to DNOs</li> <li>- Medium implementation time.</li> <li>- Some Generators may not have the capability to undertake the works required</li> <li>- Some Generators may not be proactive enough to keep up to date with the code requirements</li> <li>- Potential to deliver significant change</li> <li>- Potential early delivery</li> <li>- Payment potentially insignificant to affect Generators whose Power Stations are at the high end of the capacity range</li> </ul>	<ul style="list-style-type: none"> <li>- A complicated setup</li> <li>- High set-up cost □£1m</li> <li>- Start subject to agreement of procurement approaches and ability to source the capability required</li> <li>- High delivery cost £20m to £50m</li> <li>- Significant resource required</li> <li>- DNOs need to manage risks and liabilities</li> <li>- Medium implementation time</li> <li>- Potential to deliver significant change</li> <li>- Option to offer lighter support at the beginning in order to avoid setup timescales and costs, resource implications, and liabilities.</li> </ul>	<ul style="list-style-type: none"> <li>- An easy to setup project</li> <li>- Low set-up cost £1ks</li> <li>- Immediate start</li> <li>- Low delivery cost £10ks</li> <li>- Low resource required</li> <li>-</li> <li>- Long implementation time</li> <li>- Some Generators may not have the capability to undertake the works required</li> <li>- Some Generators may find the costs significant.</li> <li>- Some Generators may not be proactive enough to keep up to date with the code requirements.</li> <li>- Unlikely to deliver sufficient change.</li> <li>- Likely to overrun.</li> <li>- Cannot be justified on its own</li> <li>- Unlikely to be acceptable or effective on its own</li> </ul>

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