National Grid ESO
Faraday House, Gallows Hill
Warwick, CV34 6DA

14th November 2018

Dear Industry Colleague,

Open Letter Update on the Connection and Infrastructure Options Note (CION) Process

This letter provides an update to the Connection and Infrastructure Options Note (CION) process guidance note that was published on the National Grid website on 4th March 2015.

This latest version of the guidance note aims to provide clarity and transparency to the industry on the CION process as it currently stands following the publication of Ofgem's Integrated Transmission Planning and Regulation (ITPR) final conclusions and introduction of a new licence obligation on National Grid in its role as System Operator. In summary, the changes to affected sections of the guidance note as result of these are:

Section 1: Revised text as a result of ITPR's final conclusions and National Grid's new licence condition. Further clarification on connections that will follow the CION process and with the requirement included as part of a Developer's BCA with NGESO.

Section 4.2: Revised text detailing how the economic assessment will be undertaken.

Old Section 10: This has been deleted following ITPR's final conclusions that the CION process will be applied for the assessment of interconnector connection applications.

New Section 10: This section now provides an overview of the legal obligations on Developers, TOs and NGESO as System Operator supporting the CION process.

We have attached the latest version of the guidance note to this letter and also published it on National Grid's website[1].

We are always open to discussion on how the CION process guidance note can be further developed in order to remain relevant in the evolving connection and regulatory framework. Please send your comments, suggestions and questions to **transmissionconnections@nationalgrid.com** and we will get back to you.

Yours sincerely,

Sade Adenola
GB Connections Assessment Manager
Network Capability, Electricity

[1] https://www.nationalgrideso.com/connections/registers-reports-and-guidance

nationalgridESO

The Connection and Infrastructure Options Note (CION) Process

Guidance Note V4.0

14th November 2018

Guidance Note Change Control History

Issue	Date	Reason for Change	Author(s)
Issue 001	06/10/2014	First Issue	Faith Natukunda, Sheriff Ilesanmi
Issue 002	04/03/2015	Comments from the industry have been incorporated into relevant sections	Sheriff Ilesanmi
Issue 003	30/10/2015	Update to relevant sections following publication of ITPR final conclusions and introduction of new “Enhanced SO” Licence conditions.	Sheriff Ilesanmi
Issue 004	14/11/2018	Update to reflect the SO and TO separation and minor corrections.	Christopher Phiri, Mark Worsley

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1 Introduction

The purpose of this guidance note is to explain the CION process which will provide clarity and transparency on the process. The CION process evaluates the respective transmission options required which leads to the identification and development of the overall efficient, coordinated and economical connection point, onshore connection design and, where applicable, offshore transmission system / interconnector design in line with obligation to develop and maintain an efficient, coordinated and economical system of the electricity transmission network.

This guidance describes how developers, TOs and NGESO collaborate as part of the CION process. For the purpose of this guidance note;

- **Developers** refers to developers of offshore transmission under the generator build arrangements or developers of interconnectors,
- **TO(s)** refers to **Onshore TO(s)** and/or **Offshore TO(s)**
  - **Onshore TOs** refers to National Grid Electric Transmission (NGESO) in its role as a Transmission Owner (TO), Scottish Hydro Electric Transmission (SHE-T) and Scottish Power Transmission (SPT).
  - **Offshore TOs (OFTOs)** refers to Offshore Transmission Owners
- **NGESO** refers to National Grid Electric System Operator (NGESO) in its role as a System Operator (SO).

As part of the Ofgem's Integrated Transmission Planning and Regulation (ITPR) final conclusions, the importance of the CION in the connections process was recognised[2] and as such, Ofgem has included, as part of the NGESO's "Enhanced SO" role upon completion of the ITPR project, a new licence condition[1]. In light of this obligation, we have made some minor updates to this guidance note. Further, going forward for any connection application requiring a CION, this will be provided for in the connection agreements.

NGESO will be applying the CION process as part of the connection and modification application process for connection offers received from Developers. This guidance note has been developed to provide an overview of the CION process including the roles and responsibility of each CION party.

NGESO will keep the CION process and this guidance note under review as the regulatory framework changes and in light of practical experiences of the parties during the application and evolution of the process and update as appropriate. In the event that any change(s) is/are required will inform the industry through an open consultation. Stakeholders will be invited to provide input into any proposed change before publication of an updated version of the CION process guidance note.

NGESO will also be open to discussions on how to ensure that the CION process guidance note remains relevant. Please send your comments, suggestions and questions to transmissionconnections@nationalgrid.com.

[1] Condition C8: Requirement to offer terms – item 5A
[2] https://www.ofgem.gov.uk/publications-and-updates/integrated-transmission-planning-and-regulation-itpr-project-final-conclusions - Final Conclusion 1.44

2 What is the CION?

The Connection and Infrastructure Options Note (CION) is the document where the output of the CION optioneering process is recorded. It provides a joint record of the rationale for the selection of the overall preferred connection option from the technical, commercial, regulatory, environmental, planning and deliverability aspects.

For the purpose of this guidance note, **connection option** refers to;

- The onshore connection point, the onshore transmission design and
- The offshore transmission system design for offshore transmission or interconnectors.

The CION is a live document and evolves over time to inform the TO and Developer's investment decisions on the respective transmission infrastructure and the associated planning/consenting processes.

The CION requires input from NGESO as System Operator, TOs and Developers. NGESO as System Operator coordinates this input.

Within the CION;

- The Onshore TOs record details of their assessment of all feasible onshore connection points together with the required transmission construction works
- The Offshore TOs record details of their assessment of all feasible offshore connection designs together with the required offshore transmission construction works
- During the pre-offer CION process, NGESO records any initial offshore design assumptions made about the offshore transmission design.
- During the post-signature CION process, the developer of the offshore transmission system or OFTO records the offshore design and cost assumptions during the development of the project.
- During the post-signature CION process, the developer of an interconnector records the interconnector design and cost assumptions during the development of the project.
- NGESO records the economic assessment undertaken to determine the most economic connection option.
- NGESO records the overall economic, efficient and deliverable connection option, together with the selection rationale as agreed by the Parties to the CION process

The form of the CION is that set out in Appendix B2 of STCP 18-1 of the System Operator Transmission Owner Code (STC) and is included in **Appendix B** of this guidance note for reference.

2.1 What is the purpose of the CION?

The CION records the output of the work between the Developers, TOs and NGESO to identify the overall economic, efficient and coordinated connection option.

2.2 Who owns the CION?

The CION is a document developed and jointly owned by the parties to the CION process. NGESO is responsible for coordinating the development of the CION, however, each party is responsible for the accuracy of any information they provide to the CION as part of the CION process. The CION parties shall send email confirmation to NGESO to agree on the CION version for sign off.

3 What is the CION process?

The CION process is an optioneering process to identify the overall economic and efficient connection option. It provides a clear, transparent, repeatable and non-discriminatory process to ensure all relevant developers are treated in a consistent manner.

This optioneering process involves Developers, TOs and NGESO and takes place both pre-offer and post-signature as further explained within this note.

The output of the CION process is recorded in the CION and this informs the offer to the developer and specifically the works to be provided for in accordance with the CUSC and STC codes.

4 Basic CION Process

4.1 Overview

The CION process occurs both in the pre-offer and post-signature project stages;

- The **pre-offer CION process** is the optioneering process that takes place as part of the initial connection application process to identify the preferred connection option and transmission works for new offshore generation or interconnector connections.
- The **post-signature CION process** is the optioneering process that takes place after the developer has signed a connection offer. It covers any subsequent CION process reviews by the parties to the CION process as a result of material trigger(s) in line with Modification Applications or Modification Notices as defined within the CUSC and STCP 18-1.

The flow charts showing the CION process is shown in **Appendix A**.

4.2 Pre-Offer CION Process

NGESO informs developer of clock start

The Pre-Offer CION process is initiated when NGESO informs the Developer and the TO(s) of the clock start date. This clock start date is dependent on NGESO receiving the Developer's application fee and the application being technically deemed competent following submission of requested data in accordance to the Data Registration Code (DRC). Once the clock starts, the TO(s) and NGESO initiate their different assessments to facilitate identification of the most economic and efficient connection option as described below.

Onshore TO(s) assess onshore connection options

In order to identify the most economic and efficient transmission works to deliver the connection, the Onshore TO(s) undertake an optioneering process to assess a range of onshore connection options in order to identify a preferred connection point. The Onshore TO(s) assess the onshore connection options in accordance with STCP 18-1 in the STC and take into consideration the Developer's preferred onshore connection point as outlined in the Developer's Connection Application.

As part of the Pre-Offer CION process, the Onshore TO(s) provide NGESO with the details of the assessed onshore connection points which include;

- a list of the required transmission works,
- the cost of the transmission works,
- and a high level appraisal of technical, environmental, planning consent and deliverability issues related to each onshore connection point

The TO(s) provide NGESO with details on the onshore connection points and designs within the CION (Provided as Appendix B2 of STCP 18-1). The details would be available to other CION parties except subjected any confidentiality clause(s).

Development of the offshore transmission designs

The offshore transmission designs can be developed using two approaches. These two approaches are applied during the pre-offer CION process while only option B is applicable during the post-signature CION process.

A). NGESO makes assumptions on the offshore transmission designs

As allowed for in CUSC section 2.13.8, in order to make the connection offer, NGESO makes initial assumptions about the offshore transmission design. These assumptions are recorded by NGESO within the CION and used by NGESO (and the onshore TOs) to identify the preferred connection option reflected in the Construction Agreement.

- NGESO takes into account any design information submitted by the developer as part of the Connection Application such as connection voltage and technology in line with the Planning Code (PC).
- NGESO develops a range of offshore transmission design options, taking into account available technology as published in the annual Electricity Ten Year Statement (ETYS) and records the offshore transmission design options within the CION.
- NGESO costs the offshore transmission design option(s) based on generic costs published within the latest available ETYS and records these costs within the CION.

B). Developer or OFTO provides offshore transmission designs to NGESO

The Developer or OFTO provides the details of the Offshore Transmission System Designs and Costs to NGESO in the form of the CION in the pre-offer CION process.

- NGESO provides the Developer with the range of onshore connection options under consideration by the TO(s) in the form of the CION. The Developer investigates onshore and offshore transmission connection routes, develops offshore transmission design options, and costs the different options. The Developer provides all these details to NGESO in the form of the CION.
- The Developer also provides NGESO with a high-level appraisal of the technical, environmental, planning consent and deliverability issues related to each transmission design option within the CION.
- The Developer may also provide NGESO with Cost Benefit Analysis (CBA) related to each connection option which NGESO might take into account in its economic assessment of the connection options.

In the event that the Developer is not in position to provide the above mentioned information on the offshore transmission designs during the pre-offer CION process, then NGESO will make assumptions on the offshore transmission design as described above for offshore generation (i.e. Option A) and record these assumptions within the CION.

NGESO undertakes economic assessment of the options

In order to identify the most economic and efficient connection option, the TO(s), Developer(s) and NGESO will analyse all connection designs covering the offshore transmission/ interconnector designs and the onshore connection point transmission designs. These are then short-listed from a design and power system analysis perspective to identify a suitable range of options to assess in a Cost Benefit Analysis (CBA).

The Developer(s) and TO(s) provide NGESO with project capital costs for each design solution and connection point, along with other economic and system parameter data as requested by NGESO including but not limited to, wider system boundary capability impacts, capital cost phasing and Weighted Average Cost of Capital (WACC).

NGESO undertakes a lifetime Present Value based CBA on the options taking into account the capital cost as well as the associated forecast operational constraint cost and Cross Border Balancing costs

attributable to the connection option. Regret analysis is then used to rationalise the different connection options.

Following the CBA, NGESO records the result of the economic assessment within the CION and lists the connection options starting with the most economic design option.

Selection of the overall preferred connection option

NGESO sets up meeting(s) with representatives from each of the parties involved within the CION process. The purpose of this meeting is for all parties to select the overall preferred connection option.

The main objective in selecting the overall preferred connection option is **to ensure that the most economic and efficient design connection option is developed for the overall benefit of the Great Britain (GB) consumer**.

In order to select the overall preferred connection option, the parties consider;

- The CBA results provided by NGESO
- The technical, environmental, planning, consenting and deliverability issues associated with each connection option as highlighted within the CION.

NGESO records the selected preferred connection option together with the selection rationale within the CION.

The selected preferred connection option forms the basis of the connection offer issued to the developer in accordance with the CUSC.

4.3 Post-Offer Negotiation

On receipt of a connection offer, the CUSC provides the developer with a 90 day post-offer period to review and sign their connection offer.

For a new offshore connection, as part of the post-offer period, NGESO will coordinate the review of the CION with the developer or OFTO and onshore TO(s).

The purpose of this CION review is to allow the developer to review the offshore transmission design assumptions initially made by NGESO as provided within the CION issued with the connection offer. This will provide an opportunity for the developer to review/update the cost assumptions for the offshore transmission design or any other relevant information within the CION. However, in the event that the information provided at this stage indicates a possible change in connection point or design, then NGESO will advise the developer of the timescales for a revised offer or whether a new application is required as stated in STCP 18-1.

4.4 Post-Signature CION Process

The post-signature CION process is the optioneering process that takes place after the developer has a signed connection offer which has within it the works associated with the preferred connection option.

A post-signature CION process can be initiated by NGESO, the developer or the TO(s), following a material trigger which could result in a change to the onshore connection point, the onshore transmission design or the offshore transmission design. The CION optioneering process will be revisited to re-assess whether the preferred connection option remains or whether an alternative option is the overall economic and efficient option.

The material trigger(s) generally require a Modification Application or a Modification Notice as defined within the CUSC and STCP 18-1.

The review of the impact of the trigger on the connection options will follow the process as described for the pre-offer CION process, although in this case, the offshore transmission design assumptions and costs will be updated and documented within the CION by the respective developer or OFTO rather than NGESO (i.e. As described in ‘Development of Offshore Transmission designs - Option B’). The onshore TO(s) will also provide any available updates on the onshore connection point and onshore transmission design.

Any changes to the preferred connection option, together with the selection justifications will be recorded in the CION, which is saved as an incremental version.

5 Triggers for the review of the CION process

Material triggers are any changes that affect the overall design or connection point that will require for the need to review the connection option. If these changes are deemed material by the CION parties, then any re-assessment of the design option will fall under the Modification Process as defined in the CUSC and STCP 18-1. The process can be initiated by NGESO, the developer or the TO(s) and this shall take the form of a Modification Application or a Modification Notice as appropriate. In an event that the CION parties can't agree that a change is material then this is refer to Ofgem for determination.

The CION review following a material trigger will need to consider the deliverability of the connection options by taking into account the impact and cost of any project developments undertaken so far such as planning status, consenting status, cost of preliminary works by the CION parties and where applicable, a risk assessment to capture sunk costs.

Examples of material changes which could affect the onshore connection point, or the onshore or offshore transmission designs include:

- Changes in SO assumptions – such as significant changes in the Construction Planning Assumptions (CPA) or generation background.
- Changes in TO assumptions – such as changes in generation background that impact on TO investments and affects the Construction Planning Assumptions that form the basis for the TO Construction offer to NGESO.
- Changes to the developer assumptions – such as changes in Transmission Entry Capacity (TEC), changes in offshore technology, etc.
- Planning decisions
- Changes to the electricity regulatory framework.
- Changes to key fundamental economics inputs for CBA – such as FES, ETYS, ELSI model etc.

6 What criteria are considered in selection of the preferred connection option?

A number of considerations are taken into account in order to select the overall preferred connection option. The main objective for the parties to the CION process in selecting the preferred option is **to ensure that the most economic and efficient connection option is developed for the overall benefit of the GB consumer**.

The selection of the preferred connection option does not only look at the most economic option from the Cost Benefit Analysis (CBA) exercise but also considers the following criteria; environmental impact, deliverability, time of market, technology risk, PCI status, planning and consenting risk. It should be noted that the listed criteria is not a conclusive list. The parties to the CION process will also consider other criteria alongside those listed criteria which they deem relevant to the project during the selection of the preferred connection option.

7 Do we "freeze" the CION?

The CION is a live document which evolves with the project both pre-offer and post-signature to reflect any changes and/or updates to the preferred connection option. The CION will continually be reviewed throughout the development of the project with reviews initiated periodically or by material triggers to ensure that the preferred connection option is the still the most economic, efficient and deliverable option. Any CION review will take into account the project's development at that point in time. The CION will continue to be revised until there is no further enhancement of benefit to the GB consumer.

8 What happens if parties do not agree with the preferred connection option?

NGESO will work with developers to agree the connection option in line with the developer's preferred connection/landing point as outlined in the connection application. NGESO will also consider other options based on an economic and efficient assessment working with the relevant TO's. Where the parties to the CION process cannot agree on a connection option, then NGESO will make an offer on the connection option NGESO considers to be the overall economic and efficient option for the benefit of the GB consumer in compliance with NGESO's licence requirements.

The developer then has three options available within the CUSC in respect of this offer; to accept, to refer or to lapse the offer. Where agreement cannot be reached through post offer discussions, and the terms of the offer are in dispute, the developer would be able to refer the offer to Ofgem for determination.

9 How can coordinated/ integrated offers be treated as part of the CION process?

We propose that coordinated options should be considered as part of the CION process, following receipt of connection applications where there is opportunity for coordination/integration to provide benefit. Coordinated/integrated options should also be investigated following system reinforcement drivers as identified in the Electricity Ten Year Statement (ETYS).

- In the pre-offer and post-signature CION process, NGESO, the developers or TOs can indicate to the parties involved in a CION process, any known opportunities for coordination/integration. NGESO and the parties shall agree whether there is sufficient time within the CION process duration to review the coordinated/integrated options and if necessary request an extension from Ofgem.

- One separate CION should be developed to investigate and develop Coordinated/Integrated options and this CION should be expanded to include additional parties as and when necessary.

Within the CION for coordinated/integrated projects, NGESO shall coordinate the completion of the CION so as to respect the confidentiality and non-disclosure undertakings associated with confidential or commercially sensitive information that it received from CION parties. For example NGESO will only provide summary cost information to the other parties, while keeping detailed unit cost information for individual parties confidential.

With regards to wider network benefit or anticipatory investment reinforcements, NGESO shall utilise the Future Energy Scenarios (FES) and adopt the least regret analysis identified in Network Options Assessment (NOA) to reduce risk of stranded assets with any arising wider network benefit or anticipatory investment requirements being supported by NGESO.

In proposing coordinated/Integrated options, the development stages of the different projects involved will be considered, and options will be assessed in line with the criteria described in the earlier sections of this note.

It should be noted however, that further commercial and regulatory clarity on how coordinated/integrated options can be treated will be provided by Ofgem.

10 Legal obligations supporting the CION process

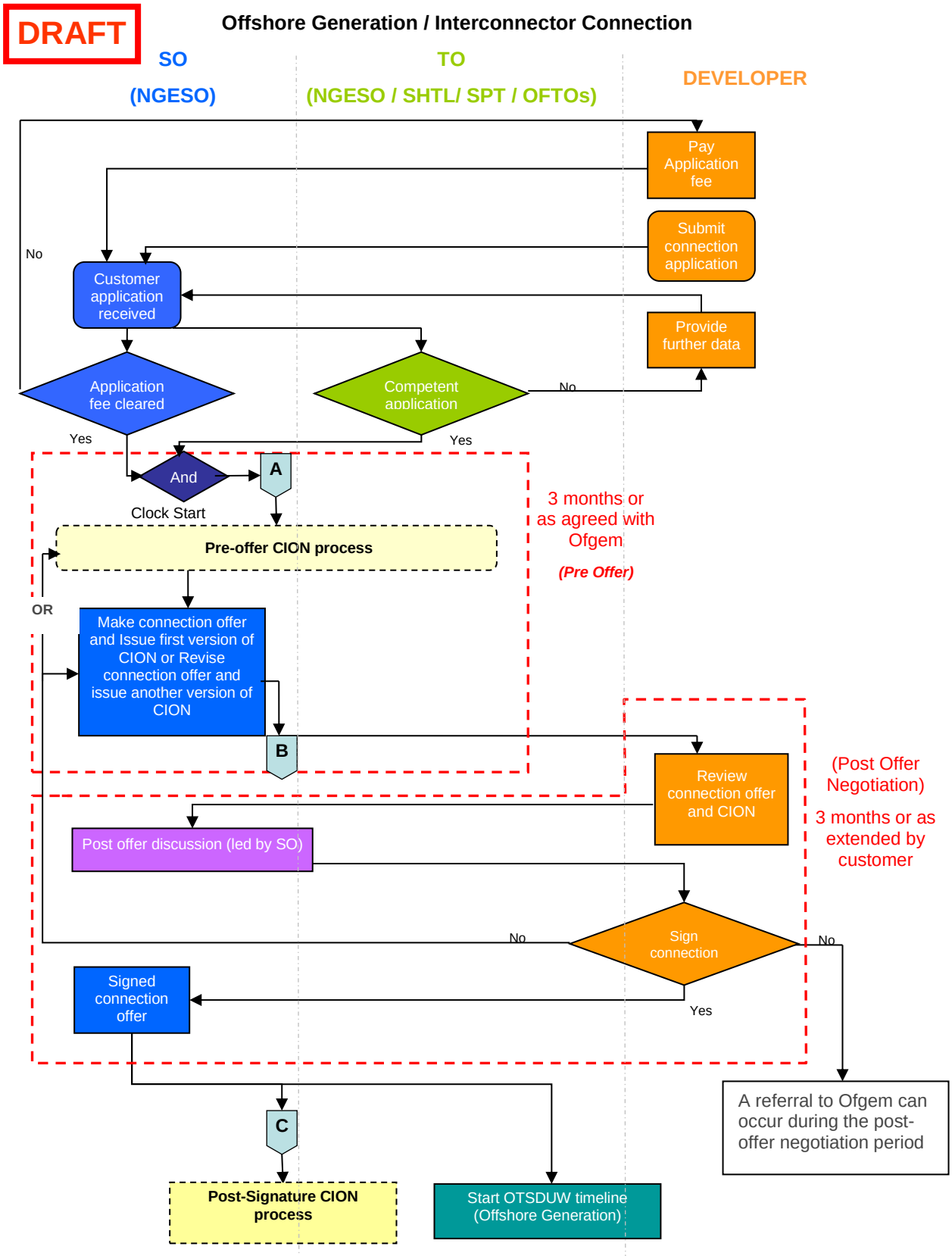
NGESO and onshore TOs have a statutory licence obligation as contained in section 9 of the Electricity Act 1989 (as amended by the Utilities Act 2000) to develop and maintain an efficient, co-ordinated and economical system of electricity transmission and this is reflected in the specific requirement of the transmission licences.

In the context of the onshore TOs and NGESO delivering connections, STCP 18-1 and the CION process within it is the "tool" used by those parties to identify and record the connection options

considered and the overall economic and efficient connection option. The CION process is embedded as part the connection and modification application as defined in STCP 18-1.

As Developers are developing transmission systems that will form part of the National Electricity Transmission System (NETS), for the connection agreements will provide for participation in the CION process, by reference to this guidance note. Developers are obligated to fulfil their roles and responsibilities as highlighted in this guidance note. The initial offshore assumptions made by NGESO as part of the Pre-Offer CION process enable it to identify the connection point/design which meets the statutory duty referred to above based on those assumptions. The Post-Signature CION process then enables the developers, onshore TOs and NGESO to further evaluate, using actual information about the offshore transmission system and any material triggers, to validate or update the assumptions to identify a preferred connection option which meets the statutory duty referred to above. The CION process then informs the developers and onshore TOs works in the construction agreement.

APPENDIX A: CION PROCESS CHARTS



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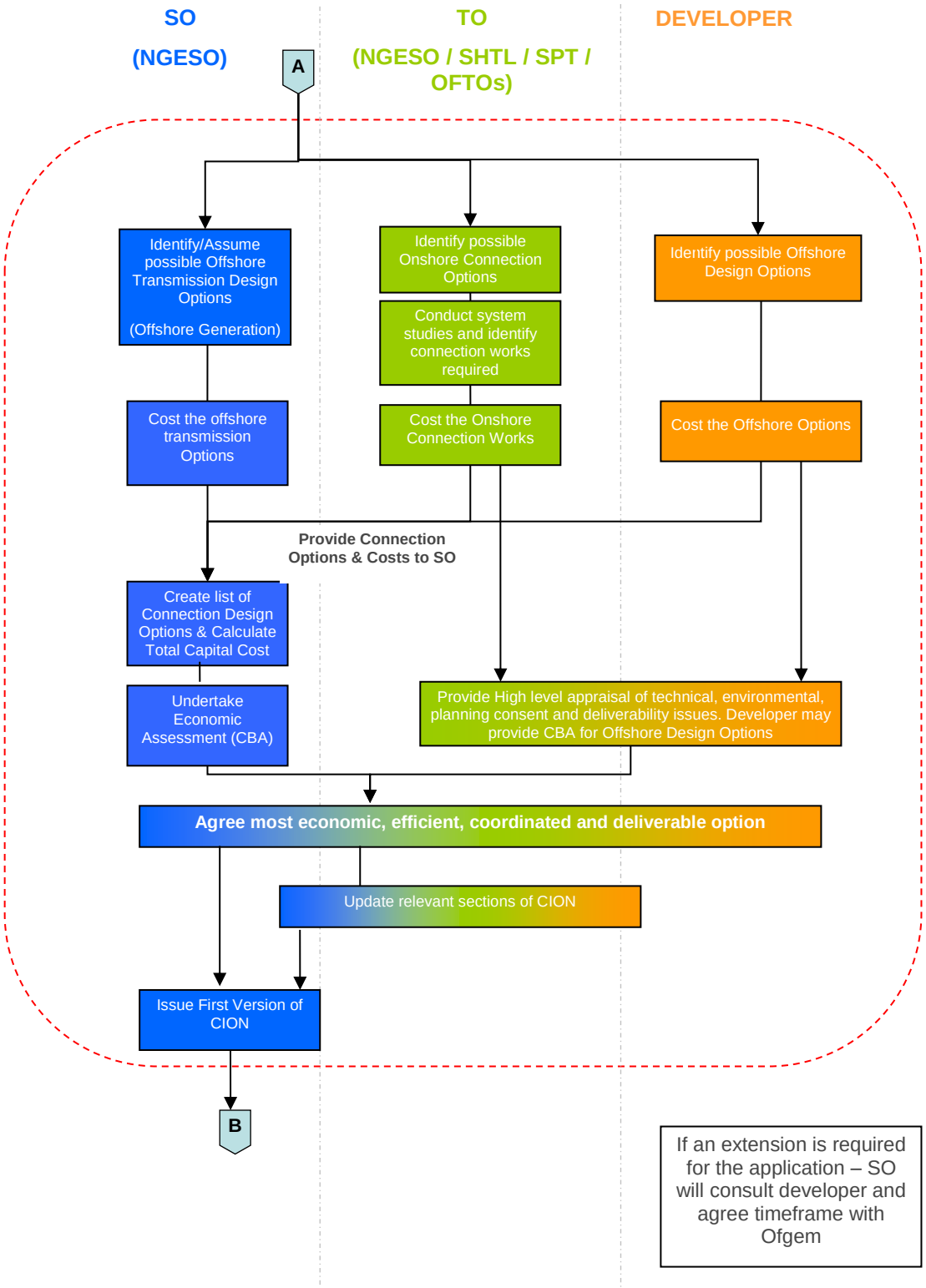
Pre-Offer CION Process



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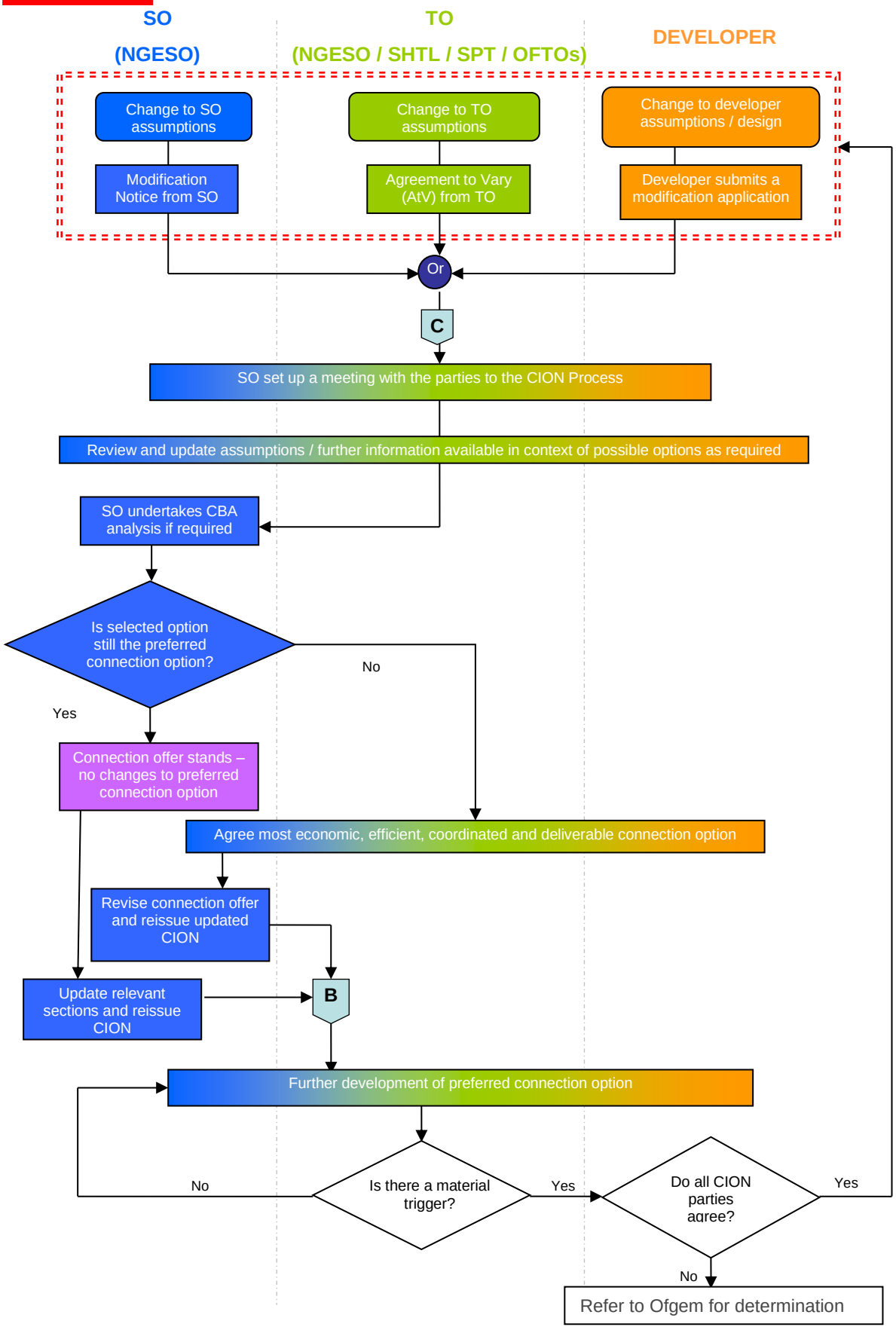
Post-Signature CION Process



APPENDIX B: The CION Template

Please delete or type over any red text, which is guidance on how to fill in this document.

STCP 18-1 Appendix B2 – Offshore Connections and Infrastructure Options Note

Connection and Infrastructure Options Note				
User	Insert Developer's name			
Site Name	Insert site name			
Application Steering Group Members (Add / Delete As Applicable)	**NGESO as SO**	NGESO	**Lead details** Name: Contact No: Email:	
	Host TO	Insert	**Lead details** Name: Contact No: Email:	
	Affected TO 1	Insert	**Lead details** Name: Contact No: Email:	
	Affected TO 2	Insert	**Lead details** Name: Contact No: Email:	Add additional rows as required
Application Type	New Generation Connection Application			
Overview of the application (Short description of the application)	Provide a short description of the connection using information provided within the customer connection application; ▪ Capacity of the connection (CEC, TEC) ▪ Type of generation ▪ Coordinates of generation site ▪ Ownership boundary ▪ Connection date requested ▪ Whether customer has requested a NETS SQSS design variation ▪ If this is an offshore connection and thus whether the Applicant is undertaking an OTSDUW Build			

Revision Number	Date of Revision	Reason for Revision	Revised by
001	Day/Month/Year	First Draft	Person 1 **(NGESO)**
002	Day/Month/Year	Final V1.0: Issued with Grid Connection offer	Person 1 **(NGESO)**

Notes for Completion:

1. *Please complete the tables above when the document is first used for a scheme and when any subsequent revisions are made to any of the information in the live document.*

2. *Please insert the site name and document version number in the header.*

3. *This page should be retained throughout the life of the document and remain with the final version.*

CION Executive Summary

In this section, provide an overall summary of the CION highlighting what the preferred Connection and Infrastructure option is and how it has been selected.

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Purpose of CION

The aim of this document is to provide a record of the assessment undertaken in considering the connection of [Insert project name] to the National Electricity Transmission System. The document facilitates an appraisal of a variety of options and identifies the preferred onshore connection points and offshore transmission network configuration.

The Connection and Infrastructure Options Note (CION) has been developed to initially make a representative Connection Offer to an applicant and subsequently develop the most economic and efficient design option. The purpose of the CION is;

- To provide a joint process to centrally record decisions and design rationale from the technical, commercial, regulatory, environmental, and socio-economic aspects of a project as it progresses
- To document the clear reasoning why a specific design option has been chosen
- To provide visibility of the decision making process and to record the underlying assumptions

As part of the economic assessment, the CION will consider the total life cost – assessing both the capital and projected operational costs (over a project's lifetime) to determine the overall economic and efficient design option.

The CION supports the initial customer connection offer and is issued together with the customer offer - **it is however a working document and is subject to periodic review until a final preferred design solution is reached.**

Following the initial customer connection offer, all the parties undertake more detailed assessments which take into account (but are not limited to) deliverability, construction complexity, land issues, consents, technology, costs, and Environmental issues. These detailed assessments will either reconfirm the initial preferred design option or trigger the need for a modification application. Also, these assessments will feed directly into an Interface Selection Report which is used to support planning applications.

Further development of the costs, updates in technology and the commercial frameworks will continue to be edited into the CION as existing and alternative options are further explored. It is customary that once the preferred design option (i.e. the most economic and efficient) is reached this document will be finalised and signed-off by all Steering Group Members.

Overview of Options Appraisal Process

The appraisal process assists the assessment of the optimal way to connect [Insert project name]. This process enables NGESO and the Affected Parties to identify and balance technical, environmental and cost considerations in selecting options, while also documenting the information on which judgements have been based. The options appraisal process is carried out in three stages and decisions are made based on the best available information at the time. A description of the appraisal process is given below and identifies the respective filters applied at each stage:

Stage 1 captures the onshore TO's assessment of the potential locations for connecting the generation. As part of the initial connection application process, technical, environmental and benefit filters are applied to narrow the onshore interface sites; options are assessed against distance from the generation site, the extent of onshore reinforcements, NETS SQSS compliance, technical limitations and high level environmental issues. At this stage, options can be Discounted, Parked or Taken Forward. Within the subsequent iterations of the CION, the onshore TOs will undertake more detailed assessments of the options 'Taken Forward'. This detailed assessment will cover NETS SQSS compliance, deliverability, construction complexity, Land issues, Technology, Costs, and Environmental issues.

Stage 2 captures the offshore TO's assessment of various offshore transmission network design concepts to connect the generation to the onshore interface sites. Technical and benefit filters are applied to narrow the transmission network design concepts; options are assessed against chosen interface points for compliance with NETS SQSS, for various transmission technologies and network flexibility. Integrated options are also considered as part of the offshore design options. At this stage, options can be Discounted, Parked or Taken Forward. Within the subsequent iterations of the CION, the offshore TOs will undertake more detailed assessments of the options 'Taken Forward'. This detailed assessment will cover NETS SQSS compliance, Deliverability, construction complexity, Land issues, Offshore consents, Technology, Costs, and Environmental issues.

At **Stage 3**, the shortlisted options from Stage 1 & 2 are appraised in more detail to determine the most economic and efficient solution and therefore identify the preferred option. Shortlisted options are

economically assessed by taking into account the capital costs and operational costs with major risks highlighted. The offshore TO costs used in the economic assessment are initially based on published costs within the National Grid Electricity Ten Year statement; however, these are subsequently revised by the relevant parties in subsequent CION revisions.

Common Assumptions for Options

[Expand as appropriate]

The following assumptions are common across all listed options within this document and are agreed as of [Insert date].

- Onshore and offshore cable routes are estimated and have been chosen to avoid known constraints, e.g. existing wind farms in the area. Cable routes may be subject to revision following detailed survey works.
- There remains significant uncertainty around some costs, particularly HVDC converter station costs and of offshore cable installation. All costs used are estimated from past projects and market intelligence at the time of writing.
- Onshore converter station to be located near to MITS substation.
- Cable parameters are estimated on a set of generic assumptions. May be subject to revision following detailed design works. [Please insert any cable assumptions made]
- Detailed dynamic reactive compliance studies have not been performed and the reactive compensation provided is simply indicative. The sizing of reactive compensation plant will be subject to detailed studies undertaken by the developer in line with Grid Code requirements.
- Harmonic studies have not been performed and at present no allowance has been made for harmonic filtering plant.
- Costs of cable sealing ends have not been included at this stage.
- Onshore works are based upon contracted generation background as of [Insert date]
- The changes in generation background are the following:
    - X terminated on Day/Month/Year
    - Y terminated on Day/Month/Year
- Environmental and consenting risks have been assessed qualitatively; no financial weighting has been applied.
- No consideration has been given to the lifetime cost of electrical losses in this analysis.
- Offshore turbine details and location of substations is based upon information within the grid connection application submitted by the Developer as of dd/mm/yy ref XXXXX
- No consideration in this analysis has been given to developer sunk costs with respect to the X connection option, or the impact repeating survey works would have on the deliverability of the project for Year.Day/Month/Year and accepted Day/Month/Year
- Electrical plant for the OFTO onshore substation has been costed as installed.
- The onshore costs are attributed only to [Insert project name]. Cost sharing with other generators was not taken into consideration

SECTION 1 – Project Overview

Introduction

In this section provide an overview of the proposed project covering the following key pieces of information. Provide a historic background to the project where necessary;

- Location
- Type of project, e.g. offshore wind, interconnector, etc.
- Capacity
- Number of phases / platforms (if applicable)

SECTION 2 – Stage 1: Onshore TO Interface Points Appraisal

Onshore and Offshore Distances

In this section, provide the assumed onshore and offshore distances within the table provided. Include a geographical map showing the project location with reference to the onshore interface points under consideration.

MAP
Insert Map

Table 1: Summary of project distances

	Distance (km)		
Site	**Onshore**	**Offshore**	**Total distance**
SITE A 132kV			
SITE B 275kV			
SITE C 400kV			

Onshore TO Interface point appraisal Matrix

In this section, provide a summary of the appraisal of all the onshore connection points considered. Include descriptions of the connection, assumed landing points, technical limitations, assessment of required transmission works, and environmental issues. Provide an overall option appraisal together with a justification for the appraisal. The onshore TO should cost all the options **'taken forward'** and provide the capital cost to NGESO for the stage 3 economic assessment.

Connection Point	Connection Route Distance from XX to Interface point on GB MITS (km)[3]	Connection Issues and Technical Limitations (to include Thermal/Voltage/Stability/ Fault Level)	Onshore TO / DNO Transmission Works (Minimal/Local/ Moderate/Extensive)[4]	Environmental Issues	Overall Options Appraisal[5]
SITE A 132kV	[Insert distance from Table 1]	Describe any technical / connection issues	**Minimal / Local/Moderate / Extensive** (Delete as appropriate and include a short summary of the required works) E.g. ▪ A new substation is required ▪ New xxkm OHL	Provide high level summary of environmental issues where applicable	**Discounted / Parked / Taken Forward** (Delete as appropriate and include reasoning for the overall appraisal)
SITE B 275kV	[Insert distance]				
SITE C 400kV	[Insert distance]				

[3] Distances have been estimated using Google Earth; direct routes have been used with some high level engineering judgement.
[4] For guidance the Transmission Works are defined as: **Minimal** = limited to works to satisfy Chapter 2.6 of NETS SQSS (i.e. additional bay at a connection point); **Local** = requiring circuit uprating and compensation up to and including the next adjacent substation (in any direction); **Moderate** = requiring circuit reconfigurations, some reconductoring and compensation in local vicinity (i.e. up to 3 substations away); **Extensive** = new circuits or upgrading 275 kV to 400 kV or widespread re-conductoring and compensation.

[5] Definition of terms is included in Appendix A.

SECTION 3 – Stage 2: Offshore TO design concepts Appraisal

In this section, provide the variety of Offshore Transmission design concepts under consideration including the future OFTO network and onshore substations. Consider integrated design options. Include single line diagrams and apply technical and benefit filters to narrow the transmission network design concepts: assess options against compliance with NETS SQSS, cable technology and network flexibility. The Offshore TO should cost all the options **'taken forward'** and provide the capital cost to NGESO for the stage 3 economic assessment.

Option A – [Include short description]	
[Insert Single Line Diagram]	**Pros**: **Cons**: **Discounted / Parked / Taken Forward** (Delete as appropriate and include reasoning for the overall appraisal)
Option B – [Include short description]	
[Insert Single Line Diagram]	**Pros**: **Cons**: **Discounted / Parked / Taken Forward** (Delete as appropriate and include reasoning for the overall appraisal)
Option C – [Include short description]	
[Insert Single Line Diagram]	**Pros**: **Cons**: **Discounted / Parked / Taken Forward** (Delete as appropriate and include reasoning for the overall appraisal)

SECTION 4 – Stage 3: Overall economic and efficient options Appraisal

In this section, NGESO will combine the options taken forward from stage 1 and stage 2 to provide a list of options for economic assessment. NGESO will use the capital costs provided by the onshore and offshore TOs to assess the total cost of the options. The economic assessment will consider both the capital cost and operational cost associated with each option. Major risks associated with the options will also be highlighted.

Option	Summary	Major Risks	Capital Cost		Operational Cost[6]	Total Cost (£m)
			Onshore Network Costs (£m)	Offshore Network Costs (£m)	Constraint cost / Cost of Energy not supplied	
1	Provide a summary of the design option – connection point, technology, voltage	• Highlight any major risks – technological, environmental, regulatory				
2		•				
3		•				
4		•				
5		•				
6		•				
7	.	•				

[6] See Appendix C: Cost Benefit Analysis Methodology

SECTION 5 – The Preferred Option

This section aims to capture the reasoning behind the selection of the preferred option and to provide a record of any changes to the preferred option at any point and the rationale at the time for the change.

Current preferred option	Option name, e.g. Option 4 – Sensitivity 03
Brief Description	Brief description of the option design
Reasoning	Reasoning behind decision to select as the preferred option
Preferred option within initial connection offer	Preferred option at the initial connection offer acceptance
Reason for change (if applicable)	Brief description of the reason of change of preferred option from connection offer acceptance to now, i.e. what assumptions have changed to make a different option preferred
Previous preferred option (if applicable)	Any other options which were preferred options, CION version & date when investigated and reasons for change

This section provides the details of the preferred option including onshore and offshore works, single line diagrams and any risks and outage requirements.

Option X – [Insert short description, connection point] **(Preferred Option)**		
Offshore Works (completed by Relevant TO/OTSDUW))	**Description of Works** (Detailed description of the works)	**Offshore Works:**
	Cost	[Insert cost breakdown for the offshore TO works] Cables – £m Onshore Substation – £m Offshore Platform – £m TOTAL – £m
	Completion Date	Assumed to be completed prior to connection date
	Issues, Risks & Comments	TBC
	Outage Requirements	
Onshore Works (completed by Affected TO)	**Description of Works** (Detailed description of the works)	**Onshore Works:**
	Cost	[Insert total cost of onshore TO works] TOTAL - £m
	Completion Date	[Insert completion date from contract]
	Issues, Risks & Comments	[Insert any potential issues which may impact on the delivery of the work]
	Outage Requirements	[Insert comment on outage programme required for works to be completed]

Option X – [Insert short description, connection point] **(Preferred Option)**	
Single Line Diagram	[Insert single line diagram]

SECTION 6 – Alternative Options

This section provides the details of the alternative options which have **NOT** been taken forward following the stage 3 assessment. It describes the onshore and offshore works, single line diagrams and any risks and outage requirements.

Option X – [Insert short description, connection point]		
Offshore Works (completed by Relevant TO/OTSDUW))	**Description of Works** (Detailed description of the works)	**Offshore Works:**
	Cost	[Insert cost breakdown for the offshore TO works] Cables – £m Onshore Substation – £m Offshore Platform – £m TOTAL – £m
	Completion Date	TBC
	Issues, Risks & Comments	TBC
	Outage Requirements	
Onshore Works (completed by Affected TO)	**Description of Works** (Detailed description of the works)	**Onshore Works**
	Cost	[Insert total cost of onshore TO works] TOTAL - £m
	Completion Date	TBC
	Issues, Risks & Comments	
	Outage Requirements	

Option X – [Insert short description, connection point]	
Single Line Diagram	[Insert single line diagram]

Appendix A – Glossary of Terms

Discounted: An option can be discounted after it has been demonstrated sufficiently that it is not technically feasible to implement.

Parked: An option can be parked when it is demonstrated sufficiently that it does not provide additional benefit in comparison to all other options as part of the 'benefit filter'. It can however be revisited and re-appraised again should circumstances change.
Preferred: An option is categorised as preferred when it is demonstrated to be the most optimal design (i.e. Economic, efficient & coordinated) considering all criteria (i.e. Technical, Cost, Environmental & Deliverability).

Taken Forward: Means that an option is being progressed for economic assessment
Within the Stage 1 onshore assessment, Transmission Works levels were defined as follows;

Minimal = limited to works to satisfy Chapter 2.6 of NETS SQSS (i.e. additional bay at a connection point);
Local = requiring circuit uprating and compensation up to and including the next adjacent substation (in any direction);
Moderate = requiring circuit reconfigurations, some reconductoring and compensation in local vicinity (i.e. up to 3 substations away);
Extensive = new circuits or upgrading 275 kV to 400 kV or widespread re-conductoring and compensation.

Appendix B– Unit Cost Assumptions

[Insert summary of unit cost assumptions]

Appendix C – Cost Benefit Analysis (CBA) methodology

[Insert specific cost benefit assumptions where appropriate]
As part of the economic assessment, NGESO will undertake a cost benefit analysis to account for the total life cost of the options. As part of this assessment;

- NGESO will utilise the capital costs of the options as provided by the Transmission Owners
- NGESO will calculate the constraint costs by taking into equipment unavailability due to failure and maintenance. Assumptions on the cost of energy, failure rates, Mean time to repair (MTTR), Mean time between failure (MTBF), mean time between planned maintenance (MTBM) will be based on industry agreed figures were available or Transmission Owner assumptions based on existing practice.
- For wind generation, **Expected Energy Curtailed per year** = Wind Farm Output X Constrained Energy Factor X Load factor X failure/maintenance rate X number of circuits X duration of failure/maintenance
- NGESO will calculate the Net Present Value using the Spakman approach which is used in discounting CBAs that involve private investment for public benefit[7]

[7] https://www.ofgem.gov.uk/publications-and-updates/discounting-cost-benefit-analysis-involving-private-investment-public-benefit