LOW CARBON CONTRACTS COMPANY

POWERING NET ZERO

Solar PV (>5MW) Commissioning Guidance

80% of Installed Capacity
Operational Condition Precedent 2.1 (B)

Issued February 2023

Version 2

Applicable to Investment Contracts, CFD Agreement and CFD Standard Terms and Conditions issued in August 2014, March 2017, May 2019 and November 2021

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Disclaimer

This guidance does not and is not intended to supersede or replace the provisions of the CFD. This guidance does not constitute legal or investment advice and should not be relied upon as such. Generators should consult their professional advisors where they require advice, whether legal or otherwise. LCCC further reserves the right to amend this guidance and any associated guidance from time to time.

This guidance should not be viewed as in any way restricting LCCC in the nature, type and/or amount of evidence, information and documentation it will require to satisfy itself of the Generator's fulfilment of the Operational Conditions Precedent, nor as to the nature, level and timing of our consideration or reconsideration of the evidence that is provided. LCCC reserves the right at any time to request further or additional evidence, and to review or reconsider the evidence already provided.

1. Introduction

This document provides Generators with guidance on the forms of evidence that the Low Carbon Contracts Company considers acceptable in order to demonstrate that no less than 80% of the Installed Capacity Estimate has been Commissioned.

1.1 The Operational Conditions Precedent (OCP) must be fulfilled by the Generator in order for it to be able to issue a Start Date Notice and commence generation that is eligible for CFD payments. It is therefore important that Generators give proper consideration ahead of time to how they intend to evidence that they have fulfilled the OCPs.

1.2 This guidance is intended to assist CFD Generators whose Generation Technology is Solar PV (>5MW) in considering what evidence they will need to provide to the Low Carbon Contracts Company (LCCC) to demonstrate that they have fulfilled the Operational Condition Precedent 2.1 (B) in Schedule 1 (Conditions Precedent) of the Contract for Difference ("CFD").

1.3 As a general principle, it is LCCC's intention that, insofar as it is possible, a Generator should be able to utilise processes, procedures, documentation, and tests that already form part of its commissioning plan as submissible evidence, providing that these meet the requirements and are in accordance with the Reasonable and Prudent Standard. This guidance is indicative of what would be acceptable to LCCC. If a Generator is concerned their project may not be in a position to provide any of the alternatives listed in Section 4, 5 and 6 they are encouraged to contact their Contract Manager as soon as possible.

1.4 LCCC would encourage Generators to engage early in the OCP process. This will enable the parties to discuss the approach, if the submission of any of the evidence is at risk and for LCCC to gain an understanding of the Generators' commissioning plan.

1.5 Before the Generator proceeds with the formal submission, we recommend that submissions are made in draft form so that LCCC can comment on the following:

- any evidence that the Generator is intending to submit with the OCP Notice; and
- the details of any commissioning programmes / proposed pass-fail criteria / planned tests intended to meet the requirements of OCP 2.1 (B).

2. Definitions

2.1 The "CFD Counterparty" is the Low Carbon Contracts Company Ltd.

2.2 Defined terms used in this guidance and not defined herein should be given the meaning provided in the "CFD" (which is comprised of the CFD Agreement and the CFD Standard Terms and Conditions as published by the Department of Energy and Climate Change on 29 August 2014[1], March 2017[2], May 2019[3] and November 2021[4]). This guidance is also applicable to Investment Contracts. However, Generators with Investment Contracts are advised to review the equivalent clauses.

2.3 The CFD defines "Commissioned" as meaning "*all of the Commissioning Tests have been successfully completed, followed or passed (as appropriate) in relation to the Facility (or a part of the Facility)...*"

2.4 The definition of "Commissioning Tests" as set out in the CFD means "*all of the procedures and tests which, in accordance with the Reasonable and Prudent Standard, and in compliance with industry guidelines, practices and standards, are:*

- *A relevant to generating facilities which are the same as, or similar type to, the Facility (including those which are relevant to the Facility Generation Technology); and*

- *B required to be completed, followed or passed (as appropriate): (i) in order for a generating Facility to generate electricity; or (ii) to demonstrate that a generating Facility is fit for commercial operation".*

2.5 Please note that Installed Capacity is determined at the Defined Metering Point[5]. The *Installed Capacity and Final Installed Capacity guidance[6] issued by LCCC defines Installed Capacity as "…the capacity of the Facility*

[1] Department of Energy and Climate Change, Contract for Difference: Standard Terms and Conditions, published 29 August 2014.

[2] Department for Business, Energy & Industrial Strategy, Contracts for Difference: standard terms and conditions, version 2 published 13 March 2017.

[3] Department for Business, Energy & Industrial Strategy, Contracts for Difference: standard terms and conditions, version 3 published 1 May 2019.

[4] Department for Business, Energy & Industrial Strategy, Contracts for Difference: standard terms and conditions, version 4 published 25 Nov 2021

[5] The Defined Metering Point, as defined in the relevant Code of Practice 1, 2 or 3 associated with the Balancing and Settlement Code

[6] Low Carbon Contracts Company, Installed Capacity and Final Installed Capacity Guidance - August 2020 | Low Carbon Contracts Company.

(expressed in MW) were it to be operated at optimal operating conditions at the Facility on a continual basis for a sustained period at the maximum capacity possible without causing damage to it, net of:

- *A all electrical loads required so to operate the Facility and/or deliver electricity; and*

- *B all electrical losses that would be incurred from the Generating Unit(s) to the Metering Equipment at the Boundary Point in so operating the Facility and/or delivering electricity*

assuming any source of power used by the Facility to generate electricity was available to it without interruption and provided that, where a Facility uses combined heat and power, the capacity of the Facility shall be determined by reference to a condition where any reduction of heat generated would not result in any increase in electrical generation."

3. Context

3.1 The CFD[7] requires the delivery to the CFD Counterparty of: "evidence, in form *and content satisfactory to the CFD Counterparty, acting reasonably, that an Installed Capacity of not less than eighty per cent. (80%) of the Installed Capacity Estimate has been Commissioned".*

3.2 As a result of the definitions that are relevant to OCP 2.1 (B), two overarching requirements need to be evidenced:

1. that the Facility has been "Commissioned" meaning that the Commissioning Tests have been completed and it can generate electricity or, is fit for commercial operation; and
2. an AC capacity of at least 80% of its Installed Capacity Estimate can generate electricity on a continuous basis without causing damage to the Facility.

3.3 To fulfil requirement 1 above, LCCC would expect to see evidence to confirm commissioning of the following, that constitute 80% of the Installed Capacity Estimate:

- PV modules, inverters and tracker system (if applicable) Commissioned;
- SCADA and power plant controller (PPC) Commissioned; and
- Electrical and balance of plant (EBOP) Commissioned;

To fulfil requirement 2 above, LCCC would expect to see evidence of:

- Sufficient number of PV modules, inverters and tracker system (if applicable) Commissioned to meet 80% installed capacity threshold;
- Facility layout is consistent with other evidence; and
- Whole Facility producing electricity (without causing any damage to the Facility, and supporting functioning of SCADA).

Sections 4, 5 and 6 of this document set out specific documents that we have considered acceptable to satisfy the two overarching requirements. We have sought to rely as far as possible on industry standard documents.

The table overleaf summarises broadly which main documents as a minimum LCCC considers will satisfy each requirement.

[7] At Schedule 1, Part B (Further Conditions Precedent), paragraph 2.1 (B).

Requirement to be evidenced (as per section 3.3)	Minimum acceptable evidence to satisfy requirement					
	Commissioning Completion Certificates (CCCs)	Type Certificates, flash test data	List of Functional Tests	Facility layout, single line diagram	ION	Whole Facility test
4.1A. PV Modules, inverters, tracker system, EBoP, SCADA and Power Plant Controller Commissioned	✓		✓			
4.1B. Sufficient number of PV panels, inverters Commissioned to meet the 80% threshold		✓				
4.1C. Facility layout is consistent with other evidence				✓		
5A-E. Facility as a whole capable of producing electricity					✓	✓

4. Commissioning Evidence

4.1 This section provides further guidance on the form and nature of evidence LCCC is prepared to accept and would expect to find in a Solar PV Generator's submission of evidence to demonstrate the capabilities listed under 3.3:

– A Evidence of successful commissioning of sufficient equipment in the Facility comprising in aggregate not less than 80% of the AC Installed Capacity Estimate of the Facility in the form of either a) or b), followed by the mandatory submission of c);

a) **Dated, valid Take Over Certificate(s) (TOCs) for the Solar PV Facility or TOCs for each of the PV modules and inverters** comprising in aggregate not less than 80% of the Installed Capacity Estimate of the Facility (see Section 4.1 D on how to perform the 80% calculation). The TOCs must be supplemented with Supporting Information of the technical requirements and tests undertaken to enable the issuance of respective certificate(s); or

b) **Dated, valid Commissioning Completion Certificates (CCCs) for the following main equipment** that is sufficient to generate 80% of AC Installed Capacity Estimate;

i. PV modules;
ii. Inverters;
iii. Tracker system (if applicable);
iv. SCADA and power plant controller (PPC); and
v. Electrical and balance of plant (EBoP).

The CCCs must be supplemented with Supporting Information of the technical requirements and Commissioning Tests undertaken to be able to issue the respective certificate. The Supporting Information should include the type of test performed on each component, date of the test, results of the test in binary fashion (pass/fail) and a summary of any anomalies that occurred during the test. For the avoidance of doubt, LCCC is not requesting the actual test report(s) in this example, however, LCCC retains the right to request the submission of actual test reports.

For PV modules, as a minimum, the list should include, functional tests on PV strings including but not limited to polarity tests,

insulation resistance tests, IV curves, thermographic inspections and open circuit voltage and short circuit current tests performed as per the IEC 62446 standard.

For the EBoP, as a minimum, the list should include Factory Acceptance Tests (FATs), Site Acceptance Tests (SATs), Pre-energisation Tests and Energisation Tests for the main components. In all instances, LCCC does not require the submission of a related snagging list; the Directors' Certificate substitutes as satisfactory evidence of completion against 80%.

c) In addition to either of the above, the submissions must be accompanied by a Directors' Certificate (DC), clearly identifying the corresponding specification of the equipment comprising the Facility, confirming the completion of commissioning. This may be submitted as a stand-alone DC or included as part of a consolidated 2.1B Directors' Certificate, as explained in Section 6.

– **B There are four necessary components to establish that sufficient PV equipment (PV modules and inverters) has been Commissioned in the Facility to meet the 80% threshold:**

a) **Calculation of the equivalent net capacity of PV modules** to establish whether enough PV modules have been Commissioned to meet the 80% Installed Capacity Estimate threshold.

To establish the number of PV modules, the capacity must be assessed on a net basis. Test certificates and flash test data provided in a spreadsheet containing sufficient data for the number of PV modules that is required to be Commissioned to allow the Facility to generate 80% of the Installed Capacity Estimate on an AC basis. This determines the minimum capacity of PV modules needed for the TOCs / CCCs issued as referred to in point 4.1A. LCCC will assume that total Electrical Losses for the project are 15% (100% - guaranteed Performance Ratio for the project), as per the example below.

Example: if the Installed Capacity Estimate is 100MW and with 15% losses, the Generator will need to provide TOCs or CCCs (point 4.1A above) for PV direct current capacity totalling at least ([100MW x 80%] divided by (1-0.15)] = 94.11MW of nameplate capacity[8].

A full Electrical Losses study will need to be provided to justify the use of a value lower than 15%. An example of the requirements for an

[8] nameplate capacity being equal to the sum of the capacity indicated in the type certificates (taking into account any power modes incorporated) and any other additional capacity noted in the Directors' Certificate referenced in 4.1C(c).

Electrical Losses study can be found in the Final Installed Capacity guidance and the exact criteria for the OCP Electrical Losses study should be agreed in advance with your Contract Manager.

b) **Type certificate of the inverters** issued by the manufacturer indicating the nameplate capacity[8] of the inverters, with the incorporation of power modes/operating modes reflected on the type certificate itself or supplementary data sheet.

c) **Calculation of the equivalent net capacity of PV inverters** to establish whether enough inverters have been Commissioned to meet the 80% Installed Capacity Estimate threshold.

To establish the number of inverters required to achieve the 80% Installed Capacity Estimate threshold, LCCC will review inverter nameplate capacity[8] expressed at 35^0C, to assess sufficient inverter capacity is installed to meet the 80% Installed Capacity Estimate threshold. This determines the minimum capacity of inverters needed for the TOCs / CCCs issued as referred to in point 4.1A.

Example: Calculation table For 100MWac facility

Temperature	25^0c	35^0c	45^0c
Output Power Rating	250kVA	225kVA	200kVA
MW output	0.250	0.225	0.200
No. of inverters required	400	445	500
80% threshold	320	356	400

d) **Directors' Certificate (DC) clearly identifying the corresponding specification of main solar PV equipment (PV modules and inverters) and the rated output power of the modules.** The DC should certify that the capacity of equipment installed and Commissioned is ready for commercial operation. This may be submitted as a stand-alone DC or included as part of a consolidated 2.1B Directors' Certificate, as explained in Section 6.

– C **In order to gain a full understanding and context of the Facility which is progressing through OCP 2.1 (B) the Generator must provide:**

a) **Facility layout**, containing a scale drawing of the Facility, in high resolution, with the following clearly shown:

- Layout of the PV plant including the locations of the main components (as referenced in 4.1A);

- Depiction of the Facility boundary (asset ownership boundary);
- General arrangement of the substation(s);
- Power cable or OHL route from the Facility boundary to the grid connection substation; and
- Location of Facility Metering Equipment.

b) **Single line diagram** indicating the main components (as referenced in 4.1A) and their locations.

5. Facility Commissioning Evidence

5.1 This section provides further guidance on the form and nature of the evidence LCCC is prepared to accept and would expect to find in a Solar PV Generator's submission of evidence to demonstrate the whole Facility producing electricity (without damaging the Facility).

– A **All Facilities that are distribution connected must provide the G99 test certificate**[9] (except where already accepted under an alternative Operational Condition Precedent and the CP Response Notice confirms that the Generator has fulfilled the Operational Condition Precedent).

– B **All Facilities connected to the Transmission System, all 'Large' distribution connected projects as defined in the Grid Code, and all 'Medium' distribution connected projects as defined in the Grid Code that are subject to a Bilateral Agreement**[10]**, must provide an ION** (except where already accepted under an alternative Operational Condition Precedent and the CP Response Notice confirms that the Generator has fulfilled the Operational Condition Precedent).

– C **All Facilities must Perform a "Whole Facility" test and provide historic metered output data** to demonstrate that the equipment Commissioned as part of the Facility is effectively operating together (rather than in isolation), while indirectly supporting SCADA system functionality, as described in a) and b) below.

a) **The Whole Facility Test ("WFT")**

The WFT must demonstrate that the Facility's capacity evidenced for the purpose of the OCP submission (i.e. PV modules, inverters, tracker system (if applicable) and all associated EBoP) is Commissioned and satisfies the 80% threshold Installed Capacity for OCP2.1 (B). Calibration certificates of all irradiation and temperature sensors shall be provided to LCCC.

[9] Or provide evidence of a derogation having been issued, demonstrating a G99 test certificate isn't available

[10] As defined in the Connection and Use of System Code (CUSC).

Aspect	Test Requirements
Test Pre-requisites	Pre-requisites which must be fulfilled for the tests to be undertaken are as follows: • All Commissioning Tests as stated in Table 1 above are successfully completed and supporting documentation provided • Facility has been successfully interconnected to the grid and energised • All modules are cleaned to ensure no soiling loss • Irradiation sensors are calibrated and cleaned
Test Duration	The WFT shall be a continuous period of at least two hours and the following criteria shall be met during the testing period: • The irradiance measured on the plane of the array is greater than 500 W/m² • In case the irradiation conditions are not achieved the test will be extended accordingly by the relevant number of hours until the required number of hours, satisfying the condition is achieved • Uninterrupted 100% availability of the grid connection, throughout the test period • Other source of power including batteries and standby power generators are not permitted to contribute during the test period
Data recorded	The achieved capacity during the WFT must be calculated on the basis of operating data recorded by the SCADA system measuring the parameters listed below, with a sampling interval consistent with the capability of the instruments, as close as practicable to thirty (30) seconds and average interval of five (5) minutes: • AC power output at the fiscal meter • Irradiation at the plane of the array • PV module temperature
Methodology	Measured generation data (kWh) should be converted to capacity data (kW) and corrected to reference conditions defined as 1,000 W/m2 and 25°C of PV module temperature following the procedure defined in IEC 61724-2.

Below is a simplified example of a SCADA whole Facility test output that should be used to demonstrate successful plant generation.

Date/time (interval)	PV Plant output – Fiscal meter	Meteo station – Average irradiance	Meteo station – Average module temperature
	(kWh)	(W/m2)	(°C)
01/01/2022 10:00	416.5	554	41.5
01/01/2022 10:05	418.6	555	41.7
01/01/2022 10:10	417.5	554	41.6

b) **Historic metered output data.**

LCCC will review the provided historic metered output data and assess whether the total generation outputs are broadly expected and aligned with local weather conditions and the timing of the installation of your solar PV plant. If your SCADA output provides solar irradiation data, please provide this also.

– D **The submission must be accompanied by a Directors' Certificate (DC),** certifying that in the immediate and foreseeable future, there is no expected or anticipated risk of failure that should be brought to the CFD Counterparty's attention, nothing to stop exporting at no less than 80% in AC of the Installed Capacity Estimate and the Facility is fit for commercial operation certifying the EBOP is ready for commercial operation. This may be submitted as a stand-alone DC or included as part of a consolidated 2.1 (B) Directors' Certificate, as explained in Section 6.

6. Directors' Certificate Requirements

6.1 Operational Condition Precedent 2.1 (B) must be accompanied by a Directors' Certificate certifying that the information contained in, and enclosed with, the Operational Condition Precedent Notice is true, complete and accurate in all material respects and is not misleading, in each case by reference to the facts and circumstances then existing.

6.2 The Directors' Certificate must also be provided to certify each of the following:

- PV modules, inverters, mounting structures and associated Electrical Balance of Plant ("EBoP") installed and Commissioned are ready for commercial operation;
- the specified rated power output power of each item of equipment in the accompanying specification of PV modules and inverters installed;
- for the equipment forming the EBoP (array power cables, transmission power cables, overhead lines, switchgear, transformers, power quality compliance equipment, reactive compensation equipment, Facility Metering Equipment), the commissioning process implemented is in line with good industry practice, that nothing material is outstanding and that the commissioning process has been completed successfully; and

- in the immediate and foreseeable future there is no expected or anticipated risk of failure that should be brought to the CfD Counterparty's attention, nothing to stop exporting at no less than 80% of the Installed Capacity Estimate and the Facility is fit for commercial operation..

For convenience, a consolidated Directors' Certificate template is attached at Annex A of this guidance.

7. Annexes

7.1 Annex A: Director's Certificate

See - Directors' Certificate (OCP 2.1 B) Solar PV - Consolidated Template - February 2023.

7.2 Annex B: OCP Solar PV Commissioning Guidance Tracker

See - Solar PV (5MW) - OCP 2.1 B Tracker - February 2023

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