NATIONAL TRANSMISSION & DESPATCH COMPANY LTD.
(NTDCL)

GRID CODE ADDENDUM-II

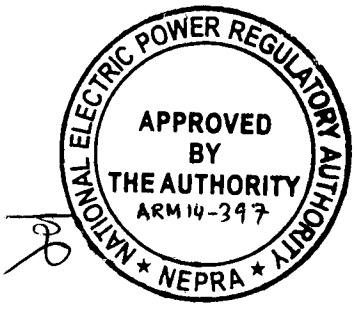
FOR

GRID INTEGRATION

OF

PHOTOVOLTAIC (PV) & CONCENTRATED SOLAR POWER (CSP) PLANTS

JUNE, 2014



NTDC Grid Code Addendum No. 2 dated /06 /2014
for Grid Integration of Photovoltaic (PV) and Concentrated Solar Power (CSP) Plants

1. General

(i) This addendum is applicable to only Grid Connected PV/CSP power plants.

(ii) This addendum becomes part of Grid Code with immediate effect.

(iii) All other clauses of Grid Code, which are not covered by this addendum, if otherwise applicable as such, shall be applicable to Grid Connected PV/CSP power plants.

(iv) All relevant clauses of Grid Code, which are covered through this addendum, shall be treated as amended as per this addendum.

(v) Any provisions of this addendum which have not been previously provided in the Grid Code, shall now form part of Grid Code, applicable to PV/CSP power plants only.

(vi) Regulator may approve any subsequent modification to this addendum proposed by NTDC through the Grid Code Review Panel (GCRP). However, a Grid Connected PV/CSP power plant may operate, for its full EPA term, in compliance to Grid Code prevailing at the time of its financial closing.

(vii) Notwithstanding anything contained in this Grid Code Addendum No.2 for PV/CSP power plants, the Regulator may review, amend, modify or change the Addendum from time to time.

2. Definitions

2.1 Black Start
As defined in the Grid Code.

2.2 Energy Purchase Agreement
The agreement, along with all schedules and annexures attached therewith, by and between the Seller and the Purchaser, for the purposes of Sale and Purchase of electrical energy from a solar power project.

2.3 Financial Closure
As defined in the relevant Energy Purchase Agreement (EPA).

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2.4 Grid Connected Power Plant
A power plant which can deliver Electrical Energy to the National Grid System/DISCO systems.

2.5 PV/CSP Hybrid Generating System
A Generating System in which the power plant utilizes more than one input power resources.

2.6 Islanded Operation
Operational mode of a power plant in which it stands alone in generating electrical power and feeding a particular load with no other generator running in parallel.

2.7 Low Voltage Ride Through (LVRT)
The capability of a Generator to withstand the impact of low voltage dip, for a certain time, to remain connected to Grid without being damaged, in case of external fault conditions.

2.8 Ramp Rate
Upper limit of a Generator in terms of rate of increase of real power (MW/min).

2.9 Regulator
National Electric Power Regulatory Authority (NEPRA) established under Section 3 of NEPRA Act.

2.10 Retained Voltage
The value of voltage, normally in percentage of normal rated voltage, which persists at a particular point of a Grid System in case of fault conditions.

2.11 Solar Inverter (Grid – Connected)
Device that converts variable Direct Current (DC) output of the Photovoltaic (PV) modules into the Alternating Current (AC) of Grid frequency with control system capability to deliver both active and reactive power, in synchronism with the three-phase system and matching with the sinewave of the grid.

2.12 Stuck Breaker Case
A case of fault condition at a Grid System, in which the fault is not cleared by operation of the concerned breaker, being stuck, and is therefore cleared by the breaker(s) at zones other than faulty zone.

2.13 Term
The total period of Energy Purchase Agreement for Sale and Purchase of electrical energy.

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2.14 PV Solar Power Plant

An installation, with the capability of converting solar light energy into electrical energy through photovoltaic (PV) cells/panels/modules.

2.15 Concentrated Solar Power Plant

An installation, with the capability of converting solar heat into steam to run steam turbine and generate electricity. The generator is a conventional synchronous generator and its technology is same as already covered in Grid Code.

3. Solar Power Technology Requirements in the Grid (Not Applicable for conventional synchronous generators in the existing Grid Code)

(i) Sizing and siting of a solar park would be carefully determined in view of techno-economic viability of grid interconnection and radiance levels.

4. Solar Power Plant Data Requirements (Refer to existing Grid Code Clause OC 4.6, and Appendix A Part-2 Clauses PC.A.3.3.1, 3.3.2 and 3.3.3)

(i) A PV Solar Power Plant will be required to provide its data applicable to Grid side interface in terms of voltage, current, frequency, active and reactive power, and power quality related issues of harmonics, flicker and unbalance.

(ii) Data requirements of generators in CSP power projects would be the same as already mentioned in the Grid Code for conventional synchronous generator. However the solar thermal capabilities in terms of site specific heat radiance, thermal units (BTU or else), heat rates and efficiency etc. would be provided in addition.

5. Black Start and Islanded Operation Requirements (Refer to existing Grid Code Clauses OC 12.1.2, 12.3.6, OC 12.5, SDC 2.4.2.15, SDC 3.1

(i) A PV/CSP power plant is exempted from Black Start and Islanded Operation for full Term of Energy Purchase Agreement.

(ii) In case of blackout, PV Power Plants will be required to be disconnected from the Grid. The PV Inverter will have anti-islanding protection built in; it will inject small pulses that are slightly out of phase with the AC electrical system in order to cancel any stray resonances that may be present when the grid shuts down.

6. Synchronization / De-Synchronization (Refer to existing Grid Code Clause SDC 2.4.2.14)

(i) A PV/CSP power plant will manage for :-

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(a) Smooth Synchronization
(b) Smooth De-Synchronization

(ii) The above operations, achieved through appropriate equipment, will be without jerk(s).

7. Active Power and Frequency Control(Refer to existing Grid Code Clauses OC 1.2(a), SDC 1.4.3.3 (g), SDC 1.4.3.11, SDC 2.4.2.18, SDC 2.A.4 and SDC 3,

(a) PV Solar Power Plant must be capable of increasing or decreasing of active power output in steps of 10 % of the rated power i.e. at a Ramp Rate of 10% of plant installed capacity per minute
(b) There can be 4 or 5 or any set points agreed with NTDC such as 100%, 70%, 50%, 30% and 0% etc. which the PV Plant must achieve from any instantaneous operating point in any operation mode.
(c) Both (a) and (b) would be subject to appropriate availability of light at the instant when such variations are required.

8. Reactive Power and Voltage Control (Refer to existing Grid Code Clauses CC 5.4 Technical, Design and Operational Data Clause e (ii)

A PV Solar Power Plant will manage the following at interconnection point.

(i) Reactive Power Control to maintain the power factor within the range of 0.95 lagging to 0.95 leading, at full active power output, according to Dispatch Instructions/Voltage adjustment requirements.

(ii) The provisions of clause 8(i) will be reviewed as and when required by GCRP

9. Power Quality Requirements (Refer to existing Grid Code Clause CC 5.4 Technical, Design and Operational Data Clause a (iii)

(i) Power quality parameters, of power output of a PV Solar Power Plant, will be governed by relevant IEC Standards such as IEC 60904, 61850 and any other relevant to PV or batteries.

(ii) The Seller shall, as part of Grid Interconnection Study before, establish the fact that harmonic emissions from the Plant and other Power Quality indices will be complied as per IEC Standards

(iii) Monitoring of power quality parameters, for implementation of clause 9(i), will be observed at interconnection point of the PV Solar Power Plant.

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(iv) For continuous monitoring of power quality parameters, a PV Solar Power Plant will install and maintain necessary monitoring equipment, at site.

(v) Clause 9(i), 9(ii) and 9(iii) will be applicable to the Grid Connected PV solar capacity except any related revision of Grid Code.

10. Low Voltage Ride Through (LVRT) Requirements (Not Applicable for conventional synchronous generators in the existing Grid Code)

(i) A PV Solar Power Project must withstand a voltage dip down to 30% Retained Voltage for a duration of at least 100 ms for a normal clearing case and at least for 180 ms in case of Stuck Breaker.

(ii) The PV Solar Power Project will manage active power restoration, after voltage recovery, at a rate of at least 20% of nominal output power per second.

(iii) Revision of clause 10 will be necessary for any addition of Grid Connected PV Solar power capacity greater than the value stated in the Clause 3.

11. Power Generation Capability Forecasting Requirements (Refer to existing Grid Code Clause SDC 1.4.3.11, SDC 2.4.1.3 and SDC 3.7)

(i) Power Generation Capability Forecasting will be managed by a PV/CSP solar power plant for the tentative estimation but it will not be binding as of conventional power plants.

(ii) The forecasting, as required at 11(i), will be estimated by PV/CSP power plant through:

(a) Expected availability of plant during the period of forecast.
(b) Predicted value of irradiation at site based upon analysis of historic irradiation data available.

(iii) The forecasting, as required at 11(i), will be on the basis of total PV and CSP power plant output and break-up for each solar module will not be required.

12. Limitation on Total Grid Connected PV/CSP Capacity (Not Applicable for conventional synchronous generators in the existing Grid Code)

(i) In order to enable the Regulator to keep the total Grid Connected PV/CSP power capacity within allowed limit, no PV/CSP power plant will be connected to grid except after prior permission by NEPRA.

The End

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