Table 7.2: List of Test Laboratories

Sl. No.	Product	Indian Standard Number	Title of India Standard	Test Labs Recognized by BIS
1.	Crystalline Silicon Terrestrial Photovoltaic (PV) Modules (Si Wafer based)	IS-14286	Crystalline Silicon Terrestrial Photovoltaic (PV) Modules - Design Qualification and type Approval	1. Hi Physix Laboratory India Pvt. Ltd., Pune 2. UL India Pvt. Ltd., Bengaluru 3. TUV Rheinland, Bengaluru
2.	Thin-Film Terrestrial Photovoltaic (PV) Modules (a-Si, CiGs and CdTe)	IS-16077	Thin-Film Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval	1. Hi Physix Laboratory India Pvt. Ltd., Pune 2. UL India Pvt. Ltd., Bengaluru
3.	PV Module (Si Wafer and Thin Film)	IS/IEC 61730 (Part-1) IS/ IEC 61730 (Part-2)	Photovoltaic (PV) Module Safety Qualification Part-1 Requirements for Construction Photovoltaic (PV) Module Safety Qualification Part-2 Requirements for Testing	1. Hi Physix Laboratory India Pvt. Ltd., Pune 2. UL India Pvt. Ltd., Bengaluru. 3. TUV Rheinland, Bengaluru
4.	Power Inverters for use in Photovoltaic Power System	IS 16221 (Part-2)	Safety of Power Converters for use in Photovoltaic Power Systems Part-2 – Particular Requirements for Inverters	1. CPRI, Bengaluru 2. Hi-Physix Laboratory India Pvt. Ltd., Pune
5.	Utility – Interconnected Photovoltaic Inverters	IS-16169	Test Procedures of Islanding Prevention Measures for Utility- Interconnected Photovoltaic Inverters	1. CPRI, Bengaluru 2. Hi-Physix Laboratory India Pvt. Ltd., Pune 3. UL India Pvt. Ltd., Bengaluru
6.	Storage Battery	IS-16270	Secondary Cells and Batteries for Solar Photovoltaic Application General - Requirements and Methods of Test	1. CPRI, Bengaluru 2. CECRI, Karaikudi, Tamil Nadu 3. Hi Physix Laboratory India Pvt. Ltd., Pune

7.11.5 BIS Registration of Products

The data on the number of registrations granted by Bureau of Indian Standards (BIS) for SPV Modules, SPV inverters and Storage Battery as per standards specified in MNRE Quality Control Order till 31.12.2020 is given in **Table 7.3.** Out of 234 nos. manufacturers who were granted registration for SPV Modules, 126 Nos. are domestic manufacturers (53%). The MNRE has decided that only SPV Modules with BIS Mark will be used in SPV Power Projects in the country. Thus, the Quality Control

Order has given boost to not only quality control of SPV Modules but also domestic manufacture of SPV Modules with quality at international level, hence fulfilling the objective of Atmanirbhar Bharat. In addition, the order also offers opportunities to domestic manufacturers for collaboration with high efficiency overseas module manufacturers for indigenous manufacture of high efficiency SPV Modules in the country.

Table 7.3: Registration Numbers granted by BIS under MNRE Quality Control Order (CRO) 2017 till 31.12.2020

Details of Indian Standards	Product Category	Domestic	Foreign
IS 14286: 2010/ IEC 61215 : 2005, IS/IEC 61730 (Part 1) : 2004 & IS/IEC 61730 (Part 2) : 2004	Crystalline Silicon Terrestrial Photovoltaic (PV) Modules (Si wafer based)	126	105
IS 16077: 2013/ IEC 61646 : 2008, IS/IEC 61730 (Part 1) : 2004 & IS/IEC 61730 (Part 2) : 2004	Thin Film Terrestrial Photovoltaic(PV) Modules a-Si, CiGs and CdTe)	0	3
IS 16221 (Part 2) : 2015/IEC 62109-2 : 2011	Power Invertors for use in Photovoltaic Power Systems	7	1
IS 16221 (Part 2):2015/IEC 62109-2 :2011 & IS 16169 :2014/IEC 62116 :2008	Utility-Interconnected Photovoltaic Inverters	4	16
IS 16270: 2014	Storage Batteries for Solar Photovoltaic Application	5	0

7.11.6 New Initiatives:

(a) Revised Standard on Battery Storage

Indian Standard (IS 16270) for "Secondary Cells and Batteries for Solar Photovoltaic Application – General requirements and Methods of Test", which is specified in quality control order as applicable to lead acid and nickel-based chemistry batteries. The standard was reviewed in consultation with subject experts and BIS. In addition, the developments in Lithium ion batteries for SPV applications was also discussed and it was considered that standard on lithium ion batteries for SPV applications should be developed. Amendments in IS 16270 and the need of standard on Lithium ion batteries was suggested to BIS. BIS in the related 21st Meeting of ETD 11 held at BIS on 20.12.2019 took a decision to set up a Panel with Dr. B S Negi, Adviser, MNRE as convener and comprising related subject experts from R&D institutions and battery industries and a Member Secretary from BIS for finalizing a draft incorporating the amendments to IS 16270 and requirements for lithium batteries covered in IEC 61427-I (Secondary Cells and batteries for renewable energy Storage-General requirements and methods of test- Part 1: Photovoltaic Off-Grid application).

Accordingly, a day-long meeting of the Panel was held on 3.2.2020 at 10:30 AM in MNRE to discuss the amendments to IS 16270 and the requirements of lithium batteries as per IEC 61427-I. Extensive discussions were held in the meeting on developing a combined standard inclusive of lead acid, nickel based, lithium ion, etc. for quality control of batteries for off-grid applications in the country. On the basis of discussions held in the meeting it was decided to prepare a draft revised standard IS 16270 covering all relevant batteries including lithium ion as per IEC 61427-I. The panel prepared a draft which was extensively reviewed through mails for finalizing the draft. In this regard a virtual meet of the Panel was held on 6th August, 2020 at 11 AM which was coordinated by the Convener for

discussion and finalizing the draft revised IS 16270, which was subsequently reviewed through mails and finally the final draft was provided to BIS in October, 2020 for necessary action. The draft revised IS 16270 (2020/21) is under process in BIS.

Fig. 7.17 *The First meeting of the Panel on 3.2.2020 in MNRE Committee Room*

(b) Quality Control Order on Solar Thermal Collectors

The MNRE reviewed standards and market of Solar Thermal Systems for quality control. A draft Quality control order was prepared by MNRE in consultation with BIS for quality control of flat plate collector and Evacuated Tube Collectors (ETC). The status of the draft order was reviewed by Secretary, Department of Consumer Affairs through a virtual meet on 18.12.2020. In this regard, a stakeholder consultations meeting was held on 6th January 2021 through virtual mode under the chairmanship of Secretary, MNRE to discuss the need of a Quality Control Order on Solar Thermal Systems. A detailed discussion was held on standards available including standards under revision and the market of solar thermal systems. The meeting was attended by 35 participants from industry, BIS and Department of Commerce. The industry representatives voiced serious concerns for quality control order for Solar Thermal Systems particularly for ETC. The MNRE is examining the proposal keeping in view the standards available and the need of test laboratories.

(c) Standard on SPV Grid-Tie Inverter

The MNRE initiated interaction with experts from R&D, academic institutions, test laboratories and industries for developing a draft standard on PV Grid Tie Inverters inclusive of all testing requirements for complete performance evaluation and certification. At present two standards on inverters are specified in the Quality Control Order. These standards cover safety requirements as per IS-16221-Part II and the corresponding IEC 62109-2:2011 and for islanding prevention measures as per IS 16169 and the corresponding IEC 62116:2008. A draft standard titled Technical Requirements for PV Grid

Tied Inverters to be Connected to the Grid" inclusive of efficiency, grid integration and environmental tests aspects as per relevant IEC and other national and international standards was prepared and was uploaded on MNRE web on 21/4/2020 for comments of stakeholders till 7/5/2020. Comments and inputs were received from experts from R&D, academic institutions, test laboratories, industries and regulatory bodies such as Power Grid Corp. of India Ltd. (PGCIL), Power System Operation Corp. Ltd. (POSOCO), and Central Electricity Authority (CEA) among others.

A group of experts from MNRE, R&D, academic institutions, Test Labs, CEA, POSOCO, and inverter industries, was set up for perusal of comments and inputs. The draft was revised incorporating the relevant comments after proper analysis, and was discussed with related select stakeholders through a series of Virtual Meets during August-October, 2020. The last virtual meet with the select stakeholders was held on 21.10.2020, when various issues were discussed for finalizing the draft document. Thereafter, the team interacted through virtual meets for finalizing the draft document which was finalized and submitted to MNRE on 14.01.2021. The draft document is under process for forwarding to BIS for further necessary action. This is an important initiative for complete performance evaluation and certification of inverters for quality control in SPV Power projects.

(d) Star Labelling for SPV Module

An Interaction was held with Bureau of Energy Efficiency (BEE) regarding the latter's proposal for Star Labelling of SPV Modules. A proper scientific methodology involving relevant performance parameters is being developed in consultation with BEE for star rating of modules.

CHAPTER

8

RENEWABLE ENERGY IN THE NORTH-EASTERN REGION STATES

RENEWABLE ENERGY IN THE NORTH-EASTERN REGION STATES

8.1 INTRODUCTION:

Special attention is being given to the development of renewable energy in the entire North Eastern region through a separate budgetary allocation of 10% under various Renewable Energy programmes for deployment of grid and off-grid Solar Energy Systems, Wind Energy Systems, Small Hydro Projects and Bio-gas Plants among others, in the region.

8.2 A total of estimated potential for renewable energy in the North Eastern Region from Solar, Small Hydro and Bio-energy is around 65,837 MW, a substantial part of which is suitable for grid connected applications. State-wise details are shown in **Table 8.1**.

Table 8.1: State-wise Renewable Energy Potential in the North Eastern States of India

Sl. No.	STATES & UTs	Small Hydro Power	Bio-Energy		Solar	Total
			Biomass Power	Waste To Energy		
		(MW)	(MW)	(MW)	(MW)	(MW)
1	Arunachal Pradesh	2064.92	8	-	8650	10723
2	Assam	201.99	212	8	13760	14182
3	Manipur	99.95	13	2	10630	10745
4	Meghalaya	230.05	11	2	5860	6103
5	Mizoram	168.90	1	2	9090	9261
6	Nagaland	182.18	10	-	7290	7482
7	Sikkim	266.64	2	-	4940	5209
8	Tripura	46.86	3	2	2080	2132
Total		**3261.49**	**260**	**16**	**62300**	**65837**

8.3 The state-wise status of Grid-Connected, Renewable Energy capacity installed, as on 31.12.2020, in the North-Eastern Region is given in **Table 8.2.**

Table 8.2: State-wise installed capacity, of Grid Connected Renewable Power as on 31.12.2020

S. No.	States & Union Territories	Small Hydro Power	Bio-Power	Solar Power	Total Capacity	Capacity Addition during 2020-21
1	Arunachal Pradesh	131.105		5.61	136.72	0
2	Assam	34.11	2.00	42.99	79.10	3.76
3	Manipur	5.45		6.36	11.81	1.2
4	Meghalaya	32.53	13.80	0.12	46.45	0
5	Mizoram	36.47		1.53	38.00	0.01
6	Nagaland	30.67		1.00	31.67	0
7	Sikkim	52.11		0.07	52.18	0
8	Tripura	16.01		9.41	25.42	0
Total (MW)		**338.46**	**15.80**	**67.09**	**421.35**	**4.97**

8.4 SMALL HYDRO POWER PROGRAMME

North-Eastern States of India have a fairly good potential to develop Small Hydro Power projects. Among the NE States, Arunachal Pradesh has the highest potential followed by Sikkim, Meghalaya and Mizoram. MNRE has been giving special emphasis for the development of Small Hydro projects in the NE region. SHP projects can provide energy almost uninterrupted without any major maintenance or dependence on weather. The region, which is beleaguered by large energy deficits and poor quality of energy services, can benefit from greater decentralization and accountability associated with

Small Hydro Power projects. Small Hydro Power projects can generate sufficient electricity to power domestic households, schools and clinics in rural areas and catalyse entrepreneurship activities. The State-wise installed capacity vis-a-vis potential in North-Eastern States & Sikkim is given in **Table 8.3** below:

Table 8.3: State wise list of potential sites and installed projects SHP Projects in NE Region (as on 30.11.2020)

Sl. No.	State	Total Potential		Total Installed	
		Numbers	Capacity (MW)	Numbers	Capacity (MW)
1	Arunachal Pradesh	800	2064.92	156	131.11
2	Assam	106	201.99	6	34.11
3	Manipur	110	99.95	8	5.45
4	Meghalaya	97	230.05	5	32.53
5	Mizoram	72	168.9	18	36.47
6	Nagaland	98	182.18	12	30.67
7	Sikkim	88	266.64	17	52.11
8	Tripura	13	46.86	3	16.01
Total		**1384**	**3261.49**	**225**	**338.46**

Following are the major Small Hydro Power Projects which are currently under implementation is given in **Table 8.4:**

Table 8.4: Small Hydro Projects Under Implementation in the North-Eastern States of India

Sl. No.	Name of the Project	Capacity (MW)	Implementing Agency
Arunachal Pradesh			
1	Tirru Nallah in Longding Dist.	0.1	Department of Hydro Power Development
2	Fure in Kurukungme Dist.	0.05	Department of Hydro Power Development
3	Pakhankha in Changlang District	0.5	Department of Hydro Power Development
4	Payu at Pinchi in Kurung Kumey Dist.	0.5	Department of Hydro Power Development
5	Khajalong in West Kameng Dist.	2.0	Department of Hydro Power Development
6	Sumbachu SHP in Tawang Dist.	3	Hydro Power Development Corp. of Arunachal Pradesh
7	Taksang Chu SHP in Tawang Dist	3.4	Hydro Power Development Corp. of Arunachal Pradesh
8	Kinmey Gompa in Tawang Dist.	0.1	Department of Hydro Power Development
Meghalaya			
9	Ganol SHP West Garo Hills Dist.	22.50	Meghalaya Power Generation Corp. Ltd.
10	Riangdo SHP in West Garo Hills Dist.	3.0	Meghalaya Power Generation Corp. Ltd.
Mizoram			
11	Kawlbem in Champhai Dist.	3.50	Power & Electricity Dept. Government of Mizoram
12	Tlawva SHP in Champhai Dist.	5.00	Power & Electricity Dept. Government of Mizoram
Nagaland			
13	Ponglefo SHP in Kiphire Dist.	1.00	Department of Power, Government of Nagaland
Sikkim			
14	Chatten Stage-II in North Sikkim Dist.	3 .00	Sikkim Power Development Corp. Ltd.

8.5 PM'S PACKAGE FOR ARUNACHAL PRADESH

The Hon'ble Prime Minister had announced a package of ₹550 crore to electrify and illuminate border villages of Arunachal Pradesh. Accordingly, a plan was made to electrify and illuminate 1,053 un-electrified villages of all border districts of Arunachal Pradesh by installation of 5,758 SPV Home Lighting Systems and 153 Micro Hydel and Small Hydel Projects. The project is completed except commissioning of five Small Hydro Power Projects by the Department of Hydro Power Development.

8.6 SOLAR PARKS

Ministry is implementing a Scheme for Development of Solar Parks and Ultra Mega Solar Power Projects. The main objective of Scheme is to scale up setting up of solar projects in a short span of time. Under the Scheme, it is proposed to set up at least 50 Solar parks targeting setting up of 40,000 MW of Solar power projects by 2021-22. All the States and Union Territories are eligible for getting benefit under the scheme. The capacity of the Solar parks shall be 500 MW and above. However, smaller parks are also considered in States where there is shortage of non-agricultural land. The following Solar Parks have been approved in the under mentioned States of NE region as given in **Table 8.5**:

Table 8.5: Solar Parks approved in the North-Eastern States of India

Sl. No.	Name of the State	Capacity (MW)	Implementing Agency	Land identified at
1	Arunachal Pradesh	20	Arunachal Pradesh Energy Development Agency (APEDA)	Tezu township in Lohit Dist.
2	Manipur	20	Manipur Tribal Development Corporation Ltd. (MTDCL)	Bukpi village, Pherzawl Dist.
3	Meghalaya	20	Meghalaya Power Generation Corporation Ltd (MePGCL)	Thamar, West Jaintia Hills & Suchen, East Jaintia Hills Dist
4	Mizoram	20	Power & Electricity Department	Vankal, Champhai Dist.

The 70 MW Amguri Solar Park in Assam and 23 MW Solar Park in Nagaland were cancelled due to slow progress. Further, the capacity of Solar Park in Arunachal Pradesh was reduced from 30 MW to 20 MW on request of the State Government.

Fig. 8.1: *Transmission System in 20 MW Vankal Solar Park in Mizoram*

8.7 GRID-CONNECTED ROOFTOP AND SMALL SOLAR POWER PLANTS PROGRAMME IN THE NORTH-EASTERN STATES

PHASE II:

Under the Phase II of the Grid-connected Rooftop Solar Programme Central Financial Assistance (CFA) upto 40% of the benchmark cost is provided for RTS projects up to 3 kW capacity and 20% for RTS system capacity beyond 3 kW and upto 10 kW in residential sectors. For Group Housing Societies (GHS) and Residential Welfare Associations (RWA), CFA is limited to 20% for RTS plants for supply of power to common facilities maximum upto 500 kW capacity.

Fig. 8.2: *Ramakrishna Mission School 50 kW West Tripura*

During the year 2020-21, a total of 77.8 MW capacity has been allocated to Electricity Departments or DISCOMs of various NE States, thereby leading to overall allocated capacity of 84.3 MW to 6 North-Eastern States as on 31.12.2020 under the programme, details of which are given in **Table 8.6**:

Table 8.6: Grid-Connected Rooftop Solar Programme Phase-II – Capacity Allocated

S. No.	State	Capacity allocated in FY 2019-20 (MW)	Capacity allocated in FY 2020-21 (MW)	Total allocated capacity (MW)
1	Assam	--	2.0	2.0
2	Manipur	0	1.0	1.0
3	Meghalaya	0	70.0	70.0
4	Mizoram	0.5	1.0	1.5
5	Nagaland	1.0	3.8	4.8
6	Sikkim	5.0	0.0	5.0
Total		**6.5**	**77.8**	**84.3**

The Phase II of the programme has provision of incentives to DISCOMs. As per the scheme DISCOMs will get the incentive for achieving in the financial year above the baseline capacity as on 31st March of the previous year. There is no incentives for capacity addition up to 10% capacity. There is 5% incentives for addition beyond 10% and up to 15%; and 10% incentives for addition beyond 15%.

Phase I

An amount of Rs. 4.03 crore has been released to Manipur Renewable Energy Development Agency towards partial settlement of projects. Overall installed capacity (with or without CFA) as on 31.12.2020 is given in **Table 8.7**:

Table 8.7. Grid-Connected Rooftop Solar Programme Phase-I Capacity Installed as on 31.12.2020

Sl.No.	State /UTs	Installed Capacity (MW)
1	Arunachal Pradesh	0.22
2	Assam	32.32
3	Manipur	6.04
4	Meghalaya	0.12
5	Mizoram	1.43
6	Nagaland	0.08
7	Sikkim	0.07
8	Tripura	2.83
Total		**43.11**

Fig. 8.3: *ONGC Cachar, Srikona, Silchar,Assam- 85 kW*

8.8 OFF-GRID SOLAR PV PROGRAMME

Solar Off-grid Programme is being implemented in the North Eastern Region through Off-grid and Decentralized Solar PV Applications Scheme Phase-III and PM KUSUM Scheme. Under Off-grid and Decentralized Solar PV Applications Scheme Phase-III, Solar Study lamps, solar street lights and off-grid solar power plants (upto 25 kW) are being installed in North Eastern Region. Under PM-KUSUM Scheme, grid-connected solar power plants upto 2 MW, standalone solar pumps and solarization of existing grid-connected agricultural pumps are being supported. Under Atal Jyoti Yojana (AJAY) Phase-II, which was discontinued with effect from 01.04.2020, sanctioned solar street lights are being installed in North-Eastern States.

Under Off-grid and Decentralised Solar PV Applications Scheme Phase-III, the projects for installation of off-grid solar power plants which have been completed or under implementation are shown in **Table 8.8.**

Table 8.8: Off-grid and Decentralised Solar PV Power Plants Scheme Phase-III Completed or Under Implementation

State	Sanctioned Projects	Status
Manipur	25 kWp capacity Solar Power Plant at Deputy Commissioner's Office, Kangpoki Dist.	Completed
Mizoram	24 Solar Power Plants of aggregate 230 kWp capacity for various Government buildings.	Completed
	53 Solar Power Plants of aggregate 460 kWp capacity in Community Hall, Government Offices, Schools, multi-farming Cooperative Society.	Under Installation
	29 Solar Power Plants of aggregate 249 kWp capacity in Government buildings.	Completed

Further, under the Phase-III Scheme, 35,333 nos. of Solar Street Lights have been installed and 3.28 lakh Solar Study Lamps have been distributed in North Eastern States. Detailed status of cumulative installation or distribution as on 31.12.2020 is as given in **Table 8.9.**

Table 8.9: Progress of Solar Street Lights Installation and Solar Study Lamps Distribution in the North-Eastern States

State	Solar Street Lights Installed (Nos.)	Solar Study Lamps Distributed (Nos.)
Arunachal Pradesh	8,733	57,850
Assam	3,116	--
Manipur	10,250	--
Mizoram	4,792	80,689
Nagaland	4,872	--
Tripura	3,570	1,89,431
Total	**35,333**	**3,27,970**

Under PM KUSUM Scheme following allocations were made in the North Eastern Region during FY 2019-20, which are under installation is given in **Table 8.10**:

Table 8.10: Allocation Made under PM-KUSUM Programme in 2019-20 under implementation in the year 2020-21			
State	**Component-A** Grid-connected Power Plants up to 2 MW	**Component-B** Standalone Solar Pumps (Units)	**Component-C** Solarization of existing grid based agricultural pumps (Units)
Meghalaya	10 MW	1,700	60
Tripura	5 MW	1,300	1,300
Manipur	--	100	--

Under the Atal Jyoti Yojana (AJAY): Phase-II, 2,000 Solar Street Lights are available for installation in Lok Sabha constituencies of the North Eastern States including Sikkim. Solar Street Lights sanctioned till 31.03.2020 are being installed. Sanctions were received from District Administrations of the concerned Lok Sabha constituencies for **13,005 lights**, out of which **5,945 lights** have been installed upto 31.12.2020.

Details of all SPV Systems and standalone SPV Power Plants in the North Eastern States as on 31.12.2020 are given in the **Table 8.11**.

Table 8.11: SPV Systems and standalone SPV Power Plants in the North Eastern States as on 31.12.2020						
Sl. No.	**Name of the States**	**Solar Home Light (No. of Units)**	**Solar Lamp (No. of Units)**	**Solar Street Light (No. of Units)**	**Solar Pump (No. of Units)**	**Solar Power Plant (kW)**
1	Arunachal Pradesh	35,065	76,401	13,741	22	963.2
2	Assam	46,879	6,47,761	16,338	45	1605
3	Manipur	24,583	9,058	22,217	40	1580.5
4	Meghalaya	14,874	40,750	5,800	19	2004
5	Mizoram	12,060	91,201	10,117	37	3,665.6
6	Nagaland	1,045	6,766	11,107	3	1506
7	Sikkim	15,059	23,300	504	0	850
8	Tripura	32,723	2,53,443	6,242	151	867

8.9 BIOGAS PROGRAMME

Different Agencies have been actively implementing MNREs New National Biogas and Organic Manure Programme (NNBOMP) Programmes for providing clean gaseous fuel mainly for cooking, lighting and organic manure to rural and semi-urban households in the North Eastern Region States through State Government Nodal Departments or the State Nodal Agencies. The status is as follows:

- MNRE has allocated targets to the State Rural Development Departments for implementing the NNBOMP in the States of Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura during the year. A target of 5,400 Biogas plants are being set up in the North Eastern region for the year 2020-21.
- A Biogas Development and Training Centre for all the NER States to provide training and technical support under the NNBOMP has been continued and functional at Department of Mechanical Engineering, Indian Institute of Technology, Guwahati, Assam.

» The progress of implementation of the Biogas Programmes including New National Biogas and Organic Manure Programme (NNBOMP); Biogas based Power Generation (Off-Grid) Programme; and Activities and Targets of Biogas Development and Training Centre in North Eastern Region States during the current year 2020-21 has been reviewed on virtual platform under the Chairmanship of Secretary MNRE, on 23rd October, 2020 and also a virtual learning session has been conducted for using national Biogas portal and Mobile App. for NNBOMP scheme on 24th December 2020.

8.10. STATUS OF WIND ENERGY PROGRAMME IN THE NORTH-EASTERN STATES

National Institute of Wind Energy (NIWE) in collaboration with RISO DTU, Denmark had prepared the Indian Wind Atlas for the country including NE Region during the year 2010. According to this Indian Wind Atlas, the wind potential of NE at 50 meter level is estimated to be 406 MW. The State-Wise break-up is given in **Table 8.12.**

Table 8.12: State-wise Wind Power Potential Estimation of NE Region

Sl.No.	States	Estimated potential (MW)
1	Arunachal Pradesh	201
2	Assam	53
3	Manipur	7
4	Meghalaya	44
5	Nagaland	3
6	Sikkim	98
Total		**406**

In NE States, there are scattered potential pockets available for Wind farm development due to the localized Wind flows. To tap these, the Ministry decided to carry out extensive Wind Resource Assessment studies in NE regions including Sikkim. Accordingly, as on 31.12.2020, a total of 97 Wind Resource Assessment instrumentation using 25 meter and 50 meter meteorological masts were carried out at NE regions and currently four 50 meter Wind Resource Assessment stations are operational and the remaining stations were closed down after completion of requisite data collection. The State-Wise break-up is given in **Table 8.13**.

Table 8.13: Wind Resource Assessment Stations

State	No. of Stations installed & commissioned	Level of Wind Resource Assessment stations	No. of Stations in operation
Arunachal Pradesh	17	25 m & 50 m	3
Assam	18	25 m & 50 m	Nil
Tripura	11	25 m & 50 m	Nil
Manipur	15	25 m & 50 m	Nil
Mizoram	9	25 m & 50 m	Nil
Nagaland	6	25 m & 50 m	Nil
Meghalaya	17	25 m & 50 m	1
Sikkim	4	25 m	Nil
Total	**97**		**4**

In addition, Wind Resource Assessments are also carried out at NE region using the existing Telecommunication towers. As on 31.12.2020, a total 80 of telecom towers of heights ranging from 40m to 60m were utilised for this purpose. The details are given in **Table 8.14.**

Table 8.14: Utilisation of Telecom Towers for Wind Resource Assessment

State	No. of Stations installed & commissioned	Level of Wind Resource Assessment stations	No. of Stations in operation
Meghalaya	15	50 m & 60 m	Nil
Mizoram	5	40 m & 60 m	2
Tripura	6	50 m & 60 m	3
Arunachal Pradesh	5	40 m & 50 m	Nil
Nagaland	7	50 m	Nil
Manipur	9	40 m & 60 m	9
Assam	33	50 m & 60 m	22
Total	**80**		**36**

NIWE had prepared and submitted two Detailed Project Reports on 3.5 MW Grid Connected wind-solar hybrid power plant at Phangrei, Manipur (**Fig. 8.4**) and 2.5 MW Grid connected wind-solar hybrid power plant at Chawangkining, Manipur.

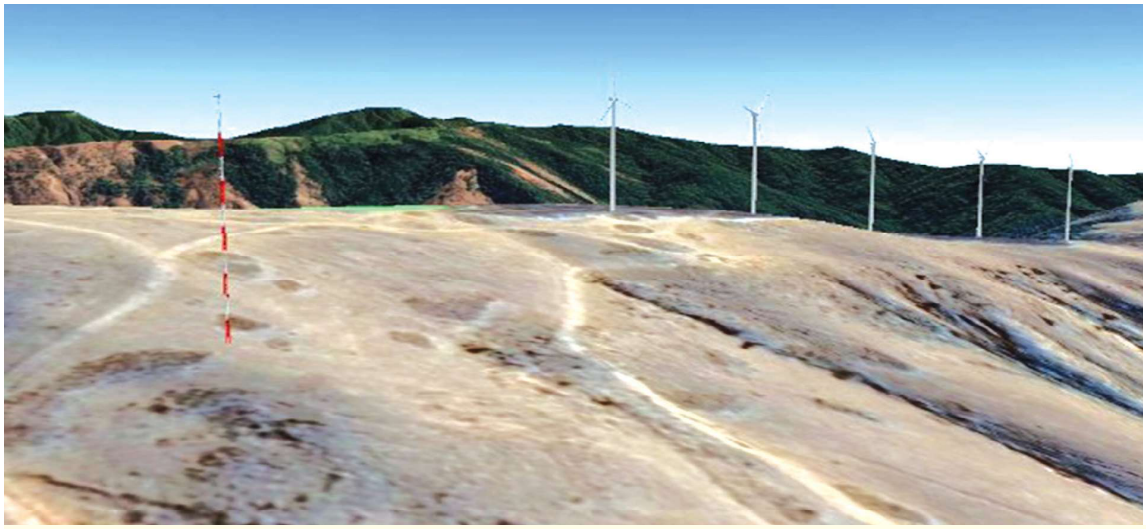


Fig. 8.4: *Proposed Wind Farm at Phangrei, Manipur*

CHAPTER

9

GREENING OF ISLANDS OF ANDAMAN & NICOBAR AND LAKSHADWEEP

GREENING OF ISLANDS OF ANDAMAN & NICOBAR AND LAKSHADWEEP

9.1 SCHEME FOR SETTING UP OF 52 MW DISTRIBUTED GRID-CONNECTED SOLAR PV POWER PROJECTS IN ANDAMAN & NICOBAR, AND LAKSHADWEEP ISLANDS WITH CAPITAL SUBSIDY FROM MNRE

9.1.1 Introduction:

MNRE, on 05.04.2016 had issued the Administrative Approval for Implementation of a scheme for setting up Distributed Grid-Connected Solar PV Power Projects of an aggregate capacity of 40 MW (now increased to 52 MW) in Andaman & Nicobar (A&N) and Lakshadweep Islands with an estimated Central Financial Assistance (CFA) of ₹192.20 crore.

9.1.2 Objective:

The objective of the scheme is to develop carbon free islands by phasing out use of diesel for generation of electricity and to contribute to the National Action Plan on Climate Change. The initiative will also help in reduction in cost of electricity generation.

9.1.3 Spatial Coverage:

Distributed grid-connected solar PV power projects of an aggregate capacity of 52 MW would be established in different islands in Andaman & Nicobar Islands and Lakshadweep Islands.

9.1.4 Types of Projects Supported:

The Scheme supports setting up of standalone Solar PV Power Project, standalone Battery Energy Storage System (BESS), Solar PV plant with Battery Energy Storage System (BESS), Transmission System for Solar PV Power Plant and Floating Solar PV power plants (with or without Battery Energy Storage System) in Andaman & Nicobar Islands and Lakshadweep Islands.

9.1.5 Implementation Arrangement:

The scheme will be implemented through Central Public Sector Undertakings (CPSUs) viz., NTPC Limited (NTPC), NLC India Limited (NLC), Rajasthan Electronic & Instruments Ltd. (REIL), Solar Energy Corporation of India Limited (SECI) etc. or by UT Administration on Build, Own and Operate (BOO) basis. The arrangements are as follows:

- Procurement of all Services and Hardware for setting up the power plants by Implementing Agencies (IAs) viz. NTPC, NLC, REIL, SECI etc. or UTs would be done through competitive bidding process.
- The total project cost will include cost of solar power plant, battery storage of upto six hours and cost of infrastructure development such as land development, evacuation & transmission among others.
- A&N and Lakshadweep Administrations will buy the electricity from the Implementing Agencies at a tariff determined by JERC/CERC by taking into account the Central Financial Assistance (CFA).

Fig. 9.1: *Govt Sr. Sec School Malacca, Car Nicobar, Andaman & Nicobar Islands -50 kW*

9.2 CENTRAL FINANCIAL ASSISTANCE (CFA):

9.2.1 Eligibility

The total eligible Financial Assistance and its release pattern will be as under:

- Ministry will provide 40% of the project cost discovered through competitive bidding process as grant;
- No additional grant for the preparation of Detailed Project Report (DPR), conducting field survey, fund handling or service charge will be provided.
- The Capital Subsidy will be released in three tranches as mentioned below:
  - 15% on completion of site development and civil works at site;
  - 60% on successful commissioning of the plant; and
  - Balance 25% after one year of operation of the plant.

The amount and sequence of funds released during implementation period can be modified if necessary with the approval of the Competent Authority.

9.2.2 Status of Projects under MNRE'S Scheme (As of 31.12.2020)

- A 20 MW Solar PV power plant with 8 MWh Battery Energy Storage System (BESS) by NLC India Limited, at Attampahad and Dollygunj in UT of Andaman & Nicobar Islands, has been commissioned on 30.06.2020.

» Solar Energy Corporation of India Limited (SECI) is implementing solar PV power plants of aggregate 1.95 MW capacity and Battery Energy Storage Systems of aggregate 2.15 MWh capacity, at four different Islands of Union Territory of Lakshadweep. The details are shown in **Table 9.1**:

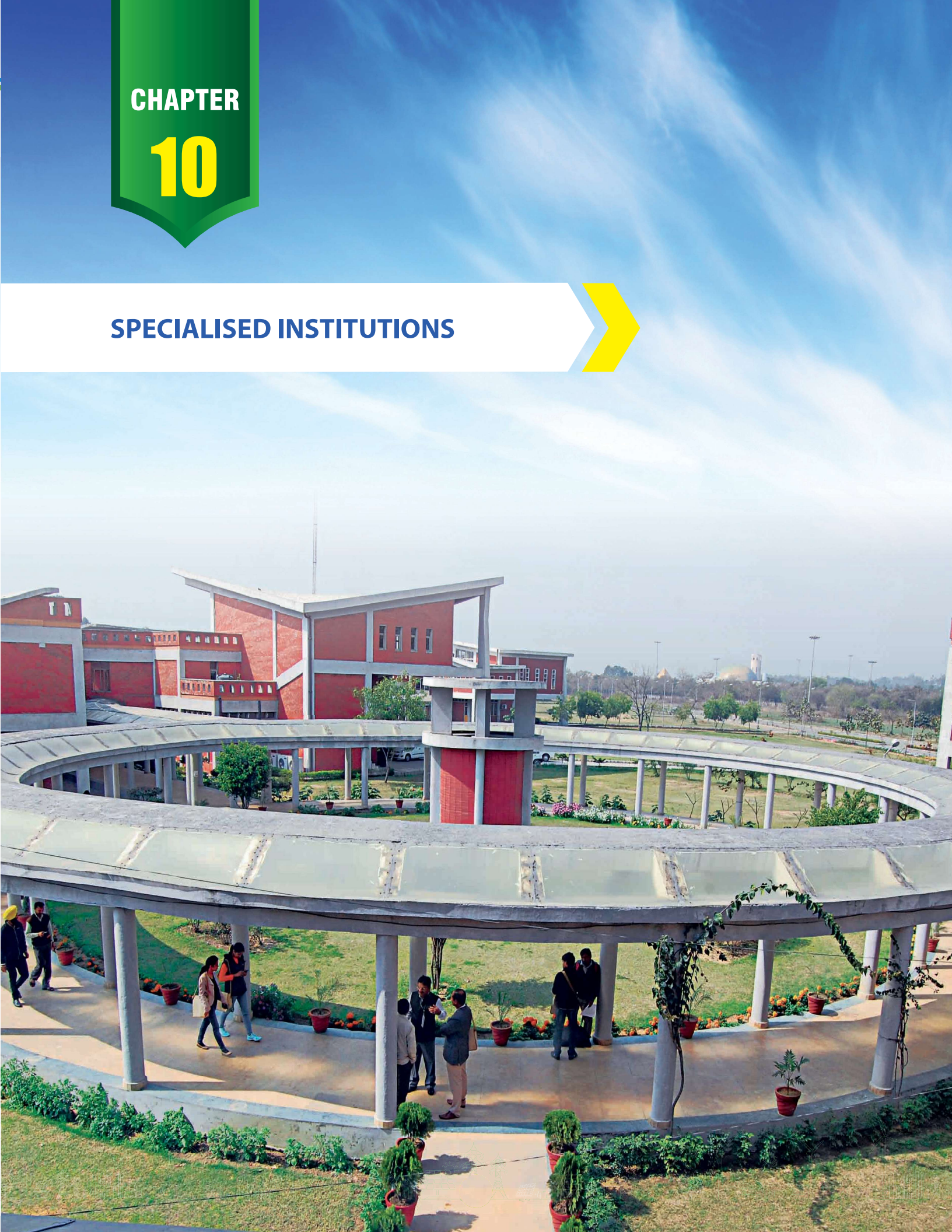
Table 9.1: Capacities of Solar PV Plants and Battery Energy Storage Systems

Island in UT of Lakshadweep	Solar PV Capacity (kWp)	Battery Energy Storage System (BESS) Capacity (kWh)
Kavaratti	1400	1400
Agatti	300	0
Bangaram	150	450
Thinnakara	100	300
Total	**1950**	**2150**

CHAPTER

10

SPECIALISED INSTITUTIONS



SPECIALISED INSTITUTIONS

10.1 NATIONAL INSTITUTE OF SOLAR ENERGY (NISE)

10.1.1 National Institute of Solar Energy (NISE), an autonomous institution under Ministry of New and Renewable (MNRE), is the National Research and Development (R&D) institution in the field of Solar Energy. NISE supports the Ministry of New and Renewable Energy (MNRE) in implementing the National Solar Mission (NSM). NISE carries out R&D activities in various aspects of Solar Energy and also in the field of Hydrogen energy. NISE also host various skill development programmes in the field of solar energy.

10.1.2 NISE has established itself as a leading Institute in the field of Solar Energy through Resource Assessment, Research & Development, Design, Development and Demonstration of Solar Energy Technologies for various applications such as Testing, Certification and Standardization, Monitoring and Evaluation, Economic and Policy Planning, Human Resource Development and Active collaborations with prominent National & International organisations etc.

10.1.3 NISE is maintaining NABL accredited Solar Photovoltaic module testing laboratory, lighting system test laboratory, battery testing facility and solar water pumping system test rig and outdoor test facilities. The Institute has fully developed testing facility for small and large size Solar Thermal Systems and Solar Resource Assessment.

10.1.4 Research and Development

Details of various research and development projects being carried out at NISE are given in **Table 10.1**

Table 10.1 Details of ongoing R&D Projects at NISE

Sl. No.	Project	Funding Agency	Remarks
	R&D Solar PV		
1.	*"Development of high efficiency (21%/ 19%) PERC type of c-Si/ mc-Si solar cells".* A joint project between NISE and BHEL for developing PERC type solar cells with benchmark efficiencies in the country.	MNRE	The test & characterization equipment in this project such as Spectral Response Measurement System (QE-SRMS), Spectroscopic Ellipsometer, Optical Microscope, Semi-Automatic Four Probe resistivity meter, have been commissioned.
2.	*"All India Survey of PV module"* A joint project between NISE and NCPRE, IITB for doing the reliability analysis of PV modules across various locations in India.	NISE & IIT B	Report published

3.	*"High-Efficiency Solar Water Pumping Systems"* NISE has collaborated with different stakeholders to develop new and improved models of solar water pumping Systems under this project.	MNRE	The project aims to design and develop low cost high efficiency specialized controller and to improve overall wire to water efficiency up to 45 % from existing level (around 30 to 40 %) and to prepare and publish the practices and guidelines. Installation of test rig and development of efficient controller are in progress.
4.	*"Supply of Clean Drinking Water through IoT based solar-powered station at a large village in Haryana through automated dispensing while improving the water table: Pilot – Faridpur"*	DST	A joint project between NISE and Saurya Ener Tech Pvt Limited for the developing and installing of clean water purification set up using solar PV modules. The project has been installed. Commissioning is in progress. The project will provide 30,000 liters per day of RO quality water to the village.
5.	*"Performance analysis of bifacial solar PV modules"*	NISE	An in-house project of NISE for the performance and reliability analysis of bifacial PV module. Installation is in progress.
6.	*"PV Back sheet performance analysis through sequential testing as per IEC 61215 and customized test conditions"*	NISE & DuPont	An inhouse project with DuPont, a back sheet manufacturer company to analyze the performance of different back sheets of different make. An MoU signed with the industry partner. Measurements are in progress.
7.	*"Optimization of parallel row spacing between the PV array of solar power plant"*	NISE	An inhouse project on the performance enhancement of PV power plant. Development is in progress.
8.	*"Comparison of NOCT and NMOT temperature"*	NISE	An inhouse project on the comparison of NOCT and NMOT temperature and its use in performance modelling. Development is in progress.
9.	*"Performance evaluation of a solar module under wind load stress"*	NISE	An inhouse project on the reliability analysis and testing condition design for PV module. Development is in progress.
10.	*"UV radiation effect on the performance of the PV module"*	NISE	An inhouse project on the reliability analysis of PV module under UV radiation. Development is in progress.
11.	*"Making improvements in the I-V test set up for solar cells"*	NISE	An inhouse project on the designing of rig for testing of solar cell. Development is in progress.
R&D -Solar Thermal			
12.	*"Solar Dryer cum Space Heating System"*	NISE	An inhouse project for drying of agricultural products and or space heating during winters. Product developed and commercialized.

13.	*"Designing of Solar Based Space Heating"*	NISE	An inhouse project for drying of agricultural products and or space heating during winters. Product developed and commercialized.
14.	*"Design Improvements and Deployment of solar (SPV) Cold Storage with Thermal Storage"*	NISE	Collaborative project with an industry on Solar Cold Storage with integration of solar photovoltaic and thermal storage system for 24x7 operation. Product developed and commercialized.
15.	*"Solar Powered Bulk Milk Cooler using Thermal Storage "*	NISE	Collaborative project with an industry on powered bulk milk chiller with integration of solar photovoltaic and thermal storage system for 24x7 operation. Product developed and commercialized.
16.	*"Modular Central Receiver Concentrated Solar Power Plant For Decentralized Power Generation"*	MNRE	Project for power generation using central receiver concentrated solar power technology. Project Closed.

Fig. 10.1: *Advanced PV Characterization Laboratory, clean room facility at NISE*

10.1.5 Solar Photovoltaic Testing Facility (PVTF)

The Photovoltaic Module Testing Facility at NISE has National Accreditation Board for Testing & Calibration Laboratories (NABL) accredited laboratory as per ISO/IEC 17025:2005 standard for Qualification Testing and Customised Testing as per customers' requirements. This facility is recognized by the Bureau of Indian Standard (BIS) for PV Module Testing as a Type 2 category facility. The laboratory is well equipped with facilities for testing as per IEC/IS standards, IEC 61215: 2016/ IS 14286, IS/IEC 61701: 2011, IS/IEC 61730-1, 61730-2: 2016, IEC 61853-part I: 2011/IS 16170: Part 1, IEC 61853-2, and IS 17210-1-2019/IEC TS 62804: 2015/MNRE specifications.

The photovoltaic testing laboratory has upgraded its facilities with the addition of these equipments and systems, i.e., (i) Leakage current measurement setup for Potential Induced Degradation (PID) testing, (ii) Robustness of terminations test, (iii) Junction box pull tester, (iv) Cut susceptibility tester (v) Nominal Module Operating Temperature (NMOT) set up, (vi) Module breakage test, (vii) Screw connections tester, (viii) New solar simulator.

This year a total number of 266 modules have been tested as per International and BIS standards till December, 2020. The PVTF lab was identified by the Task Working Group 2 (WG2) of IEC TS 82 for testing and data analysis of Light and elevated temperature induced degradation (LeTID) testing of PV module. NISE has completed the test, and the data has already been shared with different labs of WG2. The Electroluminescence (EL) imaging at NISE is a non-destructive technique for conducting such an analysis of the degradation of PV Modules. The EL facility at NISE follows DIN IEC 60904-13:2016 standard. It enables in identifying the defects which are sensitive to the Solar PV Modules. Various test equipment used for testing of PV modules are shown in **Fig. 10.2**.

(a) *(b)*

Fig. 10.2: *Test equipment at Module Testing Lab*
(a) Module breakage tester and (b) Chord anchorage tester.

Upcoming activities in PV module test laboratory are:

1. Full testing set up for IS/IEC 61730-1,61730-2: Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction; Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing
2. IEC 62716: 2013: Photovoltaic (PV) modules - Ammonia corrosion testing
3. IEC TS 62782:2016: Photovoltaic (PV) modules - Cyclic (dynamic) mechanical load testing
4. IEC 61853-3:2018 Photovoltaic (PV) module performance testing and energy rating - Part 3: Energy rating of PV modules
5. IEC 61853-4:2018 Photovoltaic (PV) module performance testing and energy rating - Part 4: Standard reference climatic profiles.

10.1.6 Power Electronics Laboratory

NISE has established facilities for testing and evaluation of Solar Inverters/ power conditioning Units (PCU) of capacity ranging up to 100 KVA. All types of PCUs, hybrid, standalone, Grid-tied inverters (GI) pump controllers and Charge Controller can be tested. A total of 8 Nos inverters were tested this year as per International standards and MNRE specifications till December, 2020.

10.1.7 Battery Test & Characterization

The Battery Test & Characterization laboratory is in the process of obtaining the NABL accreditation for different tests under different standards. The battery test & characterization laboratory is engaged in different analysis, performance evaluation & research work as follows: (i) Development of Testing Profile/Test Methodologies for emerging battery technologies, (ii) Life Cycle Tests on different secondary battery, (iii) Exploring Battery health analysis technique, (iv) Degradation Analysis of secondary battery/Effect of different parameter on the degradation of battery. A total of 37 Nos batteries were tested as per different National/International Standards during this year, till December, 2020.

10.1.8 Advanced SPV system & lighting laboratory

The Solar Photovoltaic (SPV) system and Lighting laboratory is involved in performance testing and reliability of off-grid systems including solar lighting systems. The lab is well equipped with modern testing equipment like Integrating Sphere Photometer for Total Luminous Flux measurement, Digital Programmable AC/DC power supplies, and other Digital Auxiliary equipment for conformity/ type testing of wide range of products against latest standards and specifications adopted by BIS/MNRE. The tested products include all type of lighting in solar photovoltaic system such as Solar Lantern, Solar study lamp, Solar Home Lighting, Solar Street lighting system, etc. In the year 2020-21, a total of 51 industry samples on SPV lighting were tested. The solar PV lighting test facility at NISE is shown in **Fig. 10.3**.

Fig. 10.3: *Testing of Solar Street Lights with Integrating sphere system.*

10.1.9 Solar Cell Characterization and Outdoor Module Testing Facility

Solar cell characterization group at NISE has added a new spectro-radiometer facility for testing spectral content of light for different wavelength. The lab is now capable of estimating mismatch current factor of solar cell with known spectral response data. The spectral response system installation in solar cell is under process. NISE is undertaking a process to incorporate new advanced

testing facility for different solar cells. Presently, NISE has a 6 inch 6 bus bar. Customized solar zig is introduced in the design structure for the development solar cell testing for the proper collection of current and Fill factor and reduce a shading losses due to the bus bar. In the year 2020-21, a total of 4 solar cell samples were tested.

10.1.10 Solar Water Pump Test Facility

Solar Water Pump Testing Facility (**Fig. 10.4**) at NISE is a fully automated state of the art testing facility in India. The laboratory strictly adheres to MNRE Guidelines. It has a capacity of 0.5 HP to 10 HP. The capacity is being upgraded to 50 HP under the project titled Design and Development of High Efficiency Solar Water Pumping Systems (project supported by MNRE). The test facility is equipped with advanced tools such as Solar Array Simulators, Automatic Data loggers, Power Analysers, Power Meters, Flow Meters, Pressure Transmitters, Automatic gate valves, various sophisticated sensors and a dedicated software. All tests are performed against a suitable standard. The facility is also responsible for carrying out the analysis and R&D of solar water pumping systems. A total of 14 solar water pumps have been tested in the year 2020-21. It comprises of all major pumping technologies such as submersible, surface, AC and DC systems.

Fig. 10.4: *Solar PV Pump test facility at NISE*

10.1.11 Solar Thermal Technologies

Solar Dryer cum Space Heating System

NISE has indigenously designed and developed an innovative Solar Dryer cum Space Heating System with thermal storage system and filed an application for grant of Intellectual Property Rights (IPR) with Indian Provisional Patent Application No.: 201811013091. The system is ideally suited for drying of agricultural products such as crops, fruits, vegetables, spices, chips, fish, tea etc. NISE has successfully installed and commissioned 10 Nos. of solar dryer units (5 in Leh and 5 in Kargil) on trial basis **(Fig. 10.5)** to evaluate performance in actual field conditions in July, 2018. NISE carried out the design

improvements based on the feedback received from beneficiaries and Horticulture Department of J&K. These design improvements was done to enhance the performance of the system and for easy handling in terms of usage and installations. Based on the satisfactory performance of the system, Horticulture department of J&K requested NISE to supply and install 300 units of Solar Dryers cum Space Heating System in Ladakh, which are under installation.

Fig. 10.5: *Solar dryer units at Leh-Ladakh region*

National Institute of Solar Energy (NISE) has been carrying out research and analysis work for development of possible solution for space heating system in Ladakh and other Himalayan regions. NISE has carried out the designing of radiant floor heating system for Defence Institute of High Altitude Research (DIHAR), DRDO. Thermal analysis of the system was done on the Loop-CAD software.

Solar Cold Storage System

NISE has implemented 03 pilot installations of Solar Cold Storage for Horticulture Research Center Agartala, Agricultural Department Komalpur, Dhalai and Krishak Bandhu Center Gomti Udaipur in Tripura state. ANERT (Agency for Non-Conventional Energy and Rural Technology) has also installed 5 MT capacity Solar Cold Storage in Nochad, Kerala. NISE is regularly monitoring the performance of the pilot systems through online monitoring system. Based on the requirements of the pilot installations of various states, R&D work is being constantly carried out to meet the specific requirements apart from the standard product.

Fig. 10.6: *Solar Cold Storage System*

Bulk Milk Chiller System

NISE has also signed a Memorandum of Agreement (MoA) with industry partner for carrying out pilot installations and commercialization of the system and has successfully installed more than 15 Bulk Milk Chiller with thermal storage throughout India in the States of Punjab, Gujarat, Sikkim, Uttar Pradesh, Tamil Nadu, Karnataka and Maharashtra.

Fig. 10.7: *Bulk Milk Chiller System*

NISE has implemented an R&D project entitled "Modular Central Receiver Concentrated Solar Power Plant for Decentralized Power Generation" sanctioned by MNRE. The O&M activities were performed during the year 2019-20 to meet the objective of the R&D projects. The project has been concluded by MNRE on 31st March, 2020 and it was recommended that NISE shall utilize the existing facility for training and demonstration purpose.

NISE bags Platinum "QCI – D.L Shah Quality Award 2020" for Solar Dryer cum Space Heating Project in Ladakh

National Institute of Solar Energy (NISE) has won Platinum Award in 13th QCI – D.L Shah Quality Award 2020 on 17th December 2020, for the Solar Dryer Project implemented in Ladakh. The award is given by Quality Council of India as a recognition for successful projects of an organisation that have resulted in continuous improvement of processes, products and/or services, better/effective operations and increased customers and stake-holders satisfaction.

NISE has indigenously designed and developed an innovative Solar Dryer cum space heating system with thermal storage system. The technology can be used for a variety of agricultural process applications. The system is ideally suited for agricultural applications, such as crop, fruits, vegetables, spices, chips, fish, tea etc and other process drying. The system completely runs on the solar along with innovative thermal energy storage for continuous operation. System is designed for dual mode operation with plug and play connection: Drying Mode and Space Heating Mode.

Fig. 10.8: *NISE has won the Platinum QCI–D.L Shah Quality Award 2020*

National Institute of Solar Energy, Gurugram and Horticulture Department of Ladakh has jointly worked for supply of 300 units of Solar Dryer cum space heating system to the farmers of Ladakh under Prime Minister Development Programme (PMDP).

During summer the system is used by the farmers of Ladakh for drying apricots and other fruits and vegetables. During winters, the system is used by the farmers for space heating of their houses. Due to the use of solar dryer, drying time of apricots has been reduced to 3-5 days from 12-15 days taken by traditional open sun drying method. Apricot is now more hygienic and freer from insects, pathogens, dust and direct sun exposure. This has resulted in the improvement in product quality in terms of colour, taste, size and moisture level. Also the system has energy storage which helps the drying to operate round the clock. During winter season in Ladakh, the system is used by the farmers for heating their room which increases the capacity utilization of the system. This results in saving to farmers and reduction of indoor air pollution and the negative health impact from use of traditional bukharis.

The project is helping farmers of far flung areas in Ladakh to preserve their fruits and vegetables for longer duration by drying and increase their product quality. Additionally it helps them to keep warm during harsh winters months, bringing smiles to the farmers of Ladakh.

Fig. 10.9 *Solar Dryer cum Space Heating unit in Ladakh*

Fig. 10.10: *The Platinum QCI–D.L Shah Quality Award 2020 and Certificate won by NISE*

10.1.12 Solar Radiation Resource Assessment (SRRA)

The Solar Radiation Calibration Laboratory (SRCL) at NISE (**Fig. 10.11**) is operational since 2016 for calibration of solar radiation measuring sensors from National solar radiation network of MNRE (SRRA). The following activities carried out during the FY 2020-21.

- 8 SRRA stations equivalent to 24 solar radiometers and 6 in house facility pyranometers have been calibrated at the laboratory facility.
- Total 38 pyranometers have been calibrated at the facility from private organizations during this year under the commercial program.
- A comprehensive study is carried out on reference solar radiometer calibration methodology & analysis with establishing the traceability to the World Radiometric Reference using an absolute cavity radiometer.
- The periodical calibration data analysis is carrying out to develop the calibration protocols for improving the quality and reliability of measured solar radiation data.

Fig. 10.11. *Calibration of Radiometers at NISE (Project funded by MNRE)*

10.1.13 Skill Development And Capacity Building

NISE has taken several initiatives towards skill development and capacity building activities. During this year, across different states, a total of 2900 Suryamitras were trained in the field of installation and maintenance of the solar photovoltaic systems. NISE conducted 11 National programmes, imparting training to 319 professionals and 3 International training programs thereby provided training to 90 participants from various countries. NISE also successfully completed the advance professional program on solar energy for 20 participants, during February, 2020. **Fig. 10.12** shows the group photograph from 11th Renewable energy training programme for armed forces officials conducted in January, 2020.