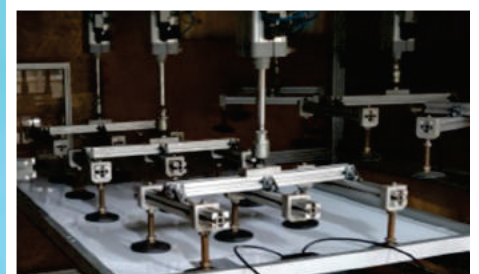
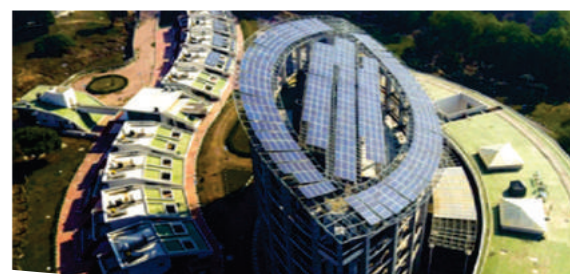
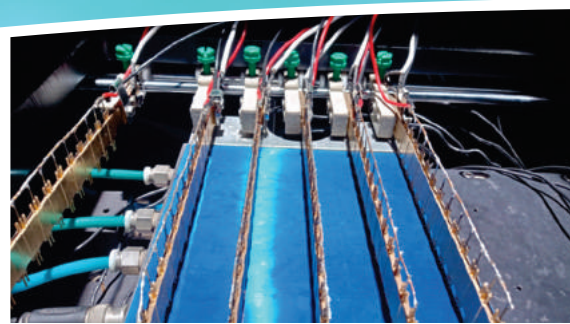


ANNUAL REPORT 2019-20



NATIONAL INSTITUTE OF SOLAR ENERGY

(An Autonomous Institute of Ministry of New and Renewable Energy, Government of India)

NATIONAL INSTITUTE OF SOLAR ENERGY

GOVERNING COUNCIL

1.	Shri Anand Kumar, Secretary, Ministry of New and Renewable Energy (MNRE).	President (Ex- officio)
2.	Shri Praveen Garg, AS&FA, MNRE	Member (Ex- officio)
3.	Shri Amitesh Kumar Sinha, Joint Secretary (Solar), MNRE	Member (Ex- officio)
4.	Shri J.N. Swain, Managing Director, SECI	Member
5.	Director General, Central Power Research Institute (CPRI)	Member
6.	Director, Gujarat Energy Development Agency (GEDA)	Member
7.	Managing Director, Karnataka Renewable Energy Development Ltd. (KREDL)	Member
8.	Shri Ashish Khanna, Executive Director & Chief Executive Officer, TATA Power Solar System Ltd.	Member
9.	Shri Vineet Mittal, MD, Welspun Energy Ltd.	Member
10.	Dr. Arun K Tripathi, Director General, NISE	Member
11.	Dr. Rajesh Kumar, DDG/ Scientist 'F', NISE	Member
12.	Dr. Anil Kumar Saxena, Additional G.M., BHEL	Member
13.	Prof. Shireesh B. Kedare, Professor, IIT Bombay	Member
14.	Dr. T. C. Kandpal, Professor IIT, Delhi	Member
15.	Dr. Pradip Datta, Professor, IISc, Bengaluru	Member
16.	Dr. Chandan Banerjee, DDG/Sci-F, NISE	Member, Secretary

Special Invitee

Representative nominated by Secretary, Department of Science & Technology (DST), New Delhi

FINANCE COMMITTEE

1.	Financial Advisor, Ministry of New and Renewable Energy	Chairman
2.	Joint Secretary (Solar), Ministry of New and Renewable Energy	Member
3.	Director General, NISE	Member

ANNUAL REPORT 2019-20



National Institute of Solar Energy

(An Autonomous Institute of Ministry of New and Renewable Energy, Government of India)

**Gurugram-Faridabad Road, Gwal Pahari
Gurugram - 122003 (Haryana)**

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OVERVIEW

When it comes to the utilization of energy and electricity, the world focus is on renewable power sources. India is playing a significant role in green energy transition initiatives, thus leading the world with examples. India is committed for a target of 40% of installed power capacity from clean energy sources by 2030. To achieve this, the Government of India has announced a target of 175 GW of renewable power installations by 2022, out of which 87.07 GW has been set up as on 31st March 2020. Solar power capacity has increased from 2.6 GW to 34.62 GW in the last five years. According to 2018 climate scope report, the world's largest renewable auction market has positioned India as 2nd among the other 103 countries worldwide. This is based on key indicators such as clean energy policies, power sector initiatives, emissions, and installed capacities, etc.

For the previous years, Government of India has taken various policy initiatives in the solar sector, such as PM-KUSUM scheme for agricultural applications, regulatory interventions, development of solar parks, skill development initiatives and employment in renewable energy sector.

National Institute of Solar Energy (NISE) plays a crucial role by supporting Ministry of New and Renewable Energy (MNRE) in implementation of the National Solar Mission and carrying out research and development activities in the solar sector. NISE engages in research and development and testing of solar components, developing and assisting in standard and certification, solar photovoltaic technology consultancy projects, skill development programs, and development of the rural community by deploying solar products

developed at NISE.

In the Financial Year (FY) 2019-20, NISE has utilized its resources in a well-planned manner for a significant progress in the renewable energy sector. This annual report presents various technical and other activities of NISE during FY 2019-20. The first chapter provides an executive overview of various activities. Chapter 2 introduces the institute and its vision, thrust area, and objectives. The detailed activities of various technical divisions of NISE are provided from Chapter 3 to Chapter 8. The various outreach activities of NISE with international collaborations are detailed in Chapter 9 and Chapter 10 respectively. Chapter 11 presents the general activities and facilities including administrative activities of NISE. The publications and patents are given in Chapter 12. Finally, the audited financial accounts have been presented in Chapter 13.

GOVERNING COUNCIL

The Governing Council (GC) of NISE has its members from industry, research institutions, Government departments, and experts from the field of solar energy. In the FY 2019-20, two Governing Council meetings were held on 20th June 2019 (8th GC meeting) & 24th September 2019 (9th GC meeting).

FINANCE COMMITTEE

The two meetings of the Finance Committee (FC) of NISE were held on 29th June 2019 (7th FC meeting) & 19th September 2019 (8th FC meeting). The Finance Committee has approved the Statutory Audited Accounts and Audited Reports for FY 2019-20 in the 9th meeting of the Finance Committee held on 12th and 21st October 2020.

EXECUTIVE COMMITTEE

The Executive Committee (EC) takes decisions related to technical, administration, policy, finance & accounts related matters and for the improvement of the overall functioning of NISE. Three Executive Committee (EC) meetings of NISE were held on 5th April 2019, 15th May 2019 and 26th August 2019.

SCIENTIFIC AND OTHER ACTIVITIES OF NISE

NISE acts as a catalyst for the forthcoming solar energy transition in India. Strengthening of labs and manpower of NISE has been a core mandate. The experts from NISE participated in various meetings of MNRE and provided necessary technical support. Accordingly, for the implementation, coordination, and development the extensive actions were followed at NISE. The following is the executive summary of activities conducted in various labs/divisions at NISE.

SOLAR RADIATION RESOURCE ASSESSMENT (SRRA)

Solar Radiation Calibration Laboratory (SRCL) of NISE has completed the calibration of 45 radiometers from 15 SRRA stations. Under the commercial calibration mode program, calibration of total 17 Pyranometer sensors received at SRCL facility from various private organizations were completed, and calibration reports were issued. NISE, has been listed as a member of the Baseline Solar Radiation Network (BSRN), a worldwide solar radiation network established under the World Climate Research Program (WCRP) by the World Meteorological Organisation (WMO). The SRRA station of NISE is listed as Station No. 56, with site specification as plain terrain, medium black soil. NISE has initiated a Solar Radiation Forecasting activity for the prediction of radiation data at different zone of India.

SOLAR PHOTOVOLTAIC TECHNOLOGIES

In the FY 2019-20, the photovoltaic testing laboratory has upgraded its facilities with the addition of many new test setup and equipments. The PVTF labs

have tested a total of 939 module samples at NISE. Considering this attempt put forth by the management system, the lab was identified by the Task Working Group 2 (WG 2) of IEC TS 82 for testing and data analysis of Light and Elevated Temperature Induced Degradation (LeTID) testing of the PV module. NISE has upgraded its facilities for testing and evaluation of Solar Inverters/ Power Conditioning Units (PCU) for a capacity ranging up to 100 kVA. During FY 2019-20, the laboratory was undergoing enhancements for NABL accreditation. A total of 23 battery samples were tested and certified at NISE during the FY 2019-20. The 'Test Rig' has been further improved to test more numbers of solar pumping systems. A total of 41 samples for different types of solar pumps were tested for Certification. In the FY 2019-20, a total of 39 industry samples on SPV lighting were tested.

SOLAR THERMAL TECHNOLOGIES

The development and use of thermal energy storage materials and systems is an essential activity at NISE. Four Concentrated Solar Technology thermal systems were tested in the test facility of NISE. Solar thermal division of NISE is actively focused on solar thermal power/energy generation using parabolic trough, linear fresnel reflector, and central receiver technologies. Use of concentrating solar thermal (CST) technologies is done for applications related to supply of process heat, drying, cooking, space cooling & heating and water desalination. The hybrid system based on CST and biomass gasifier system for power generation and cooling has also been developed. Solar thermal division is implementing the projects based on cooling and heating applications i.e. Solar Dryer cum Space Heating System, Solar Powered Cold Storage, Solar Powered Bulk Milk Cooler, for the benefits of farmers, dairies to preserve agriculture products and milk production. The horticulture department of J&K has requested NISE to supply and install 670 units of Solar Dryers cum Space Heating System in Ladakh region. Figure 1.1 shows the photograph of the solar dryer being used by a farmer in Leh region. NISE has



Figure 1.1. Solar drier in use at Leh.

supplied 300 units of Solar Dryers till March 2020 in Leh and Ladakh which are under installation. NISE and Ministry of Agriculture and Farmers Welfare (MoAFW) are jointly implementing a few pilot-scale installations in different states through the Mission for Integrated Development of Horticulture (MIDH) scheme. During the FY 2019-20, total of 13 installations were done in Assam, Orrisa, Uttar Pradesh, Karnataka, and Kerala.

HYDROGEN ENERGY

Hydrogen Energy is an emerging clean and sustainable energy carrier due to its production from renewable energy resources. Therefore, recognizing its importance as a clean fuel for the transport sector, a hydrogen production, storage and dispensing facility has been installed at NISE by utilizing the electricity generated by the solar photovoltaic system. NISE has started the implementation of a new Research and Development project entitled "Setting up of a Centre of Excellence on Hydrogen Energy" in the campus supported with the financial assistance of Rs.10.30 Crore from the MNRE. The project aims at augmenting inhouse hydrogen production capacity of the existing Hydrogen refueling facility by installing another alkaline electrolyzer.

RESEARCH AND DEVELOPMENT

Solar drier cum space heating system, solar-powered cold storage with a thermal storage system, and solar-powered bulk milk cooler with thermal storage system developed at NISE have been developed up to commercial use.

In the FY 2019-20, NISE, in association with NCPRE, IIT Bombay published a report on the study on the performance of Solar Photovoltaic Modules installed at different parts of India in various climatic conditions. NISE has continued its development in various R&D projects such as PERC solar cells, SWAJAL- clean drinking water, high-efficiency solar water pumping in association with the Motor, Pump, and Controller manufacturers and developers. NISE has established



Figure 1.2. Development of clean room and characterization facility for solar cell testing

a laboratory space of 140 sq. m, Class 100K (ISO Class 8) cleanroom i.e. Advanced PV Characterization Laboratory for housing the test and characterization equipment for solar cells. The development of cleanroom is shown in Figure 1.2.

SKILL DEVELOPMENT AND CAPACITY BUILDING

NISE has taken several initiatives towards skill development and capacity building activities. During the FY 2019-20, across different states, a total of 16,074 Suryamitras were trained in the field of installation

and maintenance of the solar photovoltaic systems. NISE conducted 21 National programs, imparting training to 514 professionals and 7 International training programs thereby provided training to 213 professionals from 108 countries in various fields of solar energy.

In the FY 2019-20, NISE has also organized six months advanced solar professionals course, which was attended by 20 professionals from industry and institutions. Figure 1.3 shows the participants of solar start-up training program.



Figure 1.3. Participants from training program for Solar Start up

NATIONAL/INTERNATIONAL COOPERATION

NISE has signed MOU with the Ministry of New and Renewable Energy, Government of India, indicating the physical and financial targets and also the thrust areas. As per MOU, the performance of NISE was rated as “very good”.

NISE signed MoU’s with 16 National Organizations and 3 International Organizations and partnered with PTB Germany for strengthening the quality infrastructure for the solar industry. NISE is working along with the German Agency for International Cooperation (GIZ) to launch the first portable residential Solar Rooftop Photovoltaic System in India termed as “PV Port & Store”. NISE is closely working with ISA having an objective to transform every international

member country through technical assistance, skill development and investments. NISE is supporting ISA in various thrust areas, ie. Solar rooftops, solar water pumping, solar e-mobility, and skill development.

ADMINISTRATION AND FINANCE

Efforts were made to fill the regular positions at NISE. Out of 40 sanctioned regular posts, the selection has been completed for 31 posts out of which 11 technical persons joined till 31.03.2020 and remaining are in the process of joining.

OTHER INITIATIVES

NISE has continued its consultancy services and provided consultancy on Detailed Project Report (DPR) preparation, vetting, performance evaluation,

training, etc. and generated a revenue of Rs.45.5 Lakhs. NISE was involved as the independent engineer performing inspection and commissioning of the 750 MWp REWA Solar Park. A view of the project is shown in Figure 1.4. NISE has developed its infrastructure and facilities with the advancement of the library, IT system, and automation of customer services.

The Scientific/Technical staff of NISE continued their efforts in publishing research articles and reports on various evolving topics of solar energy. During FY 2019-20, a total of 14 research papers were published in reputed international/national journals. Besides, five chapters were also published in various books. NISE has filed one patent application during FY 2019-20.



Figure 1.4. 750 MWp ultra mega solar power project at Rewa

INTRODUCTION

NISE is an autonomous specialized institute under the Ministry of New and Renewable Energy (MNRE), Government of India, mandated for research and development, solar component testing and certification, capacity building, and development of solar products and applications. The technical support of NISE complements the requirements of MNRE to become a self-reliable renewable power producing nation and accept the series of challenges intervened in amidst of implementation of the National Solar Mission (NSM). NISE has established in the solar energy sector through continuous efforts by developing newer technologies, developing standards, and catering to the changing needs in the industry. Furthermore, NISE envisions in accelerating the proliferation of the renewable energy sector by intently working together with the Government of India.

VISION OF NISE

To establish itself as one of the world's premier referral leading Institute in the field of Solar Energy through Resource Assessment; Research & Development; Design, Development, and Demonstration of solar energy technologies for various applications; Testing, Certification, and Standardization; Monitoring and Evaluation; Economics and Policy Planning; Human Resource Development and active collaborations with prominent National & International organizations.

OBJECTIVES

The main objectives include (i) To function as the National Research Organization for undertaking and/ or sponsoring Research and Development Projects on

various aspects of solar energy technologies; (ii) To act as an Apex organization for testing, certification, development of specification, and standards; and (iii) To create skilled man power and offer consultancy services on Solar energy technologies.

THE INSTITUTION

NISE is situated at Gwal Pahari on Gurugram-Faridabad Road in Haryana. The institute is linked through open and wide roads. It is about 22 km away from the nearest airport, 30 kms away from New Delhi Railway station, and 25 km away from MNRE. The institute has continuous connecting services via road through commuting facilities outside its premises.

The institute has a 200-acre campus which is registered as a society under the Haryana Registration and Regulation of Societies Act 2012 (Registration No. is HR-018-2013-01092). The campus is beautifully landscaped with green vegetation and R&D projects such as Swajal, 1.0 MW Solar Thermal Power Plant, 500 kW_p Solar Photovoltaic Power Plant, 150 kW_p Solar Rooftop Photovoltaic Power Plant and 120 kW_p Solar Photovoltaic Power Plant for hydrogen facility to harness the solar energy to the maximum extent. The campus area includes the energy-efficient buildings known as Aditya Bhawan and Surya Bhawan with conference halls, seminar rooms, committee rooms, guest houses, and a library. The halls and rooms are furnished with modern amenities, projectors, sound systems with a seating arrangement for more than 150 individuals. The library has the latest updated standards, journals/conference papers both international/national, magazines, newspapers, and more than 3000 books. The authorization and

bookings are made convenient through the e-online library portal, easily accessible from the NISE website. The Surya Bhawan also comprises of the Administrative Department, Skill Development Division, and International Solar Alliance (ISA) Secretariat. Figure 2.1 shows the Aditya Bhawan, and Figure 2.2 shows the Surya Bhawan buildings of NISE.

The Aditya Bhawan of NISE, designed on the principles of solar passive architecture is exclusively a technical block comprising of “state-of-the-art” testing facilities, laboratories, workshops, and R&D cell. NISE includes world-class, well-equipped testing facilities and R&D rooms spaced at Aditya Bhawan. The solar radiation data centers with suitable equipments are also located within the campus for the collection of real-time solar radiation data.

NISE has guest house facilities for trainers, staff and international delegates with cafeterias in both buildings to serve them with sumptuous food. NISE campus has an ATM at its main gate and offers amenities such as playing field, gyms, indoor games, yoga halls, etc. within the premises.

QUALITY POLICY OF NISE

NISE is committed for providing performance evaluation and testing services for Solar Cells, PV Modules, Solar Water Pumping System, Inverters, Charge Controllers, Batteries, Advanced Lighting System and to calibrate Solar cells, PV Modules, Pyrheliometer, and Pyranometer. The test facilities established at NISE meet the requirements to conduct the tests as per the National/International Standards.

This is being achieved by using the best engineering practices, continuous upgradation of the infrastructure, and updating of the state-of-the-art test facilities, test methods, test personnel and continual improvement in the effectiveness of the Quality Management System as per International Standard ISO 17025:2017.

ORGANISATION STRUCTURE OF NISE

The rules of affairs at NISE are managed by a Governing Council chaired by Secretary, MNRE, and an Executive Committee chaired by Director General, NISE. An organization chart of the structure and management of NISE is shown in Figure 2.3. The second Governing Council was constituted by Government of India, MNRE, on 15th January 2018, to manage the affairs and funds of NISE in accordance with the Memorandum of Association, Rules, Regulations, and By-laws of NISE.



Figure 2.1. Aditya Bhawan Building at NISE, Gurugram



Figure 2.2. Surya Bhawan Building at NISE, Gurugram

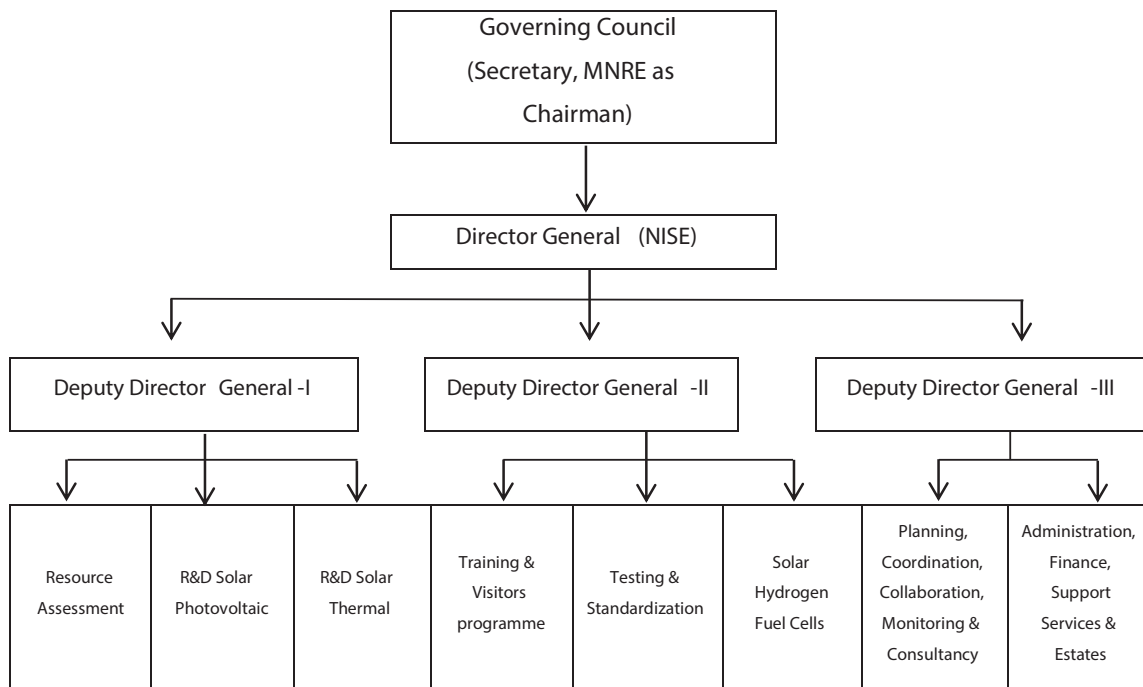


Figure 2.3. Organization Structure of NISE

There are 18 members including Secretary, MNRE, who is ex-officio President, NISE. The Governing Council constitutes of members from industry, premier institution, MNRE, NISE and experts from reputed organisations. The Executive Committee has five members headed by DG, NISE to manage the day to day affairs of NISE and to take decisions on matters under the power delegated to it. During the period of report, three Executive Committee meetings were held under the chairmanship of DG, NISE. The Finance Committee of NISE have three members comprising of Financial Advisor, MNRE as Chairman and Joint Secretary (Solar), MNRE and DG (NISE) as its member. The Deputy Director Generals are supported by Directors, Administrative officer, Deputy Directors, Assistant Directors, and Executive Assistants for various technical and administrative activities.

THRUST AREAS

The basic function of NISE is to serve as a technical focal point in solar energy related areas. NISE is committed to perform at its best in all spheres relating

to solar energy and continually provide assistance and guidance with high standard of quality in its work. NISE recognises the process of developments and continuously relate for significant and notable changes taking place in solar industry. NISE has the following thrust areas for its contribution and exploration of knowledge in this area.

(i) To work increasingly in frontline areas that transcend discipline. The following thrust areas form part of this effort:

- Research and Development in Solar Photovoltaic and Solar thermal systems.
- Solar Resources Assessment.
- Testing of Solar Systems and devices (both large and small).
- Standards and Certification.
- Database Management and Information dissemination.
- Capacity Building, training , teaching and visitors programme.
- Collaborations, Monitoring and Consultancy

Services.

- ✿ Development of Solar Energy Products & Hybrid System.
- ✿ Consultancy Services, Monitoring, Collaborations (National and International)
- ✿ Innovations, solar product development & commercialization.
- ✿ Solar Hydrogen and Fuel Cells.

- (ii) To have a perception and value system appropriate to the pursuit of high engineering science to meet the critically evaluated need of the industry.
- (iii) To maintain and foster interactive linkages with leading technological Institutions and Institutes of research in India and abroad.
- (iv) Interface between Government, Industry, Academia and Individuals.

MAJOR ACTIVITIES

The main functions of the Institute include:

- i. Assisting the Ministry in implementing the NSM objectives through appropriate mechanisms, evolving Science & Technology (S&T) programmes and projects, managing special projects, overseeing and coordinating with all relevant stakeholder agencies in the pursuit of the above objectives.
- ii. The Institute is responsible for providing thrust to R&D in solar energy and related technologies under the Mission. It would facilitate work related to demonstration and technology validation projects. The Institute will also consider the sector-specific R&D needs to commercialize the solar applications. These target sectors could be buildings, rural areas, and industries for lighting and any other applications. The objective of solar application and R&D efforts should also target replacement of kerosene and diesel being used by the sectors stated above.

- iii. The Institute is responsible for R&D, resource assessment, training, testing/standardization work assigned to the Institute by the Ministry from time to time. It will maintain a data bank for use by industry and other institutions.
- iv. The Institute also undertakes R&D projects on different aspects of solar energy technologies, hybrid systems and storage techniques/systems.
- v. The internal administrative functions, international cooperation projects on research, training, and testing, technology validation are also undertaken by the institute.
- vi. The Institute also works as the Secretariat for the work of the R&D Advisory Council. The Solar Research Advisory Council facilitates the development of a technology roadmap and provides inputs on all matters related to R&D and capacity building to the Mission Steering Group. The Institute also works closely with the Solar Corporation of India set up by the Ministry for implementation of the Mission.
- vii. The Institution under the guidance of the Ministry and the Mission Steering Group is responsible for Coordination with the (i) other Centres of Excellence identified under the Mission, (ii) R&D projects funded in the field of solar energy in the country, (iii) other S&T Ministries/Organizations in the country.
- viii. The Institute strives to bridge the gap between existing R&D institutions and Industry, and get the Industry on board, through partnership programmes and projects.
- ix. The Institute collaborates with the international S&T organizations for R&D and capacity building activities in the areas of solar energy assigned to the Institute by the Ministry from time to time.
- x. The Institute keeps track of latest global developments based on technology forecasting



and fore sighting relating to solar energy and related technologies including storage techniques and provides inputs to the Ministry and the Mission Steering Group for the accelerated development of the indigenous solar energy technologies and industry in the country.

- xi. The Institute also provides technical support to other R&D and testing organizations, as considered necessary.
- xii. The Institute assists the Ministry in preparation of a technology roadmap and the related S&T policies for effective implementation of the S&T component of the Mission.
- xiii. The Institute also coordinates the work of technical monitoring of projects covered under the S&T roadmap for the Mission and undertakes technical studies and evaluations.
- xiv. The Institute is eligible to receive research grants from MNRE, other Ministries/organizations including international funding to carry out various assigned tasks and R&D activities.

xv. The Institute also supports capacity building and supports students, teachers, and research personnel to work for higher degrees including Ph.D. The Institute would develop suitable linkage with various academic and research organizations for this purpose.

xvi. Any other tasks assigned by the Government from time to time.

NISE is a technical hub for all solar linked activities, standardization, designing, consultancy, and skill development programs. The institution is committed to deliver quality in all the efforts put in to promote and grow solar energy in India. The institution aims to address the gaps and work towards the National Solar Mission in the most significant procedure.

NISE believes on the technology evolutions. This helps to anticipate and prepare for future challenges. New opportunities for innovation will be the major focus for future growth. Preparing the solar Industry for a cost optimized solution, with emphasis on quality shall also be included in the forthcoming plans.

SOLAR RADIATION RESOURCE ASSESSMENT

3

As a part of Solar Radiation Resource Assessment initiative of MNRE, one Advanced Monitoring Station (AMS) and one Solar Radiation Resource Assessment (SRRA) station have been established at NISE campus. The SRRA stations generate high quality (1 Minute) solar radiation data of various parameters such as Global Horizontal Irradiance (GHI), Diffuse Horizontal Irradiance (DHI), Direct Normal Irradiance (DNI), Spectral DNI, Ground Reflected radiation and Infrared radiation. The institute has ongoing R&D projects for research in solar radiation such as calibration of solar radiometer of SRRA program of MNRE and forecasting of solar radiation. Baseline surface Radiation Network (BSRN) is the Global Network of solar radiation measurement stations from various countries monitored by World Meteorological Organisation (WMO). The SRRA station of NISE is listed as Station No. 56, with site specification as Plain terrain, Medium black soil as a part of BSRN network.

SOLAR RADIATION CALIBRATION LABORATORY

The Solar Radiation Calibration Laboratory (SRCL) at

NISE is operational since 2016 for calibration of solar radiation measuring sensors from National solar radiation network of MNRE (SRRA). The laboratory is established following the WMO guidelines where calibration is performed as per the International Standards Organisation (ISO). It has highly precise reference standard sensors such as Primary Standard Sensor/Absolute Cavity Radiometer (Highest Solar Radiation Standard) and number of secondary Standard Reference Sensors for achieving precise radiometric calibration traceable to World Radiometric Reference (WRR) scale. In addition, the facility also caters the calibration need of private organizations in the country under its commercial mode program.

CALIBRATION STATUS OF SRRA STATIONS

During the period of FY 2019-20, SRCL has performed the calibration of 45 sensors from 15 SRRA stations located at different location in the country. Additionally, 17 numbers of sensors from commercial/ research institutes were also calibrated. The details of different SRRA stations calibrated are given in Table 3.1.

Table 3.1: Calibration Status of SRRA Stations

S.No	SRRA Station	State	Types & No. of Sensor Calibrated		Total
			Pyranometer	Pyrheliometer	
1	Imphal, Manipur	05-04-2019	02	01	03
2	Kohima, Nagaland	08-04-2019	02	01	03
3	Hawrah, Kolkata	22-08-2019	02	01	03
4	Murshidabad, West Bengal	24-08-2019	02	01	03
5	Jaipur, Rajasthan	29-08-2019	02	01	03
6	Muzaffarpur, Bihar	29-9-2019	02	01	03
7	Jalpaiguri, West Bengal	03-10-2019	02	01	03
8	Deogarh, Jharkhand	10-10-2019	02	01	03

S.No	SRRA Station	State	Types & No. of Sensor Calibrated		Total
			Pyranometer	Pyrheliometer	
9	Katra ,Jammu & Kashmir	31-10-2019	02	01	03
10	Palampur, Himachal Pradesh	02-11-2019	02	01	03
11	Tripura Agartala	06-12-2019	02	01	03
12	Purnea, Bihar	12-12-2019	02	01	03
13	Mathania, Rajasthan	25-12-2019	02	01	03
14	Ratangarh, Rajasthan	21-02-2020	02	01	03
15	Jodhpur, Rajasthan	21-02-2020	02	01	03

SOLAR RESOURCE ASSESSMENT FOR INDIA (SOLINDIA)

The collaboration project with National Remote Sensing Centre (ISRO) aimed at estimating surface reaching Global Horizontal Irradiance (GHI), Direct Normal Irradiance (DNI), and Diffuse Solar Irradiance (DSI) maps for India.

The project closure conclusions were presented in the FY 2019-20, with deliverable of irradiance maps for monthly hourly values of GHI, DNI and DSI for consecutive three years, and validation there by. Waste land maps were also developed. The study was carried out using satellite imagery and, validation is performed based on the ground measured data. The results of the study were fruitful. The Diffuse Solar Irradiance map (DSI) for a specific year is shown in the Figure 3.1.

Soiling effect on the performance of solar radiometers in the composite climatic zone of India

The effect of soiling on the performance of solar radiometers was studied at National Institute of Solar Energy (NISE), Gurugram having latitude and longitude

coordinates as 28.420 °N and 77.150 °E, respectively. The test pyranometer and pyrheliometer were subjected to unclean condition during the soiling test period for a period of two months. Dust accumulation was allowed on the glass surface of pyranometer

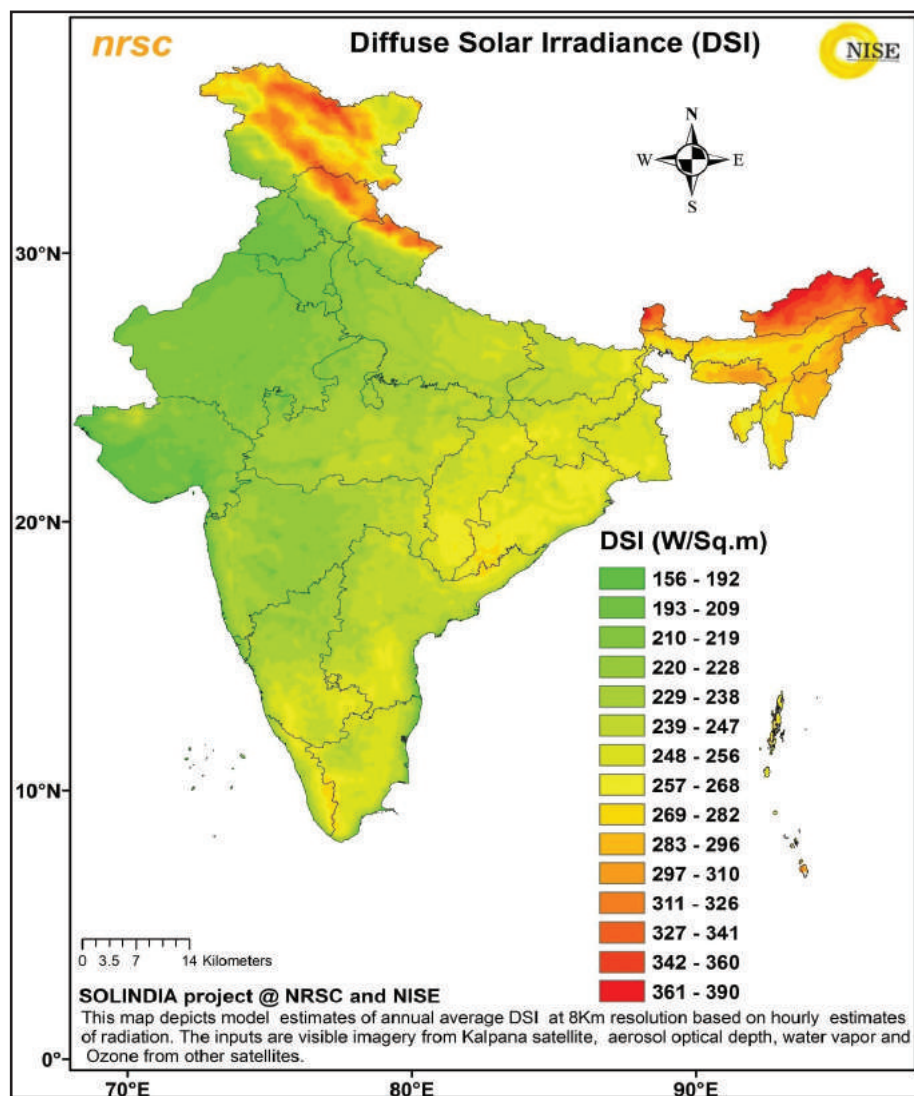


Figure 3.1. DSI average map for a specific year

hemispherical glass dome and pyr heliometer aperture glass for two months. The reference pyranometer and pyr heliometer were cleaned daily basis and the measurements were recorded. The test sensors, however, were washed by rain during the intermittent test period.

Study of soiling effect on pyranometer and pyr heliometers measurements were carried out by using two statistical methods, Relative Root Mean Square Error (rRMSE) and relative bias (rBias). By the use of these two approaches, we have identified test solar radiometers measurement degradation as a function of time.

The daily values from the test sensor and reference sensor were used for calculation of percentage error in rRMSE. It was observed that 0.28 % per day and 0.2 % per day of rRMSE value increased due to soiling for pyranometer and pyr heliometer, respectively. Two-months variations are shown in the Figure 3.2. The calibration facilities are shown in Figure 3.3 and, demonstration of the facility to the training participants is shown in Figure 3.4.



Figure. 3.3 Solar Radiometer Calibration Laboratory (SRCL), NISE.



Figure. 3.4 Participants of International Training Programme of Solar Energy Technologies & Application under India Technical an Economic Co-operation (ITEC) visited to Advanced Measurement Station (AMS) at NISE, Gurugram.

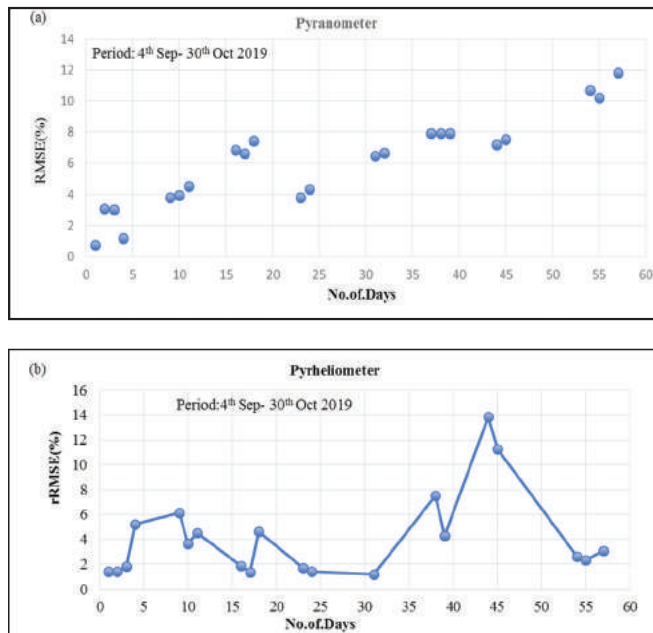


Figure. 3.2 (a) and (b) Variation of RMSE values for Pyranometer and Pyr heliometer for a period of two months.

UPCOMING ACTIVITIES

NISE has initiated efforts for setting up an operational solar power forecasting facility. The establishment of Indoor Calibration and Characterization facility for Solar Radiometers in collation with PTB, Germany is under consideration. The NABL accreditations for the Solar Radiometer calibration facility are under process. It is also proposed to carry out the Calibration of Solar Radiometers from SRRR stations at Eastern, North Eastern Regions of the country at the calibration laboratory facility. The real time data assimilation techniques, and development of computational tools for forecasting is also under consideration.

SOLAR PHOTOVOLTAIC TECHNOLOGIES

4

INTRODUCTION

Quality assurance and performance standard tests are necessary mandates for any solar PV system. Demonstration of the robust long-term yield of systems under an abreast change of climate, is a prerequisite for the reliability of the system. It is equally essential that the performance characterization, according to the set parameters, is delivered to the customers according to the required parameter yield. NISE has ISO 17025:2017 accredited laboratory, which performs testing and certification of solar PV systems according to the National/International Standards. NISE ensures that the proper procedures are followed to test the solar products from the manufacturers and retailers, to guarantee the quality and performance standards being tested. NISE has an ISO certified laboratory with proper testing protocols (National/International standards) for clarity of procedures and methodology. It also has NABL accredited laboratories with a comprehensive list of testing instruments, for developing standards and up-gradation of testing facilities with new developments in the market. There are test facilities for Solar PV modules, Inverters, batteries, Lighting systems, Pumps and mobile testing of PV power plants. NISE is looking ahead to maintain laboratory management and information system to facilitate the testing and procedures.

SOLAR PHOTOVOLTAIC TESTING FACILITY (PVTF)

Photovoltaic module testing facility

The Photovoltaic Module Testing Facility at NISE has National Accreditation Board for Testing & Calibration

Laboratories (NABL) accredited laboratory as per ISO 17025:2017 standard for Qualification Testing and Customised Testing as per customer 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 as given below:

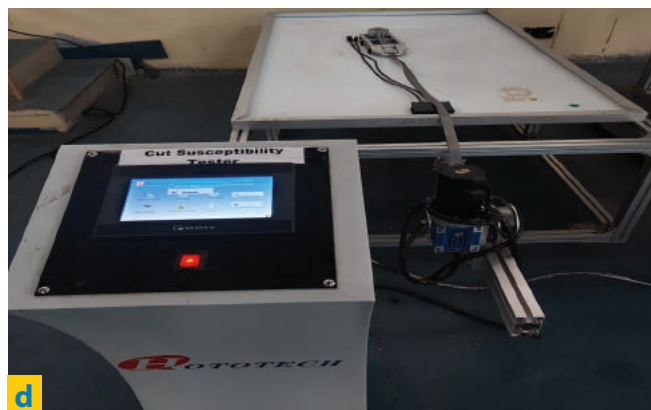
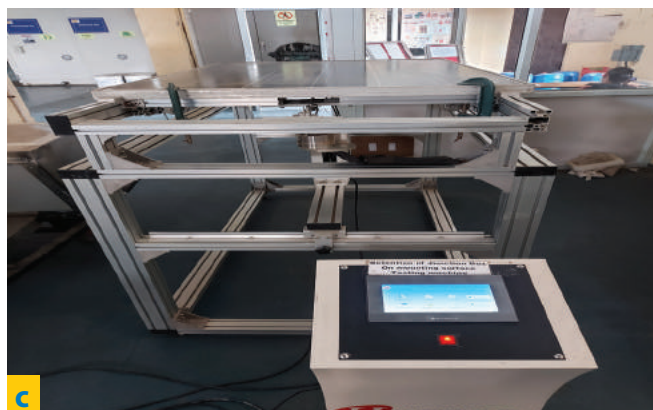
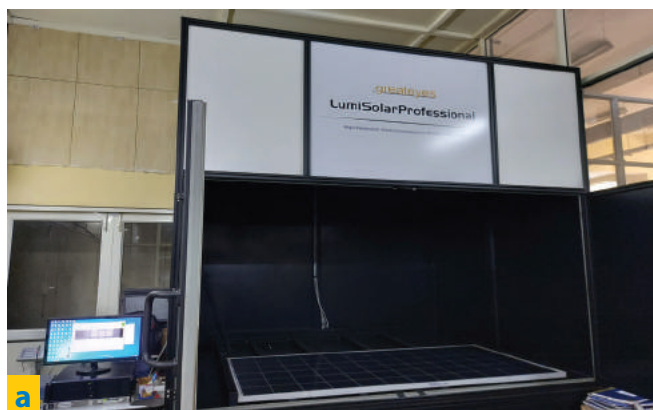
1. IEC 61215: 2016/ IS 14286(partial, accreditation process going on): Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1: Test requirements; Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 2: Test procedures.
2. IS/IEC 61701: 2011: Salt mist corrosion testing of photovoltaic (PV) modules
3. IS/IEC 61730-1, 61730-2: 2016 (partial, accreditation process going on): Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction; Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing.
4. IEC 61853-part I: 2011/IS 16170: Part 1 (accreditation process going on): Photovoltaic (PV) module performance testing and energy rating - Part 1: Irradiance and temperature performance measurements and power rating.
5. IEC 61853-2: Photovoltaic (PV) module performance testing and energy rating - Part 2: Spectral responsivity, incidence angle, and module operating temperature measurements.
6. IS 17210-1-2019/IEC TS 62804: 2015/MNRE

specifications (accreditation process going on):
Photovoltaic (PV) modules - Test methods for the detection of potential-induced degradation - Part 1: Crystalline silicon

In the FY 2019-20, the photovoltaic testing laboratory has upgraded its facilities with the addition of few new equipment and system, 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. The PVTF tested a total of 939 module samples at NISE.

The in-house activities of the PV facility at NISE have always extended its efforts for maintaining the quality management system of laboratory testing services. Considering this attempt put forth by the management system, the 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 various labs of WG2. The lifetime performance of a module is an essential criterion for predicting the cause of degradation of a solar photovoltaic module. 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 identification of the defects which are sensitive to the Solar PV Modules. The characterization of PV Modules is conducted while applying a current to a module and collecting the emitted radiation from the module. The EL image shows in homogeneities, micro-cracks, defects on electrical interconnections, and even Potential Induced Degradation (PID) effects on the cells.



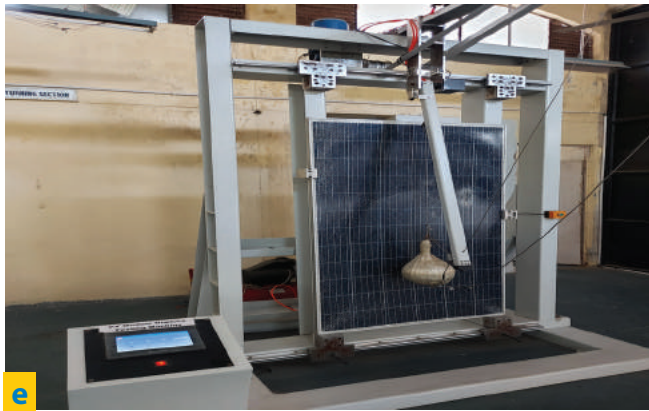


Figure 4.1. Test equipment at Module Testing Lab: (a) EL imaging setup, (b) Heating chamber, (c) Robustness of termination tester, (d) Cut susceptibility tester, (e) Module breakage tester and (f) Chord anchorage tester.

Various test equipment used for testing of PV modules are shown in Figure 4.1.

Upcoming activities in module test lab 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.

POWER ELECTRONICS LABORATORY

The Power Electronics Laboratory (PEL) at NISE conducts testing of all types of power conditioning units (PCUs), hybrid, standalone, Grid-tied inverters (GI) and pump controllers. PEL is accredited by National Accreditation Board for Testing & Calibration Laboratories (NABL) as per ISO 17025:2017. This facility

is recognised by Bureau of Indian Standard (BIS) for IS 161619. Test procedure of Islanding Prevention Measures for Utility-Interconnected Photovoltaic Inverters. During the year FY 2019-20, NISE has upgraded its facilities for testing and evaluation of Solar Inverters/ power conditioning Units (PCU) for a capacity ranging up to 100 kVA. The laboratory is well equipped with facilities for testing as per IEC/IS standards as given below:

1. IEC 61683:1999: Photovoltaic systems –Power conditioners –Procedure for measuring efficiency.
2. IS 16169/ IEC 62116:2008: Test procedure of islanding prevention measures for utility-interconnected photovoltaic inverters.
3. CEI IEC 61727:2004: Photovoltaic (PV) systems –Characteristics of the utility interface.
4. IEC 62509:2010 Performance and functioning of charge controller.
5. EN50530:2010: Overall efficiency of grid connected photovoltaic inverters .
6. IEC 60068-2 -1: 2007: Environmental test A: cold.
7. IEC 60068-2 -2: 2007: Environmental test B: Dry heat.
8. IEC 60068-2 -14:2009: Environmental test N: Dry heat Change of temperature.

9. IEC 60068-2 -14:2005 Environmental test Db: Damp heat cycle.

total of 38 Nos. of testing services provided as per International standards and MNRE specifications.

Figure 4.2 shows the testing facility of Power Electronics Laboratory at NISE. In the FY 2019-20, a

Forthcoming, the power electronics laboratory at NISE has the following activities for further enhancement



Figure 4.2. Power Electronics Laboratory setup

as given below:

1. IS 16221 (Part 2) : 2015/IEC 62109-2 : 2011: Safety of Power Converters for Use in Photovoltaic Power Systems: Part 2 Particular Requirements for Inverters
2. IEC TS 62910:2015: Utility-interconnected photovoltaic inverters - Test procedure for low voltage ride-through measurements

BATTERY TEST & CHARACTERIZATION LAB

The battery test and characterization laboratory at NISE is recognized by Bureau of Indian Standards (BIS), for IS 16270:2014- secondary cells and batteries for solar photovoltaic application general - requirements and methods of test services. This laboratory tests the battery technologies as given in Figure 4.3. The laboratory also follows different National/International Standards for variety of secondary batteries, these batteries are operated with broad range of climatic chambers and water thermal bath for a broader range of temperature control and detailed parameter analysis. During the FY 2019-20, the laboratory was

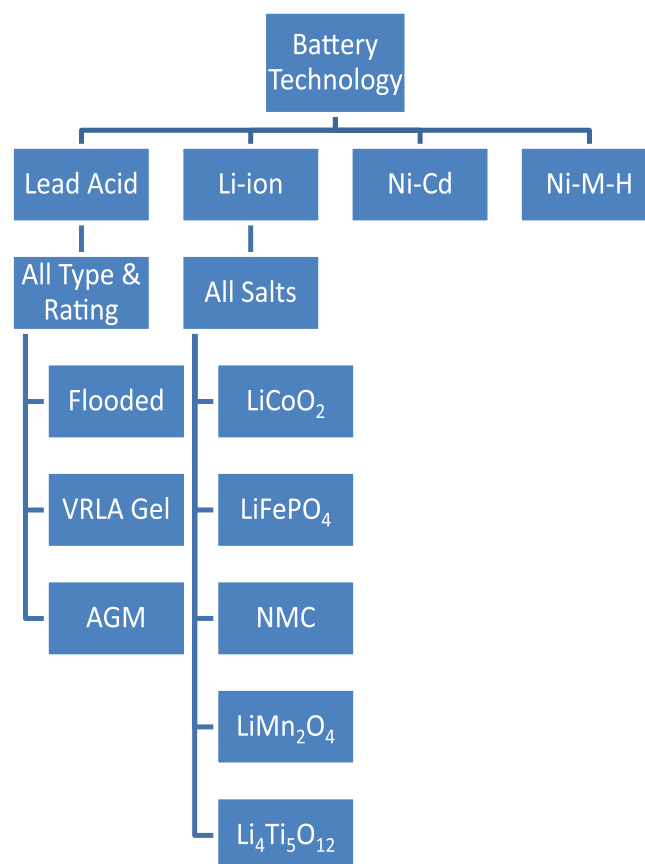


Figure 4.3: Different types of Secondary batteries serviced for Testing and Certification

undergoing enhancements for NABL accreditation. A total of 23 battery samples were tested and certified at

NISE during the FY 2019-20. The battery test facilities of NISE is shown in Figure 4.4.



Figure 4.4 Battery test Laboratory setup

SOLAR PHOTOVOLTAIC PUMP TEST FACILITY

The ‘Solar Water Pumping Systems Test Set-up’ at NISE is one of its prestigious facility in the country for ‘Testing, Evaluation and Certification’ of the ‘Solar Water Pumping Systems’ as per MNRE specifications and Guidelines. NISE takes pride to have formulated the “Standard Test Procedure” for the testing of Solar Pumps under simulated and actual field conditions. Solar array simulators have been deployed in this test facility for simulating the Solar Array, and the electrical output is logged by the SCADA system automatically. It records all the parameters including the array voltage, current, motor/pump voltage, current, irradiance level (both horizontal and tilted module surface) and temperature continuously. Solar Array have also been installed in the test facility to test the solar pumps under actual field conditions. The suction / delivery head (as well as total dynamic head) is simulated and recorded along with the flow rate and total water discharge over the day.

Test rig at NISE has the facility for testing of 0.5 hp to 10 hp ‘Solar Pumping Systems’ and the test setup has eight slots (six for testing submersible AC pumps, one for submersible DC pump- set and one for surface AC/ DC pump-sets). During the FY 2019-20, ‘Test Rig’ has been further improved for testing of more numbers

of ‘Solar Pumping Systems’ (to reduce the waiting time for the solar pump manufacturers and System Integrators). This year, 41 samples for different types of solar pumps were tested for Certification. A new, ‘State of the Art’ Test Facility is under construction near the existing test facility. However, in addition to the routine pump testing, the solar pump testing laboratory has also been utilised for developmental work of ‘Efficient Solar Pumping Systems’. Framework of new policies and guidelines as well as the improvements in testing procedure were also devised for the implementation of ‘Pradhan Mantri KUSUM (Kisan Urja Suraksha evam Utthan Mahabhiyan) Scheme’. The solar PV water pumping system test facility at NISE is shown in Figure 4.5. NISE is upgrading water pumping lab from the present capacity of testing 10 hp to 50 hp through a project “High Efficiency Solar Water Pumping Systems” funded by MNRE. The tender was floated and the evaluation has been completed.

ADVANCED SPV SYSTEM & LIGHTING LABORATORY

The solar lighting lab at NISE was established by Ministry of New and Renewable Energy (MNRE), Government of India. The Solar Photovoltaic (SPV) and Lighting laboratory is involved in performance testing and reliability of off-grid systems. The lab is



Figure 4.5 Solar PV Water Pumping Systems Test Facility at NISE

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 laboratory is proficient in testing according to these standards, (i) IESNA LM-78-07 (IESNA Approved Method for Total luminous Flux Measurement of Lamps), (ii) IES LM-79-08/IS 16106: 2012 (Method of Electrical and Photometric Measurements of Solid State Lighting products), (iii) IESNA LM-82-12 (The approved method for determining photometric properties as a function of temperature for LED light engines and integral lamps), (iv) CIE S 025/ E: 2015 (Test method for LED lamps, LED luminaries and LED Modules), (v) IESTM-30-15 (Method for Evaluating Light Source Colour Rendition), (vi) ANSI C78.377-2017 (Electric lamps- Specifications for

the Chromaticity of Solid State Lighting Products), (vii) Flicker test as per IESNA and IEEE recommendations..

Testing is also carried according to manufacturer defined technical specifications. The products include all type of lighting in solar photovoltaics (Solar Lantern, Solar study lamp, Solar Home Lighting, Solar Street lighting, etc.). In the FY 2019-20, a total of 39 industry samples on SPV lighting were tested. The solar PV based street lighting test facility at NISE is shown in Figure 4.6.

MOBILE TESTING FACILITY

NISE has developed a mobile testing set up for testing of solar PV power plant. The lab is well equipped with trained man power and world class equipment. This Mobile Photovoltaic testing facility provides in-depth analysis in the field for (i) visual inspection (ii) outdoor module testing, (iii) electroluminescence inspection



Figure 4.6 Testing of Solar Street Lights and Integrating sphere system with temperature control

of PV power plants, (iv) infra-red imaging inspection of PV power plants (v) insulation testing (vi) inverter checking in field (vii) inspection of off-grid solar applications (viii) solar water pump testing in field (ix) failure mode analysis and quantification of reliability of PV power plant (x) cost priority number estimation of PV power plant. Figure 4.7 shows the mobile test facility bus. The lab can carry out the commissioning test which includes document verification, design/physical verification and testing of the power plant. The lab is also equipped for performance guarantee test of PV power plant which includes visual inspection, string I-V Test, I-V Test of module, insulation and wet leakage testing of modules, thermal imaging, EL imaging and Inverter test.



Figure 4.7. Mobile testing facility

Other Services and Technical Support provided:

- (i) Testing of wide range of solar products.
- (ii) Developing new innovative solar products
- (iii) Guiding Industry for design and development of highly efficient solar products.
- (iv) Guiding State Nodal Agencies in implementing new solar related schemes.

QUALITY MANAGEMENT AT NISE

NISE provides testing, validation, and verification services for various Solar Photovoltaic Technology. The quality management system has a clear structure for managing lab activities as per the provisions of ISO 17025:2017. During the FY 2019-20, the NABL accreditation audit was conducted for examining

compliance with the standard. The test facilities were marked up to date with few suggestions for further improvements. The new scope of services is also proposed to be included in the existing services of the testing facility at NISE as per NABL and BIS requirements.

ACHIEVEMENTS

During the FY 2019-20, a total of 1102 samples were tested and calibrated at NISE, thereby, the total revenue of Rs. 108.30 Lakhs was generated from the testing services. The details of the samples and revenue generated are given in Table 4.1.

Table 4.1 Details of sample tested and revenue generated by the respective laboratories

S.No	Testing Samples	Quantity (Number of Samples)	Funds Generated (Rs.in lakh)
1.	Solar Photovoltaic Module	939	34.15
2.	Inverter	38	19.74
3.	Battery	23	21.32
4.	SPV Water Pumps	41	13.51
5.	LED Systems	39	17.54
6.	Solar Thermal	4	1.84
7.	Solar Cell Characterization	1	0.06
8.	Solar Radiometer Calibration	17	0.14
	Total	1102	108.30

FUTURE PROSPECTS AND DEVELOPMENT

NISE has made sincere efforts on testing and R&D on solar PV systems and applications. The division aims to enhance the capacity of testing, increase the number of testing, standard and testing protocol development, imparting training and skill development in the solar PV sector.

SOLAR THERMAL TECHNOLOGIES



INTRODUCTION

A total of almost 65,000 m² of concentrating collectors for heat production were in operation throughout India by the end of March 2020. A survey conducted by Global Solar Thermal Energy Council has placed India as 3rd fastest growing solar process heat market in 2019 and the only country in the world with highest steam cooking systems. All these milestones were achieved with the continuous research and development in the field of solar thermal technologies. The development, demonstration and testing of solar thermal systems and products is one of the core activities at NISE.

During the FY 2019-20 NISE has worked on various research and development project supported by MNRE. These activities were focused on solar thermal power/energy generation using parabolic trough, linear Fresnel reflector and central receiver technologies, use of Concentrating Solar Thermal (CST) technologies for applications related to supply of process heat, drying, cooking, space cooling and heating, water desalination and also development of hybrid system based on CST and biomass gasifier system for power generation and cooling. The development and use of thermal energy storage materials and systems is another important activity at NISE. In addition, NISE has conducted testing of different CST technologies. NISE has undertaken the following activities during FY 2019-20 in the area of solar thermal energy utilization.

COMMERCIALIZATION OF SOLAR THERMAL TECHNOLOGIES

Technological innovation is essential for the future

well-being of the country. One important aspect of that impact is its capacity to move research results from the laboratory into new or improved products and services in the open market place. The success in translating research results into practice not only accelerates the beneficial aspects of our research, but also has a major positive impact on our region's economy. NISE has been carrying out research and development activities for the development of innovative products for efficient utilization of solar energy for cooling, heating, drinking water etc. Solar Dryer cum Space Heating System, Solar Powered Cold Storage, Solar Powered Bulk Milk Cooler, Solar Powered drinking water ATM for the benefits of farmers, dairies to preserve agriculture and milk produce are few systems developed at NISE. NISE, remains fully committed at the highest levels to supporting commercialization of these innovation.

SOLAR DRYER CUM SPACE HEATING SYSTEM

NISE has designed and developed an innovative solar dryer cum space heating system with thermal storage system. The solar dryer can be used for drying of variety of agricultural and horticulture produce. NISE has successfully deployed 10 solar dryer units (5 in Leh and 5 in Kargil) on trial basis to evaluate its performance in actual field conditions in July 2018. Based on the satisfactory performance of the system, Horticulture department of J&K requested NISE to supply and install 670 units of Solar Dryers cum space heating system in Ladakh of which at present 300 systems are under installations in phase-I.

SOLAR POWERED COLD STORAGE

Solar Powered Cold Storage unit has been jointly developed by National Institute of Solar Energy (NISE) and M/s. Infocold India Pvt. Ltd. The cold storage unit runs on power generated from Solar Photovoltaic. During sunshine hours the electricity generated from solar photovoltaic is used to provide cooling to cold storage unit as well as charging in the Thermal Storage System. During non-solar hours, the cooling needs of cold storage unit are met through the stored cooling in the thermal energy storage. During the FY 2019-20, a total of 13 numbers of installations were done in the states of Assam, Orissa, Uttar Pradesh, Karnataka, and Kerala.

NISE and Ministry of Agriculture and Farmers Welfare (MoAFW) have jointly decided to undertake a few pilot scale installation in different states through Mission for Integrated Development of Horticulture (MIDH) scheme. During the FY 2019-20, NISE has completed 04 pilot installations of Solar Cold Storage Systems, one each at Horticulture Research Center Agartala, Agricultural Department Komalpur, Dhalai and Krishak Bandhu Center Gomti Udaipur in Tripura. ANERT (Agency for Non-conventional Energy and Rural Technology) has also installed a 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.

SOLAR POWERED BULK MILK CHILLER

Solar Powered Cold Storage unit has been jointly developed by National Institute of Solar Energy (NISE) and M/s. Infocold India Pvt. Ltd. The cold storage unit runs on power generated from Solar Photovoltaic panels. During sunshine hours the electricity generated from solar photovoltaic is used to provide

cooling for bulk milk cooling as well as charging the Thermal Storage System. During non-solar hours, the cooling needs of bulk milk cooler are met through the stored cooling in the thermal energy storage. NISE and M/s Infocold has also signed a Memorandum of Agreement (MoA) for carrying out pilot installations and commercialization of the system.

CONCENTRATING SOLAR THERMAL TECHNOLOGY

Potential & Application in India

Industrial energy consumption is responsible for 32 % of India's total energy consumption. A small part of energy demand is met by electricity, rest by coal, biomass, oil products and gas, indicating that a large amount of energy in the industrial sectors is used to provide thermal energy/heat. Industrial heat is characterized by a wide diversity with respect to temperature levels, pressures and production processes to meet the many different industrial process demands as shown in Figure 5.1. Energy demand of the industrial sector accounted for 42 % of the imported crude oil in 2014-15 (189.43 mil. tonnes), out of which around 30 mil. tonnes provided thermal energy at temperatures below 250 °C. It is also noticed that 1.7 % is the average annual growth of industrial heat demand until 2030. Concentrated Solar Thermal (CST) technologies can produce a range of temperatures, between 50 °C and 400 °C, which can be used in a variety of these thermal applications.

Concentrated Solar Thermal (CST) technologies track the sun's incoming radiation with mirror fields, which concentrate the energy towards absorbers, which then transfer it thermally to the working medium. The heated fluid or steam may reach high temperatures and may be used for various process heat requirements. The industries having good potential for deployment of CST technologies are food processing, dairy, paper and pulp, chemicals, textiles, fertilizer, breweries, electroplating, pharmaceutical, rubber, desalination, tobacco etc. Any industrial/

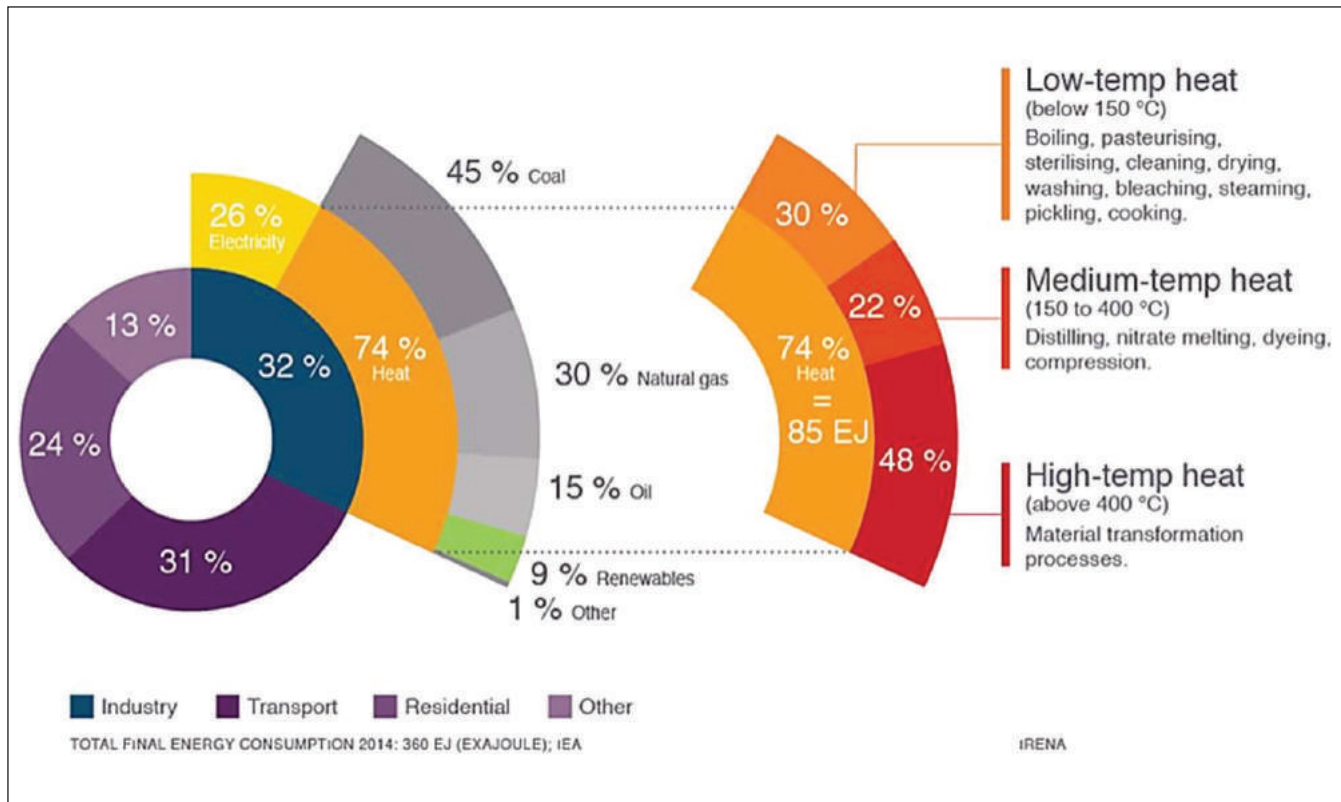


Figure 5.1: Potential of Solar Concentrated Thermal Applications

commercial establishments currently using steam/hot water for process applications can also employ CST technologies with a minimum tinkering to the existing setup.

Deployment of CST technologies have only recently started gaining confidence of the users. MNRE has identified that CST technologies have a total estimated market potential of 6.45 GWth for industrial applications in India. In order to maintain standardization among products, systems and components manufactured by various manufacturers across India, MNRE has established a state-of-art of test facility for testing and characterization of CST technologies at NISE.

A total of almost 65,000 m² of concentrating collectors for heat production were in operation throughout India by the end of March 2020 – A survey undertaken by Global Solar Thermal Energy Council places India as 3rd fastest growing solar process heat market in 2019

and only country in the world with highest steam cooking systems.

CST TEST LABORATORY AT NISE

NISE has a ‘state-of-the-art’ of test facility for testing and characterization of CST Technologies. The CST test facility at NISE can analyse thermal and optical performance of all available types of CST technologies. The schematics of the of test rig and test facility are shown in Figure 5.2 and Figure 5.3 respectively.

The CST test laboratory at NISE is first of its kind in the country. The laboratory was established with its own weather station and has the following facilities for testing of CST technologies:

1. Test facility for testing of hot water/ Steam based CST systems.
 - a) CST test rig: All available CST technology can be tested, characterized and analyzed for its

- optical and thermal performance as per BIS Standard, IS 16648 (Part 5): 2017 'Concentrated Solar Thermal - Specification Part 5 Test methods'
- b) CST system capacity of up to 25 kWth can be tested in this facility.
 - c) Weather station: Dedicated advance weather station for solar radiation measurement.
2. Mobile test facility for on-site performance evaluation of CST systems.
- a) Mobile test facility: for testing of all available CST technologies to evaluate their optical and thermal properties in the field as per BIS Standard, IS 16648 (Part 5): 2017 'Concentrated Solar Thermal - Specification Part 5 Test methods'
 - b) CST system of any capacity can be tested using mobile test facility.
 - c) Portable weather station for radiation measurement.
3. Concentrated Solar Thermal component test facility.
- a) Reflectometer: Reflectivity measurement of Concentrator.
 - b) Heat Loss Measurement: For measurement of heat loss coefficients of receiver tube.

CST TEST RIG

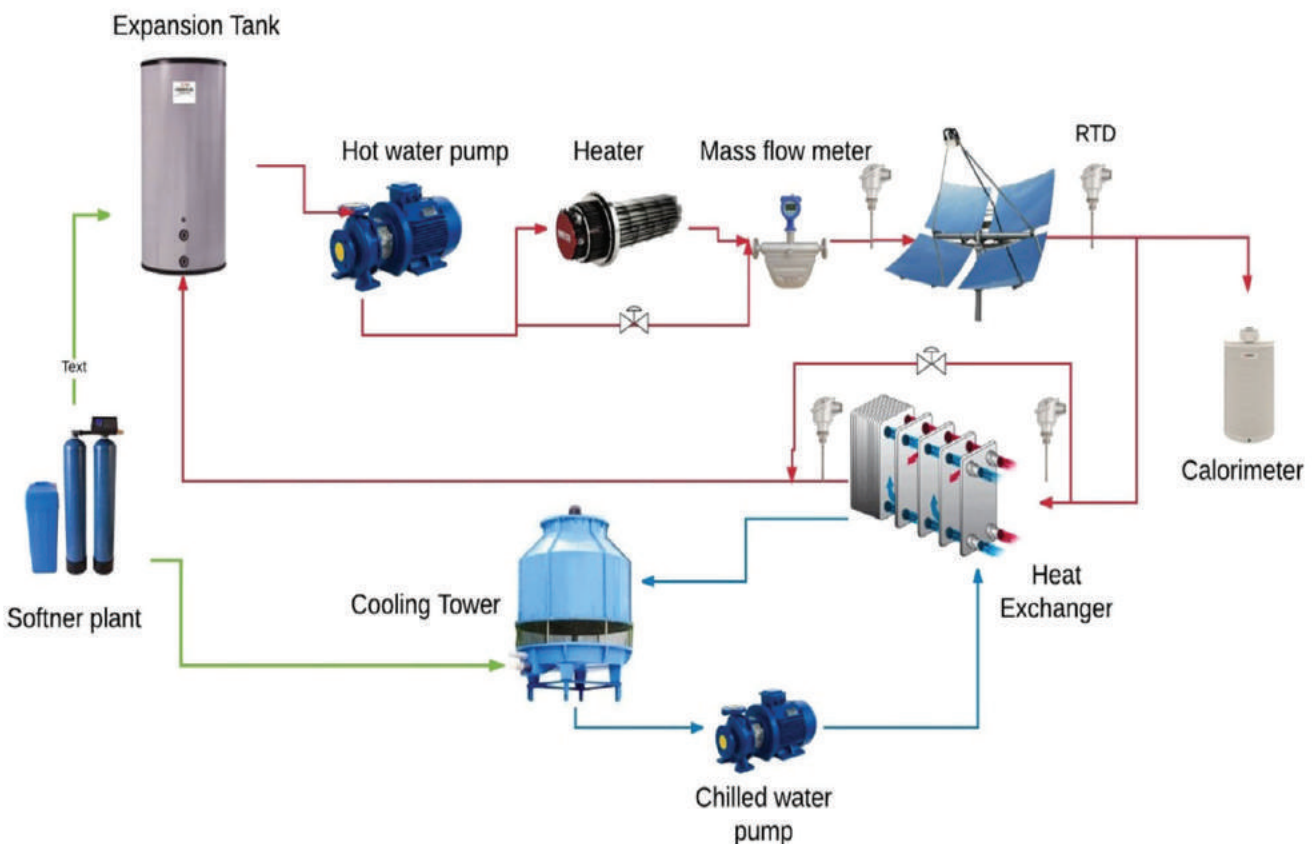


Figure 5.2: Schematic diagram of CST test rig



Figure 5.3: Test facility for testing of hot water/steam based CST systems



TESTING RESULTS OF DIFFERENT TECHNOLOGIES

During the FY 2019-20, four CST technologies were tested through mobile and immobile (CST test Rig) testing facility at NISE. Compound Parabolic Collector of 3 m², Evacuated Tube with Heat Pipe Based Solar Air Heater of 6 m², Polycarbonate Glazing Flat Plate Collector and Polypropylene based Storage Tank of 1.28 m² are some of the innovative technologies tested in this lab. The data and the results generated from the testing are also used for characterization of CST technologies which helps in further design improvements in the systems.

SOLAR THERMAL POWER PLANT (1.0 MW)

The 1.0 MWe Solar Thermal Power Plant (STPP) uses two different solar fields: Parabolic Trough Collectors (PTC) and Linear Fresnel Reflectors (LFR). The integration of these two technologies into one project makes it India's first power plant to run on two different solar thermal technologies. The pictorial presentation of the 1.0 MWe plant is shown in Figure 5.4. The plant combines the advantages of synthetic oil based Parabolic Trough Collector (PTC) field and Direct Steam Generation (DSG) of Linear Fresnel Reflector (LFR) field. The heat supplied for generation of steam is received from two different solar fields. The PTC field (aperture area of 8175 m²) supplies about

60 % (3 MWth) of the required heat, while the LFR field (aperture area of 7020 m²) supplies the balance about 40 % (2 MWth) of the required heat at design condition.



Figure 5.4 PTC Solar fields of the 1.0 MWe STPP at NISE

There were many operational and technical challenges to operate the power plant. During the FY 2019-20, NISE in collaboration with UNIDO, has carried out a joint assessment of the plant to trouble shoot the operational challenges, and to make the power plant operational. The report indicated that the plant needs a major repair and replacement of the many components of solar and power generation field for revival of the plant. At present the plant is being utilised for training and demonstration purpose.

MODULAR CENTRAL RECEIVER CONCENTRATED SOLAR POWER PLANT FOR DECENTRALIZED POWER GENERATION

NISE is implementing an R&D project entitled “Modular Central Receiver Concentrated Solar Power Plant for Decentralized Power Generation” funded by MNRE. Brief progress of the project during FY 2019-20 includes (i) repair/overhauling/refurbishment of gear motors (Azimuth), helical drive motors (Elevation), helical screws, motor drive limit switches and encoders of heliostat field. (ii) procurement and replacement of faulty PLCs and VFDs of control panel of individual heliostat. (iii) validation and operation of PLCs and VFDs installed in heliostat field (iv) manual and automatic tracking of heliostat field for dual axis tracking i.e. azimuth and elevation. (v) repair/overhauling/refurbishment of underground pipes and installation of Ethernet cables for communication between control room and heliostat field. (vi) repair/overhauling/ refurbishment of 2 Ton jib crane, blower motor drive, water pumps for water circulation through heat exchanger. (vii) coating of ceramic insulation and alignment fitting of porous mess inside the 50 kWth cavity receiver. (viii) establishing, communication protocol between software and data logger for

50 kWth receiver set up. (ix) calibration of various thermocouple sensors, flow sensors and integration with National Instrument Data Logger. (x) renovation of civil establishment for workshop and office facility. (xi) installation and commissioned of a new 100 LPH dual stage RO plant for cleaning of heliostat field. The Project Monitoring Committee (PMC) reviewed the progress on 21.11.2019 and recommended that NISE should maintain the installed facility and utilize for training and demonstration purpose by NISE. The project has been closed by MNRE on 31.03.2020.

FUTURE PROSPECTS AND DEVELOPMENT

NISE has made sincere efforts for dissemination of Solar Dryer, Cold Storage units throughout India. NISE participated in various trade shows and exhibitions and showcased the live demonstration of Cold Storage and Solar dryer units. The institute has received enquiries from various states, where a substantial potential exists for providing customized solar solutions. NISE would make endeavors for customizing the design of Solar Dryer and Solar Cold Storage to meet the requirements of beneficiaries in addition to efforts being made for design and development of Solar Desalination System and pilot installation of Solar Thermal Based Space Heating System.

HYDROGEN ENERGY

INTRODUCTION

Hydrogen is not only considered as an important energy vector in world water-energy nexus but also emerging as a clean and sustainable energy carrier, if produced from renewable energy resources. It can be used as an attractive energy storage medium for variable energy resources such as solar and wind and has the potential to solve the grid stability issues of modern power grids that are experiencing increasing penetration of solar and wind based electricity. Industries such as fertiliser and refineries have been using hydrogen for long for different applications. It is also emerging as a viable option as a reducing agent in iron and steel plants. Recognising the importance of hydrogen as a clean energy carrier, even for transport sector where the need for decarbonisation is being increasingly recognised to reduce emissions,

a hydrogen production, storage and dispensing facility operated by electricity generated from solar photovoltaic system was installed and commissioned in the campus of NISE in December, 2014 under a project supported by the Ministry of New and Renewable Energy (MNRE) by the University of Petroleum and Energy Studies. Since January, 2015 NISE has been maintaining the facility and providing hydrogen fuel to Hydrogen-Diesel dual fuel vehicles from October, 2015 onwards. This facility is equipped to support some vehicles requiring neat hydrogen for their operations.

The facility is shown in Figure 6.1. There are operational and technical challenges for the regular operation of the hydrogen facility from time to time. With a view to ensure regular operation of the facility, efforts were made by NISE to put in place a mechanism for



Figure. 6.1 Test and production facility of hydrogen at NISE

preventive maintenance of the hydrogen production cum dispensing facility by constituting a Committee of Experts to look into the matter. The Committee submitted its report to NISE and follow up action was taken by NISE to operationalize the facility. NISE has also made efforts for augmenting hydrogen supply from external sources at the facility that would help in meeting hydrogen requirement whenever in-house production is either insufficient or not available due to operational issues. However, this arrangement could not be operationalised during the period of the report.

NISE has earlier established a fuel cell laboratory in its campus with 2x1 kW and 1x2 kW Polymer Electrolyte Membrane Fuel Cell (PEMFC) along with necessary arrangement for supply of hydrogen to fuel cells using commercial bottled hydrogen.

PRESENT ACTIVITIES

NISE is implementing a new RD&D project entitled **“Setting up of a Centre of Excellence on Hydrogen Energy at National Institute of Solar Energy (NISE)”** supported with financial assistance of Rs.10.30 Crore from the MNRE. The project aims at augmenting in-house hydrogen production capacity of the existing Hydrogen refuelling facility by installing another alkaline electrolyser of 10 Nm³/hr capacity (in addition to 5 Nm³/hr capacity alkaline electrolyser) on one side and ensuring trouble free operation of the facility by covering the high-pressure facility under a preventive maintenance contract on the other side. During the period of this report, NISE finalised the specifications of the electrolyser to be procured and also invited bids through international competitive bidding process. In respect of preventive maintenance contract, an order was issued on the original equipment supplier, M/s Air Products and Chemicals, USA along with a purchase order for supply of recommended spares. NISE also invited bids for logistics support for shipment of the core of the existing electrolyser to Europe and its return after the repairs.

As desired by the Hon’ble Minister of State for Ministry

of Power and New & Renewable Energy (I/C) and Skill Development, a meeting was held in the chamber of the Hon’ble Minister on 26th July, 2019 with representative of industry and senior officials of NISE to discuss various technical issues related to hydrogen fuelled vehicles, including their cost economics.

One of the Hydrogen-Diesel Dual Fuel Vehicles, developed by Mahindra & Mahindra (M&M) in technical cooperation with Saskatchewan Research Council, Canada under an R&D project supported by the MNRE, was shown to the Hon’ble Minister (Figure 6.2). The technical features and capabilities of the vehicle were explained to the Hon’ble Minister.



Figure 6.2: Demonstration of Hydrogen-Diesel dual fuel vehicle to Sh. Raj Kumar Singh, Hon’ble Minister of State (IC) for (Power, New & Renewable Energy) & Minister of State (Skill Development and Entrepreneurship).

During the period of the report, NISE undertook preparation of a comprehensive report on **“Comparison of Electric and Hydrogen Fuelled Vehicles, including Lithium Ion Batteries and Hydrogen”** as per the directions of the Hon’ble Minister, in view of growing importance of hydrogen as an energy carrier for decarbonisation of the different sectors of the economy alongside electricity. The report was expected to help the policy makers in developing suitable policy measures for further



development and deployment of hydrogen and fuel cell-based technologies along with associated infrastructure for supply of hydrogen in the country. For undertaking the study, NISE constituted a Joint Working Group comprising the experts drawn from industry, academic institution, industry association and NISE. For preparation and finalising the report of the study, two meetings of the Joint Group were held and the draft report was ready for submission to the Hon'ble Minister in March, 2020.

In general, NISE was also engaged in having preliminary discussions for possible technical cooperation with international institutions from the France, Japan and International Energy Agency. A number of visitors from international as well as national organisations have been visiting hydrogen production cum dispensing facility at NISE. Hydrogen Energy Division of the NISE has also been delivering lectures on hydrogen production cum dispensing facility of NISE in particular and hydrogen energy and fuel cells in general for the benefit of participants attending different training programmes at NISE.

During the year, NISE was also in discussion with Bhabha Atomic Research Centre (BARC) for possible co-operation between the two organisations in the area of Hydrogen Energy.

A paper entitled "Hydrogen from Chlor-alkali Units - Role for Transport Applications in India" authored by Prakash Jha, Rudranath Sarkhel, Chandan Banerjee, A. K. Tripathi and M.R. Nouni was presented during 2nd International Conference on Recent Trends in Environmental Sustainable Development-2019 (RTESD-19) held from 17th to 19th October, 2019 at Jaipur.

FUTURE ACTIVITIES

NISE will work towards creation of a Centre of Excellence on Hydrogen Energy in its campus. NISE aim to operate and maintain its hydrogen production cum dispensing facility and increase hydrogen production capacity by setting up a 10 Nm³/hr electrolyser. This would help NISE in providing hydrogen fuel to vehicles for demonstration/field trials.

RESEARCH AND DEVELOPMENT

7

INTRODUCTION

National Institute of Solar Energy has a pool of experienced scientific and technical manpower from different parts of the country in the area of solar energy. As an autonomous institute of the Ministry of New and Renewable Energy, Govt. of India, the primary goal is to perform research and development for the development of the society. Few thrust research areas of NISE are as follows:

SOLAR PV:

- a. Performance and Reliability enhancement of solar PV applications.
- b. Engineering, Measurements & Characterization of solar PV systems.
- c. Research on solar cells.
- d. Performance modeling of solar PV systems.
- e. Grid modernization and energy system integration.
- f. Research on energy storage.
- g. Research on off-grid applications like solar water pump, lighting systems, electric vehicles, etc.
- h. Policy making and standardization.
- i. Feasibility of technology.

SOLAR THERMAL :

- a. Performance mapping and characterization of solar thermal systems.

- b. Research on low & high-temperature applications.
- c. Engineering, Measurements & benchmarking of solar thermal systems.
- d. Research on Poly generation, desalination, and other related topics.
- e. Research on thermal energy storage.
- f. Research on space heating applications.
- g. Feasibility of thermal technology.
- h. Policy making, testing protocol, and standardization.

HYDROGEN ENERGY:

- a. Research on hydrogen production & dispensing
- b. Application of hydrogen energy in transportation

As an R&D institute, NISE intends to meet the current and future requirements in the solar energy sector through sustainable development. The research and development is focused on the need of society. Product-based research would be more beneficial and have to ensure economic feasibility, reliability, and efficiency. NISE performs research in the field of solar energy applications to cut down the cost along with enhancing reliability.

ONGOING RESEARCH AND DEVELOPMENT PROJECTS

Details of various research and development projects being carried out at NISE are given in Table 7.1.

Table 7.1. Details of ongoing R&D projects.

Sl. No.	Project	Funding Agency	Status
R&D Solar PV			
1	<p>“Development of high efficiency (21%/ 19%) PERC type of c-Si/mc-Si solar cells”.</p> <p>A joint project between NISE and BHEL for developing PERC type solar cells with benchmark efficiencies in the country.</p>	MNRE	Ongoing. Procurement of equipment is almost completed. The cell development is in progress.
2	<p>“All India Survey of PV module”</p> <p>A joint project between NISE and NCPRE, IITB for doing the reliability analysis of PV modules across various locations in India.</p>	NISE & IIT B	Report published
3	<p>“High-Efficiency Solar Water Pumping Systems”</p> <p>NISE has collaborated with different stakeholders to develop new and improved models of solar water pumping Systems under this project.</p>	MNRE	Ongoing. Tender process completed. Installation of test rig and development of efficient controller in progress.
4	<p>“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”</p> <p>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.</p>	DST	Ongoing. Installation of set up is in progress.
5	<p>“Performance analysis of bifacial solar PV modules”</p> <p>An in-house project of NISE for doing the performance and reliability analysis of bifacial PV module.</p>	NISE	Ongoing. Tender process completed.
6	<p>“PV Back sheet performance analysis through sequential testing as per IEC 61215 and customized test conditions”</p> <p>An inhouse project with DuPont, a back sheet manufacturer company to analyze the performance of different back sheets of different make.</p>	NISE & DuPont	Ongoing. MoU signed between the industry partner. Initial measurements are going on.
7	<p>“Optimization of parallel row spacing between the PV array of solar power plant”</p> <p>An inhouse project on the performance enhancement of PV power plant.</p>	NISE	In Progress
8	<p>“Comparison of NOCT and NMOT temperature”</p> <p>An inhouse project on the comparison of NOCT and NMOT temperature and its use in performance modelling</p>	NISE	In Progress
9	<p>“Performance evaluation of a solar module under wind load stress”</p> <p>An inhouse project on the reliability analysis and testing condition design for PV module</p>	NISE	In Progress

Sl. No.	Project	Funding Agency	Status
10	“UV radiation effect on the performance of the PV module” An inhouse project on the reliability analysis of PV module under UV radiation	NISE	In Progress
11	“Making improvements in the I-V test set up for solar cells” An inhouse project on the designing of rig for testing of solar cell	NISE	In Progress
R&D - Solar Thermal			
12	“Solar Dryer cum Space Heating System” An inhouse project for drying of agricultural products and sor space heating during winters	NISE	Product developed and commercialized.
13	“Designing of Solar Based Space Heating” Inhouse research on development of the possible solutions for the space heating system in Ladakh and other Himalayan regions	NISE	In Progress
14	“Design Improvements and Deployment of solar (SPV) Cold Storage with Thermal Storage” Collaborative project with an industry on Solar Cold Storage with integration of solar photovoltaic and thermal storage system for 24x7 operation.	NISE	Product developed and commercialized.
15	“Solar Powered Bulk Milk Cooler using Thermal Storage” Collaborative project with an industry on powered bulk milk chiller with integration of solar photovoltaic and thermal storage system for 24x7 operation	NISE	Product developed and commercialized.
16	“Modular Central Receiver Concentrated Solar Power Plant For Decentralized Power Generation” Project for power generation using central receiver concentrated solar power technology.	MNRE	Closed

PROJECT ON PERC SOLAR CELL DEVELOPMENT

Research and development project supported by MNRE, entitled “Development of high efficiency (21 % / 19 %) PERC type of c-Si/mc-Si solar cells,” is being implemented jointly by NISE and BHEL ASSCP. This project involves the development of PERC type solar cells with benchmark efficiencies in the country. The BHEL-ASSCP has the responsibility of carrying out entire processing while NISE has the responsibility of test and characterization of materials and devices. The major activity in the PERC project was to

determine the course of action for the procurement of special process and testing equipment. The capital equipment such as Plasma Enhanced Chemical Vapour Deposition (PECVD) vacuum system, Laser Scriber and Diffusion Furnace etc. for process development have been commissioned at BHEL. The unit process optimization trials for diffusion and laser contact opening is in progress and rear and front dielectric layer optimization using PECVD is also in progress. NISE has established a laboratory space of 140 sq. m, Class 100K (ISO Class 8) clean room - “Advanced PV Characterization Laboratory” in the Aditya Bhawan for housing the test and characterization equipment

under a single roof. NISE has initiated the procurement of all components of the test & characterization equipment such as Spectral Response Measurement System (QE-SRMS), Spectroscopic Ellipsometer, Electrochemical Capacitance Voltage (ECV) Profiler, Optical Microscope, Surface Profilometer, Semi-Automatic Four Probe resistivity meter and Field Emission Scanning Electron Microscopy (FESEM) with EDS of which Spectral Response Measurement System (QE-SRMS), Optical Microscope and Spectroscopic

Ellipsometer have been procured. The operation of Spectroscopic Ellipsometer is shown in Figure 7.1.

The procurement of some equipment like Electrochemical Capacitance Voltage (ECV) Profiler, Surface Profilometer, Four Probe Resistivity System, Field Emission Scanning Electron Microscopy (FESEM) with EDS is in progress. The supporting service utilities such as Compressed Dry Air, N₂ Ar gas, and gas manifold has also been initiated at NISE for the above equipment.



Figure 7.1 Scientist operating Spectroscopic Ellipsometer in the Advanced PV Characterization Laboratory

All India survey of PV modules installed in the country

In the FY 2019-20, NISE, in association with NCPRE, IIT Bombay published a report on the study on the performance of Solar Photovoltaic Modules installed at different parts of India in different climatic

conditions. This study was conducted based on specific parameters such as voltage output, current output, power degradation, etc. The distribution of degradation rate of crystalline silicon PV module is shown Figure 7.2 and comparison between degradation rates under hot and cold climatic zones is shown in Figure 7.3.

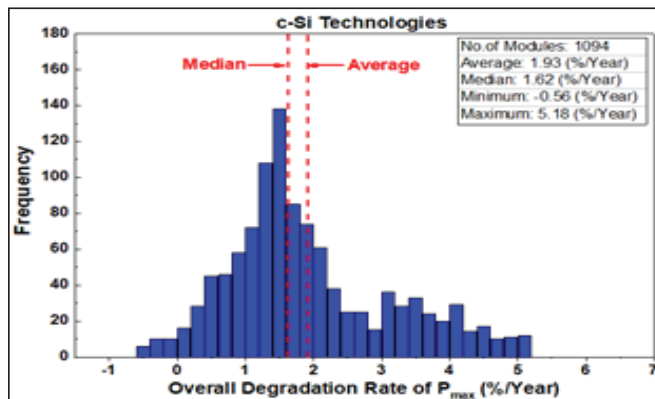


Figure 7.2 Histogram of Overall and Linear Pmax Degradation Rates (%/year) for c-Si technologies only

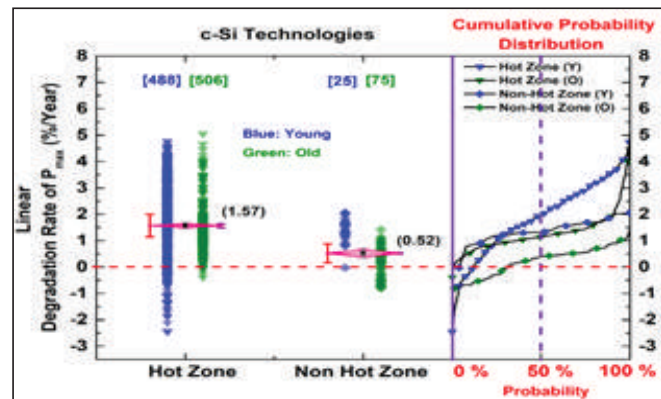


Figure 7.3 Comparison between degradation rate under hot and cold climatic zones Figure

Based on the field observations, analysis, and results of the 2018 All-India Survey, the report recommends the following :

- ✿ Due diligence should be exercised while selecting and procuring modules.
- ✿ The tender specifications need to be much more elaborated than currently being used.
- ✿ Owners and installers of power plants should be vigilant about “overrating” malpractice.
- ✿ Field-based electroluminescence (EL) study should be performed
- ✿ PID observed in the installed PV power plant
- ✿ ‘Hot’ climates present a harsh operating environment for PV modules.
- ✿ Modules and sites perform very well in the ‘Cold & Sunny’ climate of Ladakh.
- ✿ The quality issues seen especially in the young modules are the result of aggressive pricing and timelines and improper handling/installation.

DESIGN AND DEVELOPMENT OF HIGH EFFICIENCY SOLAR WATER PUMPING SYSTEMS

MNRE has sanctioned an R&D Project to NISE to design and develop “High-Efficiency Solar Water Pumping Systems”. NISE is executing the project in close co-ordination with the Motor, Pump, and Controller manufacturers and the developers. NISE has selected five organizations (involved in the manufacturing and development of motors, pumps, and controllers) to develop new and improved models of ‘Solar Water Pumping Systems’. Development work is under progress. NISE would soon start testing (and development work) with the updated samples to be provided by these parties. Based on the guidance and feedback from NISE, the samples would be further modified, and ‘High Performance Solar Pumping

Systems’ shall be developed and demonstrated at NISE campus. A new ‘state-of-the-art, Testing and R&D Facility’ for Solar Water Pumping Systems is being developed. A survey of the existing ‘Test Facilities for Solar Water Pumping Systems’ in the country was carried out. Based on the feedback, detailed specifications, and drawings for the proposed “Test Facility” were prepared. Construction of the ‘Test Facility’ is under progress. Development of “High Efficiency Solar Water Pumping Systems” will result in the development of an efficient & reliable ‘Solar Water Pumping System’ with improvement in performance, and makes it ‘Cost Effective’. This would essentially mean an additional benefit to the farmers.

SUPPLY OF CLEAN DRINKING WATER THROUGH SOLAR-POWERED STATION AT FARIDPUR

It is a collaborative project between NISE and M/s Saurya EnerTech Pvt Ltd. funded by DST. The objectives of this project are -

- ✿ Provision of clean drinking water to people of village Faridpur, district Gurgaon while keeping a completely sustainable water cycle and energy requirement in the forefront
- ✿ Augmentation of the water table to the extent of supporting the usage of water through rainwater harvesting
- ✿ Demonstrate through the pilot clear and replicable method of provision of clean drinking water to large size village/ small towns where both water and energy are not available.

The other stakeholder of this project are PHED and Gram Panchayat. PHED Gurgaon is responsible for providing drinking water to the inhabitants of the district. PHED is providing borewell and site land for implementation of the project.

End users are the residents of village Faridpur. The Gram Panchayat has passed a resolution that

they shall be maintaining the plant after project completion through a village water committee. It would be responsible for deciding the price of water

to be charged, the collection of money and overall management. Figure 7.4 shows the image from the clean drinking water project from Faridpur.



Figure 7.4 PV module installed for the clean drinking water project

OPTIMIZATION OF PARALLEL ROW SPACING BETWEEN THE PV ARRAY OF SOLAR POWER PLANT

While designing and installation of the PV power plant, the spacing between the array, is done by calculating the shadow length on winter solstice and experience-based assumptions. The optimization of parallel row spacing will increase the energy density of the PV power plant. In this work, annual shadow length variation were estimated for different spacing behind the module and the change in effective irradiance was observed. Seasonal maximum shadow length and cast pattern was found out experimentally for 1m, 1.2 m, 1.3 m, 1.4 m, 1.5 m array spacing corresponding to radiation below 500 W/m² (Figure 7.5). Yearly energy loss percentage with and without shadow for different spacing within the array has been computed and found that the payback period of solar power plant with 1.5 times spacing and 1.4 times found to be almost similar. Hence, this can be concluded that the inter-row spacing for the solar power plant can also be taken as 1.4 times of the height of the module from the ground. However, this value depends on the geographical location and technology of the PV module.

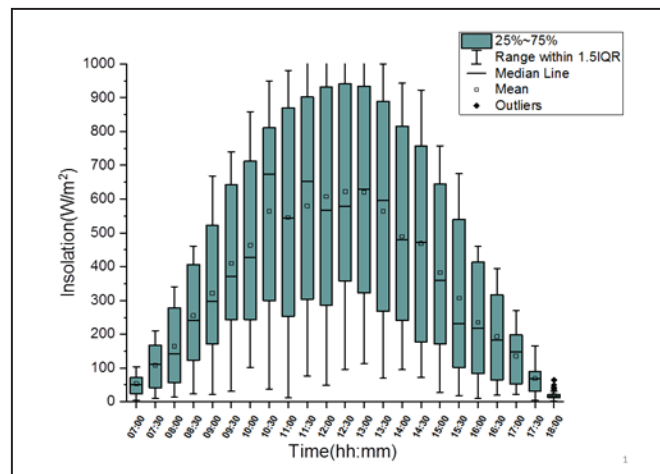


Figure 7.5 Timewise distribution of solar radiation for a particular month at NISE

COMPARISON OF NOCT AND NMOT TEMPERATURE

Nominal Operating Cell Temperature (NOCT) is a simple parameter to distinguish the thermal performance of one PV module design from another. Nominal Module Operating Temperature (NMOT) is the field parameter indicating the PV module temperature at field conditions. A study has been done on the comparison of NOCT and NMOT temperature for different module technologies in the composite climate of India. It has been observed that there is at least 100C

variation in the NOCT and NMOT temperature value on different days. Figure 7.6 shows wind speed v/s

$$\frac{\text{Irradiance}}{\text{Module temperature-Ambient Temperature}}$$

for multi crystalline silicon technology modules.

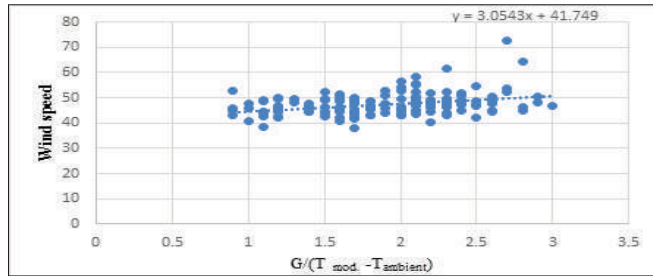


Figure 7.6 Wind speed vs. Irradiance/ (difference in module temperature and ambient temperature)

PERFORMANCE EVALUATION OF A SOLAR MODULE UNDER WIND LOAD STRESS

In this study, the behavior of module under wind load stress for two different cities Delhi and Mysore has been analyzed. For Delhi, wind load stress beyond the 2400Pa and for Mysore under the 2400Pa is used for study. It was observed that wind stress over the modules are different for different zones of India. The existing static mechanical load stress as per IEC 61215 is not sufficient for actual pressure in different climatic zones. Test set up and EL results after mechanical load testing of PV module is shown in Figure 7.7.

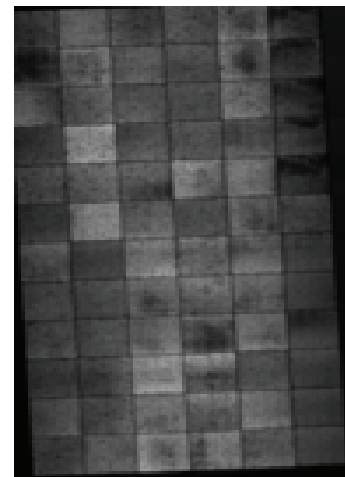
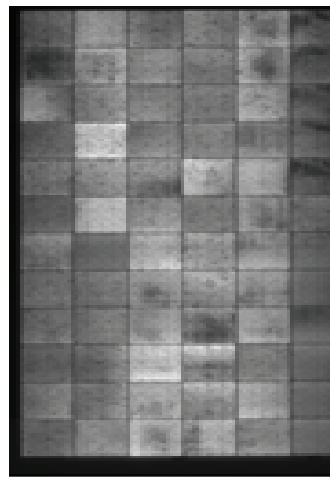


Figure 7.7. Mechanical load tester and EL image of PV module before and after stress

UV RADIATION EFFECT ON THE PERFORMANCE OF THE PV MODULE

A study has been carried out on the accelerated testing conditions of UV of the PV module. The UV stress for different climatic zones has been estimated and found that the testing condition, as per IEC 61215, is not sufficient for the field. An indoor UV exposure test has also been done to investigate the consequence of UV radiation on the performance of the PV module.

MAKING IMPROVEMENTS IN THE I-V TEST SET UP FOR SOLAR CELLS

The I-V test set up for solar cells at NISE had a contact

probe system, developed in-house a couple of years ago, meant for a maximum of four bus bars in a commercial solar cell. With upgradation in solar cell technology, the number of bus bars has gone up to five and six in a commercial solar cell measuring 156 mm x 156 mm. This called for making necessary changes in the set up by developing a new contact probe system for an increased number of bus bars. Simultaneously, design changes were also made in the new set up for reduced shadowing, application of uniform and controlled probe pressure on cells, and ensuring improved alignment of probes with the bus bars on solar cells. The upgraded I-V test set up for solar cell is shown in Figure 7.8.

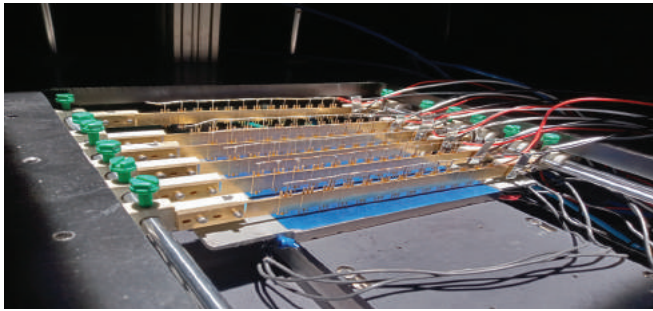


Figure 7.8. Upgraded I-V Test set up for Solar Cell

PERFORMANCE ANALYSIS OF BIFACIAL SOLAR PV MODULES

A bifacial PV module is capable of generating power from the solar light falling on both the front and rear sides. It's the responsibility of NISE to study the performance and reliability of these types of modules whose market share is increasing significantly in recent times. NISE has planned a project to study the bifacial modules in the field conditions and its comparison with the mono facial counterparts. NISE will also do the feasibility analysis of the Agro-Photovoltaic power plant using the bifacial module. The tendering process of this project has been completed.

PV BACKSHEET PERFORMANCE ANALYSIS THROUGH SEQUENTIAL TESTING AS PER IEC 61215 AND CUSTOMIZED TEST CONDITIONS

This is a joint project between NISE and DuPont to analyze the PV backsheet as per different accelerated testing conditions. A comparison will be done of different backsheets of different compositions under UV, humidity and temperature conditions. The climatic conditions of India are very harsh to the PV module, to find out suitable PV backsheets for Indian climate, the result of this project will be of immense help. An MoU between NISE and DuPont has been signed and initial measurements are going on under this project.

RESEARCH & DEVELOPMENT IN SOLAR THERMAL DIVISION

NISE has carried out R&D activities to further develop and demonstrate their three products; solar drier cum

space heating system, solar powered cold storage with thermal storage system and solar powered bulk milk cooler with thermal storage system. These innovative products developed in-house are utilized for providing services in cooling, heating and drying application in niche areas. The target users of these products are farmers and these products are expected to help them in storing milk and preserving their agriculture produce. These R&D projects undertaken at NISE were self-financed and implemented in collaboration with industrial partners.

SOLAR DRYER CUM SPACE HEATING SYSTEM

NISE has indigenously designed and developed an innovative Solar Dryer cum space heating system with a thermal storage system and applied for grant of Intellectual Property Right (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. The system can heat incoming air up to 60 °C above ambient ($\Delta T=60$ °C), thereby making it ideally suited for many agriculture drying applications. The solar air heating system may provide all of the heat during a sunny day or act as a pre-heat system during cloudy conditions. For cold regions like Ladakh, where ambient temperatures during winters drop to -20 °C, the system can be used for space heating purpose thus keeping inside temperatures of homes and offices comfortable during harsh winters. The system is modular and can be installed in any size and numbers as per the requirement of drying and space heating.

NISE has successfully installed and commissioned 10 numbers of solar dryer units (5 in Leh and 5 in Kargil) on trial basis to evaluate performance in actual field conditions in July 2018. NISE has 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 which are noted below:

- (i) Re-circulation mechanism has been provided for efficient utilization of heat energy and better air flow moments inside the chamber.
- (ii) Mesh size of trays reduced to 5 mm from 20 mm making it suitable for drying of smaller agro products such as sea buckthorn, leafy vegetables, seeds etc.
- (iii) Weight of the trays has been reduced up to 50% by using mesh based design. This makes the handling (loading and unloading) and reshuffling easier.
- (iv) Joints, ducting and valve mechanism has been

- improved to withstand higher temperature and making it plug and play connections.
- (v) Baffle design trays for better air flow movements inside the chamber.
- (vi) Blower motor place outside for longer life and avoid damage due to hot air. Outlet of blower made in a conical shape for reducing pressure drop at exit of blower.
- (vii) Optimize the insulation of drying chamber and ducting pipes.

The simulation results of Fluid dynamics analysis done for dryer chamber of the solar dryer are shown in Figure. 7.9.

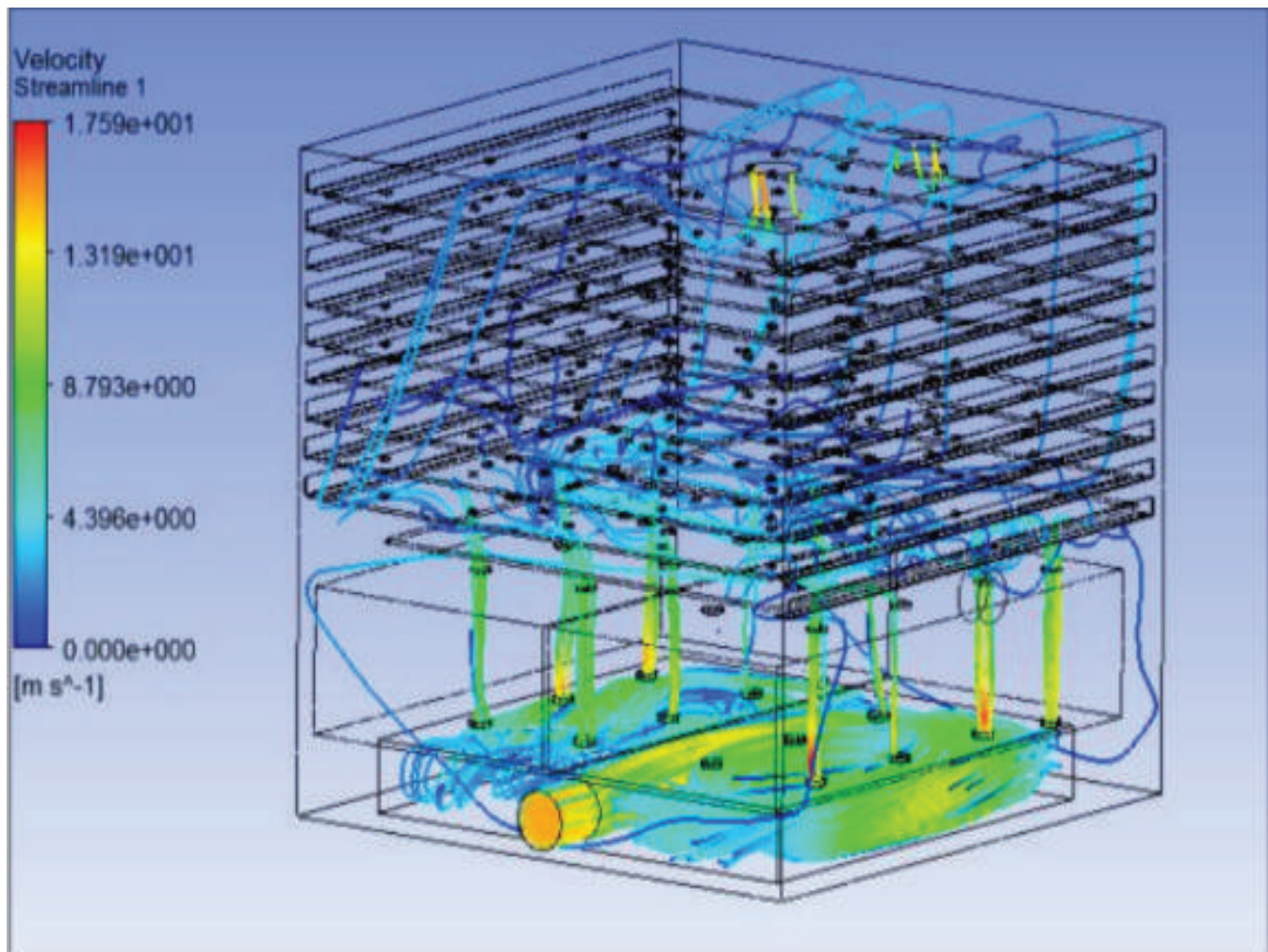


Figure. 7.9 Computational Fluid Dynamics Analysis of Drying Chamber for Solar Dryer



Figure. 7.10 Experimental Testing of Solar Dyer

NISE has tested the improved solar dryer for its performance by experimental testing (Figure 7.10). Based on the satisfactory performance of the improved designed system, Horticulture Department of J&K has requested NISE to supply and install 300 units of Solar Dryers in Leh and Kargil Districts of J&K on turnkey basis. NISE has taken-up the e-tendering and successfully completed the evaluation process for supply of 300 system in July 2019. Thereafter, NISE has started deploying 300 units of solar dryer out of which 150 units were supplied in Kargil district and 150 units in Leh District during the FY 2019-20. The installation is in progress in Leh and Kargil region (Figure 7.11).



Figure. 7.11 Photograph of Solar Dryer cum Space Heating System installed in Ladakh

DESIGNING OF SOLAR BASED SPACE HEATING

National Institute of Solar Energy (NISE) has been carrying out research and analysis work for the development of the possible solutions for the space heating system in Ladakh and other Himalayan regions. Study and Analysis has been carried out for various designs, such as solar thermal based heating

using water as heat transfer medium, solar thermal based heating using air as heat transfer medium, solar PV and heat pump based technology, heat storage technologies for off sunshine working etc. NISE has carried hourly simulations of 8760 hours in a year using software, Ground station and satellite based solar resource data and performance analysis tool.

Heat load calculation of the offices is carried out through manual calculation. An excel calculator has been developed for determining the heat loss calculation from the house/building. The dimensions, material specifications and other data available through local sources and literature have been used for calculating the heat loss from the house/building. Heat Load calculation of army shelter is carried using manual calculation, Loop-CAD software and SAM Software. The dimensions, material specifications and other data provided by DRDO-DIHAR has been used for calculating the heat loss from the army shelter. The climate data from SRRRA station and SAM has software has been used for the calculation purpose. NISE has carried out the designing of radiant floor heating system for the said the project (Figures 7.12 and 7.13). Thermal analysis of the system was done on the Loop-CAD software. Experimental room was divided into zones.

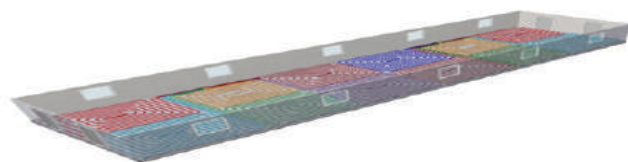


Figure. 7.12 3-D view of designed solar space heating solution (Radiant Floor Heating)

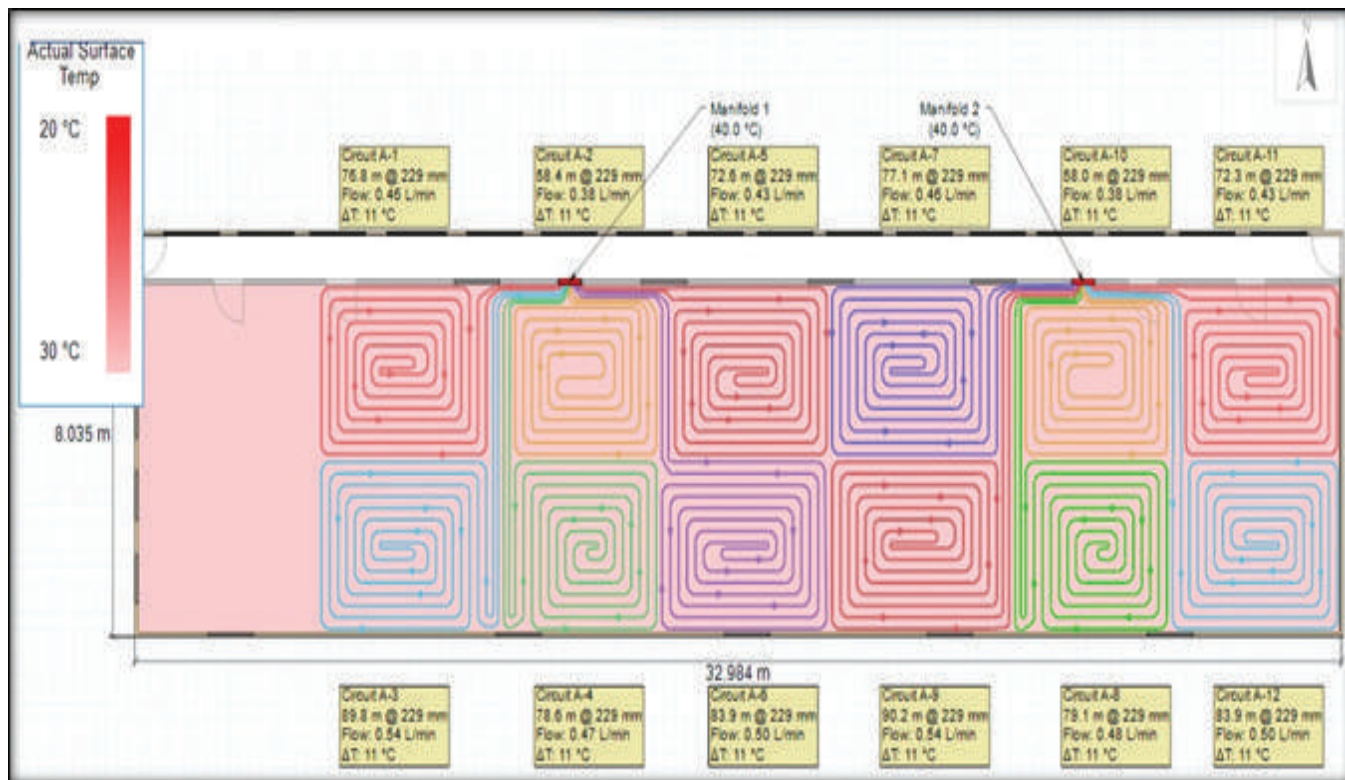


Figure 7.13 Thermal Imaging of the Radiant Floor Heating Solution

DESIGN IMPROVEMENTS AND DEPLOYMENT OF SOLAR POWERED COLD STORAGE WITH THERMAL STORAGE

NISE has implemented Solar Cold Storage project in collaboration with an industry during the FY 2019-20 and made few improvements. The technology offers integration of solar photovoltaic and thermal storage system for 24x7 operation of cold storage. Cold storage is one of the crucial requirements to reduce post-harvest losses in agriculture and horticulture sector. The solar cold storage can be used for various application such as short term farm level storage, long term farm level storage, fruit ripening, small food processing centres, retail/mandi storage and cold storage cum kiosk.

The electric energy generated by solar photovoltaic panels directly powers a variable speed compressor. These compressors use low GWP refrigerant with an option of using zero GWP refrigerant. Speed

of the compressor is directly proportional to the instantaneous solar radiation. The compressor generates cooling, which is stored in the form of ice inside the thermal energy storage system. When solar energy is low or not available, cooling in the cold storage is provided by the Thermal storage system (TSS). Cooling from the TSS to the cold storage is provided through a refrigerant loop, which is the key differentiating feature of systems that has never been used before. Such a refrigerant loop allows the use of a traditional refrigerant based evaporating unit that enables the cold storage to achieve as low as 3 °C temperature with only ice as an energy storage medium. A small electrical battery is used for providing power to the fans of evaporating unit and overall system controller. The entire system can be switched over to grid in case of extended non-solar / cloudy days. The overall system architecture and components is shown in Figure 7.14 and 7.15.

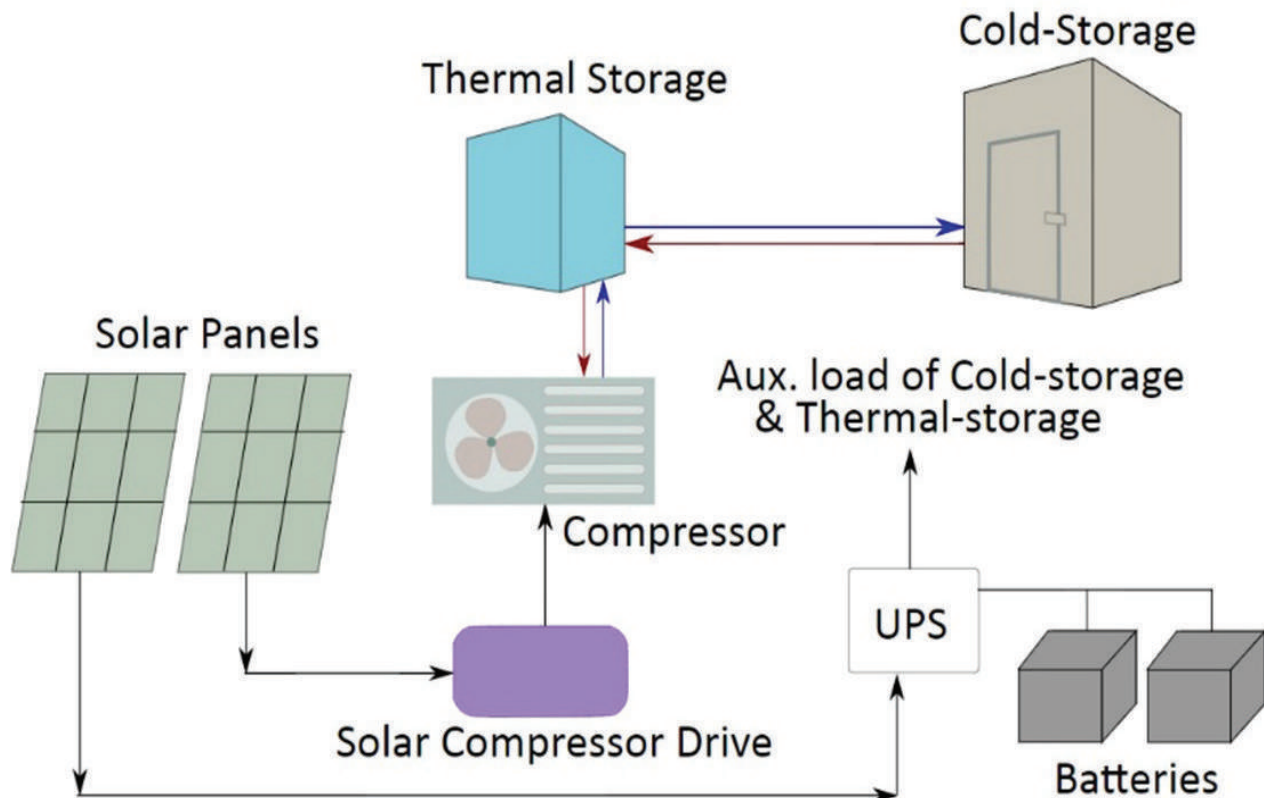


Figure. 7.14 System architecture OF SOLAR Cold Storage with thermal Energy Storage Backup

System Improvements:

- Design improvement has been carried out in solar controllers for reducing the surge loads and total harmonic distortions.
- The cooling performance of the system has been improved which has increased the daily pre-cooling capacity of fresh commodity to 1250 – 3000 kg from earlier capacity of 700 kg.
- Design of thermal energy storage system has been improved by changing the cooper coil arrangements which has doubled its cooling storage capacity to 200 MJ.
- The cold storage units has been configured into standard hi-cube 20 feet and 40 feet ISO marine grade shipping containers which enhances the life and durability of the products.
- The container based design prevents the possible water leakage that can occur in an outdoor installation with a bare bone modular PUF panel based cold storage units.
- The system has been made portable with factory installed BOS for easy transport and installation without anyneed of civil construction at site.
- The cooling performance of the system has been improved which has increased the daily pre-cooling capacity of fresh commodity to 1250 – 3000 kg from earlier capacity of 700 kg.
- Design of thermal energy storage system has been improved by changing the cooper coil arrangements which has doubled its cooling storage capacity to 200 MJ.

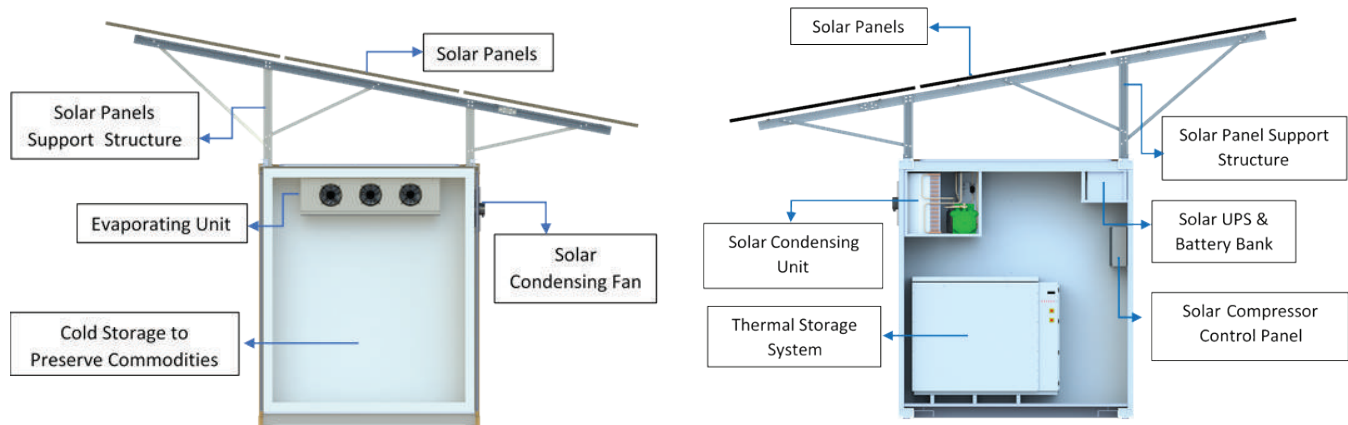


Figure. 7.15 Major components of Solar Powered cold storage system – Front and backside sectional view

DEPLOYMENT OF SOLAR COLD STORAGE IN THE FIELD

National Institute of Solar Energy (NISE) in association with the industry has installed seven numbers of solar cold storage systems in FY 2019-20 at locations as

given in Table 7.2. Photographs of system installed at different location in India is shown in Figure 7.16. The system is now commercially available in the country.

Table 7.2. Details of cold storage systems installed by NISE at various locations in India.

Organization	No. of Systems	Capacity in Metric Ton (MT)	Installed locations
Directorate of Horticulture & Soil Conservation, Department of Agriculture, Govt. of Tripura	3	6	Agartala, Tripura
Agency for Non-conventional Energy and Rural Technology (ANERT), Government of Kerala	1	5	Kozhikode, Kerala
Wildlife conservation center	2	5	Mathura, Uttar Pradesh
SELCO Foundation	1	5	Gokarna Temple, Gokarna, Karnataka



Figure. 7.16 Photographs of cold storage system installed at different locations across India

DATA ANALYSIS OF SOLAR COLD STORAGE

The performance of the system is regularly monitored and studied from the systems installed at Tripura and Kerala. The performance graph for various parameters such as cold room temperature, Thermal energy storage charge level, compressor running frequency etc. are shown in the Figure 7.17 and Figure 7.18. For the testing it has been observed that the system has

worked completely on Solar Energy independent of grid during the testing period. It was found that Thermal Storage System (TSS) was maintained at 70 to 100 % level throughout the testing period. The system has operated smoothly during the testing period. Day time cooling is provided through direct cooling mode and cloudy/night time cooling is provided through TSS. The whole operation is completely automated with no manual intervention.

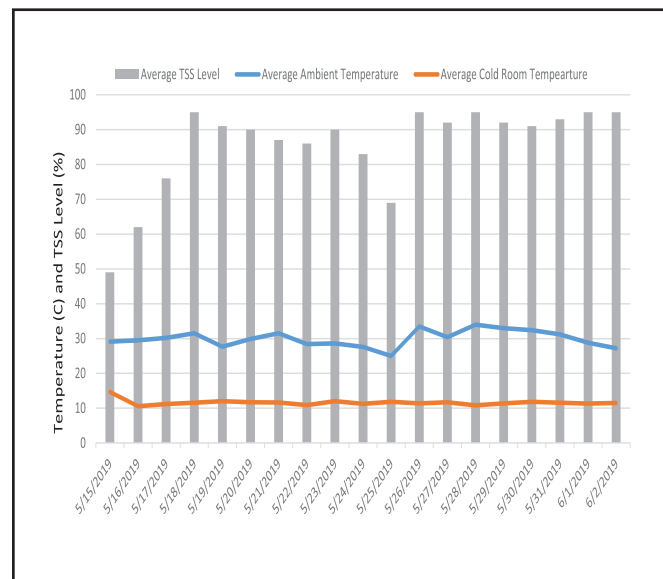
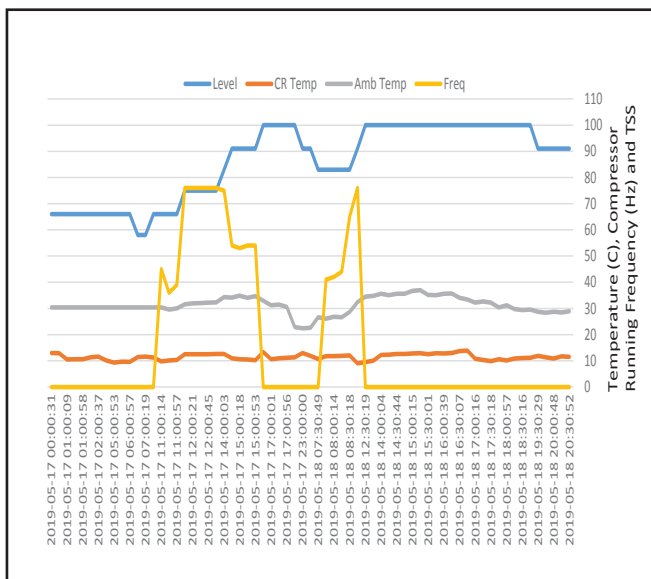


Figure. 7.17 Performance Data of the system installed in Tripura

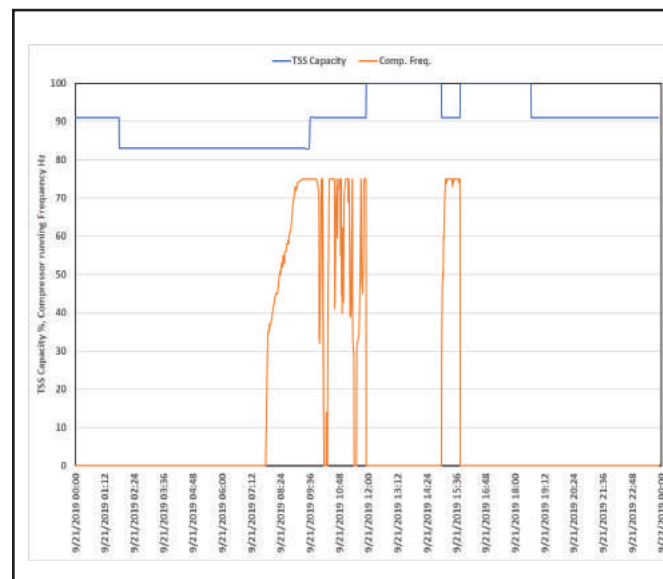
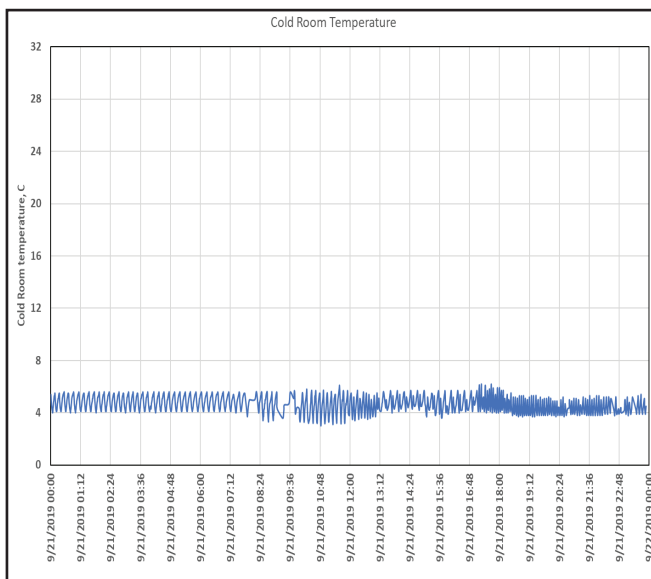


Figure. 7.18 Performance Data of the system for system installed in Kerala

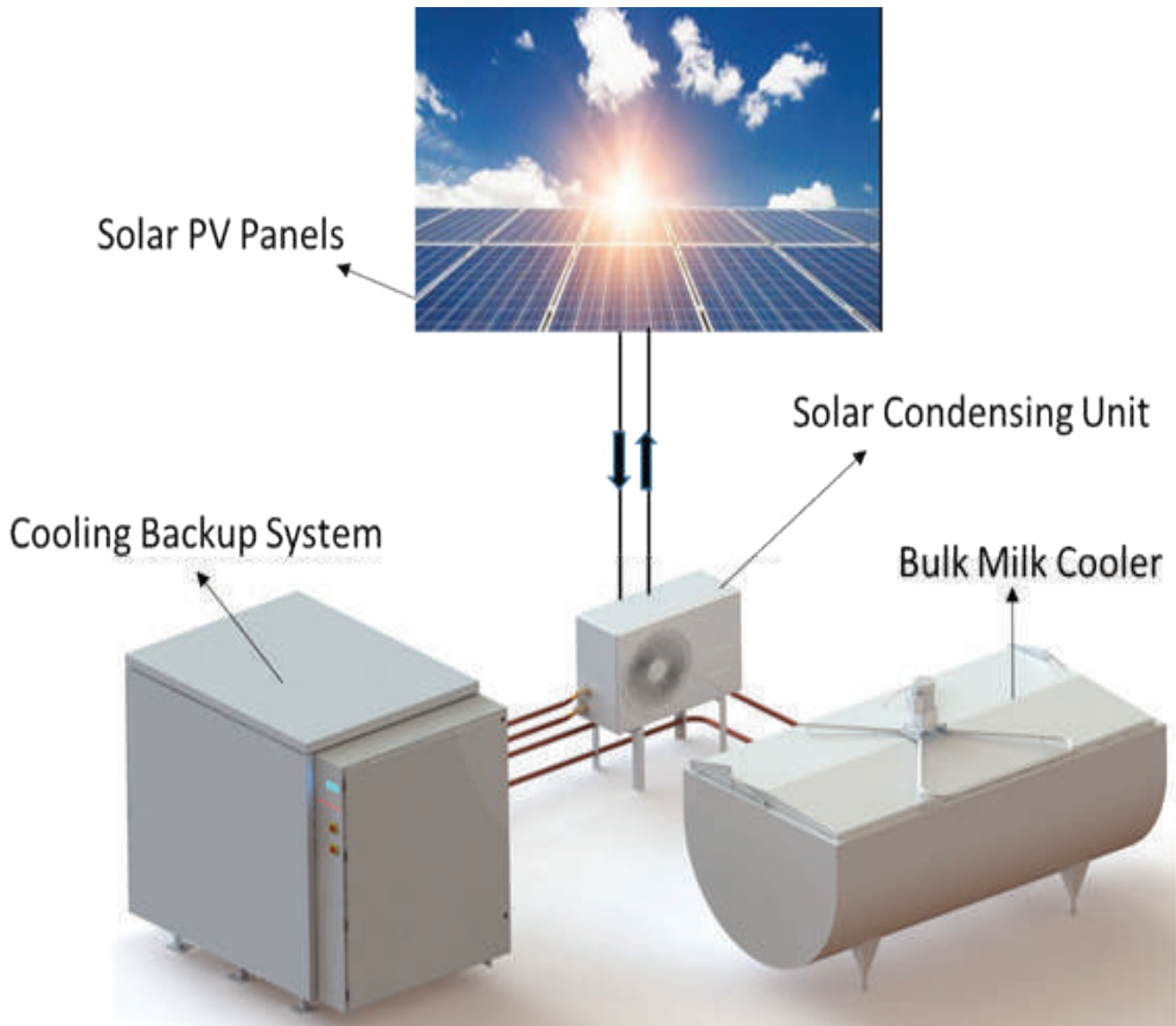


Figure. 7.19 Solar Photovoltaic Based Bulk Milk Chiller with instant milk chiller

System Improvements (Bulk Milk Chiller):

- ✱ Design improvements has been carried out in solar controllers for reducing the surge loads and total harmonic distortions.
- ✱ The cooling performance of the system has been improved by introducing Plate Heat Exchanger

(PHE) for reducing the milk cooling time to 2.5 hours. Figure 7.19 shows the layout of a Bulk Milk Chiller with instant milk chiller.

- ✱ Design of thermal energy storage system has been improved by changing the cooper coil arrangements which has doubled its cooling storage capacity to 200 MJ.

DEMONSTRATION OF SOLAR COLD STORAGE AND SOLAR DRYER IN VARIOUS EXHIBITIONS

Innovative solar products developed by NISE have been demonstrated in various national level exhibitions recognized by (i) Ms.Harsimrat Kaur Badal

Union Cabinet Minister of Food Processing Industries during Organic Food Festival 2020 held on 21-23rd February 2020 at JLN Stadium, Delhi and (ii) North East Trade Facilitation Fair 2020 held on 28th February 2020 at Guwahati. Images from the exhibitions are shown in Figure 7.20.

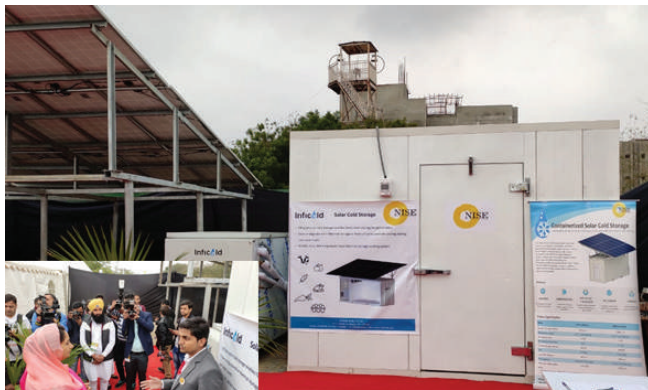


Figure 7.20. Demonstration of solar cold storage

MODULAR CENTRAL RECEIVER CONCENTRATED SOLAR POWER PLANT FOR DECENTRALIZED POWER GENERATION

NISE is implementing an R&D project entitled “Modular Central Receiver Concentrated Solar Power Plant for Decentralized Power Generation” sanctioned by MNRE. The following activities were performed to meet the objective of the R&D projects.

Heliostat Field:

- (i) Repair/overhauling/refurbishment of 12 nos. of gear motors (Azimuth), 12 nos. of helical drive motors (Elevation), 12 nos. of helical screws, 24 nos. of motor drive limit switches and encoders, adjustment of 12 nos. of shaft joints of heliostat field.
- (ii) Procurement and replacement of faulty PLCs and VFDs of control panel of individual heliostat.
- (iii) Validation and operation of PLCs and VFDs installed in heliostat field.

- (iv) Manual and automatic tracking of heliostat field for dual axis tracking i.e. Azimuth and Elevation.
- (v) Repair / overhauling / refurbishment of underground pipes and installation of Ethernet cables for communication between control room and heliostat field.

Receiver:

- (i) Repair/overhauling/refurbishment of 2 Tons capacity of jib crane, one blower motor drive, 3 nos. of water pumps for water circulation through heat exchanger.
- (ii) Coating of ceramic insulation on 50 kWth receiver.
- (iii) Fitting and alignment of porous mesh inside the cavity of 50 kWth receiver.
- (iv) Assembly of the complete 50 kWth receiver set up.



Figure. 7.21. Various O&M activities at Modular Central Receiver Power Plant

Control System:

- (i) Established communication protocol between Lab View programming and PLCs for field control and LabView programming and National Instrument Data Logger for 50 kWth receiver set up.
- (ii) Calibration of various thermocouple sensors, flow sensors and integration with National Instrument Data Logger.
- (iii) Control Room: Repair/overhauling/refurbishment of UPS, 3 Phase power supply, Main control panel, 3 nos. of server for heliostat field control, power tower receiver control and other software and simulation.

Photographs of the Various O&M activities and operation at Modular Central Receiver Power Plant is shown in Figures 7.21 and 7.22. This R&D project has

been closed by MNRE and the facility is being utilized for the training and demonstration purpose.



Figure. 7.22. Preliminary operation of 50 kWth receiver.

R & D PROJECT CO-ORDINATION

NISE contributes to the establishment and supervision of research and development activities in renewable energy technologies. NISE represents a pivotal role in the evaluation, monitoring, validation, and technical documentation of solar photovoltaic and solar thermal R&D projects. NISE has been coordinating various research activities of MNRE pertaining to solar photovoltaic cells, water pumping systems, different solar technologies, etc. NISE collaborates with National/International research institutions, other Central/State Government organizations, and industries for implementation of various R&D projects in renewable technology. To monitor the progress of ongoing R&D Projects in Solar PV sanctioned by the Ministry of New and Renewable Energy (MNRE), a meeting was held on 23rd September 2019 at NISE. The details of 14 projects were presented and reviewed by technical committee in this meeting.

SHAPING FUTURE WITH INNOVATION

Continuous innovations and discoveries are happening in solar energy technology right from the efficiency enhancement in the generation to improvements in energy utilization as well as the storage. As the World is moving towards an eco-friendly future, NISE intends to play a significant role in developing more and more affordable and reliable solar energy technologies to harness the maximum from nature. NISE intends to focus on the following major areas of innovative R&D work.

- ✿ Quantum dot mediated energy transfer solar cells: Using different size of quantum dot it is possible to transfer the radiative and non-radiative energy to silicon nano-structures as well as these nano-structure based solar cells. This process enhances efficiency by up to 30 %. NISE is planning to work in this type of solar cell.
- ✿ Silicon micro-wire assisted radial junction solar cell: Radial junction allows separation of charge carriers

with short distance travel, so the recombination of carriers reduces. That allows using of the low-grade silicon wafer to achieve moderate efficiency at a low cost. Radial junction also decouples light absorption direction and photo-generated charge carrier separation direction. Soon, NISE will extend research and development in this area.

- ✿ Heterojunction solar cell with Transition Metal Oxide transport layers: The doping phenomenon in solar cell fabrication is not only expensive but also detrimental in case of performance. By using different Electron Selective Layer (ESL) and Hole Selective Layer (HSL) of various Transition Metal Oxides (TMO), the doping process can be eliminated. The ESL and HSL have to perform two major roles of passivation and selectivity. Passivation is achieved by reducing the recombination at the interface of the selective layer and absorber. At the same time, selectivity is achieved by tuning the Fermi level so that the built-in electric field can separate the charge carriers. These heterojunction solar cells can achieve an efficiency near the Shockley–Queisser limit. NISE is planning to work in this type of solar cell.
- ✿ Recycling of PV module: NISE is planning to work on recycling of PV module after its lifetime. We need to study about the different possible PV recycling processes for solar modules to create new pathways for PV waste management industry development. A robust and transparent regulatory framework is also required to develop to support the recycling of PV module.
- ✿ Reliability enhancement of PV systems for Indian climatic conditions: The climatic conditions of India is very harsh for the PV module in the field. For enhancing the reliability of the PV component in the field conditions, accelerated testing conditions should be designed as per field conditions. NISE is already working in this direction, and further study will be added.



- ✿ Reliability analysis on lithium ion batteries: NISE intends to work on the testing, performance characterization and reliability analysis of Lithium ion batteries and its applications in electric vehicles.
- ✿ High efficient solar water pumping system: NISE is working on high efficient solar water pumping system. NISE proposes to design, performance evaluation system of this pump as per different conditions of India.
- ✿ Grid instability due to PV sources: The stability of the grid will be a significant issue soon for Indian grid due to injection of power from renewable sources. NISE intends to perform R & D work on this for sustainable development.
- ✿ Development of hybrid System: As of today, standalone and Grid connected solar PV system are well developed, however, the optimum energy utilization as well as energy security can be provided only by hybrid PV systems. These proposed hybrid systems can share power from any available renewable resources as well as share the power from grid with storing power in Battery. These systems mainly play vital role in agriculture-based ecosystems and help the propagation of PV technology in rooftop PV system.
- ✿ Development & upgradation of hydrogen fuel cell facility & outreach activities: NISE intends to upgrade the R&D facility of hydrogen generation

and dispensing system. The collaborative work with other research institute of the different part of the world will be carried out.

- ✿ Development and analysis of off grid solar applications: NISE intends to work on the development of off grid solar applications in different field. Based on the requirement of the society NISE will carry out the development and analysis of the product.
- ✿ Large aperture parabolic trough solar collector: NISE intends to work on the development of cost effective large aperture parabolic trough collector to lower the levelised cost of electricity.
- ✿ Design and development of solar powered desalination system: To fulfill the basic need of the clean water for everyone, NISE will work to provide the economical desalination solution which can reach to masses.
- ✿ Performance evaluation of thermal energy storage: The storage of the energy harnessed from the sun is one of the most important parameter to lower the cost of the solar thermal systems and also to provide the reliable and uninterrupted energy supply. NISE will work on the development of the facility to evaluate the performance of the thermal energy storage.

The above research work will be carried out with funding from various agencies in collaboration with relevant academic institutes and industry partners.

SKILL DEVELOPMENT & CAPACITY BUILDING

8

INTRODUCTION

National Institute of Solar Energy extends capacity building opportunity for skilling up young minds across the world. The organisation empowers people by conducting skill development programmes, training, short term courses, client specific courses on solar photovoltaic technology. The proposed mandate enable to meet the challenges, maintain quality and upgrade itself in this competitive environment.

NISE has organised various technical training programs for both National and International participants. The training curriculum launched for various training programmes were developed, scrutinized and duly improved by industry experts, renowned professors and professional experts. NISE considers this as an opportunity to contribute to the world's pressing needs and link its potential individual to prospective employer.

During the year, NISE has imparted trainings to wide variety of Government Departments, Schools, Colleges, Armed Forces, Nodal agencies and Public Sector Undertaking companies through short term training courses specifically devised according to the need of the participants. Additionally, International training programs were also organised for active growing solar environment and sustainability. The photographs of the participants of various trainings are shown in Figures 8.1 and 8.2. In the FY 2019-20, newly developed training courses were introduced for enhancement of knowledge sharing. A total of 21 numbers of national and international level

training courses were conducted in which 514 participants were imparted trainings. The state-wise details of the Suryamitra Training Programs for the FY 2019-20 is given in Table 8.1. The details of the Training Program conducted at NISE for the FY 2019-20 is given in Table 8.2.

NISE offers highly motivated individual an opportunity to contribute in latest research, learn testing of solar photovoltaic technologies and improve their skills through internship at the institute. The students are considered for internship based on their professional and academic background. NISE encourages women candidates to join in the field of solar dominion. The students, for internship, are enrolled for a minimum period of three months. The students here are trained to gain experience and work in a varied environment.

SURYAMITRA SKILL DEVELOPMENT PROGRAM PAN INDIA BASIS

The Suryamitra Skill Development Programme was designed with an objective to develop a skilled and employable workforce (Suryamitras) for catering to the needs of Solar PV industries and EPC projects. These participants were trained to perform jobs related to Installation, Commissioning and Operation & Maintenance of a Solar PV system in EPC projects. Further, on completion of the training program, Suryamitras were offered positions such as technician, supervisor, and managers in Solar PV organizations and also an opportunity to emerge as an entrepreneur in the Solar PV Industry. During

the FY 2019-20 , a total of 16,074 Suryamitras were trained to develop skilled manpower in the field of solar photovoltaic system. A glimpse

of Suryamitra Training program conducted at various affiliated institutes in India is shown in Figure 8.1.



Figure 8.1 Suryamitra Training Programme conducted at various affiliated institutes in India

Table 8.1. The State-wise progress of Suryamitra Skill Development Programme

Progress of Suryamitra Training Programme				
S.No	State/UTs	No. of Suryamitra trained till 31.03.2019	No. of Suryamitra trained during 01.04.2019 to 31.03.2020	Total Suryamitras as on 31.03.2020
1	Andhra pradesh	1308	488	1796
2	Arunachal Pradesh	30	0	30
3	Assam	833	561	1394
4	Bihar	1139	568	1707
5	Chandigarh	148	90	238
6	Chhattisgarh	1227	778	2005
7	Delhi	432	240	672
8	Goa	174	117	291
9	Gujarat	2136	856	2992
10	Haryana	937	480	1417
11	Himachal Pradesh	324	120	444

Progress of Suryamitra Training Programme				
S.No	State/UTs	No. of Suryamitra trained till 31.03.2019	No. of Suryamitra trained during 01.04.2019 to 31.03.2020	Total Suryamitras as on 31.03.2020
12	Jammu & Kashmir	244	306	550
13	Jharkhand	517	269	786
14	Karnataka	1371	363	1734
15	Kerala	495	240	735
16	Lakshadweep	30	0	30
17	Madhya Pradesh	2522	1616	4138
18	Maharashtra	2933	1275	4208
19	Manipur	150	0	150
20	Nagaland	60	0	60
21	Orissa	1766	511	2277
22	Puducherry	62	0	62
23	Punjab	323	84	407
24	Rajasthan	2006	1116	3122
25	Tamil Nadu	2142	1132	3274
26	Telngana	1914	1401	3315
27	Tripura	148	30	178
28	Uttar Pradesh	2608	1604	4212
29	Uttrakhand	680	263	943
30	West Bengal	2433	1566	3999
	Total	31,092	16,074	47,166



Figure 8.2 Armed Forces Participants for five days skill development program on “Renewable Energy Technologies”

Table 8.2. Skill development programs conducted at NISE during FY 2019-20

S No.	Program	Number of Programs	Duration of Programs (Days)	Date	Number of Participants
1	Solar PV System Design using "PVSYST & PVSOL" Software with cost Economic and Policies	3	5	22-26 July 2019.	12
				04-08 November 2019.	17
				03-07 February 2020.	17
2	Workshop on Start-up India Skill Development program	3	5	10-14 June 2019.	42
				15-19 July 2019.	30
				17-21 February 2020.	18
3	RE Training Program for Armed Forces	1	5	13-17 January 2020.	41
4	Advance Solar Professional Course	1	180	13 August 2019 12 February 2020	20
5	International Training Programs	7	21	12-30 August 2019	40
				16 Sep - 04 Oct 2019	33
				04 – 22 November 2019	21
				25 Nov – 13 Dec 2019.	29
				6-24 January 2020.	33
				10 –28 February 2020.	30
02-20 March 2020.	27				
6	Solar Analytics	1	5	4-8 November 2019.	18
7	Training Program for Industry & PSU/ ONGC Military Engineering Service (MES) \ Power Finance Corporation Ltd (PFC)	2	3	29 Jan - 01 Feb 2020	15
				17-19 February 2020	16
		1	5	23-27 September 2019	14
				25-26 February 2020	17
				26-27 February 2020	24
	Total	21			514

SOLAR PV SYSTEM DESIGN USING “PVSYST & PVSOL” SOFTWARE WITH COST ECONOMICS AND POLICIES

A sustainable solar solution and appropriate financing of a solar PV System depends upon the solar PV system design and its simulation. This training program foresees to enable an individual to design and analyse a PV system. The participants are given knowledge

regarding 3D simulation, 3D modelling, calculation of production and economic profitability, etc. During the year, NISE organised three training programmes for PV SYST and PV Sol Software training and a total of 46 participants were qualified through this program. Figure 8.3 shows the participants of Solar PV System Design using “PVSYST and PVSOL” Software with cost economics and policies.



Figure 8.3. Participants of Solar PV System Design using “PVSYST and PVSOL” Software with cost economics and policies.

START-UP IN SOLAR ENERGY TECHNOLOGIES

NISE has organised many start up training programmes in solar energy technologies and has trained entrepreneurs, EPC contractors, Engineers, Govt. Officials etc. across the country. This course

provides implementation methodologies, latest market strategies, new trends and technology concept, financing, business strategies etc. NISE has conducted three workshops on prospects of solar energy technologies. Figure 8.4 shows the participants of Start-up Training program conducted at NISE.



Figure 8.4. Participants of Start-up Training program conducted at NISE

SOLAR ANALYTICS PROGRAM

NISE has commenced a new skill development training program on solar analytics. This programme demonstrates solar plant data analysis applying descriptive analytics, diagnostic analysis, predictive analysis assessing the plant condition, real time analysis of data applying machine learning principles.

This Solar Analytics programme aims at developing Centre of Excellence (CoE) on analytics for organization as well as developing skills for managing the same. The five days skill development programme was organized in Nov 2019 at NISE in which 18 participants actively participated. The participants of Solar Analytics Training Program is shown in Figure 8.5.



Figure 8.5. Participants of Solar Analytics Training Program

TRAINING PROGRAM FOR INDUSTRY & PUBLIC SECTOR UNITS

NISE has designed & conducted training programs for industry and organisation according to their field job knowledge and prospective requirements. These customised programs are developed for an organisation for development of skills, knowledge of solar technologies, market and update information of present technology in solar field. This training program covered various sectors of Solar Energy i.e.

start-up India scheme, solar photovoltaic applications, business model for solar in Industry, opportunities for entrepreneurs in solar sector etc. During the FY 2019-20, NISE has conducted training programmes for ONGC, Military Engineering Services (MES) and Power Finance Corporation (PFC). A total of 31 participants from ONGC 14 participants from MES and 51 participants from PFC participated in this program. Figures 8.6 to 8.8 show the participants of ONGC, MES & PFC participated in Training program conducted in NISE.



Figure 8.6 (i) and (ii). Participants of ONGC for Training Program conducted at NISE



Figure 8.7. Participants of Military Engineering Services (MES) for Training Program conducted at NISE



Figure 8.8. Participants of Power Finance Corporation (PFC) for Training Program conducted at NISE

INTERNATIONAL TRAINING PROGRAM

The Skill Development Division at NISE organizes and conducts various International training programs for delegates from different countries under International organisations (groups) politically connected to India, viz. Indian Technical and Economic Cooperation (ITEC), India –Africa Forum Summit (IAFS-III) and International Training Program for International Solar

Alliance (ISA). The International Training Division plays a central and collaborative role within an institution by leading and facilitating visits of these international delegates and educating them on Renewable Energy and Solar Technologies. The countries such as Afghanistan, Bangladesh, Cambodia, Cuba, Sudan, South Africa, Algeria, Ghana etc. participated in the training program.

The primary objective of these training programs is to appraise the participants with the latest developments about Solar Technologies, Policy Aspects, Quality Control and Utilization Aspects of Renewable Energy. These training programs also helped them to understand the possibilities of bilateral and multilateral cooperation in the field of

solar energy projects. The program enhanced the technical capabilities of the participants and imparted knowledge of the Global trends on Solar Technology by exchange of information. These programmes are fully funded by Ministry of External Affairs of Govt. The details on International Training Program concluded during the FY 2019-20, are given in Table 8.3.

Table 8.3. International Training Program Concluded during Financial Year 2019-20.

S. No.	Program Name	Period	No. of Participants	No. of Countries
1.	International Training Programme on Solar Technologies and Applications	16th Sep – 04th Oct 2019	33	19
		25th Nov – 13th Dec 2019	29	21
		02nd Mar - 20th Mar 2020	27	14
2.	ITEC Programme in Solar Energy for Master Trainers from ISA Member Countries	04th Nov – 22nd Nov 2019	21	12
		06th Jan – 24th Jan 2020	33	15
		10th Feb – 28th Feb 2020	30	15
3.	Renewable Energy Capacity building program for India Africa Forum Summit III	12th Aug - 30th Aug 2020	40	12
Total			213	108

* IAFS: India-Africa Forum Summit,

Renewable Energy Capacity Building Programme for Delegates from African Countries under India –Africa Forum Summit (IAFS-III). This programme under India-Africa Forum Summit (IAFS-III), was fully funded and supported by Ministry of External Affairs, Govt. of

India. A total 40 participants joined the course from 12 African Countries (Figure 8.9). During the program, the participants visited different sites on solar pumping and rooftop solar projects in different cities of India.

International Training Programme of Solar Energy



Figure 8.9. International Training program on “Renewable Energy Capacity Building” under India- Africa Forum Summit (IAFS) -III

Technologies and Application under Indian Technical Economic Co-operation (ITEC)

Every year NISE organizes, three weeks Indian Technical and Economic Co-operation (ITEC) programs fully funded by Ministry of External Affairs, Govt. of India.

Under these programs, 89 participants participated from 54 countries around the world in three batches (Figure 8.10). It also brought in mutual knowledge under development in the field of Solar Energy around the world.



Figure 8.10 Participants of International Training Programme of Solar Energy Technologies and Application under Indian Technical and Economic Co-operation (ITEC)

INTERNATIONAL TRAINING PROGRAMME FOR INTERNATIONAL SOLAR ALLIANCE (ISA)

This program was conducted for various ISA member countries. NISE successfully organized and completed

five programs for 84 participants from 42 ISA member countries. Figure 8.11 shows the participants of International Training Programme supported by International Solar Alliance (ISA).



Figure 8.11 Participants of International Training Programme supported by International Solar Alliance (ISA).

**ADVANCED SOLAR PROFESSIONAL COURSE
(6 MONTHS) COURSE CODE: NISE/010/2017-18**

The “Advanced Solar Professionals Course” has been one of the many flagship program. It is a job oriented and technologically advanced training program. The course profile covers the solar energy concepts for creating the solar entrepreneurs. The course has been designed with 30% theory sessions and 70% practical sessions which include classroom lecture, practical, field visit, industrial visits, lab visits, internship, project profiles –Business Entrepreneurship etc.. The students

have to undergo NISE internal exams and final assessment & certification by NISE at the end of the program. The class infrastructure / facilities and highly qualified and experienced faculty for all the subjects on solar PV, thermal and entrepreneurship impart quality training. During the year, batch of this course starting from 13th August 2019 to 12th February was organised. A total of 20 candidates were shortlisted as per their qualifications and experiences. Figure 8.12 shows the participants of Six Months Advanced Solar Course with eminent faculty and scientist.



Figure 8.12 Participants of Six Months Advanced Solar Course with eminent faculty and scientist.

INTERNSHIP FOR STUDENTS

Apart from various training programs, NISE has conducted internship training programs for B.Tech/M. Tech/MSc/Ph.D. students on solar energy technologies every year. For the FY 2019-20, there were ten B. Tech and nine M. Tech students from reputed institutions. These trainees were involved in research and testing activities for their research projects at NISE.

CENTRE OF EXCELLENCE IN THE FIELD OF SOLAR ENERGY AND HIGHER LEARNING

NISE is setting up a Centre of Excellence (CoE) in collaboration with Power Sector Skill Council (PSSC), Schneider Electric Foundation India (SEFI) and National Skill Development Corporation (NSDC) for the high end learning in the area of power and solar sector. The centre aims to provide state of the art equipment and



facilities with a focus to provide training in the area of electricity, automation and solar energy related aspects. The centre shall design and deliver Training of Trainers, Instructors and Training of Assessors and high end programs in the area mentioned above. In this regard an MoU has been signed between NISE, PSSC, SEFI and NSDC on 24th October 2019. As per the MoU, CoE will operate from the NISE premises for which NISE shall provide the 4000 Sq. ft area. The space needed is to accommodate class rooms, labs, Director and Co-Director's office and conference rooms etc. The facilities so developed will also be available for NISE to utilize as per their program and requirement.

FUTURE PROSPECTS AND DEVELOPMENT

NISE intends to introduce new structured courses such as data analytics, design and development of power electronics, converters and on training programs in solar using machine learning and artificial intelligence. NISE shall organise International Training programs with enhanced practical trainings and structured modules. Furthermore, in the forthcoming year, NISE has planned extensive courses on solar thermal technologies. NISE also plans to organise on-line trainings in future.

OUT REACH ACTIVITIES

CUSTOMER SERVICE CELL

Customer Service Cell (CSC) is centrally responsible for management of testing, calibration and consultancy services in National Institute of Solar Energy. CSC enables its customers to avail testing services from online portal available at NISE website. This testing portal allows easy access for selection of testing services, payment and release of reports. NISE offers comprehensive range of testing services (IEC, BIS, MNRE specifications etc.) that facilitates testing as per National /International standards for various solar energy products and their components. In this financial year, all personnel including the newly recruited Scientists in NISE were ISO 17025:2017 certified, ensuring quality, better administration and technical operations.

Consultancy for testing of various solar products is one of the revenue generating wing. Testing protocols for various tests are under formulation. To maintain high customer satisfaction, CSC follows industry standards & processes, and periodically collect feedback to continuously improve and set higher standards of service.

NISE offers world class testing and calibration services through its various labs i.e. Solar Cell Testing Lab, ii) Solar PV Module Testing Lab; iii) Solar Inverter Testing Lab; iv) Battery Testing Lab; v) Solar Water Pump Testing Lab; vi) Solar Light /LED Testing Lab; vii) Solar Thermal Systems Testing Lab, viii) Calibration Lab.

CSC is a gateway to avail testing, calibration and consultancy services through all the above listed labs. CSC caters to all possible needs of customer

from the application stage to test progress and report handling. CSC has also proactively taken various quality interventions in its operations and to improve services of various labs.

CONSULTANCY SERVICES

NISE offers various consultancy services to projects in Solar Photovoltaic & Solar Thermal Technologies. The consultancy division provides specialized services to its clients in designing and offers excellent solutions to various stakeholders i.e. facility owners, Investors, Financial Institutions, Armed forces, Banks, EPC Contractors, Independent Power Producers (IPP), Project Developers, Service Providers and Insurance Firms interested in assessing the performance of Solar PV Power Plants.

SERVICE BASED CONSULTANCY SCOPES

- a. Vetting of Technical specifications/ documents and Tender.
- b. Yield assessment.
- c. Field/Plant testing of MW scale SPV Power Plants.
- d. Final power plant acceptance Test.
- e. Pre-Commissioning and Post- Commissioning Checks.
- f. Visual Inspection, EL and Thermography and Workmanship check.
- g. Quality Checks on PV System.
- h. Performance Trouble shooting

SOLUTION BASED CONSULTANCY SCOPES

- ✿ Preparation of Tenders.
- ✿ DPR preparations of the Solar Power Plants.
- ✿ Feasibility Study of the Solar Power Plants.

- ✿ Project planning.
- ✿ Solar Resource assessment.
- ✿ Design of Customized solutions.
- ✿ PV system Design (PVSYST and PVSOL)
- ✿ Technical Consultation on Solar based demonstration facilities.

NISE has started on site testing of large scale Solar Photovoltaic Projects for quality and performance of Solar Plants. Technical experts from NISE were involved in the testing and commissioning of the 750 MW REWA Ultra Mega Solar project (Figure 9.1). The team of technical experts renders advice to their clients on various technical parameters found during on site testing, this enables the clients to take the appropriate measures to improve the plants performance. NISE has also supported ISA Member Countries i.e. Ghana, Peru, Guyana through International Solar Alliance (ISA) for deployment of Solar Power Projects. NISE has vetted design & drawing documents of more than

12 MW SPV Power Plant in FY 2019-20 at different locations and many are in pipe line for next coming years. The different consultancy services provided by NISE in FY 2019-20 generated a revenue of Rs. 45.5 Lakhs, as per details given in Table 9.1.



Figure 9.1. The 750 MW REWA Ultra Mega Solar project.

Table 9.1: Consultancy Services provided by NISE during 2019-20

S. No.	Project Capacity in (MW)	Major Scope
1	1 MW (MES, Nagpur Project)	Vetting of the Tender document, Design and Drawings documents. Technical Inspection and Testing at field.
2	1 MW (MES, Chakeri Project)	
3	1 MW (MES Ojhar Project)	
4	1.5 MW (Air Force ProjectLeh)	
5.	500 KW (Air Force Station, Deoli, Nagpur)	
6.	600 KW (MES Bamrauli)	
7.	450 KW (MES Meerut)	
8.	100 KW (NCS Vishakhapatanam)	
9.	2 MW(MES Meerut)	
10.	4 MW(MES Meerut)	
11.	750 MW REWA Ultra Solar Power Project	Testing and Commissioning Services.

COORDINATION & INTERNATIONAL COLLABORATIONS

10

One of core functions of NISE is to develop and coordinate national and international collaborations. This facilitates for mobilizing partnerships and galvanizing efforts of different institutes/ organisations to work towards national and global research challenges. NISE partners with government, academia, entrepreneurs and non-profit organisations for partnering and accelerate the growth of renewable energy technologies. NISE seeks to provide highly specialised services for developments and agreements. The partnering provides access to new innovations, technical expertise and support for projects. It acknowledges the large-scale implementation of projects while maintaining its quality and enhancement.

NISE has worked with various such organizations for training, business and product development. The partnership has accelerated into new agreements and assignments. These opportunities have licensed for execution of various products in the market and further fostering for the expansion of renewable energy technologies.

MOU'S SIGNED BY NISE

In the FY 2019-20, NISE has established its partnerships with esteemed organizations by signing 19 MoUs. During the year, 3 MoUs were signed with international organizations and 16 with various National organizations (Table 10.1). MOU signing with GERMI Gandhinagar and Shri Mata Vaishno Devi University, J&K are given in Figures 10.1 and 10.2.



Figure 10.1. NISE Exchanging MoU with GERMI, Gandhinagar



Figure 10.2. NISE Exchanging MoU with Shri Mata Vaishno Devi University, J&K

Table 10.1: MoUs signed during FY 2019-20

S. No.	Organisation	Date of Signing
International Organizations		
1.	United Nations Industrial Development Organization (UNIDO), Vienna, Austria	7th August, 2019
2.	Memorandum of Agreement between NISE & CEA-INES, France on cooperation in Hydrogen Technology	22nd August, 2019



S. No.	Organisation	Date of Signing
3.	PTB Germany	26th November, 2019
National Organizations		
4.	GERMI, Gandhinagar	8th April, 2019
5.	Ruchi Telecom Private Limited, New Delhi	15th May, 2019
6.	University of Lucknow, Lucknow	4th July, 2019
7.	RGPV, Bhopal	9th July, 2019
8.	National Productivity Council (NPC), New Delhi	24th July, 2019
9.	Ministry of New & Renewable Energy (MNRE)	25th July, 2019
10.	Shri Mata Vaishno Devi University, J&K	2nd August, 2019
11.	Gautam Buddha University, Greater Noida	29th August, 2019
12.	MeghnadSaha Institute of Technology (MSIT), Nazirabad, Kolkata	23rd September, 2019
13.	IISc Bangalore	9th October, 2019
14.	NSDC-Schneider Electric-Power Sector Skill Council for Setting up of Centre of Excellence at NISE	6th November, 2019
15.	Department of Horticulture, J&K Government	13th November, 2019
16.	National Institute of Food Technology Entrepreneurship and Management (NIFTEM), Kundli, Sonapat	17th January, 2020
17.	Madan Mohan Malaviya University, Gorakhpur	14th February, 2020
18.	Earnest & Young (EY), Gurugram	25th February, 2020
19.	CENTILEA Power Pvt. Ltd., New Delhi	4th March, 2020

INTERNATIONAL ALLIANCE

Project with PTB Germany

NISE and PTB have been cooperating closely since 2014 when the first phase of the BMZ-funded project “Strengthening quality infrastructure for the solar industry” started and NISE became the implementing partner of PTB, while MNRE as political partner (first phase: 2014 – 2019, second phase: 2019 – 2022). Building on the achievements already made, the cooperation will be continued in the framework of a follow-up project for at least 3 more years: Notes of exchange have been signed by the German and the Indian side in July 2019 for a project of 2 Million EUR for a period from August, 2019 to July, 2022.

In the framework of the first phase of the project “Strengthening quality infrastructure for the solar industry”(2014-2019) various activities/work packages have been realized in the areas of standardization, testing, metrology and awareness raising, for example:

- ✿ Consultancy of NISE, NPL and IIT Bombay on secondary cell calibration (calibrated cells are required by the PV industry).
- ✿ Module testing:
 - Round robin test of solar modules with Fraunhofer ISE
 - Workshop on new solar module standards and electroluminescence
- ✿ Consultancy of BIS and the related technical working group on the question, which international standards should be adopted to the Indian Standard System. Based on the consultancy, many new BIS standards were published, including the relevant quality criteria.
- ✿ Pilot study on the quality of selected PV power plants in India. This study highlighted possibilities for improvement of quality assurance criteria and processes in the Indian Solar sector and was used

for awareness raising activities, amongst others in the financial sector.

- ✿ Testing: Organization of an inverter round robin with Fraunhofer IEE as international reference laboratory - all key solar inverter labs of India participate
- ✿ Metrology: Consultancy with regard to NISE's plans to set up an indoor pyranometer calibration facility (close cooperation with the German Weather Service, DWW)
- ✿ Kick-off meeting laboratory network in Bangalore on Nov. 28, 2019
- ✿ Consultancy program on module calibration initiated (calibrated modules are required for high

quality module production). NISE has purchased world class solar sun simulator for the module calibration set up and likely to start this facility by end of this year. Module calibration facility will be very helpful for the solar module manufacturer in India.

- ✿ Recommending SECI for the Implementation of Quality Criteria and supporting in bid evaluation process .
- ✿ Development a tool/ checklist for assessing the quality of the solar project for IREDA and other Financial Institutions. The tool has been finalized for construction phase of the PV power plants. A workshop with Lenders's Engineers of Fis was organized in November, 2019.



Figure 10.3. Kick-off meeting laboratory network in Bangalore on Nov. 28, 2019

PV PORT & STORE PROJECT WITH GERMAN COOPERATION GIZ

India has set a target of 40 MW grid connected Solar Rooftop until 2022. The Government of India through

its Nodal Ministry MNRE has observed that the solar rooftop system is more beneficial when installed in the premises of residential household consumer and solar is distributed across the network of distribution company. To address the concerns of the residential

consumer and to provide solar as a solution for demand management function for DISCOMs, NISE is working along with German Development Cooperation (GIZ) to launch the first portable residential Solar Rooftop Photovoltaic System in India termed as “**PV Port & Store**”. The objective of this project is to manage procurement, field test, research and evaluate different versions of PV Port. This pilot phase intends to validate the technical concept and further upscale and commercialise PV Port & Store systems in India. This project will envisage activities to improve the quality of product, to provide easy transport and assembling, selection of suitable consumer, development of PV Port portal and mobile application and training of qualified *Suryamitra* for installation of solar rooftop system. The PV Port & Store system installed at NISE is shown in Figure 10.4.



Figure 10.4: PV Port & Store System at NISE

PV Port & Store System is available in five versions with a 2 kWp DC capacity (solar) with battery storage (Lead Acid & Li-ion) designed for 100% self-consumption with no power being fed back to the Grid. The key features of PV port systems are:

- (i) Standardized – High performance with good quality
- (ii) Energy Savings – Maximum savings on Electricity bills up to 3200 units annually
- (iii) Backup power – power your loads in a grid outage
- (iv) Portable & Easy – PV port system are easy to transport, assemble and shift from one location to another
- (v) Safety – Certified according to IEC/BIS standards;
- (vi) Usability – Area under PV Port & Store system is practically useable.

COLLABORATION WITH INTERNATIONAL SOLAR ALLIANCE (ISA)

NISE is closely working with ISA with the objective to provide technical assistance , skill development and consultancy in the solar sector for member countries. In past two years, NISE have trained 216 participants from 41 ISA member Countries in 8 batches. NISE have arranged visits of International delegates across the country presenting them with technical knowledge and assistance in solar photovoltaic technologies. NISE is also implementing the “ISA Fellowship Programme” at IIT Delhi for the two years M.Tech Programme on “Renewable Energy Technologies and Management”. A total number of 21 candidates for first semester were duly selected by a committee represented by ISA ,NISE and IIT Delhi for the Session 2019-20 w.e.f 19th July 2019 at IIT Delhi. First Semester of the batch has been completed and second semester is ongoing. The programme is designed to meet the requirements of policy makers, planners, administrators, managers in the government, public and private sectors, non-governmental organizations, who have a public service commitment, demonstrated leadership potential, and commitment to their own country’s development. Furthermore, the proposals have also been submitted for e-ITEC programme for the FY 2020-21 to organize online 10 days e-ITEC programme on Solar Energy Technologies for African countries, covering up to 100 participants in a group

of single batches for sanction from MEA.

NISE is continually participating in various events/ meetings organised by ISA (Figure 10.5). NISE is

providing immense support to ISA for administrative services and financial assistance. NISE has signed an MoU with ISA to provide technical support.



Figure. 10.5 Interactions with ISA Officials.

GENERAL FACILITIES AND ACTIVITIES

11

National Institute of Solar Energy has state-of-art facilities for trainings, lecture rooms, library, sports, Information Technology etc. NISE encourages its staff to take active part in various activities. The events i.e. celebrations of functions, debates, lectures, are organised with full enthusiasm.

LIBRARY

The Institute's Library (Figure 11.1) was established in September, 2013. The Library is fully automated. Facilities and services of library are availed by visitors and trainees of different departments. The Library has a very rich collection of 8250 volumes of books, bound volumes of Journals and other reading material, to

cater to the requirements of its users. Apart from books and journals, the library also has a large collection of National and International Standards. The library subscribes many Hindi and English journal and newspapers. In addition, a number of electronic academic and scientific journals are subscribed for use, apart from annual report and project reports. The library has been modernized by strengthening of Internet services with the addition of 5 Computers, computerization of library catalogue, automation of Check-out Check-in functions, barcoding of collection, data entry of entire collection, automation of stock verification, creation of Digital Library and establishment of Multimedia Library etc..



Figure. 11.1 NISE Library

SPORTS FACILITIES

The sports facility developed at NISE (Figure 11.2) ensures the quality facility and opportunity for its employees to participate in sports and physical activities. The access to the facility of gym, yoga, indoor activities are imparted by a well-trained coach within the institute. The equipment and facilities are well maintained by the instructor. As sports is the integral part in discipline and stress management, quality programme schedules, diet and yoga sessions are organised for the staff and trainees at NISE.



Figure 11.2 Sports facility at NISE

INFORMATION TECHNOLOGY DIVISION (IT)

The IT division (Figure 11.3) implemented several important tasks and projects to make NISE technically competing and progressive. IT division implemented advance software backup solution in NISE, as recommended by the quality management system, during the internal audit conducted in NISE. This enables that, all raw data and test reports generated by testing laboratory can be stored on server for maintaining the electronic record, data protection and for back up of records. The testing machine are now directly interfaced with the server and the raw data is directly stored on server. NISE has a local data centre with high end server and 10 TB storage capacity. The local data center stored NISE data for security and data backup purpose. IT division is closely working with MNRE and provides support in various projects like Renewable energy job portal and Investment and grievance portal. During the

FY 2019-20, the Government e-Market (GeM) portal procurement was fully used by IT Division. Human resource manpower tender and cleaning services tender allotment was also done through Government e-Market place. The candidates report verification functionality of Suryamitra program was supported by IT division, by developing suitable IT platform. NISE is now using online Tender wizard portal solution to publish, evaluate and award the tenders online for transparency.



Figure 11.3 IT Division at NISE

PROMOTION OF OFFICIAL LANGUAGE

With a view to implement the Official Language Policy of the Government of India, an official language section has been established. Its functions are: i) Implementation of the Official Language Policy of the Govt. of India, ii) Translation of work to the Hindi Language, and iii) Publications in Hindi. During the year, concerted efforts were made to ensure proper compliance of the provision of Official Language Act - 1963 and Rules were framed thereunder. For promotion of official language policy and to create more conducive environment for the officials to do more work in Hindi, various programmes/schemes were undertaken which include, (i) To make the Institute's revamped website bilingual, (ii) All documents coming under section 3(3) of the O.L. Act 1963, e.g. Press Release, Tender Notices, Rules, General

Orders, Notification and other Documents to be laid in the Parliament were prepared bilingually, (iii) Letters received in Hindi were invariably replied in Hindi and Rule (5) of the Official Language Rules 1976 was fully complied, (iv) A display board has been installed at the entrance of the Surya Bhawan in the Institute and a new Hindi word is demonstrated daily at the Reception, (v) Standard Forms were prepared in Hindi and uploaded on the Website of NISE for convenience of officers/staff, (vi) The Annual Report 2018-19 of the institute was printed in both Hindi and English languages. (vii) All navigation boards, general boards, nameplates and rubber stamps etc. in the institute are bilingual.

To review the progress made in the implementation of Official Language policy, quarterly meetings



Figure 11.4 Prize Distribution ceremony by Dr. Arun K Tripathi, DG NISE on the Closing Ceremony of Hindi Pakhwada.

The Official Language Implementation Committee of MNRE inspected National Institute of Solar Energy on 2nd January, 2020. NISE received the membership of Town Official Language Implementation Committee (TOLIC), Gurugram on 27th September 2018. NISE is enthusiastically participating in the programs organized under the aegis of TOLIC.

of Official Language Implementation Committee were held regularly. The divisions were advised to achieve the targets specified by the Department of Official Language. During the year, various measures were taken for effective implementation of Official Language Policy in the Institute. Special emphasis was laid on increasing originating correspondence in Hindi. 'Hindi Pakhwada' was organised during 1st to 14th September 2019 to create awareness and to increase the use of Hindi in official work. Various competitions like hindi essay writing, poetry, and dictation were organized among the officers and employees of the Institute. In these competitions, the officers and staff of the institute enthusiastically participated. Based on their performances, memento, certificates and cash prizes were awarded to the participants by the DG, NISE (Figure11.4).



INDEPENDENCE DAY CELEBRATION

Independence Day is one of the national festivals of India, which was celebrated on 15th August, 2019 with great zeal and respect throughout the country. Like every year, Independence Day was celebrated with great enthusiasm in NISE. Photographs from independence day celebrations conducted at NISE are shown in Figure 11.5.



Figure. 11.5 (i) and (ii) Independence Day celebration

REPUBLIC DAY CELEBRATION

Like every year, Republic Day (Figure 11.6) was celebrated with great enthusiasm in NISE. The flag

was hoisted in the courtyard of Aditya Bhawan of the institute and a small parade was also organized by the security personnel of the institute.



Figure. 11.6. Republic Day celebration

SWACHH BHARAT ABHIYAAN

A Swachh Bharath Abhiyan campaign was observed from 2nd October to 27th October 2019. All officers and employees of the institute actively participated. Dr. Arun Kumar Tripathi, Director General inaugurated the program. The Director General spoke about the importance and maintenance of cleanliness in our homes and importance of cleaning our offices, equipment related to our work, tools and machines etc. The officials and staff present on this occasion also pledged to take full care of cleanliness.

During this time the process was started to make the institute plastic-free. Single use plastic was banned in the institute. The process of collecting recyclable plastic and proper disposal of plastic has been initiated. Water pipes and sewer lines were cleaned. Proper management of solid and wet waste was done and regular cleaning of water tanks was carried out.

VIGILANCE AWARENESS WEEK

The Central Vigilance Commission observes the Vigilance Awareness Week every year. This observance of Vigilance Awareness week is conducted during the birthday of Hon'ble Sardar Vallabhbhai Patel. This year it was observed during 28th October – 2nd November 2019. The theme of the Vigilance Awareness Week-2019 was 'Integrity – A way of life'. NISE followed this endeavour actively. A pledge was also taken by all the employees of the institution for being a part of the drive against corruption.

All the officers and employees of the institute pledged (Figure 11.7) to continue to strive towards the corruption-free nation by taking the "Satyanistha Pledge". During this period, a painting competition was organized in two groups (classes I to IV and classes V to VIII) in the Rajkiya Vidyalaya, Baliawas, Gurugram (Figure 11.8). A total cash amount of Rs 18,000 was distributed by NISE to the winning participants in the competition.



Figure. 11.7: Oath taking ceremony during vigilance awareness week at NISE



Figure. 11.8: Painting competition organized at Rajkiya Vidyalaya, Baliawas, Gurugram

INTERNATIONAL YOGA DAY

International Yoga Day was organized in the NISE on 21st June 2019. About 100 officers and employees of the institute participated, who had undergone yoga training by the Yogacharya Shri Ramesh Kandpal. Figure 11.9 shows the International Yoga Day celebration conducted at NISE. In the beginning of the yoga class, Shri Kandpal told that the day of June 21 is the longest in the year and Yoga also provides a long life to human being. He practiced the smallest, important verbs of yoga and asana-pranayama.

DG, NISE said that for the first time this day was celebrated on 21st June 2015. DG, NISE presented a memento on behalf of the Institute to Mr. Ramesh Kandpal and urged that continuous yoga classes should be regularly organized in NISE.



Figure 11.9 International Yoga Day celebration at NISE

COMMITTEE FOR PREVENTION OF SEXUAL HARASSMENT OF WOMEN AT WORKPLACE

In accordance with Government instructions, a complaints committee for women for redressal of complaints concerning sexual harassment in the workplace has been constituted at NISE. No complaints were received during the FY 2019-20.

RIGHT TO INFORMATION ACT

The Institute is implementing the Right to Information (RTI) Act, 2005 as per the guidelines issued by for Department of Personnel and Training (DoPT), Central Information Commission and Ministry of Home Affairs. The Procedure/other details regarding seeking information under RTI Act, 2005 are available at the Institute's website www.nise.res.in

The Institute has designated CPIOs and Appellate Authorities to respond to the RTI applications and the first Appeals in accordance with subjects assigned to them. Respective CPIOs and First Appellate Authorities replied to RTI applications/Appeals within the stipulated timelines to the extent possible. The progress report in terms of RTI application/First

Appeals received, disposed-off, as well as pendency during the year (from 01.04.2019 to 31.03.2020), is given in Table 11.1 and a list of CPIOs and first Appellate authorities is given in Table 11.2.

Table 11.1: Status of RTI Applications

Item	Received	Disposed-off	Pending as on 31.03.2020
RTI Applications*	(71)	(71)	(NIL)
First Appeals*	(33)	(33)	(NIL)

* As per Quarterly report submitted on RTI Portal.

Table 11.2 Name and Designation of the CPIOs and Appellate Authorities in NISE under Right to Information Act, 2005

Name and Designation of the CPIOs and Appellate Authorities in NISE under Right to Information Act, 2005.			
S. No.	Subject	CPIO	Appellate Authority
1	All matters concerning Research and Development, Technology and Laboratory and Technology	Dr. Chandan Banerjee Scientist 'F' (Deputy Director General)	Dr. Arun K Tripathi Director General
2	All matters concerning Finance	Shri Ankeshwar Mishra Deputy Director Administration	
3	All Administrative Matters (Except Financial Matters)	Ms. Akanksha Sharma Administrative Officer	
4	Public Grievance Officer	Shri Ankeshwar Mishra Deputy Director Administration	

ADMINISTRATION & STAFF

NISE is an autonomous institute under the Ministry of New & Renewable Energy (MNRE). The institute is set up for assisting the Government of India in the national solar mission under the official and authoritative decisions made by MNRE. The organisation is administered by the head of the institution, Director General, NISE. The scientific staff, senior consultants, consultants, executive assistants, multi-tasking staff and other staff provide support in the smooth functioning of the organisation.

The Government of India has sanctioned 41 regular posts including the post of Director General. The Institute has framed Recruitment Rules for the following sanctioned 41 regular scientific, technical and administrative posts. The Rules were approved by the Governing Council in its 3rd meeting held on 6th April 2015. Efforts were made to fill up these posts through written test/interviews. Out of 40 sanctioned regular posts, the selection has been completed for 31 posts out of which 11 joined and remaining are in the process of joining. The status of filling up of the posts is given in Table 11.3.

Table 11.3: Status of Scientific/Technical and Administrative Posts (as on 31.03.2020)

Sl. No.	Name of the post	Pay Level	Pay Matrix (in ₹)	No. of posts	Selected	Filled*
I.	Scientific / Technical					
1.	Deputy Director General	13A	131100-216600	03	01	01
2.	Director	12	78800-209200	02	01	-
3.	Deputy Director	11	67700-208700	06	06	-
4.	Assistant Director	10	56100-177500	07	07	06
5.	Executive Officer	08	47600-151100	04	04	-
6.	Executive Assistant –I	07	44900-142400	08	08	-
II.	Administrative					
1.	Director	12	78800-209200	01	-	-
2.	Deputy Director	11	67700-208700	02	01	01
3.	Administrative Officer	11	67700-208700	01	01	01
4.	Assistant Director	10	56100-177500	02	02	02
5.	Office Secretary	09	53100-167800	01	-	-
6.	Office Secretary-I	08	47600-151100	03	-	-
	Total			40	31	11

*Others are in the process of joining.

PUBLICATION & PATENTS

During the FY 2019-20, various divisions of NISE published 14 research papers in various journals & conference proceedings, 4 chapters in book publications, 1 technical report and filed one patent. The details are as follows:

Research Papers

1. Singh, R., Sharma, M., & Banerjee, C. (2019). Field Analysis of three different Silicon-based Technologies in Composite Climatic Condition. *Solar Energy*, 182, 102-116.
2. Ray, S., Pal, B., Ghosh, H., Mitra, S., Ghosh, S., Mondal, A., Banerjee, C., Saha, H., & Gangopadhyay, U. (2019). Passivation study of n-type c-Si solar cells involving different dielectric layers. *Materials Research Express* (accepted)
3. Singh, R., Sharma, M., Bora, B., Sastry, O. S., Yadav, K., & Banerjee, C. (2018). Estimation of Dynamic resistance of HIT technology module in dark and illuminated condition. *Materials Today: Proceedings*, 5(11), 23242-23248.
4. Hamisu, N., Bora, B., & Banerjee, C. (2019). Power degradation and performance analysis of 100kW grid connected PV solar system in Nigeria. *Journal of Advanced Research in Dynamical & Control System*, 11, 37-43.
5. Umar, N. H., Bora, B., & Banerjee, C. (2019). Effect of Hot-Spotted Cell on PV Module Performance. *International Journal of Mechanical Engineering and Technology*, 10(3).
6. Umar, N. H., Gupta, P., Bora, B., & Banerjee, C. (2019). Discoloration of photovoltaic module and correlation with electrical parameters degradation. *International journal of Engineering and Advanced Technology*. 8, 2450-2452.
7. Umar, N. H., Bora, B., Banerjee, C., & Panwar, B. S. (2019). Photovoltaic performance degradation due to dust accumulation. *American Journal of Engineering Research*. 8, 185-188.
8. Singh, R., Sharma, M., Rawat, R., & Banerjee, C. (2020). Field Analysis of three different silicon-based Technologies in Composite Climate Condition–Part II–Seasonal assessment and performance degradation rates using statistical tools. *Renewable Energy*, 147, 2102-2117.
9. Ray, S., Pal, B., Ghosh, H., Mitra, S., Mondal, A. K., Banerjee, C., ... & Gangopadhyay, U. (2020). Effect of Induced Charges on the Performance of Different Dielectric Layers of c-Si Solar Cell by Experimental and Theoretical Approach. *Silicon*, 1-9.
10. Parmar, R., Tripathi, A. K., Kumar, S., Banerjee, C., Yadav, K., & Kumar, M. (2019). Solar Photovoltaic Power Converters: Technologies and Their Testing Protocols for Indian Inevitabilities. In 2019 International Conference on Power Electronics, Control and Automation (ICPECA) (pp. 1-6). IEEE.
11. Jha, P., Sarkhel, R., Banerjee, C., Tripathi, A.K., & Nouni, M.R. (2019). Hydrogen from Chlor-alkali Units - Role for Transport Applications in India. 2nd International Conference on Recent Trends in Environmental Sustainable Development-2019 (RTESD-19)

12. Kumar, S., Yadav, V., Sahoo, U., & Singh, S. K. (2019). Experimental investigation of 16 square meter Scheffler concentrator system and its performance assessments for various regions of India. *Thermal Science and Engineering Progress*, 10, 103-111.
13. Mohammed, H., Gupta, R., Sastry, O., Bora, B., Magare, D., Singh, Y., & Kumar, S. (2019, August). Estimation of most frequent operating conditions of different technology silicon photovoltaic module in India using IEC 61853-1 approach. In *AIP Conference Proceedings* (Vol. 2147, No. 1, p. 090004). AIP Publishing LLC.
14. Golive, Y. R., Zachariah, S., Dubey, R., Chattopadhyay, S., Bhaduri, S., Singh, H. K., Bora, B., & Vasi, J. (2019). Analysis of Field Degradation Rates Observed in All-India Survey of Photovoltaic Module Reliability 2018. *IEEE Journal of Photovoltaics*, 10(2), 560-567.
2. Bora, B., Sastry, O. S., Mondal, S., & Prasad, B. (2019). Reliability Testing of PV Module in the Outdoor Condition. *Progress in Solar Energy Technologies and Applications*, 1-37.
3. Ushasree, P. M., & Bora, B. (2019). *Silicon Solar Cells*. Royal Society of Chemistry.
4. Ginley, D., Ager, J., Agrawal, R., Alam, M. A., Arora, B. M., Avasthi, S. Bora, B. & Braunecker, W. A. (2020). Sustainable Photovoltaics. In *Solar Energy Research Institute for India and the United States (SERIIUS)* (pp. 25-85). Springer, Cham.

BOOK CHAPTERS

1. Sahoo, K., Bandhyopadhyay, B., Mukhopadhyay, S., Sahoo, U., Kumar, T. S., Yadav, V., & Singh, Y. (2019). Cold Storage with Backup Thermal Energy Storage System. *Progress in Solar Energy Technologies and Applications*, 181-232.

TECHNICAL REPORT

All-India Survey of Photovoltaic Module Reliability: (2018), a joint technical report between NISE and IITB, https://nise.res.in/wp-content/uploads/2020/01/All-India-Survey-of-Photovoltaic-Module-Reliability_2018_Report.pdf

PATENT FILED

1. Method to de-sulphate lead acid battery electrodes in a solar power charging circuit. [Application No. 201911037857]



FINANCE AND ACCOUNTS

13

NISE has both Internal Finance Division (IFD) and Finance & Accounts Division (F&A) which looks after the concurrence and preparation of accounts respectively. IFD scrutinises and concurs to all financial proposals for payments whereas, the F&A division deals with budget preparation, maintenance of accounts and audit functions.

NISE is registered with Income Tax as well GST, and complies all the statutory provisions of both the Act. The statutory auditor of NISE is appointed out of the panel of Chartered Accountants provided by

CAG. The annual accounts is approved by the Finance Committee (FC) before submission of the same to the Governing Council (GC) and Annual General Meeting (AGM).

The annual accounts of the NISE for the FY 2019-20, duly audited by the statutory auditor is presented herewith after duly approved by the finance committee in its 9th meeting held on 12th & 21st October 2020 and duly adopted by the Governing Council of NISE, in its 10th meeting and 4th Annual General Meeting held on 11th December, 2020.

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Chartered Accountants

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B/H MMI School Sector-40, Gurgaon-122001
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Independent Auditor's report

Report on the Financial Statement

We have audited the accompanying financial statements of **NATIONAL INSTITUTE OF SOLAR ENERGY** ("The Institute"), which comprise the Balance Sheet as at 31 March 2020 and the statement of Income & Expenditure for the year then ended and a summary of significant policies and other explanatory information.

Management's responsibilities for the Financial Statement

The Management is responsible for the preparation of these financial statement that give a true and fair view of the financial position and financial performance of the Institute in accordance with the accounting principles generally accepted in India. The responsibility also includes the maintenance of adequate accounting records in accordance with the provision of the act for safeguarding of the assets of the Institute and for preventing and detecting the frauds and other irregularities; selection and application of appropriate accounting policies; making judgment and estimates that are reasonable and prudent; and design, implementation and maintenance of internal financial control, that were operating effectively for ensuring the accuracy and completeness of the accounting records, relevant to the preparation and presentation of the financial statement that give a true and fair view and free from material misstatement, whether due to fraud or error.

Auditor's Responsibility

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with the Standards on Auditing issued by ICAI. Those Standards require that we comply with ethical requirement and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedure to obtain audit evidence about the amount and disclosure in the financial statement. The procedures selected depend on the auditor's judgment, including the assessment of the risk of material misstatement of the financial statement, whether due to fraud or error. In making those risk assessments, the auditor considers internal financial control relevant to the Institute's preparation of the financial statements that give true and fair view in order to design audit procedure that are appropriate in the circumstance. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of the accounting estimates made by Institute Director's as well as evaluating presentation of the financial statement.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion on the financial statement.



S.M.SAINI & ASSOCIATES
Chartered Accountants

120, Mohyal Colony
B/H MMI School Sector-40, Gurgaon-122001
Ph.09310832563, 09868275687,01244276532
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Report on the legal and regulatory Requirements

1. The internal control system of the Institute needs to be strengthened. During the course of our audit, some statutory, administrative and financial lapses were found, which are given in the **Annexure A** attached in summarized form. The details of such observation were provided to the management separately which they have noted for future compliance and kept on record along their comments.
2. We report that:
 - a) We have sought and obtained all the information and explanation which to the best of our knowledge and belief were necessary for the purpose of audit;
 - b) In our opinion proper books of accounts as required by law have been kept by the Institute so far as appears from our examination of those books.
 - c) The Balance sheet and the Statement of Income & Expenditure dealt with by this Report agreement with the books of accounts.
 - d) In our opinion, the balance Sheet & Income & Expenditure dealt with by this report complies with the accounting Standards issued by the Institute of Chartered Accountants of India.

Opinion

In our opinion and to the best of our information and according to the explanation given to us, the aforesaid financial statements, **read together with the annexure attached**, give the information required by the Act in the manner so required and give a true and fair view in conformity with the accounting principles generally accepted in India.

- a) In the case of the Balance Sheet, of the state of affairs of the Institute as at March 31,2020;
- b) In the case of the Statement of Income & Expenditure, of the **excess of income over expenditure** for the year ended on that date;

For SM SAINI & ASSOCIATES
Chartered Accountants
FRN: - 014267N\

(Laxmikant Saini)
(Partner)

Membership No. 512056
Place : Gurugram
UDIN: 20512056AAAAAC8703
Dated: 28th September 2020

S.M.SAINI & ASSOCIATES
Chartered Accountants

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Annexure - A

Annexure to the Independent Audit Report on the financial statement of National Institute of Solar Energy for the FY 2019-20 as referred in the said report.

1. Certain Advances were found outstanding for more than three years. The list of such advances as on 31.03.2020 is as under:

Party Name	2018-19	2019-20
C- DAC	2,07,31,550.00	20,731,550.00
Executive engineer Delhi aviation division CPWD	79,96,000.00	7,996,000.00
Tata Power Solar system LTD	3,67,93,151.00	NIL
Executive engineer E (Delhi elect Div. VII)	55,92,468.00	9,18,218.00
Total	7,11,13,169.00	2,96,45,768.00

Management Remark:

- i) The advances to C-DAC was given by the erstwhile Solar Energy Centre (MNRE) for works to be executed at Bangalore, Kolkata and NISE for different agencies. The matter has been intimated to the agency and their response is awaited.
- ii) The matter has been taken up with the concerned division of CPWD. The utilization certificate from their end is still awaited.
- iii) The matter has been taken up with the concerned division and the utilization certificate for balance Rs.9,18,218 is still awaited.

2. Grant not received: We found in some cases where total grant has not been received from concerned Ministry and UC has been submitted for the same.

S.No.	Name of Ministry	2018-19	2019-20	Reason of Outstanding	Related Period
1.	Ministry of External Affairs	1,36,00,695	12,56,895	Programme conducted, UC submitted but grant not received	2019-20
2.	Ministry of New & Renewable Energy	81,63,259	85,20,940	Programme conducted but grant not received	2017-18 to 2019-20

Management Remark:

These are the balance amount of grant which will be released after submission of Utilization Certificate. We are perusing the matter for release of payment.



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3. The Utilization Certificate in respect of advances released in earlier years to different State Nodal Agencies amounting Rs. 25,41,660/- has not been received. These advances are 2 to 3 years old.

Management Remarks:

The State Nodal Agencies, where advances are outstanding, have partially completed and the revised UC for the same has been received FY 2020-21 and which is under process.

4. Advances to Staff: An amount of Rs.34,478/- is outstanding against advance to staff since 2016-17.

Management Remark:

The matter has been taken up with the concerned and the response is still awaited. Further action will be taken accordingly.

5. During the course of audit we have come across the cases (06 Nos.) where TDS was deducted by the customers but the same is not showing in 26AS. Financial implications is of Rs. 42,918/-

(Last Year it was Rs. 5,59,393/- for 14 Nos. of Cases. Out of that Rs.4,46,329/- has been received)

Management Remark:

We are taken the matter with concerned parties for remitting the above amount. In case of the regular customer the same will be deducted from their next payment.

For SM Saini & Associates
Chartered Accountants
FRN: 014267N



(Laxmi Kant Saini)
(Partner)
Membership No.512056
Place: Gurugram
Dated: 28th September 2020

NATIONAL INSTITUTE OF SOLAR ENERGY
(An Autonomous Institute of Ministry of New & Renewable Energy, Govt. of India)
Gurgaon-Faridabad Road, Gwalpahari, Gurgaon, Haryana-122003

BALANCE SHEET AS AT 31ST MARCH 2020

CORPUS/CAPITAL FUND AND LIABILITIES	SCHEDULE	AS AT MARCH 31, 2020		AS AT MARCH 31, 2019	
		TOTAL	TOTAL	TOTAL	TOTAL
Corpus/Capital Fund Gross Corpus/ Capital Fund Less : Accumulated Depreciation Net Corpus/ Capital Fund	1	11408,47,870	10577,91,580	1669,91,105	8908,00,476
		2503,43,184	8905,04,686		
Current Liabilities & Provisions	2	13540,90,691	13540,90,693	9426,28,299	9426,28,299
Total		22445,95,380		18334,28,775	
ASSETS	SCHEDULE	AS AT MARCH 31, 2020		AS AT MARCH 31, 2019	
		TOTAL	TOTAL	TOTAL	TOTAL
Fixed Assets Gross Block Less : Accumulated Depreciation Net Block	3	9208,32,895	7852,38,328	1669,91,105	6182,47,224
		2503,43,184	6704,89,711		
Current Assets, Loans & Advances	4	15741,05,667	15741,05,667	12151,81,551	12151,81,551
Total		22445,95,380		18334,28,775	
SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO ACCOUNTS	11				

As per our Audit Report of even date
For SM SAINI & ASSOCIATES
Chartered Accountants
(FRN-014267N)



M. No. 512056
Place: Gurugram
Dated: 28.09.2020

FOR NATIONAL INSTITUTE OF SOLAR ENERGY

[Signature]
Dr. Chandan Bajpejee
(Dy. Director General)

[Signature]
Dr. A.K. Tripathi
(Director General)



NATIONAL INSTITUTE OF SOLAR ENERGY
(An Autonomous Institute of Ministry of New & Renewable Energy, Govt. of India)
Gurgaon-Faridabad Road, Gwalpahari, Gurgaon, Haryana-122003

Amount in ₹

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH 2020			
PARTICULARS	Schedule	2019-20	2018-19
		TOTAL	TOTAL
INCOME			
Receipts from Testing & Operations	5	608,97,189	487,13,280
Grants/Subsidies utilised for Revenue Expenditure	6	5336,43,406	5191,63,985
Interest Earned	7	37,65,166	48,17,096
Other Income		49,34,974	35,47,492
Interest Earned on Grant Account(Contra)		469,65,554	358,44,728
Depreciation (As per Contra)	3	833,52,080	735,85,816
Total (A)		7335,58,369	6856,72,396
EXPENDITURE			
Establishment Expenses	8	338,59,901	288,51,082
Other Administrative Expenses	9	832,17,470	766,88,718
Operational Expenses	10	4692,58,081	4554,47,001
Interest Payable on Grant Account (Contra)		469,65,554	358,44,728
Depreciation (As per Contra)	3	833,52,080	735,85,816
Total (B)		7166,53,086	6704,17,345
Net Surplus/(Deficit) for the year		169,05,283	152,55,051
Provision for Taxation		-	-
Balance being Surplus/(Deficit) for the year transferred to General Reserve (A-B)		169,05,283	152,55,051
SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO ACCOUNTS	11		

As per our Audit Report of even date
For **SM SAINI & ASSOCIATES**

For **NATIONAL INSTITUTE OF SOLAR ENERGY**

Chartered Accountants
(FRN/014267N)
(Laxmikant Saini)
(Partner)
M. No.512056



Dr. Chandan Banerjee
(Dy. Director General)

Dr. A.K. Tripathi
(Director General)

Place: Gurugram
Dated: 28.09.2020

NATIONAL INSTITUTE OF SOLAR ENERGY
(An Autonomous Institute of Ministry of New & Renewable Energy, Govt. of India)
Gurgaon-Faridabad Road, Gwalpahari, Gurgaon, Haryana-122003

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2020	AS AT MARCH 31, 2020		AS AT MARCH 31, 2019	
		Total		Total
General Reserve				
Balance as at the beginning of the year	1019,33,787		1814,51,503	
Less : Transfer to ISA	-		947,72,768	
Add : Excess of income over expenditure during the year	169,05,283	1188,39,070	152,55,052	1019,33,787
Corpus Fund				
Balance of Grant Received from Govt. Non-Refundable				
Opening Balance(Refer Grant Sheet)	100,00,000		14648,85,000	
Add: Amount received during the year	-		-	
Less : Amount transfer to ISA	-		14548,85,000	
Closing Balance	-	100,00,000		100,00,000
Capital Reserve				
Grants adjusted against purchase of assets				
Opening Balance	3907,40,796		3134,93,673	
Add : Addition during the period	1146,74,275		810,96,234	
Less : Transfer to ISA	-		38,49,111	
Closing Balance		5054,15,071		3907,40,796
Capital Reserve for Building (SEC)				
Grant utilised for advances given during the year		3929,66,000		3929,66,000
Opening Balance	1621,50,997		2612,85,290	
Less : Net Adjusted during the Year	485,23,268		983,09,063	
Less : Transfer to ISA	-		8,25,230	
Closing Balance		1136,27,729		1621,50,997
Total		11408,47,870		10577,91,580



SCHEDULE 2 - CURRENT LIABILITIES AND PROVISIONS	AS AT MARCH 31, 2020		AS AT MARCH 31, 2019	
		Total		Total
Current Liabilities				
Sundry Creditors				
- For goods and services	4,08,947		7,89,176	
- Creditors For Capital Goods	268,25,874	272,34,820	31,55,102	39,44,278
Deposits				
- Earnest Money Deposit	39,25,896		46,15,200	
- Security Deposits	3,70,575		3,53,911	
- Deposit (SECI)	116,24,295		-	
- Deposit (Others)	1,33,454		-	
- Advance Received from Customers- ALMM	1534,73,139		-	
- Advance Received from Customers	640,45,955	2335,73,314	58,22,200	107,91,311
Statutory Liabilities				
- TDS Payable under Income Tax	20,21,540		-	
- TDS Payable under GST	1,43,479	21,65,019	2,59,526	2,59,526
Other Current Liabilities				
- Salary & Remuneration Payable	3,99,570		1,29,996	
- Interest refundable to Ministry	841,42,659		492,49,817	
- Advances received against training (ISA)	196,73,968		343,73,589	
- Advances received against GIZ Project	44,51,550		-	
- Other misc. liabilities	12,07,335	1098,75,082	12,00,322	849,53,725
Balance of Grants Payable to Government of India	9641,84,328	9641,84,328	8394,56,729	8394,56,729
Provisions				
Provision For Expenses	138,35,397	138,35,397		
Provision for Income Tax	32,22,730	32,22,730	32,22,730	32,22,730
Total		13540,90,691		9426,28,299



NATIONAL INSTITUTE OF SOLAR ENERGY
(An Autonomous Institute of Ministry of New & Renewable Energy, Govt. of India)
Gurgaon-Faridabad Road, Gwalpahari, Gurgaon, Haryana-122003

PARTICULARS	Rate	GROSS BLOCK					DEPRECIATION				NET BLOCK		
		A	B	C	D	E	F	G	H	I	J	K	
NATIONAL INSTITUTE OF SOLAR ENERGY													
Building-NISE	10.00%	5814,12,793	48,64,617	11,76,000	-	5874,53,410	1100,07,859	476,26,955	58,800	476,85,755	1576,93,614	4297,59,796	4714,04,934
Desktop Computers	40.00%	52,12,572	31,800	5,38,500	-	57,82,672	36,23,518	6,48,261	1,07,700	7,55,961	43,79,479	14,03,192	15,89,053.70
Printers and other IT Peripherals	15.00%	259,33,330	55,93,740	17,06,838	-	332,33,908	39,40,161	41,38,036	1,28,013	42,66,049	82,06,210	250,27,688	219,93,168.79
Air Conditioner	15.00%	20,33,188	-	2,20,248	-	22,53,436	8,79,707	1,73,022	16,519	1,89,541	10,69,248	11,84,188	11,53,481
Misc. Assets Guest House/ Office	15.00%	229,18,509	-	1,13,678	-	224,32,187	76,32,079	22,02,965	8,526	22,11,490	98,43,569	125,88,618	146,86,430.38
Scientific & Laboratory Equipments	15.00%	1297,80,400	405,23,989	91,78,887	-	1794,83,276	330,02,919	205,95,221	6,88,417	212,83,637	542,86,556	1251,96,720	967,77,481.12
Vehicles	10.00%	5,90,361	-	-	-	5,90,361	3,05,302	42,759	-	42,759	3,48,061	2,42,300	2,85,059
Furniture & Fixtures	10.00%	52,92,073	-	-	-	52,92,073	8,67,632	4,42,444	-	4,42,444	13,10,076	39,81,997	44,24,441.46
Laptops	40.00%	8,03,541	-	-	-	8,03,541	5,85,421	87,248	-	87,248	6,72,669	1,30,872	2,18,120.01
Other Assets (Training)	15.00%	79,28,390	-	-	-	79,28,390	28,49,844	7,61,782	-	7,61,782	36,11,656	43,16,764	50,78,545.67
Softwares	40.00%	39,33,170	-	24,676	-	39,57,846	32,96,662	2,54,603	4,935	2,59,538	35,56,200	4,01,646	6,36,508
500 KW Power Plant	15.00%	-	16,29,733	-	-	697,61,662	-	-	52,32,125	52,32,125	52,32,125	645,29,537	-
Transformer	15.00%	-	-	-	-	16,29,733	-	-	1,22,230	1,22,230	1,22,230	15,07,803	-
RO System	10.00%	-	-	2,30,400	-	2,30,400	-	-	11,520	11,520	11,520	2,18,880	-
Total		7852,38,327	526,43,679	829,50,889	-	9208,32,895	1669,91,104	769,73,296	63,78,784	833,52,080	2503,43,184	6704,89,711	6182,47,223



SCHEDULE 4- CURRENT ASSETS, LOANS & ADVANCES	AS AT MARCH 31, 2020		AS AT MARCH 31, 2019	
		Total		Total
Current Assets				
Cash Balance in hand	-		-	
Balance with Bank :				
-Saving & Current Accounts	1494,69,888		2808,97,779	
Auto Sweep Account	10580,80,848	12075,50,735	6067,26,192	8876,23,971
Fixed Deposit:				
Fixed Deposits under Grant	895,13,288		1005,40,397	
Fixed Deposits under Lien	121,27,046		-	
Fixed Deposits under Revenue	424,70,883		-	
Fixed Deposit: Corpus Fund	207,41,192	1441,11,217	-	1005,40,397
		207,41,192		-
Sundry Debtors	132,89,128		230,15,316	
Stamps in Hand	-	132,89,128	-	230,15,316
Inventory	67,83,030	67,83,030	-	-
Loan & Advances & other assets				
Advances and other amounts recoverable in cash or in kind or for value to be realized				
- Advances against capital assets	1082,70,935		1307,14,673	
- Advances against training programs	178,53,742		316,67,705	
- Advance to Vendors	49,39,098		132,35,919	
- Balances in Staff (Incl. Imprest Accounts)	4,12,002	1314,75,777	6,32,542	1762,50,839
Deposits				
- Security Deposits	3,10,965		3,10,965	
- Input Credit (GST)	152,96,144		27,01,798	
- TDS Recoverable	269,09,702		171,00,488	
- Advance Tax/Income Tax Refundable	76,37,776	501,54,588	76,37,776	277,51,028
Total		15741,05,667		12151,81,551



SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT AS AT 31ST MARCH 2020				
SCHEDULE 5- RECEIPTS FROM TESTING AND OPERATIONS	2019-20		2018-19	
		Total		Total
Receipts from Testing				
- Testing of Solar Components	98,38,426	98,38,426	184,99,854	184,99,854
Receipts under ALLM				
- Application Fees	109,03,000	109,03,000	-	-
- Inspection Fees	60,00,000	60,00,000	-	-
Other Operational Receipts				
- Receipts from Trainings and Seminars- For Domestic Participants	43,35,100	43,35,100	53,30,100	53,30,100
-for International Participants	64,35,900	64,35,900	94,85,594	94,85,594
- Administrative Charges - Training	188,34,763	188,34,763	91,35,685	91,35,685
- Consultancy on Techno Economic Feasibility Study	45,50,000	45,50,000	62,62,047	62,62,047
Total		608,97,189		487,13,280



SCHEDULE 6- GRANTS/SUBSIDIES (Irrevocable Grants & Subsidies Received)	2019-20		2018-19	
		Total		Total
Grants Received during the year-NISE(Core Grants)	1300,00,000	1300,00,000	1800,00,000	1800,00,000
Less : Grant Refunded	-		-	
Grants Received during the Year-NISE(Project Grants)	6104,56,153		6903,94,214	
Less : Grant Refunded	41,76,645		3071,38,672	
Grant Unutilised brought forward from Previous Year-NISE	8394,56,729	14457,36,237	7800,62,105	11633,17,647
Grant Adjusted towards Revenue Expenditure :				
Current Year Expenditure-NISE	5863,35,452		5609,86,801	
Less : Expenses adjusted towards current year Revenue-NISE	388,56,649		418,22,816	
Less: Provision Made against Revenue Expenditure	138,35,397		5191,63,985	
Less: Expenses Adjusted against Previous Advances-NISE	5336,43,406	5041,89,325	1642,52,910	3549,11,075
Less : Grants utilised for purchase of Fixed Assets-NISE	390,01,313		684,37,187	
Less : Grants utilised for Advances against Capital Expenses	551,87,790		377,10,520	
Less : Grants utilised for Advances against projects	121,52,206		427,49,920	
Less: Grant Utilised for Advance against General Exp.-NISE	10,21,275	1073,62,584	52,216	1489,49,843
Grants Payable to Government of India		9641,84,328		8394,56,729



Accountant



National Institute of Solar Energy

	2019-20		2018-19	
	Credited in Revenue	Total	Credited in Revenue	Total
SCHEDULE 7 - OTHER INCOME				
Bank Interest				
- Interest earned on Savings account-NISE	7,50,188		9,96,950	
- Interest earned on Auto Sweep account	1,19,529		23,73,907	
- Interest earned on F.D	27,38,568		14,46,239	
- Interest earned on Corpus Fund	1,56,881	37,65,166	-	48,17,096
Miscellaneous Income				
- Guest House Charges	19,60,900		19,96,100	
- Other Income	25,89,654	45,50,554	15,51,392	35,47,492
Others				
Supply of Solar Powered Cold Storage with Thermal	48,00,000		-	
Add: Inventory of Solar Dryer System	67,83,030		-	
Less: Purchases of Solar Powered Cold Storage with Thermal	111,98,610	3,84,420	-	-
Total		87,00,140		83,64,588



SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT AS AT 31ST MARCH 2020

SCHEDULE 8 - ESTABLISHMENT EXPENSES	2019-20				2018-19				
	Adjusted with grant	Adjusted against Advances	Provision for Expenses	Charged to Revenue	Total	Adjusted with Grant	Provision for Expenses	Charged to Revenue	Total
Consultancy Charges	31,39,568	-	-	165,60,661	197,00,229	166,87,917	-	24,40,766	191,28,683
Remuneration	141,59,672	-	-	-	141,59,672	95,63,284	-	1,59,115	97,22,399
Total	172,99,240	-	-	165,60,661	338,59,901	262,51,201	-	25,99,881	288,51,082



SCHEDULE 9- OTHER ADMINISTRATIVE EXPENSES	2019-20					2018-19				
	Adjusted with grant	Adjusted against Advances	Provision for Expenses	Charged to Revenue	Total	Adjusted with Grant	Provision for Expenses	Adjusted against Advance	Charged to Revenue	Total
Electricity / Fuel Expenses	45,05,133	-	20,00,000	15,36,945	80,42,078	57,49,012	-	-	24,68,273	82,17,285
Outsourcing Services	226,75,327	-	34,02,457	63,81,797	324,59,581	154,94,319	-	-	91,35,204	246,29,523
Security Services	149,33,641	-	-	-	149,33,641	89,28,404	-	-	35,06,515	124,34,919
Bad Debts	-	-	-	-	-	-	-	-	4,39,924	4,39,924
Miscellaneous Exp.	-	-	-	4,14,874	4,14,874	-	-	-	40,003	40,003
Office Expenses	7,69,833	24,748	-	-	7,94,581	10,78,433	-	-	2,65,301	13,43,734
Refreshment/Hospitality/Meetings	13,85,946	-	-	-	13,85,946	15,60,962	-	-	1,98,187	17,59,149
Legal & Professional Charges	21,39,364	2,235	1,76,405	4,000	23,22,004	7,49,240	-	-	4,48,300	11,97,540
Recruitment Expenses	-	-	-	24,24,193	24,24,193	-	-	-	-	-
Bank Charges	31,053	-	-	64,793	95,846	58,665	-	-	20,711	79,376
Gateway charges	-	-	-	1,88,090	1,88,090	-	-	-	1,17,677	1,17,677
Horticulture Expenses	87,254	-	-	-	87,254	22,80,496	-	-	2,768	22,83,264
Advertisement Expenses	-	-	-	-	-	78,750	-	-	-	78,750
Guest House Expenses	-	-	-	-	6,11,336	-	-	-	5,49,846	5,49,846
IT Expenses (Facilitation Charges)	18,52,750	-	17,65,100	-	36,17,850	-	-	-	-	-
Thermal Power Project Expenses	-	-	-	-	-	20,49,862	-	-	-	20,49,862
R&D Cell Expenses	-	-	-	-	-	-	-	57,793	7,28,216	7,86,009
Testing/Accreditation Charges	-	-	-	31,971	31,971	38,840	-	-	20,78,586	21,17,426
Seminars/Conferences/Training Programmes	-	-	-	9,41,276	9,41,276	20,64,541	-	-	28,15,116	48,79,657
Exhibition/ Events Expenses	-	-	-	-	-	-	-	-	-	-
Consumables/ Laboratory/Workshop Exp.	-	-	-	33,50,332	33,50,332	33,040	-	-	1,77,756	2,10,796
Library/ Books & Periodicals	80,665	-	-	-	80,665	2,85,136	-	-	2,67,594	5,52,730
Postage , courier, Printing and Stationery	10,81,372	-	2,15,948	1,03,065	14,00,385	12,49,076	-	-	3,88,299	16,37,375
Interest & Penalty	4,070	-	-	2,26,494	2,30,564	74,457	-	-	11,710	86,167
Repairs & Maintenance Expenses	11,61,576	-	2,70,986	3,30,669	17,63,231	24,86,387	-	4,50,000	6,67,767	36,04,154
Telephone Expenses	18,06,387	-	1,79,666	1,76,265	21,62,318	22,18,000	-	-	10,93,980	33,11,980
Vehicle Running & Maintenance	2,25,395	-	-	-	2,25,395	1,85,037	-	-	17,975	2,03,012
Tour / Travel & Transport	17,65,408	-	11,05,847	27,82,804	56,54,059	29,17,765	-	-	11,60,795	40,78,560
Total	545,05,174	26,983	91,16,409	195,68,904	832,17,470	495,80,422	-	5,07,793	266,00,503	766,88,718



SCHEDULE 10- OPERATIONAL EXPENSES	2019-20					2018-19				
	Adjusted with grant	Adjusted against Advances	Provision for Expenses	Charged to Revenue	Total	Adjusted with Grant	Provision for Expenses	Adjusted against Advance	Charged to Revenue	Total
SERTIUS Project Expenses	-	30,355	-	-	30,355	-	-	1,05,152	14,16,886	15,22,038
Released to State Nodal Agencies for Skill Development	3593,16,131	222,44,703	-	-	3815,60,834	2372,99,993	-	1576,45,493	-	3949,45,486
Expenses on Skill Development Programmes	-	-	-	-	-	-	-	-	51,09,203	51,09,203
Indian African Forum Summit Training (P12- TP MEA- IAFS)	-	-	-	-	-	9,80,566	-	-	-	9,80,566
ITEC/SCAAP/TCS Colombo Training Programme (P11-TP MEA- ITEC)	219,62,473	-	47,18,988	27,27,085	294,08,546	150,48,608	-	-	39,46,857	189,95,465
Hydrogen Project Exp. (P02- Hydrogen)	10,30,567	-	-	-	10,30,567	-	-	-	18,25,570	18,25,570
MNRE-USaid T.A Program (P08- TP DISCOM ER)	109,57,089	29,13,840	-	-	138,70,929	156,71,478	47,93,170	-	-	204,64,648
Solar Resource Assessment Exp.(NSRSC), Hyderabad	-	-	-	-	-	-	-	12,01,302	-	12,01,302
Solar Powered Clean Drinking Project (P03- SDWP)	7,17,419	-	-	-	7,17,419	31,83,734	-	-	-	31,83,734
BHEL R&D Project (P01- PERC)	4,60,759	-	-	-	4,60,759	12,40,398	-	-	-	12,40,398
R & D Concentrated Solar Sunbon Project (P04- CONC. SOLAR)	37,06,38	100000	-	-	46,07,759	12,97,427	-	-	-	12,97,427
Solar Radiation Calibration Lab (SRCL) (P05- SRRA)	1,90,90,26	-	-	-	38,30,638	23,62,608	-	-	-	23,62,608
Department of Science and Technology Project (P06- WPDST)	1,69,51,31	-	-	-	19,09,026	1,70,000	-	-	-	1,70,000
Solar Water Pumping System Project (P07-SWP)	93,10,342	39,58,200	-	-	1,32,68,542	16,52,803	-	-	-	16,52,803
Rooftop Grid Engineer Skill Development Project (P09 TP ROOFTOP)	124,17,170	1,80,000	-	-	1,25,97,170	1,71,837	-	-	3,23,916	4,95,753
Varunmitra Skill Development Programme (P10- TP VARUNMITRA)	-	-	-	-	-	-	-	-	-	-
Total	4323,84,910	294,27,098	47,18,988	27,27,085	4692,58,081	2790,79,452	-	1637,45,117	126,22,432	4554,47,001





NATIONAL INSTITUTE OF SOLAR ENERGY

NATIONAL INSTITUTE OF SOLAR ENERGY
 (An Autonomous Institute of Ministry of New & Renewable Energy, Govt. of India)
 Gurgaon-Parlādabad Road, Gwalpahan, Gurgaon, Haryana-122003
 STATEMENT OF GRANTS FOR THE FINANCIAL YEAR 2019-20

PARTICULARS	Opening Balance 01.04.2019	Refund/Transfer during the year 2019-20	Transfer	Receipt/Transfer during the year 20	Received in bank 20	Received Through Transfer	Utilization against advances 19-20	Utilization against Fixed Assets 19-20	Utilization against Revenue Expenses 19- 20	Total Utilization 19- 20	Closing Balance 19- 20
National Institute of Solar Energy											
Grant for Creation of Capital Assets	33239907	-	-	600,00,000	-	-	551,57,790	366,38,760	-	918,26,570	14,33,337
Grant in aid- General	367362	-	-	600,00,000	-	-	10,21,275	-	-	586,66,017	17,01,545
Grant in aid- Salaries	13112629	-	-	100,00,000	-	-	-	21,32,133	14,159,672	89,52,957	
Grant for BHEL R&D Projects (P01- PERC)	33739602	-	-	-	-	-	-	-	47,31,165	68,63,298	288,96,304
Grant for Project Hydrogen (P02- Hydrogen)	77000001	-	-	-	-	77,395	-	-	10,30,567	10,30,567	760,46,829
Grant - Skill Development Programme	554082894	-	-	5838,57,663	-	-	76,14,549	-	3593,16,131	3669,30,680	7710,09,877
Grant for SERIUS (Indo US Project)	469504	-	-	-	-	-	-	-	108,57,087	109,57,087	4,69,504
Grant for USAID TA Program (P08- TP DISCOM ER)	1506537	40,99,250	-	-	-	-	-	-	-	-	266,55,548
Grant- World Renewal Energy Museum	26655548	-	-	-	-	-	-	-	7,17,419	7,17,419	-3,17,801
Grant- Solar Powered clean drinking water project (P03-SDWP)	3996518	-	-	24,56,345	-	-	-	2,30,400	93,10,342	93,10,342	2,19,000
Grant- Project Rooftop Grid Engineering (P09- TP ROFTOP)	7072997	-	77,395	40,00,000	-	-	-	-	46,07,759	48,38,159	236,64,414
Grant- R&D Concentrated Solar Project (P04- Conc. Solar)	28579968	-	-	-	-	-	-	-	37,30,638	37,30,638	18,06,754
Grant - Solar Radiation Sensor Project (P05- SRA)	1537392	-	-	-	-	-	-	-	124,17,170	124,17,170	-22,11,507
Grant - Varanmitra Skill Development Programme (P10- TP Varanmitra)	10205663	-	-	200,64,750	-	-	-	-	219,62,473	219,62,473	21,71,064
Grant- International Training Programme (P11- TP MEA- ITEC)	4068987	-	-	-	-	-	-	-	16,95,131	16,95,131	214,04,869
Grant- Solar Pumping Project (P07- SWPUMP)	23100000	-	-	-	-	-	-	-	19,09,026	19,09,026	42,81,837
Grant - Department of Science & Technology (P06- WPOS1)	10728520	-	-	-	-	-	-	-	-	-	-
Total Grant (Balance of Grant payable to Govt. of India)	8394,56,729	40,99,250	77,395	7403,78,758	-	77,395	683,61,271	390,01,313	5041,89,323	6115,51,907	9641,84,330
Contributions for Corpus Fund											
NISE											
Contribution by IREDA	100,00,000	-	-	-	-	-	-	-	-	-	100,00,000
Total Grant Received from Govt. Non-Refundable	100,00,000	-	-	-	-	-	-	-	-	-	100,00,000

1. Transfer includes adjustment due to inter grant transfer & allocations



NATIONAL INSTITUTE OF SOLAR ENERGY

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SCHEDULE 11

SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO ACCOUNTS FORMING INTEGRAL PART OF THE FINANCIAL STATEMENTS FOR THE F.Y. 2019-20

A. SIGNIFICANT ACCOUNTING POLICIES

1. Accounting Convention

The financial statements are prepared on the basis of historical cost convention, unless otherwise stated and on the basis of accrual method of accounting.

2. Grant in Aid

a) The Institute is getting budgetary support from Ministry of New & Renewable Energy, Government of India. These grants are recurring in nature and are termed as Core Grants. Besides the recurring grants, one-time grants are also received to take up specific projects or activities. Such grants have been classified as Project Grants. The unutilized grants at the end of year have been shown in the financial statements as Grant payable to Government of India. Grants which are non-refundable are shown as corpus fund under General Reserve.

b) The Institute has adopted the policy to set off allocable revenue expenses with the internally generated resources i.e. testing and training income in accordance with Rule 229 (iv) of GFR, 2017. The surplus from the same is being shown under the head General Reserve. However, expenses incurred against specific projects and activities have been set off against the grants received for that purpose.

3. Fixed Assets and Depreciation

- a) Fixed assets are stated at cost less accumulated depreciation.
- b) Depreciation has been provided on the basis of rates as prescribed under Income Tax Act 1961.
- c) The depreciation has been charged to the grant (Capital Fund) and is recognized in the Income & Expenditure account as a contra item.

4. Employee Remuneration & Benefits

All Retirement and other Terminal Benefits such as Gratuity, Leave Encashment and Bonus etc. are not accounted on year to year basis and the same are recognized in the year of occurrence of event.

5. Revenue Recognition

Revenue is recognized on accrual basis.





B. NOTES TO ACCOUNTS

1. NISE has created the Corpus Fund as per the guidelines approved by MNRE vide letter No. 354/12/2017-NSM dated 24.06.2019 during the year. The balance of Corus Fund as on 31.03.2020 is Rs.207.41 lakhs (Previous year – NIL).
2. The guidelines for enlistment under “Approved Models and Manufactures of Solar Photovoltaic Modules (Requirements for Compulsory Registration) Order, 2019” issued by MNRE, NISE has been designated as Implementation Support Agency. The amount received under the said scheme has been considered as revenue of the Institute.
3. The accumulated depreciation amounting to Rs.25,03,43,184/- (Current Year Rs.8,33,52,080/-) has been charged to the Income & Expenditure account. Since the Institute is fully aided by the grant from Government of India, the same has been charged to the Grant (Capital Fund) and is recognized in the Income & Expenditure account as a contra item.
4. The amount of interest earned on grants and payable to MNRE is Rs. 46965554 (Previous Year Rs.35844728) and has been shown as contra item in Income and Expenditure account.
5. The Institute has taken over the facilities consisting of 200 acres of land, Administrative block, 3 Nos. technical block from erstwhile Solar Energy Centre (MNRE), the ownership of which is under process of transfer.
6. Additions made during the F.Y. 2019-20 in Capital Reserve (Purchase of Assets) amounting to Rs. 11,46,74,275/-.
7. The Institute has received a demand of Rs. 39.51 crore from income tax department for A.Y. 2019-20 U/S 143(1) of the Act. The revision of the return for the same has already been filled and Management is of the view that the same demand will be abolished.
8. The institute was maintaining its income and expenditure on cash basis except statutory liabilities and capitalised Assets. In view of the transition from cash to accrual system, the provision for expenses during the year has been made for an amount of Rs. 1,38,35,397/- (previous year - NIL).
9. A letter of credit has been opened by SBI as under: -

Party Name	LC Value
M/s. WEP, Germany	EURO € 76,146.00
M/s. Napson Corporation, Japan	JPY ¥ 29,10,935.00
M/s. Global Technosoft Pte., Singapore	EUR € 2,275.00
M/s. J A Woollam Co. Inc., USA	USD \$ 97,551
M/s. Bruker, Singapore	USD \$ 40,950
M/s. Universal (FARFAST) Pte. Ltd., Singapore	EUR € 64,427

10. The balances of sundry creditors and debtors are subject to confirmation.
11. Previous year figures have been regrouped and rearranged to make them comparable with those of current year.



[Handwritten Signature]





Social impact of products developed at NISE



NATIONAL INSTITUTE OF SOLAR ENERGY

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