



NATIONAL INSTITUTE OF SOLAR ENERGY

GOVERNING COUNCIL

- | | | |
|-----|---|-------------------------|
| 1. | Shri Anand Kumar, Secretary, Ministry of New and Renewable Energy (MNRE), | President (Ex- officio) |
| 2. | Ms. Gargi Kaul, AS&FA, MNRE | Member (Ex- officio) |
| 3. | Joint Secretary, Solar, MNRE | Member (Ex- officio) |
| 4. | 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. | Er. S. K. Singh, Advisor/ Scientist 'G', NISE | Member |
| 12. | Dr. Rajesh Kumar, DDG/ Scientist 'F', NISE | Member |
| 13. | Dr. Anil Kumar Saxena, Additional G.M., BHEL | Member |
| 14. | Prof. Shireesh B. Kedare, IIT Bombay Dept. of Energy Science and Engineering | Member |
| 15. | Dr. T. C. Kandpal, Professor IIT, Delhi | Member |
| 16. | Dr. Pradip Datta, Professor, Department of Mechanical Engg., Indian Institute of Sciences, Bengaluru | Member |
| 17. | Dr. Chandan Banerjee, DDG/Sci-F, NISE | Member, Secretary |

SPECIAL INVITEE

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

EXECUTIVE COMMITTEE

- | | | |
|----|--|----------|
| 1. | Dr. Arun K Tripathi, Director General NISE & Member Governing Council | Chairman |
| 2. | Er. S. K. Singh, Advisor/ Scientist 'G', NISE & Member Governing Council | Member |
| 3. | Dr. Rajesh Kumar, DDG/ Scientist 'F', NISE & Member Governing Council | Member |
| 4. | Dr. Chandan Banerjee, Scientist 'F', DDG (Fin), NISE & Member Secretary Governing Council | Member |
| 5. | Er. Sanjay Kumar, Scientist 'F', DDG (Admn), NISE | Member |

ANNUAL REPORT 2017-18



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

Around the Globe, there is a scientific evidence for warming of the climate system, this significant rapid climate change has compelled to adopt the sustainable ways of harnessing the solar renewable energy striking our planet and reduce our dependability on fossil fuels. With 173 thousand terawatts of solar energy striking our planet each year, solar energy is the largest source of renewable and clean energy for mankind. This energy source offers ten-thousand times the energy required by people worldwide. Therefore, solar energy is the future energy with new innovations, technology advancement, research, and skills.

1.2 National Institute of Solar Energy (NISE) is working on empowering our dependence on renewable energy resources with latest technology and research which are suitable for a long-term cost-effective solution, better operation, and maintenance of the developed technologies. It is expected to assist in National Solar Mission (NSM) to put in place processes and standards that comply with international standards and provide consumers with quality products and services. In addition, NISE has been mandated to support the Ministry of New and Renewable Energy (MNRE) in implementing the NSM and various Skill Development Programmes.

1.3 In the Financial Year (FY) 2017-18, NISE has made many achievements in new solar innovative product development, testing and certification, quality management and research. In addition, it has organised various National and International skill development training programmes. NISE has contributed with a collaborative research association with various institutions, organisations, international agencies in which it has provided its well-equipped lab facilities and expertise for the future development

of the country. All these activities have led to increased revenue generation.

GOVERNING COUNCIL

1.4 Consequent upon the completion of the tenure of the first Governing Council, the second Governing Council of NISE was constituted in January 2018 with the inclusion of members from industry, research institutions, Government departments and experts from the field of solar energy.

EXECUTIVE COMMITTEE

1.5 The Executive Committee (EC) of NISE held six meetings during the year. The EC took the administrative, policy, finance and accounts related matters and took decisions to improve upon the overall functioning of NISE.

SCIENTIFIC AND OTHER ACTIVITIES OF NISE

1.6 NISE acted as a catalyst for the forthcoming solar energy transition in India. The experts of NISE participated in various meetings of MNRE and provided the technical support. Accordingly, for the implementation, coordination, and development, the extensive actions were taken by NISE:

Solar Radiation Resource Assessment (SRRRA)

1.7 Solar Radiation Calibration laboratory (SRCL) of NISE initiated the calibration of phase-II SRRRA sensors and achieved the calibration of 24 radiometers from 8 SRRRA stations. Under the commercial calibration mode program, calibration of total 14 Pyranometer sensors received at SRCL facility from various private organizations was completed and calibration reports were issued. SRCL NISE participated in the Interlaboratory Comparison (ILC) event of the primary

standard sensor at Indian Metrological Department (IMD) Pune to validate the calibration traceability of solar radiometric calibration with World Radiometric Reference (WRR) Scale. The event was also attended by a calibration laboratory from NIWE where the primary standard sensors from SRCL was compared with the primary standard sensor from IMD for validation of its WRR traceability.

Solar Photovoltaic Technologies, Testing, Quality and Certification

1.8 During the year, solar photovoltaic laboratory facilities such as solar module testing, inverter, battery, advanced solar lighting, solar water pumping, electroluminescence testing, solar cell lab etc., upgraded their equipment. It has expanded its testing methodology while following new standards. Therefore, the performance, reliability, and validation of testing provision were improved at NISE. The PV module test lab is a NABL (National Accreditation Board for Testing & Calibration Laboratories) accredited laboratory as per standard ISO 17025: 2005 for qualification testing of PV module as per IEC 61215. The facility for conducting the testing for safety standard such as IEC 61730-1, 61730-2 was prepared for NABL accreditation. During the year, Electroluminescence lab tested 112 samples from different types of PV modules, 88 samples were tested for internal research purpose and 24 samples were tested for commercial purpose. The revenue earned through Electroluminescence testing was Rs. 96,600/- during the year.

1.9 NISE has established facilities for testing and evaluation of solar inverters/ Power Conditioning Units (PCU) of capacity ranging up to 50 KVA. All types of PCUs, hybrid, standalone, grid-tied inverters (GI) and pump controllers are tested in this laboratory. During the year, 46 samples were tested in the power electronics laboratory that generated the revenue of Rs.61.68 Lakhs.

1.10 The battery testing lab provided a variety of battery testing service from small cell to a large battery

pack system including technologies such as lead-acid, Li-ion (all salts), NiMH, NaS, and Ni-Cd. The testing services include performance parameters, reliability and endurance test on secondary battery technology. During the year, a total of 238 samples including Lead Acid and Li-ion battery samples were received and tested thereby generating a revenue of Rs.62 Lakhs.

1.11 NISE has an automated and up-gradated testing facility for testing 8 different types of water pumping systems at a time with more accuracy and data logging. In the year 2017-18, NISE has tested 70 different types of pumps and the revenue of Rs. 28 Lakh was generated.

1.12 Solar Photovoltaic Lighting System Laboratory was engaged in testing the performance and reliability of solar based lighting system as well as validation of field performance. It is the first Solar Lighting laboratory established for design, development, performance and reliability testing of PV lighting systems. This lab was upgraded and shifted in the newly created and designed lab. During the financial year 2017-18, a total of 121 samples were tested and certified in this laboratory thereby generating a revenue of Rs. 58.38 Lakhs.

1.13 A mobile solar testing facility comprising of testing equipment's, set ups and well experienced manpower for conducting the solar PV power plant inspection, reliability testing of crystalline silicon, thin film PV modules as per International standards and user specifications was created at NISE.

1.14 During the year, overall 1538 samples of various components including 951 samples of solar PV Modules were tested, which thereby generated a total revenue of Rs. 3.156 Crore in NISE.

Solar Thermal Technologies

1.15 During 2017-18 efforts were made for the revival of 1.0 MW Solar Thermal Power Plant. These efforts resulted in making the facility partially operational for producing electricity from the plant. However,

the execution for the establishment of the facility required major overhauling, repair, maintenance and its operation through a professional power generating company. However, the group had made an effort for regular operation and maintenance of the facility through the power generating company.

1.16 During the year, MNRE took an initiative to sanction a project 'Central Receiver Facility' for NISE. The facilities concerning the solar thermal cooling system and the solar thermal desalination system continued to operate during the year with a view to reducing electricity consumption for air-conditioning in some of the rooms at Aditya Bhawan at NISE.

1.17 The solar thermal R&D group of the institution developed a few solar powered products such as (i) Solar Powered Cold Storage (ii) Solar Cooking System (iii) Bulk Milk Chilling System (iv) Solar Powered RO System for supplying drinking water and (v) Solar Dryer cum space heating system. NISE has filed patents for these developed solar systems.

Hydrogen Energy and Fuel Cell

1.18 Hydrogen Energy is emerging as a clean and sustainable energy carrier due to its production from renewable energy resources and therefore recognising its importance as a clean fuel for the transport sector, a hydrogen production, storage and dispensing facility is operational at NISE by utilizing the electricity generated by the solar photovoltaic system. This facility is being used for providing hydrogen fuel to Hydrogen-Diesel dual fuel vehicles running for the field trials at NISE. During the year two Scorpio vehicles of Mahindra and Mahindra (M&M) were run on dual fuel mode through hydrogen diesel for 13,837 km and 17,829 km respectively.

1.19 Further, 2x1 kW and 1x2 kW Polymer Exchange Membrane Fuel Cell, installed in the Fuel Cell Laboratory of the institute were also demonstrated using bottled hydrogen. The second National Workshop on Hydrogen Energy and Fuel Cell was

organised at NISE in November 2017.

Skill Development and Capacity Building

1.20 NISE has taken several initiatives towards skill development and capacity building activities. The 'Suryamitra' training programme of MNRE is being implemented by NISE in which 50,000 'Suryamitras' are targeted to be trained by the year 2022. This year 8167 Suryamitra were trained. In the FY 2017-18, NISE has initiated to conduct an award ceremony for the Suryamitra institutes for motivating them to perform exceptionally towards the skill development program. The award ceremony conducted at NISE is shown in Figure 1.1. NISE has developed 10 types of new trainings and organised 32 National training programs thereby imparting trainings to 1062 number of solar professionals in various fields of Solar Energy. Besides, NISE has also organised 7 International Trainings funded by Ministry of External Affairs (MEA) & International Solar Alliance (ISA), wherein, 169 participants from different countries were imparted trainings.

Research and Development

1.21 NISE has continued its cooperation with IIT Bombay, National Renewable Energy Laboratory (NREL) and PTB Germany to conduct degradation analysis, study the performance and reliability of solar PV modules and perform quality inspection activities for its contribution in the solar industry in India. NISE has received the sanctions for two R&D projects (i) Development of PERC solar cells and (ii) Development of secondary reference cell from MNRE. Two meetings of R&D Monitoring Committee were held in which 34 ongoing R&D projects were reviewed.

National/International Cooperation

1.22 NISE has signed MoU's with 9 national organisations i.e., TERI, NPTI, SECI, etc. and one MoU with an International Institute namely INES, France to work for the development of solar technologies by collaborating in R&D activities, training and business.



Figure 1.1 : Award of Appreciation for Exceptional Performance for Suryamitra on PAN India Basis by NISE, Gurugram

OTHER INITIATIVES

1.23 NISE continued its consultancy services and provided consultancy on Detailed Project Report (DPR) preparation, vetting, performance evaluation, training etc. and generated a revenue of Rs.24.50 Lakhs. NISE has developed its infrastructure and facilities with the advancement of the library, IT system and automation of customer services and achieved 99% customer satisfaction index during the year.

1.24 The library procured 250 books, 94 Standards and 01 e – Standard relating to the solar sector. NISE Library has a rich collection of 8250 volumes of books, bound volumes of Journals and other reading material, particularly on solar energy. The IT department of NISE has developed in-house 4 web portals on, i) Suryamitra Trainings, ii) Trainings for NISE, iii)

Nationalised Centralised Monitoring Centre (NCCM) and iv) Accounts Management. The implementation of e-office management is in progress.

1.25 The scientists of NISE continued their research publications and reports on various sectors of solar energy. During 2017-18, 10 research papers were published in reputed international/national journals by the scientists of NISE. Besides, 12 papers were also published in the proceedings of national/international conferences/workshops. NISE has published technical reports on Survey of Photovoltaic Module Reliability and has filed three patent applications for solar powered technologies.

1.26 The 4th Foundation Day was celebrated on 27th October 2017 at NISE. Shri Raj Kumar Singh, Minister of State (I/C) for Power and New & Renewable Energy,

addressed the gathering of scientist, guests and staff at NISE. The Minister motivated NISE by saying, NISE should aim to establish itself as World's leading institute in the field of Solar Energy. Shri R. K. Singh also launched the automation system for Customer Service Cell for Testing Facilities at NISE. The set of

Solar Energy books published by NISE was presented to the Minister on this occasion. NISE has conducted competitions, exhibitions and cultural activities related to solar energy during this Foundation Day. The Minister gave away the awards to the winners and addressed the participants. Figure 1.2 shows the 4th Foundation Day celebrated at NISE.



Figure 1.2 : Shri Raj Kumar Singh, Minister of State for Power and New & Renewable Energy presented with a set of four books on Solar Energy published by NISE.

INTRODUCTION

India is focused to achieve its renewable energy transition with a paradigm shift away from fossil fuels through the deployment of renewable energy technologies. It also facilitates a sustainable way of meeting our energy requirement. The roadmap of renewable energy future goals of achieving its 175GW target by 2022 has created a massive thrust to attain the 4th position in solar power installed capacity in the world. This ambitious target has led to the development of historic low tariff of Rs. 2.44/unit, energy security, training, fiscal incentives, generation-based incentives (GBI), subsidies, funding, policies and deep-dyed Research & Development (R&D).

2.2 The Government of India intends to work diligently in establishing the renewable energy efficient technologies and economic growth by coupling the interaction of each individual with government and to keep everyone well acquainted with the new applications, trends, and achievements in solar energy technology.

2.3 NISE, an autonomous institute under MNRE, Government of India was established in the solar technology dominion. NISE conducts scientific research and developments in solar energy systems for bringing in technology advancement. NISE intends to provide optimised and cost-effective solutions considering the requirements of its customers. It develops new by-products for daily application of an individual in the field of solar energy. NISE has one of the best facilities for solar system testing and certifications. NISE is intensively performing towards achieving our National Solar Mission for the carbon-free clean environment for future generations. For this, it has always been ready to learn and teach the future generations and provide new entrepreneurs in this field.

2.4 Furthermore, it also associates with industries, institutions and international agencies to be updated and provide its contribution to research and new innovations. It facilitates policy development and joins to build a support network for serving each individual in the society according to the need of the hour.

VISION OF NISE

2.5 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, Economic and Policy Planning, Human Resource Development and Active collaborations with prominent National & International organisations etc.

OBJECTIVES

2.6 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, and (ii) To act as an Apex Organization for initiating and coordinating the R&D in the field of Solar Energy and related areas such as testing, certification and standards, etc.

INSTITUTION

2.7 NISE is situated at Gurugram-Faridabad Road, Haryana. The institute is linked through open and wide roads. It is about 22 kms away from the nearest airport, 28 kms away from New Delhi Railway Station and 25 kms away from MNRE. The institute has continuous connecting services such as buses, cabs and other convenient commuting facilities outside its premises.

2.8 The institute has a 200-acre campus which is registered as a society under 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, 1MW power plant, 500 kW SPV power plants, 150kW solar rooftop etc. to harness the solar energy to the maximum extent. The campus area includes the energy efficient building known as Surya Bhawan with conference halls, seminar rooms, committee rooms, guest house, and a library. The halls and rooms are furnished with modern amenities, projectors, sound systems with a seating arrangement for more than 150 individual. 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 e-online library portal, easily accessible from 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 Surya Bhawan building in NISE.

2.9 The Aditya Bhawan of NISE is exclusively a technical block comprising of testing facilities laboratory, workshops, and R&D activity laboratories. 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.

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



Figure 2.1 : Surya Bhawan Building at NISE, Gurugram

QUALITY POLICY OF NISE

2.11 National Institute of Solar Energy (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.

2.12 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 of the effectiveness of the Quality Management System as per International Standard ISO/IEC 17025:2005.

ORGANISATION STRUCTURE OF NISE

2.13 The affairs of NISE are managed by a Governing

Council headed by Secretary, MNRE and an Executive Committee headed by Director General, NISE. An organization chart giving a broad set up of the structure and management of NISE is shown in Figure 2.2. 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.

2.14 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 FY, six meetings are held under the Chairmanship of DG, NISE. The Finance Committee of NISE has three members with Joint Secretary & Financial Advisor, MNRE as its Chairman.

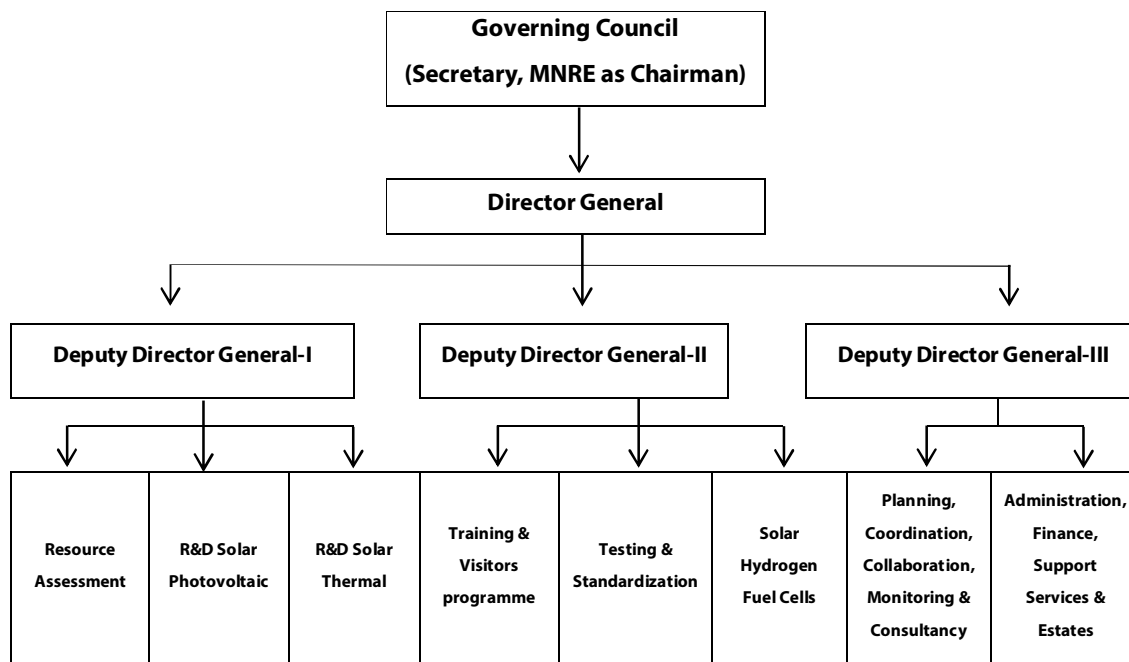


Figure 2.2: Organization Structure of NISE

MAJOR ACTIVITIES

2.15 The main functions of the Institute include:

- i. Assisting the Ministry in implementing the Mission 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 Energy 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 to further R&D and related capacity building in the areas of solar energy and the related activities 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.

2.16 Therefore, NISE is conceived as a technical solar hub for all solar linked activities, standardization, designing, consultancy, and skill development programs. The institution is united and engaged in a focused manner to establish itself as one of the premier institutions in solar energy technology. The institution aims to address the gaps and work towards the National Solar Mission in the most significant procedure.

SOLAR RADIATION RESOURCE ASSESSMENT

Solar Radiation Resource Assessment (SRRA) Program of MNRE has 111 solar radiation monitoring stations continuously adding high-quality radiation data to ground solar radiation database of the country since 2011. In addition, four Advanced Measurement Stations (AMS) were added by 2014 at four typical locations in the country, with one of the locations as NISE. To achieve the quality data generation under the SRRA program, a calibration laboratory for solar radiometers of SRRA network was established at NISE. The Solar Radiation Calibration Laboratory at NISE, an outdoor facility, is assisting the SRRA program of MNRE for quality data generation by calibration of solar radiometers of 51 SRRA stations mostly from Northern, North-Eastern region of the country. Figure 3.1 shows the SRRA facility set up at Aditya Bhawan rooftop in NISE.

3.2 The SRRA facility at NISE consists of World Metrological Organization (WMO) high-quality state-of-the-art sensors for measuring high-quality solar radiation and meteorological data with various other sophisticated parameters characterizing the quality of incoming solar radiation. The entire facility has two parts, with one measuring the basic solar radiation parameters like Global Horizontal Irradiance (GHI), Diffuse Horizontal Irradiance (DHI), Direct Normal Irradiance (DNI) by WMO high quality or International Organization for Standardization (ISO) Secondary standard sensor along with measurement of meteorological parameters like ambient temperature, relative humidity, wind speed, wind direction by National Institute of Standard and Technology (NIST) traceable sensor. The equipment used to measure



Figure 3.1 : SRRA facility at Aditya Bhawan rooftop in NISE

the GHI, DHI, DNI and sun photometer are shown in Figures 3.2 and 3.3 respectively.

3.3 The other part of the facility termed as advanced measurement facility consists of sophisticated sensors for measuring parameters characterizing the quality

of incoming solar radiation. The sensors which are part of the facility are sun photometer, albedometer, pyrgeometer, visibility sensor and silicon photodiode sensor. Table 3.1 indicates the significance of these sensors.

Table 3.1 Sensors and its Applications

| S. No. | Sensor | Parameter Measured | Application |
|--------|--------------------|---|--|
| 1 | Sun photometer | Spectral DNI at 10 discrete wavelengths | Finding the Aerosol Optical Depth (AOD), Water Vapor Column, Ozone Column |
| 2 | Albedometer | Albedo or Ground reflected radiation | For finding the quantity of ground reflected radiation at different conditions |
| 3 | Pyrgeometer | Longwave or Infrared Radiation | Measuring downward atmospheric Longwave radiation |
| 4 | Visibility sensor | Atmospheric visibility | Measure visibility due to scattering of light by suspended particles in the atmosphere |
| 5 | Silicon photodiode | Global solar radiation in visible and near infrared portion of the spectrum | Performance evaluation of PV technology |



Figure 3.2 : GHI, DHI and DNI Measurement setup



Figure 3.3 : Sun photometer

3.4 The existing SRRA facility of NISE is listed for consideration to be a member of Baseline Solar Radiation Network (BSRN), a global radiation network established under the World Climate Research Program (WCRP).

COMMENCEMENT OF ONLINE MONITORING OF ADVANCED SRRA STATION DATA

3.5 NISE initiated the proposal for online monitoring of all 4 Advanced SRRA station data in line with other SRRA station. The data from Sun photometer sensor was successfully fetched to cloud database for its remote monitoring to be useful for evaluating and calculating the parameters such as UV B, Ozone, Water vapor column and Aerosol Optical Depth (AOD). The

spectral Direct Normal Irradiance data obtained from sun photometer is shown in Figure 3.4.

SOLAR RADIATION CALIBRATION LABORATORY

3.6 Solar Radiation Calibration laboratory is an outdoor laboratory established at Surya Bhawan in NISE, under the supervision of MNRE. The laboratory was commissioned in association with Solar Energy Corporation of India (SECI) at NISE in October 2015. The laboratory facilities have been established under the WMO guidelines, calibrating the solar radiometer from SRRA network of MNRE. The facility has state-of-the-art infrastructure and reference standard sensors for achieving precise radiometric calibration.

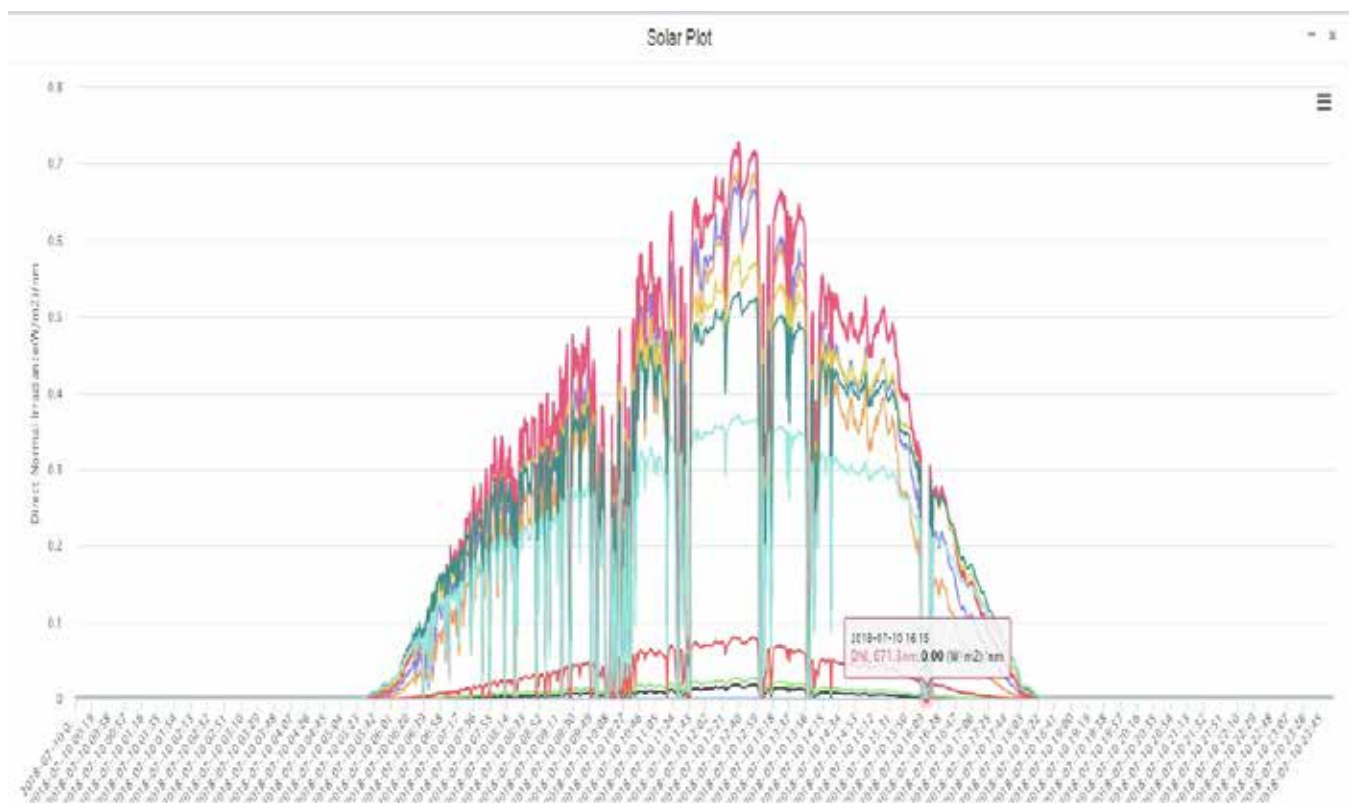


Figure 3.4 : Spectral Direct Normal Irradiance data from Sun photometer



Figure 3.5 : Solar Radiation calibration facility at Surya Bhawan in NISE

In addition, the facility is also catering the calibration need of private organizations in the country under its commercial mode program.

3.7 In March 2018, MNRE issued directives for the transfer of laboratory facility operation from SECI to NISE. As per new directives, NISE would now be solely responsible for the successful implementation of calibration laboratory activities for meeting the calibration requirement of MNRE SRRA network. Figure 3.5 shows the solar radiation calibration facility at Surya Bhawan in NISE.

CALIBRATION OF RADIOMETERS FROM PHASE – II OF SRRA PROGRAM

3.8 After calibration of 45 solar radiometers from all 15 Phase-I SRRA stations in 2016 -2017, SRCL initiated the program for calibration of sensors from Phase-II stations. The laboratory facility was upgraded with equipment for calibration of Hukseflux make radiometers from SRRA phase-II. During the year 2017-18, calibration of 24 solar radiometers from 8 SRRA phase -II stations have been achieved. The calibration status of solar radiometers from Phase – II of SRRA program is given in Table 3.2.



Figure 3.6 : ILC event at IMD Pune surface meteorological laboratory held in Pashan, Pune March 2018

Table 3.2 Calibration Status of solar radiometers from Phase – II of SRRR program

| Sr. No | Phase-II SRRR location | No. of the type of sensors | | Total |
|--------------|-------------------------|----------------------------|---------------|-----------|
| | | Pyranometer | Pyrheliometer | |
| 1 | Chandigarh | 2 | 1 | 3 |
| 2 | Murthal | 2 | 1 | 3 |
| 3 | Kapurthala | 2 | 1 | 3 |
| 4 | Solan, Himachal Pradesh | 2 | 1 | 3 |
| 5 | Jamshedpur | 2 | 1 | 3 |
| 6 | Ranchi | 2 | 1 | 3 |
| 7 | Talwandi Saboo, Punjab | 2 | 1 | 3 |
| 8 | Dehradun | 2 | 1 | 3 |
| Total | | 16 | 8 | 24 |

CALIBRATION OF RADIOMETERS UNDER COMMERCIAL MODE

3.9 The commercial calibration mode program was initiated in 2017 by NISE to extend the calibration services to any private organization and Institute in

the country at applicable calibration charges. During the period, the Pyranometer sensors from various solar PV Power Plant were received for calibration at SRCL. Total 14 Pyranometer from 5 different firms were successfully calibrated at SRCL and calibration reports were issued.

INTER-LABORATORY COMPARISON (ILC) OF PRIMARY STANDARD SOLAR RADIATION SENSOR OR ABSOLUTE CAVITY RADIOMETER (ACR) AT INDIAN METROLOGICAL DEPARTMENT (IMD), PUNE

3.10 To validate the calibration traceability of solar radiometric calibration with World Radiometric Reference (WRR) Scale, Inter-laboratory Comparison (ILC) event of the primary standard sensor was organized at IMD Pune in March 2018, following the proposal from NISE. The event saw the participation of other organizations like calibration laboratory from National Institute of Wind Energy (NIWE). IMD Pune is World Meteorological Organization (WMO) designated Regional Radiation Center (RRC) for the Asian region, responsible for dissipating the WRR traceability to National Calibration laboratories like SRCL operating within the country. The event was organized with an objective for establishing the reliability of operation of SRCL Primary Standard

Sensor or Absolute Cavity Radiometer (ACR) (Eppley make AHF-AWX) by comparison with IMD Pune ACR under various conditions. This national level event continued for approximately 13 days at IMD Pune surface Meteorological laboratory where NISE and NIWE lab ACR were compared with respect to IMD ACR. The event was successfully concluded with ACR from SRCL NISE and NIWE lab showing stable performance in comparison to IMD ACR with variation under the WMO stated values. Figure 3.6 shows the ILC event at IMD Pune surface meteorological laboratory held in Pashan, Pune March 2018.

UPCOMING ACTIVITIES

3.11 Solar Resource Division of NISE is working on the enhancement of existing SRRA facility by addition of UV measurement facility consisting of higher standards such as UV A and UV B radiation measuring sensors. NISE aims to further upgrade its facilities to provide scheduling and forecasting services to other countries and private organizations.

SOLAR PHOTOVOLTAIC TECHNOLOGIES, TESTING, QUALITY & CERTIFICATION

NISE is a premier government institute established for providing testing, and certification of different solar photovoltaic components such as modules, water pumps, charge controllers, inverters, batteries, etc. During the year, NISE has certified and conducted testing of 1,538 samples while maintaining the quality and assessing the safety of each product. The Test facilities were upgraded for providing better performance in measurements. Furthermore, NISE conducts inspection of relevant performance parameters and analyses the root cause for the improvement in the system.

4.2 Solar Photovoltaic Module testing facility and inverter laboratory has maintained its NABL (National Accreditation Board for testing & calibration Laboratories) accreditation as per standard ISO 17025: 2005. The testing of Solar PV module and inverters were continued as per IEC 61215. The enhancement of the facilities for conducting the testing for safety standard following IEC 61730-1, 61730-2 were prepared for NABL accreditation. Electroluminescence lab was augmented with addition of equipments for testing the degradation mechanism of solar PV Modules. Advanced SPV Systems & Lighting Laboratory was renovated into a new well-equipped testing arrangement. The certification of major secondary battery technologies according to relevant national and international standards up to a capacity of 18V and 2000Ah were provided. Additionally, during the year, NISE has set up a conveyable Mobile Testing Set up for an ease of testing of solar photovoltaic components in the solar power plant. This Mobile application is equipped with facilities for testing of solar photovoltaic modules, inverters, solar water pumping system etc.

PHOTOVOLTAIC TESTING FACILITY (PVTF)

4.3 Photovoltaic Testing Division in NISE has been established for providing the customers with accurate and reliable results while maintaining its quality. In the year 2017-18, this laboratory has been committed to acquiring the BIS recognition. The laboratory gradually expanded its facilities while offering the range of services and catered the needs of the customers. The new state of the art laboratory scientific equipment were procured i.e. (i) Large Area Temperature Controlled Water Bath, (ii) Water Tensiometer, (iii) Robustness of Terminations, (iv) Infrared Thermometer and Multi-Function Meter, (v) UV Chamber (Consignment shipped), (vi) Sun Simulator with Built-in Temperature Control Unit (Under Procurement), (vii) Three Large Area High Capacity Environmental Chambers (Under Procurement), (viii) Mechanical Safety-Related Equipment (Under Procurement). The photovoltaic testing laboratory activities continued by the team, during the year by following the good practices of laboratory quality management, and generated a major share of revenue for NISE. Figure 4.1 shows the photovoltaic test facility available at the NISE campus. The activities of the laboratory in-house at NISE has the following facilities.

TESTING OF MODULES AS PER IEC 61853 (Part1)

4.4 NISE has the test facility for testing of PV module at 23 different irradiance and temperature conditions as per IEC 61853 (part 1). The testing of PV module is done in both indoor & outdoor conditions and the certification and translation procedure are followed as per IEC 60891 (Edition 2).

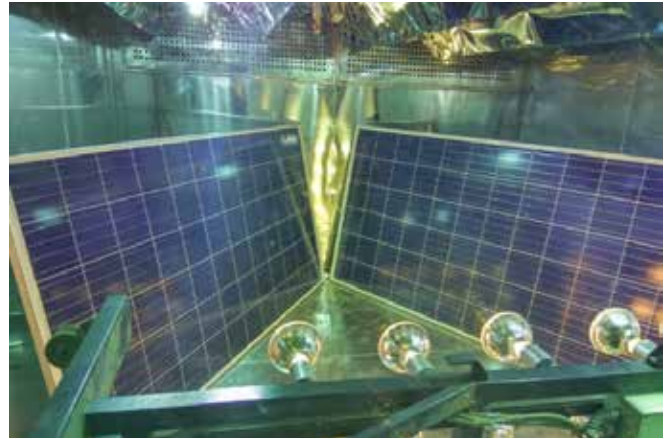


Figure 4.1 : Photovoltaic Test Facility

SALT MIST CORROSION TEST

4.5 This standard describes the test sequence used to determine the variation in the resistance of different PV modules caused due to corrosion from salt mist containing Cl⁻ (NaCl, MgCl₂, etc.). This standard also provides the means to evaluate possible faults caused in PV modules while operating under wet atmospheres having a high concentration of dissolved salts (NaCl). Depending upon the specific nature of the surrounding atmosphere to which the module

is exposed in real operation, testing severities can be applied. Some of the severities with its duration and purpose are given in the Table 4.1. The severity Level 1 is intended to be used for PV modules used in marine environment, or in close proximity to the sea. The severities level 3 to 6 are intended for PV modules operating in locations where there could be a change between the salt-laden atmosphere and dry atmosphere. There are five severities applicable for the PV Modules according to IEC 61701: 2011 and IEC 60068-2-52 Kb: 1996.

Table 4.1 Duration and purpose of the severities of the test

| Severity | Purpose | Test conditions | Duration of conditioning |
|----------------------|---|--|--------------------------|
| Level 1: Generalized | Marine Environment and commonly used as a general corrosion test in Component Quality Assurance Procedures. | 4 cycles [1 cycle consists of Salt spray: 2hrs, followed by Humidity Storage: 7 days] | 28 days |
| Level 2: | Not Applicable for PV modules (very Light Test Conditions) | 3 cycles [1 cycle consists of Salt spray: 2hrs, followed by Humidity Storage: 20-22 hrs.] | 3 days |
| Level 3: | Salt-laden and Dry Atmosphere | 1 Test cycle: 4 cycles + 3 Days ambient storage at 23°C and 45% - 50% R.H. [1 Cycle: Salt spray: 2 hrs. followed by Humidity storage: 20-22 hrs.] | 7 days |
| Level 4: | Salt-laden and Dry Atmosphere | 2 Test Cycles. | 14 days |
| Level 5: | Salt-laden and Dry Atmosphere | 4 Test Cycles. | 28 days |
| Level 6: | Salt-laden and Dry Atmosphere | 8 Test Cycles. | 56 days |

Note: The Comprehensive Test Sequence takes much more time than the above-specified duration for conditioning. The test time depends on the queue.

PID TESTING

4.6 The IEC 62804 standard has been modified by keeping in mind the harsh environmental conditions of India. In India PV module failure rate is very high due to the hot and humid conditions, in order to simulate the Indian operating conditions, NISE is carrying out the PID testing as per the MNRE specifications (a) Module temperature: $85^{\circ}\text{C} \pm 2^{\circ}\text{C}$, (b) Chamber relative humidity: $85\% \pm 3\%$ Relative Humidity, (c) Dwell: 96 h at the above stated temperature and relative humidity (not including stabilization), (d) Cycle-3, (e) Voltage: Module rated system voltage (positive and negative polarity).

4.7 After each round of stress, the module shall be allowed to recover for a period of 2 hours followed by visual inspection, Electroluminescence (EL) measurements, insulation test and power measurement at Standard Test Conditions (STC). After completion of the test, modules shall meet the pass criterion of visual inspection and insulation test. No micro-cracks shall be detected during EL measurement and power degradation at STC shall be less than 5%, in order to pass the test. The system voltage details of the module are to be provided by the module manufacturer.

UV TESTING OF PV MODULES

4.8 NISE has established UV chamber facility with UVA and UVB radiation along with variations in humidity and temperature. The procedure for UV susceptibility testing of PV is followed as per IEC 61345 & IEC 61215. The objective of this test is to determine the ability of the module to withstand the exposure to ultraviolet (UV) radiation from 280 nm to 400 nm. This test is useful for evaluating the UV resistance of materials such as polymer, protective coating, etc.

ELECTROLUMINESCENCE (EL) TESTING & CHARACTERIZATION

4.9 The Electroluminescence laboratory acquaints its customers with the fact of degradation in the solar photovoltaic modules. It helps in the prediction of

the life of solar PV modules and predicts the cause for its degradation. This EL testing highlights the information that is normally not detectable with visual inspection. Figure 4.2 shows the EL images of tested modules before and after the PID test. The test identifies microcracks, degradation and shunted areas on the cells in the PV module. NISE is capable of EL test facility for PV modules up to the size of 2 m x 2 m. This test is performed in the laboratory at NISE with manual operation (loading/unloading) for indoor measurement of PV Modules (framed/unframed), both before and after lamination as per the DIN IEC 60904-13:2016 standard. During the financial year 2017-18, this lab tested 112 samples from different types of PV modules, 88 samples tested were for internal users and 24 samples were tested for commercial purpose.

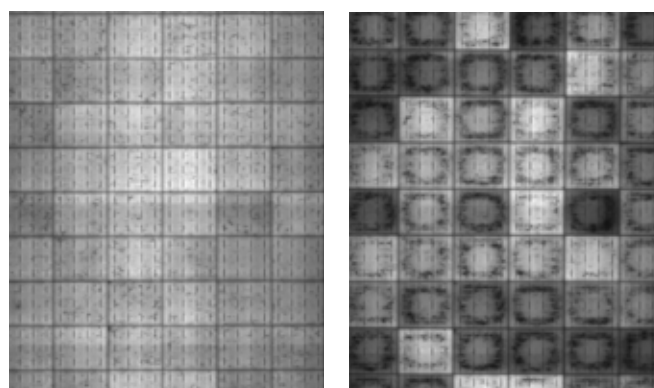


Figure 4.2 : Shows the EL images of the tested modules before and after the PID test

POWER ELECTRONICS LABORATORY

4.10 NISE has established facilities for testing and evaluation of Solar Inverters/ Power Conditioning Units (PCU) of capacity ranging up to 50 KVA. All types of PCUs, Hybrid, Standalone, Grid-tied Inverters (GI) and Pump Controllers are tested in this laboratory. The test report comprises all important parameters, including those parameters required as per International standards and MNRE specifications. The report also includes claims made by manufacturers and observations made during the evaluation of the samples. The details of the tests and standards followed in NISE are given in Table 4.2 and the testing setup of power electronics laboratory is shown in Figure 4.3.



Figure 4.3 : Power Electronics Laboratory Setup

Table 4.2 Name of tests and Standard for testing of PV Power converters

| SPV Inverter: Standalone [(Solar + Battery only), (Solar + Grid import + Battery only)] | SPV Inverter: Hybrid [(Solar + Grid import & Export + Battery only + any other source)] | SPV Inverter: Grid-tied [string inverter] | SPV charge controller | SPV pump controller |
|--|--|---|--|---|
| <p>a) Visual Inspection b) Performance testing i. Inverter efficiency test as per IEC 61683 ii. MPPT efficiency test as Per EN 50530 iii. A charge controller performance test as per IEC 62509 c) Protection test i. Battery reverse Polarity test ii. PV reverse polarity test iii. Insulation resistance test d) Environmental test as per IEC 60068-2-(1,2,14 & 30)</p> | <p>a) Visual Inspection b) Performance testing i. Inverter efficiency test as per IEC 61683 ii. MPPT efficiency test as Per EN 50530 iii. A charge controller performance test as per IEC 62509 iv. Islanding prevention measures for utility-interconnected inverter photovoltaic inverters as per IEC 62116 v. Photovoltaic Systems-characteristics of utility interface as per IEC 61727 c) Protection test i. Battery reverse Polarity test ii. PV reverse polarity test iii. Insulation resistance test d) Environmental test as per IEC 60068-2-(1,2,14 & 30)</p> | <p>a) Visual Inspection b) Performance testing i. Inverter efficiency test as per IEC 61683 ii. Over all system & MPPT efficiency test as Per EN 50530 iii. Islanding prevention measures for utility-interconnected inverter photovoltaic inverters as per IEC 62116 iv. Photovoltaic Systems-characteristics of utility interface as per IEC 61727 c) Protection test i. Battery reverse Polarity test ii. PV reverse polarity test d) Environmental test as per IEC 60068-2-(1,2,14 & 30)</p> | <p>a) Visual Inspection b) Performance testing i. MPPT efficiency test as Per EN 50530 ii. Charge controller performance test as per IEC 62509 c) Environmental test as per IEC 60068-2-(1,2,14 & 30)</p> | <p>a) Visual Inspection b) Performance testing i. MPPT efficiency test ii. System efficiency test iii. Overall system efficiency test c) Protection test i. PV reverse polarity test ii. Short- circuit test iii. Open circuit test iv. Dry run test v. Insulation resistance test d) Data monitoring test i. Electrical parameter Logging ii. Continuous flow iii. Cumulative sum of flow iv. Fault indication e) Environmental test as per IEC 60068-2-(1,2,14 & 30)</p> |

BATTERY TEST & CHARACTERIZATION

4.11 The Battery Characterization Laboratory has a comprehensive set-up to carry out testing and certification of major secondary battery storage technologies. The lab is dedicated to providing service to the energy storage community, research programs, quality testing and leadership in battery safety and dependability. The lab is serving battery/cell manufacturers by supplying first-class service at a nominal price as compared to other testing laboratories.

4.12 The manufacturers were advised to follow best practices to bring about long-lasting and effective products. The lab provides a variety of battery testing service from small cell to large battery pack system including technologies like lead-acid, Li-ion (all salts), NiMH, NaS and Ni-Cd. The testing services include measurements such as performance parameter, reliability and endurance test on secondary battery technology. For maintaining standard testing conditions, the lab is following the IS and IEC standards and this laboratory offers testing under different types of climatic chambers having a broad range of controlling temperature. The details of standards being followed for different types of batteries, major test facilities offered and the battery types/technologies being tested at NISE are given in Figures 4.4, 4.5, 4.6 and 4.7 respectively. The total 238 number of Lead Acid and Li-ion battery samples were received and tested in the financial year 2017-18.



Figure 4.4: Test set up of battery testing laboratory

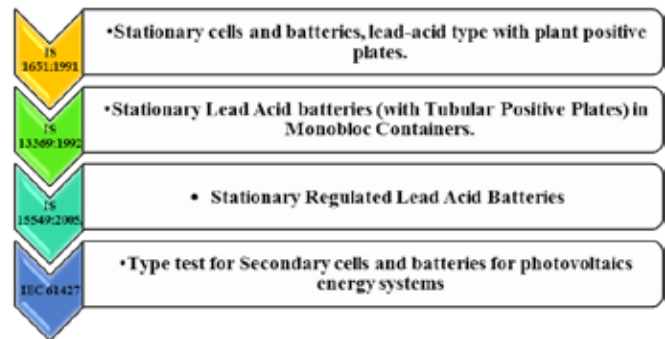


Figure 4.5: Battery test facilities and their corresponding standards.

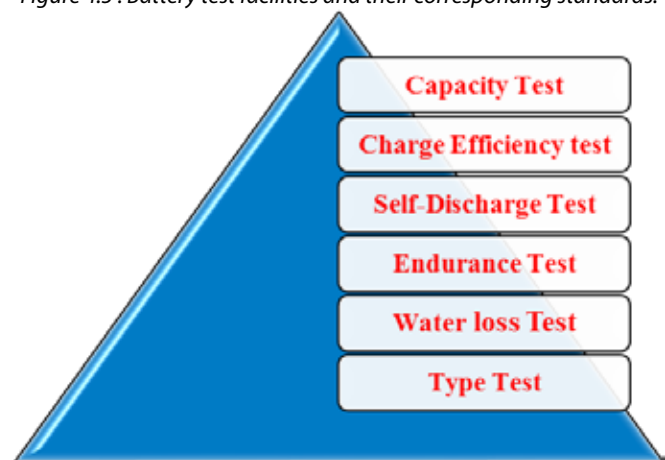


Figure 4.6: Major test Facility being offered at NISE

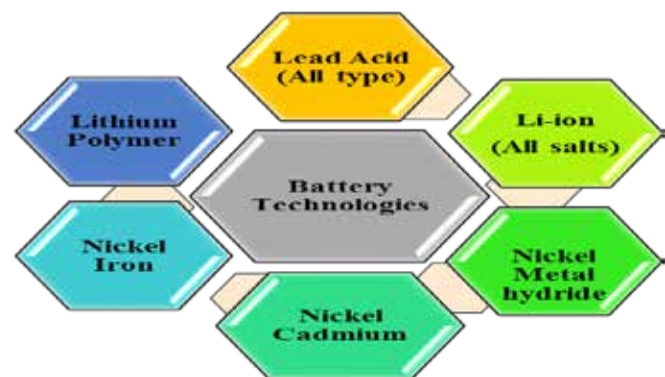


Figure 4.7: Battery technologies being tested at NISE

4.13 In addition to routine testing, battery test lab is also enlisted in different research and development projects as follows:

- Evolution of Testing Profile for emerging battery technologies.
- Life Cycle Tests on different batteries.

- iii. Exploring Battery Health analysis techniques.
- iv. Degradation Analysis of battery technologies.

SOLAR WATER PUMPING TEST FACILITY

4.14 The institute has an automated and upgraded testing facility for testing 8 different types of water pumping systems at a time with more accuracy and data logging. In addition to this, the indoor testing and simulation facility is also available for testing under different conditions for all the seasons.

4.15 The testing and certification for SPV pumps were performed as per MNRE specifications and guidelines. It has a testing facility for performance evaluation

and analysis, optimization of different types of pumps (AC as well as DC and Submersible as well as Surface pumps) of capacities ranging 1 HP to 10 HP for different head ranging from 10 m to 100 m. The parameters measured and evaluated are “Wire to Water efficiency”, “total water output per day”, “water output per day per watt of STC capacity of PV array”, maximum dynamic head, remote monitoring operation, different protections testing i.e., dry running, short circuit protection and open circuit protection. A set up of water pumping test facility at NISE is shown in Figure 4.8. During the year 2017-18, NISE has tested 70 different types of pumps.



Figure 4.8: Pump testing arrangement at test bed along with Control room for display and data logging

4.16 The following major activities were performed by the solar water pumping laboratory during 2017-18:

- Study on a suitable selection of different pumps and optimization of different components at different climatic conditions.
- Collaboration with renowned industries for technological advancements and knowledge sharing.
- Testing of different types of pumps of capacity from 0.5 HP to 10 HP in real outdoor conditions as per MNRE guidelines.
- Testing of different types of pumps of capacity from 1 HP to 10 HP with array simulator for different day profiles taking temperature and irradiance correction into account as per MNRE guidelines.
- During the year two papers were published on SPV water pumping in renowned national and international journal.
- A new project on “Establishment of Centre of Excellence for Solar Pumping Systems (CESPS)” is in its final stage of approval.

ADVANCED SPV SYSTEM AND LIGHTING LABORATORY

4.17 NISE is playing an important role in testing the performance and reliability of solar based lighting system. The certification and testing were performed as per MNRE Technical Specifications for White LED (W-LED) based Solar Photovoltaic Lighting systems and User defined Technical Specifications for other PV based system i.e. road stud, garden light, task light, study lamp, torch, solar e-rickshaw, air conditioner etc. The following are the recommended sequence of testing for qualification testing of SPV Lighting system:

(i) Visual Screening & Sample Preparation,



Figure 4.9 : Performance testing of solar lighting system



Figure 4.10 : Advanced SPV System and Lighting Laboratory

(ii) Light Output & Distribution Test, (iii) Driver Efficiency, Charge controller behaviour & Solar Charge efficiency test, (iv) Temperature Compensation, (v) Duty cycle Test & Autonomy Test, (vi) Other Protection Test, (vii) PV Module Characteristics Test, (viii) Battery Capacity Test. Figure 4.9 shows the performance testing of solar lighting laboratory. During the financial year 2017-18, this Advanced SPV Lighting Laboratory was renovated and established with the new testing arrangement as shown in Figure 4.10. A total of 121 samples were tested and certified in this laboratory.

4.18 Additionally, for development of this laboratory new facilities were created/upgraded, and the following major initiatives were taken by the scientists:

- i. Procurement of new instruments for R&D, and testing purpose such as Temperature controlled Integrating Sphere System, Advance Gonio Photometer, Environmental Chambers, and Ingress Protection Chambers etc.
- ii. Preparation of BIS/IEC Accreditation of the laboratory for available standards.
- iii. R&D in degradation of photometric properties as a function of temperature for LED luminaries.
- iv. Inclusion of standards like IESNA LM-78-07 (IESNA, Approved Method for Total Luminous Flux Measurement of Lamps Using an Integrating Sphere Photometer), IES LM-79-08/ IS 16106:2012 (Method of Electrical and Photometric Measurements of Solid State Lighting (LED) Products) and IESNA LM-82-12 (The approved method for determining photometric properties as a function of temperature for LED light engines and integral lamps).
- v. Research and development on Flicker test, Horticultural lighting performance reporting computing PPF, PRF, Photon Efficiency, Photosynthetic Photon Flux (PPF) etc.
- vi. Inclusion of Ingress protection and lumen

maintenance test for the performance and reliability study of the lighting systems.

4.19 Besides, the regular testing of solar lighting system, the laboratory is involved in development of testing methodology of other PV based systems such as solar e-rickshaw, solar air conditioner, solar weighing machine, solar stud, solar power pack etc., for Performance evaluation of different types of charge controller topologies for Solar Street lighting system, Comparative study of performance of different types of charge controllers in different climatic conditions, experimental & practical study to find best suited protection scheme for solar street lighting system and comparison of different heat sink arrangement of Solar Street lighting systems to find the best heat sink design for heat dissipation. Figure 4.11 shows the solar E- rickshaw and user-defined solar power pack.



Figure 4.11 : Solar E-rickshaw & User defined solar power pack

SOLAR CELL CHARACTERIZATION AND OUTDOOR MODULE TESTING FACILITY

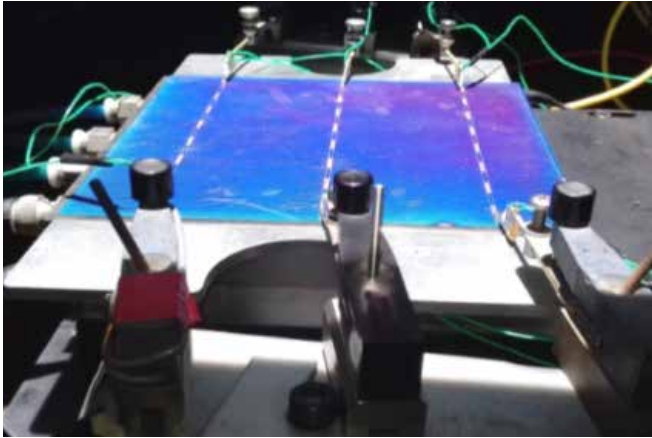


Figure 4.12 : Solar cell testing set up

4.20 Solar cell characterization laboratory focuses on enhancing the research and testing of solar cells, energy and power evaluation at Standard Test Condition (STC) and establish new improvements in standardization for the testing procedure. Figure 4.12 shows the solar cell testing set up available at NISE. The testing was performed on solar cell at standard test condition (1000 W/m^2 , 25°C cell temperature, Air mass 1.5), at different temperature and irradiance condition as per IEC 60904-1:2006/IS 12762 (Part-1) The solar cell testing and characterization facility at NISE is capable of handling solar cells up to 6-inch x 6-inch with up to 4 bus bars in size. A new Spectro-Radiometer was added to the facility for testing spectral content of light. Therefore, the lab is now capable of estimating mismatch factor of solar cell with known spectral response data. Furthermore, to upgrade the facility, the procurement of Spectral Response System is under process.

4.21 The research & development activities performed during the year for analyzing the performance of solar cells are as follows:

Uniformity of light

4.22 Uniformity of light of the solar simulator was tested using the reference solar cell. It has been observed that the non-uniformity of light on 6 X 6 square inches of solar cells holding chuck is 1.08%. Work is going on to estimate the total uncertainty of the system including all the required parameters. Figure 4.13 shows the Uniformity of light throughout the testing area.

Study about the Spectrum of light:

4.23 The group has studied the spectrum content of light at different irradiance conditions. The percentage contribution of energy with respect to the wavelength of spectrum for different intensity range is estimated. Figures 4.13 & 4.14 show the change of spectrum and percentage contribution of energy for different wavelength and Intensity.

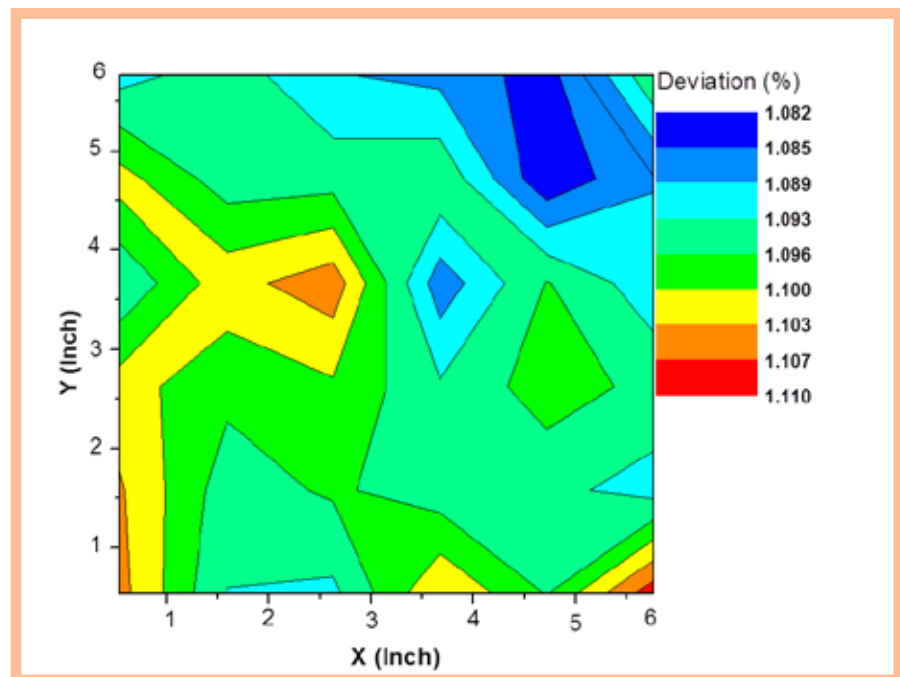


Figure 4.13 : Uniformity of light throughout the testing area

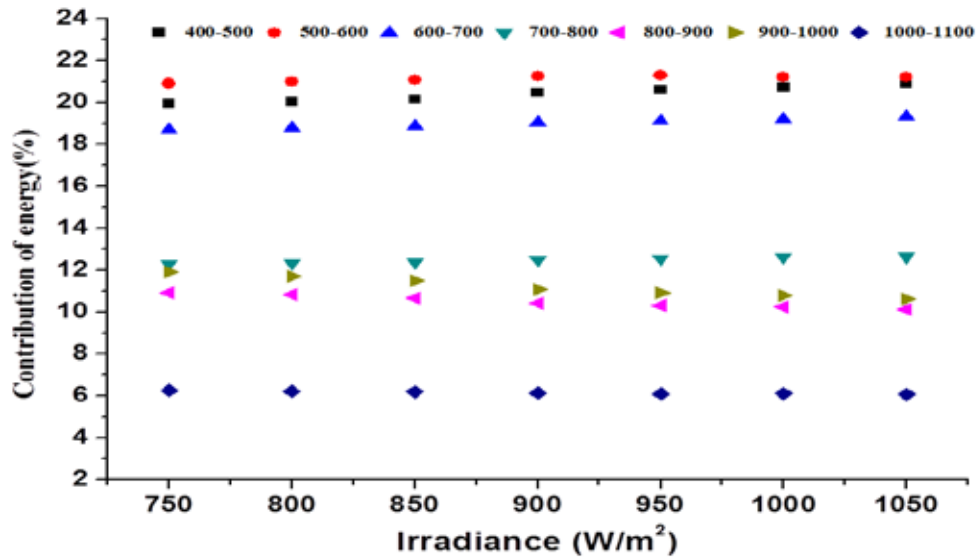


Figure 4.14 : Change of Spectrum and % Contribution of energy for different wavelength and Intensity

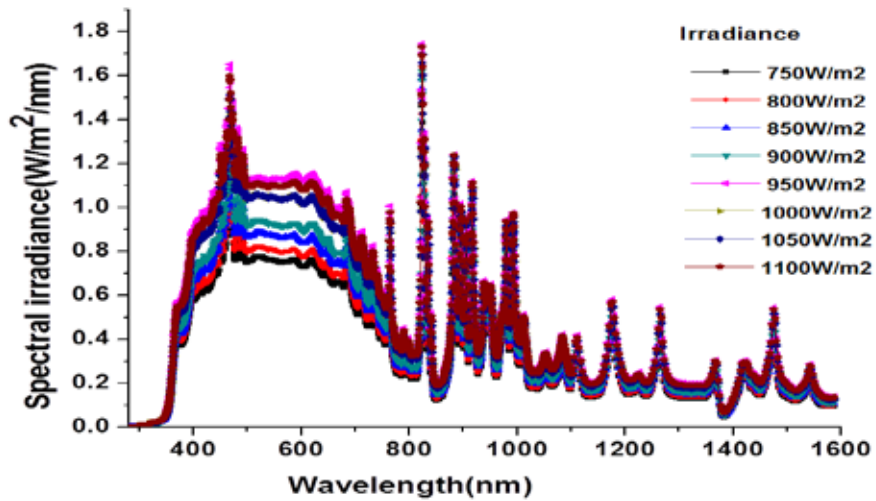


Figure 4.15 : Change in Spectrum for different Intensity



Figure 4.16 : Test set up for Mono C-Si technology PV module

OUTDOOR MODULE TESTING FACILITY

4.24 NISE has an outdoor photovoltaic modules characterization facility comprising of test equipments and set-ups for determining the energy rating of crystalline silicon as well as thin film PV Modules as per the International standards such as IEC 61853 (Part-1) and IEC 60891 (Edition 2.0), IEC 61829. Figure 4.16 shows the test set

up for Mono C-Si technology PV Module. I-V measurements on PV modules under outdoor conditions, close to standard test condition were performed by using a mounting structure which can track the Sun. For STC rating of the module, I-V data were translated from close to STC of radiation, temperature, and spectrum using IEC 60891 procedures. Long-term performance and stability of different PV technologies arrays is also conducted under various weather conditions. Using an I-V tracer (PVPM), measurements are performed continuously at preset intervals. PVPM enables the measurement of I-V-curve of a single photovoltaic module as well as of string of modules. The outdoor testing of PV modules consists of following tests, (i) Maximum Power determination, (ii) Low irradiance performance, (iii) Long-term Module performance and stability, (iv) Outdoor median performance, (v) PID testing.

MULTIPLEXING SYSTEM FOR I-V CURVE MEASUREMENT OF PV MODULES

4.25 To measure the performance of PV modules under natural sunlight conditions it is necessary to measure their I-V curves periodically under all possible weather conditions. I-V curve measurement system is built completely modular, so that different combinations of modules, electronic loads (passive or active) or meteorological sensors can be realized. The setup as shown in Figure 4.17 is able to measure different types of modules within the same multiplexing system viz. crystalline modules, thin film modules, and even single cells are possible. Several options for a customized optimization of the MUX are available, such as additional data logging, complete meteorological sensor station or additional temperature sensors for every module.



Figure 4.17: Test set up for IV tracing of PV Module

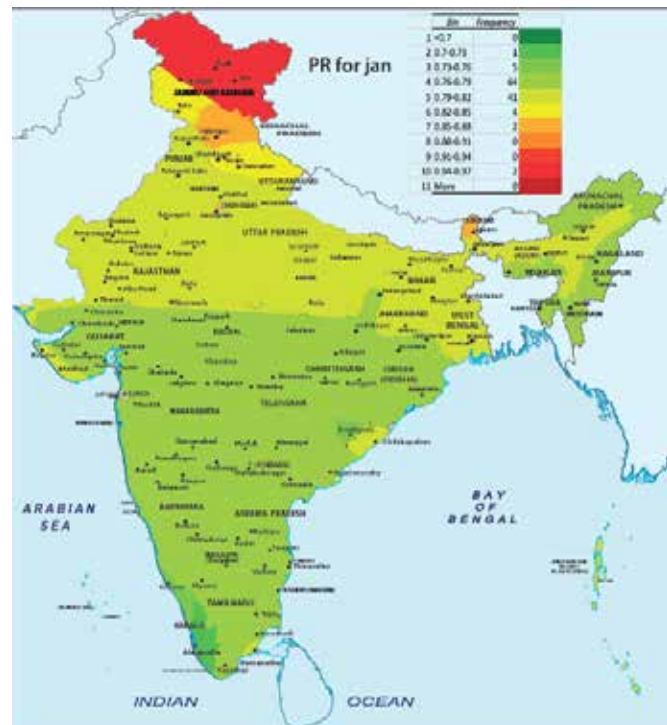


Figure 4.18: PR distribution of C-Si

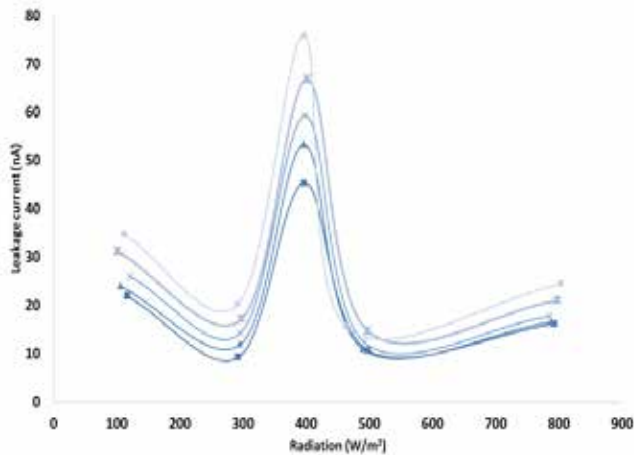


Figure 4.19 : Effect of intensity on leakage current of PV module

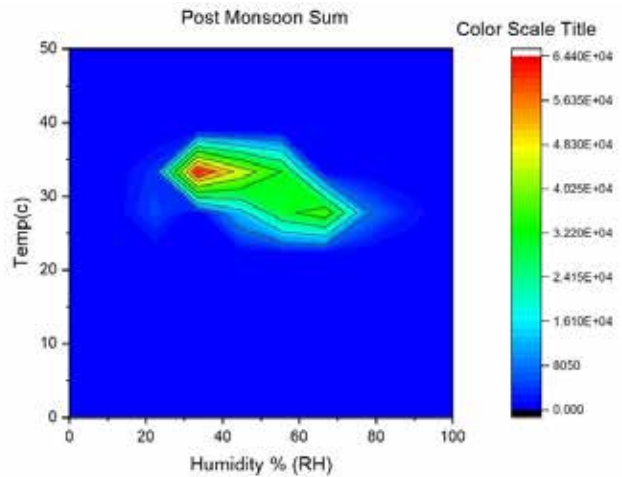


Figure 4.20 : Distribution of humidity and ambient temperature for the studied site

SOLAR PHOTOVOLTAIC OUTDOOR R&D PROJECTS

4.26 The R&D projects executed during the year are:

Classification of climatic zones of India based on the performance of PV module

4.27 Usually, the climatic zones are divided based on irradiance, temperature, humidity and other environmental parameters. But the effect of each environmental parameter is different in terms of performance of PV module. To find out the suitable PV technologies and potentiality for different places, this group was working to classify the climatic zones of India based on the performance of the PV module. Figure 4.18 shows an isopleth map of performance ratio (PR) of C-Si technology for the month of January.

Analysis of climatic parameter and applied voltage effect on the leakage current & Potential Induced Degradation (PID) of the different photovoltaic module.

4.28 The analysis to understand the leakage current at different voltages and under different environmental conditions were performed in the laboratory. The leakage detection circuit for PID detection in the field condition was designed during the research and the analysis about the effect of PID on the performance

of PV module, different detection methodologies, and testing procedures were performed during the study conducted at NISE. The Figure 4.19 shows the effect of leakage current with respect to intensity variation on solar PV module.

Soldering defect and its effect on the performance of PV module

4.29 The study was performed for the solder bond failure mode in field aged PV module. The mechanism showed the cracks and hotspot formation at the module level from solder bond defect. The further study was conducted about the growth in soldering defect by applying stress in terms of temperature and humidity cycles using climatic chamber. An image processing technique is developed to find out the soldering defect. Figure 4.20 shows the condition of the site in which the solar modules are tested.

Payback period estimation of PV power plant using existing policies for different climatic zones of India and providing a framework for new solar policy.

4.30 The research was performed for developing solar policies and advise customers with this information. The suitability of thin film technologies in terms of payback period for different climatic zones using

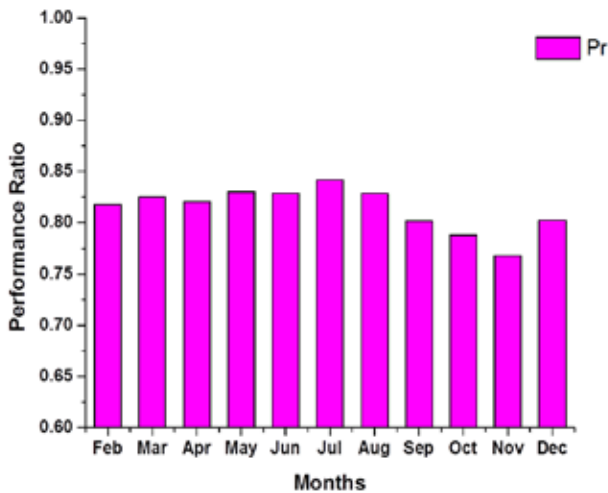


Figure 4.21 : Distribution of PR of CdTe technology for the studied site

different energy estimation methods were being analysed. Figure 4.21 shows the performance ratio of CdTe technology.

MOBILE TESTING SET UP

4.31 NISE has developed a Mobile testing set up for testing of solar photovoltaic components in the solar power plant. Figure 4.22 shows the solar mobile test facility. This Mobile application is equipped with facilities for testing of solar photovoltaic modules, inverters, solar water pumping system etc. Solution-oriented testing services and programs for solar power plants are the specialties of this moveable Mobile Vehicle. During the year, it has performed inspection of rooftop and ground-mounted PV power plants across the country. This facility also provides consultancy



Figure 4.22 : Mobile solar test facility developed at NISE

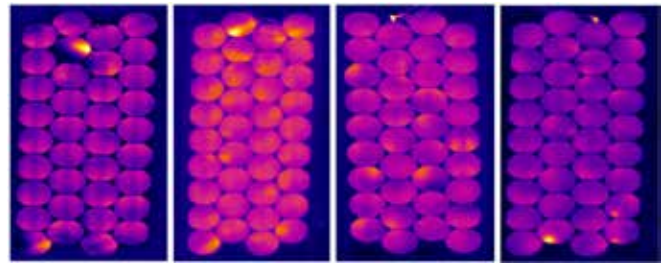


Figure 4.23 : IR images of Solar PV module

for improving the performance of PV power plant. This Mobile Photovoltaic testing facility provides in-depth analysis in the field for, (i) Visual Inspection of PV power plants, (ii) Outdoor module testing, (iii) Electroluminescence inspection 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. Figure 4.23 shows the IR (Infra-red) images of Solar PV Modules.

QUALITY MANAGEMENT AT NISE

4.32 Quality plays an essential role for any organisation to adhere to the national & international standards. NISE is continuously striving to achieve quality in testing of solar systems to meet the requirement of all stakeholders by its continuous & rigorous methodologies of audit plans and standards of IEC/ ISO 17025. To meet the quality, the laboratory test equipment's are calibrated each year as per the norms of Lab Policy to meet accuracy and standards. The management has established an objective to satisfy the National Accreditation Board for Testing and Calibration Laboratories (NABL) for performing quality testing services to its customers. The management frequently reviews documentation by conducting an internal audit, analyzing the scope of improvement in the testing procedures and continually improve the effectiveness of its Quality Management System.

4.33 Additionally, this is also being maintained by the state of the art infrastructure, testing methods

of International level, well-trained employees and continual improvement of the effectiveness of the quality management system as per International Standard ISO/IEC 17025:2005. During the year, the photovoltaic testing facility has maintained its NABL Accreditation and the quality management system has prepared the draft and facilities for obtaining BIS recognition.

4.34 During the financial year 2017-18, the NABL accreditation of these tests were obtained by NISE (i) Salt-Mist Spray Test as per IEC 61701, (ii) Inverter Test Lab, (iii) Hail Test (IEC 61215), (iv) Mechanical Load Test (IEC 61215). The test set-up prepared for NABL Accreditation are (i) Battery tests as per IS: 13369, IS: 15549, IS: 1651, (ii) Solar - lantern as per IS standards, (iii) PID testing of crystalline silicon modules as per IEC:TS: 62804-1.

QUALITY POLICY OF NISE LABORATORY

4.35 National Institute of Solar Energy is committed to provide Performance Evaluation and Testing Services for Solar Cells, PV Systems, Inverters, Charge Controllers, Batteries and PV modules by adopting the best Engineering practices in accordance with International Quality Standards. The test facilities established at NISE meet the requirements to conduct the tests as per National/International Standards. This is being achieved by continuous upgradation of the infrastructure and updating of the state of art test facilities, test methods, test personnel and continual improvement of the effectiveness of the Quality Management System as per International Standard ISO/IEC 17025:2005.

FUTURE PLANNING FOR ACCREDITATION AT NISE

4.36 The following test facilities are planned to be established with accreditation from NABL and BIS in NISE.

- i. Establishment of IEC TS 62782 (Dynamic Mechanical Load Test).
- ii. Establishment of IEC 62716 (Ammonia corrosion testing)
- iii. Establishment of Mobile test facility for PV & BoS.
- iv. Establishment of IP test facility.
- v. Accreditation of NABL, BIS/IECEE certification systems for Energy rating as per IEC 61853, PID (as per MNRE Guidelines/IEC TS 62804) IEC 61730 & Mobile test facility as per IECRE.

ACHIEVEMENTS

4.37 During the year a total of 1538 samples were tested, that generated a total revenue of Rs.3.156 crore. The details of samples and revenue generated from testing and certification at solar photovoltaic facility at NISE are shown in Table 4.3.

Table 4.3 The number of samples tested, the revenue generated

| S. No. | Testing of Samples | Quantity (Number of Samples) | Revenue (Rs. In Crores) |
|--------|--------------------------------|------------------------------|-------------------------|
| 1. | Solar Photovoltaic Module | 951 | 1.05 |
| 2. | Electroluminescence Laboratory | 112 | 0.096 |
| 3. | SPV Inverter | 46 | 0.62 |
| 4. | Battery Testing | 238 | 0.62 |
| 5. | SPV Water Pumps | 70 | 0.28 |
| 6. | LED Lightning Testing facility | 121 | 0.59 |
| | Total | 1538 | 3.156 |

SOLAR THERMAL TECHNOLOGIES

The Solar Thermal Division of NISE has been involved in the implementation of various research projects in collaboration with National/International research organizations, academic institutions, and industries. It has developed various innovative solar thermal systems. The major research and development facilities developed, and installed in the campus of NISE and the activities undertaken are presented herewith.

1.0 MW SOLAR THERMAL POWER PLANT

5.2 A grid-interactive solar thermal power plant with a capacity of 1 MWe at Direct Normal Irradiance (DNI) of 600 W/m^2 has been designed, developed, installed and commissioned at NISE. Figure 5.1 shows the 1MW solar thermal power plant at NISE. The unique feature of this plant is power generation with the integration of two different solar thermal technologies such as Parabolic Trough Collector (PTC) and Linear Fresnel Reflector (LFR), without any fossil fuel backup. Additionally, the plant combines the advantage of synthetic oil with PTC for high efficiency and Direct Steam Generation (DSG) from LFR to lower down the cost of generation.

5.3 The facility was designed to operate with steam at a pressure of 40 bar and temperature of 350°C to run a turbine. The LFR has been designed to generate saturated steam at 40 bar and 250°C . The PTC has been designed to achieve a Thermic-fluid temperature of 390°C for a parallel steam generation. However, steam generated from both the solar systems gets superheated in the superheater. Besides, the plant also incorporates 15-18 minutes of sensible storage in the form of oil, which acts as a buffer for periods when the radiation was either low or during cloudy condition. Figure 5.2 shows the process flow diagram of the 1MW solar thermal power plant.



Figure 5.1 : 1 MW Solar Thermal Power Plant at National Institute of Solar Energy

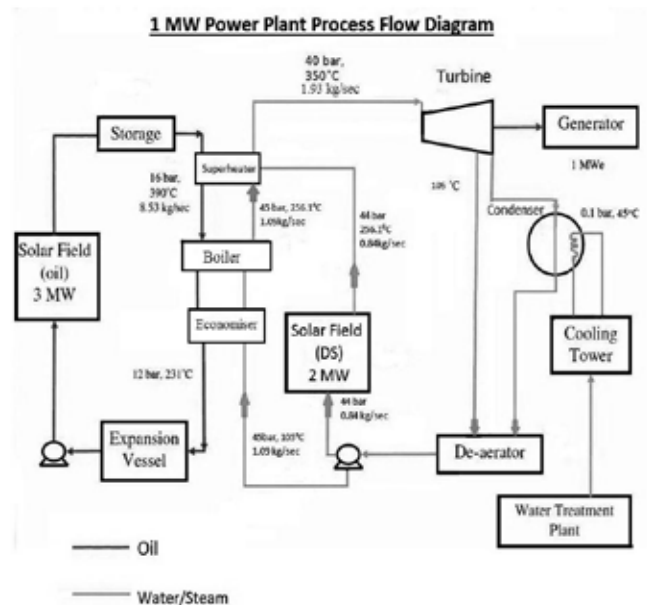


Figure 5.2 : Process Flow Diagram of 1MWe Solar Thermal Power Plant

5.4 This project was established with the main objectives of (i) establishment of a national research facility on solar thermal power (1MW grid-interactive), (ii) standardized testing, characterization and rating procedures providing an equitable basis for comparing the performance of different types of solar thermal concentrators and thermal components, (iii) Development of simulation facility for future scale-up of plant capacity.

5.5 The facility remained non-operative for a long time due to technical and administrative reasons. During the period of review, NISE has made serious efforts to resolve the technical problems in the plants. As a result of these efforts, it was possible to operate the plant at 300 kW (approx.) for certain hours during March 2018. The efforts are underway for making the plant fully operational by engaging a third party. The endeavour will be operating the plant at the optimal level depending on the resource availability.

MODULAR CENTRAL RECEIVER CONCENTRATED SOLAR POWER PLANT FOR DECENTRALIZED POWER GENERATION

5.6 Another research project for development of central cavity receiver based solar thermal storage system has been implemented at NISE. This system was developed with the financial support of the MNRE along with M/s Sun Borne Energy Technologies Pvt. Ltd. The system has been set up with the objectives of: (i) optimized design of the heliostat field, volumetric air receiver, thermal storage, the three major components of a Concentrated Solar Power (CSP) Central Receiver plant, (ii) local sources for all the key components of the plant with a focus on lowering costs, which will make the technology competitive with other forms of energy. PV tracking technology has been adopted to develop a non-pedestal heliostat system having a size of 150 m² using improved mirror curving and canting methodologies. The current heliostat tracking methodology is able to focus on a fixed target to acceptable errors of ± 1 meridians. Figure 5.3 shows

the Heliostat reflector installed at NISE.

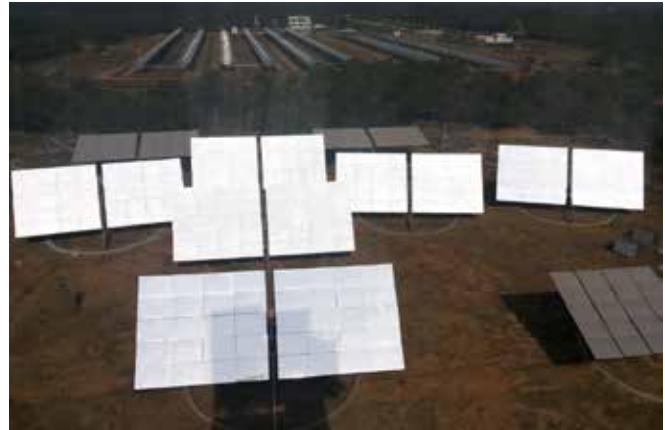


Figure 5.3 : Heliostat Reflector installed at NISE

5.7 The project was not completed fully by the project implementing agency and therefore, NISE volunteered to complete the project. Therefore, this project has been sanctioned/ supported by the MNRE to NISE in March 2018. NISE reviewed the project and made a plan with following activities to be undertaken by NISE during project duration of 18 months:

- i. Installation of further 3 more different Heliostats.
- ii. Flux characterization of the Heliostats and testing & optimization of their control system.
- iii. Reliability test for solar field commercialization.
- iv. Further testing and evaluation of 50kW receiver.
- v. Design finalization of 1 MW receiver on the basis of test results obtained from prototype receiver.
- vi. Designing and construction of a storage element, including vessel manufacturing, fill material filling, site preparation and assembling.
- vii. 1 MW Pilot plant testing and performance evaluation
- viii. The testing of the receiver & storage subsystems, including the development of a testing plan, testing for sufficient duration at different solar conditions and performance evaluation.
- ix. Overall testing & performance evaluation of Heliostat, receiver and thermal storage including control strategy during start up, shutdown and transient period.

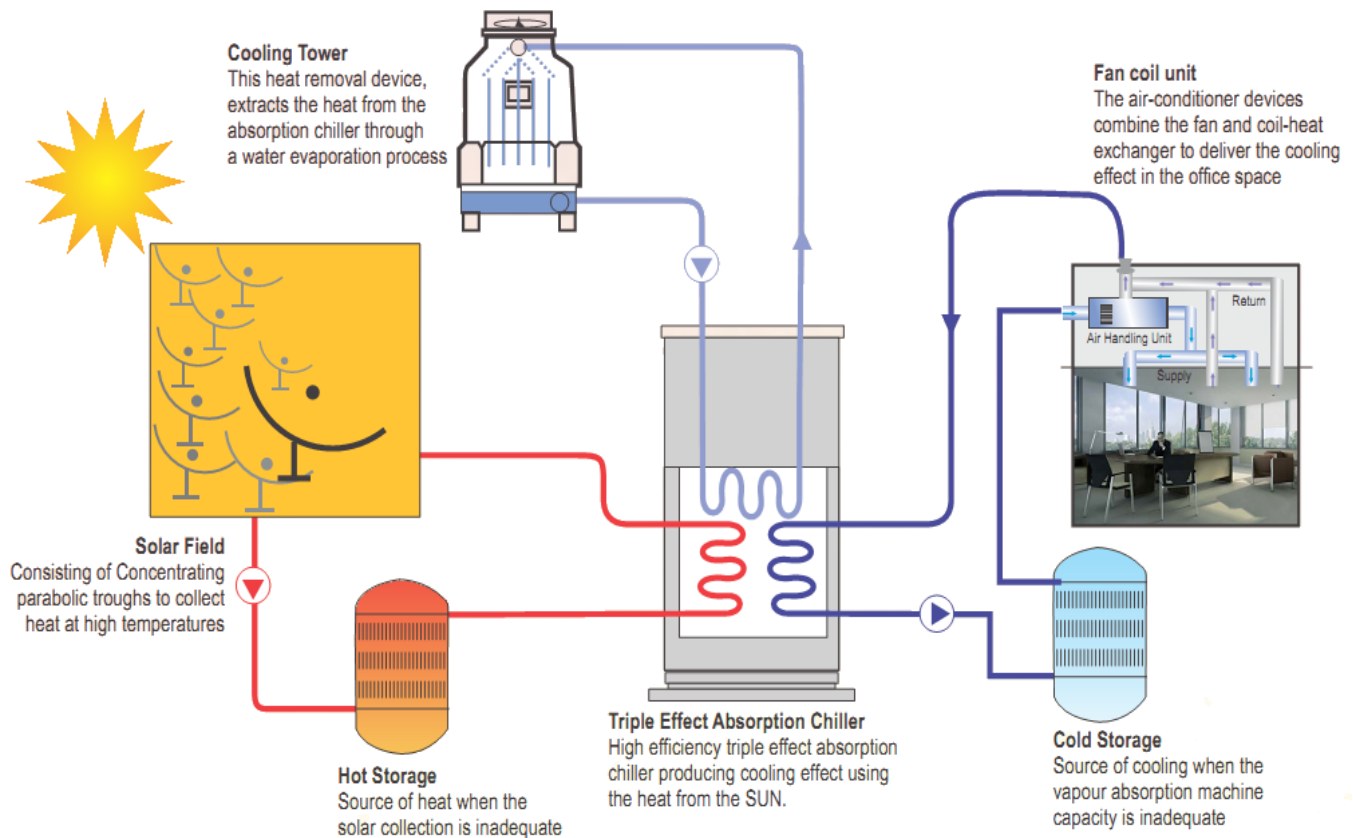


Figure 5.4 : Schematic layout of the 100 kW Absorption System

100 kW HIGH EFFICIENCY ABSORPTION PROTOTYPE SYSTEM

5.8 The system consists of a high efficiency three stage (triple effect) Vapour Absorption Machine (VAM) based on LiBr-H₂O cycle with Coefficient of Performance (COP) of 1.7 at suitable medium temperature of solar concentrating collectors with appropriate storage system. PTCs of aperture area 288m² provide pressurized water at 210°C temperature. This heat is used in VAM to generate 7°C chilled water which in turn is circulated through the Fan Coil Unit (FCU) installed in various rooms to be cooled. Figure 5.4 shows the schematic layout of 100kW absorption system. Besides, the triple effect unit, the system has indigenously built medium temperature parabolic troughs for the collection of solar energy. The system has a special arrangement for storage of heat and cool using Phase Change Materials (PCM).

In winter, the solar heated water, instead of pushing through the VAM, was circulated through the Fan Coil Unit to provide heating. Figure 5.5 shows the 100kW high efficiency triple effect vapor absorption system.

5.9 The system was commissioned in 2011. M/s Thermax Ltd operated the system up to July 2017. Fourteen Fan Coil units are currently connected with the system. During the year, this system was operated and maintained at NISE for providing cooling by utilizing the solar energy and the data was collected for the further system analysis.

15 kW ABSORPTION PROTOTYPE SYSTEM WITH AIR COOLING

5.10 A 15 kW LiBr- H₂O water double effect absorption prototype system with air cooling was installed and commissioned in December 2013 at the NISE campus.



Figure 5.5: 100 kW High Efficiency Triple Effect Vapor Absorption System

This unit used hot water at around 170°C as heat source and indigenously developed PTCs were used to provide the required pressurized hot water to the VAM with a total collector area of 96 m². This pressurized hot water in VAM was used to generate chilled water at 9°C which was circulated through the Fan Coil Unit installed in various rooms to be cooled. The system was operated and maintained by NISE during the year. Figure 5.6 shows the 15kW solar absorption refrigeration system installed at NISE.



5 kW ADSORPTION PROTOTYPE SYSTEM

5.11 A 5 kW prototype system based on water cooled adsorption cycle was installed in December 2013 at the NISE campus. The adsorbents are specially synthesized to suite the tropical climatic conditions. The objective of the project were development of cost effective high efficiency cooling engine and indigenous components for VAM. Compound Parabolic Concentrator (CPC), an enhanced version of Evacuated Tube Collectors was used to provide the required heat to the Adsorption Machine with a



Figure 5.6: 15 kW Solar Absorption Refrigeration System (Air Cooled)

total collector area of 61 m². The system provides 5 kW of air conditioning to an office cabin with chilled water at 9°C circulated through a Fan Coil Unit. The system was operated and maintained during the year.

5.12 In the year 2017-18, NISE has undertaken a study on the effect of cycle time, input temperature and condensation temperature for optimization of the system. 1 FCU of 2 ton was operated through this



Figure 5.7: 5 kW Adsorption Refrigeration system

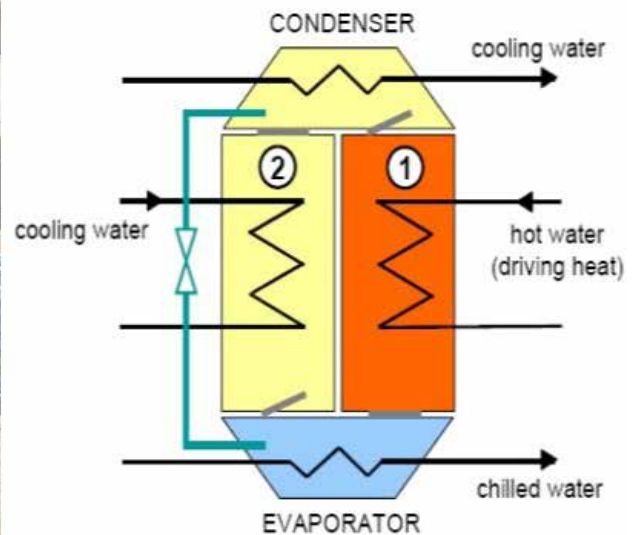
system. The total consumption of this system for the whole day was $1.5\text{kW} \times 8 = 12\text{kWh}$ (approx.) (Equivalent to the conventional AC of 1.5 ton). Figure 5.7 shows the 5 kW Adsorption Refrigeration system.

SOLAR DISTILLATION SYSTEM

5.13 A solar water desalination system was installed at the NISE campus under a collaborative project with an Australian company, FCUBED Pvt. Ltd to evaluate performance in different Indian climatic conditions. The system consists of 10 specially designed solar collector of 3 m^2 area each. A provision of SPV panel and DC pump has also been used for lifting of water from storage tank to solar collector. During the year,



Figure 5.8: Experimental setup of Flat Plate type Solar Water Distillation system



performance evaluation study was carried out and study reveals that it can produce drinking water up to 180-210 litres per day (approx.). This system is the one of the most efficient and cost effective compared to other water distillation systems. Figures 5.8 and 5.9 show the experimental set up of solar water distillation system at NISE.

50 kW SOLAR – BIOMASS HYBRID COLD STORAGE CUM POWER GENERATION SYSTEM FOR RURAL ELECTRIFICATION

5.14 A 50 kW solar-biomass hybrid cold storage cum power generation system for rural electrification was installed and commissioned at NISE campus



Figure 5.9: Experimental setup of Flat Plate type Solar Water Distillation system

in February 2012. The system consists of a 200 kW biomass gasifier including gas cleaning and cooling system, 50 kW capacity 100% producer gas engine, heat recovery unit, 15 kW (NH₃+H₂O) VAM, 4x16 m² Scheffler Dishes and cold storage room of capacity 20 metric tons.

5.15 This 50 kW biomass gasifier system generates electricity by using waste heat of the engine (exhaust) as the main source of energy for the cold storage. During the day time when the sunshine is available, the Scheffler Dishes along with engine exhaust provides heat to the system. During evening, when the sun is not available, the gasifier was run to meet the electricity load and the cold storage will operate only on engine exhaust. In case, no sunshine is available and engine exhaust was also not sufficient to meet heat requirement of VAM for cold storage, provision has been made for firing of producer gas in the Heat Recovery Unit for an uninterrupted heat supply to VAM. The electricity generated by the plant has been fed to a resistive load of 40 kW (approx.). During the year, this system is capable of generating 40-45 kWh (approx.) of electricity by consuming wood at 70kg/hr (approx.). Figure 5.10 shows the experimental set up of 50 kW Solar Biomass Hybrid Cold Storage Cum Power Generation System for Rural Electrification. During the FY 2017-18, the system was operated and maintained.

SOLAR THERMAL TESTING FACILITIES FOR CONCENTRATED SOLAR THERMAL AND SOLAR WATER HEATING SYSTEM

5.16 NISE has established test facility for testing and certification of Concentrated Solar thermal (CST) technologies. The test laboratory was developed under UNDP-GEF Project “Market Development and Promotion of Solar Concentrated based Process Heat Application in India (India CSH)”. The test laboratory was a unique and first of its kind laboratory for testing of Concentrated Solar thermal (CST) technologies



Figure 5.10 : Experimental setup of 50 kW Solar Biomass Hybrid Cold Storage Cum Power Generation System for Rural Electrification

in Asia. The testing laboratory has its own weather station and has the following facilities for testing of CST technologies, (i) Test facility for testing of hot water/ steam based CST systems, (ii) Test facility for testing of thermal oil based CST systems, (iii) Mobile

test facility for on-site performance evaluation of CST systems, (iv) Concentrated Solar Thermal (CST) component test facility.

HOT WATER BASED SOLAR THERMAL TEST FACILITIES FOR CST

5.17 NISE has created facility for characterization and testing of all type of concentrating solar technologies. During the year, 10 concentrating solar technologies across the country were tested. The data collected from the testing were utilized for the characterizations and performance mapping of the technologies. Figure 5.11 shows the test facility for testing of hot water/steam-based CST systems.



Figure 5.11 : Test facility for testing of hot water/steam-based CST systems

THERMIC FLUID BASED TEST SET UP FOR CST

5.18 In 2012, NISE has established a thermic fluid based CSTs test facility to test the thermal performance as part of the project entitled “Development of a Megawatt-scale Solar Thermal Power Testing, Simulation and Research Facility” in collaboration with IIT Bombay. This test facility was capable to test all the CSTs using thermic fluid as heat transfer fluid with temperature up to 400°C. The heat transfer fluid for testing was Therminol VP-1. The CST have been tested using heat transfer oil at various temperatures up to 400°C at oil flow rates from 5-7 kg/s, and pressures

up to 10-15 bar. During the year, the test facility offered the characterization of CST by providing an opportunity for design improvement and selection of concentrators for various applications. Figure 5.12 shows the Thermic fluid-based Test Set-up for CSTs at NISE.



Figure 5.12 : Thermic fluid-based Test Set-up for CSTs at NISE

MAJOR WORKS & ACHIEVEMENTS UNDER CST AND SOLAR WATER HEATING TEST FACILITY

5.19 The major work conducted under this test facility are as follows

BIS Standard for CST technologies developed

5.20 Under this project the Indian Test standard for CST technologies has been prepared and submitted to BIS for publications. This is the only standard available in international platform which describes the details

about all worldwide available concentrating solar thermal concentrators. Following Bureau of Indian Standard (BIS) of CST for off – grid applications have been developed and published.

- (i) IS 16648 (PART 1):2017 Concentrated Solar Thermal Specification – Part 1 Paraboloid Dish Concentrator
- (ii) IS 16648 (PART 2):2017 Concentrated Solar Thermal Specification – Part 2 Scheffler Concentrator
- (iii) IS 16648 (PART 3):2017 Concentrated Solar Thermal Specification – Part 3 Parabolic Trough Concentrator
- (iv) IS 16648 (PART 4):2017 Concentrated Solar Thermal Specification – Part 4 Non Imaging Concentrator
- (v) IS 16648 (PART 5): 2017 Concentrated Solar Thermal – Test Methods

Characterization of CST technologies

5.21 Six different Concentrated Solar Thermal (CST) technologies from different manufacturers has been tested so far and the data collected from the testing were been utilized for the characterizations of the CST technologies.

Standardization of CST test protocol

5.22. 23 field installed projects were monitored online and the data were collected & analysed frequently for standardization of the test protocol and test standards.

SOLAR THERMAL R&D PRODUCT DEVELOPMENT AT NISE

5.23 NISE has undertaken project for Research, Design, Development and Demonstration of solar technologies offering integration of solar photovoltaic and solar thermal technologies for 24x7 operation. For designing the various systems, a prototype model has been developed and demonstrated in NISE campus. The detailed description is discussed in the forthcoming chapter. The systems developed are as

follows:

1. Solar Powered Cold Storage Unit with Thermal Storage
2. Solar Powered Bulk Milk Cooler Unit with Thermal Storage
3. Solar Drier
4. Solar PV Cooking System
5. Bio-fuel Generation using Solar Energy

5.24 Besides, NISE has acquired an assignment from Ministry of Food Processing Industries (MOFPI) to assist State Government of J&K in conducting techno-economic feasibility study and preparation of Detailed Project Report (DPR) for setting up of solar driers and solar energy based cold storages in Ladakh regions of J&K (Leh & Kargil). NISE has successfully undertaken the above assignment and submitted the feasibility report to MOFPI in February 2015. Based on the feasibility report the project was sanctioned with tentative budget of Rs 32.77 Crores and estimated timeline of three year i.e. 2016-2019.

5.25 In continuation of the feasibility study, Jammu & Kashmir Horticulture Department had approached NISE for designing, development and installation of Solar Air Drier unit for drying of apricot in Ladakh region. NISE has designed, developed and filed patent for an innovative solar drier cum space heating system along with thermal storage. The installation and commissioning of 10 solar drier is planned for the year 2018-19.

OTHER ACTIVITIES

5.26 The following research activities were also carried out in Solar Thermal Technologies during the year:

- The long-term performance analysis and profiling of various configuration of different solar collectors for cooling applications along with evaluation of data from solar cooling system.
- Data collection for performance evaluation of inclined plate type solar distillation.

- NISE has developed solar powered cold storage unit with thermal storage, solar photovoltaic cooking system, bulk milk chilling units, solar drier, solar powered RO based clean drinking water system, biofuel generation from biomass using solar energy under a project for research, design and development in solar thermal technologies. The detailed description is discussed in the following chapter in this report.
- Two research paper in peer reviewed journal and five papers in the proceedings of National/ International conference have been published.
- Three patents relating to solar thermal technologies (Solar Powered Cooling Apparatus, Solar Powered Cooking System, Solar Drier) have been filed during year 2017-18.
- Three M.Tech and Five B.Tech students completed their internships on various solar thermal projects during the year.
- Visits of various dignitaries, stakeholders and participants of in-house training programmes to solar thermal projects were organized for awareness and knowledge enhancement.

FUTURE PROSPECTS AND DEVELOPMENT

5.27 In future, NISE would strive to implement these innovative solar thermal technology/systems (Solar Powered Cold Storage Unit with Thermal Storage, Solar Powered Bulk Milk Cooler Unit with Thermal Storage, Solar Drier and Solar PV Cooking System) through National Level Programme of MNRE in the country. Further, a large number of Solar drier cum space heating system will be deployed in Leh & Kargil districts in J&K.

R&D PROJECTS & COORDINATION

NISE has deployed many R&D projects with its in-house team of scientists. It has authorized a suitable alliance with International institutes, industries and academia to strengthen the quality infrastructure, research, laboratory up gradation and testing procedures. Furthermore, in collaboration with various industries, solar demonstration projects were set up on the premises providing the real-time data analysis, increased efficiency, optimization tool and profitable solutions. NISE has successfully developed and filed patents against different novel concepts and has conducted research in the field of solar energy. In addition, NISE has been the core center for the evaluation, monitoring, validation and technical documentation of solar photovoltaic and solar thermal R&D projects. These project proposals were received from various organisations, industries, and academic institutions for evaluation. The on-going projects approved by the committee were scrutinized and monitored by the R&D Cell.

R&D COORDINATION CELL (SOLAR PHOTOVOLTAIC)

Project Evaluation

6.2 A committee comprising members from MNRE and NISE evaluated at 34 new project proposals in PV that were sent to NISE by the Solar R&D Division of MNRE. For convenience, the projects were divided into two groups, namely the solar cells and materials group (12 project proposals) and system and applications group (22 project proposals). Out of these, only 17 proposals, 4 in the cell and materials category and 13 in the application and systems category qualified after internal screening for further processing. These were then sent to external experts for evaluation. Following evaluation, 2 projects in the cell category

and 5 proposals in the application category were recommended to the MNRE for consideration in the RDSPAC meetings. Also, the next lot of 18 new R&D project proposals were received for evaluation.

Monitoring of the on-going R&D projects in photovoltaic

6.3 As a part of the bi-annual project review meeting for the on-going PV R&D projects sponsored by the MNRE, NISE conducted two meetings at its premises on 27th June 2017 and on 9th January 2018 respectively. The meetings were attended by the PIs of the on-going R&D projects who made brief presentations to a Project Review Committee (PRC) comprising external experts. Subsequently, the PIs were provided suggestions to implement the project as per the recommendation of the PRC, in line with the sanctioned project objectives.

Technical documentation

6.4 As desired by MNRE, a detailed study was undertaken to identify the projects that have been approved in the recent years by the funding agencies such as the MNRE and DST towards the enhancement of efficiency of solar cells, reliability of PV modules and storage devices. The study revealed that between 2010 and now, MNRE has sponsored a total of 13 projects with a total commitment of Rs. 122 Crores in the categories of efficiency, enhancement, and reliability. In the same category, DST has, however, sponsored 89 projects with a total commitment of Rs. 117 Crore, thus making a total investment of around Rs. 240 Cr in this area. In the area of storage, MNRE has so far sponsored part of 1 project whereas DST has so far sponsored 11 projects. The total commitment in this area added up to Rs. 8.18 Crore. In another effort,

consolidation was made for the evaluation process of new R&D project proposals at NISE since its inception in 2015.

R&D COORDINATION CELL (SOLAR THERMAL)

6.5 NISE has been involved in scrutinizing the R&D project proposals submitted to the Ministry at the initial stage, getting the expert comments, arranging RDPAC and RDSPAC meetings and recommending proposals to the MNRE for sanction. It has also been responsible for monitoring the on-going R&D projects through expert visits, organizing reviews, suggesting mid-course corrections and monitoring and verifying claims as an independent, unbiased agency. Recently, a new trend has been set at NISE by conducting a review of the on-going R&D projects in PV and ST through an interactive meeting at NISE with the internal and external experts as well as all the PIs. These meetings were held every six months to have close monitoring of the projects.

6.6 Since April 2017, around 30 project proposals have been received in the area of solar thermal energy for evaluation and further processing. These projects were mainly on small-scale power generation, solar refrigeration and air-conditioning, solar cookers, solar distillation and solar industrial process heating. All these projects were evaluated by experts in the RDPAC and RDSPAC meetings organized. The expert panel has also been updated and a meeting of experts for evaluating and midterm correction was organized for all the ongoing projects.

PROJECT ON PERC SOLAR CELL DEVELOPMENT

6.7 The Amorphous Silicon Solar Cell Plant of BHEL (BHEL-ASSCP) and NISE, both located in adjacent campuses, jointly submitted a collaborative R&D Project to MNRE, entitled "Development of high efficiency (21% / 19%) PERC type of c-Si/mc-Si solar cells". In this project, the role of BHEL-ASSCP and NISE were clearly defined. BHEL-ASSCP was specified with the responsibility of carrying out the entire

processing and NISE had the responsibility of test and characterization of materials and devices. During the FY 2017-18, both the technical teams have formulated the design specifications for the procurement of the equipment for setting up the centre for carrying out industrial research on large area silicon solar cells. Furthermore, the procurement of the majority of the equipment is now planned for the next financial year i.e. 2018-19.

ALL INDIA SURVEY OF PV MODULES INSTALLED IN THE COUNTRY, A JOINT VENTURE BETWEEN NISE AND NCPRE, IIT BOMBAY

6.8 In the FY 2017-18, a joint project between NISE, and NCPRE, IIT Bombay was implemented to study the field performance of SPV modules installed over a period of time ranging from 20 years to recent installations in different climatic conditions of India. In this survey, the data needed to understand the reliability and process of degradation of PV modules under Indian field conditions were collected and analyzed. Although the modules qualify IEC 61215, 61646 and 61730 standards, due to the diversity of harsh climatic conditions existing in the country, the long-term performance and annual degradation rates of these modules are different. The environmental

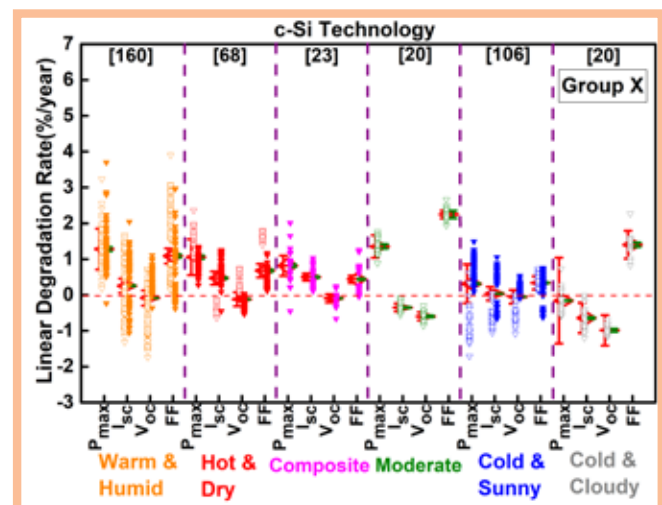


Figure 6.1 : I-V parameter degradation distributions with respect to six-zone classification system (2016)

parameters strongly influence the cost economics and user confidence. Figure 6.1 shows the I-V parameter degradation distributions with respect to six-zone classification. Based on the All India survey of PV module reliability conducted by the team. Reports were generated and these are available on the website of NISE.

SERIIUS PROJECT

6.9 SERIIUS (Solar Energy Research Institute for India and the United States) was a joint project between US Department of Energy (DOE) and the Government of India in response to the US-India Joint Funding

Opportunity Announcement issued in May 2011 to conduct R&D in the area of solar energy. This project was completed by March 2018. The final report has already been submitted. Under the SERIIUS project in the FY 2017-18, NISE conducted the characterization to carry out reliability studies. Under this activity, NISE has worked in different areas during last year like reliability index of PV module, potentially induced degradation, degradation of different PV module technology, dust mitigation, decentralized application of PV modules etc. Figure 6.2 shows the development of defect database by NISE and its quantification for Indian climate under this project.

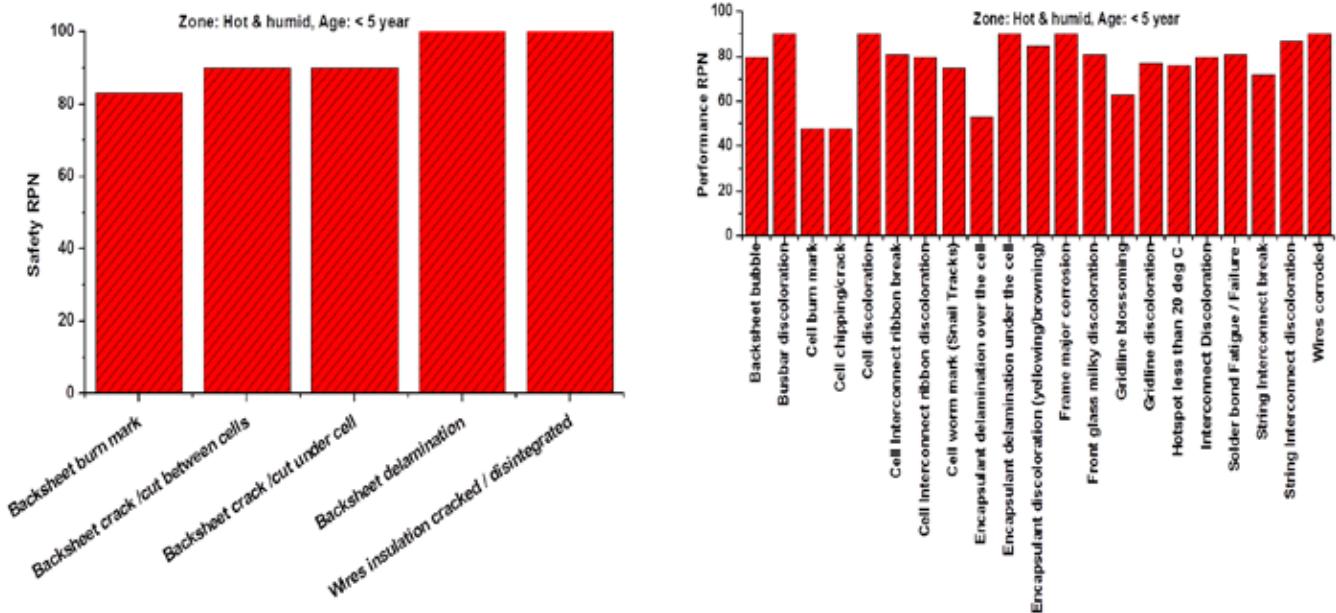


Figure 6.2 : Development of defect database by NISE and its quantification for Indian climate under this project

SECONDARY REFERENCE CELL CALIBRATION FOR LARGE AREA SOLAR CELLS

6.10 Under this project in the FY 2017-18, this lab has completed round robin test of 6 inch X 6 inch and 5 inch X 5-inch solar cells along with Fraunhofer ISE, IIT

Bombay and NPL, Delhi. Table 6.1 shows the deviation of Isc, Voc, and Fill factor (FF) in the first phase of a round robin test conducted at NISE and Fraunhofer ISE. After this round robin testing, NISE has improved its set up as per the suggestions by Fraunhofer ISE. The second phase of the project is ongoing.

Table 6.1 Deviation of Isc, Voc, and FF in first round robin test conducted at NISE

| Cell Id | Dev. Isc | Dev. Voc | Dev. FF |
|-----------|----------|----------|---------|
| 1, 5 X 5 | 1.39% | -0.82% | -2.36% |
| 2, 5 X 5 | 1.88% | -0.72% | -2.33% |
| 3, 5 X 5 | -1.86% | -0.95% | -1.60% |
| 4, 5 X 5 | -1.84% | 0.19% | -2.57% |
| 5, 5 X 5 | -0.67% | 0.59% | -1.97% |
| 6, 6 X 6 | -1.87% | 0.66% | -0.25% |
| 7, 6 X 6 | -0.11% | -0.96% | -1% |
| 8, 6 X 6 | -0.24% | -0.84% | -0.42% |
| 9, 6 X 6 | -1.16% | -0.12% | -0.41% |
| 10, 6 X 6 | -0.78% | -0.69% | -0.49% |

PERFORMANCE COMPARISON OF THIN FILM MODULE IN INDIA AND USA, A JOINT PROJECT BETWEEN NISE AND NREL, USA

6.11 NISE and NREL have embarked on a project to compare the performance of sister thin-film modules deployed in India and in Colorado, USA. NISE has purchased a set of modules and shipped 6 of these modules to NREL. The thin-film modules were deployed in the real outdoor condition in December 2013. First joint technical report with NREL was already published. The result has been presented at the conference on Reliability of PV module organized by NREL. During the year, long-term measurement of performance of the modules was conducted for further analysis.

500kWp MULTI-TECHNOLOGY POWER PLANT

6.12 NISE has installed a 500kWp multi-technology solar photovoltaic power plant to cater the day to day increasing energy requirement in campus and also to provide the R & D infrastructure to study SPV module reliability of different technology module both in on-grid/off-grid configuration in composite climatic condition and study the smart grid design. The main idea is to provide uninterrupted power supply in the campus 24x7, the power plant consists of five different technologies which are split into two configuration where 200 kWp is connected to the battery bank and 300 kWp is connected to the grid.

The five different technologies and configuration of Plant are: (i) 100 kWp Battery Back-up SPP with Multi-crystalline modules, (ii) 100 kWp Battery Back-up SPP with Panasonic HIT modules, (iii) 100 kWp Grid Tied SPP with CdTe modules, (iv) 100 kWp Grid Tied SPP with CIGS modules, (v) 100 kWp Grid Tied SPP Maxeon Sun Power with single axis Tracking. During the year, the project was completed and the continuous monitoring of this power plant was carried out to study the performance yield of this system.

PRODUCT DEVELOPMENT

6.13 NISE has developed new products with a configuration to harness the solar energy and offer additional benefits to the customers. These products are designed to provide maximum efficiency and utilization depending upon the present scenario, location and demand. The following solar system have been developed by NISE in the year 2017-18.

Solar Powered Cold Storage Unit with Thermal Storage

6.14 NISE has designed, developed and demonstrated a solar photovoltaic (SPV) cold storage for 24x7 operations using thermal storage. The technology offers integration of solar photovoltaic and solar thermal technologies for the 24x7 operation of cold storage. Schematic of Solar Powered Cold Storage Unit with Thermal Battery is shown in Figure 6.3 and specifications of the system are listed in the table 6.2.

6.15 The system has the following major components:

Cold Storage unit: The cold storage unit is an insulated cold room of 1600 cubic feet volume having a storage capacity of 8-10 tons (approx.) of vegetables, fruits, and dairy products.

Solar Photovoltaic System: The system consists of 5 kWp of solar PV panels and 5kVA off the grid-inverter system.

Compressor Unit: The compressor unit is for

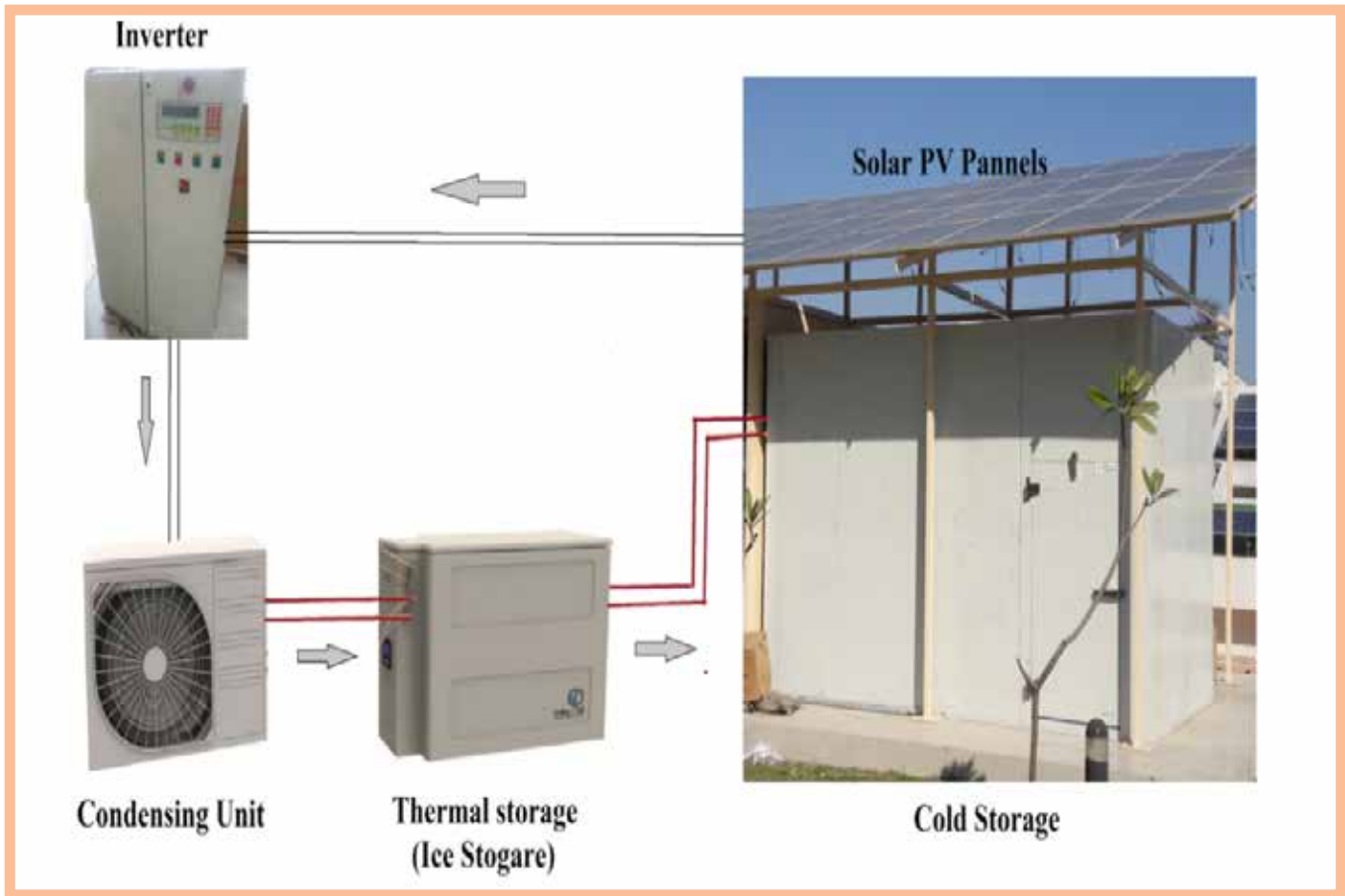


Figure 6.3 : Schematic of Solar Powered Cold Storage Unit with Thermal Storage

providing cooling to the system. The compressor unit has a capacity to provide 1.5 tons of cooling effect.

Thermal Storage Unit: A Phase Change Material (PCM) based thermal storage unit has been designed and developed by NISE in collaboration with Inficold Pvt. Ltd. The thermal storage is sized to provide 48 hours of backup in a single charge. The thermal energy storage has three times lower capital cost & about ten times longer life in comparison to lead-acid batteries. It provides cooling backup for 8-10 metric tons (approx.) of perishable products stored in an approximately 1600 cubic feet cold storage at 4-15 °C temperature range.

Control Unit: The control unit integrates various components of the system. Intelligent control

panel select operation modes automatically based on the electricity availability from PV and cooling requirements. The various input and operating parameter data such as power consumption, operating temperature, ambient temperature are logged and transmitted to the internet and can be remotely accessed.

6.16 During sunshine hours, the electricity generated from solar photovoltaic was used to provide cooling to cold storage and the excess cooling was stored in the thermal battery. In a thermal battery, the cooling effect was stored into PCM (a mixture of water and salt). During night/non-sunshine hours the cold stored in the thermal battery was used to provide a cooling effect to cold storage.

Table 6.2 Specification of Cold Storage Unit with Thermal Storage

| Project Highlights | |
|-------------------------------------|--|
| Implementing Organization | National Institute of Solar Energy in Collaboration with Infocold India Pvt. Ltd |
| Cold Storage Volume | 1600 Cubic Feet |
| Storage Capacity | 8-10 MT |
| Temperature Range | 4 – 15 °C |
| Equivalent Cooling Storage Capacity | 30000 kCal \approx 35 kWh |
| PV Capacity | 5 kWp |



Compressor Unit

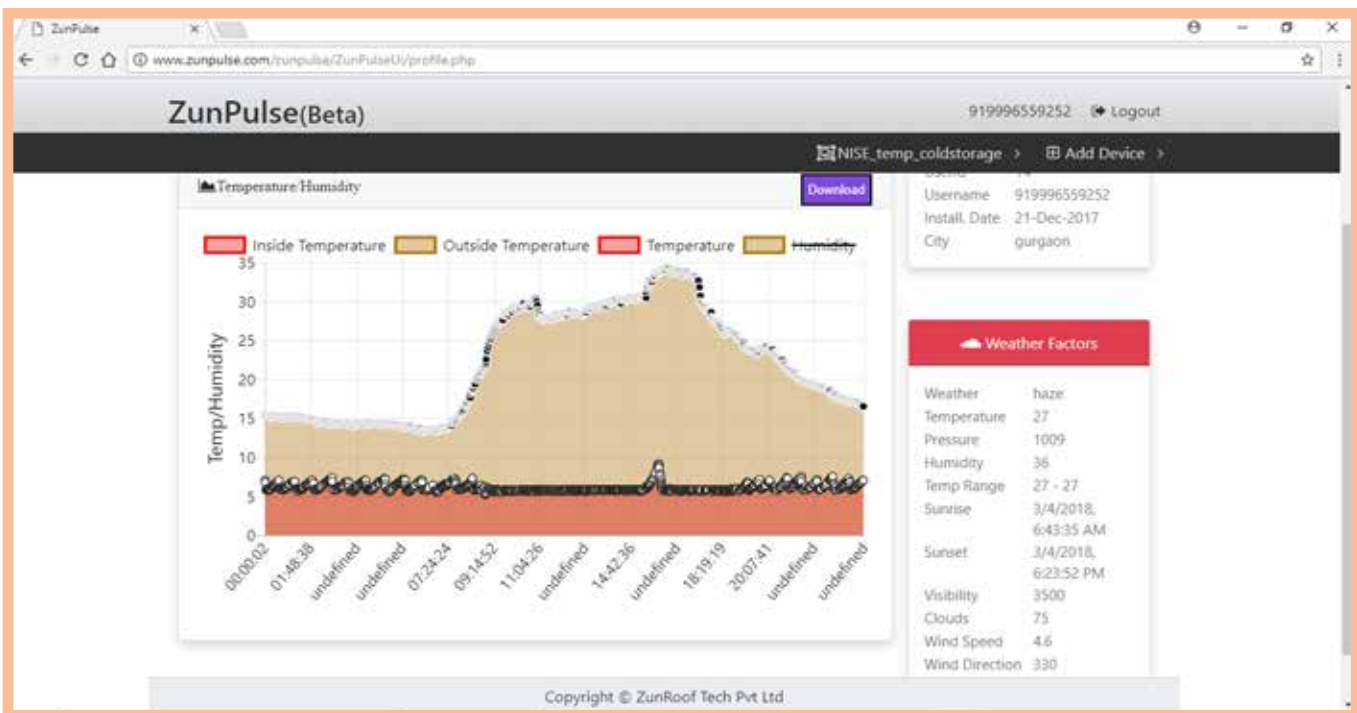


Figure 6.4 : Online data monitoring of Cold Storage System

6.17 Further, NISE is carrying out further research for the improvement of the system. The research was being carried out to incorporate the DC compressor instead of the AC compressor. The advantage of using a DC compressor is that it is more efficient than an AC compressor and it can be directly connected to PV panels and obviate the need for an inverter. Moreover, controlling the DC system was easier and more reliable as compared to AC systems. Figure 6.4 shows the online data monitoring of cold storage system.

Solar PV Cooking System

6.18 Energy requirement for cooking accounts for 36% of total primary energy consumption in India. In India, households generally use a combination of energy sources for cooking that can be categorized as traditional (such as dung cakes, agricultural residues, and fuelwood), intermediate (such as charcoal and kerosene) or modern (such as LPG, biogas, and electricity). Use of fuelwood, agricultural residues and animal dung results in high emissions of carbon

monoxide, hydrocarbons, and particulate matter. Women and children suffer most from poor indoor air pollution because they are traditionally responsible for cooking and other household chores, which involve spending hours by the cooking fire exposed to smoke. Charcoal, on the other hand, is usually produced from forest resources. Charcoal production is often inefficient and can lead to localized deforestation and land degradation. LPG is commercially available but issues of affordability and distribution limit its use in rural areas.

6.19 Although solar cookers are available for last 5 decades, the main disadvantage of the traditional box type solar cooker is that it lacks the ability to store energy and most households are not able or willing to cook when the sun is high in the sky. Another limitation was that chapati cannot be cooked using it. One of the reasons for low penetration of solar cooker is its inability to cook in the late evening. A solar cooker with heat storage can address this problem. Many researchers have worked on a solar cooker based on the box type collector, evacuated tube solar collector, parabolic dish collector and parabolic trough collector with sensible and phase change thermal storage unit. But, these concepts for family size kitchen solar cooking system with thermal storage are clumsy, costly, requires constant engineering, and safety. None of these have taken any shape out of a laboratory or presented.

6.20 NISE has designed and developed an innovative solar chulha based indoor cooktop. The solar chulha use PV system to charge a thermal storage (shown in Figure 6.6). The Solar chulha stores solar energy in heat form and provides a cooking solution while working indoor, cooks all dishes for 24x365, provides convenience and conventional cooking experience. The innovative thermal storage is in the form of a cooking pot filled with thermal storage material which stores the heat for off-sunshine cooking. The capacity for thermal storage can be increased/decreased by increasing/decreasing the size of thermal storage. The

thermal storage is well insulated to store the heat for up to 48 hours when not in use.

Solar PV Based Cooking System with Thermal Battery

6.21 The solar PV based cooking system with thermal battery consist of a solar photovoltaic panel, it runs by a DC heater and charges the thermal battery during day time. The thermal battery cum cook stove is placed inside the kitchen. The cook stove is covered with a lid when it is being charged and the lid can be opened while cooking.

6.22 Solar PV based cooking system with thermal battery consists of following components, i) Solar PV Panels, it consists of two PV panels of each capacity 300 watts each. ii) Heater - specially designed with 48 volts, 600-watts flat type heaters and iii) Thermal Battery cum cook stove, the thermal battery is in the shape of a cookstove placed inside the kitchen. The thermal battery is being tested using different latent and sensible heat storage materials.

6.23 The Two designs of Thermal Battery cum cook stove are as follows:

- a). In this design, there are three containers of different sizes placed concentrically (shown in Figure 6.5). The innermost container is filled with PCM. The space between the middle and inner container is filled with Rockwool insulation and vacuum is created between the outer and middle container to decrease the heat loss. A DC-based flat heater (48 volts, 600 Watt) is placed at the bottom of the innermost container providing heat to the innermost container. The innermost container is provided with fins attached to the cooktop to deliver/transfer the heat from bottom to top. The system is covered with an insulated cover/lid. The cook stove is covered with a lid when it is being charged and the lid can be opened while cooking. Figure 6.5, 6.6 and 6.7 shows the solar PV cooking system.

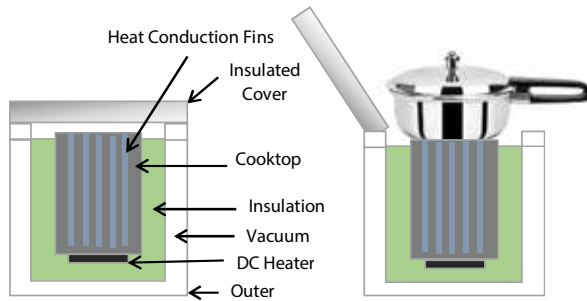


Figure 6.5 : Design of Thermal Battery cum cook stove



Figure 6.6 : Solar PV based cooking system with thermal battery

b). In this design, PCM is filled in a rectangular tank (shown in Figure 6.7). The rectangular tank is Poly Urethane Foam (PUF) insulated on all sides except the top side. A DC-based flat heater (48 volts, 600 Watts) is placed at the bottom of the rectangular tank providing heat to the tank. Three cooking plates are provided on top surface of the rectangular tank for a different rate of cooking. The first plate has fins attached for a fast rate of cooking. The second plate has smaller fins attached for a medium rate of cooking. The third plate is for a slow rate of cooking as it has no fins attached. The system is covered with an insulated cover/lid.

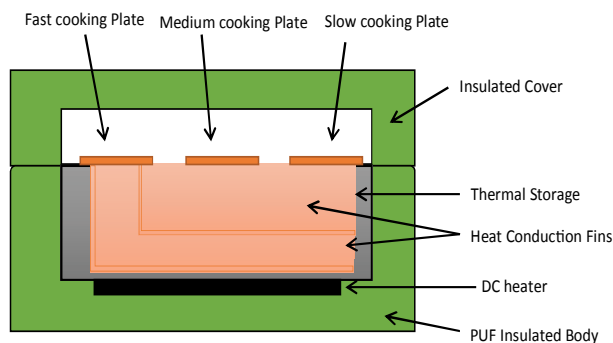


Figure 6.7 : Design of Thermal Battery cum cook stove

Solar Powered Bulk Milk Cooler Unit with Thermal Storage

6.24 NISE has designed, developed and demonstrated a Solar Powered Bulk Milk Cooler (BMC) Unit with Thermal Storage. Figure 6.8 shows the solar-powered bulk milk cooler unit with thermal storage. The project has been implemented in Collaboration with Inficold India Pvt. Ltd. The BMC unit runs on power generated from Solar Photovoltaic. During sunshine hours, the electricity generated from solar photovoltaic was used to provide cooling to BMC and the excess cooling was stored in the thermal battery. In a thermal battery, the cooling effect was stored into PCM (a mixture of water and salt). During non-sunshine/night hours, the cold stored in the thermal battery was used to provide a cooling effect to BMC. Table 6.3 shows the specification of the solar-powered bulk milk cooler unit with thermal storage.



Figure 6.8 : Solar Powered Bulk Milk Cooler Unit with Thermal Storage

Table 6.3 Specification of Solar Powered Bulk Milk Cooler Unit with Thermal Storage

| Project Highlights | |
|-------------------------------------|--|
| Implementing Organization | National Institute of Solar Energy in Collaboration with Inficold India Pvt. Ltd |
| Milk Storage Volume | 500 L |
| Operating Temperature | 4 °C |
| Equivalent Cooling Storage Capacity | 30000 kCal |
| Cooling Back-Up | Two Milking Cycle of 250L each. |
| PV Capacity | 5 kW |

Solar Powered RO Based Clean Drinking Water System

6.25 Even though water covers sixty percent of the world’s surface, clean and uncontaminated drinking water is becoming a rare and scarce resource. It has been reported that over 1.5 billion people in the world have no direct access to drinkable water. The World Health Organization (WHO) reports that each year over 5 million people die of water-related diseases. The consumption of poor quality water results in a lot of health problems. It has been shown that improving water and sanitation brings valuable benefits to both social and economic development.

6.26 Water in some regions is limited, while in many regions supplies are adequate but of poor quality because of contamination and therefore it is harmful for human consumption. In many remote areas, the problem of contaminated water was compounded by the lack of a reliable electricity supply needed for the power water treatment plant. Where water supplies have been contaminated by salts and other pollutants, more than 40% of the cost of providing water lies in the energy required to purify it.



Figure 6.9: Prototype RO system installed at NISE

6.27 NISE in association with M/s. Saurya Eneritech Pvt. Ltd. has developed a solar-powered clean drinking water system for communities without piped water line and electricity. The concept was to use the solar energy to power the water treatment system i.e. Reverse Osmosis (RO) system and Filtration so that the purified water can be accessed by the people living in the remote areas. The smart management

system will help to remotely fetch the data of various parameters related to water quality as well as water supply management. A prototype of solar-powered RO system with capacity 500LPH has been developed and installed at NISE campus as shown in Figure 6.9. This system is being used for supplying water to the entire campus.

Solar Drier

6.28 Drying is one of the oldest methods of preserving food. Dried foods can be stored for long periods without deterioration. Large numbers of vegetables, fruits, spices, grains, meat and other products are dried to inhibit microbial development and quality decay.

6.29 NISE has designed and developed an innovative solar drier system. Figure 6.10 shows the solar drier system designed at NISE. The system has the following features, (i) Drier uses very efficient and cost-effective solar thermal technology for supplying heat, (ii) Complete off-grid system running on solar power, (iii) Drying chamber having a drying capacity of 50-70 kg (approx.) in one time, (iv) Designed for 24*7 operation with an innovative thermal storage system having heat storage capacity of 6 kWh exclusively designed by NISE, (v) A system designed for dual mode operation with plug and play connection: (i) Drying Mode, (ii) Space Heating Mode.



Figure 6.10: Solar Drier system designed at NISE

Biofuel Generation from Biomass using Solar Energy

6.30 NISE has carried out experiments in collaboration with CSIR-Indian Institute of Petroleum (IIP), Dehradun and Indian Railways Organisation for Alternate Fuels

(IROAF) to generate biofuels from various biomass wastes using solar energy. Hydrothermal and pyrolysis experiments have been carried out using solar concentrating technology. Different types of biomass namely rice husk, kitchen organic waste, wood pellets, dried leaves, and grass have been tested. The initial results were encouraging and a few more experiments and a pilot project was planned for execution. Figure 6.11 and 6.12 shows the experimental set up for hydrothermal reactor and biofuels generated from

the experiment.

FUTURE PROSPECTS AND DEVELOPMENT

6.31 In future, NISE proposes for further transaction and promotions of these developed Solar products/systems in the country. The focus will be to develop innovative solar systems for various applications such as solar water pumping systems, lighting and cooking purpose. A patent is planned to be filed for the projects developed at NISE.

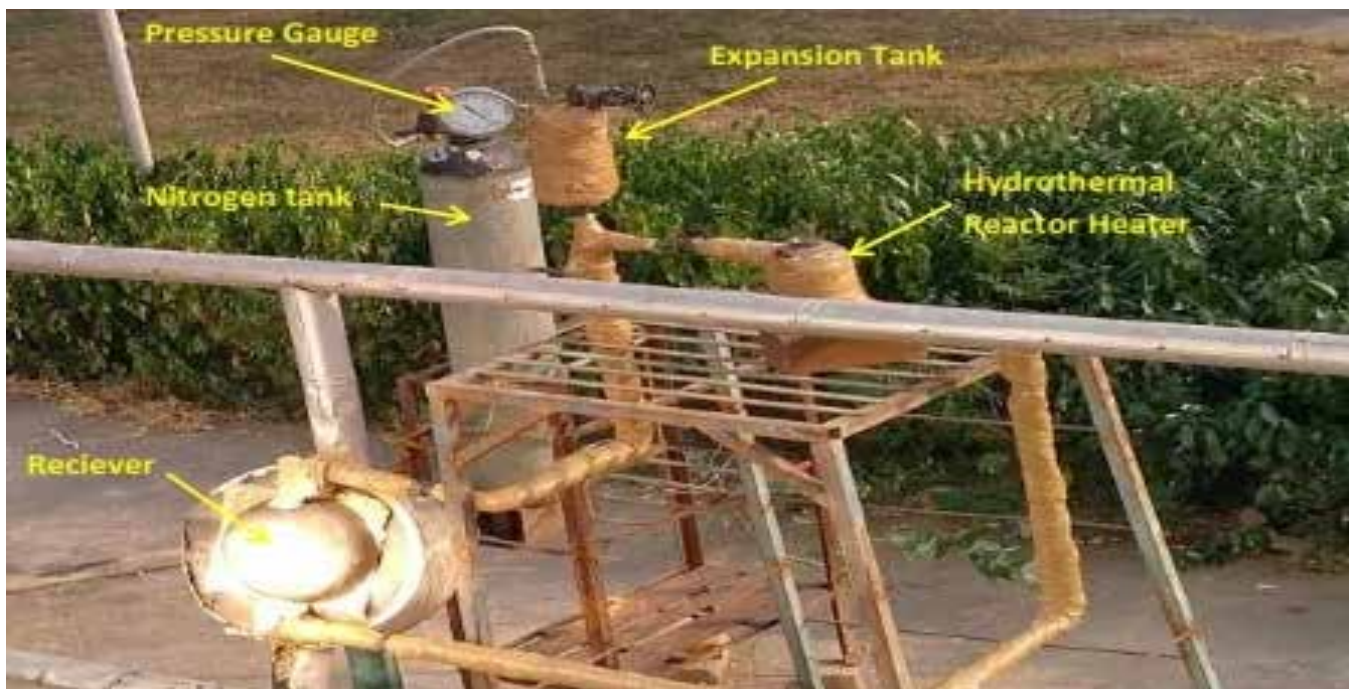


Figure 6.11 : Experimental setup for hydrothermal reactor



Figure 6.12 : Biofuel generated from the experiments

HYDROGEN ENERGY & FUEL CELL

A solar hydrogen production cum dispensing facility was installed and commissioned in the campus of the NISE in December 2014. The facility became operational in late 2015 after an adequate amount of hydrogen got accumulated in high-pressure storage tubes of the facility. Thereafter, NISE has been operating and maintaining the facility for regular production and dispensing of hydrogen. This is the first of its kind facility in the country to utilise solar energy for the production of hydrogen, storage and dispensing facility. The Hydrogen facility at NISE along with H₂-Diesel Dual Fuel Vehicles developed by Mahindra & Mahindra is shown in Figure 7.1.



Figure 7.1 : Hydrogen facility at NISE along with H₂-Diesel Dual Fuel Vehicles developed by Mahindra & Mahindra

PRESENT ACTIVITIES AND PLANS FOR UPGRADATION OF EXISTING FACILITIES

7.2 NISE continued to implement an R&D Project entitled “Demonstration and Performance Evaluation of Various Hydrogen Technologies” sanctioned by the Ministry of New and Renewable Energy in December 2014 with a broad objective of demonstration and performance evaluation of various technologies of hydrogen energy at NISE up to 31.12.2017.

The specific objectives of the project included:

- Operation and maintenance of solar hydrogen facility at NISE, Gwal Pahari
- To demonstrate hydrogen/hydrogen blended fuelled vehicles (3-wheelers & 4-wheelers) developed under the R&D projects supported by the Ministry
- To operate/demonstrate fuel cell-based systems for stationary power generation
- To organise training programme on different aspects of hydrogen energy and fuel cell technologies.

7.3 The hydrogen production cum dispensing facility at NISE consists of an alkaline electrolyser of 5Nm³/hr capacity that splits water to produce hydrogen and oxygen using electricity generated by a 120 kW_p SPV system. Hydrogen produced by the electrolyser is of 99.999% purity, which can be used in Polymer Electrolyte Membrane Fuel Cells. The Oxygen produced by the electrolyser is vented in the atmosphere. Hydrogen produced from the electrolyser is compressed up to 450 bar pressure using a double stage reciprocating compressor and stored

in high-pressure storage tubes. The stored hydrogen is dispensed into vehicles. During the year, the facility was continued to be used for providing hydrogen for trial runs of two hydrogen-diesel dual-fuel vehicles, developed by M/s Mahindra & Mahindra under an R&D project supported by them. This facility has been set up at NISE in accordance with clearances of Petroleum and Explosives Safety Organisation (PESO). Field trials of hydrogen-diesel dual-fuel vehicles being carried out by Mahindra & Mahindra in association with NISE have indicated that the vehicles on one side showed improved performance in dual-fuel mode and reduced emissions on the other compared to the diesel-only mode of operation.

7.4 NISE plans to augment hydrogen production capacity at the existing site by installing another electrolyser of 10 Nm³/hr capacity. Fuel Cell laboratory was also proposed to be upgraded. For this purpose,



a new proposal has been submitted to the Ministry of New and Renewable Energy for seeking financial assistance. Efforts for setting up of a Fuel Cell Testing Laboratory were initiated and the infrastructure required for operation of fuel cell system was completed during the year. 1x2 kW and 2x1 kW Polymer Electrolyte Membrane Fuel Cell (PEMFC) systems that were procured earlier were operated under demonstration mode for a cumulative of 50 hours using commercially bottled hydrogen. Hydrogen leak detectors with alarms were installed for safety purpose. Up-gradation of the laboratory is likely to be taken up in the future. NISE plans to make use of the hydrogen produced from its own facility for operation of fuel cells by storing hydrogen in Type-3 composite cylinders. Figure 7.2 shows the Fuel cell testing laboratory setup (inside the lab) and Hydrogen gas set up (outside the lab).



Figure 7.2: Fuel cell testing laboratory setup (inside the lab) and Hydrogen gas set up (outside the lab)

RUNNING OF HYDROGEN FUELLED VEHICLE

7.5 A total of 140.9 kg of hydrogen fuel was dispensed from the hydrogen refueling the facility of NISE into hydrogen-diesel dual-fuel vehicle during the period of the report. The two vehicles under-going field trials under a project supported by MNRE logged 13,837 km and 17,829 km respectively. Their field trials of the other three vehicles were on the recommendation of the Project Monitoring Committee of MNRE.

NEW INITIATIVES

7.6 A MoU has been signed between NISE and M/s Tiger Power, Belgium to have a collaborative project for the validation of a hybrid system comprising SPV system – Batteries – Electrolyser – Hydrogen Storage– Fuel Cell and its techno-commercial viability in Indian climatological conditions. The first segment of the project from M/s Tiger Power, Belgium has been installed in the campus of NISE. This segment consists

of a 4.77 kW_p PV panels along with storage batteries of 14.4kWh (24 number of batteries of 2V and 300Ah capacity of each) and inverter installed on the top of a shipping container. This facility has a remote monitoring, which enables performance evaluation of the PV system in the Indian conditions. Figure 7.3 shows the Hybrid System installed in NISE by M/s Tiger Power, Belgium under a collaborative project.

7.7 The 2nd National Workshop on Hydrogen Energy and Fuel Cells was organized successfully in NISE during 22-23 November 2017. This workshop provided a platform to researchers from academic institutions, research laboratories, industries and individual professionals to interact on hydrogen and fuel cells technologies. Based on the deliberations

during the workshop, a report and recommendations have been prepared by the NISE and sent to MNRE for information. Figure 7.4 shows the participants of the 2nd National Workshop on Hydrogen Energy and Fuel Cells.

FUTURE PROSPECTS AND DEVELOPMENT

7.8 NISE would like to demonstrate fuel cells for actual applications such as providing power for operation of ATM and/or a telecom tower. In future NISE proposes to increase in-house hydrogen production and utilisation capacity through augmentation, demonstration, and collaboration with industry and academia. NISE envisages helping in establishing hydrogen economy in the country by being an active player in this field.



Figure 7.3 : Hybrid System installed in NISE by M/s Tiger Power, Belgium under a collaborative project



Figure 7.4 : Participants of 2nd National Workshop on Hydrogen Energy and Fuel Cells

SKILL DEVELOPMENT & CAPACITY BUILDING

NISE is one of the leading institutes in India for Training & Skill Development. During the year 2017-18, NISE has conducted 32 National training programs and 7 International training programs comprising of both National and International participants across the globe. Additionally, NISE has also specially designed training programs for Senior Defence Ministry officials, GAIL officials, EESL officials during the year. The Armed Forces participants for five days skill development program on renewable energy technologies is shown in Figure 8.1. These training programs are structured according to the competency required in the respective industry, focusing on providing them with a hands-on training, interactive sessions, workshops, customer requirements and demonstrations so that it

would improve their insight on the subject.

8.2 NISE regularly invites experts from the solar industry and interacts with them to identify the gaps in the new recruits of the renewable energy industry. The participants were certified through Skill Council for Green Jobs (SCGJ). The training modules expanded their knowledge to make them skilled in the competitive market. The International Training programs equip each participant to take up the projects in their countries and come up with a center of excellence in their individual fields. During the financial year 2017-18, a total of 1,062 participants participated in the national training programs conducted by NISE. These trainings were self sustained with total revenue



Figure 8.1 : Armed Forces Participants for five days skill development program on "Renewable Energy Technologies"

generated by these training programs was Rs.1.78 Crore.

8.3 NISE also extends an internship opportunity to B.Tech/M.Tech/Ph.D./MSc./International Students. The selected students were encouraged to work along with our research team utilizing the available facilities of the laboratory. The students were motivated to pursue their interest in solar renewable technologies. NISE

had offered the following core areas for internship: (i) Solar Resource Assessment, (ii) Solar Photovoltaic Power Plants, (iii) Solar Thermal Technologies – Cooling, Cooking, Water ATM, Heliostat, Cold Storage etc., (iv) Solar Photovoltaic Hydrogen Facility, (v) Solar Water Pumping, (vi) 1MW Solar Thermal Power Plant.

8.4 The following Skill development programs were conducted at NISE during 2017-18:

| 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 | 7 | 3 | 26-28 April 2017 | 23 |
| | | | 3 | 24-26 May 2017 | 16 |
| | | | 3 | 28-30 June 2017 | 15 |
| | | | 3 | 26-28 July 2017 | 19 |
| | | | 5 | 25-29 Sep 2017 | 19 |
| | | | 5 | 20-24 Nov 2017 | 14 |
| | | | 5 | 15-19 Jan 2018 | 25 |
| 2 | Workshop on Start-up India Skill Development program | 5 | 1 | 21 June 2017 | 98 |
| | | | 1 | 30 Aug 2017 | 105 |
| | | | 1 | 27 Sep 2017 | 51 |
| | | | 2 | 28-29 Nov 2017 | 55 |
| | | | 2 | 21-22 Feb 2018 | 35 |
| 3 | Training Program on Solar Resource Measurement | 1 | 2 | 4-5 July 2017 | 24 |
| 4 | Skill Development Program on Sustainable Development using Solar for IOCL Officials | 1 | 3 | 26-28 July 2017 | 29 |
| 5 | RE Training Program for Armed Forces | 2 | 5 | 31 July-4 Aug 2017 | 47 |
| | | | 5 | 19-23 Feb 2018 | 34 |
| 6 | Design, Installation & Commissioning of Solar Water Pumping System Training Program | 1 | 2 | 10-11 Aug 2017 | 10 |
| 7 | Utility Engineers ToT | 1 | 2 | 18-20 Sep 2017 | 30 |
| 8 | Solar Rooftop Grid Engineers Course | 1 | 12 | 11-22 Sep 2017 | 30 |
| 9 | Training for PCRA Officials | 1 | 1 | 18 Sep 2017 | 10 |
| 10 | Training Program Utility Engineers (DHBVN) | 1 | 2 | 5-6 Oct 2017 | 32 |
| 11 | Hydrogen Energy & Fuel Cell | 1 | 2 | 22-23 Nov 2017 | 20 |

| S No. | Program | Number of Programs | Duration of Programs (Days) | Date | Number of Participants |
|--------------|--|--------------------|-----------------------------|------------------------|------------------------|
| 12 | Solar Rooftop Grid Engineers Course | 1 | 12 | 11-22 Dec 2017 | 26 |
| 13 | Training Program for GAIL Officials | 1 | 3 | 20-22 Dec 2017 | 29 |
| 14 | Training Program for EESL Officials | 1 | 2 | 9-10 Jan 2018 | 48 |
| 15 | Suryamitra Programme at NISE | 3 | 90 | 3 Apr-30 Jun 2017 | 34 |
| | | | 90 | 3 Jul-30 Sep 2017 | 34 |
| | | | 90 | 3 Oct-30 Dec 2017 | 34 |
| 16 | Advance Solar Professional Course | 1 | 180 | 7 Feb 2018 to Aug 2018 | 41 |
| 17 | Chartered Engineers Training Program | 2 | 3 | 18-20 April 2017 | 23 |
| | | | 3 | 18-20 July 2017 | 8 |
| 18 | Performance Evaluation O&M Solar Systems | 1 | 5 | 20-24 April 2017 | 44 |
| Total | | 32 | | Total | 1062 |

DESIGN, INSTALLATION & COMMISSIONING OF SOLAR WATER PUMPING SYSTEM TRAINING PROGRAM

8.5 NISE has aimed to impart knowledge for the deployment of various solar water pumping technologies. This program covered various aspects of solar water pumping system such as Solar Resource Assessment & Basics, understanding of Mounting structures, site feasibility, water table, efficiency and different Types of Heads, Solar Water Pumping components such as DC-DC converter, inverter, battery, motors, pump – motor set, design and Installation of Grid & Standalone Solar PV Water Pumping System, Testing & Commissioning, O&M, Safety Practices for Solar PV Water Pumping System, Overview of Policies, Subsidy, Standards & MNRE Guidelines, Business Aspects, Financial Analysis, Customer need & Start-up. During the year, NISE has conducted one training

program on solar water pumping system.

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

8.6 The vision of this programme was to enable the participants to “Design and Simulate SPV System”. The participants were Graduate Engineers with basic knowledge of Electronics, Mechanical, Electrical & Civil Engineering, Renewable Energy, Solar Energy, Solar Entrepreneurs, Scientists, Researchers, Engineering college faculty, MNRE channel partners, C.A., Senior Energy Department Officials of Govt. of India and Officers from State Nodal Agencies etc. During the year more than 247 individuals across the globe were educated for the design and simulation of solar power plants. Figure 8.2 shows the participants of Solar PV System Design using “PVSYST & PVSOL” Software with cost Economic and Policies.



Figure 8.2 : Participants of Solar PV System Design using “PVSYSY & PVSOL” Software with cost Economic and Policies

WORKSHOP ON PROSPECTS FOR START-UP IN SOLAR ENERGY TECHNOLOGIES

8.7 NISE has conducted 5 workshops on prospects for start-up in Solar Energy Technologies which were hugely successful in the FY 2017-18. During the year, 344 participants from the different States of India were well trained to start up their business in the

solar sector. The target audience prospective for this course were Solar Entrepreneurs, EPC contractors, Graduate Engineers, Energy department officials of Govt. of India, Officers from state nodal Agencies and individual business-men interested in the solar field. Figure 8.3 shows the participants of this workshop program.



Figure 8.3 : Workshops on prospects for startups in Solar Energy Technologies

SOLAR RESOURCE MEASUREMENT, ASSESSMENT, AND CALIBRATION TRAINING PROGRAM

8.8 The two-day skill development program on “Solar Resource” was conducted in NISE. There were 26 participants from academia, R&D, Indian Engineering services, Manufacturers and some young entrepreneurs. The program covered topics such as solar radiation, various assessment techniques, application of solar resource for technology selection,

SRRA projects in India and the methods to interpret solar resource data, calibration of solar radiometers, solar forecasting, selection of solar PV Module based on different weather conditions, site visit to calibration facility at NISE and SRRA station and hands-on exercise on measurement of solar radiation. Figure 8.4 shows the glimpse of hands-on session conducted during Training program on solar resource measurement, assessment, and calibration.



Figure 8.4: Training program on solar resource measurement, assessment and calibration

INTERNATIONAL TRAINING PROGRAMS

8.9 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), its corollary Special Commonwealth African Assistance Programme (SCAAP), TCS Colombo Plan, India–Africa Forum Summit (IAFS-III), South Asian Association for Regional Cooperation (SAARC) and 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.

8.10 The primary objective of these training programs were 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 impart knowledge of the Global trends on Solar Technology by exchange of information. The knowledge gained during the program was utilized by the participants to further develop an understanding of the respective field and its implementation to mature the Solar Technologies. The officials were nominated from different countries to attend these training programs. The details on International Training Program concluded during the FY 2017-18, is given in Table 8.1.

Table 8.1 International Training Program Concluded during Financial Year 2017-18.

| S. No. | Program Name | Period | No. of Participants | No. of Countries |
|--------|--|--|---------------------|------------------|
| 1. | Renewable Energy Capacity building program for Delegates from Africa under IAFS -III | 1 st -21 st August, 2017 | 38 | 19 |
| 2. | Skill Development Programme on Solar Technologies for officials from the SAARC Member States | 12 th - 29 th Sep, 2017 | 16 | 5 |
| 3. | International Training Programme of Solar Energy Technologies and Application under ITEC | 15 th Nov – 6 th Dec, 2017 | 30 | 22 |
| 4. | ISA National Focal Point Conclave -2017 | 7 th - 15 th Dec, 2017 | 19 | 19 |
| 5. | International Training Programme of Solar Energy Technologies and Application under ITEC | 3 rd - 24 th Jan, 2018 | 23 | 16 |
| 6. | Renewable Energy Capacity building program for Delegates from Africa under IAFS -III | 5 th - 23 rd Feb, 2018 | 30 | 15 |
| 7. | ISA National Focal Point Conclave -2018 | 10 th -18 th March, 2018 | 13 | 13 |
| | | Total | 169 | 109 |

* IAFS: India-Africa Forum Summit, SAARC: South Asian Association for Regional Cooperation, ITEC.



Figure 8.5 : International Training program on “Renewable Energy Capacity Building” under India- Africa Forum Summit (IAFS) -III

Renewable Energy Capacity Building Programme for Delegates from African Countries under India –Africa Forum Summit (IAFS-III)

8.11 This programme under India- Africa Forum Summit (IAFS-III), was fully funded and supported by Ministry of External Affairs, Govt. of India. Under these programs, a total number of 68 participants had joined the course from 21 African Countries. Different topics on Renewable Energy were taught by speakers from the Institute and other organizations and Industries as well. During the program, the participants visited different sites on solar pumping and rooftop solar projects in different cities of India. Figure 8.5 shows the participants of International Training program on “Renewable Energy Capacity Building” under India-Africa Forum Summit (IAFS) –III.

Skill Development Programme on Solar Technologies for officials from the South Asian Association for Regional Cooperation (SAARC) the Member States

8.12 The South Asian Association for Regional Cooperation (SAARC) comprises of 8 countries namely: Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, Pakistan, Sri Lanka and India. NISE has organised one program for officers from the member states of this group, a total number of 16 participants attended the course from 5 Member states. The presentations by senior officials from industries and academia in the field of solar technology were delivered to the participants. During the field visits, the participants were taken to the 50 MW solar power plant located in India named Anantapur Solar Park in Andhra Pradesh, and to the world’s largest single rooftop solar plant at Amritsar, Punjab. Figure 8.6 shows the participants of the International Training program on “Skill Development Programme on Solar Technologies” for SAARC member states.



Figure 8.6 : International Training program on “Skill Development Programme on Solar Technologies” for SAARC member states

International Solar Alliance (ISA): National Focal Point for ISA member countries – 9 days

8.13 ISA is an alliance of 121 solar rich countries lying fully or partially between the Tropic of Cancer and Tropic of Capricorn. This program was conducted for

National Focal Points of each ISA country by NISE at its campus. Under these programs NISE has successfully organized and completed two programs, 32 participants from 32 ISA member countries attended these programs. Figure 8.7 shows the participants of National Focal Point for ISA member countries.



Figure 8.7 : Participants of National Focal Point for ISA member countries

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

8.14 Every year NISE organizes, three weeks Indian Technical and Economic Co-operation (ITEC) and Special Commonwealth Assistance for Africa Program (SCAAP) programs fully funded by Ministry of External Affairs, Govt. of India. Under these programs, 53 participants had joined the course

from 33 developing countries around the world in two batches. This program was planned for the delegates from developing countries, hence countries like Russia, Egypt, Armenia Guatemala, Sudan etc. have participated in the course. It also brought in mutual knowledge under development in the field of Solar Energy around the world. Figure 8.8 shows the participants of the International Training Programme of Solar Energy Technologies and Application under Indian Technical an Economic Co-operation (ITEC).



Figure 8.8 : Participants of International Training Programme of Solar Energy Technologies and Application under Indian Technical an Economic Co-operation (ITEC)

SURYAMITRA SKILL DEVELOPMENT PROGRAM PAN INDIA BASIS

8.15 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 financial year 2017-18, 8167 were trained to develop skilled manpower in the field of solar photovoltaic system.

SURYAMITRA TRAINING PROGRAM AT NISE

8.16 NISE has successfully conducted three batches of Suryamitra Skill Development Program in the FY 2017-18. All the Suryamitra participants trained at NISE are very well placed in reputed organizations of Solar Energy sector such as Azure power, Rigava solutions, Suryaday Pvt. Ltd., Sunfuel, Network, Zolt Energy etc. These participants were selected in the organizations for different field including Sales, Operation & Maintenance, Installation, Business development, and Training etc. Additionally, NISE also promoted its trained Suryamitra participants to enhance their skill for starting up their own firm in the Solar Photovoltaic Industry. Figure 8.9 to 8.14 shows the participants of Suryamitra batches at NISE.



Figure 8.9 : Participants of Suryamitra performing solar photovoltaic experiments at NISE



Figure 8.10 : Hands-on Experience of Suryamitra Participants of Suryamitra for inverters experiments at NISE.



Figure 8.11 : Participants of Suryamitra Batch-6 practicing Fire-fighting Exercises at NISE Gurugram



Figure 8.12 : Suryamitra candidates Practicing Cable Crimping



Figure 8.13 : Suryamitra participants at the SPV outdoor site demonstrated by NISE scientist



Figure 8.14 : Motivational & Self Defence Workshop for Suryamitra participants by Dr. Divya Gupta (Jwala Foundation)

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

8.17 The Advanced Solar Professional Course” has been launched since 6th Feb 2018. Figure 8.15 shows the Launch Ceremony of 6-months Advanced Solar Professionals Course batch along with Shri Upendra Tripathi - IDG ISA, Dr. Arun K. Tripathi – DG NISE, Dr. Praveen Kr. Saxena, CEO-SCGJ and other officials. This course aims a better understanding and hands-on-practice in the different streams of solar energy including Solar Photovoltaic technologies, On-grid and Off-grid systems, Solar Water Pumping System, Solar Thermal technologies, Applications of Solar

Thermal technologies, Solar Resource Assessment, Business Entrepreneurship, etc. This course has been developed by NISE and it incorporates 14 Qualification packs (QPs) of Skill Council for Green jobs (SCGJ). This course contains 30% Theory and 70% Practical sessions along with industrial visits related to Electrical, Solar Photovoltaic, and Solar Thermal. On successful completion of this course, the participants will be awarded a joint certificate from NISE and SCGJ. The certificates of this course are recognized in 27 different countries (countries listed by NSDC, MSDE) including India. Figures 8.16 and 8.17 shows the activities performed by the participants during the



Figure 8.15 : Launch Ceremony of 6-months Advanced Solar Professionals Course batch along with Shri Upendra Tripathi, IDG-ISA (Former Secretary MNRE), Dr. Arun K. Tripathi – DG NISE, Dr. Praveen Kr. Saxena, CEO-SCGJ and other officials



Figure 8.16 : Participants of Six Months Advanced Solar Professional Course visited M/s Central Electronics Ltd., Ghaziabad



Figure 8.17 : Interaction of Participants of Six Months Advanced Solar Professional Course with eminent faculty and scientist



Figure 8.18 : First batch of Rooftop Solar Grid Engineer Course at NISE

advanced professional course. A total number of 40 participants were there in this program. The revenue generated for this program was twenty-two lac rupees Rs. 22 Lacs (approx.) excluding the GST amount.

ROOFTOP SOLAR GRID ENGINEERS COURSE CODE: NISE/008/2017-18

8.18 The Rooftop Solar Grid Engineer was the first course successfully launched at National Institute of Solar Energy dated 11th-22nd Sep 2017. The training has been conducted based on Qualification Pack (QP) SGJ/0106 which was certified by the National Skill Development Corporation (NSDC). This course QP has been developed based on Industry Requirement in the field of Solar Rooftop Grid-tied system. After completion of this course, assessment and certification were conducted by the Skill Council for Green Jobs. Figure 8.18 and 8.19 shows the glimpse of the solar rooftop grid engineer course conducted at NISE.

INTERNSHIP TRAINING FOR B.Tech/M.Tech/ MSc/Ph.D.

8.19 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 year 2017-18, there were four B.Tech, five M. Tech and a Ph.D. student from reputed institutions. These trainees were involved in research and testing activities for their research projects at NISE.

FUTURE PROSPECTS AND DEVELOPMENT

8.20 NISE intends to organise ten international training programme for ISA member countries and three trainings for other international countries. Furthermore, NISE has structured new advanced training programmes for the skill development in solar energy. In the forthcoming year, NISE has planned 35 National Training programs on various aspects of solar energy.



Figure 8.19 : Second Batch of Rooftop Solar Grid Engineer during 11th -22nd Dec 2017 at NISE

COORDINATION & INTERNATIONAL COLLABORATIONS

NISE is a growing scientific organisation with research and development (R&D), innovation, knowledge sharing, trainings, technology evaluation, consultancy, performance analysis of technologies and collaborations for valuable partnership with academia, industries, government institution, new

entrepreneurs or international organisations. NISE has been persistent for its course of action in bridging the gap between the innovation, successful development and presentation of new solar technologies in the market and addressing the people with the latest trends and new expansions.



Figure 9.1 : NISE Exchanging MoU with NPTI, Faridabad and Jamia Millia Islamia.

9.2 NISE has always been keen to work with specialised institutions/organisations to augment its strength. NISE has signed a Memorandum of Understanding (MoU) with various organisations to operate a collaborative venture for development and dissemination of solar energy in the country and to ensure a clean energy environment. These associations outreach different parts of the country escalating the energy security and confronting our today's challenges.

9.3 These partnerships identify the following activities:

- Joint association for analysis of solar power technologies and establish suitable guidelines for its regular operation.
- Developing testing protocols and their implementation.
- Suitable association for joint R&D (Research and

development) projects.

- For new innovation and commercialization of new products.
- To venture for developing skilled manpower and capacity building via. Training programs.
- Performance and evaluation of projects, data collections, validation, policy making etc.

MoU's SIGNED BY NISE

9.4 Six MoUs were signed during 2017-18, taking a total MoUs signed by NISE to 10. These organisations were working with NISE for innovation, R&D, Capacity Building etc. A list of the MoUs signed during 2017-18 and previous years is given in Table 9.1 and 9.2 respectively. Figure 9.1 shows, NISE exchanging MoU with NPTI Faridabad and Jamia Millia Islamia.

Table 9.1 MoUs signed during 2017-18

| S. No. | MoU | Date of Signing | Validity |
|--------|--|-------------------------------|----------|
| 1. | NISE & INES (The National Solar Energy Institute – INES, France ‘CEA’) | 10 th March 2018 | 5 Years |
| 2. | NISE & SECI (Solar Energy Corporation India – SECI) | 28 th July 2017 | 5 Years |
| 3. | NISE & TERI (The Energy Resource Institute - TERI) | 31 st August 2017 | 5 Years |
| 4. | NISE & NPTI (National Power Training Institute – NPTI) | 4 th October 2017 | 5 Years |
| 5. | NISE & AFC (Agricultural Finance Corporation Ltd.) | 25 th January 2018 | 5 Years |
| 6. | NISE & DUPONT India Private Limited | 23 rd March 2018 | 2 Years |

Table 9.2 MoUs signed previously and are under implementation

| S. No. | Organisations with whom MoU signed | Date of signing | Validity |
|--------|---|---------------------------------|------------|
| 1. | NISE & DTU (The National Solar Energy Institute – Delhi Technological University) | 22 nd May 2012 | Continuing |
| 2. | NISE & NRSC (National Remote Sensing Centre, Indian Space Research Organisation Department of Space – NRSC) | 24 th February 2016 | 2 Years |
| 3. | NISE & IREDA (Indian Renewable Energy Development Agency Ltd. - IREDA) | 6 th April 2016 | Continuing |
| 4. | NISE & IIST (Indian Institute of Engineering Science and Technology, Shibpur – IIST) | 28 th September 2016 | 5 Years |

INTERNATIONAL ALLIANCE

Association with USAID

9.5 India, with its tropical climate and favourable weather condition, harbours approximately 300 clear and sunny days harnessing a large potential capacity for solar energy development. Thus, solar energy is a rapidly progressing sector in the country. The nation has one of the most ambitious renewable energy expansion programs with a target of 175 gigawatts installed capacity as a contribution by renewable energy by 2022. There are various solar power plants, projects and institutions spread throughout the country which are working to achieve this target. However, capturing, monitoring, comparing and consolidating the data generated by these facilities to facilitate the faster progress of the sector figures as a problem, as the existing infrastructure is inadequate to relay the performance data that will be of use to various stakeholders like developers, consumers, policy makers, investors, etc.

9.6 To tackle this issue NISE in collaboration with United States Agency for International Development (USAID) under the supervision of the MNRE, GOI is working on a National Level Centralized Monitoring Centre (NCMC), an ambitious project to create a Centralized Online Monitoring System for capturing and processing of live data from solar energy projects/plants across Northern India.

9.7 This system will provide live, real-time information over a web portal for performance tracking, evaluation, and comparison. The NCMC would serve various purposes like capturing static and dynamic parameters on a real-time basis, converting the data captured from various sources into user-friendly formats, will include customized data sets for utility and the scope of the project will be such that it would be capable of expansion throughout the country at later stages. This project aims to cater to the demands created by the rapidly growing solar power sector and contributing to the pace by attracting investors by increased awareness and accessibility.

Project with PTB Germany

9.8 NISE has jointly worked with PTB Germany under Indo-German Cooperation for the Solar Industry under a project, “Strengthening of Quality Infrastructure for the Solar Industry”. The objective of this project is to analyse different standards and assess the performance of the system in accordance with the end-use condition. The project will envisage activities to improve the quality infrastructure services for assuring the quality and safety of photovoltaic systems and their components, creating the basis for the sustainable development of the photovoltaic sector and it will work for the inclusion of quality criteria in Standardization/Accreditation. Furthermore, the project will also develop capacities for the development of the calibration laboratories.

Collaboration with International Solar Alliance (ISA)

9.9 NISE is providing active support to the ISA, which is housed in the campus of NISE. NISE conducted 3 International trainings for the National Focal Points of ISA member countries. During the FY, 200 number of visitors from ISA member countries visited NISE and its facilities, including the innovative technologies developed at NISE. NISE is regularly participating in the monthly meetings and other events being organised by ISA with the Embassies of the member countries and other organisations. NISE also maintains the financial accounts of ISA and provides the financial and administrative services to ISA Secretariat situated at NISE campus.

SUPPORT PROGRAMMES AND ACTIVITIES

CONSULTANCY SERVICE

NISE has a variety of technical expertise in all fields of solar energy. Many implementing organisation, associated institutions of MNRE, and state governments regularly approach NISE for seeking solutions to the field problems, field performance, evaluation of their projects, and to augment the output of the solar energy-related projects.

10.2 NISE has developed capabilities to provide solutions to these issues, consultancy is one of the technical wings of this institute to prove its technical credibility. Figure 10.1 shows the EL testing performed at the power plant site. With an excellent pool of scientific manpower and management experts, NISE is handling various consultancy projects like:

- All India site survey for module reliability & performance with IITs.
- Solar System Design and Vetting of tender documents and specifications Project management & EPC advisory
- Detailed project report
- Design of Solar power Plant
- Energy yield assessment
- Site weather monitoring & Reporting
- Review of Project Specification
- Construction Supervision and Safety – relevant plant inspection
- Compliance of PV plant with plant specification
- A functional check of the entire plant
- Detection and listing of faults
- Inspection of fault elimination and follow up inspection
- Solar power plant performance evaluation & monitoring in the fields.
- Testing & performance of the solar systems with Mobile Lab facilities.



Figure 10.1 : EL Testing performed at power plant site

10.3 NISE is capable of setting up Laboratories worldwide. The institute has active collaborations and MoUs with prominent national & international organizations in solar energy technologies for consultancy services. Figure 10.2 shows the glimpse of consultancy services provided by NISE at site. Different consultancy services provided by NISE, Gurugram is given in Table 10.1.



Figure 10.2 : Consultancy services provided by NISE

Table 10.1 Consultancy Services provided by NISE during 2017-18

| S. No. | Vendor Details | Project | Date | Amount (Rs. in Lacs) |
|--------|-------------------------------------|---------------------------------------|--------------|----------------------|
| 1 | Saugor Cantonment Board. (M.P.) | Consultancy for Solar Panels/ Modules | 12-06-2017 | 1.72 |
| 2 | Garrison Engineer (AF), Bhisiana | Vetting of DPR | 27-04-2017 | 3.00 |
| 3 | Garrison Engineer (AF), Bhisiana | Vetting of 1MW Solar PC Power | 29-04-2017 | 3.00 |
| 4 | Garrison Engineer INA, Kerala | Consultancy for INA, Ezhimala, Kerala | 25-05-2017 | 4.85 |
| 5 | Saugor Cantonment Board. (M.P.) | Consultancy | 21-06-2017 | 1.72 |
| 6 | Saugor Cantonment Board. (M.P.) | Consultancy | 14-06-2017 | 1.72 |
| 7 | M/s Sterling & Wilson | Vetting | 12.10.2017 | 1.83 |
| 8 | M/s Nirman Encon projects Pvt. Ltd. | Vetting | 26.07.2017 | 6.65 |
| | | | Total | 24.50 |

LIBRARY

10.4 The Institute’s Library was established in September 2013. The Library is fully automated since April 2017. These facilities and services of the library are availed by official/ staff, visitors and many trainees from different departments. During the year 2017-18, 250 books, 94 Standards and 01 e-Standard were purchased. The NISE Library has a very rich collection of 8,250 volumes of books, bound volumes of Journals and other reading material particularly on solar energy, 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 on solar modules, inverters, batteries etc. The library subscribes to Scientific Journals and Newspapers in Hindi and English languages. In addition, several electronic, academic, and scientific journals are subscribed to apart from annual reports and project reports.

10.5 The library uses online software (e-Granthalaya) for circulation of books. The library is being modernized by strengthening of Internet services with the addition of 06 Computers, computerization of library catalog, automation of Check-in, Check-out functions, barcoding of collections, data entry of entire collection, automation of stock verification, the creation of Digital Library and the establishment of Multimedia Library.

10.6 The NISE Library organized a Books and Scientific Journals Exhibitions on 18th September 2017 on a large scale. A total number of 6 authorised vendors of NISE had participated in the Exhibition. Around 5000 books from 15 different publishers were displayed by the vendors. Figure 10.3 and 10.4 shows the exhibition organised at NISE, and the library section in the campus.

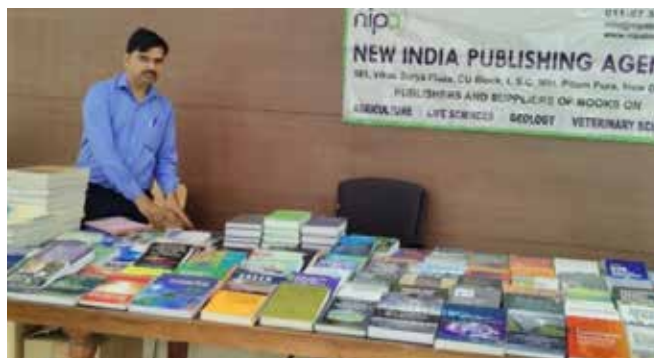


Figure 10.3 : Exhibition of Books and Scientific Journals organised at NISE



Figure 10.4 : Library section at NISE



Figure 10.5 : Sports Facility at NISE

SPORTS FACILITIES

10.7 NISE has designed infrastructure for indoor game activities, yoga, and gym facilities within the campus. The gym is equipped with quality cardio, strengthening and free weight equipment's. These are focused to provide the staff, trainee, and interns with the best way to burn calories, gain strength and stay fit. The workout space is clean, safe and comfortable. Additionally, the institute comprises of a hall in Surya Bhawan exclusively customised for yoga training. The international participants and trainees are provided with sessions from well-renowned yoga instructors for an authentic experience of meditation. NISE has provided indoor game facilities for carom board, billiards, table tennis etc. These facilities are open on all days throughout the year. Figure 10.5 shows the sports facility at NISE.

INFORMATION TECHNOLOGY DIVISION (IT)

10.8 The information technology division is the main supporting pillar of this organisation. It has redesigned the NISE website and developed new content for an exceptional presentation of NISE to the far outside people. Its sincere efforts have kept the solar community updated and have created a 24*7 platform for the interaction of the associates with the NISE staff. The department has carried out the following activities for the upgradation of this institute:

- i. Procured 52 Desktops and 25 printers, 25 UPS, through GeM web portal.
- ii. Established 3 Video Conferencing Facilities in NISE Campus.
- iii. Installation of 2 EPABX Telephone Exchange Systems with 128 and 36 capacities for three buildings including Guest Houses.
- iv. Laying of Networking System in the entire campus (in progress) to ensure e-office management in NISE, networking facility, Wi-Fi etc. through NIC-SI.
- v. Installation of CCTV network for Security arrangements.
- vi. Procurement of Large Screen Display Monitor for the Data Centre.
- vii. In-house Development of 4 web portals on
 - a) Suryamitra Trainings
 - b) Trainings for NISE
 - c) Nationalised Centralised Monitoring Centre (NCCM)
 - d) Accounts management.
- viii. Procurement of Cloud service from NIC for hosting the NISE portals and other data.

10.9 Further, for the development of Data Research Centre for the performance evaluation and monitoring of solar power plants, the center is establishing and proposing to expand its team which shall also look after at the forecasting and scheduling of solar power generation, solar resource assessment etc. The department is conducive in creation and maintenance of web portals for specific applications, creation and management of IT-related hardware, creation and maintenance of networking facilities, security equipment, creation, and maintenance of e-office management system. Thus, the information and technology department is committed to providing the world-class amenities to NISE for conquering the mission.

CUSTOMER SERVICE CELL

10.10 Customer Service Cell (CSC) in National Institute of Solar Energy, Gurugram, is the single-point interface between customers and NISE for a complete range of device testing services offered by the institute. CSC facilitates testing of various solar energy product and their components - Solar Cell, Solar Photovoltaic (PV) Modules, Solar Inverter, Batteries, Solar Pumps, and Solar Thermal (ST) systems from well-equipped laboratories in the institute as per National and International standards. CSC provides a gamut of services - ranging from service inquiry, testing request, fee processing to test report dispatch. CSC is committed to providing unparalleled customer service and has been successful in meeting the customer expectations, leading to repeat business from existing customers. To maintain a high customer satisfaction index, CSC follows industry standards & processes and periodically collects feedback to continuously improve and set higher standards of service. The personnel are ISO/IEC 17025:2005 certified, ensuring

ability to flawlessly develop management system for quality, administrative and technical operations.

UPGRADATION OF SERVICES

10.11 To upgrade our services to customers, an online testing portal has been created. Customers avail testing services by getting registered on the online portal available at NISE website. It becomes easy to make payment, to know and choose testing services and receive reports online. The functional output of online portal solutions are as follows, (i) Facility for business user to register themselves and avail testing service by making payment online, (ii) Ability of business user to inquire with the CSC department on any query related to testing services, (iii) A seamless communication channel from order placement to test completion, (iv) Facility for the CSC department to manage and process orders received, (v) Management reporting facility to track and improve customer satisfaction. Figure 10.6 and 10.7 shows the testing revenue and customer satisfaction index of NISE during the year 2017-18.



Figure 10.6 : depicts the testing revenue generated at NISE during 2017-18



Figure 10.7 : depicts the customer satisfaction index of NISE during 2017-18

PROMOTION OF OFFICIAL LANGUAGE HINDI

10.12 With a view to implementing the Official Language Policy of the Government of India, a Hindi Section has been set up in the NISE this year. 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) Publication 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 being undertaken which include the following, (i) Work is in progress 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 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 placed on the Website of NISE for convenience of officers/staff, (vi) The Annual Reports 2013-14, 2014-15 and 2015-16 of the institute were printed in both Hindi and English languages. These reports were presented in Rajya Sabha on 06.02.2018 and Lok Sabha on 08.02.2018. These Annual Reports are available in both languages on the website of NISE. The Annual Report of 2016-17 was also prepared in Hindi language, (vii) All navigation boards, general boards, nameplates and rubber stamps etc. in the institute are bi-lingual, (viii) During the year, two Hindi training workshops were organized in the institute. In these workshops, a good number of participants participated, (ix) The Standard Operating Procedure (SOP) of the Institute laboratories is being prepared in bi-lingual mode, (x) First working day of every month is celebrated as Hindi Divas in the institute. On this day most of the work is done in Hindi, (xi) on 6th March 2018, Books on Glossary of Administration Terms were distributed among officers/ library/ staff of NISE.

10.13 To review the progress made in the implementation of Official Language policy, quarterly meetings of Official Language Implementation Committee were held regularly. The Sections/ 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.

10.14 'Hindi Pakhwada' was celebrated in the Institute during 1st to 14th September 2017 to create awareness and to increase the use of Hindi in official work. Various competitions like Hindi Essay writing, poetry, text recitation and debate competitions 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 performance, memento, certificates and cash prizes were awarded to the participants by the DG, NISE. On 4th September 2017, a special speech on 'Vishwa Patal Par Hindi Bhasha' was delivered by Dr. Harshvardhan Pandey, as well as on 9th September 2017 at 'Hasya Kavi Sammelan' organized by Hindi Section of NISE. Figure 10.8 shows the prize distribution ceremony by Dr. A. K. Tripathi, Director General, NISE on the Closing ceremony of Hindi Pakhwada and Participants of Kavi Sammelan at NISE for Hindi Pakhwada Day.



Figure 10.8 : Prize Distribution ceremony by Dr. A. K. Tripathi, Director General, NISE on the Closing ceremony of Hindi Pakhwada and Participants of Kavi Sammelan at NISE for Hindi Pakhwada Day



Figure 10.9: Greenovation Exhibition conducted at TERI

INFORMATION & PUBLICITY

10.15 NISE participated in “World Sustainable Development Summit 2018” from 14th-17th Feb 2018 at “Greenovation Exhibition” at IHC, New Delhi conducted by TERI. NISE set up a stall to promote its facilities/services. Over 1000 visitor visited the stall & gave many innovative ideas and were keen to know more about the institute. Figure 10.9 shows the exhibition conducted at TERI.

10.16 NISE actively participated in a five-day exposition ELECHEMA 2018, from 10-14 March 2018. The

information desk was set up along with International Solar Alliance (ISA) for sharing the information and literature pertaining to the solar awareness. Over 300 visitors, from Public and Private Sector Enterprises particularly from the Renewable sector, Electrical industry, Media Houses, etc. visited the stall. Figure 10.10 shows the exhibition conducted at Greater Noida in association with ISA.

FOUNDATION DAY AT NISE

10.17 For the first time, NISE organised its Foundation Day on 27th October 2017. Shri Raj Kumar Singh, Minister of State (I/C) for Power and New & Renewable Energy addressed the gathering of scientists, research staff and other guests on the 4th Foundation Day celebrations of National Institute of Solar Energy (NISE), at its campus in Gurugram, Haryana. Shri Raj Kumar Singh motivated us by saying that, NISE should aim to establish itself as the World’s leading institute in the field of solar energy through its world-class R&D, Testing & Certification, and Training, it should aim to emerge as a “Centre of Excellence”. NISE should strive further and set up regional centers for research and development in solar energy.



Figure 10.10: Elecrama 2018 in association with International Solar Alliance (ISA)



Figure 10.11 : Shri Raj Kumar Singh, Minister of State for Power and New & Renewable Energy addressing scientists, research staff and other guests on the 4th Foundation Day celebrations of National Institute of Solar Energy (NISE) on 27th October 2017.

10.18 “There is no dearth of funds for R&D activities”, the Minister added, while complimenting on the number of innovative prototype projects developed at NISE. He said that NISE should work quickly and patent some of the products and encouraged scientists to work out strategies for public-private collaborations to reach end-users. The Minister also launched the Automation System for Customer Service Cell for Testing Facilities at NISE. The Minister was also presented with a set of four books on Solar Energy published by NISE. Figure 10.11 and 10.12 shows the glimpse of the 4th Foundation day at NISE.

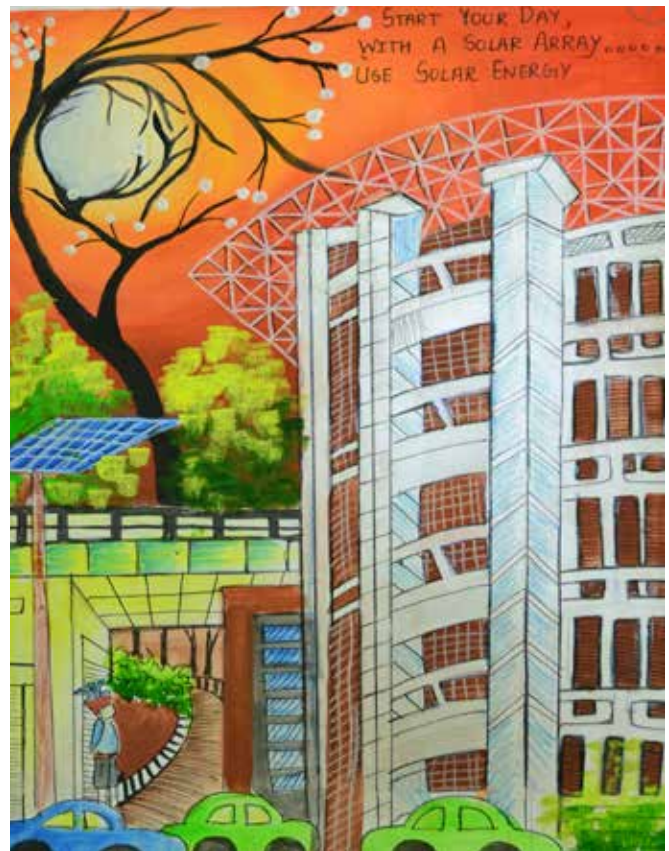
10.19 An exhibition of solar products was organised in which many companies displayed their products. An open day was organised and NISE was opened for the public on the foundation day. Prior to the Foundation Day, NISE organised painting competition, essay writing competition, model making competition, Quiz, and cultural activities on solar energy with the teachers and students of many schools of Haryana, coordinated by Delhi Public School, Gurugram. Over 200 students participated in these competitions. The Minister also gave away awards to school children who won prizes on various competitions on Solar Energy. Figure 10.13 shows the glimpse of paintings exhibition after painting competition organised by NISE.



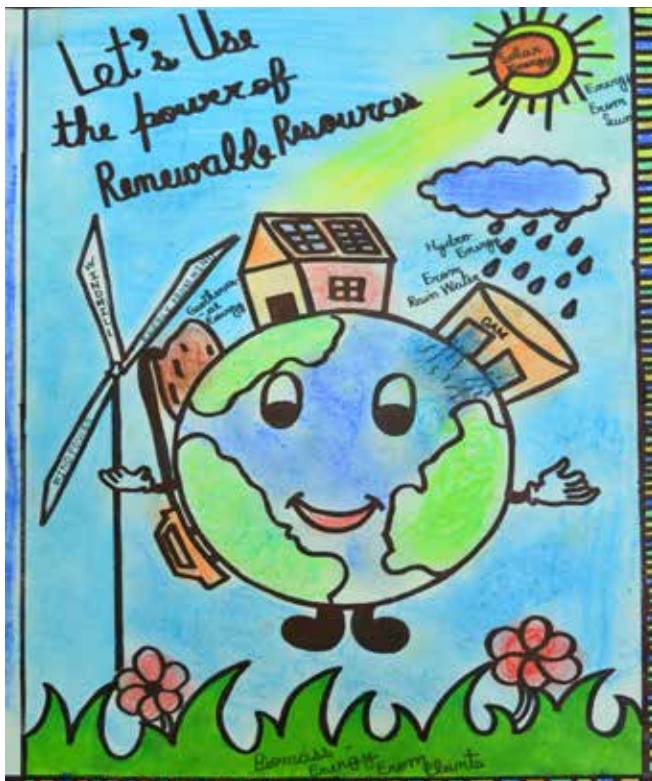
Figure 10.12 : Shri Raj Kumar Singh, Minister of State for Power and New & Renewable Energy, actively participating in the 4th Foundation Day at NISE on 27th October 2017.



Anshika Sharma, The Maurya School, 8-B, Group 2



Sakshi Sonawane, Class 9, Lions Public school



Namanmeet Singh, 7 B, DPSG Palam Vihar, Group 2, 5A



Meenakshi, 7, Aakash public school, Group -2. 1B

Figure 10.13 : Glimpse of Painting exhibition after painting competition organised by NISE

INDEPENDENCE DAY CELEBRATION

10.20 On August 15th, 2017 the Independence Day was celebrated at the National Institute of Solar Energy with great fanfare. On this occasion, the National Flag was hoisted by Dr. Arun Kumar Tripathi, Director General of the Institute. He gave warm greetings to all the officers and employees of the institute and said that all of us must always remember the importance of freedom and the sacrifices made by the freedom fighters, and the commitment of the dedicated



Figure 10.14 : Independence Day celebration at NISE

SWACHH BHARAT ABHIYAAN

10.22 Swachh Bharat Abhiyaan, a programme related to cleanliness was organized for the Institutes cleanliness awareness from 15th September to 2nd October 2017. All officers and employees of the institute took an active part in this Abhiyaan. The Programme was duly inaugurated on 15th September 2017 and addressed by the Director General of the Institute. He emphasized on keeping the campus of the institute neat and clean. A special cleaning campaign was organized every day in different parts of the institute.

soldiers in the service of the country should be considered paramount.

10.21 On this occasion, a plantation programme was organized to keep the campus of the institute green and environment-friendly. The officials and the student of Suryamitra also took part in this occasion. After hoisting of the flag, cultural events were performed by the Suryamitras and sweets were distributed. Figure 10.14 shows the Independence Day celebration at NISE.



VIGILANCE AWARENESS WEEK - 2017

10.23 Vigilance Awareness Week was organized from 1st to 7th November 2017. It was launched with the promise of *Satya Nishtha Pratigya*, given by the DG of the Institute. All the officers and employees of the institute pledged their allegiance to the integrity and promised to work with the utmost honesty and fight against corruption at every step. Figure 10.15 shows the oath taking ceremony celebrated during vigilance awareness week at NISE.



Figure 10.15 : Oath taking ceremony during vigilance awareness week at NISE

VIGILANCE

10.24 The Vigilance Division of the Institute is entrusted with taking anti-corruption measures in accordance with various rules, guidelines, instructions issued by the Government of India and the Central Vigilance Commission. In addition to taking anti-corruption measures, the Division is entrusted with the upkeep of Annual Performance Appraisal Reports (APARs) of all the officials of NISE.

10.25 The summary of complaints, received/dealt by the Vigilance Division during 2017-18, is as follows:

- | | |
|---|-----|
| i. Total No of Complaints/fraud cases received during 2017 -18: | NIL |
| ii. Anonymous / Pseudonymous: | NIL |
| iii. Verified complaints: | NIL |
| iv. No. of complaints closed: | NIL |
| v. Pending cases: | NIL |
| vi. Transferred to State Govt.: | NIL |
| vii. No. of complaints transferred to police: | NIL |
| viii. No. of complaints transferred to CBI: | NIL |

COMMITTEE FOR PREVENTION OF SEXUAL HARASSMENT OF WOMEN AT WORKPLACE

10.26 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 received during the year 2017-18.

RIGHT TO INFORMATION ACT

10.27 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

10.28 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. A list of CPIOs and First Appellate Authorities is listed below. Respective CPIOs and First Appellate Authorities reply to RTI applications/Appeals within the stipulated timelines to the extent possible.

10.29 The progress report in terms of RTI application/ First Appeals received, disposed-off, as well as pendency during the year (from 01.04.2017 to 31.03.2018), is given in Table 10.2.

Table 10.2 Status of RTI Application received during 2017-18

| Item | Received | Disposed-off | Pending as on 31.03.2017 |
|------------------|----------|--------------|--------------------------|
| RTI Applications | 36 | 36 | NIL |
| First Appeals | NIL | NIL | NIL |

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 NISE | Dr. Rajesh Kumar Scientist 'F' (Deputy Director General) | Dr. Arun K Tripathi Director General |
| 2 | All matters concerning NISE | Dr. Chandan Banerjee Scientist 'F' (Deputy Director General) | Sh. S.K. Singh Scientist G (Addl. Charge) |
| 3 | All matters concerning NISE | Er. Sanjay Kumar Scientist 'F' (Deputy Director General) | Dr. Arun K Tripathi Director General |

ADMINISTRATION & STAFF

10.30 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 various department in this institution function under the supervision of the Deputy Director General, (DDG) NISE. The Scientific Staff, Senior Consultants, Consultants, Executive Assistants, Multi-Tasking Staff and other staff support in the smooth functioning of the organisation.

10.31 The Government of India has sanctioned 41 regular posts. 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. The posts were advertised on All India basis in Employment News, and on the Ministry and Institute websites. The recruitment is in progress and the posts are listed in Table 10.3.

Table 10.3 Recruitment post at NISE

| S. No. | Name of the post | PB+GP | No of Posts | | | Status |
|--------------|-------------------------|------------|-------------|-----------|-----------|---------------------------------|
| | | | Technical | Admin | Total | |
| 1. | Director General | PB-4+10000 | 1 | 0 | 1 | Filled |
| 2. | Deputy Director General | PB-4+8900 | 3 | 0 | 3 | 2 posts filled |
| 3. | Director | PB-3+7600 | 2 | 1 | 3 | Selection made for 1 Admin Post |
| 4. | Deputy Director | PB-3+6600 | 6 | 2 | 8 | Selection made for 2 Admin Post |
| 5. | Assistant Director | PB-3+5400 | 7 | 2 | 9 | Selection made for 2 Admin Post |
| 6. | Administrative Officer | PB-3+6600 | 0 | 1 | 1 | Selection made for 1 Admin Post |
| 7. | Office Secretary | PB-2+5400 | 0 | 1 | 1 | Recruitment in Progress |
| 8. | Office Secretary-I | PB-2+4800 | 0 | 3 | 3 | Recruitment in Progress |
| 9. | Executive Officer | PB-2+4800 | 4 | 0 | 4 | Recruitment in Progress |
| 10. | Executive Assistant-I | PB-2+4600 | 8 | 0 | 8 | Recruitment in Progress |
| Total | | | 31 | 10 | 41 | |

10.32 In the meantime, 2 officers from MNRE have also been posted in the Institute. Senior Consultants and Consultants have also been engaged for the specific and specialised work. Few Project Fellows/ Research

Scientists are also working in NISE to carry out mainly Research and Testing related work. The regular activities of horticulture, security, housekeeping, canteen etc. have been outsourced.

RESEARCH PUBLICATIONS, BOOKS & PATENTS

RESEARCH PUBLICATIONS

NISE is an Apex Institute for research in the field of solar energy technologies. NISE has conducted a detailed study in relation to the specific problems, concerns, and issues in solar photovoltaics and solar thermal field. The team of scientists has constantly studied and monitored the real-time data, and it has proved to be an effective tool for the people around the world to analyse the system before installation and predicts its output. The research and application applied was published in various national and international publication for the exchange of knowledge. The reports on the All India survey of photovoltaic modules and books related to solar energy is published along with NISE is a knowledge pool. During the year, NISE has filed a patent for the various new technologies developed in solar energy. The list of the publications, books, reports, patents is listed below.

INTERNATIONAL/NATIONAL JOURNALS

- [1] Reliability study of Solar PV Power Production in Terms of Weather Parameters Using Monte Carlo Simulation, Himani Sharma, Birinchi Bora, Shubham Sharma, Rajesh Kumar, Rashmi Jain, Int. Journal of Engineering Research and Application www.ijera.com, ISSN : 2248-9622, Vol. 7, Issue 7, (Part -5) July2017, pp.37-45
- [2] Non-intrusive real-time monitoring of PV generation at inverters using internet of photovoltaics, Subrahmanyam Pulipaka, Rajneesh Kumar, Birinchi Bora, S. Kumar and S.K. Singh, Electronics Letters · May 2017, DOI: 10.1049/el.2017.0694.
- [3] Wind Effect Modeling and Analysis for Estimation of Photovoltaic Module Temperature, Dhiraj Magare, Oruganti Sastry, Rajesh Gupta, Birinchi Bora, Yogesh Singh, Humaid Mohammed, Journal of Solar Energy Engineering, Feb. 2018, Vol. 140, DOI: 10.1115/1.4038590
- [4] Mitigation of PID in Commercial PV Modules using Current Interruption Method, Birinchi Bora, Jaewon Oh, Sai Tatapudi, O.S. Sastry, R. Kumar, B. Prasad, G. Tamizh Mani, SPIE 2017, DOI 10.1117/12.2281112
- [5] U.Sahoo, R.Kumar, P.C.Pant, R. Chaudhary. Development of an innovative polygeneration process in hybrid solar-biomass system for combined power, cooling and desalination. Applied Thermal Engineering 2017, 120: 560–567.
- [6] NUR Rather, S Moses, U. Sahoo, A Tripathi. Performance Evaluation of Hybrid Cold Storage using Solar & Exhaust heat of Biomass Gasifier for Rural Development. International Journal on Recent and Innovation Trends in Computing and Communication 2017, 5: 563-569.
- [7] Amit KumarYadav, Vikrant Sharma, Hamat Malik & S. S. Chandel, "Daily array yield prediction of the grid-interactive photovoltaic plant using relief attribute evaluator based Radial Basis Function Neural Network" Renewable and Sustainable Energy Reviews 2018, 18: 2115-2127.
- [8] "Ag implantation-induced modification of Ni-Ti shape memory alloy thin films" Kumar, R. Singhal, R. Vishnoi, M.K. Banerjee, M.C. Sharma, K. Asokan & M. Kumar Radiation Effects and Defects in Solids, 172, 629-942 (2017)

- [9] "Impact of thermal treatment parameter on the properties of $\text{Cu}_2\text{ZnSnS}_4$ solar absorber layer" Indu B. Vashistha, Mahesh C. Sharma, and S.K. Sharma, *Advanced Materials Proceedings*, 3(1), 13-16 (2018).
- [10] "Mathematical method to find best-suited PV Technology for different climatic zones of India", Suprava Chakraborty, Rajesh Kumar, Avinash Kumar Haldkar, Shishu Ranjan, *International Journal of Energy and Environmental Engineering* (Springer), June 2017, Vol. 8(2), pp: 153-166.
- [6] Optimum Sizing and Performance Modeling of Solar Photovoltaic (SPV) Water Pumps for Different Climatic Conditions, Renu, Birinchi Bora, Basudev Prasad, O.S. Sastry, Atul Kumar and Manander Bangar, *Solar Energy*, 2017.
- [7] Analysis of Temperature effect on Optimum Sizing of Solar Photovoltaic Water Pumping System, Renu, Birinchi Bora, Kamlesh Yadav, Manander Bangar, Arun Kumar, and O.S. Sastry, 42nd IEEE PVSC, 2017.

INTERNATIONAL/NATIONAL CONFERENCES

- [1] "Experimental Analysis and Performance Mapping of Various CST Technology at Different Location across India ". Senthil Kumar, Vikrant Yadav, Puneet Saini, National Conference on Recent Advances in Mechanical Engineering (NCRAME 2017) ISBN: 978-93-86256-88-1, Vol.2, Pg. 306-309.
- [2] "Design and Development of Solar Air dryer for drying of Apricot for Ladhak Region". Senthil Kumar, Vikrant Yadav, Yogendra Singh, Sudhir Kumar Singh. Kerala Renewable Energy Congress, 2018.
- [3] "Solar Based Indoor Kitchen Cooking Chulha for Household". Vikrant Yadav, Senthil Kumar, Yogendra Singh, Sudhir Kumar Singh. Kerala Renewable Energy Congress, 2018.
- [4] "Solar Air Driers: A walk through ". Sh. S K Singh, Mr. Senthil, Mr. Vikrant Yadav, Mr. Yogendra Singh, Dr. Nikhil P G, Kerala Renewable Energy Congress, 2018.
- [5] Kamlesh Yadav, Atul Kumar, Rajesh Kumar, Rupesh Wandhare, Mithilesh Kumar, O.S. Sastry, "Commonly observed degradation and its mitigation in field-aged photovoltaic modules in India" Research Conclave IIT Guwahati, 2018.
- [8] "Defects Detection in Photovoltaic Technology by Electroluminescence Characterization Technique" Mahesh C. Sharma and Chandan Banerjee, International conference on "Environment Sustainable Development" (RTESD-2018), organized by Vivekananda Global University (VGU), Jaipur.

ORAL PRESENTATION IN 2017

Fuel Cell Seminar and Exposition held during 7-9 November 2017 at Long Beach, California

Operation of a Solar Hydrogen Production Cum Dispensing Facility and Demonstration of Hydrogen - Diesel Dual Fuel Vehicles at National Institute of Solar Energy, Gwal Pahari, Gurugram, Haryana (India) - Shweta Soam, National Institute of Solar Energy", Shweta Soam*, Amit Katiyar, Pragati Rajput, Prakash Jha, M.R.Nouni, S.K.Singh

POSTER PRESENTATION

6th International Hydrogen & Fuel Cell Conference (IHFC – 2017), held during December 10th – 12th, 2017 at Hyatt Pune, Pune, India

- [1] Catalytic Reforming of CO₂ for Production of Gaseous and Liquid Fuels using Hydrogen generated from Variable Renewable Energy Systems, Shweta Soam*, M.R.Nouni, and S.K.Singh

- [2] Operational Issues with Hydrogen Fuelling Station at National Institute of Solar Energy, Gwal Pahari, Gurugram, Prakash Jha, Pragati Rajput and Amit Katiyar*

PATENTS

The following patent applications have been filed during the financial year 2017-18.

- [1] "Solar Powered Cooling Apparatus", Indian Provisional Patent Application No. 201811012872
- [2] "Solar Powered Cooking System", Indian Provisional Patent Application No. 201811013090
- [3] "Solar Drier Cum Space Heating System", Indian Provisional Patent Application No. 201811013091

BOOKS

- [1] Advances in Solar Energy, Science and Engineering, Vol. 4 edited by H. P. Garg, S. K Singh and T C Kandpal, 2017.
- [2] Dr. Nikhil PG contributed for the Chapters on Solar Energy in E-Pathasala, an e-content knowledge pool developed by MHRD.

REPORTS

- [1] All-India Survey of Photovoltaic Module Reliability: 2016, https://nise.res.in/wp-content/uploads/2018/01/All-India-Survey-of-Photovoltaic-Module-Reliability-2016-_-Rev2_25012018_online_lowres.pdf



FINANCE AND ACCOUNTS

NISE has both Integrated Finance as well Finance & Accounts Division which looks after the concurrence and preparation of accounts respectively. The Integrated Finance division scrutinises and concurs to all payment proposals whereas the Finance & Accounts Division deals with budget preparation, maintenance of accounts and audit functions.

12.2 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 auditors provided by CAG. The Annual Accounts is approved by the Finance Committee before submission to the Governing Council (GC) for adoption of the same.

12.3 The Independent Auditor's Report for the year 2017-18, duly approved by the Finance Committee is presented herewith.



S.M.SAINI & ASSOCIATES
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 2018 and the statement of Income & Expenditure for the year 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.

We are also at: Delhi, Jaipur & Rewari

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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.

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 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 is in 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.

We are also at: Delhi, Jaipur & Rewari

S.M.SAINI & ASSOCIATES
Chartered Accountants

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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 31,2018;
- 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: Gurgaon

Dated: 24th September 2018

We are also at: Delhi, Jaipur & Rewari

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 financial year 2017-18 as referred in the said report.

1. Goods and Service Tax: -

Goods and Service tax input credit claimed on refreshment supplied by catering services for consumption of staff. These services are not covered under the definition of Input service as per section 17(5)(b)(1) of CGST Act 2017.

Management Remark:

We have reversed the ineligible input credit in the books. We will also reverse the input credit from GSTR-2, while filing the same. We have sufficient input tax credit in our input tax ledger under GST, therefore no need to pay GST in cash on such ineligible input tax credit.

2. TDS Deduction, deposit & Return: -

- a) TDS was not deducted in some cases thus violating the provision of Income Tax Act, 1961. Aggregate of such expenses during the F.Y was Rs. 13, 89,295. However the same has been deposited with interest after audit observation.

Management Remark:

We have deposited an amount of Rs.16,476/- and interest Rs.3,516/- and correction has been made in the TDS return accordingly.

- b) TDS was deducted at inappropriate rate in some cases, as compared to the relevant provision of Income Tax Act, 1961. . Aggregate of such amount during the F.Y was Rs. 3,49,222/-

Management Remark:

As per section - 40(a)(ia) of the Income tax Act, 1961,if we have not deducted, not deducted and deposited or deducted at lower rate, then non-compliance should be considered .

We are also at: Delhi, Jaipur & Rewari



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We have deducted at higher rate and deposited the same, therefore no compliance liability will arise on NISE. However it will be kept in view in future.

- c) During the course of audit we have come across the cases (37 No.s) where TDS was deducted by the customers but the same is not showing in 26AS. Financial implications is of Rs.4.25 Lakhs.

Management Remark:

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

- 3. Certain advances were found outstanding for more than three years. The list of such advance against contract as on 31.03.2018 is as under :-

| Party Name | Amount |
|--|----------------------|
| C-DAC | 20,731,550.00 |
| Executive engineer Delhi aviation division CPWD | 7,996,000.00 |
| Tata power solar system LTD. | 36,793,151.00 |
| Executive engineer E (Delhi central elect. Div. VII) | 4,416,468.00 |
| Total | 69,937,169.00 |

Management Remark:

- i) The advance to C-DAC was initially given by MNRE for works to be executed at Bangalore, Kolkata and NISE. The status in respect of execution of work is being ascertained and adjustment will be done in our Books.
- ii) The utilization certificate from CPWD is awaited. We are taking up the matter for early settlement.
- iii) The work from Tata Power is nearing completion and will be adjusted in Current financial year.
- iv) The utilization certificate from CPWD is awaited. Matter is being taken up for early settlement.

We are also at: Delhi, Jaipur & Rewari

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4. The Utilization certificate in respect of advances released to different State Nodal Agencies amounting Rs. 1,67,87,160/- has not been received. Some of the advances are more than 2 to 3 years old at the end of Current Financial Year.

Management Remark:

Utilization certificate of Rs. 1,35,90,000/- has been received during F.Y. 18-19 and adjusted accordingly. For balance utilization certificate, the matter is being taken up with the SNAs.

- d) **Advances to Staff:** It has been found that in some cases supporting documents is kept in relevant files and not attached with Vouchers. Supporting documents should be kept in attached with the relevant vouchers also.

Management Remark:

The supporting Invoices were kept in relevant files. The point has been noted for future compliance.

5. **Grant not received:** We found in some cases where Total Grant has not been received from the concerned ministry and the programme has been conducted & UC submitted for the same.

| S.No. | Name of Party | Amount | Reason of Outstanding | Related Period |
|-------|------------------------------------|------------|--|---------------------|
| 1 | Ministry of External Affairs | 7,672,805 | Programme conducted, UC submitted but grant not received | 2016-17 and 2017-18 |
| 2 | Ministry of New & Renewable Energy | 12,773,319 | Programme conducted but grant not received | 2017-18 |

Management Remark:

We are also at: Delhi, Jaipur & Rewari

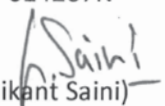


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Utilization certificates has been submitted to ministry for claiming the balance amount. We are perusing the matter for release of payment.

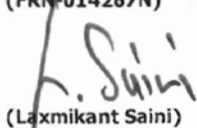



For SM SAINI & ASSOCIATES
Chartered Accountants
FRN: - 014267N


(Laxmikant Saini)
(Partner)

Membership No. 512056
Place: Gurgaon
Dated: 24th September 2018



We are also at: Delhi, Jaipur & Rewari

| NATIONAL INSTITUTE OF SOLAR ENERGY | | | | | |
|---|---|---|--|----------------------|----------------------|
| (An Autonomus Institute of Ministry of New & Renewable Energy ,Govt.of India) | | | | | |
| Gurgoan-Faridabad Road, Gwalpahari, Gurgaon, Haryana-122003 | | | | | |
| BALANCE SHEET AS AT 31ST MARCH 2018 | | | | | |
| CORPUS/CAPITAL FUND AND LIABILITIES | SCHEDULE | AS AT MARCH 31, 2018 | | AS AT MARCH 31, 2017 | |
| | | TOTAL | | TOTAL | |
| Corpus/Capital Fund | 1 | | | | |
| Gross Corpus/ Capital Fund | | 2,614,081,466 | | 1,639,844,230 | |
| Less : Accumulated Depreciation | | 94,269,430 | | 20,474,403 | |
| Net Corpus/ Capital Fund | | | 2,519,812,037 | | 1,619,369,827 |
| Current Liabilities & Provisions | 2 | 1,081,656,922 | 1,081,656,922 | | 768,054,061 |
| Total | | | 3,601,468,959 | | 2,387,423,888 |
| ASSETS | SCHEDULE | AS AT MARCH 31, 2018 | | AS AT MARCH 31, 2017 | |
| | | TOTAL | | TOTAL | |
| Fixed Assets | 3 | | | | |
| Gross Block | | 708,392,764 | | 104,475,781 | |
| Less : Accumulated Depreciation | | 94,269,430 | | 20,474,403 | |
| Net Block | | | 614,123,335 | | 84,001,378 |
| Current Assets, Loans & Advances | 4 | | 2,987,345,624 | | 2,303,422,510 |
| Total | | | 3,601,468,959 | | 2,387,423,888 |
| SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO ACCOUNTS | 11 | | | | |
| As per our Audit Report of even date For SM SAINI & ASSOCIATES Chartered Accountants (FRN-014267N) | | For NATIONAL INSTITUTE OF SOLAR ENERGY | | | |
|  (Laxmikant Saini) (Partner) M. No.512056 |  |  Dr. Chandan Banerjee (Dy. Director General) |  Dr. A.K. Tripathi (Director General) | | |
| Place: Gurugram Dated: 24.09.2018 | | | | | |

NATIONAL INSTITUTE OF SOLAR ENERGY

(An Autonomus Institute of Ministry of New & Renewable Energy, Govt. of India)

Gurgoan-Faridabad Road, Gwalpahari, Gurgoan, Haryana-122003

Amount in ₹

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH 2018

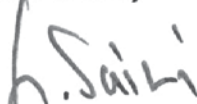
| PARTICULARS | Schedule | 2017-18 | 2016-17 |
|--|----------|--------------------|--------------------|
| | | TOTAL | TOTAL |
| INCOME | | | |
| Receipts from Testing & Operations | 5 | 53,616,780 | 42,253,487 |
| Grants/Subsidies utilised for Revenue Expenditure | 6 | 409,872,061 | 221,981,233 |
| Interest Earned | 7 | 60,289,491 | 36,465,541 |
| Other Income | | 1,705,126 | 2,057,426 |
| Depreciation (As per Contra) | 3 | 73,795,026 | 14,712,859 |
| Total (A) | | 599,278,483 | 317,470,546 |
| EXPENDITURE | | | |
| Establishment Expenses | 8 | 41,874,139 | 38,650,248 |
| Other Administrative Expenses | 9 | 105,892,649 | 81,567,340 |
| Operational Expenses | 10 | 278,831,102 | 122,778,665 |
| Depreciation (As per Contra) | 3 | 73,795,026 | 14,712,859 |
| Total (B) | | 500,392,915 | 257,709,110 |
| Net Surplus/(Deficit) for the year | | 98,885,568 | 59,761,436 |
| Provision for Taxation | | - | 180,285 |
| Balance being Surplus/(Deficit) for the year transferred to General Reserve (A-B) | | 98,885,568 | 59,581,151 |
| SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO ACCOUNTS | 11 | | |

As per our Audit Report of even date

For **SM SAINI & ASSOCIATES**

Chartered Accountants

(FRN-014267N)



(Laxmikant Saini)

(Partner)

M. No.512056

Place: Gurugram

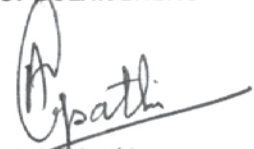
Dated: 24.09.2018



For **NATIONAL INSTITUTE OF SOLAR ENERGY**



Dr. Chandan Banerjee
(Dy. Director General)



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

| SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2018 | | AS AT MARCH 31, 2018 | | AS AT MARCH 31, 2017 | |
|---|---------------|----------------------|----------------------|----------------------|----------------------|
| | | Total | | Total | |
| SCHEDULE 1- CORPUS/ CAPITAL FUND | | | | | |
| General Reserve | | | | | |
| Balance as at the beginning of the year | | 82,565,936 | | 22,984,785 | 82,565,936 |
| Add : Excess of income over expenditure during the year | | 98,885,568 | | 59,581,151 | |
| Corpus Fund | | | | | |
| Balance of Grant Received from Govt. Non-Refundable | | | | 1,141,872,500 | |
| Opening Balance(Refer Grant Sheet) | 1,141,872,500 | | | | |
| Add: Amount received during the Year | 323,012,500 | | | | |
| Closing Balance | | 1,464,885,000 | 1,464,885,000 | 1,141,872,500 | 1,141,872,500 |
| Capital Reserve | | | | | |
| Grants adjusted against purchase of assets | | | | | |
| Opening Balance | | 99,745,263 | | 34,120,865 | |
| Add : Addition during the period | | 213,748,410 | | 65,624,398 | |
| Closing Balance | | 313,493,673 | 313,493,673 | 99,745,263 | 99,745,263 |
| Capital Reserve for Building (SEC) | | 392,966,000 | 392,966,000 | | |
| Grant utilised for advances given during the year | | | | | |
| Opening Balance | | 315,660,531 | | 278,968,123 | |
| Less : Net Adjusted during the Year | | 54,375,241 | | 36,692,408 | |
| Closing Balance | | 261,285,290 | 261,285,290 | 315,660,531 | 315,660,531 |
| Total | | 2,614,081,466 | 2,614,081,466 | 1,639,844,230 | 1,639,844,230 |



| SCHEDULE 2- CURRENT LIABILITIES AND PROVISIONS | AS AT MARCH 31, 2018 | | AS AT MARCH 31, 2017 | |
|--|----------------------|----------------------|----------------------|--------------------|
| | | Total | | Total |
| Current Liabilities | | | | |
| Sundry Creditors | | | | |
| - For goods and services | 975,829 | | 101,118 | |
| - Creditors For Capital Goods | 542,664 | 1,518,493 | 4,563,682 | 4,664,800 |
| Deposits | | | | |
| - Earnest Money Deposit | 2,175,200 | | 1,719,200 | |
| - Guest House Security Deposits | 251,250 | | - | |
| - Advance Received from Customers | 5,785,830 | 8,212,280 | 846,951 | 2,566,151 |
| Statutory Liabilities | | | | |
| - TDS Payable | 2,712,109 | 2,712,109 | 812,470 | 812,470 |
| Other Current Liabilities | | | | |
| - Salary & Remuneration Payable | 34,201 | | 176,044 | |
| - Interest refundable to Ministry | 45,763,763 | | 30,768,155 | |
| - Advances received against training | - | 45,797,964 | 46,000 | |
| - Other misc. liabilities | - | | 232,843 | 31,223,042 |
| Balance of Grants Payable to Government of India | 1,023,416,076 | 1,023,416,076 | 725,394,583 | 725,394,583 |
| Provisions | | | | |
| Provision for Income Tax | | | 3,403,015 | 3,403,015 |
| Total | | 1,081,656,922 | | 768,054,061 |



NATIONAL INSTITUTE OF SOLAR ENERGY

(An Autonomous Institute of Ministry of New & Renewable Energy, Govt. of India)
Gurgaon-Fardabad Road, Gwalpahari, Gurgaon, Haryana-122003

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2018

GROSS BLOCK

DEPRECIATION

NET BLOCK

| PARTICULARS | GROSS BLOCK | | | | | | DEPRECIATION | | | | NET BLOCK | |
|---|--------------------|----------------------------|---------------------------|------------------------------------|--------------------|-------------------|-----------------------------|---------------------------|----------------------------|--------------------------|----------------------------|----------------------|
| | As at 01.04.2017 | Addition before 30.09.2017 | Addition After 01.10.2017 | Sales/ Adjustmen t during the year | As at 31.03.2018 | As at 01.04.2017 | Current Depreciation on L+C | Current Depreciation on D | Total Current Depreciation | Total Depreciation (G+H) | WDV as on 31.03.2018 (F-I) | WDV as on 31.03.2017 |
| A | B | C | D | E | F | G | H | I | J | | | |
| NATIONAL INSTITUTE OF SOLAR ENERGY | | | | | | | | | | | | |
| Building-NISE | - | 571,966,000 | 8,658,655 | - | 580,624,655 | - | 57,196,600 | 432,933 | 57,629,533 | 57,629,533 | 522,995,122 | - |
| Desktop Computers | 2,556,344 | - | 1,956,398 | - | 4,512,742 | 2,005,945 | 220,160 | 391,280 | 611,439 | 2,617,384 | 1,895,358 | 550,399 |
| Printers and other IT Peripherals | 4,091,319 | 14,526 | 3,004,333 | - | 7,110,178 | 632,739 | 520,966 | 225,325 | 746,291 | 1,379,030 | 5,731,148 | 3,458,580 |
| Air Conditioner | 1,740,577 | - | 1,740,577 | - | 1,740,577 | 496,752 | 186,574 | - | 186,574 | 683,326 | 1,057,251 | 1,243,825 |
| Misc. Assets Guest House/ Office | 18,087,529 | 763,221 | 1,139,411 | - | 19,990,161 | 2,635,057 | 2,432,354 | 85,455 | 2,517,810 | 5,152,867 | 14,837,294 | 15,452,472 |
| Scientific & Laboratory Equipments | 63,846,563 | 8,477,780 | 3,025,286 | - | 75,349,629 | 10,401,290 | 9,288,458 | 226,896 | 9,515,354 | 19,916,644 | 55,432,985 | 53,445,273 |
| Vehicles | 590,361 | - | - | - | 590,361 | 195,816 | 59,182 | - | 59,182 | 254,998 | 335,363 | 394,545 |
| Furniture & Fixtures | 1,121,162 | 24,661 | 1,643,669 | - | 2,789,492 | 240,216 | 90,561 | 82,183 | 172,744 | 412,960 | 2,376,532 | 880,946 |
| Laptops | 492,765 | - | 59,221 | - | 551,986 | 385,096 | 43,068 | 11,844 | 54,912 | 440,008 | 111,978 | 107,659 |
| Other Assets (Training) | 7,589,954 | - | - | - | 7,589,954 | 974,083 | 992,381 | - | 992,381 | 1,966,464 | 5,623,490 | 6,615,871 |
| Softwares | 3,693,917 | - | - | - | 3,693,917 | 2,457,513 | 494,562 | - | 494,562 | 2,952,075 | 741,842 | 1,286,404 |
| Total (1) | 103,810,491 | 581,246,188 | 19,486,973 | - | 704,543,652 | 20,424,507 | 71,524,864 | 1,455,917 | 72,980,781 | 93,405,288 | 611,138,365 | 83,385,984 |
| INTERNATIONAL SOLAR ALLIANCE | | | | | | | | | | | | |
| Printers and other IT Peripherals | 650,790 | - | 17,950 | - | 668,740 | 48,809 | 240,792 | 3,590 | 244,382 | 293,191 | 375,549 | 601,981 |
| Computer and Laptops | - | 233,190 | 2,067,000 | - | 2,300,190 | - | 93,276 | 413,400 | 506,676 | 506,676 | 1,793,514 | - |
| Miscellaneous other Assets | 14,500 | - | 715,617 | - | 730,117 | 1,088 | 2,012 | 53,671 | 55,683 | 56,771 | 673,346 | 13,412 |
| Furniture & Fixtures | - | - | 150,065 | - | 150,065 | - | - | 7,503 | 7,503 | 7,503 | 142,562 | - |
| Total (2) | 665,290 | 233,190 | 2,950,632 | - | 3,849,112 | 49,897 | 336,080 | 478,165 | 814,245 | 864,142 | 2,984,970 | 615,393 |
| Total | 104,475,781 | 581,479,378 | 22,437,605 | - | 708,392,764 | 20,474,404 | 71,860,944 | 1,934,082 | 73,795,026 | 94,269,430 | 614,123,335 | 84,001,378 |



| SCHEDULE 4 - CURRENT ASSETS, LOANS & ADVANCES | AS AT MARCH 31, 2018 | | AS AT MARCH 31, 2017 | |
|---|----------------------|----------------------|----------------------|----------------------|
| | | Total | | Total |
| Current Assets | | | | |
| Cash Balance in hand | - | | | 351,332 |
| Balance with Bank : | | | | |
| - Saving Accounts | 332,734,446 | | 1,690,154,609 | |
| Auto Sweep Account | 255,192,032 | | 240,259,766 | |
| Fixed Deposits | 2,075,855,674 | | 447,736 | |
| Fixed Deposits under Lien | 10,179,446 | | 20,798,559 | |
| Sundry Debtors | 22,996,773 | | 7,996,237 | |
| Stamps in Hand | - | 2,696,958,371 | 852 | 1,959,657,759 |
| Loan & Advances & other assets | | | | |
| Advances and other amounts recoverable in cash or in kind or for value to be realized | | | | |
| - Advances against capital assets | 103,949,451 | | 248,384,335 | |
| - Advances against training programs | 160,799,612 | | 73,453,210 | |
| - Advance to Vendors | 5,309,740 | | 7,611,036 | |
| - Recoverable against Training | - | | 101,100 | |
| - Balances in Staff Imprest Accounts | 358,382 | 270,417,185 | 3,228,856 | 332,778,537 |
| Deposits | | | | |
| - Security Deposits | 427,465 | | 370,703 | |
| - Input Credit | 4,962,177 | | 2,446,119 | |
| - TDS Recoverable | 10,165,380 | | 4,682,940 | |
| - Advance Tax/Income Tax Refundable | 4,415,046 | 19,970,068 | 3,135,120 | 10,634,882 |
| Total | | 2,987,345,624 | | 2,303,422,510 |



| SCHEDULE 5- RECEIPTS FROM TESTING AND OPERATIONS | 2017-18 | | 2016-17 | |
|---|------------|-------------------|------------|-------------------|
| | | Total | | Total |
| Receipts from Testing | | | | |
| - Testing of Solar Components | 27,403,422 | 27,403,422 | 24,459,200 | 24,459,200 |
| Other Operational Receipts | | | | |
| - Receipts from Trainings and Seminars- For Domestic Participants | 14,615,205 | | 7,032,346 | |
| -for International Participants | 4,047,648 | | 3,385,600 | |
| - Administrative Charges - Training | 6,240,143 | | 7,026,341 | |
| - Consultancy on Techno Economic Feasibility Study | 1,310,362 | 26,213,358 | 350,000 | 17,794,287 |
| Total | | 53,616,780 | | 42,253,487 |



| SCHEDULE 6- GRANTS/SUBSIDIES & Subsidies Received) | (Irrevocable Grants | 2017-18 | | Total | 2016-17 | | Total |
|--|---------------------|----------------|-------------|---------------------|-------------|--|--------------------|
| | | | | | | | |
| Grants Received during the year-NISE(Core Grants) | | | 146,401,841 | | 70,000,000 | | |
| Grant Received during the Year -ISA | | | 150,000,000 | | 150,000,000 | | |
| Less : Grant Refunded | | | - | 296,401,841 | | | 220,000,000 |
| Grants Received during the Year-NISE(Project Grants) | | | 569,178,875 | | 715,370,156 | | 712,293,600 |
| Less : Grant Refunded | | | 635,497 | 568,543,378 | 3,076,556 | | 712,293,600 |
| Grant Unutilised brought forward from Previous Year-NISE | | | 580,903,130 | 580,903,130 | | | 123,822,802 |
| Grant Unutilised brought forward from Previous Year-ISA | | | 144,481,453 | 144,481,453 | | | |
| Grant Adjusted towards Revenue Expenditure : | | | | | | | |
| Current Year Expenditure-NISE | | 379,479,460.44 | | | 238,142,994 | | |
| Current Year Expenditure-ISA | | 47,118,429.00 | | | 4,853,257 | | |
| Less : Expenses adjusted towards current year Revenue-NISE | | 16,725,828 | | | 21,015,018 | | |
| | | 405,872,061 | | | 221,981,233 | | |
| Less: Expenses Adjusted against Previous Advances-NISE | | 12,771,794 | 397,100,267 | | 16,859,096 | | 205,122,137 |
| Less: Grant Utilised for Purchase of Fixed Assets-ISA | | | 3,183,822 | | | | 665,290 |
| Less : Grants utilised for purchase of Fixed Assets-NISE | | | 25,694,674 | | | | 56,559,008 |
| Less : Grants utilised for Advances against Capital Expenses | | | 36,681,574 | | | | 716,150 |
| Less : Grants utilised for Advances against projects | | | 100,561,041 | | | | 67,669,234 |
| Less: Grant Utilised for Advance against General Exp.-NISE | | | 2,867,118 | | | | |
| Less: Grant Utilised for Advance against General Exp.-ISA | | | 825,230 | | | | |
| | | | | 566,913,726 | | | |
| Grants Payable to Government of India | | | | 1023,416,076 | | | 725,384,583 |



| SCHEDULE 7- OTHER INCOME | 2017-18 | | 2016-17 | |
|---|---------------------|-------------------|---------------------|-------------------|
| | Credited in Revenue | Total | Credited in Revenue | Total |
| Bank Interest | | | | |
| - Interest earned on Savings account-NISE | 817,623 | | 27,165,801 | |
| - Interest earned on Savings account-ISA | 1,892,228 | | | |
| - Interest earned on Grants account | - | | | |
| - Interest earned on Auto Sweep account/F.D-ISA | 57,579,640 | 60,289,491 | 9,299,740 | 36,465,541 |
| Miscellaneous Income | | | | |
| - Guest House Charges | 1,157,695 | | 1,516,050 | |
| - Other Income | 547,431 | 1,705,126 | 541,376 | 2,057,426 |
| Total | | 61,994,617 | | 38,522,967 |



| SCHEDULE 8- ESTABLISHMENT EXPENSES | 2017-18 | | | | 2016-17 | | |
|------------------------------------|---------------------|---------------------------|--------------------|-------------------|---------------------|--------------------|-------------------|
| | Adjusted with grant | Adjusted against Advances | Charged to Revenue | Total | Adjusted with Grant | Charged to Revenue | Total |
| Consultancy Charges | 32,238,632 | - | 8,700 | 32,247,332 | 11,990,189 | - | 11,990,189 |
| Remuneration | 9,337,865 | - | 288,942 | 9,626,807 | 23,923,492 | 2,726,567 | 26,650,059 |
| Honorarium | - | - | - | - | - | 10,000 | 10,000 |
| Total | 41,576,497 | - | 297,642 | 41,874,139 | 35,913,681 | 2,736,567 | 38,650,248 |



| SCHEDULE 9 - OTHER ADMINISTRATIVE EXPENSES | 2017-18 | | | | 2016-17 | | | |
|--|---------------------|---------------------------|--------------------|--------------------|---------------------|--------------------------|--------------------|-------------------|
| | Adjusted with grant | Adjusted against Advances | Charged to Revenue | Total(A) | Adjusted with Grant | Adjusted against Advance | Charged to Revenue | Total |
| Electricity / Fuel Expenses | 4,124,298 | - | 4,103,477 | 8,227,776 | 5,182,621 | - | 5,182,621 | 10,365,242 |
| Outsourcing Services | 17,962,194 | - | 1,952,775 | 19,914,969 | 21,512,595 | - | - | 21,512,595 |
| Security Services | 9,432,333 | - | - | 9,432,333 | 10,685,333 | - | - | 10,685,333 |
| Bad Debts | - | - | 69,198 | 69,198 | - | - | - | - |
| Loss of Input Tax Credit | - | - | 1,756,853 | 1,756,853 | - | - | - | - |
| Miscellaneous Exp. | 16,476 | - | 35,161 | 51,637 | - | - | - | - |
| Office Expenses | 5,503,502 | - | 13,389 | 5,516,991 | 991,335 | - | - | 991,335 |
| Refreshment/Hospitality/Meetings | 719,480 | - | - | 719,480 | 688,660 | - | - | 688,660 |
| Legal & Professional Charges | 666,401 | - | - | 666,401 | 105,385 | - | - | 105,385 |
| Bank Charges | 28,670 | - | 49,198 | 77,868 | - | - | 220,853 | 220,853 |
| Discount on Training Fees | - | - | - | - | - | - | 9,000 | 9,000 |
| Horticulture Expenses | 3,327,142 | - | - | 3,327,142 | 51,550 | - | - | 51,560 |
| Advertisement Expenses | 361,895 | - | - | 361,895 | 736,352 | - | - | 736,352 |
| Guest House Expenses | - | - | 40,388 | 40,388 | - | - | - | - |
| Thermal Power Project Expenses | 3,703,312 | - | - | 3,703,312 | 109,683 | - | - | 109,683 |
| R&D Cell Expenses | 217,445 | - | - | 217,445 | - | - | - | - |
| Seminars/Accreditation Charges | - | - | 801,068 | 801,068 | - | - | - | - |
| Exhibition/ Events Expenses | 20,200,072 | 235,689 | 2,130,734 | 22,566,495 | 8,199,213 | - | - | 12,219,825 |
| Consumables/ Laboratory/Workshop Exp. | 6,490 | 643,640 | 622,244 | 1,272,374 | 491,841 | - | - | 2,285,028 |
| Library Books & Periodicals | 1,766,195 | - | 3,327 | 1,769,522 | 2,070,529 | 715,425 | - | 2,785,954 |
| Postage , courier, Printing and Stationery | 5,644,733 | - | 23,473 | 5,668,206 | 2,242,755 | - | - | 2,266,290 |
| Interest & Penalty | - | - | 53,560 | 53,560 | - | - | 400 | 400 |
| Repairs & Maintenance Expenses | 2,469,270 | 46,000 | - | 2,515,270 | 5,505,671 | 110,258 | - | 5,615,929 |
| Telephone Expenses | 4,038,356 | - | - | 4,038,356 | 553,464 | 3,557,700 | - | 4,111,164 |
| Vehicle Running & Maintenance | 1,757,590 | - | - | 1,757,590 | 292,146 | - | - | 292,146 |
| Tour / Travel & Transport | 11,365,027 | - | 1,494 | 11,366,521 | 1,916,337 | 18,507 | 1,114,989 | 3,049,833 |
| Total | 93,310,981 | 925,329 | 11,656,338 | 105,892,649 | 61,335,480 | 4,401,890 | 15,829,971 | 81,567,340 |



| SCHEDULE 10- OPERATIONAL EXPENSES | 2017-18 | | | | 2016-17 | | | |
|--|---------------------|---------------------------|--------------------|--------------------|---------------------|--------------------------|--------------------|--------------------|
| | Adjusted with grant | Adjusted against Advances | Charged to Revenue | Total(A) | Adjusted with Grant | Adjusted against Advance | Charged to Revenue | Total |
| SERILUS Project Expenses | 2,236,401 | - | - | 2,236,401 | 280,194 | 409,000 | - | 689,194 |
| NAM S&T Center Research Training Fellowship | - | - | - | - | 181,828 | - | - | 181,828 |
| North East Training Programme | 5,904,894 | 5,802,057 | 247,565 | 11,954,516 | 1,981,158 | - | - | 1,981,158 |
| Released to State Nodal Agencies for Skill Development | 224,784,495 | - | - | 224,784,495 | 102,981,921 | 12,048,206 | - | 115,030,127 |
| Expenses on Skill Development Programmes | - | - | 4,524,283 | 4,524,283 | - | - | 2,413,126 | 2,413,126 |
| Indian African Forum Summit Training | 6,283,596 | - | - | 6,283,596 | - | - | - | - |
| Advance orientation Program for Focal Point(IRENA) | 5,200,444 | - | - | 5,552,324 | - | - | - | - |
| Skill Development Program for SAARC | 2,956,917 | - | - | 2,956,917 | - | - | - | - |
| ITTE/SCAAP/TCS Columbo Training Programme | 5,527,767 | - | - | 5,527,767 | 2,168,051 | - | - | 2,168,051 |
| Hydrogen Project Exp. | 1,958,122 | - | - | 1,958,122 | 103,076 | - | - | 103,076 |
| UNDP-GEF Project Expenses | 1,683,163 | - | - | 1,683,163 | - | - | - | - |
| MNRE-USDAID T.A Program | 3,281,230 | - | - | 3,281,230 | 176,750 | - | 35,355 | 212,105 |
| Other Operational Expenses | - | - | - | - | - | - | - | - |
| Solar Resource Assessment Exp. (INSSEC), Hyderabad | - | 692,528 | - | 692,528 | - | - | - | - |
| Solar Powered Clean Drinking Project | 2,395,760 | 5,000,000 | - | 7,395,760 | - | - | - | - |
| Total | 262,212,789 | 11,846,465 | 4,771,848 | 278,831,102 | 107,872,978 | 12,457,206 | 2,448,481 | 122,778,665 |





NATIONAL INSTITUTE OF SOLAR ENERGY
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STATEMENT OF GRANTS FOR THE FINANCIAL YEAR 2017-18

| PARTICULARS | Opening Balance@01.04.2017-18 | Refunded during the year 2017-18 | Receipt during the year 2017-18 | Utilization against advances 17-18 | Utilization against Fixed Assets 17-18 | Utilization against Revenue Expenses 17-18 | Total Utilization 17-18 | Closing Balance 17-18 |
|---|-------------------------------|----------------------------------|---------------------------------|------------------------------------|--|--|-------------------------|-----------------------|
| National Institute of Solar Energy | | | | | | | | |
| Grant for Creation of Capital Assets | 46,818,552 | - | 58,181,448 | 36,681,574 | 24,845,750 | 57,132,882 | 61,527,324 | 43,472,676 |
| Grant in aid- General | - | - | 60,000,000 | 2,867,118 | - | 30,636,170 | 60,000,000 | - |
| Grant in aid- Salaries | 6,779,607 | - | 28,220,393 | - | - | 30,636,170 | 30,636,170 | 4,363,830 |
| Grant for BHEL R&D Projects | - | - | 35,000,000 | - | - | - | - | 35,000,000 |
| Grant for Skill Development Program for SAARC | - | - | 2,956,917 | - | - | 2,956,917 | 2,956,917 | - |
| Grant for Training on Small Power Plants | 615,562 | - | - | - | - | - | - | 615,562 |
| Grant for Project Hydrogen | - | - | 2,800,000 | - | 703,350 | 1,958,120 | 2,661,470 | 138,530 |
| Grant-Skill Development Programme | 177,096,966 | 635,497 | 423,874,319 | 92,252,348 | - | 224,784,495 | 317,036,843 | 283,298,945 |
| Grant UNDP | 1,797,454 | - | 800,000 | - | - | 1,683,163 | 1,683,163 | 914,291 |
| Grant for SERIUS (Indo US Project) | 2,859,807 | - | - | 193,588 | - | 2,236,401 | 2,429,969 | 429,838 |
| Grant for USAID TA Program | - | - | 41,798,545 | 6,415,125 | - | 3,281,230 | 9,696,355 | 32,102,190 |
| Grant- Solar Based Pilot Proj. (for African Countries) | 304,600,000 | - | - | - | - | - | - | 304,600,000 |
| Grant- World Renewable Energy Museum | 26,655,548 | - | - | - | 145,574 | 2,395,760 | 4,241,334 | 26,655,548 |
| Grant- Solar Powered clean drinking water project | 3,371,418 | - | 5,310,000 | 1,700,000 | - | 5,200,443 | 5,200,443 | 4,440,084 |
| Grant- Adv. Orientation program for focal points (REWA) | 5,241,093 | - | - | - | - | 5,904,894 | 5,904,894 | 40,650 |
| Grant-North East Training Program | 5,904,894 | - | - | 13,132,000 | - | - | - | 13,132,000 |
| Grant- Project (Solar Water Pumping System) | - | - | - | 29,877,395 | - | 5,527,767 | 5,527,767 | 29,877,395 |
| Grant- R&D and International Cooperation | - | - | 7,264,162 | - | - | 6,283,596 | 6,283,596 | 980,566 |
| Grant for SCAAP TCS Colombo and ITEC | - | - | 837,770 | - | - | - | - | - |
| Grant for IAFS | - | - | - | - | - | - | - | - |
| Grant- Int. Trg. Courses for Eurasian and African Countries | -837,770 | - | 837,770 | - | - | - | - | - |
| Total (A) | 580,903,130 | 635,497 | 715,580,716 | 140,109,733 | 25,694,674 | 349,981,838 | 515,786,245 | 780,062,104 |
| International Solar Alliance | | | | | | | | |
| Grant-General | 144,481,453 | - | 150,000,000 | 825,230 | 3,183,822 | 47,118,429 | 51,127,481 | 243,553,972 |
| Total (B) | 144,481,453 | - | 150,000,000 | 825,230 | 3,183,822 | 47,118,429 | 51,127,481 | 243,553,972 |
| Total Grant (A+B)=(Balance of Grant payable to Govt. of India) | 725,384,583 | 635,497 | 865,580,716 | 140,934,963 | 28,878,496 | 397,100,267 | 566,913,726 | 1,023,616,076 |
| Contributions for Corpus Fund | | | | | | | | |
| NISE | | | | | | | | |
| Contribution by IREDA | 10,000,000 | - | - | - | - | - | - | 10,000,000 |
| Total (D)NISE | 10,000,000 | - | - | - | - | - | - | 10,000,000 |
| ISA | | | | | | | | |
| Contribution by Ministry of New & Renewable Energy | 1,000,000,000 | - | - | - | - | - | - | 1,000,000,000 |
| NTPC | - | - | 63,610,000 | - | - | - | - | 63,610,000 |
| SOFT BANK | - | - | 129,975,000 | - | - | - | - | 129,975,000 |
| CLP | - | - | 64,777,500 | - | - | - | - | 64,777,500 |
| POWER GRID | - | - | 64,650,000 | - | - | - | - | 64,650,000 |
| Contribution from Indian Renewable Energy Dev. Agency | 66,940,000 | - | - | - | - | - | - | 66,940,000 |
| Contribution from Solar Energy Corporation of India | 64,932,500 | - | - | - | - | - | - | 64,932,500 |
| Total (E) ISA | 1,311,872,500 | - | 323,012,500 | - | - | - | - | 1,454,885,000 |
| Balance of Grant Received from Govt. Non-Refundable(D+E) | 1,141,872,500 | - | 323,012,500 | - | - | - | - | 1,464,885,000 |



NATIONAL INSTITUTE OF SOLAR ENERGY

SCHEDULE 11

SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO ACCOUNTS FORMING INTEGRAL PART OF THE FINANCIAL STATEMENTS FOR THE F.Y. 2017-18

A. SIGNIFICANT ACCOUNTING POLICIES

1. Basis of Accounting

The financial statements have been prepared as prescribed by ICAI in accordance with generally accepted accounting principles. The National institute of Solar Energy (here in after referred to as Institute) adopts cash system of accounting in respect of its income as well expenditure. The accounting policies adopted and applied in the preparation of financial statements are consistent with GFR rules 2017 in general.

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

Income and expenditure are accounted for on cash basis, as they are earned or incurred.



B. NOTES TO ACCOUNTS

1. In line with the direction of the Governing Council, the institute is required to create a corpus fund with a view to achieve sustainability in the longer run. Necessary guidelines for creating such corpus fund is under finalization.
2. The Government of India has approved formation of International Solar Alliance (ISA) consisting of countries rich in solar resources having its head-quarter in India. It was further approved that till the time a separate legal entity in the name of ISA is formed the funds for preparatory work will be routed through the Institute. Accordingly, financial figures relating to grants received for ISA and expenses incurred on its behalf, have been consolidated in the financial statement of the Institute.
3. The accumulated depreciation amounting to Rs.9,42,69,430/- (Current Year Rs.7,37,95,036) 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 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.
5. The Surya Bhavan Complex along with the guest house facility has been capitalized for an amount of Rs.57,89,66,000. The payment of Rs. 39,29,66,000, released by erstwhile Solar Energy Center (MNRE) has been credited to capital reserve (building) A/c.
6. Additions made during the F.Y. 2017-18 in Capital Reserve (Purchase of Assets) amounting to Rs. 21,37,48,410 includes Rs.20,82,78,048 for NISE, Rs. 31,83,821 for ISA and Rs.22,86,541 for the machinery transferred from erstwhile Solar Energy Center (MNRE).
7. The Institute has received a demand of Rs. 5.64 crore from income tax department for A.Y. 2015-16 U/S 143(1) of the Act. An appeal has been filed against the same. Management is of the view that the same demand will be abolished.
8. A letter of credit for 1,29,300 Euro has been opened by SBI in favor of M/s. Angelantoni Test Technologies India Pvt Ltd. (ATT) for supply of UV chamber. An amount of Rs.1,01,79,446 in the form of draft has been kept under lien for the same.
9. The balances of sundry creditors and debtors are subject to confirmation.
10. Previous year figures have been regrouped and rearranged to make them comparable with those of current year.







Shri Raj Kumar Singh, Minister of State for Power and New & Renewable Energy visiting Solar Exhibition organised by NISE during 4th Foundation Day, 2017



Solar Thermal Air Conditioning System at NISE



Yash Sharma, Class 8B, Group 6A, DPSG Palam Vihar



Nancy Yadav, 10 E, DPSG Palam Vihar, Group - 3



Anjali Jha, Lions Public school, 9-B



Shubham Jha, Lions Public School, Group 2B

Winners of Painting Competition Organised by NISE during 4th Foundation Day, 2017



NATIONAL INSTITUTE OF SOLAR ENERGY

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