Annual Report
2016-17

NISE

NATIONAL INSTITUTE OF SOLAR ENERGY

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

www.nise.res.in

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3.	JS, MNRE	Member (ex-officio)
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15.	Prof. J. Vasi, Director (NCPV), IIT Bombay	Member
16.	Dr.Ashvini Kumar, Director (Solar), SECI	Member
17.	Prof. R.C. Budhani, Director, NPL	Member
18.	Shri S.S. Bedi, Scientist 'F', NISE	Member Secretary

Special Invitee

1. Dr. S. Gomathinayagam, Executive Director, C-WET
2. Prof.Yogender Kumar Yadav, Director, NIRE

ANNUAL REPORT
2016-17

National Institute of Solar Energy

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

Gurugram-Faridabad Road, Gwalpahari,
Gurugram - 122003 (Haryana)

CONTENTS

CHAPTER
1

OVERVIEW

The National Solar Mission (NSM) has seen large scale penetration of solar energy in the power generation capacity of the country. In addition, Solar Energy systems and devices have played a key role in providing light to millions of homes where, men, women and school going children have benefited, while improving the living conditions of rural, far flung communities. National Institute of Solar Energy (NISE) has been mandated to assist the 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 implement and support the Ministry of New and Renewable Energy's (MNRE) Suryamitra Programme, a flagship Skill Development Programme.

1.2 The year 2016-17 saw many new achievements for NISE. Apart from consolidating on the earlier year's progress, this year saw improvement in the testing and research infrastructure, with addition of key equipment and scientific staff, leading to a quantum jump in the revenue generated from testing and certification. In addition, significant progress has been made in implementing the Skill Development Programme, by way of the Suryamitra Programme and the Institute's own Training Programmes.

GOVERNING COUNCIL

1.3 The fifth meeting of the Governing Council (GC) of NISE was held on 3rd August 2016 at MNRE, New Delhi under the Chairmanship of Shri Upendra Tripathy, the erstwhile Secretary, MNRE and President, Governing Council, NISE. The Council unanimously confirmed the minutes of the fourth meeting of the Governing Council. After the Statutory Compliance Report was presented and approved, the GC took up agenda matters for discussion and deliberations. The GC deliberated on policy, administrative and technical matters and conveyed its decisions on a number of matters for the DG, NISE to take further actions. The GC also gave suggestions for necessary action on matters that have to be placed for the concurrence and approval of the Ministry. The GC made recommendations for concretising many other proposals for action to be taken in concurrence with the Ministry.

EXECUTIVE COMMITTEE

1.4 The Executive Committee (EC) of NISE held five meetings during the year. The EC took up administrative, policy and finance matters for deliberations and took decisions under its powers. The EC further conveyed some of its recommendations for the GC to deliberate and decide upon.

SCIENTIFIC AND OTHER ACTIVITIES OF NISE

1.5 The Solar Photovoltaic (SPV) Testing Facility received its two-year NABL Accreditation and has expanded its testing standards by including IEC 61701, salt spray, IEC 62804 PID and IEC 61853 Energy Rating and has included PV Power plant surveys, Training and Consultancy Services. With the addition of various test facilities there was a 75 per cent jump in the earnings of this facility. The SPV testing facilities completed various tests of 1390 SPV modules and generated a revenue of Rs.1.08 crore.

1.6 The Power Electronics Laboratory, which also received its two-year NABL Accreditation has capabilities and expertise in measurements, characterization, reliability, engineering, scientific computing, and theory to support SPV research, Balance of System and development across a range of alternative technologies and scales. For the testing and deployment of Solar Inverters up to 50 KVA, as per Indian conditions, this group is closely working with renowned institutes to develop world class

facility at NISE. This Laboratory has tested 41 systems from 18 different manufacturers during 2016-17 and generated revenue of Rs.35.35 lakh.

1.7 The Battery Testing and Characterisation Laboratory facility at NISE provides a variety of battery testing services, from small cell to large battery pack system and lab proving test facility over all technology like lead acid, Ni-Cd, NiMH, lithium ion, lithium ion battery packs etc. These test setups, in the laboratory, are an integral part of programmable power supply, load and data logger and meets international specifications for testing equipment. During the year, the Laboratory has augmented its testing capacity by adding 3 new setup, Bitrode LCV Deep life cycle battery test equipment of 0-20 VDC & 0-300 ADC which contain two circuits and two units of Chroma-17020 of different current and voltage rating from 0-100 VDC and 0-100 ADC which contains total eight test circuits. The laboratory tested 48 samples and generated revenue of Rs.34.78 lakh.

1.8 The Advanced Solar Lighting and other System Testing Laboratory facility, the first Solar Lighting laboratory deployed by MNRE, is engaged in testing of performance and reliability of solar based lighting system as well as validation of field performance. NISE continues to assist MNRE when it revised technical specification for the Off-grid Solar Applications Scheme 2016-2017. This Laboratory tests and certifies major Solar PV lighting systems promoted by MNRE including portable Solar Lantern, Solar Home Lighting and, Solar Street lighting systems, etc. for their desired quality, efficiency, reliability, ruggedness, ease of operation. The laboratory tested 181 Solar Lighting Systems and generated a revenue of Rs.59.40 lakh.

1.9 NISE is playing a big role as a testing and certification body as per MNRE's specifications and guidelines and is also involved in research and development activities related to SPV water pumping systems available in Indian market. It has a testing facility for SPV water pump systems 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 heads from 10 m to 100 m. The pumps are tested as per MNRE specifications for different models. NISE also provides technical knowledge and training to the four MNRE-recognised SPV Water Pumping test facilities across the country. The laboratory tested 80 SPV water pumping systems and generated revenue of Rs.22.01 lakh.

1.10 The long-term vision of the Solar cell characterization and outdoor PV module testing group is to establish expertise in measurements, characterization, reliability engineering and scientific computing in performance estimation. This group has continued to demonstrate its capabilities for improvements in the research & development and testing, standardization of testing condition for establishing the reliability of PV modules without compromising its cost. The performance test of solar cell at standard test condition as per IEC 60904-1:2006/IS 12762 (Part-1) is being done at NISE. The solar cell testing and characterization facility at NISE is capable of handling solar cells up to 6 inch x 6 inch in size as per the IEC 60904-1:2006-09 /IS 12762 (Part 1):2010 standards. The setup is capable of testing solar cells with up to 4 bus bars. It has the ability to measure temperature coefficients of electrical parameters of solar cells. NISE has an outdoor Photovoltaics modules characterization facility comprising of test equipment 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.

1.11 The Group continued its national and international cooperation projects with NREL and SERIIUS and with Fraunhoffer ISE, IIT Bombay and NPL, Delhi during the year. The group continued its research and development projects to study reliability index of PV module, degradation analysis of different PV module technology, potential induced degradation of PV modules, modeling of PV System based on environmental conditions using different neural network, and estimation of soiling losses and dust mitigation for different SPV technology. Solar design simulation lab is a new initiative of NISE for the development of project proposal, consultancy, training and other research and development

Shri Chandrababu Naidu, Chief Minister, Andhra Pradesh, awarding Suryamitras at ANU, Guntur, AP

purposes. Currently this lab is a full-fledged functioning lab, comprising of audio visual facility for demonstration. There are different softwares available in this laboratory which can be used for the design of PV power plants.

1.12 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. In another MNRE project sponsored to Mahindra and Mahindra (M&M) entitled "Development and demonstration of diesel hydrogen fuel SUV, the project implementing agency has developed five hydrogen diesel dual-fuel ICE vehicles (two passengers and three goods carriers). To facilitate the trial runs of up to one lakh km of each vehicle on dual-fuel mode of operation, hydrogen was provided from the facility at NISE. From end January, 2017 onwards hydrogen was provided only to two passenger vehicles in view of the decision taken by the Project Monitoring Committee constituted by MNRE. During the period of report, the hydrogen production storage and dispensing facility at NISE was one of the three facilities in India ensuring the refuelling of hydrogen to vehicles, other facilities being at IOCL R&D centre Faridabad and at Pragati Maidan, New Delhi. A total of 19,440 kms of trial runs for all the five vehicles were covered up to 31.3.2017 and 88.72 kgs of hydrogen was dispensed to the dual-fuel hydrogen diesel vehicles for trials conducted on dual-fuel mode of operation till that date. With a view to undertake demonstration of hydrogen fuelled three-wheelers developed by Banaras Hindu University (BHU), Varanasi, a team of Scientists from NISE visited BHU, Varanasi in January, 2017. These three wheelers store hydrogen in metal hydride instead of metallic/ composite cylinder in high pressure gaseous form. Four three-wheelers, to be received by NISE from BHU, will undergo demonstration in the campus of NISE. However, for providing hydrogen to engine of

the three-wheelers, necessary mechanism will be required to be developed by NISE that will be suitable for charging of metal hydride storage.

1.13 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 NISE by the year 2022. During 2016-17, 279 nos. of Suryamitras training programmes have been organized in which 8407 nos. of Suyramitras were trained against a target of 6900 nos. sanctioned by MNRE. Besides, NISE organised 41 national trainings and trained 1647 nos. of solar professionals on various aspects of Solar Energy. NISE organised 6 nos. International Trainings funded by MEA & ISA, wherein, 114 participants from 85 countries were imparted training.

INTELLECTUAL PROPERTY

1.14 The Scientists of NISE continued research publications and reports on various sectors of Solar Energy out of the research work carried out in NISE. During 2016-17, 23 research papers were published in reputed international/national journals by the scientists of NISE. Besides, 25 reports/papers were also published in the proceedings of national/international conferences/workshops. NISE has also published six technical reports and has filed two patent applications for registration.

CHAPTER
2

INTRODUCTION

NISE is the apex National R&D institution under MNRE, Government of India. It came into being in 2013 after being registered as a Society under Haryana Registration and Regulation of Societies Act 2012 (Registration No. is **HR-018-2013-01092).**

2.2 NISE is situated on a 200 acre sprawling green campus at Gwal Pahari village in Gurugram, Haryana. The NISE campus has modern infrastructure that includes Surya Bhavan building with five floors, besides large lecture halls, a large conference-cum-exhibition hall, and library, whereas Aditya Bhavan has one auditorium, lecture halls, solar thermal and solar PV laboratory facilities. There are two guest houses in the campus of NISE. There are two canteens, one each in Surya Bhavan and Aditya Bhavan, which serves employees of NISE and International Solar Alliance (ISA), besides visitors and participants of training programmes, workshops, etc. The headquarters of a renowned International Organisation, namely ISA is also, at present, housed in the Surya Bhavan of NISE. Some of the Research and Development projects being run in NISE campus are – 1 MW Solar Thermal Power Plant, 700 kW SPV Power Plant and a Solar Powered Water ATM with a capacity of 5000 lpd, solar cold storage, solar milk chiller, etc.

VISION OF NISE

2.3 To establish itself as one of the world's leading Institute in the field of Solar Energy through Research & Development, Testing, Certification and Standardization, Monitoring and Evaluation, Economic and Policy Planning, Capacity Building, etc.

OBJECTIVES

2.4 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 and testing, certification and standards.

MAJOR ACTIVITIES

2.5 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 provide inputs on all matters related to R&D and capacity building to the Mission Steering Group. The Institute also works closely with the Solar Corporation of India set up by the Ministry for implementation of the Mission.

vii. The Institution under the guidance of the Ministry and the Mission Steering Group is responsible for Coordination with the (i) other Centers 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 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 also undertake technical studies and evaluations.

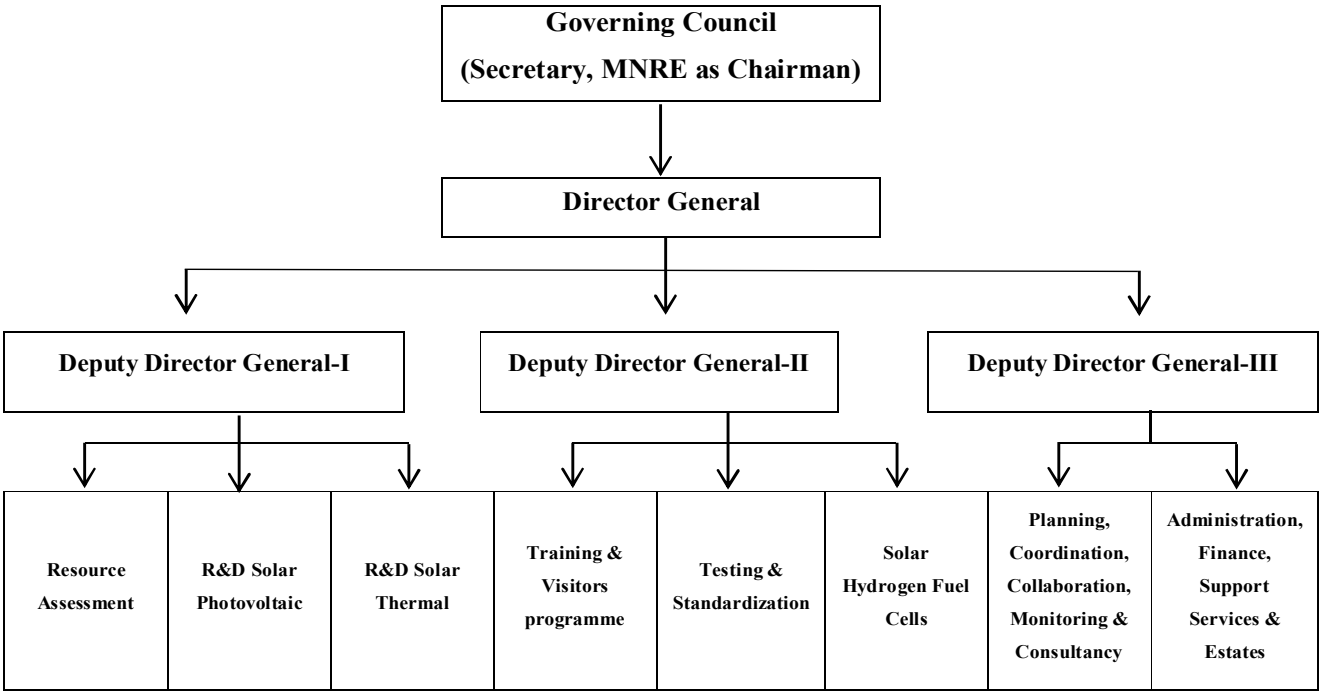
xiv. The Institute is eligible to receive research grants from MNRE, other Ministries/organizations including the international funding to carry out various assigned tasks and & R&D activities.

xv. The Institute also supports capacity building and support 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.

ORGANIZATIONAL STRUCTURE OF NISE

2.6 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 broad set up of structure and management of NISE is as follows:



2.7 The first Governing Council was constituted by Government of India, MNRE, on 26th December 2013, to manage the affairs and funds of NISE in accordance with the Memorandum of Association and Rules, Regulations and Bye-laws of NISE. There are 18 members including Secretary, MNRE, who is ex-officio President NISE. The GC held five meetings during its three-year term that ended in December 2016. The Executive Committee constituted on 16.3.2015 has five members headed by DG, NISE to manage the day-to-day affairs of NISE and to take the decisions on matters under the powers delegated to it. The Finance Committee of NISE has three members with Joint Secretary & Financial Advisor, MNRE as its Chairman.

CHAPTER
3

SOLAR PHOTOVOLTAIC TECHNOLOGIES & TESTING

The SPV testing facilities at NISE comprise of several laboratories, conducting testing, certification and calibration of various types of photovoltaic modules, devices, batteries and other products. These laboratories have state-of-the-art equipment for testing and have well-trained staff for each specific activity of testing and certification as per national and international standards. The various SPV testing laboratories housed at NISE are as under:-

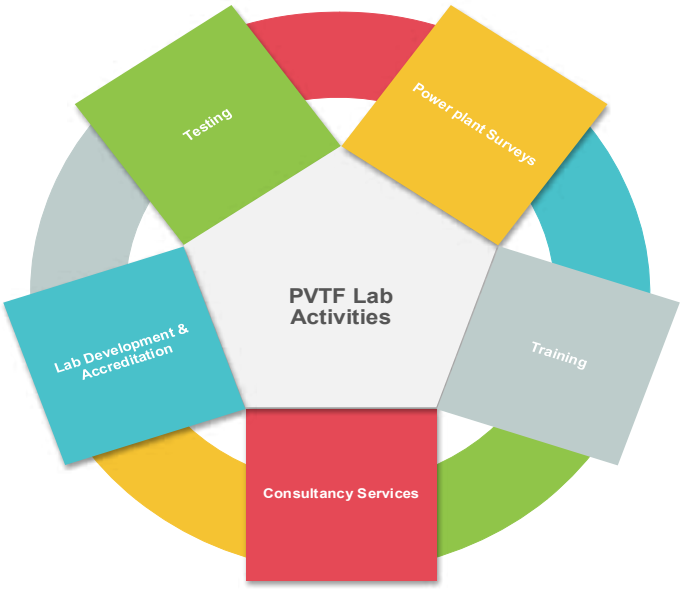
1. Photovoltaic Testing Facility (PVTF)
2. Power Electronics Laboratory
3. Battery Test and Characterization Laboratory
4. Advanced SPV System and Lighting Laboratory
5. Solar Water Pumping Test Facility
6. Solar Cell Characterization and Outdoor Module Testing Facility
7. Solar Design Simulation Laboratory

I. PHOTOVOLTAIC TESTING FACILITY

3.2 The Photovoltaic Testing Facility (PVTF) is an NABL accredited laboratory as per ISO 17025 and is under recognition with BIS. It is a leading test Lab in India in the field of module testing. The laboratory is well equipped with the state-of-the-art equipment, scientists and trained staff well versed in the field of solar PV testing, operation & maintenance of the equipments. The team has good practices of Laboratory Quality Management System (LQMS). It offers a range of services and caters to the needs of the masses and generates a major share in the revenue of NISE.

Lab Activities

3.3 The lab initially started with testing of module as per IEC 61215 and IEC 61646, gradually expanding its boundaries to PV Power plant survey, training, consultancy services, as well as incorporated new testing Standards IEC 61701 for salt spray, IEC 62804/ MNRE specifications for Potential Induced Degradation



IEC 61730-1&2

Photovoltaic (PV) module safety qualification

IEC 61701

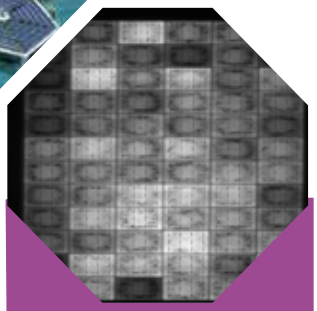
Salt Mist Corrosion Testing of PV modules

Design Qualification & type approval of PV technologies

IEC 61215

Photovoltaic (PV) module performance testing & Energy rating

IEC 61853-1



Test methods for detection of PID Sensitivity Testing MNRE Guidelines.

IEC TS 62804

National Accreditation Board for Testing and Calibration Laboratories
(A Constituent Board of Quality Council of India)

CERTIFICATE OF ACCREDITATION

PHOTOVOLTIC TEST FACILITY, NATIONAL INSTITUTE OF SOLAR ENERGY

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2005

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

19th Milestone, Gurgaon-Faridabad Road, Gwalpahari, Gurgaon, Haryana

in the field of

TESTING

Certificate Number	TC-5697 *(In lieu of T-1848)*		
Issue Date	23/02/2017	**Valid Until**	22/02/2019

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.

(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Signed for and on behalf of NABL

N. Venkateswaran
Program Director

Anil Relia
Chief Executive Officer

(PID) and IEC 61853-1 for Energy Rating.

Training Programs/Conferences Attended

3.4 The technical team of this lab attended four days Training Programmes on "Laboratory Quality Management Systems (LQMS) and Internal Audit as per IS/ISO 17025:2005", from 1st Nov 2016 to 4th Nov 2016.

Consultancy

3.5 NISE has done a feasibility study of renewable energy potential and deployment for Jhansi Cantonment Board on selected available land area particularly on rooftops of Board office, Public schools, General hospitals, Guest houses, etc. It was recommended that in and around the Jhansi Cantonment Board there is ample scope for SPV

Jhansi Cantonment Board Survey area

installations.

PV Power Plant Surveys

3.6 The technical team of this lab has conducted PV power plant surveys of the following two sites with team from PI Berlin.

- 100 MW, Jodhpur, Rajasthan.
- 50 MW, Pokhran, Jaisalmer, Rajasthan.

Creation of New test facilities

Salt mist test setup

3.7 Depending on the specific nature of the surrounding atmosphere to which the module is exposed in real operation, testing severities can be applied. For example, Severity (1) is intended to be used for PV modules used in marine environment, or in close proximity to the sea. Severities (3) to (6) are intended for PV modules operating in locations where there could be change between salt-laden

Salt spray Chamber

atmosphere and dry atmosphere, as in places where salt is used to melt ice formations.

PID testing setup

3.8 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 following MNRE specification for:

a) Module temperature: 85 °C ± 2 °C.
b) Chamber relative humidity: 85 % ± 3 % Relative Humidity.
c) Dwell: 96 h at the above stated temperature and relative humidity (not including stabilization).

Pictorial representation of Salt spray test Sequence.

d) Cycle-3

e) *Voltage:* Module rated system voltage and polarities applied for the above given dwell duration and during ramp down of temperature to ambient conditions.

3.9 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.

Electroluminescence (EL) test and characterization facility

3.10 The Electroluminescence (EL) test and characterization facility at NISE is capable to test different type of PV modules up to size of 2 m x 2 m as per the DIN IEC 60904-13:2016 standard. The EL test is performed in the laboratory, off-line with manual operation (loading/unloading) for indoor measurement of PV Modules (framed/unframed), both before and after lamination. The Greateyes LumiSolar Professional BL 16Mpx (Bottom Load) System consists of high performance sensitive near-infrared Cameras. The cameras are used in combination with a precision linear axis. Together they form a fast working EL imaging unit

Electroluminescence Test Set-up

Power Electronics Laboratory Setup

which offers both, market-leading sensitivity and high resolution through the scanning process.

II. POWER ELECTRONICS LAB

3.11 Power electronics lab is an NABL accredited lab. This lab has capabilities 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 charge controllers can be tested. NISE's power electronics lab has 4 Solar Array Simulators (15 kVA X 4), Actual RLC load 60 kVA, Electronic load simulators (4.5 kVAx3), programmable AC source (6 kVA), four channel and six channel Power Analyzer, Digital Oscilloscopes, Bench Top Dual Display Multi-meters etc.. The test report contains all the useful parameters measured at NISE, including those parameters required as per International standards and MNRE specifications. The report also includes claims made by manufacturer and observations made during the evaluation of the sample.

Details of tests and standard for testing of PV inverters

3.12 The different tests done and procedure used in this lab are as follows:

PV inverter/ PCU		
• Safety of power converters	• General requirements (GI/ standalone/ other) • Particular requirements of inverter • Parallel operation of inverter	• IEC 62109-1 • IEC 62109-2 • IEC 61727
• Installation & commissioning	• Islanding protection (All except standalone inverter)	• IEC 62116
• Procedure of measuring efficiency	• Procedure for measuring efficiency (GI/ OFF-GRID/ ROOF TOP) • Measuring the efficiency of MPPT algorithm and overall system efficiency of Grid interactive inverter	• IEC 61683 • EN 50530
Charge Controller • Charge controller/ Maximum Power Point Tracking (MPPT) units	• Battery charge controller for photovoltaic system	• IEC 62509
• Power conditioners/ inverters including MPPT and charge controller	• Environmental testing	• IEC 60068-2 (1, 2, 14, 30)

3.13 The scope of approved clauses for testing of PV inverters is indicated in the following NABL accreditation certificate

National Accreditation Board for Testing and Calibration Laboratories

(A Constituent Board of Quality Council of India)

SCOPE OF ACCREDITATION

Laboratory	Photovoltic Test Facility, National Institute of Solar Energy, 19th Milestone, Gurgaon-Faridabad Road, Gwalpahari, Gurgaon, Haryana	
Accreditation Standard	ISO/IEC 17025: 2005	
Certificate Number	TC-5697 *(In lieu of T-1848)*	Page 2 of 2
Validity	23.02.2017 to 22.02.2019	Last Amended on 18.05.2017

Sl.	Product / Material of Test	Specific Test Performed	Test Method Specification against which tests are performed	Range of Testing / Limits of Detection
2.	Photovoltaic Power Conditioners- On Grid & Off Grid	Static MPPT efficiency	EN 50530 Cl. 4.3	300 W to 50 kW
		Dynamic MPPT efficiency	EN 50530 Cl 4.4	300 W to 50 kW
		Static Power Conversion efficiency	EN 50530 Cl 4.5	300 W to 50 kW
		Rated output efficiency	IS/IEC 61683 Cl 5.1	300 W to 50 kW (PF 0.25 – 1)
		Partial output efficiency	IS/IEC 61683 Cl 5.2	300 W to 50 kW
3.	Utility Interconnected Photovoltaic Inverters	Islanding prevention and measurement for utility interconnected photovoltaic inverters	IS 16169 IEC 62116	300 W to 50 kW
		DC Injection	CEI -IEC 61727 Cl 4.4	300 VA to 10 kVA 1 – 33 (Even + Odd harmonics) (PF 0.25 – 1)1V - 600 V
		Harmonics and wave form distortion	CEI -IEC 61727 Cl 4.6	
		Power factor	CEI -IEC 61727 Cl 4.7	
		Over/under voltage	CEI -IEC 61727 Cl. 5.2.1	
		Over/under frequency	CEI -IEC 61727 Cl. 5.2.2	
		Islanding protection	CEI -IEC 61727 Cl. 5.3	
		Response of utility recovery	CEI -IEC 61727 Cl. 5.4	
II.	ENVIRONMENTAL TEST FACILITY			
1.	Photovoltaic Power Conditioners- On Grid & Off Grid	Damp Heat Cycle	IEC 60068-2-30	25°C to 60°C 90 % R.H to 96 % R.H
		Change of Temperature	IEC 60068-2-14	(-)20°C to 60°C
		Cold	IEC 60068-2-1	(-)20°C to 25°C
		Dry Heat	IEC 60068-2-2	20°C to 60°C

Ravi Johri
Convenor

N. Venkateswaran
Program Director

III. BATTERY TEST AND CHARACTERIZATION LAB

3.14 Battery test laboratory at NISE provides a variety of battery testing services, from small cell to large battery pack system and lab proving test facility over all technology like lead acid, Ni-Cd, NiMH, lithium ion, lithium ion battery packs etc. The testing services include performance parameter, reliability and endurance test on secondary battery technology. The major test equipments are life cycle testing machine, regenerative battery pack test systems. These test setups are an integral of programmable power supply, load and data logger and meets international specifications for testing equipment.

Testing Facility Being Offered

3.15 Battery Test laboratory at the NISE provides the testing facility is as given below:-

- Capacity
- Charge-efficiency
- W-h efficiency
- Self-Discharge
- Endurance
- Water loss Test
- Type Test (Endurance life cycle test in extreme conditions)

Inclusion of new test setups

3.16 Battery test lab have augmented its testing capacity by adding 3 new setup, LCV Deep life cycle battery test equipment of 0-20 Volt Direct Current (VDC) & 0-300 Ampere Direct Current (ADC) which contains two nos. of circuit and 02 unit of Chroma-17020 of different current and voltage rating from 0-100 VDC and 0-100 ADC which contains total 8 nos. of test circuit. The battery test lab has extended its test facility by adding some new test apart from the routine test which is required in the field of SPV based on the application. Endurance test, water loss test and type test are included on secondary batteries technologies. Type test provide details about the performance of Secondary battery at extreme condition to estimate the service life of a battery.

Bitrode-LCN

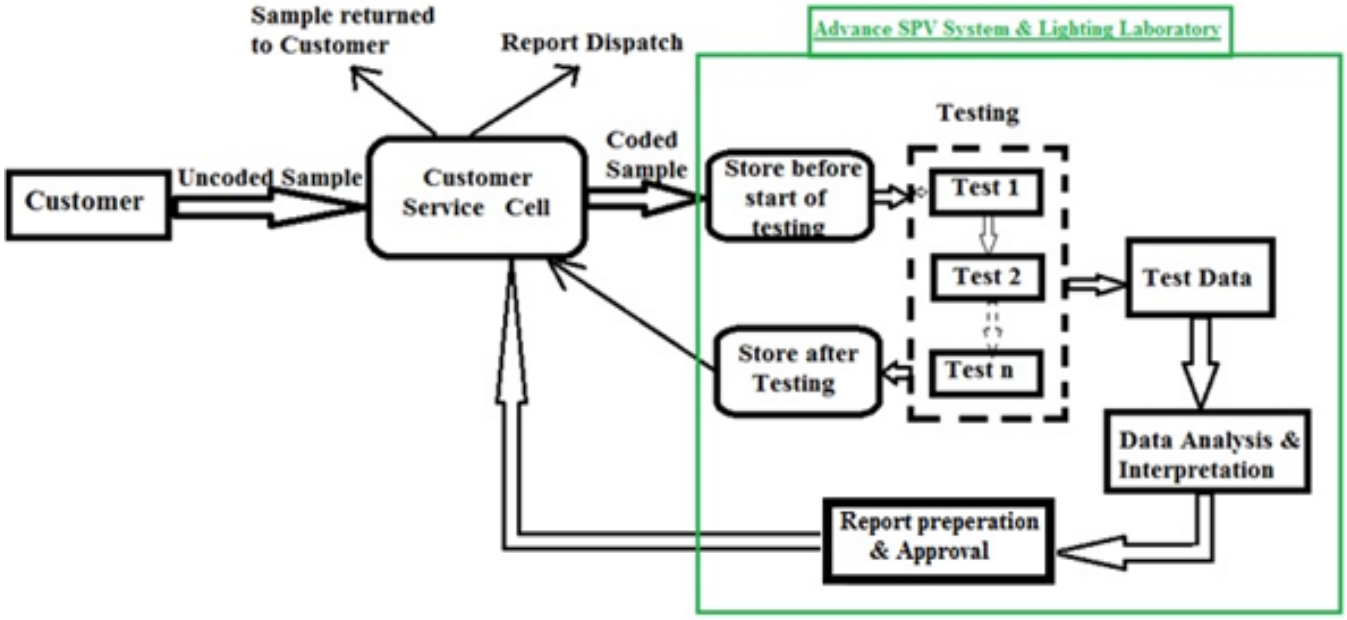
Bitrode LCV

Chroma-17020

Chroma-17020

IV. ADVANCED SPV SYSTEM & LIGHTING LABORATORY

3.17 Solar Photo-voltaic Lighting System Laboratory is 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 in India for design, development, performance and reliability testing of PV lighting systems. Schematic presentation of the sample receiving to report dispatch process of the laboratory is presented below:



Schematic presentation of the Sample receiving to report dispatch process of the Laboratory

Testing standards/ specifications

3.18 The following standards/ specifications are currently in use in the laboratory:

i. MNRE Technical Specifications for White LED (W-LED) based Solar Photovoltaic Lighting systems (Solar Lantern, Solar Study Lamp, Solar Home lighting system, Solar Home lighting system –batten type, Solar Street Lighting System, Solar Power Pack : DC & AC Model, Solar Dome).

ii. 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.

Services & technical support

3.19 The following services and technical support is provided:-

i. Testing of Solar Lighting and other system as per MNRE specifications.

ii. Testing of other PV Lighting system as per user specification.

iii. Developing technical specifications for other PV systems for different applications and their performance reliability evaluation.

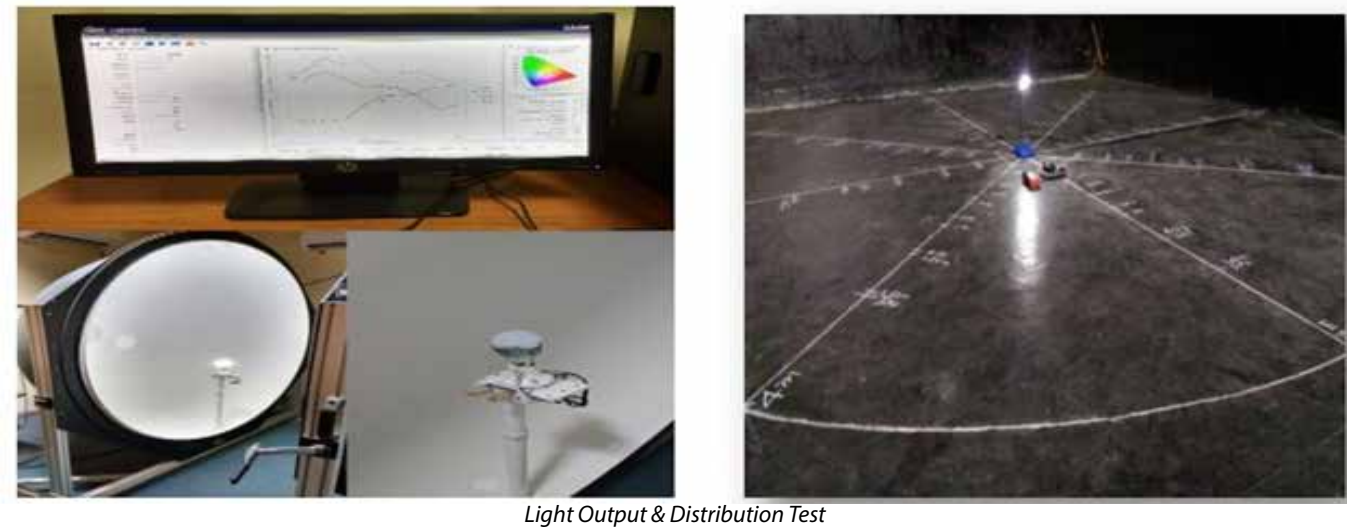
iv. Guiding the industry for design & development of the PV system for different applications i.e. Solar home systems for different household requirement, road studs, security lights, path finders, solar rickshaw, solar AC etc.by way of developmental testing.

v. Environmental stress testing of solar lighting system & other PV systems.

vi. Guiding the state nodal agencies and other programme implanting organizations in preparation of different user defined system specification and development of the system conforming to the specification.

Virtual visit to advance SPV system & lighting laboratory

Virtual Visit to the SPV Lighting System Laboratory



Light Output & Distribution Test

Driver Efficiency, Performance & protection testing of Charge Controller/Solar Inverter

V. SOLAR PHOTOVOLTAIC WATER PUMPING TEST FACILITY

3.20 NISE is playing an important role as a testing and certification body for SPV pumps as per MNRE's specifications and guidelines, and is also involved in research and development activities related to SPV water pumping systems. It has a testing facility for SPV water pump systems 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 from 10 m to maximum up to 100 m. The pumps are tested as per Ministry of New & Renewable Energy (MNRE) specifications for different models. The parameters measured and evaluated are "Wire to Water efficiency", "total water output per day" and "water output per day per watt of STC capacity of PV array" of SPV water pumping system along with maximum dynamic head, remote monitoring operation, different protections testing i.e., dry running, short circuit protection and open circuit protection.

Solar Water pump test Facility at NISE

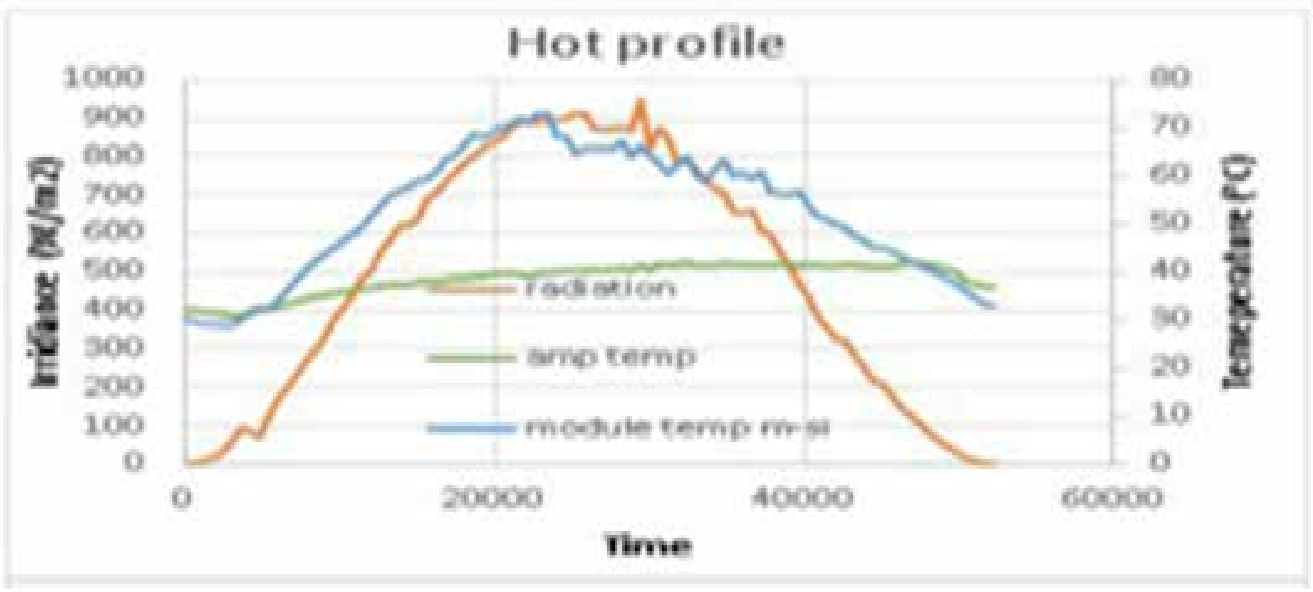
Flow and pressure measurement and control arrangement for pump testing at test bed

Control room for display and data logging

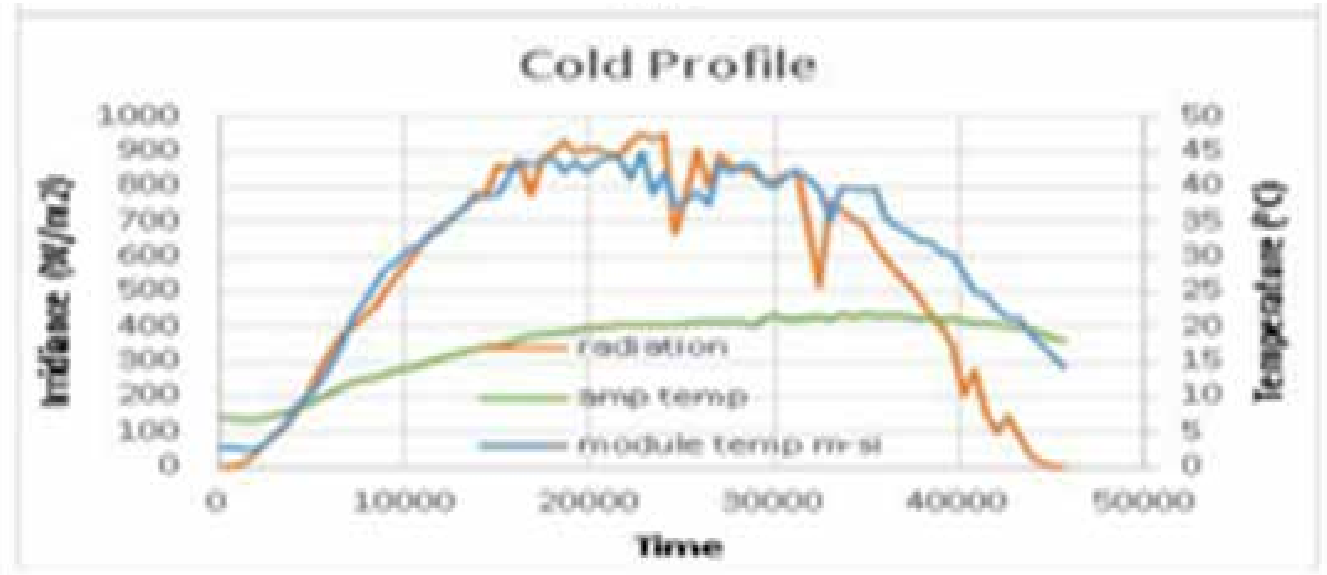
Major Activities

3.21 The major activities of SPV Water Pumping Laboratory include:

- Study on suitable selection of different pumps and optimization of different components at different climatic conditions.
- Collaboration with renowned industries for technical advancement 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 time 7 days.
- 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 testing time 2 days.
- Conducting many training programs like Varunmitra as well as Suryamitra program for awareness & knowledge sharing among students and farmer in SPV water pumping systems.



Hot profile of SPV water pump system testing

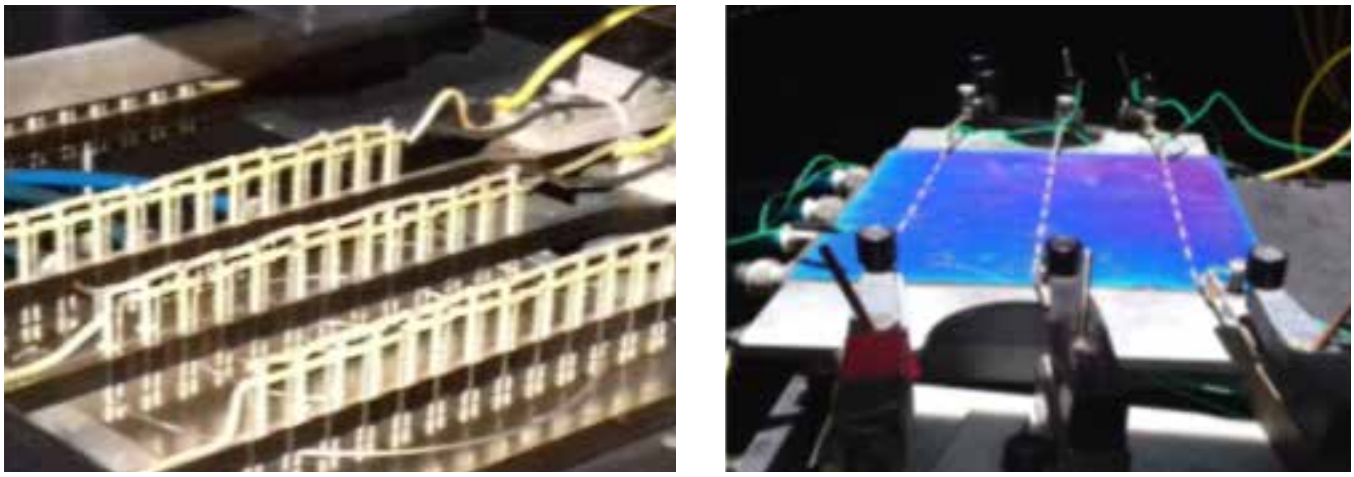


Cold profile of SPV water pump system testing

VI. SOLAR CELL CHARACTERIZATION AND OUTDOOR MODULE TESTING LAB

Solar Cell Characterization Lab

3.22 Solar cell characterization lab has a set up to test solar cells of any type as per IEC 60904-1:2006/ IS 12762 (Part-1). The facility has an ORIEL's class AAA "SUN Simulator" which provides a continuous steady state source. The lab is capable of handling solar cells up to 6 inch x 6 inch in size with up to 4 bus bars. It has the ability to measure temperature coefficients of electrical parameters of solar cells also.



Testing set up for solar cell testing

Outdoor PV module characterization lab

3.23 NISE has an outdoor Photovoltaics 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 IEC 61853 (Part-1) and IEC 60891 (Edition 2.0), IEC 61829. I-V measurements on PV modules under outdoor conditions, close to standard test conditions, are performed by using a mounting structure with manual tracking. Long term performance and stability of different PV technologies arrays is also conducted under various weather conditions. Using an I-V tracer

Test set up for Sun power technology PV module

(PVPM) measurements are performed continuously, at preset intervals. PVPM enables the measurement of I-V-curve of single photovoltaic module as well as of string of modules.

3.24 The outdoor testing of PV modules consist of following tests

- Maximum Power determination
- Low irradiance performance
- Long term module performance and stability
- Outdoor median performance

Multiplexing system for I-V Curve measurement of PV modules

3.25 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 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.

Test set up for IV Tracing of PV Module

500 kWp multi technology power plant

3.26 NISE has installed a 500 kWp solar photovoltaic power plant to study SPV module reliability of different technologies module on Grid and Off Grid configuration in composite climatic condition. The power plant consists of five different technologies and is split into two configuration where 200 kWp connected to Battery bank and 300 kWp connected to Grid.

3.27 Details of different technologies and its configuration are as follows:

I. 100 kWp Battery Back-up SPP with Multi-crystalline modules

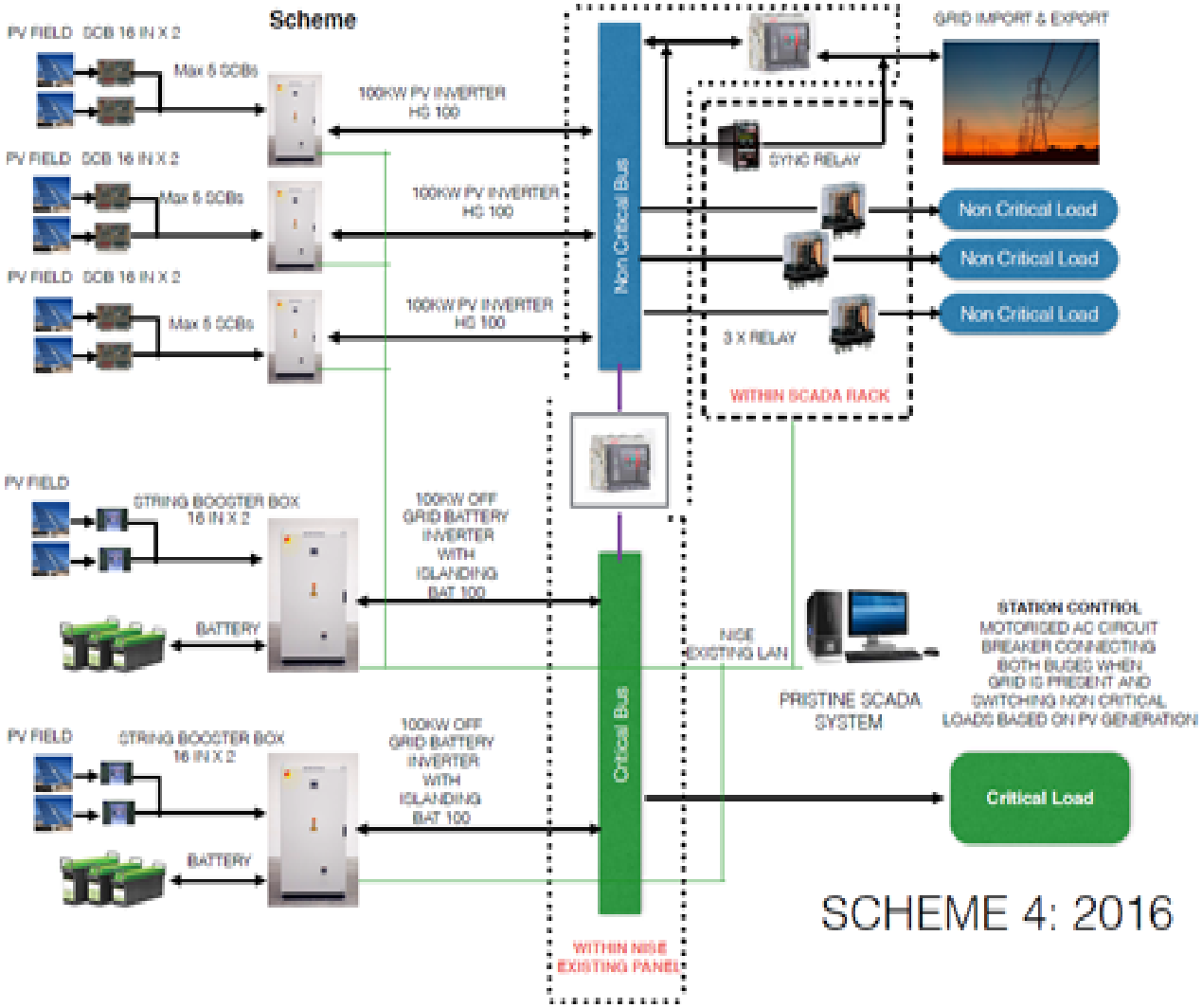
II. 100 kWp Battery Back-up SPP with Panasonic HIT© modules

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

3.28 The smart grid schematic diagram is shown below. There are five different technologies and each technology connected with the single 100 KVA inverter. A dedicated load is connected to the battery bank, the system is being created in such a way during the unavailability of grid, battery connected power plant will work as reference grid.



Smart Grid Schematic diagram

VI. SOLAR DESIGN SIMULATION LAB

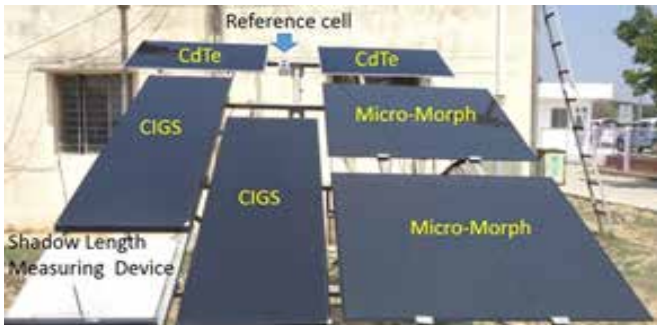
3.29 Solar design simulation lab is a new initiative of NISE for the development of project proposal, consultancy, training and other research and development purposes. Currently this lab is a full-fledged functioning lab, comprising of audio visual facility for the demonstration. The PVSYST, PVSOL, TSOL, SAM, RET Screen, Archelios are being used in this laboratory for the design of PV power plant. This simulation lab is dealing with consultancy of different projects and training of people from different counterpart, industries, students etc. In this past year this lab was involved in the training of senior engineers and managers from SJVN, Fishery department Andhra Pradesh and international trainees through ITEC.

Pictrorial representation of various training programmes conducted by Solar Design Simulation Lab

NATIONAL/INTERNATIONAL CO-OPERATION/JOINT PROJECTS OF SOLAR PV DIVISION

Performance comparison of thin film module at India and USA,

3.30 NISE and NREL have embarked on a project to compare the performance of thin-film modules deployed in India and in Colorado, USA. Continuous monitoring of the performance of PV module and its analysis is going on as earlier. A joint technical report of NISE and NREL has been published. The name of the report is "Analysis of a Single Year of Performance Data for Thin Film Modules Deployed at NREL and NISE".



Test set up for thin film PV module

All India Survey of PV module (2016), a joint project between Solar Photovoltaic Division, NISE and NCPRE, IIT Bombay

3.31 This a joint project between the whole Solar Photovoltaic division, NISE and NCPRE, IIT Bombay to study the field performance of SPV modules installed over period of time ranging from 20 years to recent installations in different climatic conditions of India.

SERIIUS Project

3.32 SERIIUS is a research management plan under Solar Energy Research Institute of India and the United States. Under the SERIIUS project NISE's involvement is as characterization Centre to carry reliability studies. Under this activity NISE has worked in different areas during last year like reliability index of PV module, potential induced degradation, degradation of different PV module technology, dust mitigation, decentralized application of PV modules etc.

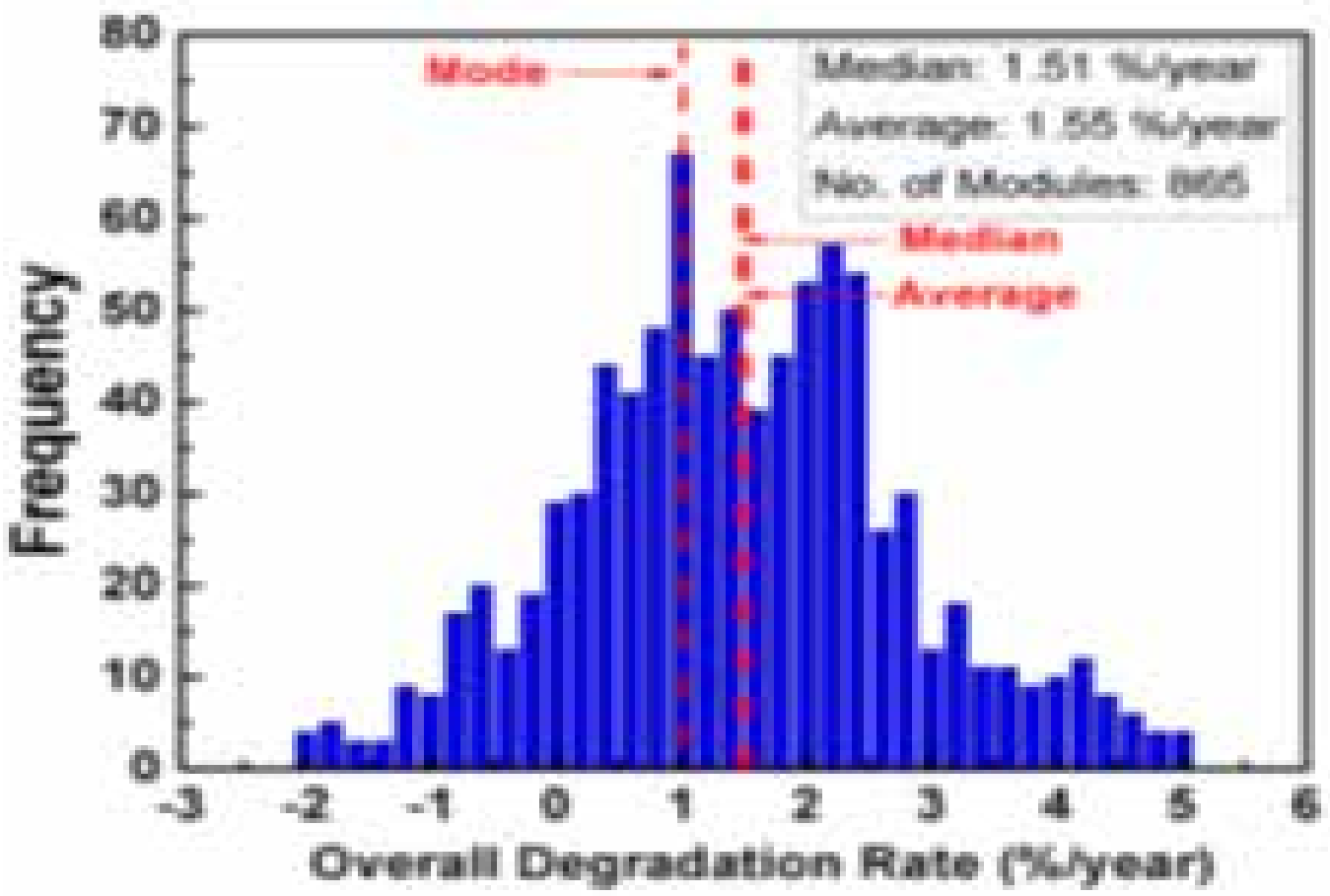


Figure: Degradation rates of PV modules from survey 2016

NISE - PTB (Physikalisch-Technische Bundesanstalt) project on strengthening the quality infrastructure for solar industry in India

Secondary reference solar cell calibration

3.33 Under this project Solar cell characterization lab has completed round robin test of 6 inch x 6 inch and 5 inch x 5 inch solar cells along with Fraunhoffer ISE, IIT Bombay and NPL, Delhi. The comparison report of this round-robin will be published soon.

Improving quality infrastructure of testing procedure and set up in India for solar inverter

3.34 PTB and Fraunhofer Institute, and The National Standards Laboratory of Germany collaborate with Power Electronics Lab, NISE for the successful implementation of improving quality infrastructure of testing procedure and set up in India and also helps in improving measurement techniques like uncertainty of the systems. The main mission is to use of premium-quality and secure solar energy systems which are adapted to international standards in India.

Testing and quality assurance of PV pump in India

3.35 PTB and Fraunhofer Institute, collaborate with SPV water pump testing Lab, NISE for improving quality infrastructure of testing procedure and set up in India.

Testing and quality assurance of PV module in India

3.36 PTB and Fraunhofer Institute, collaborate with PV module testing Lab, NISE for improving quality infrastructure. They have provided training to the technical team of module testing group about the uncertainty estimation and best practices.

Awards/recognition

3.37 The following research scientists received awards and internships during the year:-

Ms. Rashmi Singh, JRS of this group has been selected for summer internships at PTB, Germany

Mr. Birinchi Bora, SRS of this group has done internships at Arizona State University for 10 weeks under SERIIUS – MAGEEP Scholarship.

3.38 The details of samples system tested and the total revenue generated from testing and certification at SPV laboratories of NISE during the Year 2016-2017 is shown in **Table 3.1**.

Table 3.1: Revenue from SPV Laboratories of NISE for Testing and Certification

S.No.	Particulars	Quantity	Amount (Rs. in Lakh)
	SPV Water Pump	80	22.01
	SPV Inverter	41	35.36
	SPV Module	1,390	108.12
	Led Lights *(HLS,SLN,SLS,CC,SPP)	181	59.40
	Battery	48(Sample)	34.78
	Total	1740	259.67

*HLS=Home Light System, SLN=Solar Lantern, SLS=Solar Street Light, CC=Charge Controller, SPP=Solar Power Pack.

CHAPTER
4

SOLAR THERMAL TECHNOLOGIES & RESOURCE ASSESSMENT

The Solar Thermal Division of NISE has undertaken various research projects in collaboration with national/international research institutions/ organizations and industries. The following major R&D facilities have been established in the NISE campus:

i. On-going R & D projects
   - Design and Development of solar thermal cold storage for 24x7 operation
   - Solar Photovoltaic Bulk Milk Cooler using Thermal Storage
   - Solar Cooling Facility
   - Solar Distillation System

ii. In house Research and Development Projects

iii. Solar Thermal Testing Facilities for Concentrated Solar Thermal and Solar Water heating Systems

iv. Solar Resource Assessment and Calibration

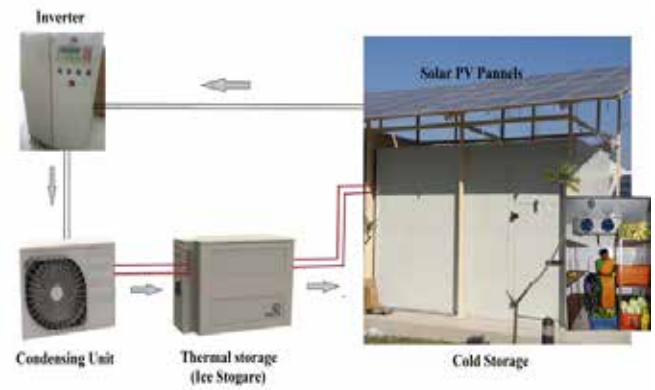
ONGOING R & D PROJECTS

Design and Development of SPV Cold Storage for 24x7 operations using Thermal Storage.

4.2 NISE has undertaken a project for Research, Design, Development and Demonstration (RDD&D) of solar (SPV) cold storage for 24x7 operation using thermal storage. The technology offers integration of solar photovoltaic and solar thermal technologies for 24x7 operation of cold storage. The project has the following objectives:

- Design of cold chamber with control system.
- Design of SPV system for thermal cold storage requirement.
- Design of special solar PV converter (Variable Frequency based cum battery charger).
- Design and optimization of thermal storage system for operation during non-sunshine hours.
- Design of Phase Change Material (PCM) storage system for 24x7 operations.
- Installation and integration of all the components.
- Performance evaluation of the system in different climatic and load conditions.
- Optimization of various parameters for better output.
- Design and Simulation of performance of system in different locations of India.

4.3 After designing the various systems, a prototype



Solar Photovoltaic Based Cold Storage using Thermal Storage

model has been developed and demonstrated in NISE campus. The systems along with its various components are shown above. The system has the following major components:

i. **Cold Storage unit:** The cold storage unit is an insulated cold room of 1600 cubic feet volume with a storage capacity of 8-10 tons of vegetables.

ii. **Solar Photovoltaic System:** The system consists of 5 kW of solar PV panels and 5 kVA off-grid

inverter system.

iii. **Compressor Unit:** The compressor unit is for providing cooling to the system. The compressor unit has a capacity to provide 1.5 tons of cooling effect. Study and analysis are being carried out for Variable Frequency Drive (VFD) compressor and DC compressor.

iv. **Thermal Storage Unit:** A PCM based thermal storage unit has been designed and developed by NISE in collaboration with Inficold Pvt. Limited. It is ideally suited for providing round the clock cooling with limited solar power.

v. **Control Unit:** The control unit integrates various components of the system. The Intelligent control panel selects operation modes automatically based on electricity availability from PV and cooling requirements.

4.4 The system is based on a thermodynamic cycle which allows retrofitting of thermal storage to existing refrigeration systems without need of any modification of the existing control architectures. The system uses advanced two-phase cooling to achieve high heat transfer rate even with a small flow rate, thereby minimizing parasitic pumping losses and increasing overall system efficiency. It is refrigerant agnostic and works with existing and future green refrigerants.

4.5 The thermal storage solution for cold storage applications is configured in a manner that solar electricity generated from solar photovoltaic panels is converted into cold form through a vapour compression cycle. This cold energy is either stored in a low cost environment-friendly PCM or transferred to the cold storage unit depending on the usage needs. During non-solar hours, the cooling needs of cold storage unit are met through the stored cooling in the thermal storage.

4.6 The thermal storage is sized to provide 24 hours of backup in a single charge. The thermal energy storage has three times lower capital cost and about ten time's longer life in comparison to lead acid batteries. It is ideal for providing cooling backup for 8-10 metric tons of perishable products stored in an approximately 1600 cubic feet cold storage at 4-15^{0}C temperature range.

4.7 Research and analysis are also being carried out to optimize solar field size along with an innovatively managed compressor startup load.

SOLAR PHOTOVOLTAIC BULK MILK COOLER USING THERMAL STORAGE

4.8 NISE has designed, developed and demonstrated a solar photovoltaic bulk milk cooler (BMC) using thermal storage (shown below) in collaboration with Inficold Pvt. Limited. The developed system is totally unique and the first in the world to achieve a system which can enable retrofittable thermal energy storage which can convert any existing refrigeration system into a power backup integrated refrigeration system. It is refrigerant agnostic and works with existing and future green refrigerants. This thermal storage unit can be retrofitted between compressor and cooling units of the BMC system. An Intelligent control panel selects operation modes automatically based on electricity availability and cooling requirements.

Solar Photovoltaic Bulk Milk Cooler using Thermal Storage

4.9 This product is based on a thermodynamic cycle which allows retrofitting of thermal storage to the existing refrigeration system, without need of any modification of the existing control architecture. The system uses advanced two-phase cooling to achieve a high heat transfer rate even with a small flow rate, thereby minimizing parasitic pumping losses and increasing overall system efficiency.

4.10 The system meets ISO-5708, Class 2A II milk cooling norms. The thermal storage is sized to provide 24 hours of backup in a single charge. This thermal energy storage has three times lower capital cost and ten times longer life in comparison to lead acid batteries. The system has been developed in size of 500L for bulk milk cooler applications.

4.11 Research and analysis is being carried out to optimize the solar field size along with an innovatively managed compressor startup load. The resulting product of this collaboration has the potential to revolutionize the milk supply chain.

SOLAR COOLING

4.12 Under an MNRE sanctioned R & D project, NISE in collaboration with M/s Thermax Ltd. Pune have taken up a project on Design, Development and Demonstration of the following three solar cooling systems in different configurations using solar thermal energy:

100 kW High Efficiency Absorption Prototype System

4.13 The system consists of a high efficiency three stage Vapour Absorption Machine (VAM) based on LiBr-H_2O cycle with Coefficient of Performance (COP) of 1.7, at suitable medium temperature of solar concentrating collectors with appropriate storage system. Parabolic Trough Collectors (PTC) of aperture area 288 m^2 provide 210°C temperature pressurized water. This heat is used in Vapour Adsorption Machine (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. Besides the triple effect unit, the system has indigenously built medium temperature parabolic troughs for the collection of solar energy. System has special arrangement of storage of heat and cool using PCM (shown below).

4.14 In winter, the solar heated water, instead of pushing through the VAM, is circulated through the FCU to provide heating.

100 kW High Efficiency Triple Effect Vapor Absorption System

15 kW Absorption Prototype System with air cooling

4.15 A 15 kW LiBr- H2O double effect absorption prototype system with air cooling was installed and commissioned in December 2013 at the NISE campus. This unit uses hot water at around 1700C as a heat source. Indigenously developed PTC are used to provide the required pressurized hot water to the VAM. The total collector area is 96 m2. This pressurized hot water in VAM is used to generate chilled water at 90C which is circulated through the FCU installed in various rooms to be cooled.

Figure 4.4: 15 kW Solar Absorption Refrigeration System (Air Cooled)

5 kW Adsorption Prototype System

4.16 A 5 kW prototype system based on a water cooled adsorption cycle was installed in December 2013 at the NISE campus. The adsorbents are specially synthesized to suit tropical climatic conditions. The objectives are development of cost effective high efficiency cooling engine and indigenization of components for VAM. Compound Parabolic Concentrator (CPC), an enhanced version of Evacuated Tube Collectors is used to provide the required heat to the Adsorption Machine. The total collector area is 61 m^2. The system provides 5 kW of air conditioning to an office cabin with chilled water at 9°C circulated through a FCU.

5 kW Adsorption Refrigeration system

Solar Water Distillation System

4.17 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 No. of specially designed solar collectors of 3 m^2 area each. A provision of SPV panel and DC pump has also been provided for lifting of water from the storage tank to the solar collector. Performance evaluation study reveals that it can produce pure clean drinking water up to 180-210 litres per day from any type of water. This system is the one of the most efficient and cost effective compared to other water distillation systems.

Experimental setup of Flat Plate type Solar Water Distillation system

IN HOUSE RESEARCH AND DEVELOPMENT ACTIVITIES

4.18 NISE has carried out research, design & development in the following areas of solar thermal systems:

Design, development and fabrication of low cost single chamber multi effect desalination system.

4.19 A Lab-Scale high efficiency low cost single chamber multi effect desalination system was designed and fabricated at the Solar Thermal R&D Laboratory. The system has a capacity of producing two liters of distilled water per hour using the concept of evaporation of raw water and condensation of steam. In the evaporator the hot water at a temperature of 80-85°C is being heated through solar heat and the produced steam gets condensed in a water tube condenser (spiral based copper tube) and air cooled condenser as shown below.

Low cost single chamber multi effect desalination system

4.20 The system is especially environmentally friendly since it produces minimum waste products. It improves the quality of life of inhabitants living in rural areas. It is especially useful for domestic household, remote areas, and defence establishment which require fresh water for drinking. The tentative market estimated cost of drinking water is approximately 20-30 paisa/ liter. After successful completion of the proto type system, it is proposed to develop a large scale advance desalination system using multi condenser at NISE.

Design and Optimization of hybrid solar-biomass power plant with combined power, cooling, and desalination in poly generation process.

4.21 A study has been carried out on the design and optimization of a hybrid solar-biomass power plant with combined power, cooling and desalination in polygeneration processing software in different parts of the country.

4.22 The Major Activities in 2016-17 are:

- Data collection from solar photovoltaic based cold storage using thermal storage system is under process which will facilitate R&D activities to understand the long-term performance and optimize solar photovoltaic field size along with innovatively managed compressor startup load.
- Data collection from various solar cooling system is under process which will facilitate R&D activities to understand the long-term performance and profiling of various configurations of different solar collectors for cooling applications.
- A polygeneration process in hybrid solar-biomass power plant for power, cooling and desalination has been developed and optimized for various location in India and PhD project has also been realized through this project.
- The process of handing over of the 50 kW Solar-Biomass Hybrid Cold Storage cum Power Generation System for Rural Electrification was initiated. The performance evaluation of the Scheffler dishes are being undertaken in this project.
- Data collection for performance evaluation of inclined plate type solar distillation is underway.
- Six research papers, one national conference paper & two articles have been published during the year 2016-17.
- Various M.Tech and B.Tech students completed their internships on solar thermal projects.
- Visit of various dignitaries, stakeholders and in-house trained participants were organized for knowledge enhancement in various solar thermal projects.

Solar Thermal Testing Facilities for Concentrated Solar Thermal and Solar Water heating Systems

4.23 NISE has developed state of art test laboratories 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 is first of its kind laboratory for testing of CST technologies in Asia. The testing laboratory has their own weather station and has the following facilities for testing of CST technologies:

- Test facility for testing of hot water/ steam based CST systems.
- Test facility for testing of thermal oil based CST systems.
- Mobile test facility for on-site performance evaluation of CST systems.
- CST component test facility.

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

HOT WATER BASED SOLAR THERMAL TEST FACILITIES FOR CSTS

4.24 NISE has created facility for characterization and testing of all type of concentrating solar technologies. Concentrating solar technologies across the country can prove to be a foundation for emerging solar thermal and related applications in the booming solar energy industry.

Thermic fluid based test set up for CSTs

4.25 In 2012, NISE established a thermic fluid based CST 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 is 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 is Therminol VP-1. The CSTs 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. The test facility offers the characterization of CSTs to provide the opportunity for design improvements and selection of concentrators for various applications.

Thermic fluid based Test Set-up for CSTs at NISE

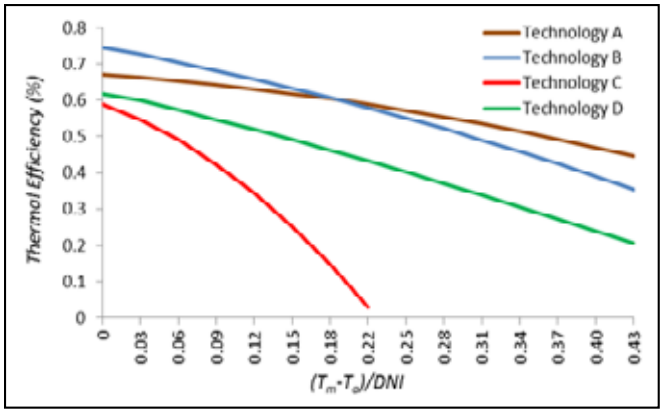
Testing Results of CST Technologies

4.26 Six technologies have been tested by the CST facility of NISE. The **Table 4.1** shows the list of the technologies tested and their results:

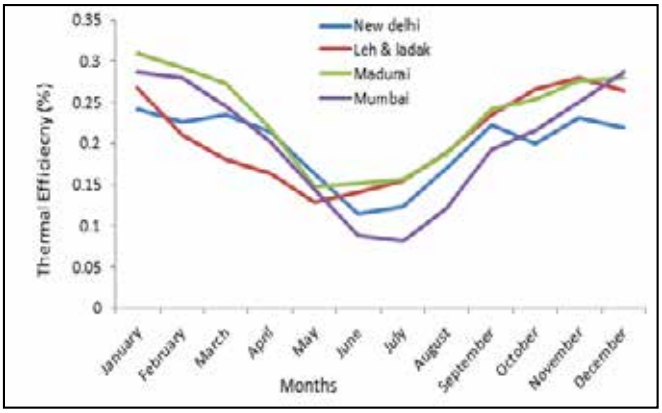
Table 4.1: List of Products Tested by NISE CST Test Facility

Sl. No.	Product/ Technology	Size m^2	Test Results		
			Optical Efficiency (ηo) (%)	Conductive and convective heat loss coefficient (a1) (W/m^2K)	Radiative heat loss coefficient (a2) (W/m^2K^2)
1.	Dual axis tracking paraboloid dish	4	79.62	0.253	0.001
2.	Non-Imaging concentrators	1	61.2	1.15	0.011
3.	Single axis tracking Scheffler Dish	16	59	1.2	0.01
4.	Non-Imaging concentrators	3	61.74	1.1	0.001
5.	Dual axis tracking paraboloid dish	108	67.0	0.24	0.001
6.	Heat pipe based Non-Imaging concentrators	4.4	66.5	1.4	0.001
7.	Dual axis tracking paraboloid dish	4.4	Under Testing		

4.27 The data and the results generated are used for characterizations of performance of CST technologies. Performance maps are being developed using the test results which can be used in simulating the output from a CST technology at various location and under different climatic conditions. This performance mapping tool can be understood by a common person and he/she can make a comparison between performances of different CST technologies at different application requirements. The test data and results are also used for benchmarking the performance parameters of CST technologies and their components. Benchmarking will ensure quality and uniformity among the products/ system manufactured/supplied in the country.



Performance Curve



Simulated output of single CST system at various locations

4.28 From the experience of testing of CST technologies and after analysing international standards, the Indian standard for CST technologies has been developed under UNDP–GEF & MNRE initiative. The following Indian standards for CST technologies have been developed and sent to BIS for publications:

- **Concentrated solar thermal Part 1:** Paraboloid dish concentrator
- **Concentrated Solar Thermal Part 2:** Scheffler Concentrator
- **Concentrated Solar Thermal Part 3:** Parabolic Trough Concentrator
- **Concentrated solar thermal Part 4:** Non imaging

concentrator
- Concentrated Solar Thermal Part 5: Test Methods

4.29 Major works & achievements under CST test facility during the year are:-

- **Developed BIS Standard for CST technologies** 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 till date which describes in detail about all worldwide available concentrating solar thermal concentrators.
- **Characterization of CST technologies** Six different Concentrated Solar Thermal (CST) technologies from different manufacturers have been tested so far and the data collected from the testing has been utilized for the characterizations of the CST technologies.
- **Standardization of CST test protocol** 23 field installed projects were monitored online and the data were collected & analyzed frequently for standardization of the test protocol and test standards.

SOLAR RADIATION CALIBRATION LABORATORY PROJECT

4.30 All the equipment for setting up of the laboratory was procured and laboratory successfully commissioned in October 2015. The Solar Radiation Calibration Laboratory (SRCL) is equipped with facility to calibrate six Pyranometers and three Pyrheliometers at the same time. Presently, the laboratory can calibrate the radiation sensors from the companies such as Eppley, Kipp & Zonen and Huseflux whose sensors are being widely used all over world. The laboratory is equipped with primary standard such as Absolute Cavity Radiometer (ACR), Model AHX-AWX by Eppley lab, which is directly traceable to World Radiation Center (WRC). The reference standard sensors that is being used at the laboratory for calibration of field Pyranometer and Pyrheliometer sensors, belong to category of 'Secondary Standard 'and is also supplied by Eppley lab. The various International standards that are followed at the laboratory for calibration of field sensors are ISO 9847 (Specifies the calibration of field Pyranometer by comparison to a reference Pyranometer), ISO 9059 (Specifies the calibration of field Pyrheliometer by comparison to a reference Pyrheliometer) and ISO 9060 (Provides Specification and classification of instruments for measuring hemispherical solar radiation and direct solar radiation).

ACTIVITIES DURING FY 2016-17

Calibration of Solar Radiometers from SRRA stations and private firms

4.31 Till date SRCL has completed the calibration of the solar radiation sensors from all 15 SRRA stations. The details are presented in **Table 4.2**. This is equivalent to calibration of total 45 sensors from SRRA program (Calibration results presented in **Table-4.3**).

Table:4.2 Phase-I, SRRA station calibrated sensors details

Sr. No.	SRRA Station Location	No. of Sensors Calibrated at SRCL		Total
		Pyranometer	Pyrheliometer	
1	Rajasthan	24	12	
2	Leh,Jammu & Kashmir	2	1	
3	Bilaspur, Chhattisgarh	2	1	
4	NISE, Haryana	2	1	
5	Soiling Exp.Sensor	1	-	
Total		**31**	**15**	**46**

4.32 Apart from this SRCL has carried out the calibration of three Pyranometer sensors from M/s Vikram Solar under its commercial calibration mode activity and some of sensors from other private entities inline for calibration. SRCL also successfully calibrated the seven sensors from other weather stations from NISE.

4.33 Thus, the total no of sensor calibrated at SRCL from various sources is 56.

Table-4.3 Calibration results of sensors

Sr.No.	Source of sensor	No. of Sensors
1	SRRA Program of MNRE	46
2	Commercial mode of calibration	3
3	NISE weather stations (UNDP and 1 MW power plant)	7
	Total	**56**

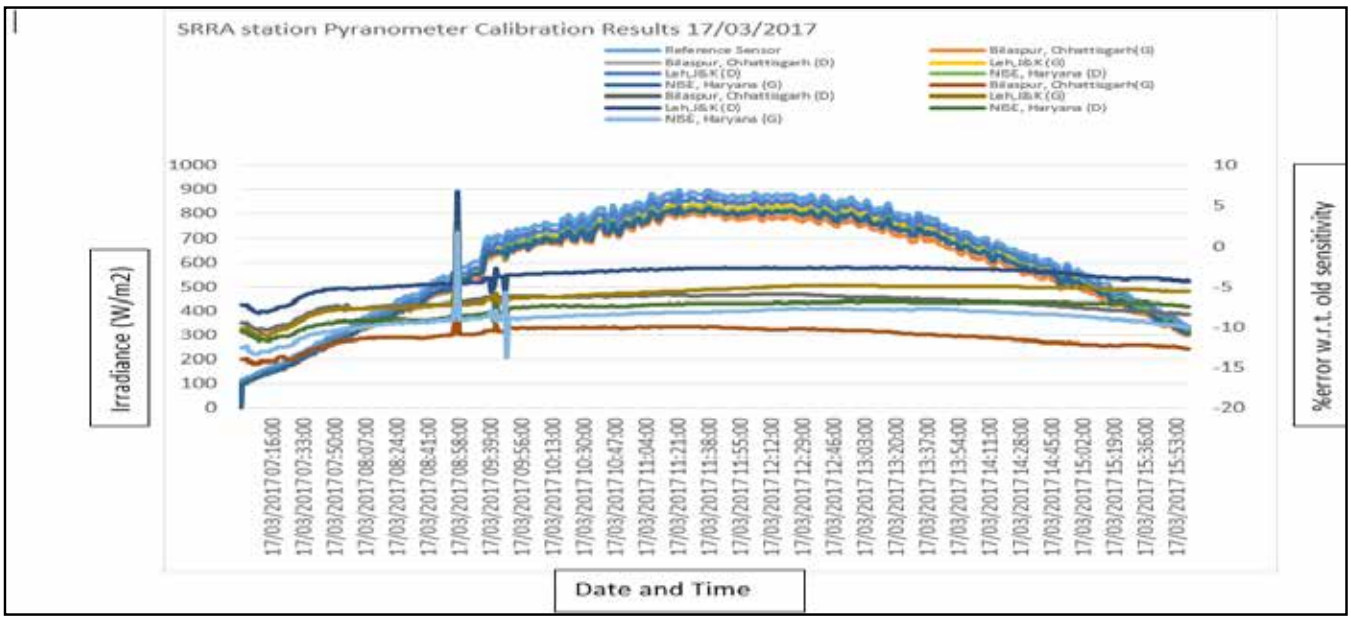
4.34 The required accessories were procured for beginning the calibration of sensors from Phase-2 SRRA stations. Two Phase – 2 SRRA stations were visited and calibration of sensors from these stations is under process.

4.35 SRCL is successfully operating the primary standard sensor i.e. Absolute Cavity Radiometer (Eppley AWX-AHF) to transfer the World Radiometric Reference (WRR) Scale to laboratory secondary standard reference sensors. This has helped to achieve the traceability of calibration to WRR scale as stated in the World Meteorological Organization (WMO) guidelines for solar radiation measuring sensors.

4.36 Along with prevailing ISO standards, SRCL is also following the ASTM standards for Calibration of Radiometers (recently procured through NISE Library) in order to get in agreement with standard calibration practices observed at various laboratories.

4.37 The typical one day calibration results for three SRRA stations NISE, Haryana; Bilaspur, Chhattisgarh; and Leh, Ladakh are depicted below.

4.38 The three SRRA stations are operating in three different climatic zones in India i.e. Leh, Bilaspur and NISE SRRA station, lie in cold desert, semi arid and composite climatic zones. These three SRRA stations sensors were calibrated after five years of their field operation from the date of station installation. Three SRRA station sensors data collected at same period of time and calibrated at SRCL under clear sky condition and one typical clear sky data plots are shown in graph below i.e. Sensors deviation (% error w.r.t old sensitivity) and irradiance (W/m^2) versus time. Retrieved results from plotting shared that, cold desert zone station (Leh, Ladakh) sensors had less deviation (Global Pyranometer: 5.46%, Shaded Pyranometer: 2.75%) than the composite (Global Pyranometer: 7.39%, Shaded Pyranometer: 7.15%) and semi-arid (Global Pyranometer: 10.54%, Shaded Pyranometer: 6.82%) climatic zone stations.

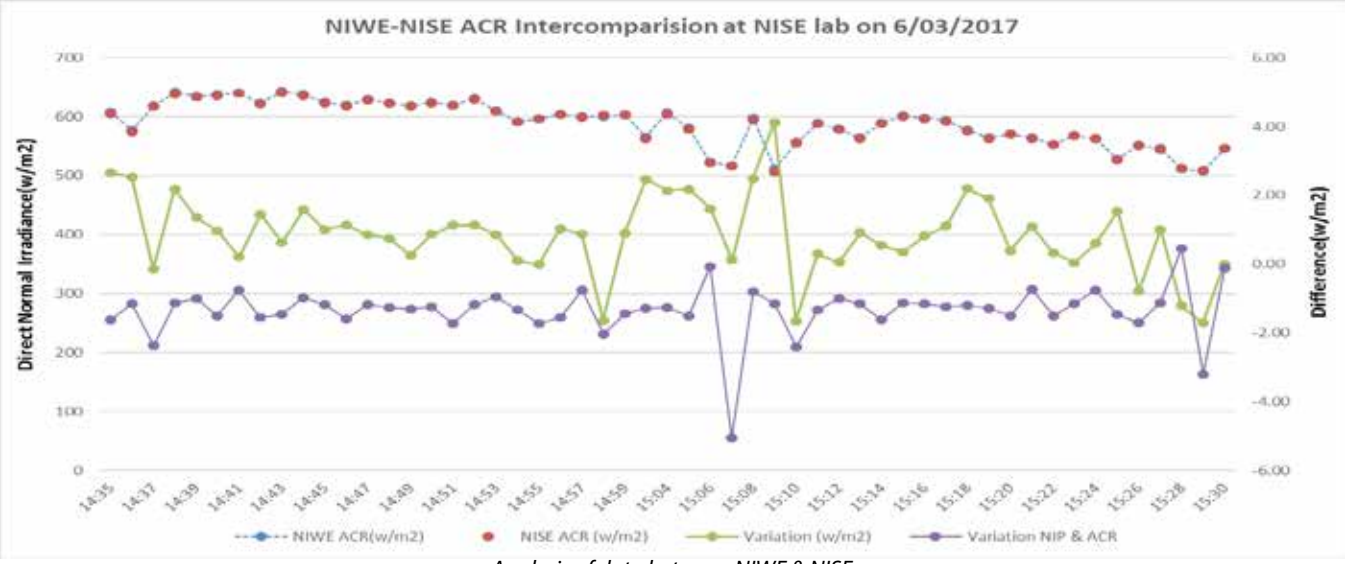


Leh, Bilaspur and NISE SRRA station one clear sky day calibration results.

Primary Standard Sensor (Make: Eppley, Model: AHF-AWX) Inter-comparison study

4.39 Inter-comparison study of Primary Standard Sensors (Make: Eppley, Model: AHF-AWX) of two calibration laboratories i.e. NIWE and NISE-SECI, was carried out at Calibration Lab, NISE. The Primary Standard Sensors of NIWE and NISE-SECI were successfully operated at Calibration Lab, NISE and the results were obtained as follows:

- The two Primary Standard Sensors were operated under the same set of conditions and measured almost closer to each and the irradiance difference in between the two AHF observed ≤ 1 W/m^2. (**Analysis of data depicted is given in graph below**)



Analysis of data between NIWE & NISE

- The calibration lab reference Pyrheliometer (NIP) measured an irradiance deviation of 1.5% with respect to Primary Standard Sensors measured irradiance of NIWE and NISE-SECI in the same set of conditions as per the standards. The Primary Standard Sensors measured less than the Reference Pyrheliometer in all conditions, which is not desirable. The obtained results are under review by expert members.

4.40 Publications from the project work: Article published in Energy Next magazine in January, 2017 issue on Solar Radiation Calibration Laboratory (SRCL) activities.

CHAPTER
5

SKILL DEVELOPMENT AND CAPACITY BUILDING

Skill India is the dream project of Honorable Prime Minister of India to create job opportunities for the unemployed youth in various service and manufacturing sectors throughout the country. This flagship programme aims to create 500 million skilled manpower by 2020.

5.2 Renewable Energy is one among the targeted sectors under skill India. NISE has been entrusted with the duty to execute various Skill Development programmes throughout the country in the field of Renewable Energy Technologies. NISE has been conducting various Solar and Renewable Energy and skill development trainings for both National and International participants. NISE is regularly interacting with people from Solar and Renewable Energy industry to identify the skill gaps in the new recruits of the renewable energy industry.

SURYAMITRA SKILL DEVELOPMENT PROGRAMME

5.3 Suryamitra skill development programme is a flagship programme under skill India, funded and supported by MNRE. This programme is designed for ITI / Diploma holders (Electrical/Electronics) only. Total duration of the programme is 600 hrs (3 months) with 30% of theory / lectures and 70% of practicals/ lab experimentation / field work and internship in Solar Industries / Projects. The main objective of this programme is to impart skill in the installation and maintenance of Solar PV Power plants. For the purpose of ensuring quality and skill level, comparable with global standards, for the workforce passed out of such programmes, the course includes various kinds of competitions, weekly tests and monthly exams, followed by a third party assessment and certification at the end of the programme.

5.4 The training programme is strictly residential with a clear daily time table which includes early morning physical exercises such as Yoga / Physical Training, etc. Basics of Electricity is covered in the first month, followed by Solar PV systems in the second month and Internship on Solar Projects in the third month. Industrial visits at the end of first and second month is an integral part of the course curriculum. From October 2016 onwards, the course curriculum of Skill Council of Green Jobs was adopted. The Qualification Pack SGJ/Q0101 was introduced for the Suryamitra programme.

Suryamithra batch at Gandhigram Rural University, Dindugal, TamilNadu

5.5 Under the programme 8407 Suryamitras were skilled during 2016-17 through various Training Partners (TP) across the country. **Table 5.1** shows the Suryamitra Progress Report for the year 2016-17.

Table 5.1 Suryamitra Progress Report

S.No	State	No of Institute for the FY 2015-16 & 2016-17	No of Programmes conducted in FY 2016-17	Total no of Cumulative programmee conducted from Inception	No of Participaints Trained in FY 2016-17	No of Cumulative Participants trained from Inception
1	Andhra Pradesh	10	14	22	398	633
2	Arunachal Pradesh	1	0	1	0	30
3	Assam	7	5	6	151	181
4	Bihar	9	12	13	402	432
5	Chhattisgarh	8	12	15	369	459
6	Delhi	2	0	3	0	50
7	Goa	2	1	2	30	60
8	Gujarat	12	32	42	954	1251
9	Haryana	3	4	6	121	173
10	Himachal Pradesh	1	1	1	36	36
11	Jammu & Kashmir	1	0	1	0	26
12	Jharkhand	5	5	5	152	152
13	Karnataka	6	14	17	420	510
14	Kerala	5	6	8	176	233
15	Madhya Pradesh	22	16	26	492	761
16	Maharashtra	31	28	50	829	1489
17	Manipur	1	1	2	30	60
18	Nagaland	1	0	1	0	30
19	Odisha	14	31	31	931	931
20	Puducherry	2	2	2	62	62
21	Punjab	2	1	2	32	62
22	Rajasthan	14	19	21	581	634
23	Tamil Nadu	9	15	20	436	558
24	Telengana	5	9	12	274	364
25	Tripura	1	0	2	0	60
26	Uttar Pradesh	17	23	32	664	849
27	Uttarakhand	6	10	12	311	371
28	West Bengal	14	18	18	556	556
Total		211	279	373	8407	11013

COLLAGE OF ACTIVITIES UNDER SURYA MITRA PROGRAMME

Teaching in Class room TATTI, TN

Doing Assessment after the program, L&T, UP

Work at site, NISE Haryana

Work at site, L& T, Pilukhwa, UP

Field Visit at Sukam by NISE, Haryana

Working in Laboratory, NISE

5.6 The revenue generated from Skill Development programmes at NISE during the year 2016-17 is Rs.1.04 Crore.

SKILL DEVELOPMENT ACTIVITIES AT NISE

5.7 NISE has been hosting various Solar and Renewable Energy training for National and International Participants. A dedicated training programme on renewable energy technologies for the Senior Defence officers is also being conducted twice a year. This year 41 programmes were conducted by NISE. NISE has developed curriculum and content on renewable energy technologies skill development programmes, designed for senior defense ministry officers and conducted two programmes during the year.

5.8 NISE has also conducted PVSYST & PV SOL software design, Chartered Engineers, Solar Water Pumping, Solar Hot Water Systems, Solar Resource Assessement and Measurement programme, Grid-Integrated Rooftop & Installation and Workshop on Start-ups India Solar Eenrgy Technologies at NISE. NISE has conducted almost training programmes on chargeable basis, but some programmes were funded by MNRE. NISE has trained 1647 participants during the F.Y. 2016-17.

5.9 **Table 5.2** shows Skill development programmes conducted at NISE during 2016-17.

Table 5.2: Skill development programmes conducted at NISE

S. No.	Name of the training programme	Date of training programme	No. of Days training	No. of trained participants
1	Grid Integrated Rooftop SPV for HAREDA Officials	05th April to 07th April, 2016	03- Days	14
2	One Day Workshop on Solar Energy	11th April, 2016	01- Day	120
3	Grid Integrated Rooftop SPV Design	12th April to 14th April, 2016	03-Days	57
4	Grid Integrated Rooftop SPV Design and Policies	25th April, 2016	01- Day	23
5	Workshop on Start-ups India Solar Energy Technology	26th April, 2016	01-Day	135
6	Solar Water Heating Systems	26th April to 28th April, 2016	03-Days	29
7	Training Programme on Solar Resource Measurement	05th May to 06th May, 2016	02-Days	11
8	Training programme on Solar PV system Design, PV SOL software	11th May to 13th May, 2016	03-Days	8
9	Grid Integrated Rooftop SPV Design	25th May to 26th May, 2016	02-Days	23
10	Solar PV system Design using "PVSYST & PVSOL" software	11th July to 13th July, 2016	03-Days	13
11	Workshop on Start-ups in Solar Energy Technologies	12th July, 2016	01-Days	99
12	Grid Integrated Rooftop SPV Design	13th July to 15th July, 2016	03-Days	37
13	Mobile App Orientation Workshop	19th July, 2016	01-Day	95
14	Workshop on Start-ups in Solar Energy Technologies	10th Aug, 2016	01-Days	99
15	RE Training Programme for Armed Forces	1st Aug to 5th Aug, 2016	05-Days	46
16	Solar Water Heating Systems	8th to 10th Aug, 2016	03-Days	20

S. No.	Name of the training programme	Date of training programme	No. of Days training	No. of trained participants
17	PV Syst and PV SOL Training Programme	22th to 24th Aug, 2016	03-Days	15
18	Grid Integrated Rooftop for HAREDA Official	30th Aug, to 31st Aug, 2016	2-Days	40
19	Grid Integrated Rooftop Policies	31st Aug, 2016	1-Day	10
20	PV SOL & PV SYST Training Programme	19th Sept, to 21st Sept, 2016	3-Days	15
21	Chartered Engineers Training Programme	4th to 6th October, 2016	3- Days	34
22	PV SOL & PV SYST Training Programme	19th Oct, to 21st Oct, 2016	3-Days	17
23	Workshop on Start-ups in Solar Energy Technologies	26th Oct, 2016	1-Day	65
24	Training Programme on Solid State Lighting	8th Nov, 2016	1-Day	1
25	Training Programme on Solar Water Heating Systems	9th Nov to 11th Nov, 2016	3-Days	15
26	Grid Integrated Rooftop Design and Technologies	15th Nov to 17th Nov, 2016	3-Days	26
27	PV SOL & PV SYST Training Programme	16th Nov to 18th Nov, 2016	3-Days	15
28	Solar Water Pumping Training Programme (VARUN)	14th Dec to 15th Dec, 2016	2-Days	17
29	Workshop on Start-ups in Solar Energy Technologies	21st Dec, 2016	1-Day	60
30	PV SOL & PV SYST Training Programme	21st Dec to 23rd Dec, 2016	3-Days	14
31	PV SOL & PV SYST Training Programme	18th Jan to 20th Jan, 2017	3-Days	10
32	1st National Workshop on Hydrogen Energy & Fuel Cells	23rd Jan to 24th Jan, 2017	2-Days	80
33	6th RE Training Programme for Armed Forces Officers	30th Jan to 3rd Feb, 2017	5-Days	37
34	Renewable Energy Training for KSEB, Kerala Officers	13th Feb to 17th Feb, 2017	5-Days	7
35	Grid Integrated Rooftop Design and Technologies	1st Mar to 3rd Mar, 2017	3-Days	60
36	Training Programme on Solar Water Heating Systems	2nd Mar to 6th Mar, 2017	5-Days	41
37	Grid Integrated Rooftop Design and Technologies	9th Mar to 10th Mar, 2017	2-Days	60
38	PV SOL & PV SYST Training Programme	15th to 17th Mar, 2017	3-Days	21
39	Workshop on Prospects for Start-ups in Solar Energy Technologies	22nd Mar, 2017	1-Day	98
40	Grid Integrated Rooftop Design and Technologies	29th to 30th Mar, 2017	2-Days	30
41	Grid Integrated Rooftop Policies	30th Mar, 2017	1-Day	30
Total Numbers of trained participants				1647

Participants at Grid Integrated Rooftop training programme for Graduate Engineers

GRID INTEGRATED ROOFTOP TRAINING PROGRAMME

5.10 NISE has conducted Grid Integrated Rooftop training programme for Graduate Engineers (with basic knowledge of Electrical Concepts), Solar Entrepreneurs, Public Sector Undertaking Officials, EPC contractors, MNRE channel partners, Senior Officials of Energy Departments of Govt. of India, and Officers from State Nodal Agencies, etc.

CHARTERED ENGINEERS TRAINING PROGRAMME

5.11 NISE has conducted 3-Day Skill Development programme for Charted Engineers (Electrical and Mechanical) as certified by Institution of Engineers, INDIA.

Participants at the 3-Day Skill Development programme for Charted Engineers

PVSYST & PVSOL TRAINING PROGRAMME

5.12 NISE has conducted a 3-Day Skill Development Training Programme on PVSYST & PVSOL for 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 Officials of Energy Departments of Govt. of India, and Officers from State Nodal Agencies, etc.

Training Programme on PVSYST & PVSOL for Graduate Engineers

RENEWABLE ENERGY TECHNOLOGIES TRAINING PROGRAMME

5.13 NISE has conducted Renewable Energy Technologies Training programme for Armed Forces Officials. NISE has designed 5-Days Skill Development programme on Renewable Technologies & Applications programmes exclusively for Armed Forces persons. This programme has been conducted twice during this year.

Renewable Energy Technologies Training programme for Armed Forces Officials

SOLAR WATER PUMPING (VARUN) TRAINING PROGRAMME

5.14 NISE has conducted 2-Day Skill Development Programme on Solar Water Pumping for Graduate Engineers with basic knowledge of Electrical Concepts, Solar Entrepreneurs, Public Sector Undertaking Officials, EPC contractors; MNRE channel partners, Senior Officials of Energy Departments of Govt. of India, and Officers from State Nodal Agencies, etc.

Skill Development programme on Solar Water Pumping for Graduate Engineers for PSU Officials, Channel Partners etc.

SOLAR RESOURCE MEASUREMENT, ASSESSMENT AND CALIBRATION

5.15 NISE has conducted 2-Day Skill Development programme for Scientists, Researchers, Engineers, Technologists, Manufacturers of Solar Business, SNA officials and individual wishing to know about Sun and its resource potential.

Participants at the 2-day skill development programme on Solar Resource Measurement, Assessment and Calibration

DESIGNING OF CONCENTRATED SOLAR THERMAL & SOLAR WATER HEATING SYSTEM

5.16 NISE has organized 5-Day Skill Development Programme for Graduate Engineers with basic knowledge of Mechanical Engineering, Renewable Energy and Solar Energy, Researcher, Solar Entrepreneurs, MNRE channel partners, Senior Officials of Energy Departments of Govt. of India and Officers from State Government and State Nodal Agencies, etc.

Participants at the 5-day skill development programme on Concentrated Solar Thermal and Solar Water Heating System

Participants at the 5-day skill development programme on Concentrated Solar Thermal and Solar Water Heating System

INTERNATIONAL TRAINING ACTIVITIES

5.17 The Skill Development Division of NISE organizes and conducts various International training programmes for delegates from different countries under International organisations (groups) and under Indian Technical and Economic Cooperation (ITEC) and its corollary Special Commonwealth African Assistance Programme (SCAAP) and for International Solar Alliance (ISA).

5.18 The International Training Division plays a central and collaborative role within the institution: leading and facilitating international engagement and education on Renewable Energy and Solar Technologies across all countries.

5.19 The primary objective of these training programmes is to acquaint the participants with the latest developments in Solar Technologies, Policy Aspects, Quality Control and Utilization Aspects of Renewable Energy. These training programmes would also help in encouraging the possibilities of bilateral and multilateral cooperation in the field of solar energy projects.

- The programme enhances the technical capabilities of the participants and imparts knowledge of the Global trends on Solar Technology.
- The knowledge can be utilized by the participants to further develop an understanding of the respective field and its implementation to develop Solar Technologies in their respective countries.

5.20 Every year the officials nominated by different Ministries from respective countries attend these training programmes. During the FY 2016-17, the participation has increased and new outreach efforts will help to encourage more foreign participants in the future. Table 5.3 shows the details of international training programmes conducted during the year.

Table 5.3 International Training Programmes conducted during the 2016-17

S. No.	Programme	Period	No. of Participants	No. of Countries
1.	Eurasia	22nd August to 2nd September, 2016	17	5
2.	ITEC / SCAAP - I	28th November to 16th December, 2016	32	25
3.	AOP for ISA Member countries- I	4th January to 12th January, 2017	12	11
4.	AOP for ISA Member countries- II	17th January to 25th January, 2017	10	10
5.	ITEC / SCAAP – II	30th January to 17th February, 2017	26	17
6.	AOP for ISA Member countries- III	5th April to 13th April, 2017	17	17

EURASIA INTERNATIONAL TRAINING PROGRAMME IN THE FIELD OF SOLAR TECHNOLOGIES

5.21 This three weeks training programme was organized for officials from the countries under Eurasia viz.: Afghanistan, Uzbekistan, Azerbaijan, Kazakhstan and Tajikistan. This programme was funded by Govt. of India, Ministry of New and Renewable Energy. Total 17 numbers of participants from 5 countries have attended the programme.

Three weeks training programme for officials from Eurasian countries by NISE (22 August to September 2016)

Advanced Orientation Programme on Solar Energy Technologies and Applications for Focal Points of IRENA for ISA member countries

ITEC/ SCAAP: SOLAR ENERGY TECHNOLOGIES AND APPLICATION

5.22 Every year, NISE organizes a three weeks long Indian Technical and Economic Co-operation (ITEC) and Special commonwealth Assistance for Africa Programme (SCCAP) fully funded by Ministry of External Affairs, Govt. of India.

INTERNATIONAL SOLAR ALLIANCE (ISA)

5.23 ISA is an alliance of 121 solar rich countries lying between the Tropic of Cancer and Tropic of Capricorn. AOP is an effort of Ministry of New and Renewable Energy and NISE. NISE has organized three training programmes during this year, in which 39 participants from 39 ISA member countries participated in these programmes. An Advanced Orientation Programme (AOP) on Solar Energy Technologies for focal points of International Renewable Energy Agency (IRENA) for ISA member countries – 9 days

CHAPTER
6

HYDROGEN ENERGY & FUEL CELLS

Apart from its existing industrial uses, hydrogen can be used for meeting energy requirement for transport and stationary power generation in a sustainable manner without impacting the environment in an adverse manner. In order to meet future energy demands, technologies are required to be developed for production, storage and applications of hydrogen in transportation sector as well as for portable and stationary power generation.

6.2 Hydrogen can be used for meeting mechanical and electrical energy requirements through use of Internal Combustion Engine (ICE) and fuel cell technologies. While there are no emissions except water vapours when hydrogen fuel cells are used, there is some emission in the form of NO_x with use of ICE. Hydrogen fuel cells can also provide some thermal energy. Hydrogen is an energy carrier, production of which requires some other primary or secondary energy. It can be produced from different sources such as natural gas, coal, biomass, water etc. using different production processes. MNRE is implementing a broad based Research, Development and Demonstration (RD&D) programme for production, storage and applications of hydrogen. In the area of hydrogen production, which is focussing on production of hydrogen using renewable energy based methods or renewable feedstock, a number of RD&D projects have been supported at different academic institutions, research organisations and industry in India.

6.3 Among these projects, NISE has been implementing an RD&D project entitled "Demonstration & Performance Evaluation of various technologies of Hydrogen Energy". This project envisages generation of hydrogen from electrolysis of water using electricity generated by SPV system, storing it at high pressure (450 bar) and dispensing hydrogen to the IC engine based vehicles. The project also covers setting up of a Fuel Cell Laboratory using Polymer Electrolyte Membrane Fuel Cells (PEMFCs) and their testing. Another objective of the project is to organise training programmes in the area of hydrogen energy and fuel cells.

6.4 Under this project the various activities are (a) Operation of the Solar-Hydrogen facility and maintaining it for regular production and dispensing of hydrogen; (b) carrying out performance tests of individual sub-systems / components; (c) facilitating completion of field trials of hydrogen / hydrogen-diesel dual fuel vehicles, developed under other RD&D projects of MNRE; (d) setting up of a fuel cell laboratory from scratch, where 2x1 kW and 1x2 kW PEMFC systems have been installed and commissioned; and (e) organising the 1st National Workshop on Hydrogen Energy and Fuel Cells in January, 2017 that was attended by the principal investigators and research personnel of MNRE sponsored RD&D projects in the area of hydrogen energy and fuel cells and other professionals from the public and private sector.

6.5 The solar-hydrogen production facility was in regular operation except for some days when different kinds of technical issues concerning operation of electrolyser, DM water plant, compressor and dispenser were experienced. These operational issues were mostly resolved by NISE through technical support provided by the supplier of the equipment i.e. M/s Air Products and Chemicals, USA through different channels of communications. The hydrogen production facility consists of an alkaline electrolyser of 5Nm^3/hr generation capacity that is operated by power generated from a Roof Top Solar

PV Power Plant of 120 kWp; a two stage reciprocating compressor that helps in storing hydrogen up to 450 bar in high-pressure storage tubes of about 2100 litres of water capacity and a dispenser that can dispense hydrogen (upto 350 bar) at a maximum flow rate of 1 kg/minute. The stored hydrogen was dispensed to Hydrogen-Diesel Dual fuel vehicles on a regular basis during the period of report. Hydrogen production cum dispensing facility at NISE is in compliance with regulations of Petroleum and Explosives Safety Organisation (PESO).

6.6 In another MNRE project awarded to Mahindra and Mahindra (M&M) entitled **"Development and demonstration of Diesel Hydrogen Fuel SUV"**, the project implementing agency has developed five Hydrogen-Diesel Dual Fuel ICE vehicles (two Passengers and three Goods Carriers). To facilitate the trial runs of up to one lakh km of each vehicle on dual fuel mode of operation, hydrogen was provided from the facility at NISE. From January end, 2017 onwards hydrogen was provided only to two passenger vehicles in view of the decision taken by the Project Monitoring Committee constituted by MNRE. During the period of report, the Hydrogen Production Storage and Dispensing facility at NISE was one of only three facilities in India ensuring the refuelling of Hydrogen vehicles, the other facilities being at IOCL R&D Centre, Faridabad and at Pragati Maidan, New Delhi.

6.7 A total of 19,440 kms of trial runs for all the five vehicles was covered up to 31.3.2017 and 88.72 kgs of hydrogen was dispensed to the Dual Fuel Hydrogen Diesel vehicles for trials conducted on dual fuel mode of operation till that date.

6.8 The Project Monitoring Committee on Hydrogen Applications, which met on 25.1.2017 at IIT Delhi observed that regarding the hydrogen production and dispensing facility at the NISE, Gwal Pahari, the Institute would ensure regular operation of the facility,

Hydrogen Refuelling station at NISE, Gwal Pahari

First National Workshop on Hydrogen Energy and Fuel Cells held during 23-24 January, 2017

in order to support the trials of Hydrogen Fuelled Vehicles developed under other MNRE sponsored projects. NISE strived to fulfil the recommendation of the Committee and ensured that the facility remained in operational mode for the maximum number of days.

6.9 With a view to undertake demonstration of hydrogen fuelled three wheelers developed by Banaras Hindu University (BHU), Varanasi, a team of Scientists from NISE visited BHU, Varanasi in January, 2017. These three wheelers store hydrogen in metal hydride instead of metallic/composite cylinder in high pressure gaseous form. Four three wheelers, to be received by NISE from BHU, will undergo demonstration in the campus of NISE. However, for providing hydrogen to the engine of the three wheelers, a mechanism will be required to be developed by NISE that will be suited to charging of Metal Hydride storage.

6.10 A National Workshop on Hydrogen Energy and Fuel Cells was organized successfully in NISE on 23-24 January 2017. This was the first workshop of its kind organized by NISE. 21 presentations were made by the eminent experts on different aspects of hydrogen energy and fuel cells, including its production, storage, application in IC engines, Fuel Cells and Hydrogen Dispensing Stations. 33 delegates attended the workshop from different academic institutions, research organizations and industry. In addition to the workshop, following activities have been undertaken to increase awareness of Hydrogen energy:

Visitors coming to NISE for participating in various training programmes were made aware about hydrogen energy related facilities at NISE and about its applications in vehicles where training programmes, lectures about hydrogen energy and fuel cells were also covered.

Three lectures on hydrogen energy and its applications were delivered during International Training Programmes organized at the NISE during 1st Feb-17th February, 2017.

6.11 Fuel cell testing laboratory was set up and the activities for operation of fuel cells have already been put in place and infrastructure development required for operation of fuel cells for the lab was completed. The equipment setup work i.e. Gas pipe mechanism for hydrogen supply & other fittings and leak detectors was completed. Performance evaluation of fuel cells for 1000 hours will start in the new financial year.

CHAPTER
7

R&D COORDINATION

All the R&D projects in the field of Solar Thermal (ST) Energy and Solar Photovoltaics (SPV) received from various academic institutions, research institutions, NGOs and industries by MNRE are forwarded by MNRE to R&D coordination cell (R&D Cell) of NISE for further processing (evaluation and monitoring). All the projects, so received, after scrutinizing at NISE level, are further scrutinized by subject experts, and reports submitted to MNRE for arranging RDSPAC and RDPAC meetings as per recommendations of the subject experts and guidelines of MNRE. In addition, the R&D Cell of NISE is responsible for monitoring the on-going R&D projects through expert visits, organizing reviews, suggesting mid-course corrections and inviting Project Investigators (PIs) of the projects for presentation and discussions with the subject experts at NISE to verify the claims as an independent, un-biased agency. NISE is involved in all stages of the development, growth, mid-term correction and logical conclusion of all the R&D projects. NISE is also very actively involved in few select thrust area R&D projects where the expertise at NISE is available. The R&D cell deals only with SPV and ST projects.

PROJECT EVALUATION AND MONITORING OF ON-GOING PROJECTS IN SOLAR THERMAL ENERGY

7.2 Out of 15 ongoing R&D projects on ST Energy, four projects have been completed during the year. In one completed project entitled "Development of Modular Central Receiver Concentrated Solar Power Plant for Decentralized Power Generation", design and fabrication of prototype receiver has been completed and currently being tested for its performance at NISE. Another completed major project on solar thermal power entitled "Development of a Megawatt Scale National Solar Thermal Power Testing Simulation and Research Facility", has been installed and tested for its functionality at NISE by IIT, Bombay.

7.3 Under Solar Radiation Resource Assessment (SRRA), 111 SRRA stations have been put up which is the world's largest network of ground measurement solar radiation resource assessment stations distributed all over the country.

7.4 A Calibration Laboratory for calibrating the SRRA instruments installed in the field has also been set up. The laboratory follows all the International standard procedures for calibration of sensors as specified by WMO and also by Regional Radiation Center eg; IMD Pune. This project has been implemented by Solar Energy Corporation of India (SECI) in collaboration with NISE, funded by MNRE. Several pyranometers and pyreheliometers received from various field stations have been tested.

SOLAR THERMAL POWER PLANT

7.5 NISE has undertaken setting up of a 1 MW_e (3.5 MW_{th}) solar thermal power plant with 16 hours thermal storage for continuous operation based on parabolic dish solar concentrators designed and fabricated indigenously, at an estimated solar to electricity efficiency of 12%.

7.6 The configuration of the power plant will include 750 solar dishes having a provision of thermal storage and each having 60 square meter aperture area. The estimated output of the power plant will be i) electrical power of 1 MW x 8 hours; ii) electrical power of 800 kW x 16 hours; iii) cogeneration of 1 million liters of hot water and iv) 8 tons of steam for 24 hours. This project has been successfully completed and further activities are planned.

7.7 Centre for Excellence in Solar Passive Architecture and Green Building Technologies at CEPT University, Ahmedabad was established during 2011 and 2016 under grant from Ministry of New and Renewable Energy, Government of India. Centre was established to enhance the energy efficiency of the building by adopting enhanced construction materials and technologies, create advanced knowledge about thermal comfort and integration of renewable energy in buildings. Centre has met its objectives by providing technical inputs in policy making, providing solutions to achieve energy efficiency to architects and engineers and by developing teaching tools for students. Laboratory infrastructure, established under MNRE grant, has become one of the best laboratories in South-East Asia. NISE is regularly monitoring the of execution projects.

7.8 At MIT, Pune, Desiccant & Ejector concept based system is being developed on prototype basis for application in air conditioning. It is intended to substitute commercially used compressor based air conditioning systems by utilizing solar energy harnessed using solar concentrator. The scope includes design, testing and performance evaluation of both types of concepts. Currently, prototype for ejector system is getting ready for performance evaluation while the conceptual design of desiccant system is in the final stages. NISE is regularly monitoring the of execution projects.

7.09 Several laboratories/facilities have been setup on ST research and education at IIT Jodhpur viz. (a) Solar Resource Assessment, (b) Material Characterization, (c) Solar Thermal, (d) Optics, and (e) Instrumentation and Smart Grid. Both research and teaching activities are actively undertaken in these laboratories leading to development of (a) a tool for resource estimation, (b) high temperature coatings and storage materials, (c) an open volumetric air receiver, (d) a solar air tower simulator facility, (e) the novel concept of solar convective furnace, (f) a radiation calorimeter, (g) a glass-to-metal seal (h) the capability of field design, and (i) a PV based 20kW DC micro-grid for integration with other renewable sources.

7.10 Indian Institute of Science (IISc), Bangalore, has developed the first prototype of a pressurized air solar receiver, as part of the project titled "Development of High Efficiency Receiver for Supercritical CO2 Integrated with Static Focus Parabolic Dish". This hybrid volumetric and cavity type receiver design consists of open-end dome-end cylindrical cavity surrounded by concentric annular porous medium. The receiver design provides flexibility of testing different materials – steel mesh, ceramic honeycomb and foams. The receiver is to be field tested with a Scheffler dish concentrator having a fixed focus.

7.11 As a part of an Institute outreach programme, an annual review cum state-of-the-art series has been planned with an objective to provide quality literature in the field of solar energy to all the stakeholders. The first volume in this series entitled "Advances in Solar Energy Science and Engineering" edited by National Institute of Solar Energy (NISE) was published in 2015.

Another volume (Vol.2) of the series focusing on Solar Thermal Energy has also been published in the year 2016. During the year 2016-17, Vol-3 & Vol-4 of the series dealing with Renewable Energy Education & Skill Development and Renewable Energy Policy and Energy Efficiency have been published.

7.12 The Scope of this serial publication (volumes) is broad and encompasses recent developments in the field and is addressed to serious students, researchers, policy analysts and energy planners seeking a fuller understanding of technical factors underlying Solar Energy Development and commercialization.

7.13 During the reporting period of April 2016 to March 2017, the R&D Co-ordination Cell for SPV has carried out the following activities:

PROJECT EVALUATION

7.14 A committee comprising members from MNRE and NISE looked at 46 new project proposals that included the projects received at MNRE during the past six months and also all the project proposals which were rejected at NISE from the previous lots. For convenience, the projects were divided into two groups, namely the Solar Cells and Materials Group (20 project proposals) and the Systems and Applications Group (26 project proposals). Out of these, only 17 proposals, (3 in the cell and materials category and 14 in the application and systems category) qualified for further processing. These were sent to external experts for evaluation. Following evaluation, 3 projects in the cell category and 4 proposals in the application category were recommended to MNRE for consideration in the RDPAC & RDSPAC meetings. Also, the next lot of 35 project proposals were received for evaluation.

MONITORING OF PROJECTS

7.15 On-site monitoring of on-going projects included visit of experts to BITS Pilani on 28.09.2016 for monitoring of the project on soft switching converter with MPPT for a stand-alone PV power station. Also, in a recent change in the project monitoring mechanism, the PIs of the on-going R&D projects are being called to NISE to attend a Project Review Meeting and make a presentation to a Project Review Committee (PRC). This activity is presently planned bi-annually with the first such meeting held at NISE on 22.11.2016. Subsequently, the PIs are being suggested to implement the project as per the recommendation of the PRC, in line with the sanctioned project objectives. The approved minutes of meeting are sent to the Solar R&D Division of MNRE with actionable points mentioned for each project. The external members of the PRC are reimbursed to and fro travel expenses together with the honorarium as per norms.

RDPAC & RDSPAC MEETINGS

7.16 The meetings of both the RDPAC and RDSPAC committees were held on 22.09.2016. The NISE prepared Agenda for these meetings, helped preparing the Minutes and arranged payments of the TA/DA for the external members attended these meetings.

VALIDATION OF CLAIMS IN ON-GOING R&D PROJECTS

7.17 With a view to authenticate validation of claims in the MNRE funded projects on solar cell development, the solar cell test facility at NISE has been upgraded by fabricating a four probe contact assembly for testing large area solar cells. The contact assembly has been designed to test silicon and non-silicon solar cells of size up to 6 inch X 6 inch. The design also allows testing of commercial silicon solar cells with up to 4 bus bars. In addition, actions have been initiated to enable measurement of temperature coefficients of the electrical parameters and spectral response of solar cells as well as spectral characteristics of the light source. The required equipment has been identified and procurement action initiated. Typical I-V characteristics of thin film micromorph and c-Si solar cells developed at IIEST are depicted in Figs. 7.1 and 7.2 respectively.

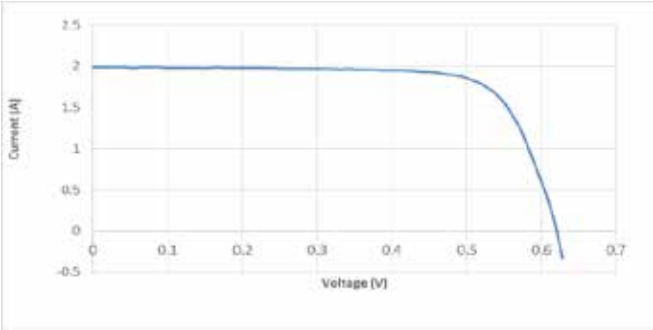


Fig. 7.1 I-V characteristic of a 10 % efficient thin film micromorph solar cells (1 sq. cm) developed at IIEST

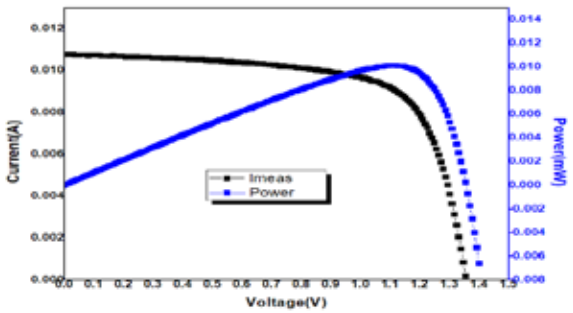


Fig. 7.2 I-V characteristic of a 17 % (7.6 cm x 7.6 cm) c-Si solar cell developed at IIEST

Apart from this, four BOS components including inverters and solar lantern chargers, which has been developed at IIEST as a part of the project, were also tested at IIEST to validate the claims made about their characteristics.

TECHNICAL DOCUMENTATION

7.18 Brief technical reports were prepared during the period on i) incubation project on solar tiles, ii) areas of collaboration with ECN, Netherlands on solar road project, iii) agro-photovoltaics, iv) technical collaboration between NISE and Fraunhofer, ISE and v) acceptance of completion reports on MNRE sponsored projects at IIT Bombay (NCPRE Ph 1) and Jain University, Bangalore.

CHAPTER
8

SUPPORT PROGRAMMES

ADMINISTRATION

National Institute of Solar Energy has been set up as an autonomous Institute by conversion of the erstwhile Solar Energy Centre, an attached office under Ministry of New & Renewable Energy. Forty one regular posts have been sanctioned for the Institute. The Institute has framed Recruitment Rules for the following sanctioned 41 regular scientific, technical and administrative posts. The Rules were approved by Governing Council in its 3rd meeting held on 6th April, 2015. The posts were advertised on All India basis in Employment News and on Ministry and Institute websites. The recruitment is in progress.

S. No.	Name of the post	PB+GP	No. of posts		
			Technical	Admin	Total
1.	Director General	PB-4+10000	1	0	1
2.	Deputy Director General	PB-4+8900	3	0	3
3.	Director Sc'D'	PB-3+7600	2	1	3
4.	Deputy Director Sc'C'	PB-3+6600	6	2	8
5.	Assistant Director Sc'B'	PB-3+5400	7	2	9
6.	Administrative Officer	PB-3+6600	0	1	1
7.	Office Secretary	PB-2+5400	0	1	1
8.	Office Secretary-I	PB-2+4800	0	3	3
9.	Executive Officer	PB-2+4800	4	0	4
10.	Executive Assistant-I	PB-2+4600	8	0	8
Total			**31**	**10**	**41**

The laboratory facilities house in Aditya Bhawan, NISE

8.2 In the meantime, the Institute has been functioning with the help of five officers from Ministry who are assisted by Senior Consultants and Consultants to attend to scientific and administrative assignments to run the Institute. The Laboratories of the Institute are run with assistance from Project Fellows, Junior Research Scientists, Research Scientists and Senior Research Scientists. Different groups formed at the Institute have been assigned activities to focus on all important functions. The support staff has been engaged through an outsourced manpower agency.

8.3 The Institute Building "Surya Bhawan" constructed by National Building Construction Corporation houses the Director General's office and Administrative Wing apart from the Library and information and technology servers. Two floors of Surya Bhawan have been assigned to International Solar Alliance Interim Secretariat.

8.4 The Institute has developed infrastructure facilities for undertaking National and International Training Programmes and arranging Suryamitra Skill Development Programmes. The Institute also continued with the process of development of appropriate infrastructure for additional energy requirements, adopting safety measures for electrical installations, internal road network etc.

VIGILANCE

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

8.6 The summary of complaints, dealt by the Vigilance Division during 2016-17, is as follows:

i. Total No of Complaints/fraud cases received during 2016 -17: 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

8.7 The Vigilance Awareness Week was observed in NISE from 1st November, 2016 to 7th November, 2016. Following activities were undertaken as part of Vigilance Awareness Week:

i. Administering the Integrity Pledge to all the staff and officers by the Director General, NISE on 01.11.2016 at 11AM.
ii. Expert lectures by two eminent persons on probity in public life and vigilance matters for the NISE officials.

ISA COORDINATION

8.8 The Headquarters of ISA is located at the NISE campus. NISE is coordinating with ISA in training and skill development programmes for the participants from the alliance countries besides, providing all technical & managerial support to ISA. NISE has organized three Advanced Orientation Programmes on Solar Energy Technologies, for focal points of ISA member countries. The batches of these programmes were dedicated for African region, Asia, Latin American and Caribbean countries with the duration of 8 days per programme. NISE had trained a total of 39 participants in 2016-17. Apart from the training programmes, NISE is also maintaining the accounts of ISA.

RIGHT TO INFORMATION ACT

8.9 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.

8.10 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 given in Table below. Respective CPIOs and First Appellate Authorities reply to RTI applications/ Appeals within the stipulated time lines to the extent possible.

8.11 The progress report in terms of RTI application/ First Appeals received, disposed-off as well as pendency during the year (from 01.04.2016 to 31.03.2017) is given below:

			(Figures in Numbers)
Item	**Received**	**Disposed off**	**Pending as on 31.03.2017**
RTI Applications	13	13	NIL
First Appeals	NIL	NIL	NIL

Table : 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	Sh. K.C. Vaghri Scientist 'F'	Sh. O.S. Sastry Director General (Addl. Charge) (upto 30.09.2016)
2	All matters concerning NISE	Sh. K.C. Vaghri Scientist 'F' (upto 31.11.2016)	Sh. S.K. Singh Director General (Addl. Charge)
3	All matters concerning NISE	Er. Sanjay Kumar Scientist 'F' (Deputy Director General) (w.e.f. 01.12.2016)	Sh. S.K. Singh Director General (Addl. Charge)

LIBRARY

8.12 The Institute's Library was established in September, 2013. The Library is fully automated since February, 2017. The library uses e–Granthalaya software for circulation of books. During the year 237 books, 11 e–Journals and 50 Standards were purchased. Facilities and services of library are availed by visitors and many trainees of different departments.

8.13 The NISE Library possesses a very rich collection of 8000 volumes of books, bound volumes of Journals and other reading material, to cater to the requirements of its users. Apart from books and journals, the library also has a large collection of National and International Standards. The library subscribes to in number of Hindi and English journal and newspapers. In addition, a number of electronic academic and scientific journals are subscribed for use, apart from annual report and project reports.

8.14 The library is being modernized by strengthening of Internet services with the addition of 06 Computers, computerization of library catalogue, automation of Check-out Check-in functions, Barcoding of collection, data entry of entire collection, automation of stock verification, creation of Digital Library and establishment of Multimedia Library.

INFORMATION TECHNOLOGY

8.15 The Institute has developed its own website (http://nise.res.in) and the Homepage of the website has been redesigned for better content management and appearance. Specific efforts were made from time to time to review, update and enhance the website of the Institute and also ensuring the compliance of guidelines for Government websites. Efforts are also being made to provide computers to all the officers and staff working for the Institute. All the buildings in campus have been provided with Wi-Fi facilities. The Institute also provides IT applications and IT enabled solutions to the working community to make use of the latest state-of-the-art technology to provide better services to its customers and users.

PROMOTION OF OFFICIAL LANGUAGE - HINDI

8.16 With a view to implement the Official Language Policy of the Government of India, a Hindi Section has been set up in the Institute. Its functions are as under:

- Implementation of the Official Language Policy of the Govt. of India.
- Translation work.
- Publication in Hindi:

8.17 During the year 2016-17, concerted efforts were made to ensure proper compliance of the provisions of Official Language Act 1963 and Rules 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 are being undertaken which include the following:

- Work is in progress to make the Institute's revamped website bilingual.
- 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.
- Standard Forms have been prepared in bilingual form and placed on the Website of the Institute for convenience of officers/staff.
- All documents coming under section 3(3) of the O.L. Act 1963, eg. Circulars, Press Release, and General Orders etc. were prepared bilingually.
- Letters received in the Hindi were invariably replied to in Hindi and Rule (5) of the Official Language Rules 1976 was fully complied with.

8.18 During the year 2016-17, various measures were taken for effective implementation of Official Language Policy in the Institute. Special emphasis was laid on increasing originating correspondence in Hindi.

8.19 In order to review the progress made in the implementation of Official Language policy, quarterly meetings of Official Language Implementation Committee were held regularly. Discussions were held on quarterly progress reports received from various Sections/Divisions of the Institute. The Sections/ Divisions were advised to achieve the targets specified by the Department of Official Language.

8.20 'Hindi Pakhwada' was observed in the Institute during 16th to 30th September, 2016 to create awareness and to increase the use of Hindi in official work.

CHAPTER
9

RESEARCH PUBLICATIONS AND REPORTS

I. INTERNATIONAL/NATIONAL SCIENTIFIC JOURNALS

1. "Argon Plasma Treatment of Silicon Nitride (SiN) for Improved Antireflection Coating on c-Si Solar Cells", Hemanta Ghosh, Suchismita Mitra, Hiranmay Saha, Swapan Kumar Datta and Chandan Banerjee, *Materials Science and Engineering* B 215 (2017) 29–36.
2. "Improvement of Photon Management in Partial Rear Contact Solar Cells Using a Combination of DBR and Plasmonic Nanostructures", Suchismita Mitra, Hemanta Ghosh, Hiranmay Saha, Swapan Kumar Datta and Chandan Banerjee, *Optics Communications* 397 (2017) 1–9.
3. "Development of n-type microcrystalline SiOx:H films and its application by innovative way to improve the performance of single junction µc-Si:H solar cell": Gourab Das, Sourav Mandal, Sukanta Dhar, Sukanta Bose, Sumita Mukhopadhyay, Chandan Banerjee and A.K. Barua, *J Mater Sci: Mater Electron*. Volume 28, Issue 8, (2017), pp 5746–5753.
4. "Light-Harvesting Properties of Embedded Tin Oxide Nanoparticles for Partial Rear Contact Silicon Solar Cells" by Hemanta Ghosh, Suchismita Mitra, Sukanta Dhar, Anupam Nandi, Sanhita Majumdar, H Saha, Swapan Kumar Datta, and Chandan Banerjee, *Plasmonics* DOI 10.1007/s11468-016-0443-7.
5. "Development of Improved n-µc-SiOx :H Films and Its Innovative Application in Silicon-Based Single Junction Thin Film Solar Cells" Gourab Das, Sourav Mandal, Sukanta Dhar, Sukanta Bose, Jayasree Roy Sharma, Sumita Mukhopadhyay, Chandan Banerjee and Asok Kumar Barua, *IEEE Journal of Photovoltaics*, Vol. 7, Issue 3, (2017) pp. 892-899.
6. "Synthesis of ITO nanoparticles at room temperature using plasma treatment process and use it as back reflector in a-Si flexible solar cell", Gourab Das, Sourav Mandal, Sukanta Dhar, P Balaji Bhargav, Chandan Banerjee, Sumita Mukhopadhyay and A.K. Barua, *Surfaces and Interfaces* 7 (2017) 83–86.
7. "Influence of excitation frequency and electrode separation on the growth of microcrystalline silicon films and their application in single junction microcrystalline solar cell", Gourab Das, Sourav Mandal, Sukanta Dhar, Sukanta Bose, Jayasree Roy Sharma, Sumita Mukhopadhyay, Chandan Banerjee and A.K. Barua, *J Mater Sci: Mater Electron* (2017) 28:10382–10390
8. "Role of dual SiOx: H based buffer at the p/i interface on the performance of single junction microcrystalline solar cells", Gourab Das, Sourav Mandal, Sukanta Dhar, Sukanta Bose, Sumita Mukhopadhyay, Chandan Banerjee and A.K. Barua, *Materials Science in Semiconductor Processing*, 66 (2017) 9–14.
9. "c-Si/n-ZnO based flexible solar cells with silica nanoparticles as light trapping metamaterial", Arijit Bardhan Roy, Sonali Das, Avra Kundu, Chandan Banerjee and Nillohit Mukherjee, *Phys. Chem. Chem. Phys*., 2017, 19, 12838.
10. "Effect of oxide based graded buffer and bottom n-layer on the performance of the single junction amorphous silicon solar cells", Gourab Das, Sourav Mandal, Sumita Mukhopadhyay, Chandan

Banerjee and Asok K. Barua, *J Mater Sci: Mater Electron* DOI 10.1007/s10854-017-7517-y.

11. "Comparison of Different Technologies for Solar PV Outdoor Performance Using Indoor Accelerated Ageing Tests for Long Term Reliability", Rahnuma Siddiqui, Rajesh Kumar, Gopal Kumar Jha, Ganesh Gowri, Manoj Morampudi, Pragati Rajput, Sneh Lata, Swati Agariya, Bharat Dubey, Gayatri Nanda and Sykam Sahan Raghava, Energy, Vol 107, pp. 550-561, 2016.
12. "Performance Analysis and MPPT Control of a Standalone Hybrid Power Generation System", Ganesh Gowri, G. Vijay Kumar, AR Vijay Babu, Y Tagore and G Srinivasa Rao, Journal of Electrical Engineering, Volume 15, Edition-1, ISSN NO.1582-4594.
13. "Development of an innovative polygeneration process in hybrid solar-biomass system for combined power, cooling and desalination" U.Sahoo, R. Kumar, P.C. Pant, R. Chaudhary, Applied Thermal Engineering 2017; 120: 560–567.
14. "Performance Evaluation of Hybrid Cold Storage using Solar & Exhaust heat of Biomass Gasifier for Rural Development", NUR Rather, S Moses, U. Sahoo, A Tripathi, International Journal on Recent and Innovation Trends in Computing and Communication 2017; 5: 563-569.
15. "Resource assessment for hybrid Solar-Biomass power plant and its thermodynamic evaluation in India", U. Sahoo, R. Kumar, P.C. Pant, R. Chaudhary, Solar Energy 2016; 139:47-57.
16. "Performance study of an inclined Flat Plate type Solar Water Distillation System", U. Sahoo, S.K. Singh, R. Kumar, P.C. Pant, I. Barbate, Renewable: wind, water and solar 2016; 3:2-5.
17. "Resources Assessments & Thermodynamics analysis of Hybrid Biomass-Solar Thermal Power Plant in India", U. Sahoo, S. K. Singh., Advances in Solar Energy Science and Engineering 2016; 2: 235-263.
18. "Comprehensive study of performance degradation of field-mounted photovoltaic modules in India", Rajiv Dubey, Shashwata Chattopadhyay, Vivek Kuthanazhi, Jim Joseph John, Chetan Singh Solanki, Anil Kottantharayil, Brij M. Arora, K. L. Narasimhan, Juzer Vasi, Birinchi Bora, Yogesh Kumar Singh and O. S. Sastry, Energy Science and Engineering 5(1)· February 2017, DOI: 10.1002/ese3.150 · License: CC BY 4.0
19. "Organic photovoltaic cells using green-MWCNTs", Samrat Paul, Bijumani Rajbongshi, Birinchi Bora, Ranjith G Nair and S K Samdarshi Carbon. 2017.02.074
20. "Estimation of Most Frequent Conditions and Performance Evaluation of Three Photovoltaic Technology Modules", Birinchi Bora, O.S. Sastry, Arun Kumar, Renu, Manander Bangar, , Journal of Solar Energy Engineering, 2016 ASME.
21. "The synergistic effect of Airmass on Outdoor Performance for different PV module", Birinchi Bora, Arun Kumar, O.S. Sastry, Renu, Manander Bangar, Takumi Takashima and B. Bandyopadhyay, International Journal of Green Energy 2016.
22. "Series Resistance measurement of Solar PV Modules using Mesh in Real Outdoor condition", Birinchi Bora, O.S. Sastry, R. Singh, M. Bangar, S. Rai, Renu, Y. k. Singh, R. Singh, B K. Das, F Azlan, P Anand, R Kuber, V Krishnan, Energy Procedia (2016); 90: 503 – 508
23. "Effect of Seasonal Spectral Variations on Performance of Three Different Photovoltaic Technologies in India", D.B. Magare, O.S. Sastry, R. Gupta, T.R. Betts, R. Gottschalg, A. Kumar, B. Bora, Y.K. Singh, International Journal of Energy and Environmental Engineering (IJEEE), DOI 10.1007/s40095-015-0190-0

II. PUBLICATION IN PROCEEDINGS OF INTERNATIONAL/NATIONAL CONFERENCES/WORKSHOPS

1. "Effect of temperature on insulation resistance of different PV technology modules", Ganesh Gowri, M. Morampudi, G.K.Jha, R.Siddiqui, R.Kumar, S. Raghava, S. Lata and P Rajput, *Proceedings of the 32nd European Photovoltaic Solar Energy Conference and Exhibition*, 2016, 2281-2285, DOI 10.4229/EUPVSEC20162016-5BV.4.36.

2. "Selection criteria of PV technology based on specific site", G.K.Jha, R.Kumar, P.K.Dash, R. Siddiqui, Ganesh Gowri, M. Morampudi, S Lata, S. Raghava and P Rajput, *Proceedings of the 32nd European Photovoltaic Solar Energy Conference and Exhibition,* 2016, 2030-2032, DOI 10.4229/EUPVSEC20162016-5BV.2.55
3. "Performance comparison of PV modules based on temperature coefficient in indoor and outdoor conditions as per IEC 61853-1", M. Morampudi, B. Bora, G.K.Jha, R.Kumar, R.Siddiqui, S. Lata, Ganesh Gowri, B Dubey, P Rajput, S. Raghava, M. Singh and J. Vyas, *Proceedings of the 32nd European Photovoltaic Solar Energy Conference and Exhibition,* 2016, 2067-2069, DOI 10.4229/EUPVSEC20162016-5BV.2.72.
4. "A Review On Different Types Of PV testing and their optimization", Gayatri Nanda, Sarat Chandra Swain, Rajesh Kumar, Ritesh Das, Gopal Jha, Rahnuma Siddiqui, *International Conference on Circuit Power and Computing Technologies-2016* (IEEE- ICCPCT), 18-19 March 2016. DOI 10.1109/ICCPCT.2016.7530330.
5. "Mitigation of PID in Commercial PV Modules using Current Interruption Method", Birinchi Bora, Jaewon Oh, Sai Tatapudi, O.S. Sastry, R. Kumar, B. Prasad and G. TamizhMani, *SPIE* 2017
6. "Degradation of different PV module technologies under field conditions in India", B. Bora, O.S. Sastry, R. Kumar, B. Prasad, *NREL/SNL/BNL PV Reliability Workshops* Feb. 28-March 2, 2017, USA
7. "Real time monitoring of PV power generation utilities using integrated network architecture for effective modeling of future installations", Pulipaka Subbu, Rajneesh Kumar, Vikrant Sharma, Birinchi Bora and Sanjay Kumar, *Solar World Congress*, 2017.
8. "Performance of Field-Aged PV Modules in India: Results from 2016 All India Survey of PV Module Reliability", R. Dubey, S. Zachariah, S. Chattopadhyay, V. Kuthanazhi, S. Rambabu, S. Bhaduri, H. K. Singh, A. Sinha, B. Bora, Rajesh Kumar, O. S. Sastry, C.S. Solanki, A. Kottantharayil, B. M. Arora, K. L. Narasimhan and J. Vasi, *IEEE PVSC* 2017.
9. "Seasonal Analysis of most frequent condition and Energy Rating of PV Module Technology", Birinchi Bora, O. S. Sastry and B. Prasad, *32nd European Photovoltaic Solar Energy Conference and Exhibition*.
10. "Performance & Seasonal analysis of outdoor performance of Sun Power based MaxeonTM Technology in Composite Climate of India", Ashish Sharma, Birinchi Bora, O. S. Sastry, Yogesh Kumar Singh, Bishnu Mohan Jha, Rashmi Singh, Supriya Rai, Manander Banger, Renu, Suprava Chakraborty, Kamlesh Yadav, Dharmveer Singh, Kaushik Saikia and S.K. Samdarshi, *32nd European Photovoltaic Solar Energy Conference and Exhibition*.
11. "Weighted efficiency of SPV Power Converter/Inverter in Indian Composite Climate", Kamlesh Yadav, O. S. Sastry, Birinchi Bora, Mithilesh Kumar, Rashmi Singh, Richa Parmar, Atul Kumar and B. Prasad, *32nd European Photovoltaic Solar Energy Conference and Exhibition.*
12. "Defect Identification and Correlation with Electrical Degradation of Field Aged Thin Film Photovoltaic Technologies in Composite Climate", Rahul Rawat, S. C. Kaushik, O. S. Sastry, Y. K. Singh, B. Bora, and Ramayan Singh, *32nd European Photovoltaic Solar Energy Conference and Exhibition.*
13. "Performance of SPV water pumping system at lower Irradiance Condition", Manander Banger, Birinchi Bora, O. S. Sastry, Rashmi Singh, Supriya Rai, Renu, *32nd European Photovoltaic Solar Energy Conference and Exhibition.*
14. "Performance comparison of three inverters with different Transformer Topology", Mithilesh Kumar, O. S. Sastry, Kamlesh Yadav, Richa Parmar Rashmi Singh and Birinchi Bora, *32nd European Photovoltaic Solar Energy Conference and Exhibition*
15. "Performance analysis of different Thin Film Module Technology in Indian Climatic Condition", Yogesh Kumar Singh, Birinchi Bora, Ramayan Singh, Suprava Chakraborty, O. S. Sastry, Rashmi Singh, Supriya Rai and Kamlesh Yadav, *32nd European Photovoltaic Solar Energy Conference and*

Exhibition

16. "Uncertainty analysis in Power Rating measurement of Solar Cell as per IEC 61853-1.", Rashmi Singh, Birinchi Bora, O. S. Sastry, Supriya Rai and Manander Banger Renu, *32nd European Photovoltaic Solar Energy Conference and Exhibition*
17. "Variation in Spectral transmittance due to dust on CdTe & Monocrystalline Module", Supriya Rai, Birinchi Bora, O. S. Sastry, Rashmi Singh, Manander Banger, Renu,Gopal Jha and Tika Ram Khadka, *32nd European Photovoltaic Solar Energy Conference and Exhibition.*
18. "Selection of weather profile(s) for testing performance of SPV Pumps in Indian Climate", Kamlesh Yadav, O. S. Sastry, Birinchi Bora, Mithilesh Kumar, Rashmi Singh, Manander Bangar, Atul Kumar and B.Prasad, *32nd European Photovoltaic Solar Energy Conference and Exhibition.*
19. "Analysis of different Shading Pattern on Total Cross Tide connected configuration of Solar PV Power Plant", Dharmveer Singh, Birinchi Bora, O. S. Sastry, Yogesh Kumar Singh, Rashmi Singh, Supriya Rai, B. Pradhan, Manander Banger, Renu, Ramayan Singh, Ashish Sharma and Kaushik Saikia, *32nd European Photovoltaic Solar Energy Conference and Exhibition.*
20. "Optimum array sizing of Solar Photovoltaic Water Pumping System", Renu, Birinchi Bora, Manander Bangar, O. S. Sastry and B. Prasad, *32nd European Photovoltaic Solar Energy Conference and Exhibition*
21. "Studying the effect of Spectral Distribution with Seasonal and Irradiance Variations", Imon Kalyan Barua, Birinchi Bora, O. S. Sastry, Rashmi Singh, Supriya Rai, Manander Bangar, Mithilesh Kumar and B. Prasad, *32nd European Photovoltaic Solar Energy Conference and Exhibition*
22. "Performance comparison of PV module Based on temperature coefficient in indoor and outdoor conditions as per IEC 61853-1", Manoj Morampudi, Birinchi Bora, Gopal Kumar Jha, Rajesh Kumar, Rahnuma Siddiqui, Sneh Lata, Ganesh Gowri Pragati Rajput Sahan Raghava, Bharat Dubey,Mayank Singh and Gayatri Nanda, *32nd European Photovoltaic Solar Energy Conference and Exhibition*
23. "Correlation of electrical and visual degradation seen in field survey in India", Rajiv Dubey, Shashwata Chattopadhyay, Vivek Kuthanazhi, Jim Joseph John, Chetan Singh Solanki, Anil Kottantharayil, Brij M. Arora, K. L. Narasimhan, Juzer Vasi, Birinchi Bora, Yogesh Kumar Singh and O. S. Sastry, 2016 *IEEE 43rd Photovoltaic Specialists Conference (PVSC)*
24. "Performance Modeling of Multi Crystalline PV Module Technology for Composite Climatic Zone of India", Kaushik Saikia, O. S. Sastry, S K Samdarshi, Birinchi Bora, Rashmi Singh, Supriya Rai, Manander Banger, Renu Dahiya, Ashish Sharma and Dharmveer Singh, *103rd Indian Science Congress*, 2016, At Mysore, Karnataka.
25. "Optimization of series–parallel combination of solar PV power plant as per series resistance", Rashmi Singh, Birinchi Bora, O. S. Sastry, Supriya Rai, Manander Banger and Renu Dahiya, *103rd Indian Science Congress*, 2016, At Mysore, Karnataka.

TECHNICAL REPORTS

1. *Analysis of a Single Year of Performance Data for Thin Film Modules Deployed at NREL and NISE,* Sara MacAlpine, Michael Deceglie, Sarah Kurtz, Birinchi Bora, O. S. Sastry, Yogesh Kumar Singh, Rashmi Singh, Supriya Rai, NREL/TP-5J00-66963August 2016
2. All India Survey of PV module Report-2013
3. All India Survey of PV module Report-2014
4. All India Survey of PV module Report-2016
5. Reliability of Photovoltaic Modules: A NISE Report, 2016
6. STAPP project report, 2016

PATENT FILED

[1] Surface texturization of glass to improve the light management in superstrate type thin film solar cell. (Indian Patent Application No.: 201711009452, Date of filing: March 17, 2017).

[2] Textured glass substrate for thin film solar cell. (Indian Patent Application No.:201711009453, Date of filing: March 17, 2017).

CHAPTER
10

FINANCE AND ACCOUNTS

NISE has an Integrated Finance Division (IFD) that scrutinizes and concurs with all payments the being made by NISE. In addition, the Finance and Accounts (F&A) section deals with the maintenance of heads-wise accounts as per the approved budget of NISE. The F&A section also maintains head-wise accounts of all projects that are being run at NISE. F&A section also prepares the annual financial statements, income and expenditure and balance sheet.

VBR & Associates
Chartered Accountants

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 2017 and the Statement of Income & Expenditure for the year then ended, and a summary of significant accounting policies and other explanatory information.

Management's Responsibility for the Financial Statement

The Management is responsible for the preparation of these financial statements 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. This 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 judgments 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 statements that give a true and fair view and are 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 requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, 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 procedures that are appropriate in the circumstances. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of the accounting estimates made by Institute's Directors, as well as evaluating the overall presentation of the financial statements.

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

91-11-43022799
91-9811300570
www.vbrindia.com

611, Roots Tower, Plot No.7
District Centre, Laxmi Nagar, Delhi-110092
email: binit@vbrindia.com

Report on the other Legal and regulatory Requirements

1. The GFR Rules 2005 in some cases during the year relating to the purchases made and the work contracts awarded by the Institute are not complied strictly. Detailed observations in this regard have been provided to the management for compliance.

2. The Internal Control system of the Institute needs to be strengthened. During the course of our audit, some statutory, administrative and financial lapses were found, which are given in the **Annexure A** attached in summarized form. The details of such observations were provided to the management separately which they have noted for future compliance and kept on record along with their comments.

3. Internal Audit System in the organization is quite weak and has failed to report the statutory, financial and administrative lapses as well as areas of weakness, to the management so that the corrective action could have been taken in due course.

4. We report that:

   a) we have sought and obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purposes of our audit;
   b) in our opinion proper books of account 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 are in agreement with the books of account.
   d) in our opinion, the Balance Sheet & Income & Expenditure dealt with by this report complies with the Accounting Standards issued by the Institute of Chartered Accountants of India.

Opinion

In our opinion and to the best of our information and according to the explanations 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, 2017;

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 **VBR & Associates**
Chartered Accountants
FRN 013174N

(Binit K. Agrawal)
(Partner)
Membership No. 088042

Place: Delhi
Dated: October 30, 2017

Annexure A

Annexure to the Independent Audit Report on the financial statements of NATIONAL INSTITUTE OF SOLAR ENERGY for financial year 2016-17 as referred in the said report

Financial Lapses: -

1. **Receivables:** - Amount aggregating to ₹2.43 lacs is receivable from various customers from last financial year. No documentary evidence was found on record to show the follow-up to recover this amount.
2. **Advances to Staff:** -Advances given to staff for official work/ projects are outstanding more than three months. Details of cases ₹15000/- and above is appended.

Purpose	Date	Name of Staff	Amount ₹
Advance More than three Months			
For purchasing of international standards	23.09.2016	Sh Vikrant Yadav	40,000
For Switch global Expo.	03.10.2016	Sh Yogesh Kumar Singh	1,45,000
For Skill Development Prog.	18.10.2016	Ms Jincy Philip	18,500
For purchase of Standards for Testing of SPV power converter	22.03.2016	Sh Kamlesh Yadav	85,000
Guest House Expenses	06.05.2016	Sh. Deepak Mathur	15,000
Advance for purchase of Consumable	12.09.2016	Sh. Mithlesh Kumar	15,000

Management Remarks: The adjustments of these advances have already come in finance and adjustment will be done in current financial year.

Statutory Lapses: -

1. ***Excess amount received from Customers:*** -Excess receipts aggregating to ₹8.47 lacs received against testing fee from the customers, is lying in the accounts of NISE. Some of such amounts were received in F.Y. 2015-16. As per provisions of Service Tax Act, the liability to pay service tax arises at the time of receipt of advance or at the time of raising the invoice, whichever is earlier. Service tax was not paid on these receipts as no invoices are issued by NISE in these cases.
   Management Remarks: Excess receipts will be adjusted against future testing's or refunded to customers.

2. ***Service Tax :***
   (a) 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 Rule-2(l) of the Cenvat Credit Rules, 2004. Hence Service tax input credit is not eligible in these cases.
   (b) Service Tax Returns for the half year ended 30th September, 2016 as well as 31st March, 2017 w.r.t Gross income, reverse charge, CENVAT credit availed & utilized and its closing balance, were having differences when compared to the accounts of NISE.

   Management Remarks: point (a) noted for future compliance, (b) difference in service tax return noted however there is no service tax liability.

3. ***TDS Deduction, deposit & Returns: -***
   (a) TDS deducted in F.Y. 2015-16 was short deposited by ₹53,897.50. TDS returns for the relevant period were also filed without incorporating this amount.
   (b) TDS was not deducted in some cases thus violating the provisions of Income Tax Act, 1961. Aggregate of such expenses during the F.Y. was ₹20,00,235/-

VBR & ASSOCIATES CHARTERED ACCOUNTANTS FRN 013174N

(c) TDS was deducted at inappropriate rate in some cases, as compared to the relevant provisions of Income Tax Act, 1961.

Management Remarks: TDS was not deducted due to certain clarification and further action has been taken in the subsequent year.

Administrative Lapses: -

(a) Administrative lapses were found in some of the material procurement/ work contract transactions of the Institute during the year. Detailed observations of each such case has been provided to the management separately. Some of the vendors with whom such transactions were done, are as follows:

1. Kendriya Bhandar
2. Sai Nath Tour and Travels
3. Paramount Krafts
4. D.B Traders
5. Ashiesh Enterprises
6. Pramod Construction Works
7. Vidutalaya
8. CPWD
9. Tata Power Solar Systems Ltd.

(b) No utilization certificates have been received from State Nodal Agencies against advances aggregating to ₹115.43 lacs given to them for Organizing Skill Development program. In some of the cases the advances are more than 12 months old from the end of the F.Y. in which grant was given. List of such State Nodal agencies has been given to the management separately.

For **VBR & Associates**
Chartered Accountants
FRN 013174N

(Binit K. Agrawal)
(Partner)
Membership No. 088042

Place: Delhi
Dated: October 30, 2017

NATIONAL INSTITUTE OF SOLAR ENERGY

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

Amount in ₹

BALANCE SHEET AS AT 31ST MARCH 2017

CORPUS/CAPITAL FUND AND LIABILITIES	SCHEDULE	AS AT MARCH 31, 2017		AS AT MARCH 31, 2016	
		TOTAL		NISE	
Corpus/Capital Asset Fund	1				
Gross Corpus/ Capital Fund		1,63,98,44,230		33,60,73,774	
Less : Accumulated Depreciation		2,04,74,403	1,61,93,69,827	58,11,440	
Net Corpus/ Capital Fund					33,02,62,333
Current Liabilities & Provisions	2		76,80,54,062		14,00,93,797
Total			**2,38,74,23,888**		**47,03,56,130**

ASSETS	SCHEDULE	AS AT MARCH 31, 2017		AS AT MARCH 31, 2016	
		TOTAL		NISE	
Fixed Assets	3				
Gross Block		10,44,75,781		3,65,40,213	
Less : Accumulated Depreciation		2,04,74,403	8,40,01,378	58,11,440	
Net Block					3,07,28,773
Current Assets, Loans & Advances	4		2,30,34,22,510		43,96,27,358
Total			**2,38,74,23,888**		**47,03,56,130**
SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO ACCOUNTS	11				

As per our Audit Report of even date
For VBR & Associates
Chartered Accountants
(FRN-013174N)

VBR & ASSOCIATES * CHARTERED ACCOUNTANTS * DELHI FRN-013174N

(Binit K Agrawal)
Partner
M. No.088042

Place: Delhi
Dated: October 30, 2017

For NATIONAL INSTITUTE OF SOLAR ENERGY

Dr. Chandan Banerjee
(Dy. Director General)

Dr. A. K. Tripathi
(Director General)

NATIONAL INSTITUTE OF SOLAR ENERGY

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

Amount in ₹

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED ON 31ST MARCH 2017

PARTICULARS	Schedule	2016-17	2015-16
		TOTAL	NISE
INCOME			
Receipts from Testing & Operations	5	3,52,27,146	1,57,97,413
Grants/Subsidies utilised for Revenue Expenditure	6	22,19,81,233	10,47,71,425
Interest Earned	7	3,64,65,541	2,34,398
Other Income	7	90,83,767	29,39,975
Depreciation (As per Contra)	3	1,47,12,859	48,92,060
Total (A)		**31,74,70,546**	**12,86,35,271**
EXPENDITURE			
Establishment Expenses	8	4,07,50,206	2,90,37,200
Other Administrative Expenses	9	6,36,31,648	5,11,75,479
Operational Expenses	10	13,86,14,398	2,92,14,865
Depreciation (As per Contra)	3	1,47,12,859	48,92,060
Total (B)		**25,77,09,110**	**11,43,19,605**
Net Surplus/(Deficit) for the year		5,97,61,436	1,43,15,667
Provision for Taxation		1,80,285	-
Balance being Surplus/(Deficit) for the year transferred to Cospus (A-B)		***5,95,81,151***	***1,43,15,667***
SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO ACCOUNTS	11		

As per our Audit Report of even date
For VBR & Associates
Chartered Accountants
(FRN-013174N)

VBR & ASSOCIATES * CHARTERED ACCOUNTANTS * DELHI FRN-013174N

(Binit K Agrawal)
Partner
M. No.088042

Place: Delhi
Dated: October 30, 2017

For NATIONAL INSTITUTE OF SOLAR ENERGY

Dr. Shandan Banerjee
(Dy. Director General)

Dr. A. K. Tripathi
(Director General)

NATIONAL INSTITUTE OF SOLAR ENERGY

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SCHEDULES FORMING PART OF FINANCIAL STATEMENTS FOR THE YEAR 2016-17

SCHEDULE 1- CORPUS/ CAPITAL FUND	AS AT MARCH 31, 2017		AS AT MARCH 31, 2016	
General Reserve				
Balance as at the beginning of the year	2,29,84,785		86,69,118	
Add : Excess of income over expenditure during the year	5,95,81,151		1,43,15,667	
Add : Non-refundable Grants received	1,14,18,72,500	1,22,44,38,436	-	2,29,84,785
Capital Fund				
Grants adjusted against purchase of assets	9,97,45,263		3,41,20,865	
Grant utilised for advances given during the year	31,56,60,531	41,54,05,794	27,89,68,124	31,30,88,989
Total		**1,63,98,44,230**		**33,60,73,774**

SCHEDULE 2- CURRENT LIABILITIES AND PROVISIONS	AS AT MARCH 31, 2017		AS AT MARCH 31, 2016	
Current Liabilities				
Sundry Creditors				
- For goods and services	1,01,118		7,13,846	
- Creditors For Capital Goods	45,63,682	46,64,800	22,86,541	30,00,387
Deposits				
- Earnest Money Deposit	17,19,200		24,97,200	
- Guest House Security Deposits	-		30,000	
- Advance Received from Customers	8,46,951	25,66,151	1,81,884	27,09,084
Statutory Liabilities				
- TDS Payable		8,12,470	11,76,512	11,76,512
Other Current Liabilities				
- Salary & Remuneration Payable	1,76,044		-	
- Interest refundable to Ministry	3,07,68,155		60,35,990	
- Advances received against trainning	46,000		1,03,300	
- Other misc. liabilities	2,32,843	3,12,23,042	22,992	61,62,282
Grants Payable to Government of India		72,53,84,583		12,38,22,802
Provisions				
Provision for Income Tax		34,03,015		32,22,730
Total		**76,80,54,062**		**14,00,93,797**

VBR & ASSOCIATES ★ CHARTERED ACCOUNTANTS ★ DELHI FRN-013174N

NATIONAL INSTITUTE OF SOLAR ENERGY

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

SCHEDULES FORMING PART OF FINANCIAL STATEMENTS FOR THE YEAR 2016-17

SCHEDULE 3- FIXED ASSETS CUM DEPRECIATION SCHEDULE

Amount in ₹

PARTICULARS	GROSS BLOCK					DEPRECIATION				NET BLOCK	
	As at 01.04.2016	Addition before 30.09.2016	Addition After 01.10.2016	Sales/ Adjustment during the year	As at 31.03.2017	As at 01.04.2016	Current Depreciation on L+C	Current Depreciation on D	Total Depreciation (G+H)	WDV as on 31.03.2017 (F-I)	WDV as on 31.03.2016
A	B	C	D	E	F	G	H	I	J	K	L
National Institute of Solar Energy											
Desktop Computers	24,98,372	-	57,972	-	25,56,344	12,23,826	7,64,728	17,392	20,05,945	5,50,399	12,74,546
Printers and other IT Peripherals	6,91,949	28,94,799	5,04,571	-	40,91,319	66,922	5,27,974	37,843	6,32,739	34,58,580	6,25,027
Air Conditioner	11,22,681	6,17,896	-	-	17,40,577	2,77,253	2,19,499	-	4,96,752	12,43,825	8,45,428
Misc. Assets Guest House/ Office	45,28,126	79,84,969	55,74,434	-	1,80,87,529	4,00,012	18,16,962	4,18,083	26,35,057	1,54,52,472	41,28,114
Scientific & Laboratory Equipments	2,26,23,073	2,43,93,390	1,68,30,100	-	6,38,46,563	24,54,780	66,84,252	12,62,258	1,04,01,290	5,34,45,273	2,01,68,293
Cycles	40,800	-	-	-	40,800	8,721	4,812	-	13,533	27,267	32,079
Furniture & Fixtures	11,21,162	-	-	-	11,21,162	1,42,333	97,883	-	2,40,216	8,80,946	9,78,829
Laptops ((Training)	90,195	-	-	-	90,195	64,940	15,153	-	80,093	10,102	25,255
Laptops	4,02,570	-	-	-	4,02,570	1,58,653	1,46,350	-	3,05,003	97,567	2,43,917
Other Assets (Training)	10,72,554	30,32,400	34,85,000	-	75,89,954	1,14,076	5,98,632	2,61,375	9,74,083	66,15,871	9,58,478
Office Car	5,49,561	-	-	-	5,49,561	1,17,469	64,814	-	1,82,283	3,67,278	4,32,092
Softwares	13,76,471	12,80,120	-	-	26,56,591	5,28,837	12,76,652	-	18,05,489	8,51,102	8,47,634
Software (Training)	4,22,699	3,75,230	2,39,397	-	10,37,326	2,53,619	3,26,586	71,819	6,52,024	3,85,302	1,69,080
International Solar Alliance											
Printers and other IT Peripherals	-	-	6,50,790	-	6,50,790	-	-	48,809	48,809	6,01,981	-
Misc. Assets Office	-	-	14,500	-	14,500	-	-	1,088	1,088	13,413	-
Total	**3,65,40,213**	**4,05,78,804**	**2,73,56,764**	**-**	**10,44,75,781**	**58,11,441**	**1,25,44,297**	**21,18,665**	**2,04,74,403**	**8,40,01,378**	**3,07,28,772**

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SCHEDULES FORMING PART OF FINANCIAL STATEMENTS FOR THE YEAR 2016-17

SCHEDULE 4- CURRENT ASSETS, LOANS & ADVANCES	AS AT MARCH 31, 2017		AS AT MARCH 31, 2016	
Current Assets				
Cash Balance in hand		3,51,332		3,28,451
Balance with Bank :				
-Saving Accounts	1,69,01,54,609		11,65,97,847	
-Auto Sweep Account	24,02,59,766		-	
-Fixed Deposits under Lien	2,12,46,295	1,95,16,60,670	1,96,91,225	13,62,89,072
Sundry Debtors		79,96,237		12,78,358
Stamps in Hand		852		832
Loan & Advances & other assets				
Advances and other amounts recoverable in cash or in kind or for value to be received				
- Advances against capital assets	24,83,84,335		25,60,52,885	
- Advances against trainning programs	7,34,53,210		3,08,28,840	
- Other advances	20,15,092		25,65,092	
- Advance to Vendors	76,11,036		49,47,355	
- Recoverable against TDS deduction	-		-	
- Recoverable against Training	1,01,100		34,200	
- Recoverable against excess payment	-		-	
- Balances in Staff Imprest Accounts	12,13,764	33,27,78,538	8,23,039	29,52,51,411
Deposits				
- Security Deposits	3,70,703		1,46,703	
- Input Credit of Service Tax	24,46,119		25,53,698	
- TDS Recoverable	46,82,940		6,43,713	
- Advance Tax	31,35,120	1,06,34,882	31,35,120	64,79,234
Total		**2,30,34,22,510**		**43,96,27,358**

SHEDULE 5- RECEIPTS FROM TESTING AND OPERATIONS	2016-17		2015-16	
Receipts from Testing				
- Testing of Solar Components	2,44,59,200	2,44,59,200	1,21,86,700	1,21,86,700
Other Operational Receipts				
- Trainings and Seminars -Domestic Participants	70,32,346		18,33,213	
-International Participants	33,85,600		16,40,000	
- Consultancy	3,50,000	1,07,67,946	1,37,500	36,10,713
Total		**3,52,27,146**		**1,57,97,413**

VBR & ASSOCIATES CHARTERED ACCOUNTANTS DELHI FRN-013174N

NATIONAL INSTITUTE OF SOLAR ENERGY

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

SCHEDULES FORMING PART OF FINANCIAL STATEMENTS FOR THE YEAR 2016-17

SCHEDULE 6- GRANTS/SUBSIDIES (Irrevocable Grants & Subsidies Received)	2016-17		2015-16	
Core Grants Received during the year- NISE	7,00,00,000		17,84,00,870	
Less : Grant Refunded	-	7,00,00,000	1,50,28,386	16,33,72,484
Core Grants Received during the year- ISA	15,00,00,000		-	
	-	15,00,00,000	-	-
Project Grants Received during the year- NISE	71,53,70,156		-	
Less : Grant Refunded	30,76,556	71,22,93,600	-	-
Grant unutilised brought forward from the previous year		12,38,22,802		18,69,65,167
Grant Adjusted towards Revenue Expenditure :				
Current Year Expenditure	24,29,96,251		10,94,27,544	
Less : Expenses adjusted towards current year income	2,10,15,018		46,56,120	
	22,19,81,233		10,47,71,425	
Less: Expenses Adjusted against Previous Advances	1,68,59,096	20,51,22,137	-	10,47,71,425
Less : Grants utilised for purchase of Fixed Assets		5,72,24,298		2,92,53,300
Less : Grants utilised for Advances against Capital Expenses		7,16,150		5,39,11,734
Less : Grants utilised for Advances against projects		6,76,69,234		3,85,78,390
Grants Payable to Government of India		**72,53,84,583**		**12,38,22,802**

SCHEDULE 7- OTHER INCOME	2016-17		2015-16	
Bank Interest				
- Interest earned on Savings account	2,71,65,801		2,34,398	
- Interest earned on Grants account	-		-	
- Interest earned on Auto Sweep account	92,99,740	3,64,65,541	-	2,34,398
Miscellaneous Income				
- Guest House Charges	15,16,050		12,14,875	
- Administrative Charges	70,26,341		17,25,000	
- Other Income	5,41,376	90,83,767	100	29,39,975
Total		**4,55,49,308**		**31,74,373**

VBR & ASSOCIATES * CHARTERED ACCOUNTANTS * DELHI FRN 015174N

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SCHEDULES FORMING PART OF FINANCIAL STATEMENTS FOR THE YEAR 2016-17

SCHEDULE 8- ESTABLISHMENT EXPENSES	2016-17				2015-16
	Utilised against grant	Utilised against previous year advances	Charged to I&E	TOTAL	TOTAL
Consultancy Charges	1,19,90,189	-	-	1,19,90,189	50,80,572
Project Fellow Stipend	-	-	-	-	-
Remuneration	2,39,23,492	-	27,26,567	2,66,50,059	2,19,32,280
Honorarium	-	-	10,000	10,000	-
Manpower Remuneration (Solar Hydrogen Project)	20,99,958	-	-	20,99,958	20,24,348
Total	**3,80,13,639**	**-**	**27,36,567**	**4,07,50,206**	**2,90,37,200**

SCHEDULE 9- OTHER ADMINISTRATIVE EXPENSES	2016-17				2015-16
	Utilised against grant	Utilised against previous year advances	Charged to I&E	Total	Total
Electricity / Fuel Expenses	51,82,621	-	51,82,621	1,03,65,242	80,07,727
Outsourcing Services	2,15,12,595	-	-	2,15,12,595	1,42,15,761
Security Services	1,06,85,333	-	-	1,06,85,333	1,27,40,130
	-	-	-	-	92,090
Office Expenses	9,91,335	-	-	9,91,335	1,55,199
Refreshment/Hospitality/Meetings	6,88,660	-	-	6,88,660	9,84,579
Legal & Professional Charges	1,05,385	-	-	1,05,385	1,06,478
Bank Charges	-	-	2,20,853	2,20,853	1,01,348
Discount on Training Fees	-	-	9,000	9,000	30,000
Horticulture Expenses	51,560	-	-	51,560	5,67,905
Advertisement Expenses	7,36,352	-	-	7,36,352	17,94,592
Guest House Expenses	-	-	1,43,618	1,43,618	1,35,174
Library Books & Periodicals	20,70,529	7,15,425	-	27,85,954	1,12,918
Postage & courier	68,158	-	23,535	91,693	49,320
Prinitng & Stationery	21,74,597	-	-	21,74,597	6,60,808
Computer Software and accessories Expenses	-	-	-	-	3,96,270
Interest & Penalty	-	-	400	400	
Repairs & Maintenance Expenses	55,05,671	1,10,258	-	56,15,929	75,21,696
Expenses written off	-	-	-	-	6,554
Telephone Expenses	5,53,464	35,57,700	-	41,11,164	7,84,937
Vehicle Running & Maintenance	2,92,146	-	-	2,92,146	3,71,869
Tour / Travel & Transport	19,16,337	18,507	11,14,989	30,49,833	23,40,126
Total	**5,25,34,742**	**44,01,890**	**66,95,016**	**6,36,31,648**	**5,11,75,479**

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SCHEDULES FORMING PART OF FINANCIAL STATEMENTS FOR THE YEAR 2016-17

SCHEDULE 10- OPERATIONAL EXPENSES	2016-17				2015-16
	Utilised against grant	Utilised against previous year advances	Charged to I&E	Total	Total
All India SPV Module Survey-II (2014)					-
SERIIUS Project Expenses	2,80,194	4,09,000	-	6,89,194	7,04,558
NAM S&T Center Research Training Felloship	1,81,828	-	-	1,81,828	
North East Training Programme	19,81,158	-	-	19,81,158	
Short Film on NISE THE SHINING STAR	-	-	-	-	-
Released to State Nodal Agencies for Skill Development	10,29,81,921	1,20,48,206	-	11,50,30,127	1,28,78,378
Expenses on Skill Development Programmes	-	-	24,13,126	24,13,126	
Thermal Power Project Expenses	1,09,683	-	-	1,09,683	15,66,100
R&D Cell Expenses	-	-	3,22,819	3,22,819	8,25,410
Testing/Accredation Charges	-	-	2,04,000	2,04,000	-
Seminars/Conferences/Training Programmes	81,99,213	-	40,20,612	1,22,19,825	69,21,422
Hydrogen Project Exp.	68,093	-	-	68,093	12,81,550
Exhibition/ Events Expenses	4,91,841	-	17,93,187	22,85,028	43,34,032
Consumables/ Laboratory/Workshop Exp.	-	-	27,94,337	27,94,337	5,64,282
UNDP-GEF Project Expenses	1,03,076	-	-	1,03,076	63,284
Other Operational Expenses	1,76,750	-	35,355	2,12,105	75,850
Total	**11,45,73,756**	**1,24,57,206**	**1,15,83,436**	**13,86,14,398**	**2,92,14,865**

VBR & ASSOCIATES CHARTERED ACCOUNTANTS DELHI FRN-013174N

NATIONAL INSTITUTE OF SOLAR ENERGY

(An Autonomus Institute of Ministry of New & Renewable Energy ,Govt.of India)
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STATEMENT OF GRANTS FOR THE FINANCIAL YEAR 2016-17

PARTICULARS	Opening Balance01.04.2016	Refunded during the year 2016-17	Receipt during the year 2016-17	Utilization against advances 16-17	Utilization against Fixed Assets 16-17	Utilization against Revenue Expenses 16-17	Total Utilization 16-17	Closing Balance 16-17
CORE GRANTS- NISE								
Grant for Creation of Capital Assets	7,76,68,694	-	2,50,00,000	7,16,150	5,51,33,992		5,58,50,142	4,68,18,552
Grant in aid- General	4,30,79,183	-	1,00,00,000	12,05,584	-	5,18,73,599	5,30,79,183	-
Grant in aid- Salaries	-		3,50,00,000		-	2,82,20,393	2,82,20,393	67,79,607
PROJECT GRANTS- NISE								
Grant for Organising International Training Courses	15,00,000	15,00,000	-	-	-		-	-
Grant for NAM & ST Fellowship	2,11,828	-	-	-	-	2,11,828	2,11,828	-
Grant for Training on Small Power Plants	12,20,000	-	-	-	-	6,04,438	6,04,438	6,15,562
Grant for Project Hydrogen	1,82,956	1,82,955	22,00,000	-	31,950	21,68,051	22,00,001	-0
Grant- Skill Development Programme	-40,84,426	-	33,82,20,560	5,55,28,450	-	10,15,10,718	15,70,39,168	17,70,96,966
Grant UNDP	10,72,363	-	25,00,000	-	-	17,74,909	17,74,909	17,97,454
Grant for SERIIUS (Indo US Project)	15,78,604	-	35,16,000	-	82,900	21,51,897	22,34,797	28,59,807
Grant-INDO-UK STAPP Project - MNRE	13,93,601	13,93,601	-	-	-	-	-	-
Grant -Solar Based Pilot Proj. (for African Countries)	-	-	30,46,00,000	-	-	-	-	30,46,00,000
Grant- World Renewal Energy Muesum	-	-	2,66,55,548	-	-	-	-	2,66,55,548
Grant- Solar Powered clean drinking water project	-	-	1,00,00,000	50,00,000	13,10,166	3,18,416	66,28,582	33,71,418
Grant -Adv. Oreintation program for focal points(IRENA)	-	-	1,02,00,000	1,23,200	-	48,35,707	49,58,907	52,41,093
Grant-North East Training Program	-	-	1,60,00,000	58,12,000	-	42,83,106	1,00,95,106	59,04,894
Grant - Int. Trg. Courses for Eurasian and African Countries	-	-	14,78,048	-	-	23,15,818	23,15,818	-8,37,770
Total	12,38,22,802	30,76,556	78,53,70,156	6,83,85,384	5,65,59,008	20,02,68,880	32,52,13,272	58,09,03,130
CORE GRANTS- ISA								
Grant-General	-	-	15,00,00,000	-	6,65,290	48,53,257	55,18,547	14,44,81,453
Total	-	-	**15,00,00,000**	-	**6,65,290**	**48,53,257**	**55,18,547**	**14,44,81,453**
Grand Total	**12,38,22,802**	**30,76,556**	**93,53,70,156**	**6,83,85,384**	**5,72,24,298**	**20,51,22,137**	**33,07,31,819**	**72,53,84,583**

NON-REFUNDABLE GRANTS- NISE								
Contribution from Indian Renewable Energy Dev. Agency	-	-	1,00,00,000	-	-	-	-	1,00,00,000
Total	-	-	**1,00,00,000**	-	-	-	-	**1,00,00,000**
NON-REFUNDABLE GRANTS- ISA								
Contribution by Ministry of New & Renewable Energy	-		1,00,00,00,000	-	-	-	-	1,00,00,00,000
Contribution from Indian Renewable Energy Dev. Agency	-	-	6,69,40,000	-	-	-	-	6,69,40,000
Contribution from Solar Energy Corporation of India	-	-	6,49,32,500	-	-	-	-	6,49,32,500
Total	-	-	**1,13,18,72,500**	-	-	-	-	**1,13,18,72,500**

VBR & ASSOCIATES CHARTERED ACCOUNTANTS DELHI

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. 2016-17

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 incomes as well as expenditure.

The accounting policies adopted and applied in the preparation of financial statements by the Institute are consistent with GFR rules 2005 in general.

2. 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 (Corpus Fund/Capital Fund) and is recognized in the Income & Expenditure account as a contra item as per AS-12 Prescribed by ICAI.

3. Grant in Aid

a) NISE is getting budgetary support from Ministry of New & Renewable Energy, Government of India which is accounted for on cash basis. These grants are recurring in nature and are termed as **Core Grants**. Besides the recurring grants, one-time grants are also received from MNRE, UNDP, IREDA etc. 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 refundable to the Ministry of New & Renewable Energy. Non-refundable grants, if any, are being disclosed separately.

b) The grants utilized for the purchase of fixed assets and have been shown under the head of Capital Assets Fund.

c) Further, grants utilized for advances against Fixed Assets, goods & services have also been shown under the head of Capital Fund.

d) The Institute has adopted policy regarding setting off its revenue expenses with the internally generated resources i.e. Testing and training income in accordance with GFR rules 2005 Chapter 9 Rule 208 (iv). In this financial year, the institute has set off some of its revenue expenditure with the grants received. Surplus from internally generated resources i.e. Income from Testing and Training has been parked to corpus/ capital fund. However, expenses incurred against specific projects and activities have been first setoff against the grants received for that purpose, if any.

VBR & ASSOCIATES CHARTERED ACCOUNTANTS DELHI FRN-013174N

4. Corpus Fund

In line with the directions of the Governing Council, NISE is required to create a corpus fund with a view to achieve sustainability in a longer run. Necessary guidelines for creating such corpus fund are under finalization.

5. International Solar Alliance

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 for this purpose, the funds for preparatory work are routed thru' NISE. Accordingly, financial figures relating to grants received for ISA and expenses incurred on its behalf, have been consolidated in the financial statements of NISE.

6. 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.

7. Revenue Recognition

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

8. Provision

A provision is recognized, when an enterprise has a present obligation as a result of past event; it is probable that an outflow of resources will be required to settle the obligation, in respect of which a reliable estimate can be made.

9. Contingent Liabilities and contingent Assets

A disclosure for a contingent liability is made when there is a possible obligation that may, but probably will not, require an outflow of resources. Where there is a possible obligation or a present obligation but the likely hood of outflow of resources is remote, no provision or disclosure is made.

B. NOTES TO ACCOUNTS

1. The depreciation of ₹1,47,12,859/- has been charged to the Income & Expenditure account. Since the Institute is fully aided by the Government of India, therefore depreciation is charged to the Grant (Corpus Fund/Capital Fund) and is recognized in the Income & Expenditure account as a contra item.

2. Advances paid against capital assets etc. have been directly set off against Grants. However, in the financial statements the same have been shown separately.

3. Current status of some of the large advance paid in previous financial years is as under:

   - Rs.367.93 lacs were paid to Tata Power Solar Systems for multi technology solar power plant. The plant is based on integration of different technology of battery and grid combination. The supplier has supplied substantial part of equipment and is expected to commission the project by December 2017.
   - Rs.200.00 lacs were paid to CDAC for upgradation of PV modules, BOS and Lightning system test facilities at Kolkata, Bangalore and NISE campus. The work has been partially completed and certain issues relating to commissioning needs to be resolved with the vendor.
   - Rs.17.90 crores were paid to NBCC for construction of new building called as Surya Bhawan Complex with 30 rooms Guest House facility. The contract was awarded to NBCC in the year 2010. Payment of Rs.1 crore has been withheld for some defects to be removed. Occupation certificate has been given in the name of MNRE in May 15.

4. The balances of sundry creditors and debtors are subject to confirmation and consequent reconciliation, if any.

5. Previous year figures have been regrouped and rearranged to make them comparable with those of current year.

As per our Audit Report of even date For VBR & Associates Chartered Accountants **(FRN-013174N)**

VBR & ASSOCIATES CHARTERED ACCOUNTANTS DELHI FRN-013174N

(Binit K Agrawal)
Partner
M. No.9811300570

Place: Delhi

Dated: October 30, 2017

For NATIONAL INSTITUTE OF SOLAR ENERGY

Dr. Chandan Banerjee
(Dy. Director General)

Dr. A. K. Tripathi
(Director General)

Solar PV Outdoor Test Bed Facility showcasing different technologies

NATIONAL INSTITUTE OF SOLAR ENERGY

(An Autonomous Institute of Ministry of New and Renewable Energy, Government of India)
Gurugram-Faridabad Road, Gwalpahari, Gurugram-122003 (Haryana)
Telephone : 0124-2579207

www.nise.res.in