

NSQF QUALIFICATION FILE

Approved in 3rd NSQC - NCVET, Dated: 20th November, 2020

CONTACT DETAILS OF THE BODY SUBMITTING THE QUALIFICATION FILE

Name and address of submitting body:

Ministry of Environment, Forest & Climate Change (MoEF&CC)
Indira Paryavaran Bhawan, Jor Bagh Road, New Delhi- 110003

Name and contact details of individual dealing with the submission

Name: Ms. Urmila

Position in the organisation: Director, MoEF&CC

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List of documents submitted in support of the Qualification File

- 1. Curriculum with training plan (Annexure-I)**
- 2. Documentary Evidence of Need (Annexure-II)**

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- SUMMARY

1	Qualification Title:	Certificate Course in: Sustain and enhance technical knowledge in Solar Energy Systems
2	Qualification Code, if any	-
3	NCO code and occupation	-
4	Nature and purpose of the qualification (Please specify whether qualification is short term or long term)	- To Support solar industry implementation - Short Term
5	Body/bodies which will award the qualification	- MoEF&CC
	Body which will accredit providers to offer courses leading to the qualification	- MoEF&CC
7	Whether accreditation/affiliation norms are already in place or not, if applicable (if yes, attach a copy)	Training programmes would be undertaken as part of the Green Skill Development Programme (GSDP) under the ENVIS Scheme. The courses would be run by the ENVIS Hubs (hosted by the respective State Government /UT Administration) and ENVIS Resource Partners (RPs)- (hosted by environment-related governmental and non-governmental organizations/ institutes of professional excellence) and other institutes. The assessment of the training programmes would be a regular exercise as part of the Memorandum of Cooperation signed with ENVIS Hubs and RPs and Memorandum of Understanding (MoU) between the ENVIS Hubs/RPs and other GSDP Partners. The courses would also be run by the Autonomous Bodies/Institutes under the Ministry for which no MoC is required.
8	Occupation(s) to which the qualification gives access	Trained solar technician, solar energy-based business
9	Job description of the occupation	Solar power plant installation, Operation and maintenance, petty contractor, solar product retailer
10	Licensing requirements	-

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11	Statutory and Regulatory requirement of the relevant sector (documentary evidence to be provided)	-
12	Level of the qualification in the NSQF	5
13	Anticipated volume of training/learning required to complete the qualification	240 hours
14	Indicative list of training tools required to deliver this qualification	Clamp meter, Multi meter, Battery tester, Earthing tester and General tool kit .
15	Entry requirements and/or recommendations and minimum age	10+2 passed or dropout, Minimum 18 years
16	Progression from the qualification (Please show Professional and academic progression)	Master Trainers/Entrepreneurship
17	Arrangements for the Recognition of Prior learning (RPL)	There is no arrangement of RPL as of now
18	International comparability where known (research evidence to be provided)	Similar programs are being offered in other countries.
19	Date of planned review of the qualification.	September 2023
20	Formal structure of the qualification	
	Mandatory components	
	Title of component and identification code/NOSs/Learning outcomes	Estimated size (learning hours)
	Level	
(i)	Introduction to Renewable and Solar Energy: <ul style="list-style-type: none"> • What is Renewable Energy • Why do we need Renewable Energies & its types • Pros & Cons of Solar energy and its Applications • Status of Solar energy in India & Solar resource • Solar energy Conversion • Solar Radiation & its Measuring Instruments 	6
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(ii)	Solar Energy & Climate Change <ul style="list-style-type: none">• Differences of Fossil Fuel & Solar Energy• Effects of Solar energy with Earth's Atmosphere & Carbon Footprint• Climate Change and Global Warming Action Plan for India• Administrative Functions and Basics of Enterprise Management• Cook Stoves	12	5
(iii)	Tools <ul style="list-style-type: none">• Screw Drivers, Measuring tape, Wrench, Pliers, Hammers, Hacksaw, Cutters, Chisels, Allen Keys, Hand Drill & drill bit, Try Square, Gimlet, vice, Plumb bob, Pipe cutter, Crimping tool, Neon tester, Mallet, Wire stripper, Centre punch, Hand grinder, etc.		
(iv)	Electromagnetism (Electricity & Magnetism) <ul style="list-style-type: none">• Brief Introduction to Electricity & Electrical circuits• Laws of Resistance, Ohms law's, Kirchhoff's law• Instrument for Measuring Electric Power• Magnetism, Magnetic Needle, Electric & Magnetic fields, Law of ampere, Solenoid, Self & Mutual Inductance, Hysteresis loss	6	5
(v)	Wires & Cables <ul style="list-style-type: none">• Understanding Electrical Wire• Understanding Electrical Cable• Insulating material, Standard wire gauge, Continuity tester, Soldering.• Safety and its importance, PPEs, Safety Signs, Safety Slogans, Safety Rules, Fire Extinguisher	6	5
(vi)	Photovoltaic Technology <ul style="list-style-type: none">• Solar/PV cells• Types of Solar cells (Crystalline Silicon, Thin film, Organic Photovoltaic cell/3rd generation)	6	5

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	<p>PV cell)</p> <ul style="list-style-type: none"> • Cell, Module, String, Array • STC & NOCT conditions • Solar cell I-V Characteristics Curves • Factors affecting the performance of solar panel • Difference between Solar PV and Solar Thermal Systems 		
(vii)	<p>Components of Photovoltaic System</p> <ul style="list-style-type: none"> • Solar Panels • Batteries, Inverter, Charge Controllers • Trackers, Balance of System • Monitoring & Metering 	6	5
(viii)	<p>Types Of PV Systems</p> <ul style="list-style-type: none"> • PV Direct System, Off Grid System • Grid Connected Systems (with & without battery) • Hybrid System <p>Photovoltaic Mounting systems</p> <ul style="list-style-type: none"> • Roof Mounted system • Ground Mounted System • Building Integrated photovoltaic • Mounting as a Shade structure 	12	5
(ix)	<p>PV System Design, Sizing & Installation Requirements</p> <ul style="list-style-type: none"> • How to Design a Solar PV system • PV System Sizing: Determine Power Consumption demands Size the PV Panels Battery, Inverter, Charge Controller Sizing's System Wiring • Solar PV system Installation Requirements: Permits & Approvals for PV installation Design & Installation checklist 		

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	<ul style="list-style-type: none"> • Line Diagram for Installation • Various Costs involved in Solar PV Project 		
(x)	<p>Installation of Solar Home System Site Assessment</p> <ul style="list-style-type: none"> • Installation of Solar Module • Installation of Charge Controller /Regulator • Installation of Battery • Wiring of Solar Home System Components • Lamp, Switch & Power Socket Installation Procedures • Components Assembly of Solar Home Systems 	12	5
(xi)	<p>Commissioning, Testing and Operation & Maintenance</p> <ul style="list-style-type: none"> • Commissioning: Final Installation checkout Visual Inspection • System Testing & Measurements Testing PV System • Operation & Maintenance:- Monitoring Troubleshooting of PV system & Common Issues • Safety Precautions Site risk & hazard assessment Safety management 	12	5
(xii)	<p>Environmental Impacts of Solar PV system</p> <p>Positive Impacts</p> <ul style="list-style-type: none"> • Air Quality Improvement • Sustainable Source of Energy • Job and Other Economic Benefits • Stable Energy Prices • Reliable Energy System <p>Negative Impacts</p>	6	5

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	<ul style="list-style-type: none"> • Land use, Water use & Natural Resource use • Hazardous Materials & Effects of E-Waste on human body • Life Cycle Global Warming Emissions • Visual Impact • Discharge of Pollutants 		
(xiii)	Recycling of WEEE <ul style="list-style-type: none"> • What about Recycling for Solar PV? :- • Lack of Regulations, Recycling of solar cells, Global experience, Indian Manufacturers, Future of Recycling • Recycle Technology of Solar panels & Batteries • Waste Electrical & Electronic Equipment • Conclusion 		
(xiv)	Basics of Computers Understanding E-Commerce	12	5
(xv)	Geographic Information System (GIS)		
(xvi)	Soft Skills for Entrepreneurs: Public Speaking, Relationship Building, Time etc.		
(xvii)	Practical exercises <ol style="list-style-type: none"> 1. Designing & Sizing of PV systems 2. Identifying & Practicing Various types of tools 3. Mounting Solar Panels, batteries, charge controllers, etc. 4. Practicing Electrical Wiring for ON/OFF Switch with power supply, Cable laying 5. Practicing Series & Parallel 	144 18 24 18 18 (4&5)	5

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	<p>Circuit Connections for Panels, Batteries etc.</p> <p>6. Connecting a Battery, Charge Controller, Inverter & Panels to a Solar System</p> <p>7. Practicing Rewiring/ Replacement of fuse, Soldering, Continuity Tester, Fault identifying</p> <p>8. Practicing usage of Multimeter, Oscilloscope, Energy meter, Wattmeter</p> <p>9. Solar Panel Output: use of multimeter to test Voltage, Current</p> <p>10. Check for Polarity of Solar Panel</p> <p>11. Battery Voltage Testing by use of Multimeter</p> <p>12. Performance of a Solar Panel in a Shade</p> <p>13. Demonstrations from a broken down inverter by identifying the components of the inverter: capacitors, resistors, inductors, diodes transistors on the printed circuit board</p> <p>14. Troubleshooting of PV system & Common Issues</p>	<p>12</p> <p>18 (7&8)</p> <p>12 (9 to 11)</p> <p>6 (12&13)</p> <p>18</p>	
	Sub Total (A)	240	5
	Optional components		
	Title of component and	Estimated size (learning	Level

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	identification code/NOSs/ Learning outcomes	hours)	
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	Sub Total (B)	-	-

Total (A+B)	240	5
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SECTION 1
ASSESSMENT

21	Body/Bodies which will carry out assessment: The assessments will be carried out by the Evaluators of Environment Protection Training and Research Institute (EPTRI), Hyderabad; The Energy and Resources Institute (TERI), Patna; Department of Environment, Chandigarh; Department of Ecology, Environment and Remote Sensing, Government of J&K; Solar Energy Corporation of India (SECI), Ministry of New and Renewable Energy; and other authorised institutes. These evaluators would be chosen from the experts who are not a part of the trainers. Based on the evaluation, certificates will be issued.
22	How will RPL assessment be managed and who will carry it out? No RPL in this programme.
23	Describe the overall assessment strategy and specific arrangements which have been put in place to ensure that assessment is always valid, reliable and fair and show that these are in line with the requirements of the NSQF. The assessment will be done on the basis of theory and practical. Students will be assessed regularly through questionnaires during and on completion of every module in the classroom and one to one interaction. In theory, a final examination will be conducted at the end of the course, in which 50% scoring will be considered to be as qualifying marks. The Assessments will be conducted through English/Hindi Questionnaires. However, the Invigilators (not Trainers/Supervisors) will be empowered to explain/translate the question to the trainees in their regional language, if required.

24. Assessment evidences

Title of Component: Green Skill Development to sustain and enhance technical knowledge in Solar Energy Systems

Outcomes to be assessed	Assessment criteria for the outcome
<p>The trainees will be able to understand:</p> <ul style="list-style-type: none"> - Basics of renewable energy, Importance of Renewable energy, Types of renewable energy - Status of Solar energy in India & Solar resource - Solar energy Conversion - Difference between renewable and non-renewable energy - Effects of the solar energy to atmosphere, global warming and climate change. - Cook stoves concepts - basic concepts of electricity and electric circuits - Basic instruments required to measure electric power - Basic concepts on electromagnetism and Inductance - Electrical cables and wires and their specifications - Insulating material , gauge, continuity tester, soldering etc., - Maintenance and safety rules of cables - Sizing of cables - Knowledge enhancement on conduits, cables, loads etc. - PV Modules and its types - Factors affect the performance of solar panel - Difference between Solar PV and Solar Thermal Systems - Solar Panels, Batteries, Inverter, Charge Controllers - Trackers, Balance of System - Monitoring & Metering - The types of solar systems off-Grid, On-Grid and Hybrid systems - mounting of solar systems- Roof mounted, Ground mounted, Building integrated systems. - Design and sizing of a Solar PV system - Determine Power Consumption demands - Size the PV Panels, Battery, Inverter, Charge Controller, wires. - Sizing System Wiring 	<p>By conducting Evaluation Test-practical exam, skill test (preparation & quality assessment, techniques implemented) and question-answer session/written test.</p>

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- Component requirement, required permits and approvals, line diagram etc.,
- Site survey for PV system installation, design / customization.
- Assessing site conditions for safe installation, identifying load to be connected, preparation of load profile.
- Installation of Solar Module
- Installation of Charge Controller/Regulator
- Installation of Battery
- Wiring of Solar Home System Components
- Lamp, Switch & Power Socket Installation Procedures
- Final installation check out and visual inspection
- Measurements and testing of system
- Operation, maintenance and trouble shooting
- Site risk , hazard assessment and safety management
- How solar energy helps in sustainable development
- Impact of solar energy in the economy- Green economy
- Opportunities and benefits in the Green – economy
- Recycling of expired solar panels and e-waste management, Rules and regulations for recycling of solar cells, Global experience, Indian Manufacturers
- Future of Recycling

Hands on training on

- hands on training on required tools in the installation, operation and maintenance of a solar plant.
- Hand hands on training for sun path diagram and shading analysis.
- Ms- Word
- MS-Excel
- PowerPoint Presentation
- Internet searching and browsing
- E-Commerce
- Basic computer tools and soft wares used in the GIS
- The basics of GIS
- Applications of GIS in the solar energy sector

Soft Skills for Entrepreneurs

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<ul style="list-style-type: none">- Public speaking- Relationship building- Marketing skills- Importance of technical knowledge and communication skills in the marketing	
Means of assessment 1 Theory and Practical exam on field and through Viva-voice	
Means of assessment 2 Set up of relevant and qualitative questions, Multiple Choice Questions (MCQ) for theory assessment. Conducting practical exams on selective Modules	
Pass/Fail The pass mark for Theory exam (Multiple Choice Questionnaire) will be 50 out of 100. In Practical, 75 marks for Practical exam and 25 marks for viva-voce. Pass mark will be 50 marks but in Practical exam. Trainee should score at least 40 marks out of 75.	

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SECTION 2

25. EVIDENCE OF LEVEL

OPTION A

Title/Name of qualification/component: Certificate Course in sustain and enhance technical knowledge in Solar Energy Systems			
			Level: 5
NSQF Domain	Outcomes of the Qualification/Component	How the outcomes relates to the NSQF level descriptors	NSQF Level
Process	Trainees would get the overall understanding and idea of Green Skill development. Solar components are well identified by the Trainees. They can understand the different types of solar devices and assessment of power, customization of solar system and its importance. They learn step-by-step methodology and designing the On-grid, Off-Grid and Hybrid type of connections of a photovoltaic (PV) system. They are able to understand and assess the market needs.	The trainee will able to understand needs of the hour for solar industry. The participants have to complete a design assignment with given site and climatic information, equipment data sheets and economic considerations of the prevailing market. After completion of course, the trainee can independently handle or work as an energy entrepreneur.	5
Professional knowledge	The trainee will attain knowledge of book keeping, taxation and systematic approval towards development of energy entrepreneur. The course meticulously covers the forms of protection used within a PV array, the method of determining whether fault current protection is required and the sizing of fault current protection. Similarly, sizing and selection of DC and AC cabling is also explained, with	Factual knowledge of PV system and its use for livelihood generation would be understood by the trainee. The trainee can calculate loading for solar arrays in different regions. The course not only provides insights of the solar PV system but also helps in assessing the importance of various parameters/ factors that affect the performance of a system.	5

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	several working examples.		
Professional skill	The course covers the foundations/ basic understanding of actual project implementation and design principles of Solar PV. This training bridges the gap between theoretical learning and implementation of knowledge with requisite technical expertise for taking on detailed Solar PV plant designing. The course focuses on on-grid , off-Grid and Hybridized systems.	The trainee would obtain advance skill and technical knowledge and expertise on Solar PV plant designing.	5
Core skill	In terms of core skills acquired, trainees will gain basic knowledge of solar PV system and electrical/ electronic. Computer, GIS, E-commerce and other soft skills knowledge will be an added advantage.	The trainee would obtain the required technical and communication skills to carry out the activities related to documentation of Solar system. Also they will obtain the basic knowledge of computer and other soft skills. The trainee develops the core skill sets required to carry out data collection, analysis as well as statistical validation and interpretation of the datasets.	5
Responsibility	The trainees would be able to independently handle the detailed Solar PV plant designing and installation.	The trainee becomes responsible for his/her own work in the area of Solar PV plant designing and installation.	5

SECTION 3

EVIDENCE OF NEED

<p>26</p>	<p>What evidence is there that the qualification is needed? What is the estimated uptake of this qualification and what is the basis of this estimate?</p>
<p>Basis</p>	<p>In case of other Awarding Bodies (Institutes under Central Ministries and states departments)</p>
<p>Need of the qualification</p>	<p>India has pledged to install an ambitious 100 gigawatts (GW) of solar energy and 60 GW of wind energy by 2022. A widespread shortage of qualified trainers has been identified in all renewable energy sub-sectors, which is considered an impediment to the development of the renewable energy sector. Rapid growth in solar energy applications will lead to higher demand for skilled manpower in solar installation and maintenance.</p>
<p>Industry Relevance</p>	<p>The curriculum/course syllabus has been jointly prepared by the Scientists/Experts in the institutions/Govt. Departments viz. EPTRI, Hyderabad; TERI, Patna; Department of Environment, Chandigarh; and Department of Ecology, Environment and Remote Sensing, Government of J&K, undertaking the course in their respective locations.</p>
<p>Usage of the qualification</p>	<p>The proposed training would create solar energy entrepreneurs in different remote areas also and help to spread the use of renewable energy. This course has been designed under GSDP for the first time.</p>
<p>Estimated uptake</p>	<p>An uptake of 30-35 students per batch at each location.</p>
<p>27</p>	<p>Recommendation from the concerned Line Ministry of the Government/Regulatory Body. To be supported by documentary evidences</p> <p>NA</p>
<p>28</p>	<p>What steps were taken to ensure that the qualification(s) does (do)</p>

	<p>not duplicate already existing or planned qualifications in the NSQF? Give justification for presenting a duplicate qualification</p> <p>National Qualifications Register was searched to assess if there was any similar qualification and it was found that there are QFs relating to the solar sector on NQR. There is a possibility that some of the components of the QFs available on NQR may overlap with the present QF. However, the present course apart from providing training in installation, operation and maintenance of solar energy equipment, also focuses on positive and negative aspects of solar energy in relation to natural and human aspects of the environment. It focuses on how solar energy helps in sustainable development.</p> <p>As per the Paris Agreement, 2015 (COP21), the target is to reduce carbon emissions and limit the global average temperature change. To move forward, there is a need to limit GHG output as the human population only increases and puts more demands on energy infrastructure. To further help the environment and secure the future of the planet for future generations, we need to move to renewable sources for our energy generation. In this context, the course covers the effects of climate change and how solar and renewable energy can help in reducing carbon footprint. It also covers environmental impacts of Solar PV System. In addition, candidates will also obtain the basic knowledge of computer, GIS, E-Commerce and other soft skills.</p>
<p>29</p>	<p>What arrangements are in place to monitor and review the qualification(s)? What data will be used and at what point will the qualification(s) be revised or updated? Specify the review process here</p> <p>Feedback would be taken from experts, students and teachers regarding the course content, structure and timeline of the programme. Feedback will also be taken from the Centres conducting the course. Changes suggested will be assessed by the Ministry before incorporating them in the curriculum. Next review will be done in September 2023.</p>

SECTION 4

EVIDENCE OF PROGRESSION

<p>30</p>	<p>What steps have been taken in the design of this or other qualifications to ensure that there is a clear path to other qualifications in this sector? Show the career map here to reflect the clear progression</p> <p>Solar Operator/Technician – On Job Training – Master Trainers/ Self Employment/ Entrepreneur</p>
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