National Occupational Skill Standard (NOSS)

Occupational Title	: Solar Electric Technician
Level	: 2
Sector	: Renewable Energy Engineering
Sub - Sector	: Solar Photovoltaic (PV)
NOSS ID/NSCO ID	:
ISCO NO	:



Council for Technical Education and Vocational Training

NATIONAL SKILL TESTING BOARD

Madhyapur Thimi-17, Sanothimi, Bhaktapur, Nepal

Developed: 25-12-2023 (09-09-2080)

S.N. Name	Designation	Organization			
1. Prof. Jagan Nath Shrestha	Coordinator	Director, Central for Energy Studies, IOE, Pulchowk President,			
		Nepal Solar Energy Society			
2. Mr. Chandra Bhakta Nakarmi	Member	Director, Skill Testing Division, CTEVT			
3. Mr. Rajendra Adhikari	Member	President, CRE, Bagbazar.			
4. Prof. Dr. Dinesh Sharma	Member	Asst. Dean, IOE, Pulchowk.			
5. Mr. Mohan Gurung	Member	Mechanical Engineer			
6. Mr. Ramesh Kumar Shrestha	Member	Director, Krishna Grill and Engg. Works.			
7. Mr. Babu Raja Shrestha	Member	CRE, Bagbazar.			
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10. Mr. Prem Bahadur Basnet	Member	Alternative Energy Resource Nepal.			
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12. Mr. Satish Gautam	Member	REDP			
13. Mr. Bikash Sharma	Member				
14. Mr. Gyan Ratna Shakya	Member	Dy. Instructor, Dept. Electronics, IOE, Pulchowk.			
15. Mr. Bimal Ghimire	Member	Suryodaya Urja			
16. Mr. Mangal Maharjan	Member	AEPC, Pulchowk			
17. Mr. Raju Bikram Joshi	Member	Kathmandu Power Company			
18. Mr. Yug Ratna Tamrakar	Member	Solar Electricity Company			
19. Mr. Pradip Pant	Member	Lotus Energy			
20. Mr. Jeevan Goff	Member	Lotus Energy			
21. Mr. Chandan Ghosh	Member	Lotus Enegy			
22. Mr. Shreedhar Mohan Ranjit	Member-Secre	tary DyDirector, Skill Testing Division, CTEVT.			
	A	would by the Tripertite National Skill Testing Peard			

The National Skill Standards and test was developed by:

Approved by the Tripartite National Skill Testing Board

1999





The National Skill Standards and test was revised by:

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6.	Mr. Bimal Ghimire	Member	Representative, SEMAN
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8.	Mr. Sri Krishna Maharjan	Member	Representative, SETS
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Sponsored by: AEPC\ESAP/CRE

Approved by the Tripartite National Skill Testing Board

February 2004





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Approved by the Tripartite National Skill Testing Board. December 2010 (2067/068)





The National Skill Standard and Test was Revised by:

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Recommended by Renewable Energy Technical Sub Committee: 25 December 2023 (09 Paush 2080)





1	Occupational Title: Solar Electric Technician
	Level: 2
2	Job Description:
	Solar Electric Technician, L-2 installs and troubleshoots off-grid solar PV system upto 10 kWp, installs and troubleshoot single/three phase on- grid solar PV system upto 10 kWp, installs and troubleshoot solar water pump upto 10 kW and installs and troubleshoot standalone/centralized solar street light.
3	UNITS OF COMPETENCY:
	1. Install and troubleshoot off-grid solar PV system upto 10 kWp
	2. Install and troubleshoot single/three phase on-grid solar PV system upto 10 kWp
	3. Install and troubleshoot solar water pump upto 10 kW
	4. Install and troubleshoot standalone/centralized solar street light
	5. Perform communication
	6. Develop professionalism
	*Note: Units 5 and 6 are not for testing purpose.
	Qualifying Notes/Prerequisites:
4	 Physical Requirements: Sound health
	Entry Requirements: As per NSTB rules
	Additional Information:
	Assessment Types: Performance and Written Test
	 Assessment Duration: 4:00 to 6:00 hours (Single Competency) 8:00 to 10:00 hours (Full Competency)
\wedge	Recommended Group Size: 5 to 7 candidates
TO	NIOSS ID: # Developed Date: 2022-12-25 Revision Number: ## Revised Date: dd/mm/wy Rage:7

5	Unit No: 1 Unit Title: Install and troubleshoot off-grid solar P kWp	PV system upto 10 Unit code:
	Elements of competency	Performance standards
		1.1.1 <i>Personal Protective Equipment (PPE)</i> used in accordance with task requirement.
	1.1 Prepare tool, equipment and materials	1.1.2 Tools, equipment and materials collected as per task requirement.
		1.1.3 Working condition of tools and equipment checked and fault tagged.
		1.2.1 Solar installation area determined in consultation with client or as per drawing.
		1.2.2 <i>Site assessment</i> conducted at peak sun hours for solar installation.
	1.2 Perform site assessment	1.2.3 Solar installation area verified as per the drawing and layout for installation.
		1.2.4 Feedback is provided to client based on-site assessment.
		1.3.1 <i>Mounting structure</i> installed firmly in line and level ensuring to withstand wind
		pressure and wind circulation.
		1.3.2 <i>Components</i> of solar PV system verified and checked for physical damage.
		1.3.3 Open circuit voltage and short circuit current measured in each module and verified
		with manufacturer's specification.
	1.3 Install PV module/array/string	1.3.4 Solar PV module(s)/array/string installed firmly on mounting structure in required
		direction and inclination as per drawing.
		1.3.5 PV module (s) connected in series or parallel as per system design to
		junction/combiner box along with wire conduit.
		1.3.6 Conduit installed and cables laid from junction/combiner box to charge
		controller/inverter through protection devices.





			Location for charge controller identified in consultation with client.				
	1.4 Install charge controller	1.4.2	Charge controller fixed firmly on designated area.				
		1.4.3	Positive and negative terminals of solar PV module(s)/array/string connected to				
			corresponding terminals of charge controller through protection devices.				
			Charge controller connected to DC loads.				
-		1.5.1	Specific gravity and voltage of battery measured and verified as per manufacturer's				
			specification.				
		1.5.2	Batteries placed in well-ventilated area with or without rack.				
		1.5.3	Batteries connected in series or parallel as per wiring diagram.				
		1.5.4	Positive and negative terminals of charge controller connected to corresponding				
	1.5 Install battery bank and solar inverter		terminals of batter bank/pack through protection devices.				
		1.5.5	Inverter firmly fixed on identified location.				
		1.5.6	Positive and negative terminals of battery bank connected to corresponding terminals				
			of inverter through protection devices.				
		1.5.7	Inverter connected to AC loads.				
-			Conduit fixed along marked route.				
			AC/DC cables laid through conduit as per specification.				
		1.6.3	Junction box mounted at shortest distance between charge controller and DC load of				
	1.6 Perform electrical wiring		building.				
			AC/DC wires connected to power sockets and loads as per single/three phase wiring				
			diagram.				
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			1.7.1	Earthing components checked	d and assembled as per manufactu	irer's instruction.		
	1.7 Install earthing and protection devices		1.7.2	Earthing with lightning arrest	or installed as per drawing.			
		and protection devices	1.7.3	Earthing system connected w	ith solar PV system as per drawinន្	J.		
		1.7.4	Protection devices fixed in line and level in designated area.					
			1.7.5	Protection devices connected	Protection devices connected with solar PV system as per wiring diagram.			
-			1.8.1	Solar PV system and individua	I components functionality check	ed as per system		
				design.				
	1.8 Test solar PV sy	ystem	1.8.2	Issues faced during installatio	n rectified.			
			1.8.3	Solar PV system activated as p	per commissioning procedures.			
			1.8.4	Client oriented on operation,	maintenance and cleaning of sola	r PV system.		
-			1.9.1	Fault history collected from clients and recorded as per industry norms.				
			1.9.2	Solar PV system inspected visually for <i>physical damage and abnormal condition</i> .				
			1.9.3	Components of solar PV system cleaned and foreign materials removed.				
			1.9.4	Electrical parameters measured and verified against specification.				
			1.9.5	Monitoring tools/display analyzed for system performance.				
	1.9 Troubleshoot s	olar PV system	1.9.6	Function/performance of major components and overall system output checked as per				
				block diagram or specification	1.			
			1.9.7	Fault and cause of fault identi	fied based on visual inspection an	d test result and		
				recorded as per industry norm	ns.			
			1.9.8	Materials and cost required for	or repair is calculated as per indus	try norms.		
			1.9.9	Wiring fault and electrical pro	oblems fixed as per circuit diagran	1.		
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		1.9.10 Defective components replaced with new components of correct specification.				
		1.9.11 Post repair testing carried out as per checklist and commissioned solar PV system.				
		1.10.1 Tools and equipment cleaned and stored in designated location.				
	1.10 Clean workplace	1.10.2 Unused and leftover materials collected and stored in designated location.				
		1.10.3 Workplace cleaned and waste disposed as per 3R's principle at designated location.				
6	Task Performance Requirements (Tool	s, Equipment and Materials):				
	• Solar PV module(s), connecting	cables (UV Protective), support structure, controller unit, battery, solar inverter, Pyranometer, magnetic				
	compass, multi-contact (MC) con	nnector, inline wire connectors, hammer, screw drivers, pliers, chisel, adjustable wrench, spanners, hacksaw,				
	knife, wire cutters, crimping too	Is, wire strippers, angle meter/set square, measuring tape, level meter, drill machine, battery operated drill				
	machine, hot air gun blower, IR Thermometer, multimeter, clamp on meter, megger, cables/wires, hydrometer, thermocouple, cable clips					
	set of nuts and bolts, cable lug, , heat shrink tube, drift, funnel, plumb bob, elbow, T-jointer, power socket, switches, junction box, bus bar					
	marker, connectors, screws, cli	os, rack, cable tie, conduit, corrugated conduit, PVC tape, petroleum jelly/grease, lightning arrestor, Earth				
	Electrodes, Earthing Strip, Earth	pit, back fill compound, Earth hole drilling machine, protection devices, dust bin, dust pan, broom, first aid				
	kit and Personal protective equi	pment (PPE).				
7	Safety and Hygiene (Occupational Hea	Ith and Safety):				
	Use personal protective equipm	ent.				
	Safe handling of tools, equipme	nt and materials.				
	Prevent from chemical and elect	trical hazards.				



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0	Required Knowledge							
8		Technical Knowledge		Applied	Calculation	Gra	phical Information	on
	 Tools, 0 0 0 0 0 1ntrodu Fundau system Solar P 0 <li0< li=""> <li0< li=""> 0 <l< th=""><th>equipment and materials Types Uses Safe handling Storage uction of solar energy and photovoltaic mentals of standalone, grid connected and hyb ns PV system Introduction Solar geometry Components and their uses Configuration banels Introduction PV modules, array and string Types Mounting position, direction and angle</th><th>orid</th><th>Applied</th><th>Calculation</th><th> Graj Read diag Read diag Read diag </th><th>phical information d and interpret nufacturer's ruction/specificat d and interpret b gram of solar PV s d and interpret s gram d and interpret w gram</th><th>tion lock system inge line /iring</th></l<></li0<></li0<>	equipment and materials Types Uses Safe handling Storage uction of solar energy and photovoltaic mentals of standalone, grid connected and hyb ns PV system Introduction Solar geometry Components and their uses Configuration banels Introduction PV modules, array and string Types Mounting position, direction and angle	orid	Applied	Calculation	 Graj Read diag Read diag Read diag 	phical information d and interpret nufacturer's ruction/specificat d and interpret b gram of solar PV s d and interpret s gram d and interpret w gram	tion lock system inge line /iring
\land	0	Installation and connection					1	TRADE
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	Inverter and a	charge controller						
	o Introd	luction						
	○ Types							
	o Functi	ions						
	Batteries							
	o Introd	luction						
	 Types 							
	o Functi	ions						
	o Electro	olyte level and specific gravity						
	o State	of charge (SoC) and Depth of discharge	(DoD)					
	o Batter	ry temperature						
	○ Life cy	<i>i</i> cle						
	Importance o	f site assessment						
	• Factors of site	e assessment as per geographical locati	on (Roof					
	orientation, o	optimum direction, shading, air circulat	ion,					
	wiring require	ement, and energy needs)						
	Roof prepara	tion and mounting techniques						
	• Fundamental	concept of electricity						
	Electrical parameters (current, resistance, voltage, continuity,							
	power, ampacity)							
^	Electrical wiring, circuit and connection							
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	Cables/wires							
	• Earthing and I	ightning arrestor						
	o Introd	uction						
	o Types							
	o Compo	onents and their function						
	o Install	ation technique						
	o Earth	resistance test						
	Protection de	vices						
	o Introd	uction						
	o Types							
	o Functi	on						
	Testing and co	ommissioning of solar PV system						
	• Dismantling a	nd assembling process						
	• Types and imp	portance of maintenance						
	Servicing tech	nique						
	o Visual	inspection						
	o Cleani	ng						
	o Checki	ing						
	o Leak d	etection						
	o Termi i	nal greasing						
\wedge	o Perfor	mance testing						
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•	Testing and fault diagnose	
•	Repair and maintenance of electrical and mechanical	
	components	
•	Fundamental concept of electricity	
•	Electrical parameters	
•	IP protection	
•	Electrical wiring, circuit and connection	
•	Recent trends in photovoltaic and solar system	
•	Cleaning and waste management	
•	Record keeping and documentation	
•	Importance of first aid	
•	Occupational health and safety rules and regulations	



9			Assessment of Competency				
	Unit: 1						
	Unit Title: Install and t	troubles	hoot off-grid solar PV system_upto 10 kWp				
			Candidate Details		As	ssessors De	tail
	Candidate's Name:			Assessors'	Name		ID/License No:
	Registration Number:			1.			
	Symbol No:			2.			
	Test Centre:		Test Date:	3.			
Ele	ment of competency	of competency Performance Standards		Standard Met	Standard Not Met	Evidence Type	Comments
-		1.1.1	Personal Protective Equipment (PPE) used in accordance				
			with task requirement.				
1.1	Prepare tool,	1.1.2	Tools, equipment and materials collected as per task				
	equipment and materials		requirement.				
		1.1.3	Working condition of tools and equipment checked and				
			fault tagged.				
		1.2.1	Solar installation area determined in consultation with				
1.2	Perform site		client or as per drawing.				
	assessment	1.2.2	Site assessment conducted at peak sun hours for solar				
			installation.				





		1.2.3	Solar installation area verifie	d as per the drawing and					
			layout for installation.						
		1.2.4	Feedback is provided to clier	nt based on-site assessment.					
		1.3.1	Mounting structure installed	firmly in line and level					
			ensuring to withstand wind p	pressure and wind circulation.					
		1.3.2	<i>Components</i> of solar PV syst	em verified and checked for					
			physical damage.						
		1.3.3	Open circuit voltage and sho	rt circuit current measured in					
			each module and verified with	th manufacturer's					
			specification.						
1.3	Install PV	1.3.4	Solar PV module(s)/array/str	ing installed firmly on					
	module/array/string		mounting structure in requir	ed direction and inclination as	5				
			per drawing.						
		1.3.5	PV module (s) connected in s	series or parallel as per system	ı				
			design to junction/combiner	box along with wire conduit.					
		1.3.6	Conduit installed and cables	laid from junction/combiner					
			box to charge controller/inve	erter through protection					
			devices.						
		1.4.1	Location for charge controlle	er identified in consultation					
1.4	Install charge		with client.						
	controller	1.4.2	Charge controller fixed firmly on designated area.						
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		1.4.3	Positive and negative terminals of solar PV		
			module(s)/array/string connected to corresponding		
			terminals of charge controller through protection devices.		
		1.4.4	Charge controller connected to DC loads.		
		1.5.1	Specific gravity and voltage of battery measured and		
			verified as per manufacturer's specification.		
		1.5.2	Batteries placed in well-ventilated area with or without		
			rack.		
		1.5.3	Batteries connected in series or parallel as per wiring		
			diagram.		
1.5	Install battery bank	1.5.4	Positive and negative terminals of charge controller		
	and solar inverter		connected to corresponding terminals of batter bank/pack		
			through protection devices.		
		1.5.5	Inverter firmly fixed on identified location.		
		1.5.6	Positive and negative terminals of battery bank connected		
			to corresponding terminals of inverter through protection		
			devices.		
		1.5.7	Inverter connected to AC loads.		
1.6	Perform electrical	1.6.1	Conduit fixed along marked route.		
wiring	wiring	1.6.2	AC/DC cables laid through conduit as per specification.		





		1.6.3	Junction box mounted at shortest distance between		
			charge controller and DC load of building.		
		1.6.4	AC/DC wires connected to power sockets and loads as per		
			single/three phase wiring diagram.		
		1.7.1	Earthing components checked and assembled as per		
			manufacturer's instruction.		
		1.7.2	Earthing with lightning arrestor installed as per drawing.		
		1.7.3	Earthing system connected with solar PV system as per		
1.7 Install earthing and	Install earthing and		drawing.		
	protection devices	1.7.4	Protection devices fixed in line and level in designated		
			area.		
		1.7.5	Protection devices connected with solar PV system as per		
			wiring diagram.		
		1.8.1	Solar PV system and individual components functionality		
			checked as per system design.		
		1.8.2	Issues faced during installation rectified.		
1.8	Test solar PV system	1.8.3	Solar PV system activated as per commissioning		
			procedures.		
		1.8.4	Client oriented on operation, maintenance and cleaning of		
			solar PV system.		





	1.9.1	Fault history collected from	clients and recorded as per			
		industry norms.				
	1.9.2	Solar PV system inspected vi	sually for physical damage			
		and abnormal condition.				
	1.9.3	Components of solar PV syst	em cleaned and foreign			
		materials removed.				
	1.9.4	Electrical parameters measu	ured and verified against			
		specification.				
	1.9.5	Monitoring tools/display and	alyzed for system			
		performance.				
1.9 Troubleshoot solar PV	1.9.6	Function/performance of ma	ajor components and overall			
system		output checked as per block	diagram or specification.			
	1.9.7	Fault and cause of fault iden	tified based on visual			
		inspection and test result an	d recorded as per industry			
		norms.				
	1.9.8	Materials and cost required	for repair is calculated as per			
		industry norms.				
	1.9.9	Wiring fault and electrical p	roblems fixed as per circuit			
		diagram.				
	1.9.10	Defective components repla	ced with new components of			
		correct specification.				
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	1.9.11 Post repair testing carried out as per checklist and
	commissioned solar PV system.
	1.10.1 Tools and equipment cleaned and stored in designated
	location.
	1.10.2 Unused and leftover materials collected and stored in
1.10 Clean workplace	designated location.
	1.10.3 Workplace cleaned and waste disposed as per 3R's
	principle at designated location.

WT- Written Test	OQ- Oral Question	PT- Practical Test	DO – Direct Observation	SR- Supervisor's report	SN –Simulation
RP - Role Play	PG – Photographs	VD - Video	CT – Certificates	TS – Testimonials (Reward)	PP – Product Produced

CS – Case Study





Range Statement

Variable		Range		
Personal protective equipment	May include but not limited to: Mask Apron Gloves Safety shoes Safety belt Helmet			
Site assessment	May include but not limited to: Roof/ground orientation/d Shading Available space for other co Wiring requirement 	irection/solar geometry omponents		
Mounting structure	May include but not limited to: Frame Pole			
Components NOSS ID: # Developed Date: 2023-12-25	May include but not limited to: PV modules/array/string Solar inverter Charge controller Battery Protection devices Revision Number: ##	ed Date: dd/mm/yy	Page:22	

	DC-DC convertors Combiner box
Protection devices	May include but not limited to:
	Surge Protection Device (SPD)
	Transient Voltage Suppressor (TVS)
	Miniature Circuit Breaker (MCB)
	Moulded Case Circuit Breaker (MCCB)
	AC/DC fuse
	High Rupturing Current (HRC) fuse
Issues	May include but not limited to:
	Electrical connection problem
	Malfunctioning of components
	Mechanical fixtures
Physical damage and abnormal condition	May include but are not limited to:
	• Leak
	Wear and tear
	Crack
	Loose support
	Position, direction and inclination of panel
	Array orientation and tilt
	Disconnection
	Broken or damaged wiring
	Broken wires and dirty connection
	Blown fuse or tripped



	 Loose connection Potential Induced Degradation (PID) Soiling Hotspots Micro cracks Electrical system Shading 							
Electrical parameters	May include but not limited to: Voltage Resistance Continuity Current Capacitance Voltage drop Short circuit Open circuit System output (Power/energy)							
Wiring fault	May include but not limited to: Broken wires Loose connection Short circuit Earth fault							
3R's principle	May include but not limited to: • Reduce • Reuse • Recycle							
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5	Unit No: 2 Unit Title: Install and troubleshoot single/three p system upto 10 kWp	hase on gird solar PV Unit code:
	Elements of competency	Performance standards
		2.1.1 <i>Personal Protective Equipment (PPE)</i> used in accordance with task requirement.
	2.1 Prepare tool, equipment and materials	2.1.2 Tools, equipment and materials collected as per task requirement.
		2.1.3 Working condition of tools and equipment checked and fault tagged.
		2.2.1 Solar installation area determined in consultation with client or as per drawing.
		2.2.2 Site assessment conducted at peak sun hours for solar installation.
	2.2 Perform site assessment	2.2.3 Solar installation area verified as per the drawing and marked/layout for installation.
		2.2.4 Feedback is provided to client based on-site assessment.
		2.3.1 <i>Mounting structure</i> installed firmly in line and level ensuring to withstand wind
		pressure and wind circulation.
		2.3.2 <i>Components</i> of solar PV system verified and checked for physical damage.
		2.3.3 Open circuit voltage and short circuit current measured of each module and verified
	2.3 Install PV module/array/string	with manufacturer's specification.
		2.3.4 Solar PV module(s)/array/string installed firmly on mounting structure in required
		direction and inclination as per drawing.
		2.3.5 PV module (s) connected in series or parallel as per system design to
		junction/combiner box through protection devices along with wire conduit.





			2.3.6	Conduit installed and cables I	aid from junction/combiner box to	grid-tied inverter	
				through protection devices.			
-			2.4.1	Grid-tied inverter firmly fixed	on identified location.		
			2.4.2	Positive and negative termina	als from junction/combiner box co	nnected to	
	2.4 Install solar gri	d-tied inverter		corresponding terminals of gr	id-tied inverter through protection	n devices.	
			2.4.3	Grid-tied inverter connected	through smart meter to NEA natio	nal grid as per NEA	
				regulation.			
-			2.5.1	Conduit fixed along marked re	oute.		
			2.5.2	DC/AC cables laid through co	nduit as per specification.		
	2.5 Perform electr	ical wiring	2.5.3	Junction box mounted at sho	rtest distance between solar PV m	odules and grid-tied	
				inverter.			
			2.6.1	Earthing components checked	d and assembled as per manufactu	rer's instruction.	
			2.6.2	Earthing with lightning arrest	or installed as per drawing.		
	2.6 Install earthing	and protection devices	2.6.3	Earthing system connected w	ith solar PV system as per drawing		
			2.6.4	Protection devices fixed in lin	e and level in designated area.		
			2.6.5	Protection devices connected	l with solar PV system as per wirin	g diagram.	
			2.7.1	Solar PV system and individua	al components functionality checke	ed as per system	
				design.			
	2.7 Test solar PV s	ystem	2.7.2	Issues faced during installation	n rectified.		
			2.7.3	Solar PV system activated as	per commissioning procedures.		
^			2.7.4	Client oriented on operation, maintenance and cleaning of solar PV system.			
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	2.8.1	Fault history collected from clients and recorded as per industry norms.
	2.8.2	Solar PV system inspected visually for <i>physical damage and abnormal condition</i> .
	2.8.3	Components of solar PV system cleaned and foreign materials removed.
	2.8.4	Electrical parameters measured and verified against specification.
	2.8.5	Monitoring tools/display analyzed for system performance.
	2.8.6	Function/performance of major components and overall system output checked as per
2.8 Troubleshoot solar PV system		block diagram or specification.
	2.8.7	Fault and cause of fault identified based on visual inspection and test result and
		recorded as per industry norms.
	2.8.8	Materials and cost required for repair is calculated as per industry norms.
	2.8.9	Wiring fault and electrical problems fixed as per circuit diagram.
	2.8.10	Defective components replaced with new components of correct specification.
	2.8.11	Post repair testing carried out as per checklist and commissioned solar PV system.
	2.9.1	Tools and equipment cleaned and stored in designated location.
2.9 Clean workplace	2.9.2	Unused and leftover materials collected and stored in designated location.
	2.9.3	Workplace cleaned and waste disposed as per 3R's principle at designated location.
	2.8 Troubleshoot solar PV system 2.9 Clean workplace	2.8.1 2.8.2 2.8.3 2.8.4 2.8.5 2.8.6 2.8 Troubleshoot solar PV system 2.8.7 2.8.8 2.8.9 2.8.10 2.8.10 2.8.11 2.9.1 2.9.1 2.9.1 2.9.2 2.9.3

6 Task Performance Requirements (Tools, Equipment and Materials):

• Solar PV module(s), connecting cables (UV Protective), support structure, grid-tied inverter, Pyranometer, magnetic compass, MC connector, hammer, screw drivers, pliers, chisel, adjustable wrench, spanners, hacksaw, knife, wire cutter, crimping tools, wire strippers, angle meter/set square, measuring tape, level meter, drill machine, battery operated drill machine, hot air gun blower, IR thermometer, multimeter, clamp





	on meter, megger, cables/wires, cable clips, galvanized/stainless steel nuts and bolts, cable lug, heat shrink tube, drift, funnel, elbow, T-
	jointer, power socket, switches, junction box, bus bar, inline cable connectors, marker, connectors, screws, clips, rack, cable tie, conduit,
	corrugated conduit, PVC tape, petroleum jelly/grease, lightning arrestor, Earth Electrodes, Earthing Strip, Earth pit, back fill compound, Earth
	hole drilling machine, protection devices, dust bin, dust pan, broom, first aid kit and Personal protective equipment (PPE).
7	Safety and Hygiene (Occupational Health and Safety):
	Use personal protective equipment.
	Safe handling of tools, equipment and materials.
	Prevent from chemical and electrical hazards.





•		Requir	ed Knowledge				
8	Technical Knowledge		Applied	Calculation	Gra	aphical Informatio	'n
	 Tools, equipment and materials Types Uses Safe handling Storage Introduction of solar energy and photovoltaic Fundamentals of standalone, grid connected and hybesystems Solar PV system Introduction Components and their uses Configuration Solar panels Introduction PV modules, array and string Types Mounting location and orientation (pitch, azirrangle and optimum direction) 	nuth	Αρριιο	Calculation	 Rea ma inst Rea dia; Rea dia; Rea dia; 	ad and interpret nufacturer's truction/specificat ad and interpret bl gram of solar PV s ad and interpret si gram ad and interpret w gram	ion ock ystem nge line iring
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	Grid-tied inve	rter						
	o Introd	uction						
	 Types 							
	o Functio	ons						
	 Islanding/anti 	-islanding features						
	Importance of	f site assessment						
	• Factors of site	assessment (Roof orientation, direc	tion,					
	shading, wirin	g requirement and energy needs)						
	Roof preparat	ion and mounting techniques						
	• Fundamental	concept of electricity						
	Electrical para	meters (current, resistance, voltage,	continuity,					
	power, ampac	city)						
	Electrical wirin	ng, circuit and connection						
	Cables/wires							
	• Earthing and I	ightning arrestor						
	o Introd	uction						
	 Types 							
	o Compo	onents and their function						
	o Installa	ation technique						
	Protection dev	vices						
\wedge	o Introd	uction						-
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	 Types 					
	o Function					
	NEA Smart meter					
	• Testing and commissioning of solar PV system					
	Dismantling and assembling process					
	Types and importance of maintenance					
	Servicing technique					
	 Visual inspection 					
	o Cleaning					
	o Checking					
	 Leak detection 					
	 Terminal greasing 					
	 Performance testing 					
	Testing and fault diagnose					
	Repair and maintenance of electrical and mechanical					
	components					
	Recent trends in photovoltaic and solar system					
	Cleaning and waste management					
	Record keeping and documentation					
	Importance of first aid and first aid kit					
\wedge	 Occupational health and safety rules and regulations 					CIEVA
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9	Assessment of Competency								
	Unit: 2								
	Unit Title: Install and t								
			Candidate Details		A	ssessors De	tail		
	Candidate's Name:			Assessors'	Name		ID/License No:		
	Registration Number:			1.					
	Symbol No:			2.					
	Test Centre:		Test Date:	3.					
Ele	ment of competency		Performance Standards		Standard Not Met	Evidence Type	Comments		
		2.1.1	Personal Protective Equipment (PPE) used in accordance						
			with task requirement.						
2.1	Prepare tool,	2.1.2	Tools, equipment and materials collected as per task						
	equipment and materials		requirement.						
		2.1.3	Working condition of tools and equipment checked and						
			fault tagged.						
		2.2.1	Solar installation area determined in consultation with						
2.2	Perform site		client or as per drawing.						
	assessment	2.2.2	Site assessment conducted at peak sun hours for solar						
			installation.						





		2.2.3	Solar installation area verified as per the drawing and		
			marked/layout for installation.		
		2.2.4	Feedback is provided to client based on-site assessment.		
		2.3.1	Mounting structure installed firmly in line and level		
			ensuring to withstand wind pressure and wind circulation.		
		2.3.2	Components of solar PV system verified and checked for		
			physical damage.		
		2.3.3	Open circuit voltage and short circuit current measured of		
			each module and verified with manufacturer's		
			specification.		
2.3	Install PV	2.3.4	Solar PV module(s)/array/string installed firmly on		
	module/array/string		mounting structure in required direction and inclination as		
			per drawing.		
		2.3.5	PV module (s) connected in series or parallel as per system		
			design to junction/combiner box through protection		
			devices along with wire conduit.		
		2.3.6	Conduit installed and cables laid from junction/combiner		
			box to grid-tied inverter through protection devices.		
2.4	Install solar grid-tied inverter	2.4.1	Grid-tied inverter firmly fixed on identified location.		





		2.4.2	Positive and negative termin	als from junction/combiner					
			box connected to correspon	ding terminals of grid-tied					
			inverter through protection	devices.					
		2.4.3	Grid-tied inverter connected	l through smart meter to NEA					
			national grid as per NEA regu	ulation.					
		2.5.1	Conduit fixed along marked	route.					
2.5	Perform electrical	2.5.2	DC/AC cables laid through co	onduit as per specification.					
	wiring	2.5.3	Junction box mounted at sho	ortest distance between solar					
			PV modules and grid-tied inv	verter.					
		2.6.1	Earthing components checke	ed and assembled as per					
			manufacturer's instruction.						
		2.6.2	Earthing with lightning arres	tor installed as per drawing.					
		2.6.3	Earthing system connected v	with solar PV system as per					
2.6	Install earthing and		drawing.						
	protection devices	2.6.4	Protection devices fixed in li	ne and level in designated					
			area.						
		2.6.5	Protection devices connecte	d with solar PV system as per					
			wiring diagram.						
		2.7.1	Solar PV system and individu	al components functionality					
2.7	Test solar PV system		checked as per system desig	n.					
		2.7.2	Issues faced during installati	on rectified.					
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		2.7.3	Solar PV system activated as per commissioning		
			procedures.		
		2.7.4	Client oriented on operation, maintenance and cleaning of		
			solar PV system.		
		2.8.1	Fault history collected from clients and recorded as per		
			industry norms.		
		2.8.2	Solar PV system inspected visually for physical damage and		
			abnormal condition.		
		2.8.3	Components of solar PV system cleaned and foreign		
			materials removed.		
		2.8.4	Electrical parameters measured and verified against		
2.8	Troubleshoot solar PV		specification.		
	system	2.8.5	Monitoring tools/display analyzed for system		
			performance.		
		2.8.6	Function/performance of major components and overall		
			system output checked as per block diagram or		
			specification.		
		2.8.7	Fault and cause of fault identified based on visual		
			inspection and test result and recorded as per industry		
			norms.		





		2.8.8	Materials and cost required for repair is calculated as per		
			industry norms.		
		2.8.9	Wiring fault and electrical problems fixed as per circuit		
			diagram.		
		2.8.10	Defective components replaced with new components of		
			correct specification.		
		2.8.11	Post repair testing carried out as per checklist and		
			commissioned solar PV system.		
		2.9.1	Tools and equipment cleaned and stored in designated		
			location.		
		2.9.2	Unused and leftover materials collected and stored in		
2.9	Clean workplace		designated location.		
		2.9.3	Workplace cleaned and waste disposed as per 3R's		
			<i>principle</i> at designated location.		

WT- Written Test	OQ - Oral Question	PT- Practical Test	DO – Direct Observation	SR- Supervisor's report	SN–Simulation
RP - Role Play	PG – Photographs	VD - Video	CT – Certificates	TS – Testimonials (Reward)	PP – Product Produced
CS – Case Study					





Range Statement

Variable	Range
Personal protective equipment	May include but not limited to:
	• Mask
	Apron
	Gloves
	Safety shoes
	Safety belt
	Helmet
Site assessment	May include but not limited to:
	 Roof/ground orientation/direction/solar geometry
	Shading
	Available space for other components
	Wiring requirement
Mounting structure	May include but not limited to:
	Frame
	Pole
Components	May include but not limited to:
	PV modules/arrav/string
	Grid-tied inverter
	Protection devices





Protection devices	 May include but not limited to: Surge Protection Device (SPD) Transient Voltage Suppressor (TVS) Miniature Circuit Breaker (MCB) Moulded Case Circuit Breaker (MCCB) AC/DC fuse High Rupturing Capacity (HRC) fuse
lssues	 May include but not limited to: Electrical connection problem Malfunctioning of components Mechanical fixtures Islanding/Anti-islanding
Physical damage and abnormal condition	 May include but are not limited to: Leak Wear and tear Crack Loose support Position, direction and inclination of panel Array orientation and tilt Disconnection Broken or damaged wiring Broken wires and dirty connection Blown fuse or tripped Loose connection



	Potential Induced Deg	gradation (PID)		
	Soiling			
	Hotspots			
	Micro cracks			
	Electrical system			
	Shading			
Electrical parameters	May include but not limited to:			
	Voltage			
	Resistance			
	Continuity			
	Current			
	Capacitance			
	Voltage drop			
	Short circuit			
	Open circuit			
	System output (Powe	er/energy)		
Wiring fault	May include but not limited to:			
	Broken wires			
	Loose connection			
	Short circuit			
	Earth fault			
3R's principle	May include but not limited to:			
	Reduce			
	• Reuse			
\wedge	Recycle			-
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5	Unit No: 3 Unit Title: Install and troubleshoot solar water p	oump upto	o 10 kW	Unit code:			
	Elements of competency				Performance standards		
		3.1.1	Personal Prot	ective Equipn	nent (PPE) used in accordance w	vith task requirement.	
	3.1 Prepare tool, equipment and materials	3.1.2	Tools, equipm	ent and mate	rials collected as per task requir	ement.	
		3.1.3	Working conc	ition of tools	and equipment checked and fau	ılt tagged.	
		3.2.1	Solar installat	on area deter	rmined in consultation with clier	nt or as per drawing.	
		3.2.2	Site assessme	nt conducted	at peak sun hours for solar insta	allation.	
		3.2.3	Draw down le	vel of PV pum	np verified.		
	3.2 Perform site assessment	3.2.4	Solar PV and J	oump compon	nents installation area verified as	s per the drawing and	
			marked/layou	t for installati	on.		
		3.2.5	Feedback is p	ovided to clie	ent based on-site assessment.		
		3.3.1	Mounting str	icture installe	ed firmly in line and level ensurir	ng to withstand wind	
			pressure and	wind circulation	on.		
		3.3.2	Components	of solar PV sys	stem verified and checked for ph	nysical damage.	
		3.3.3	Open circuit v	oltage and sh	ort circuit current measured of	each module and verified	ed
	3.3 Install PV module/array/string		with manufac	turer's specifi	cation.		
		3.3.4	Solar PV mod	ule(s)/array/st	tring installed firmly on mountir	g structure in required	
			direction and	inclination as	per drawing.		
		3.3.5	PV module (s)	connected in	series or parallel as per system	design to	
			junction/com	oiner box alor	ng with wire conduit through pro	otection devices.	
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			3.3.6	Conduit installed and cables la	aid from junction/combiner box to	o variable frequenc	су
				drive (VFD)/controller unit thr	ough protection devices.		
			3.4.1	Location for VFD/controller ur	nit identified in consultation with	client.	
			3.4.2	VFD/controller unit fixed firm	ly on designated area.		
	3.4 Install VFD and	d controller unit	3.4.3	Positive and negative termina	ls of solar PV module(s)/array/str	ing connected to	
				corresponding terminals of VF	D/controller unit through protect	tion devices.	
-			3.5.1	AC/DC PV pump and compone	ents verified as per specification.		
			3.5.2	PV pump installed as per draw	ving.		
	3.5 Install PV wate	er pump	3.5.3	Terminals of pump connected	to corresponding terminals of VF	D/controller unit	
				through protection devices as	per drawing.		
			3.6.1	Conduit fixed along marked ro	oute.		
	3.6 Perform electr	rical wiring	3.6.2	AC/DC cables laid through cor	nduit as per specification.		
			3.6.3	Junction box mounted at shor	test distance between VFD/contr	oller unit to pump.	
			3.7.1	Earthing components checked	l and assembled as per manufactu	urer's instruction.	
			3.7.2	Earthing with lightning arresto	or installed as per drawing.		
	3.7 Install earthing	g and protection devices	3.7.3	Earthing system connected wi	ith solar PV water pump system a	s per drawing.	
			3.7.4	Protection devices fixed in line	e and level in designated area.		
			3.7.5	Protection devices connected	with solar PV water pump system	n as per wiring diag	gram.
			3.8.1	Solar PV water pump system a	and individual components function	onality checked as	per
	3.8 Test solar PV w	vater pump system		system design.			
^			3.8.2	Issues faced during installation	n rectified.		م الار.
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	3.8.3	Solar PV water pump system activated as per commissioning procedures.
	3.8.4	Client oriented on operation, maintenance and cleaning of solar PV water pump
		system.
	3.9.1	Fault history collected from clients and recorded as per industry norms.
	3.9.2	Solar PV system inspected visually for <i>physical damage and abnormal condition</i> .
	3.9.3	Components of solar PV system cleaned and foreign materials removed.
	3.9.4	Electrical parameters measured and verified against specification.
	3.9.5	Monitoring tools/display analyzed for system performance.
	3.9.6	Function/performance of major components and overall system output checked as per
3.9 Troubleshoot solar PV water pump system		block diagram or specification.
	3.9.7	Fault and cause of fault identified based on visual inspection and test result and
		recorded as per industry norms.
	3.9.8	Materials and cost required for repair is calculated as per industry norms.
	3.9.9	Wiring fault and electrical problems fixed as per circuit diagram.
	3.9.10	Defective components replaced with new components of correct specification.
	3.9.11	Post repair testing carried out as per checklist and commissioned solar PV system.
	3.10.1	Tools and equipment cleaned and stored in designated location.
3.10 Clean workplace	3.10.2	Unused and left over materials collected and stored in designated location.
	3.10.3	Workplace cleaned and waste disposed as per 3R's principle at designated location.





6	Task Performance Requirements (Tools, Equipment and Materials):
	• Solar PV module(s), connecting cables (UV Protective), support structure, VFD, controller unit, water pump, check valve, Pyranometer,
	magnetic compass, MC connector, waterproof inline cable connectors, hammer, screw drivers, pliers, chisel, adjustable wrench, spanners,
	hacksaw, knife, wire cutter, crimping tools, wire strippers, angle meter/set square, measuring tape, level meter, drill machine, battery
	operated drill machine, hot air gun blower, IR thermometer, multimeter, clamp on meter, megger, cables/wires, thermocouple, cable clips,
	galvanized/stainless steel nuts and bolts, cable lug, heat shrink tube, drift, funnel, plumb bob, elbow, T-jointer, power socket, switches,
	junction box, bus bar, marker, connectors, screws, clips, rack, cable tie, conduit, corrugated conduit, PVC tape, Teflon tape, petroleum
	jelly/grease, lightning arrestor, Earth Electrodes, Earthing Strip, Earth pit, back fill compound, tool for drilling hole in the ground, protection
	devices, dust bin, dust pan, broom, first aid kit and Personal protective equipment (PPE).
7	Safety and Hygiene (Occupational Health and Safety):
	Use personal protective equipment.
	Safe handling of tools, equipment and materials.
	Prevent from chemical and electrical hazards.





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	Technical Knowledge		Applied	Calculation	Gra	phical Informat	ion
 Tools, equipm Types Uses Safe hat Storage Introduction of Solar PV syste Introduction of Composition Composition 	ent and materials andling e of solar energy and photovoltaic m uction onents and their uses				 Rea mar inst Rea diag Rea diag Rea diag 	d and interpret nufacturer's ruction/specific d and interpret gram of solar PV d and interpret gram d and interpret gram	ation block ' system singe line wiring
 Config Solar panels Introdu PV mo Types Mount Installa Variable freque Introdu Types 	uration uction dules, array and string ing position, direction and angle ation and connection ency drive and controller unit uction						CLEVA
	 Tools, equipm Types Uses Safe hat Safe hat Storage Introduction of Solar PV system Introdution of Solar panels Configu Solar panels Introdution of Types Mount Installat Variable frequt Introdut Types 	 Technical Knowledge Tools, equipment and materials Types Uses Safe handling Storage Introduction of solar energy and photovoltaic Solar PV system Introduction Components and their uses Configuration Solar panels Introduction PV modules, array and string Types Mounting position, direction and angle Installation and connection Variable frequency drive and controller unit Introduction Types 	Technical Knowledge Tools, equipment and materials Types Uses Safe handling Storage Introduction of solar energy and photovoltaic Solar PV system Introduction Components and their uses Configuration Solar panels Introduction PV modules, array and string Types Mounting position, direction and angle Installation and connection Variable frequency drive and controller unit Introduction Types Moss ID: # Developed Date: 2023-12-25 Revision Notes and N	Technical Knowledge Applied • Tools, equipment and materials • Types • Uses • Uses • Safe handling • Storage • Introduction of solar energy and photovoltaic • Solar PV system • Introduction • Components and their uses • Configuration • Configuration • Solar panels • Introduction • Introduction • Introduction • Solar panels • Introduction • Introduction • PV modules, array and string • Types • Mounting position, direction and angle • Installation and connection • Installation and controller unit • Introduction • Types	Technical Knowledge Applied Calculation • Tools, equipment and materials • Types • Uses • Uses • Safe handling • Storage • Introduction of solar energy and photovoltaic • Introduction • Solar PV system • Introduction • Introduction • Components and their uses • Configuration • Configuration • Solar panels • Introduction • Introduction • PV modules, array and string • Types • Mounting position, direction and angle • Installation and connection • Variable frequency drive and controller unit • Introduction • Introduction • Types • Mounting position, direction and angle • Installation and connection • Introduction • Introduction • Introduction • Introduction • Introduction • Installation and connection • Revision Number: ##	Technical Knowledge Applied Calculation Grave • Tools, equipment and materials • Rea mail • Types Uses mail • Uses Safe handling Rea • Storage storage diag • Introduction of solar energy and photovoltaic Rea diag • Solar PV system Introduction Rea • Introduction Components and their uses Rea • Configuration Solar panels Introduction • Introduction PV modules, array and string Rea • Installation and connection Installation and connection Fequency drive and controller unit • Introduction Installation and connection Revised Date: 2023-12-25	Technical Knowledge Applied Calculation Graphical Informat • Tools, equipment and materials • Read and interpret manufacturer's • Uses • Uses instruction/specific • Safe handling • Storage • Read and interpret • Introduction of solar energy and photovoltaic • Read and interpret diagram of solar PV • Introduction • Introduction • Read and interpret diagram • Components and their uses • Configuration • Read and interpret diagram • Solar pnels • Introduction • Read and string • Read and interpret • Introduction • PV modules, array and string • Installation and connection • Variable frequency drive and controller unit • Introduction • Introduction • Introduction • Introduction • Introduction • PV modules, array and string • Installation and connection • Variable frequency drive and controller unit • Introduction • Introduction • Introduction • Introduction • Introduction • Revision Number: ## Revised Date: dd/mm/yy Page:44

	• Functions					
	Solar water pump					
	o Introduction					
	 Surface and submersible water pump 					
	• Functions					
	 Water volume, head discharge and suction 					
	 Draw down level/static and dynamic level 					
	Importance of site assessment					
	Factors of site assessment					
	Fundamental concept of electricity					
	• Electrical parameters (current, resistance, voltage, co	ntinuity,				
	power, ampacity)					
	Electrical wiring, circuit and connection					
	Cables/wires					
	Earthing and lightning arrestor					
	o Introduction					
	o Types					
	 Components and their function 					
	 Installation technique 					
	Protection devices					
\wedge	o Introduction					.
$\langle \rangle \langle$	NOSS ID: # Developed Date: 2023-12-25	Revision Number: ##	Revised Date: dd/mm	/уу	Page:45	

 Types
o Function
• Testing and commissioning of solar PV water pump system
 Dismantling and assembling process
Types and importance of maintenance
Servicing technique
 Visual inspection
o Cleaning
o Checking
 Leak detection
 Terminal greasing
 Performance testing
Testing and fault diagnose
Repair and maintenance of electrical and mechanical
components
Recent trends in photovoltaic and solar system
Cleaning and waste management
Record keeping and documentation
Importance of first aid
 Occupational health and safety rules and regulations





9	Assessment of Competency										
	Unit: 3										
	Unit Title: Install and troubleshoot solar water pump upto 10 kW										
			Candidate Details			A	ssessors De	tail			
	Candidate's Name:				Assessors'	Name		ID/License No:			
	Registration Number:				1.						
	Symbol No:				2.						
	Test Centre:			Test Date:	3.						
Ele	lement of competency Performance Standards				Standard Met	Standard Not Met	Evidence Type	Comments			
		3.1.1	Personal Protective Equipm	ent (PPE) used in accordance							
			with task requirement.								
3.1	Prepare tool,	3.1.2	Tools, equipment and mater	rials collected as per task							
	equipment and materials		requirement.								
		3.1.3	Working condition of tools a	and equipment checked and							
			fault tagged.								
		3.2.1	Solar installation area deter	mined in consultation with							
			client or as per drawing.								
3.2	Perform site	3.2.2	Site assessment conducted	at peak sun hours for solar							
	assessment		installation.								
		3.2.3	Draw down level of PV pum	p verified.							
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		3.2.4	Solar PV and pump compone	ents installation area verified					
			as per the drawing and mark	ed/layout for installation.					
		3.2.5	Feedback is provided to clier	nt based on-site assessment.					
		3.3.1	Mounting structure installed	firmly in line and level					
			ensuring to withstand wind	pressure and wind circulation.					
		3.3.2	<i>Components</i> of solar PV syst	em verified and checked for					
			physical damage.						
		3.3.3	Open circuit voltage and sho	rt circuit current measured of					
			each module and verified wi	th manufacturer's					
			specification.						
2.2	Install PV module/array/string	3.3.4	Solar PV module(s)/array/str	ring installed firmly on					
5.5			mounting structure in requir	ed direction and inclination as	5				
			per drawing.						
		3.3.5	PV module (s) connected in s	series or parallel as per system	1				
			design to junction/combiner	box along with wire conduit					
			through protection devices.						
		3.3.6	Conduit installed and cables	laid from junction/combiner					
			box to variable frequency dr	ive (VFD)/controller unit					
			through protection devices.						
3 /	Install VED and	3.4.1	Location for VFD/controller	unit identified in consultation					
5.4	controller unit		with client.						
									CTEVA
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		3.4.2	VFD/controller unit fixed firmly on designated area.		
		3.4.3	Positive and negative terminals of solar PV		
			module(s)/array/string connected to corresponding		
			terminals of VFD/controller unit through protection		
			devices.		
		3.5.1	AC/DC PV pump and components verified as per		
			specification.		
		3.5.2	PV pump installed as per drawing.		
3.5	Install PV water pump	3.5.3	Terminals of pump connected to corresponding terminals		
			of VFD/controller unit through protection devices as per		
			drawing.		
		3.6.1	Conduit fixed along marked route.		
3.6	Perform electrical	3.6.2	AC/DC cables laid through conduit as per specification.		
	wiring	3.6.3	Junction box mounted at shortest distance between		
			VFD/controller unit to pump.		
		3.7.1	Earthing components checked and assembled as per		
			manufacturer's instruction.		
3.7	Install earthing and	3.7.2	Earthing with lightning arrestor installed as per drawing.		
	protection devices	3.7.3	Earthing system connected with solar PV water pump		
			system as per drawing.		





		3.7.4	Protection devices fixed in li	ne and level in designated					
			area.						
		3.7.5	Protection devices connecte	d with solar PV water pump					
			system as per wiring diagran	n.					
		3.8.1	Solar PV water pump system	and individual components					
			functionality checked as per	system design.					
		3.8.2	Issues faced during installati	on rectified.					
3.8	Test solar PV water	3.8.3	Solar PV water pump system	activated as per					
	pump system		commissioning procedures.						
		3.8.1	Client oriented on operation	, maintenance and cleaning of	f				
			solar PV water pump system	I.					
		3.9.1	Fault history collected from	clients and recorded as per					
			industry norms.						
		3.9.2	Solar PV system inspected vi	sually for physical damage					
			and abnormal condition.						
3 0	Troubleshoot solar PV	3.9.3	Components of solar PV syst	em cleaned and foreign					
5.5	water pump system		materials removed.						
		3.9.4	Electrical parameters measu	ured and verified against					
			specification.	pecification.					
		3.9.5	Monitoring tools/display and	alyzed for system					
			performance.						
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	3.9.6	Function/performance of major components and overall		
		system output checked as per block diagram or		
		specification.		
	3.9.7	Fault and cause of fault identified based on visual		
		inspection and test result and recorded as per industry		
		norms.		
	3.9.8	Materials and cost required for repair is calculated as per		
		industry norms.		
	3.9.9	Wiring fault and electrical problems fixed as per circuit		
		diagram.		
	3.9.10	Defective components replaced with new components of		
		correct specification.		
	3.9.11	Post repair testing carried out as per checklist and		
		commissioned solar PV system.		
	3.10.1	Tools and equipment cleaned and stored in designated		
		location.		
	3.10.2	Unused and left over materials collected and stored in		
3.10 Clean workplace		designated location.		
	3.10.3	Workplace cleaned and waste disposed as per 3R's		
		<i>principle</i> at designated location.		





WT- Written Test	OQ- Oral Question	PT- Practical Test	DO – Direct Observation	SR- Supervisor's report	SN –Simulation
RP - Role Play	PG – Photographs	VD - Video	CT – Certificates	TS – Testimonials (Reward)	PP – Product Produced

CS – Case Study



Range Statement

Variable	Range						
Personal protective equipment	May include but not limited to: Mask Apron Gloves Safety shoes Safety belt Helmet						
Site assessment	 May include but not limited to: Roof/ground orientation/direction/solar geometry Shading Available space for other components Wiring requirement 						
PV pump	May include but not limited to: Surface Submersible 						
Mounting structure	May include but not limited to: Frame Pole						
Components	May include but not limited to: • PV modules/array/string Revision Number: ## Revised Date: dd/mm/vy Page:53						

	Solar inverter			
	• VFD			
	Controller unit			
	Controller duit			
	Protection devices			
Protection devices	May include but not limited to:			
	Surge Protection Dev	vice (SPD)		
	 Transient Voltage Su 	ippressor (TVS)		
	Miniature Circuit Bre	eaker (MCB)		
	Moulded Case Circui	it Breaker (MCCB)		
	AC/DC fuse	, , , , , , , , , , , , , , , , , , ,		
Issues	May include but not limited to:			
	Electrical connection	n problem		
	 Malfunctioning of co 	omponents		
	Mechanical fixtures			
	Water discharge			
Physical damage and abnormal condition	May include but are not limited t	to:		
	• Leak			
	Wear and tear			
	Crack			
	 Loose support 			
	Position direction a	nd inclination of panel		
	Array orientation an	d tilt		
	Disconnection			
	Bisconnection	wiring		
	Broken of damaged	wiring		
NOSS ID: # Developed Date: 2023-12-25	Revision Number: ##	Revised Date: dd/mm/vv	Page:54	



	Open circuit
	Blown fuse or tripped
	Loose connection
	Potential Induced Degradation (PID)
	• Soiling
	Hotspots
	Micro cracks
	Electrical system
	Shading
Electrical parameters	May include but not limited to:
	Voltage
	Resistance
	Continuity
	• Current
	Capacitance
	Voltage drop
	Short circuit
	Open circuit
	System output (Power/energy)
Wiring fault	May include but not limited to:
	Broken wires
	Loose connection
	Short circuit
	Earth fault



2045

3R's principle	May include but not limited to:
	Reduce
	• Reuse
	Recycle





_	Unit No: 4	
5	Unit Title: Install and troubleshoot standalone/ce	ntralized solar street Unit code:
	light	Derfermence stenderde
	Elements of competency	A 1.1 Personal Protective Equipment (PPE) used in accordance with task requirement
	4.1 Prepare tool, equipment and materials	4.1.2 Tools, equipment and materials collected as per task requirement.
		4.1.3 Working condition of tools and equipment checked and fault tagged.
		4.2.1 Solar installation area determined in consultation with client or as per drawing.
		4.2.2 <i>Site assessment</i> conducted at peak sun hours for solar installation.
	4.2 Perform site assessment	4.2.3 Solar installation area verified as per the drawing and layout for installation.
		4.2.4 Feedback is provided client based on-site assessment.
		4.3.1 <i>Mounting structure</i> installed firmly in line and level ensuring to withstand wind
		pressure and wind circulation.
		4.3.2 <i>Components</i> of solar PV system verified and checked for physical damage.
		4.3.3 Open circuit voltage and short circuit current measured of each module and verified
		with manufacturer's specification.
	4.3 Install PV module/array/string for centralized system	4.3.4 Solar PV module(s)/array/string installed firmly on mounting structure in required
		direction and inclination as per drawing.
		4.3.5 PV module (s) connected in series or parallel as per system design to
		junction/combiner box along with wire conduit through protection devices.
		4.3.6 Solar street light installed in designated location as per drawing.
		4.3.7 AC cables laid through poles along the route and connected as per wiring diagram.



			4.4.1	Mounting structure and light in	nstalled firmly on pole in line and	level ensuring to		
				withstand wind pressure.				
			4.4.2	Components of solar PV syster	n verified and checked for physic	al damage.		
			4.4.3	Open circuit voltage and short	circuit current measured of each	module and verified		
	4.4 Install standal	Install standalone solar street light		with manufacturer's specificat	ion.			
			4.4.4	Solar PV module(s) installed fir	rmly on mounting frame in requir	ed direction and		
				inclination as per drawing.				
			4.4.5	PV module (s) connected as pe	er system design along with wire	conduit.		
			4.5.1	Charge controller unit and bat	tery unit fixed firmly on designate	ed area.		
		Install charge controller unit and battery unit	4.5.2	Voltage of battery measured a	Voltage of battery measured and verified as per manufacturer's specification.			
			4.5.3	Positive and negative terminals of charge controller connected to corresponding				
	4.5 Install charge			terminals of battery unit.				
	unit		4.5.4	Positive and negative terminals of solar PV module(s) connected to charge controller.				
			4.5.5	Positive and negative terminal	Positive and negative terminals of charge controller connected to corresponding			
				terminals of street light.				
			4.6.1	Functionality of street light, ba	ttery and charge controller check	ked as per system		
				design.				
	4.6 Test solar stre	et light	4.6.2	Issues faced during installation	n rectified.			
			4.6.3	Street light activated and illum	ination tested as per manufactu	rer's specification.		
			4.7.1	Fault history collected from cli	ents and recorded as per industry	y norms.		
	4.7 Troubleshoot solar street light		4.7.2	Solar PV system inspected visually for <i>physical damage and abnormal condition</i> .				
	7 NOSS ID: #	Developed Date: 2022 12 25		Povision Numbers ##	Powieced Datas del/mm/sus			
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	4.7.3	Components of solar PV system cleaned and foreign materials removed.
	4.7.4	Electrical parameters measured and verified against specification.
	4.7.5	Monitoring tools/display analyzed for system performance.
	4.7.6	Function/performance of major components checked as per block diagram or
		specification.
	4.7.7	Fault and cause of fault identified based on visual inspection and test result and
		recorded as per industry norms.
	4.7.8	Materials and cost required for repair is calculated as per industry norms.
	4.7.9	Wiring fault and electrical problems fixed as per circuit diagram.
	4.7.10	Defective components replaced with new components of correct specification.
	4.7.11	Post repair testing carried out as per checklist and commissioned solar PV system.
	4.8.1	Tools and equipment cleaned and stored in designated location.
4.8 Clean workplace	4.8.2	Unused and left over materials collected and stored in designated location.
	4.8.3	Workplace cleaned and waste disposed as per 3R's principle at designated location.

6 Task Performance Requirements (Tools, Equipment and Materials):

Solar PV module(s), connecting cables (UV Protective), support structure, charge controller unit, battery, street light, pole, Pyranometer, magnetic compass, inline connectors, MC connector, hammer, wrenches sets, screw drivers, pliers, chisel, adjustable wrench, spanners, hacksaw, knife, cutting pliers, crimping tools, wire strippers, angle meter/set square, measuring tape, level meter, drill machine, battery operated drill machine, hot air gun blower, IR thermometer, multimeter, clamp on meter, megger, cables/wires, lux meter, cable clips, galvanized/stainless steel nuts and bolts, cable lug, heat shrink tube, switches, junction box, adjustable staircase, marker, connectors, screws,





	cable tie, corrugated conduit, PVC tape, petroleum jelly/grease, protection devices, dust bin, dust pan, broom, first aid kit and Personal
	protective equipment (PPE).
7	Safety and Hygiene (Occupational Health and Safety):
	Use personal protective equipment.
	Safe handling of tools, equipment and materials.
	Prevent from chemical and electrical hazards.





			Requir	ed Knowledge				
8		Technical Knowledge		Applied	Calculation	G	raphical Informatio	on
8	 Tools, equipm Types Uses Safe handli Storage Solar panels Introdu PV mod Types Mount Standa Centra Charge controt Introdu Types Mount Standa Centra Charge controt Introdu Types Function 	Technical Knowledge ent and materials ing uction dules ing position, direction and angle lone Installation and connection proce lized Installation and connection proce ler unit uction	dure	Applied	Calculation	G N N N N N N N N N N N N N N N N N N N	raphical Informatic ead and interpret anufacturer's struction/specificat ead and interpret b agram of solar stre	tion lock et light
	o Introdu	uction						
\wedge	o Types							
	NOSS ID: #	Developed Date: 2023-12-25	Revision N	lumber: ##	Revised Date: dd/mm	/yy	Page:61	

NOSS ID: #	Developed Date: 2023-12-25	Revision Number: ##	Revised Date: dd/mm/yy	Page:62				
0	Visual inspection				CTEVA			
Servicing technique								
• Type	s and importance of maintenance							
• Dism	antling and assembling process							
• Testi	ng and commissioning of street light							
Cable	es/wires							
Elect	rical wiring, circuit and connection							
• Elect	rical parameters							
• Fund	amental concept of electricity							
Facto	ors of site assessment							
 Impo 	rtance of site assessment							
0	Cleaning and maintenance							
	ways/subways/lane							
0	Standard Illumination required for high							
0	Functions							
0	Types							
0	Introduction							
• Stree	et light							
0	State of charge (SoC) and Depth of discharge	(DoD)						
0	Electrolyte level and specific gravity							
0	Functions							

o Cleaning	
• Checking	
 Leak detection 	
 Terminal greasing 	
 Performance testing 	
Testing and fault diagnose	
Repair and maintenance of electrical and mechanical	
components	
Fundamental concept of electricity	
Electrical parameters	
Electrical wiring, circuit and connection	
Cleaning and waste management	
Record keeping and documentation	
Importance of first aid	
 Occupational health and safety rules and regulations 	



9		Assessment of Competency							
	Unit: 4								
	Unit Title: Install and t	Unit Title: Install and troubleshoot standalone/centralized solar street light							
			Candidate Details		As	ssessors De	tail		
	Candidate's Name:			Assessors'	Name		ID/License No:		
	Registration Number:			1.					
	Symbol No:			2.					
	Test Centre:		Test Date:	3.					
Ele	ment of competency	Performance Standards		Standard Met	Standard Not Met	Evidence Type	Comments		
		4.1.1	Personal Protective Equipment (PPE) used in accordance						
			with task requirement.						
4.1	Prepare tool,	4.1.2	Tools, equipment and materials collected as per task						
	equipment and materials		requirement.						
		4.1.3	Working condition of tools and equipment checked and						
			fault tagged.						
		4.2.1	Solar installation area determined in consultation with						
4.2	Perform site		client or as per drawing.						
	assessment	4.2.2	Site assessment conducted at peak sun hours for solar						
			installation.						





		4.2.3	Solar installation area verified as per the drawing and		
			layout for installation.		
		4.2.4	Feedback is provided client based on-site assessment.		
		4.3.1	Mounting structure installed firmly in line and level		
			ensuring to withstand wind pressure and wind circulation.		
		4.3.2	Components of solar PV system verified and checked for		
			physical damage.		
		4.3.3	Open circuit voltage and short circuit current measured of		
			each module and verified with manufacturer's		
			specification.		
4.2	Install D)/	4.3.4	Solar PV module(s)/array/string installed firmly on		
4.3	module/array/string		mounting structure in required direction and inclination as		
	for centralized system		per drawing.		
		4.3.5	PV module (s) connected in series or parallel as per system		
			design to junction/combiner box along with wire conduit		
			through protection devices.		
		4.3.6	Solar street light installed in designated location as per		
			drawing.		
		4.3.7	AC cables laid through poles along the route and		
			connected as per wiring diagram.		





		4.4.1	Mounting structure and light	t installed firmly on pole in line	2				
			and level ensuring to withsta	and wind pressure.					
		4.4.2	Components of solar PV syst	em verified and checked for					
			physical damage.						
		4.4.3	Open circuit voltage and sho	ort circuit current measured of					
4.4	Install standalone		each module and verified wi	th manufacturer's					
	solar street light		specification.						
		4.4.4	Solar PV module(s) installed	firmly on mounting frame in					
			required direction and inclin	ation as per drawing.					
		4.4.5	PV module (s) connected as	per system design along with					
			wire conduit.						
		4.5.1	Charge controller unit and b	attery unit fixed firmly on					
			designated area.						
		4.5.2	Voltage of battery measured	and verified as per					
			manufacturer's specification						
4.5	Install charge	4.5.3	Positive and negative termin	als of charge controller					
	controller unit and battery unit		connected to corresponding	terminals of battery unit.					
	,	4.5.4	Positive and negative termin	als of solar PV module(s)					
			connected to charge control	ler.					
		4.5.5	Positive and negative termin	als of charge controller					
•			connected to corresponding	terminals of street light.					
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		4.6.1	Functionality of street light, battery and charge controller		
			checked as per system design.		
4.6	Test solar street light	4.6.2	Issues faced during installation rectified.		
		4.6.3	Street light activated and illumination tested as per		
			manufacturer's specification.		
		4.7.1	Fault history collected from clients and recorded as per		
			industry norms.		
		4.7.2	Solar PV system inspected visually for <i>physical damage</i>		
		and abnormal condition.			
		4.7.3	Components of solar PV system cleaned and foreign		
			materials removed.		
		4.7.4	Electrical parameters measured and verified against		
4.7	Troubleshoot solar		specification.		
	street light	4.7.5	Monitoring tools/display analyzed for system		
			performance.		
		4.7.6	Function/performance of major components checked as		
			per block diagram or specification.		
		4.7.7	Fault and cause of fault identified based on visual		
			inspection and test result and recorded as per industry		
			norms.		





		4.7.8	Materials and cost required for repair is calculated as per		
			industry norms.		
		4.7.9	Wiring fault and electrical problems fixed as per circuit		
			diagram.		
		4.7.10	Defective components replaced with new components of		
			correct specification.		
		4.7.11	Post repair testing carried out as per checklist and		
			commissioned solar PV system.		
		4.8.1	Tools and equipment cleaned and stored in designated		
			location.		
		4.8.2	Unused and left over materials collected and stored in		
4.8 Clea	an workplace		designated location.		
		4.8.3	Workplace cleaned and waste disposed as per 3R's		
			<i>principle</i> at designated location.		

WT- Written Test	OQ - Oral Question	PT- Practical Test	DO – Direct Observation	SR- Supervisor's report	SN –Simulation
RP - Role Play	PG – Photographs	VD - Video	CT – Certificates	TS – Testimonials (Reward)	PP – Product Produced
CS – Case Study					





Range Statement

Variable	Range
Personal protective equipment	May include but not limited to:•Mask•Apron•Gloves•Safety shoes•Safety belt•Helmet
Site assessment	 May include but not limited to: Roof/ground orientation/direction/solar geometry Shading Available space for other components Wiring requirement
Mounting structure	May include but not limited to: Frame Pole
Components NOSS ID: # Developed Date: 2023-12-25	May include but not limited to: PV modules/array/string Solar inverter Charge controller Battery Revision Number: ## Revised Date: dd/mm/vy Page:69

		Protection devices			
		DC DC convertors			
		• DC-DC convertors			
		• Street light			
Issues	May include but not limited to:				
		Electrical connectio	n problem		
		Malfunctioning of co	omponents		
		Mechanical fixtures			
Physical damage and abnormal condition		ay include but are not limited	to:		
		• Leak			
		• Wear and tear			
		Crack			
		Loose support			
		• Position, direction a	and inclination of panel		
		Array orientation ar	nd tilt		
		Disconnection			
		Broken or damaged	wiring		
		Open circuit			
		Blown fuse or trippe	ed		
		Loose connection			
		Potential Induced D	egradation (PID)		
		Soiling			
		Hotspots			
		Micro cracks			
		Electrical system			
		Shading			
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		1	1	1	Stall TEST

Electrical narameters	May include but not limited to:	
	• Voltage	
	Resistance	
	Continuity	
	Current	
	Capacitance	
	Voltage drop	
	Short circuit	
	Open circuit	
	System output (Power/energy)	
Wiring fault	May include but not limited to:	
winng raut	Nuy melace bat not minica to.	
	Broken Wires	
	Loose connection	
	Short circuit	
	Earth fault	
3R's principle	May include but not limited to:	
	Reduce	
	Reuse	
	Recycle	



