

Solar Resource Mapping in Pakistan

SITE INSTALLATION REPORT

July 2015



This report was prepared by [CSP Services](#), under contract to [The World Bank](#).

It is one of several outputs from the solar **resource mapping component of the activity “Renewable Energy Resource Mapping and Geospatial Planning – Pakistan”** [Project ID: P146140]. This activity is funded and supported by the Energy Sector Management Assistance Program (ESMAP), a multi-donor trust fund administered by The World Bank, under a global initiative on Renewable Energy Resource Mapping. Further details on the initiative can be obtained from the [ESMAP website](#).

This document is an **interim output** from the above-mentioned project. Users are strongly advised to exercise caution when utilizing the information and data contained, as this has not been subject to full peer review. The final, validated, peer reviewed output from this project will be the Pakistan Solar Atlas, which will be published once the project is completed.

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CSPS Technical Documentation

**ESMAP Tier2 Meteorological Station
Installation Report:
University of Engineering and Technology, Lahore,
Pakistan**



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CSPS Technical Documentation

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Summary

The CSP Services (CSPS) ESMAP Project Tier2 meteorological station CSPS.MT.14.216 has been installed and tested for its correct operation by CSPS scientific staff on Oct. 22nd, 2014. The station has been installed and commissioned on the roof of the Center of Energy Research at the University of Engineering and Technology (UET) campus in Kala Shah Kaku near Lahore, Pakistan (31.694°N, 74.244°E).

The Tier2 station is equipped with a CSPS Twin-sensor Rotating Shadowband Irradiometer (RSI), a Kipp&Zonen CMP10 pyranometer for redundant GHI measurement, a Campbell Scientific CR1000 data logger, CS215 temperature and relative humidity probe, CS100 barometric pressure sensor, NRG #40C anemometer and NRG #200P wind direction sensor on a wind mast of 10 m height above the roof top.

All sensors are integrated into the Tier2 meteorological data acquisition system.

Power supply is provided by a solar panel and battery, designed for fully autonomous operation.

Station maintenance will be done by local staff of UET. The local personnel have been briefed on how the maintenance has to be done. The main task is to clean the irradiance sensors on a weekly basis. Upon request, further tasks as checking the levelling of the sensors, stability of the equipment, etc. might be carried out. Regular inspection and maintenance visits will be performed on a six-monthly interval by the company PITCO, local partner of the ESMAP solar vendor consortium.

Calibration certificates for the installed sensors will be handed over to AEDB and World Bank together with the station documentation and manual.

Data retrieval will be done by CSPS via GPRS data transmission on a daily schedule, starting with the first day after installation; data will be provided to AEDB, WB and approved stakeholders on a daily basis by email in Excel format as well as on a data publication platform provided by WB.

Completed Tasks

1. Mounting post and measurement control box installed.
2. Solar panel and battery installed, connected and checked for functionality.
3. Solar irradiation and meteorological sensors installed, connected, levelled and aligned.
4. 10 m wind mast with wind speed and wind direction sensors installed and connected, wind direction sensor oriented towards north.
5. GPRS connection to CSP Services server installed and verified. SIM card with dynamic IP provided by Telenor.
6. Irradiation sensors cleaned.
7. Measured parameters checked for correctness of values.
8. Maintenance and cleaning instruction given to the attending staff.
9. Site surroundings analyzed for possible external influences on the measurement data.

Pending Tasks

None, all works completed.

Measured Meteorological Parameters

- Global horizontal irradiance (GHI) in W/m^2 : CSPS Twin-RSI and Kipp&Zonen CMP10 Pyranometer
- Diffuse horizontal irradiance (DHI) in W/m^2 : CSPS Twin-RSI
- Direct normal irradiance (DNI) in W/m^2 : CSPS Twin-RSI
- Wind speed in m/s : NRG #40 Anemometer
- Wind direction in $^\circ\text{N}$: NRG #200 Wind vane
- Barometric pressure in hPa : Setra 278
- Ambient temperature in $^\circ\text{C}$: Campbell Scientific CS215
- Relative humidity in $\%$: Campbell Scientific CS215

(Serial numbers see below table)

Inspection Details and Comments

Site: UET Campus Kala Shah Kaku, Lahore, Pakistan		Date of installation: 2014-10-22		
Coordinates: 31.694°N, 74.244°E				
Station SN#: CSPS.MT.14.216		RSI SN#	Drive: DR.14.001.0013	
Control Box SN#: CSPS.CA.14.209.0002			PU: MS.14.001.0013	
		GHI CMP SN#:	140569	
Component		Checked/ approved		Comments
		yes	no	
Foundations, fence	Foundations correctly prepared	x	N/A	No fence required, non-public roof Door to roof is permanently locked
	Threaded bolts correctly prepared	x		
	Fence correctly prepared			
	Door can be locked	x		
MDI Stand with Control box	Fixed to Ground	x		
	Sensor mounts extended	x		
	PV mounting bar adjusted	x		
	Horizontally leveled	x		
	Grounding cable connected	x		
	All bolts tightened	x		
Wiring, ca- bles	Visual examination	x		
	Fuses ok	x		
	PV Power cable connected	x		
	All sensors connected	x		
	All cables orderly fixed	x		
RSI	Fixed to MDI Stand	x		
	PU Unit with LiCors installed	x		
	Shadow band installed	x		
	Horizontal leveling	x		
	LiCor Sensors Clean	x		
	Cable connected to RSI and Box	x		
	RSI operative	x		
T _{amb} / RH	Irradiation shield fixed to MDI stand	x		Model: CS215 SN#: E12260
	Sensor probe with filter cap inserted	x		
	Sensor Serial No.			
	Cable connected to Control Box	x		
Pressure sensor	Mounted inside control box	x		Model: Setra 278 SN#: 5949005
	Pressure exchange tube to outside box	x		
	Cables connected	x		
Solar PV panel	Fixed to PV mounting bar	x		
	Inclination angle	45°		
	Facing South?	x		
	Visual examination (no cracks, clean)	x		
	Operability (V>12 V in sunlight)	x		
	Cable connected to Panel and Box	x		

Component		Checked/ approved		Comments
		yes	no	
Wind tower, wind speed and direction sensors	Tower extended	x		Extended to length of 10 m Model: NRG#200 SN#: N/A Model: NRG#40C SN#: 1795-00229366
	Guy wires safely attached and tense	x		
	Grounding cable connected	x		
	Wind sensors installed	x		
	Wind direction sensor serial No.	x		
	Wind speed sensor serial No.	x		
	North Orientation of WD sensor	x		
	Cable fixed to sensors, tower and box	x		
	Operability of sensors	x		
Modem	SIM card inserted	x		Provider / number: Telenor APN: internet Username: Telenor Password: Telenor AT+CSQ value: 26,0
	APN, username, password of SIM			
	LED blinking code	x		
	Signal strength (AT+CSQ?)			
Datalogger	Operation system installed	x		Version: Std.27 File name: Pk-Lah_2014-10-22.xml IP: dynamic Program name: Pk-Lah_2014-10-22.cr1 Subroutines: ESMAP-Pakistan-MDI-Subroutines-2014-08-19_str_Enc.CR1 Local standard time, no daylight saving time: UTC+5
	Datalogger configuration saved	x		
	IP visible in logger configuration	x		
	Correct sensor constants in program	x		
	Correct coordinates in program	x		
	Datalogger program installed	x		
	Program set to “Run always”	x		
	Datalogger clock correct	x		
	Measurement values present	x		
	Measurement values plausible	x		
Installation performed by (person): Birk Kraas (CSP Services), Muhammad Umer Kamal (PITCO)				

Site Layout

See site layout drawing

Photographs of sensors and mountings



Figure 1: Wind Speed and Direction Sensor



Figure 2: RSI (red: protection caps)



Figure 3: CMP10 close-up, w.o. sun shield



Figure 4: CMP10 w. sun shield



Figure 5: Pyranometer Unit on RSI



Figure 6: Mounting of support structure



Figure 7: Temperature sensor in protective case



Figure 8: Setra 278 pressure sensor



Figure 9: Control box with datalogger, battery and electric equipment

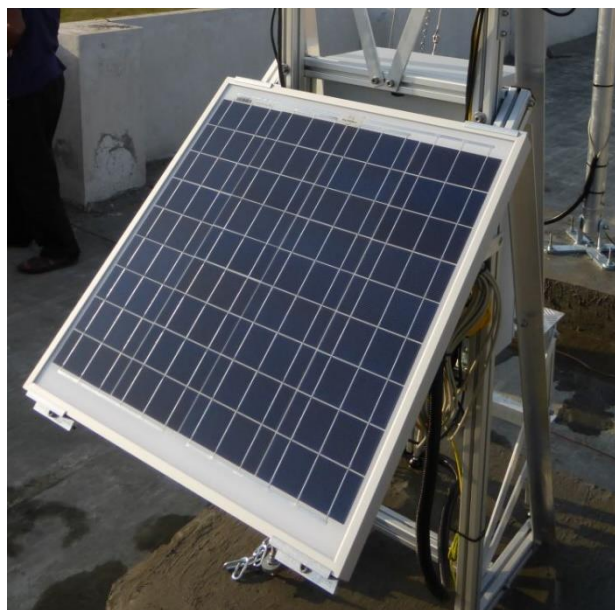


Figure 10: Solar panel



Figure 11: Datalogger

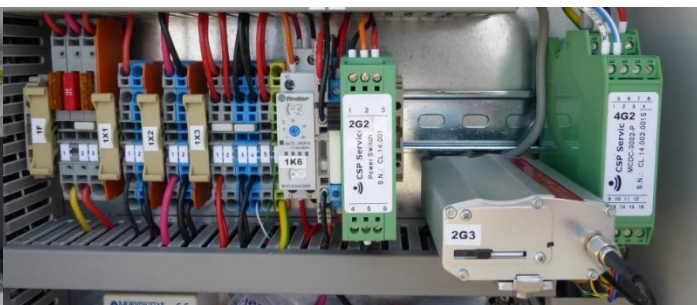


Figure 12: Connectors, GPRS modem, automatic switch



Figure 13: Station installed

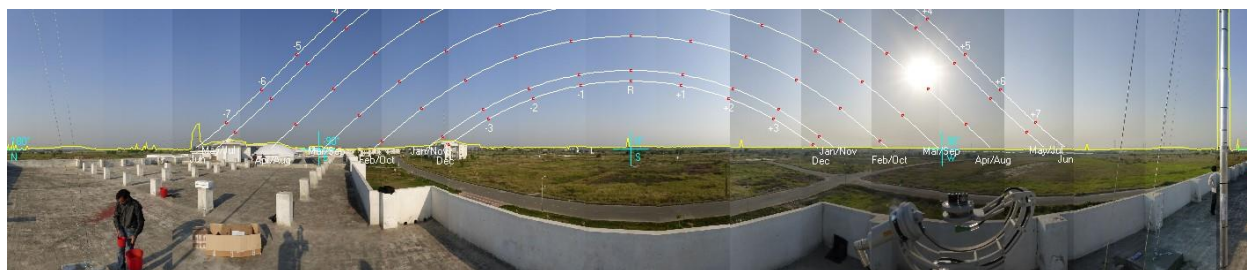


Figure 14: Wind tower base



Figure 15: Site overview

360° view from the sun sensor position with sun paths throughout the year



Only minor and uncritical influences by obstacles near horizon at sunrise and sunset, as predicted in site evaluation report.