



STATIONS AND INTRSUMENTS

ABSTRACT

This report presents a comprehensive overview of measurement stations operated by KACARE. These stations are crucial for gathering data pertaining to solar and wind energy, providing essential insights into renewable energy potential and environmental conditions. The report outlines the description, locations, and instrumentation utilized in both solar and wind measurement stations.

Solar stations Overview

KACARE's coordinated network of solar resource monitoring stations deployed starting from 2013 is now characterizing the spectral, spatial, and temporal variability of the resource, including the impact of aerosols. Collectively, the stations characterize the three components of solar radiation (direct normal irradiance [DNI], global horizontal irradiance [GHI], and diffuse horizontal irradiance [DHI]), plus related meteorological and dust parameters.

Two Tiers of solar resource monitoring stations, defined by the types and quantities of instrumentation, have been established to address the needs for acquiring data that will capture the spatial and temporal variability of solar resources throughout the Kingdom, as follows:

Tier 1 - Research Stations

This station tier is the most complete and complex of the monitoring systems, and provides the highest quality (lowest uncertainty) data, in the range of +/- 2% (sub-hourly). All Tier 1 stations comply with the measurement practices described in the World Meteorological Organization (WMO) Baseline Surface Radiation Network (BSRN) Operations Manual. Tier 1 stations are checked and cleaned on a daily schedule, and provide 1-minute level data (averaged to hourly data and above). Three configurations of Tier 1 stations are being deployed:

- **Configuration A - Research and Development Laboratory.** This configuration contains the full complement of radiometric instruments with independent and redundant solar radiation component data, plus basic meteorological instruments and instruments measuring dust deposition and horizontal visibility.
- **Configuration B - Solar Broadband and Spectral Monitoring Station.** This configuration containing all broadband solar radiometers, selected solar spectral radiometers and photometers, pyrgeometers, and basic meteorological instruments, plus instruments measuring dust deposition and horizontal visibility.

- **Configuration C - Broadband Baseline Monitoring Station.** This configuration contains instrument systems providing fundamental broadband solar irradiances (DNI, GHI, DHI, and GTI), plus basic meteorological instruments.

Tier 2- Mid-Range Stations

Based on the installation of a rotating shadowband radiometer (RSR), this station configuration produces fundamental solar resource and surface meteorological data. RSRs provide data with base uncertainty of +/- 5% (sub-hourly) plus additional uncertainty for cleaning intervals and quality checks, when properly operated. Tier 2 stations are checked and cleaned on a twice-weekly schedule, and provide 1-minute level data (averaged to hourly data and above).

All instruments are calibrated and maintained according to the manufacturer's specifications.




Solar Monitoring Network Stations

Province	City	Station Name	Station Abbreviation	Station Type (Tier)
Al Baha	Al Baha	Al Baha University	Al Baha - University	1C
Al Jouf	Al Jouf	Al Jouf College of Technology	Al Jouf - TVTC	1C
Asir	Abha	Abha Technical Institute	Abha - TVTC	1B
	Al Farshah	Tuhamat Qahtan Technical Institute	Al Farshah - TVTC	2
Eastern Province	Al Ahsa	King Faisal University	Al Ahsa - KFU	1C
	Al Dhahran	King Fahd University of Petroleum and Minerals	Al Dhahran - KFUPM	2
	Al Dammam	Imam Abdulrahman Bin Faisal University	Dammam - IAFU	1B
	Hafar Al Batin	Hafar Al Batin Technical College	Hafar Al Batin - TVTC	2
	Al Jubail	Saline Water Conversion Corporation (Jubail)	Al Jubail - SWCC	2
	Al Khafji	Saline Water Conversion Corporation (Al Khafji)	Al Khafji - SWCC	1C
Hail	Hail	Hail College of Technology	Hail - TVTC	1C
Jazan	Farasan Island	Saline Water Conversion Corporation (Farasan)	Farasan - SWCC	2
	Jazan	Jazan University	Jazan - University	1C
Madinah	Al Hanakiyah	Al Hanakiyah Technical Institute	Al Hanakiyah - TVTC	2
	Al Madinah	Taibah University	Taibah - University	1C
	Mahd ad Dahab	Mahd ad Dahab	Mahd ad Dahab	2
	Yanbu	Royal Commission of Jubail and Yanbu	Yanbu - RCJY	1C
Makkah	Hada Al Sham	King Abdulaziz University (East Hada Al Sham Campus)	Hada Al Sham - KAU	2
	Jeddah	King Abdulaziz University (Main Campus)	Jeddah - KAU	2
	Rania	Rania Technical Institute	Rania - TVTC	1C
	Makkah	Umm Al Qura University	Makkah - UQU	1C
	Osfan	King Abdulaziz University (Osfan campus)	Osfan - KAU	2
	Al Qunfudhah	Al Qunfudhah Technical Institute	Al Qunfudhah - TVTC	2
	Taif	Taif University	Taif - University	1C
	Thuwal	King Abdullah University of Science and Technology	Thuwal - KAUST	2
	Najran	Najran University	Najran - University	2
Sharurah	Sharurah Technical Institute	Sharurah - TVTC	2	
Northern Borders	Arar	Ar'ar Technical Institute	Ar'ar - TVTC	1C
	ALUwayqilah	ALUwayqilah	ALUwayqilah	2
Qassim	Qassim	Qassim University	Qassim - University	1B
Riyadh	Afif	Afif Technical Institute	Afif - TVTC	2
	Al Dawadmi	Al Dawadmi College of Technology	Al Dawadmi - TVTC	2
	Al Kharj	Prince Sattam bin Abdulaziz University	Al Kharj - SAU	2
	Layla	Al Aflaj Technical Institute	Al Aflaj - TVTC	2
	Majmaah	Majmaah University	Majmaah - University	2



	Riyadh	K.A.CARE Building Olaya St	Riyadh - K.A.CARE HQ	2
	Riyadh	K.A.CARE City Site Tier 2	Riyadh - K.A.CARE City T2	2
	Riyadh	King Saud University	Riyadh - KSU	2
	Riyadh	Al Uyaynah Research Station	Riyadh - Al Uyaynah	1A
	Shaqra	Shaqra University	Shaqra - University	2
	Wadi Addawasir	Wadi Addawasir College of Technology	Wadi Addawasir - TVTC	1C
Tabuk	Duba	Duba Technical Institute	Duba - TVTC	2
	Hagl	Saline Water Conversion Corporation (Hagl)	Hagl - SWCC	2
	Tabuk	Tabuk University	Tabuk - University	1C
	Timaa	Timaa Technical Institute	Timaa - TVTC	2
	Umluj	Saline Water Conversion Corporation (Umluj)	Umluj - SWCC	2
	Al Wajh	Al Wajh Technical Institute	Al Wajh - TVTC	1C

Solar Stations Devices:

Instrument Type	Measurement	Manufacturer	Model	Picture
CHP1	Direct Normal Irradiance (DNI)	Kipp & Zonen	CHP 1	
CMP21	Global Horizontal Irradiance (GHI) Global Tilted Irradiance (GTI).	Kipp & Zonen	CMP21	
CMP22	Diffuse Horizontal Irradiance (DHI) Upwelling solar (Shortwave) radiation	Kipp & Zonen	CMP22	

CGR4 Down Welling Infrared
Irradiance (DIR) Kipp & Zonen **CGR4**



EKO MS-710 and MS-712 Direct Normal Spectral
Irradiance **EKO** **MS-710 /
MS-712**




PQS1 Photosynthetically
Active Radiation (PAR) **Unknown** **PQS1**



UV-S-AB-T Ultra Violet Radiation A
& B **Kipp & Zonen** **UV-S-AB-T**



Rotating Shadowband Radiometer (RSR)	GHI, DHI, Computes DNI	Unknown	RSR	
LI-COR LI-200R	Global Horizontal Irradiance (GHI)	LI-COR	LI-200R	
PBT110 and Setra-27	Barometric Pressure	Vaisala / Setra	PBT110 / Setra-27	
CS215	Air Temperature Relative Humidity	Campbell Scientific	CS215	
Tipping Bucket (TB4)	Precipitation	Hydrological Services	TB4	
MetOne 034B and NGR	Wind Speed and Direction	MetOne	034B / NGR	



PWD-50	Meteorological Optical Range, Present Weather	Vaisala	PWD-50
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Wind stations Overview




Since 2014, the Measurement Network program in King Abdullah City for Atomic and Renewable Energy consisting of 10 wind ground measurement stations was put in operation to assess and quantify wind potential in the kingdom. They provide high-quality wind assessment and meteorological information. The stations are operated and maintained on a rigorous schedule, under the supervision of K.A.CARE, and in partnership with universities, technical colleges and institutes, and government agency partners.

The wind Measurement Network today consists of 100-meter steel towers equipped with 6 cup anemometers and 3 wind vanes that measure the wind speed and wind direction at 40 m, 60 m, 80 m, and 100 m. Additionally, a barometer and a thermo-hygro-sensor to measure the air pressure, temperature, and relative humidity are installed.

Wind Monitoring Network Stations

Province	City	Station Name
Al Jouf	Al Jouf	Al Jouf Abu Ajram
Eastern Province	Hafar Al Batin	Hafar Al Batin
Madinah	Yanbu	Yanbu North 1
	Yanbu	Yanbu South
Makkah	Jeddah	Jeddah Al Jazeerah
Najran	Sharurah	Sharurah
Northern Borders	Turaif	Turaif
Riyadh	Riyadh	K.A.CARE City Site A
	Riyadh	K.A.CARE City Site B
Tabuk	Al Wajh	Al Wajh Wadi Al Seeh

Wind Stations Devices:

Instrument Type	Measurement	Manufacturer	Model	Height [m]	Picture
Anemometer	Wind Speed	RISO	Anemometer	100 98 80 60 40 40	
Wind Vane	Wind direction	VECTOR	W200P	98 80 37	
Humidity & Temperature Probe	Air Temperature Relative Humidity	VAISALA	HMP155	96	
barometric pressure sensor	Barometric Pressure	Ammonit	AB60	20	