Dubai, the new location for BSRN station in Middle East/Arabian Peninsula

17-July-2018
TABLE OF CONTENTS

• Introduction to DEWA
• Motivation for Joining the BSRN
• DEWA’s Experience with Meteorological Stations
• Manpower Plan
• Site Description
• Instrumentation and Data Structure
• O&M and Calibration Plan
Introduction to DEWA
About Dubai/UAE

- Dubai is the largest and most populous city in UAE
- Dubai is a global city and a business hub of the middle east
- It attracted world attention through the construction of the world tallest building
- The location of the United Arab Emirates and Dubai within the Sunbelt highlights solar energy’s major role as a renewable source of energy.
About DEWA

Our Vision
A sustainable Innovative world-class utility

Our Mission
We are committed to the happiness of our stakeholders and promoting Dubai’s vision through the delivery of sustainable electricity and water services at a world-class level of reliability, efficiency and safety in an environment that nurtures innovation with a competent workforce and effective partnerships; supporting resources sustainability.

Our Motto
For Generations To Come.
Mohammed Bin Rashid Solar Park

- **First Phase Completed**
  - 13 MW (PV)

- **Second Phase Completed**
  - 200 MW (PV)

- **Third Phase, In construction**
  - 800 MW (PV)

- **Fourth Phase, PPA signing**
  - 700 MW (CSP)

- **Total installed capacity by 2030 (PV + CSP)**
  - 5000 MW

- **Renewables generation capacity target by 2030, & 75% by 2050**

25% renewables generation capacity target by 2030, & 75% by 2050

- **Lowest Price World Wide for PV**
  - 2.99 Cent/KWh

- **Lowest Price World Wide for CSP**
  - 7.30 Cent/KWh
DEWA’s R&D Center

DEWA R&D center programs

- Water recovery and technologies and its efficient use
- Solar water treatment technologies
- Renewable energy resource analysis as a key for efficient technology development
- Innovative generation technologies that adapt efficiently and reliably to the region
- Technologies that will drive the high penetration of renewable proposals

Focus

- Smart grid technologies for future growth and adoption
- Big Data Analytics
- Grid-open integration of renewable technologies
- Building technologies for environmental integration and element innovation
- Demand response and demand side management analysis
Solar Research

- PV Module Performance and Reliability Testing
- Soiling Effect on PV modules
- Solar Resource Assessment & Forecasting
- Other Solar Technology Performance Testing
Solar Research

- PV Module Performance and Reliability Testing
- Soiling Effect on PV modules
- Solar Resource Assessment & Forecasting
- Concentrated Solar Technology Performance Testing
Solar Research

- PV Module Performance and Reliability Testing
- Soiling Effect on PV modules
- Solar Resource Assessment & Forecasting
- Concentrated Solar Technology Performance Testing
Solar Research

- PV Module Performance and Reliability Testing
- Soiling Effect on PV modules
- Solar Resource Assessment & Forecasting
- Concentrated Solar Technology Performance Testing
Solar Research

- PV Module Performance and Reliability Testing
- Soiling Effect on PV modules
- Solar Resource Assessment & Forecasting
- Concentrated Solar Technology Performance Testing
Motivation for Joining BSRN
Motivation
Motivation

What makes the site special?

- Representing regions with hot, arid climates (very common for solar plants) in Middle East
- Same location of MBR Solar Park (one of the largest single-site solar plant in the world)
- Close to DEWA’s research facilities and outdoor test field
Objectives

• Supporting the afore-mentioned research activities with high quality meteorological data (especially radiation data)
• Supporting DEWA’s long-term plan for 5 GW of solar plants (both PV and CSP) with a total area of about 100 km2, with accurate assessment of solar resource
• For a successful integration of large PV plants in a stable electric grid, short term precise forecasting (e.g. 10 minutes to 1 hour) of future plant performance
• Conduct research studies related to assessment and forecasting of solar radiation (e.g. cloud nowcasting, sandstorm forecasting, validation/data assimilation for numerical weather prediction with respect to forecasts of PV production, validation of satellite-based solar radiation models)
• Exchange and potential participation in joint projects with the international community

Existing Station Descriptions

Weather station at the 13 MW power plant

Typical metrological Year data

![GHI (W/m²)](chart1)

- TMY
- Long Term
- 2017
- 2016
- 2015
- 2014

![POA (W/m²)](chart2)

- TMY
- Long Term
- 2017
- 2016
- 2015
- 2014

![Temperature (°C)](chart3)

- TMY
- Long Term
- 2017
- 2016
- 2015
- 2014
Existing Station Descriptions

Analyzing the seasonal variation in Solar Spectrum

Study the impact of solar spectrum distribution on the outdoor performance of different PV module technologies

- Effect of spectral irradiance distribution on the outdoor performance of PV modules in the UAE (to be submitted to progress in photovoltaics)
Manpower plan

Marco Stefancich, PhD
BSRN Station manager
over 20 years experience in solar field

Jim Joseph John, PhD
over 10 years experience in solar field

Aaesha Alnuaimi, PhD
over 7 years experience in solar field

Ammar Elnosh, M.Sc
over 7 years experience in solar field

Muhammed Perves
Station Technician with more than 5 years experience in O&M and calibration

- More than 35 years of experience in Photovoltaics
- More than 250 engineers working worldwide in the business field
- More than 20 measurement stations built in international projects with focus on Solar irradiation
- 7 international irradiation stations presently run by TUV, partly under remote control
BSRN site Description
BSRN Site description

Source: maps.google.com
BSRN Site description

Source: maps.google.com
BSRN Site description

Source: maps.google.com
Site completely fenced, security present 24/7
BSRN Site description

Source: maps.google.com
Existing Meteorological Station (Geonica)

Source: maps.google.com
Platform and Post Position

Platform 6 m x 3 m @ 2.7 m height

Hinged tower for easy cleaning maintenance of Filters and domes of radiation sensors @ 10m height

Instrumentation table @ 4 m height
Shadow, reflections and horizon analysis
Shadow, reflections and horizon analysis
Shadow, reflections and horizon analysis
Instrumentation and Data Structure
## Basic Irradiation measurement

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNI</td>
<td>First Class Pyrheliometer</td>
<td>EKO MS-57</td>
</tr>
<tr>
<td>GHI</td>
<td>Secondary Standard Pyranometer</td>
<td>EKO MS-80 + MV-01</td>
</tr>
<tr>
<td>DHI</td>
<td>Secondary Standard Pyranometer</td>
<td>EKO MS-80 + MV-01</td>
</tr>
<tr>
<td>IR&lt;sub&gt;down&lt;/sub&gt;</td>
<td>Pyrgeometer</td>
<td>K&amp;Z SGR4-A + CVF4</td>
</tr>
<tr>
<td>UV (A&amp;B)</td>
<td>UV-Sensors</td>
<td>K&amp;Z UVS-A/B-T</td>
</tr>
<tr>
<td></td>
<td>Active Tracker</td>
<td>EKO STR-22G</td>
</tr>
</tbody>
</table>

→ All irradiation sensors Ventilated  
→ All irradiation sensors calibrated with tracability to Davos Standard
## Extended Irradiation measurement

<table>
<thead>
<tr>
<th>Description</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflected Solar Radiation @ 10m height</td>
<td>EKO MS-80 + MV-01</td>
</tr>
<tr>
<td>Reflected Solar Radiation @ 1.5m height</td>
<td>EKO MS-80 + MV-01</td>
</tr>
<tr>
<td>Up-welling Infrared Radiation @ 10m height</td>
<td>K&amp;Z SGR4-A + CVF4</td>
</tr>
<tr>
<td>DNI Spectral Irradiance</td>
<td>Spectrafy SolarSIM-D2</td>
</tr>
<tr>
<td>GHI Spectral Irradiance</td>
<td>EKO MS-711</td>
</tr>
<tr>
<td>Rotating Shadowband Radiometer</td>
<td>Campbell RS-100</td>
</tr>
</tbody>
</table>
# Meteorological measurement

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind speed and wind direction @ 10m height</td>
<td>Vaisala WXT 532</td>
</tr>
<tr>
<td>Pressure, temperature, humidity &amp; precipitation @ 1.5m</td>
<td>Vaisala WXT 535</td>
</tr>
<tr>
<td>Visibility and present weather</td>
<td>Campbell CS125</td>
</tr>
<tr>
<td>GPS Perceptable Water Vapor measurement</td>
<td>Javad Delta 3</td>
</tr>
<tr>
<td>Sky Camera</td>
<td>EKO SRF-04</td>
</tr>
<tr>
<td>Automatic Sun Tracking Photometer</td>
<td>Cimel CE318</td>
</tr>
</tbody>
</table>
# Additional Sensors

<table>
<thead>
<tr>
<th>Soiling Station</th>
<th>Atonometrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence switch</td>
<td></td>
</tr>
<tr>
<td>Cameras</td>
<td></td>
</tr>
</tbody>
</table>
Data handling and storage system

Measurement, Data handling and storage system at the Photovoltaic Test Site in Dubai

- REC
  - T
  - G
  - HuH Loads
  - Keithley
- EXT
  - T
  - G
  - EA Loads
  - Acron Database
- EXT2
  - T
  - EA Loads
- SRS
  - div
  - T
  - G
  - GPS
  - Campbell
  - Linux
  - ESX
  - TÜV Control instead of SPS

- MS SQL Database
  - Import to MSDB
- Acron Database
  - Acron CSV import
  - Access via prepared SQL queries
- DEWA MySQL Database
- NTP

Grid Control
- Energy Meter
  - ATS
  - EA Loads
  - Resistant
  - Grid
  - Gen

Cloud Calculation
- Dewa Backup of .csv-files
O&M and Calibration Plan
O&M of Data and System

- Short interval maintenance:
  Dewa Technician onsite 6 d/week (Checking and cleaning)

- Long-term maintenance & annual calibration:
  TUV Rheinland contracted

- Automatic warnings in case readings fail BSRN recommended QC-tests
  - extremely rare or physically possible
  - Ratio of Global SW / Sum SW
  - Ratio of Dif SW / Global SW
  - SWup to Sum SW comparison
  - LW to Tair comparison
  - ...
Calibration procedures

- Secondary set of identical irradiation sensors

- Calibrated in Davos in two years interval
  - Serve for spare
  - Serve for on site calibration in one year intervals

- Photometer sent to NASA for calibration
THANK YOU