Scope of Work:

Denowatts Setup Tasks and Responsibilities

Great data begins with the proper setup and commissioning of the Denowatts Digital Twin Benchmarking (DTB) technology.

This scope of work describes the process for setting up the Denowatts DTB technology on new or retrofit solar arrays. *Table 1* includes a summary matrix of the key tasks and responsibilities for setup. The details of each task are described below.

Project Managers should use the Setup Tracker found at https://my.denowatts.com/admin/p/device_list to update each task's status.

Visit https://suport.denowatts.com for complete installation and setup details.

Please contact support@denowatts.com or 978.309.6688 with any questions related to the setup.

Table 1 Tasks and Responsibilities Matrix

What are the key tasks to setting up Denowatts?	*Who is responsible?*	*How long?*
Key Tasks	**Typical Responsibility**	**Typical Time**
A. Procurement		
Request for Quotation	Owner/EPC/PM	15 minutes
Quotation	Denowatts	2 days
B. Site Information Form	Owner/EPC/PM	15 minutes
C. Energy Model Upload to Denobox	Owner/EPC/PM	15 minutes
D. Meter Info (Enter IP address and model# in comment box)	Owner/PM	15 minutes
E. Hardware Setup		
Gateway Installation	EPC or Monitoring Co	60 minutes*
Gateway Network Configuration	Denowatts	15 minutes
Deno Installation	EPC	30-45 minutes each Deno
Setup Validation (by phone/text)	Denowatts and Installer	15 minutes
Deno and Meter Configuration/Validation	Denowatts	1 day
F. Sensor Commissioning Report	EPC/PM	15 minutes**
G. Monitoring Intake	EPC/PM	15 minutes
H. Active and Learning	Denowatts	

*Gateway setup assumes basic installation and gateway to Deno antenna line of sight. Rooftop installations where the gateway is inside the building may take longer.

**If adjustments are necessary by the installer this step must be repeated

Descriptions of Tasks

A. Procurement. The Request for Quotation (RFQ) button is located at the top of Denowatts.com. This form includes the solar asset's location, size, and critical design attributes. The RFQ should include site and DAS network plans, if possible, to help Denowatts determine the optimal Deno simulator quantity, type, and locations. Denowatts will typically return a Quotation within 1-2 business days with details of the service and optimal hardware configuration. Users may accept the RFQ by using the Order link found on the Quotation to place the order for hardware. Hardware can typically ship within one week.

B. Site Information Form. Found in the my.Denowatts.com performance portal, this form should be completed at the time of the service order. This includes the project manager/point of contact (POC) for the setup process, address and grid coordinates of the site, and general characteristics of the project.

C. Energy Model Intake. The Owner's energy model is the fundamental performance benchmark, consisting of two parts: 1) Expected Performance (Weather-adjusted energy output); and 2) Predicted Performance (Energy Output using P50 modeled weather conditions). The Owner's energy model is a .pdf report, often PVSyst, PlantPredict, Helioscope, PVWatts, etc., and it must be uploaded to the Denobox in the performance portal. This report is the basis for benchmark configuration, including the critical parameters for Expected Energy modeling. This also provides the energy and weather estimates for Predicted Energy (P50 TMY).

The Expected model input is completed by Denowatts or trained performance engineers on the Block Management page. Blocks, or subarrays, include parameters used for the Expected Energy benchmark.

For users desiring E2848 Capacity Testing, the Hourly/8760 energy model output is additionally required in Excel (.xlsx) format. At a minimum, this should include:
  i. Global Horizontal Irradiation
  ii. Global Effective Irradiation (POA) (note this is different from Global Incident Irradiation)
  iii. Global Rear side Irradiation (rPOA) (For bifacial modules only)
  iv. Module/Cell Temperature
  v. Energy Output (Meter)

An hourly template file may be downloaded from the Customer Model tab of the Site Configuration screen. Once the user adds the hourly data to the template file, it is uploaded to the Denowatts server for use in the capacity test. If the hourly file is unavailable, users may only complete the IEC 61724-2 Capacity Test.

D. Meter Information. Denowatts requires Net Cumulative Energy generation data for analytics. The Denowatts gateway typically reads this via Modbus TCP. Please note the IP address (and Device ID if RTU) and meter model number in the notes on the Setup screen in the Denowatts portal. Denowatts recommends using a Modbus TCP/IP (ethernet) meter whenever possible,

though if a Modbus RTU (RS485-connected) meter is used, a Modbus converter may be purchased through Denowatts.

E. Hardware Set Up. Installation of the Denowatts hardware is performed by the EPC/O&M. For new construction, the monitoring company may prefer to integrate the Denowatts gateway into the DAS enclosure, though qualified technicians may install the complete kit in the field. Installation instructions can be found at Denowatts.com/Quickstart.   Denowatts requests that the installer contacts Denowatts for live installation and commissioning support at 978.309.6688. The installer must submit photos of all components to support@denowatts.com.

1. Gateway is connected, and network settings are established. Once the gateway is installed with the DAS equipment, the network settings must be configured to allow the connection, including a static IP address if the monitoring company is to read the Denowatts gateway Modbus registers for local data. The network settings can be configured locally using the Gateway Application found at Support.Denowatts.com or configured remotely through the performance portal.
2. Arrays configured, including Modbus group. Denowatts will confirm that the array electrical characteristics and Modbus group number are properly configured.
3. Arrays written and verified with correct array data. The Array Edit page includes the remote management function to complete this task. The Client or Denowatts may complete this task.

F. Deno simulator commissioning report. Denowatts completes a simulator alignment, sensor functions check, and site generation validity test on the first clear sky day. This report may be run at any time from the Site Analysis page. The report shows PASS/FAIL findings of each sensor and quantified overall benchmark alignment. If any hardware or substantial alignment issues are reported, the Installer must make corrections before running a capacity test and beginning the benchmarking process. Upon a successful Commissioning Report, the Site Status should be updated to "Active and Learning".

G. Monitoring company intake. Denowatts data is delivered to monitoring companies by either a local Modbus connection or the Denowatts API.   Instructions for either method are included in the Modbus Map download (.csv) on the Site Analysis page and forwarded to the monitoring company for implementation. Full Modbus and API documentation are available at Support.Denowatts.com; however, most monitoring companies already have a template file for the Denowatts gateway.