webdyn

flexitron group

Application note

Generator set

using the WebdynSunPM

Introduction

This application note describes how to configure and parameter the WebdynSunPM product in the specific case of the regulation of a hybrid photovoltaic energy plus generator set production site. The purpose is to explain how the injection regulation script designed by Webdyn's design office works. The use of the "GenSet-Vx_xx" generator set script requires a paying licence. To purchase a licence, contact the Webdyn sales department (https://www.webdyn.com/contact).

Expression of needs

Depending on the customer's needs, the main energy source can be the grid, the photovoltaic system or the generator set. The system can be connected to the grid or not. In all cases, these energy sources are used to complement each other. Whether the objective is to fill the gap created by a grid failure or to reduce energy costs (fuel or other), the photovoltaic system can supply the additional energy. Batteries can also be used to store excess energy for later use.

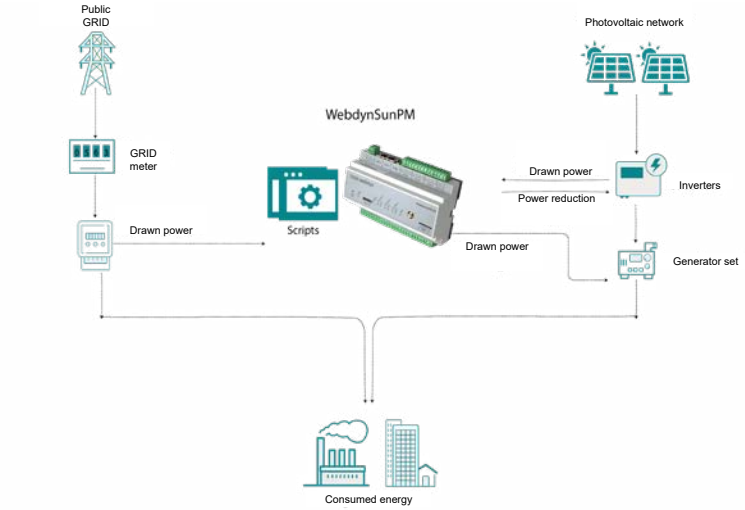
The objective is therefore to be able to regulate the injection of photovoltaic energy depending on the energy consumption of an industrial site and the use of a second energy source such as the electricity grid or generator sets.

Synopsis

The WebdynSunPM product is used to control renewable energy production depending on the site's actual energy consumption and a second energy source.

Production control is local using an LUA scenario that:

- Analyses site consumption read from an electric meter.
- Analyses energy production by querying the power inverters.
- Analyses energy production by querying the generator set energy meters.
- Reduces or increases this energy production depending on actual site consumption



Power regulation management

The power reduction factor is calculated according to the maximum solar plant power value configured in the scenario, and the main source's measured and required power.

The WebdynSunPM script sends active power set points in a dynamic control loop and adapts the photovoltaic plant's power limitation to the customer site's energy needs.

The script is able to handle the following types of regulation:

- **GRID + photovoltaic regulation:**

When all the generator set energy meters are off, the script considers that the GRID is being used.

There are two operating possibilities depending on the "Grid control enabled" parameter:

- **Enabled**: the script takes into account the GRID energy meter and regulates the photovoltaic to respect zero injection. The script complies with RD244 standard operation. The target value for the power drawn from the GRID can be configured using the "Grid Target" parameter.

If the consumed power minus the photovoltaic production is higher than the predefined "Grid Target" threshold on the GRID, we consider that the photovoltaic production is not sufficient: inverter production is increased accordingly.

If the consumed power minus the photovoltaic production is less than the predefined "Grid Target" threshold on the GRID, we consider that photovoltaic production is too high: the inverter output is reduced accordingly.

A safety threshold can be configured using the "Grid safety" parameter which the power drawn from the GRID measured by the energy meter must not fall below. If the threshold is exceeded, the photovoltaic regulation switches to 0% and the regulation restarts using the new readings. The inverter regulation time depends on the "Regulation speed" parameter value.

- **Disabled**: the script switches the photovoltaic regulation to 100%, which is the "Max Solar Power" parameter default value.

- **Generator set + photovoltaic regulation:**

When one of the generator set energy meters is on, the GRID energy meter is no longer taken into account and the regulation is started taking into account the generator set energy meter values with a default 60 second delay that can be configured using the "DG start Tempo" parameter. The script regulates the photovoltaic system to respect zero injection. The script complies with RD244 standard operation. The generator set drawn power target value can be configured using the "DG Target" parameter for each configured generator set.

If the consumed power minus the photovoltaic production is higher than the predefined "DG Target" threshold for the generator sets, we consider that the photovoltaic production is not sufficient: inverter production is increased accordingly.

If the consumed power minus the photovoltaic production is less than the predefined "DG Target" threshold for the generator sets, we consider that photovoltaic production is too high: the inverter output is reduced accordingly.

A safety threshold can be configured using the "DG safety" parameter which the power drawn from the generator sets measured by the energy meter must not fall below. If the threshold is exceeded, the photovoltaic regulation switches to 0% and the regulation restarts using the new readings. The inverter

regulation time depends on the "Regulation speed” parameter value.

When all the generator set energy meters are off, the WebdynSunPM script switches back to the GRID energy meter for regulation.

For unbalanced phases on three-phase meters, if the "Three phases" parameter is enabled, then the WebdynSunPM script takes into account the power of the weakest phase.

For single-phase installations, the "Three phases" script parameter must be disabled.

The script works either with the GRID or with generator sets but never with both at the same time.

Specific operation

When the script starts, a transient phase occurs during the inverter regulation time, this time depends on the "Regulation speed” parameter. The regulation always starts by setting the inverters to 0%.

Restarting or updating the WebdynSunPM causes the inverters to stop and then restart.

If communication with a device (inverter or energy meter) is lost, or if the script stops, the script triggers the operation selected in the “On error” parameter. When the fault disappears, the script restarts the regulation.

Prerequisite

The regulation uses a scenario which is a LUA script built into the WebdynSunPM from version 4.2.15 (the script can be imported manually). To be able to use, understand and/or parameter the injection regulation script, it is essential to:

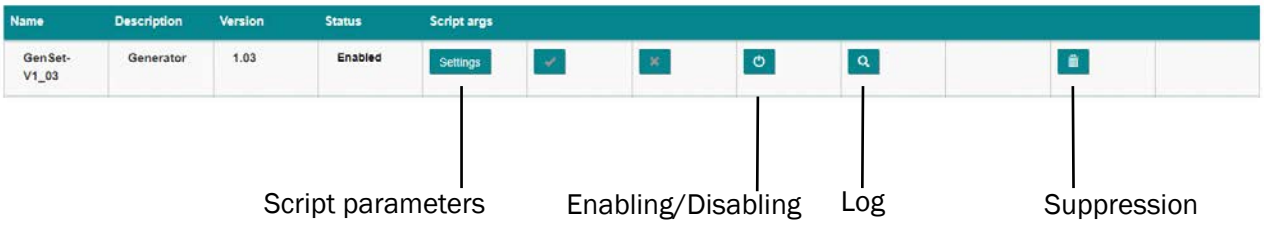
- • Have a WebdynSunPM with a "GenSet" license which is marketed by the Webdyn sales department (https://www.webdyn.com/contact).
- • Have an operational installation including an energy meter on the GRID, an energy meter per generator set (maximum 3), inverters, and a configured WebdynSunPM concentrator,
- • Have the WebdynSunPM user manual to hand.

Photovoltaic injection regulation is achieved by coupling the inverters using a LUA scenario.

This proprietary ".luaw" script specifically designed by Webdyn which includes the purchase of a Webdyn licence is available. In that case, please contact the Webdyn sales department, which will be able to advise or to request the script in a specific version: contact@webdyn.com

Lua script explanation

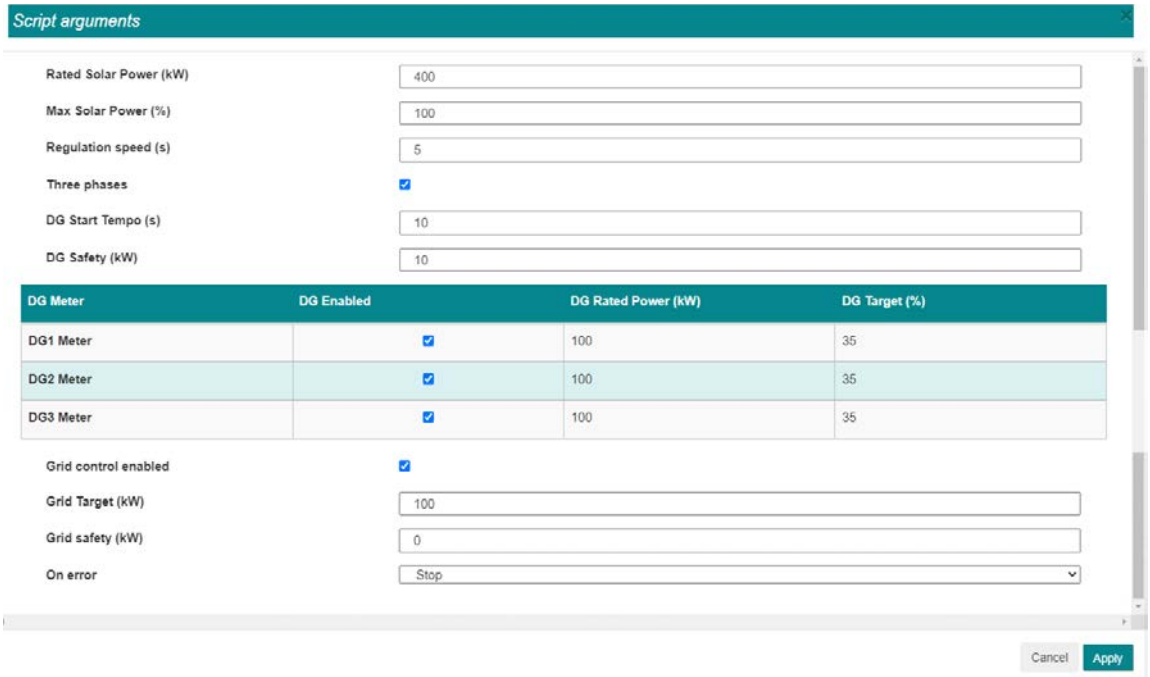
The script must be configured according to your site and your equipment. You can configure the script using the web interface or using the remote server (see section 3.1.2.1.4: “File “ _scl.ini” “ and section 4.1.6: “ “SCRIPT” scripts” in the WebdynSunPM manual).



Script log files are available on the concentrator. It may be useful to use them to monitor the photovoltaic injection regulation evolution. (See section 4.1.8.2: “script log” in the WebdynSunPM manual).

Script configuration depending on the installation

The script configuration can be accessed remotely using the "<uid>_scl.ini" file (See WebdynSunPM manual in section 3.1.2.1.4: “File “<uid>_scl.ini” “) or using the web interface “Settings” button, and a specific window is reserved for it:



The script parameters are the following:

Script parameter name in the web interface	Parameter name in the "<uid>_scl.ini" file	Description	Type	Default value
Rated Solar Power	solarRatedPowerKW	Maximum solar plant power in kW	Positive integer	None
Max Solar Power	maxSolarPowerPercent	Percentage of the maximum solar plant power for the operation of the script	Integer between 0 and 100	100
Regulation speed	regulationSpeedS	Time of each step of the regulation management in seconds	Positive integer	5
Three phases	Three phases	If enabled, regulation management uses the weakest of the 3 phases. If disabled, regulation management uses all the phases. For a single-phase installation, the parameter must be disabled.	Boolean	false
DG Start Tempo	startTempoS	The time it takes for the generator set to start up before it is operational.	Positive integer	60
DG Safety	dgSafetyKW	Safety threshold that the generator set must not fall below in kW	Positive integer	10

DG Meter settings	dg[]	List of parameters for the 3 generator sets	List including the following 3 parameters: • " D G Enabled" • " D G Rated Power" • " D G Target"	-
DG Enabled	dgEnabled	This generator set is taken into account	Boolean	False
DG Rated Power	dgRatedPowerkW	Maximum power in kW for this generator set	Positive integer	0
DG Target	dgTargetPercent	Target percentage of its maximum power that we want to keep this generator set at	Positive integer	35
Grid control enabled	gridControlEnabled	The GRID is taken into account in the regulation calculation if enabled	Boolean	false
Grid Target	gridTargetKW	Power in kW to be taken from the GRID	Positive integer	10
Grid safety	gridSafetyKW	Safety threshold that the GRID must not drop below in kW	Positive integer	0
On error	errorAction	In the event of an equipment error or script stoppage, 3 scenarios can be selected: • Stop: regulation at 0% • None: current regulation • Full: regulation at 100%	List: • none • stop • full	stop

“<uid_sc.ini>” file example:

```
SCRIPT_Args[0]=
{
   "solarRatedPowerKW":800,
   "maxSolarPowerPercent":100,
   "threePhases":true,
   "startTempoS":10,
   "regulationSpeedS":5,
   "dgSafetyKW":10,
   "dg":[
   {
        "dgEnabled":true,
        "dgRatedPowerkW":100,
        "dgTargetPercent":35
   },
   {
        "dgEnabled":true,
        "dgRatedPowerkW":100,
        "dgTargetPercent":35
   },
   {
        "dgEnabled":true,
        "dgRatedPowerkW":100,
        "dgTargetPercent":35
   }],
   "gridControlEnabled":true,
   "gridTargetKW":10,
         "gridSafetyKW":0,
   "errorAction":"full"
}
SCRIPT_Enable[0]=0
SCRIPT_File[0]=GenSet-V1_03.luaw
```

1) Configuring the electricity GRID energy meter

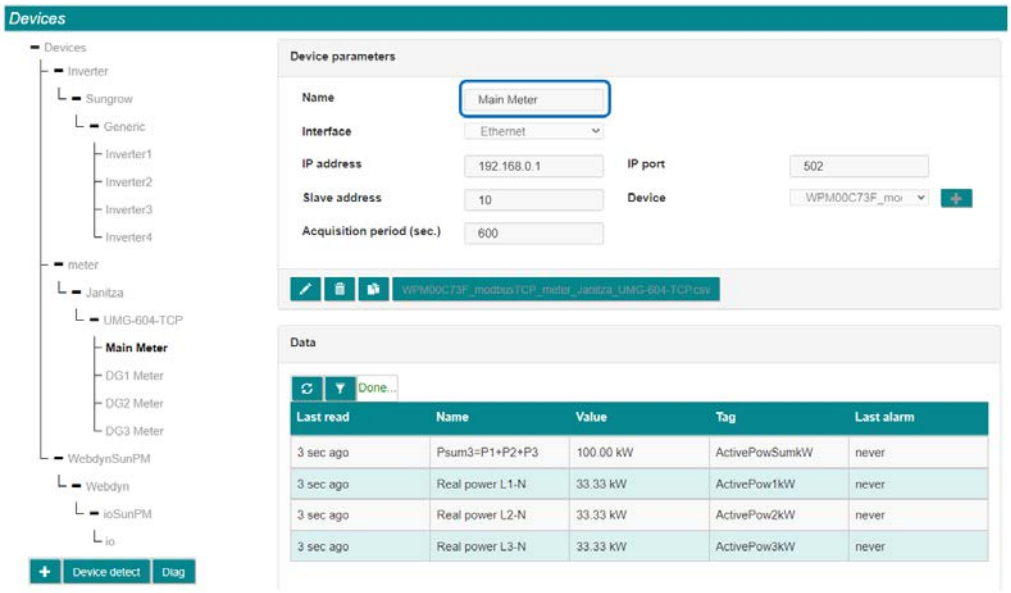
The electricity GRID Meter equipment connected to the concentrator must be identified in the concentrator acquisition file to be able to retrieve its data. Set the Meter Name field (“Name” field, column 3) of the device to "Main Meter".

When adding the equipment to the concentrator, simply select the "Device" equipment to obtain the equipment definition file that will be automatically generated by the WebdynSunPM.

Example of equipment configuration taken from an acquisition file (DAQ):

```
index;interface;name;address;acqPeriod(s);timeout(ms);serialNumber;parameters;manufacturer;model;defFile
IO;;Io;;36000;;;;Webdyn;WebdynSunPM;WPM00C75B _IO.csv
1;SERIAL2;Inverter1;1;600;0;;;Inverter;Generic;WPM00C73F_modbusRTU_Inverter_Sungrow_Generic.csv
2;SERIAL2;Inverter2;2;600;0;;;Inverter;Generic;WPM00C73F_modbusRTU_Inverter_Sungrow_Generic.csv
3;SERIAL2;Inverter3;3;600;0;;;Inverter;Generic;WPM00C73F_modbusRTU_Inverter_Sungrow_Generic.csv
4;SERIAL2;Inverter4;4;600;0;;;Inverter;Generic;WPM00C73F_modbusRTU_Inverter_Sungrow_Generic.csv
5;192.168.0.1:502;Main Meter;10;600;0;;1;meter;UMG-604-TCP;WPM00C73F_modbusTCP_meter_Janitza_UMG-604-TCP.csv
6;192.168.0.2:502;DG1 Meter;20;600;0;;1;meter;UMG-604-TCP;WPM00C73F_modbusTCP_meter_Janitza_UMG-604-TCP.csv
7;192.168.0.3:502;DG2 Meter;21;600;0;;1;meter;UMG-604-TCP;WPM00C73F_modbusTCP_meter_Janitza_UMG-604-TCP.csv
8;192.168.0.4:502;DG3 Meter;22;600;0;;1;meter;UMG-604-TCP;WPM00C73F_modbusTCP_meter_Janitza_UMG-604-TCP.csv
```

Example of equipment configuration using the local HMI:



Variables "ActivePow1kW", "ActivePow2kW", "ActivePow3kW" and "ActivePowSumkW":

In the definition file (DEF) for the Meter device connected to the concentrator, the power variables must be identified and the following tags assigned to them using the device manufacturer's manual:

- Active power of phase L1 in kW: tag "ActivePow1kW"
- Active power of phase L2 in kW: tag "ActivePow2kW"
- Active power of phase L3 in kW: tag "ActivePow3kW"
- Active power of the 3 phases in kW: tag "ActivePowSumkW"

The "Tag" fields are available in column 7 of the device.

Example of power tags taken from a Meter definition file (DEF):

```
modbusTCP;meter;Janitza;UMG-604-TCP
1;4;19020;F32;;Real power L1-N;ActivePow1kW;0.001000;0.000000;kW;4
2;4;19022;F32;;Real power L2-N;ActivePow2kW;0.001000;0.000000;kW;4
3;4;19024;F32;;Real power L3-N;ActivePow3kW;0.001000;0.000000;kW;4
4;4;19026;F32;;Psum3=P1+P2+P3;ActivePowSumkW;0.001000;0.000000;kW;4
```

2) Configuring the generator set energy meter

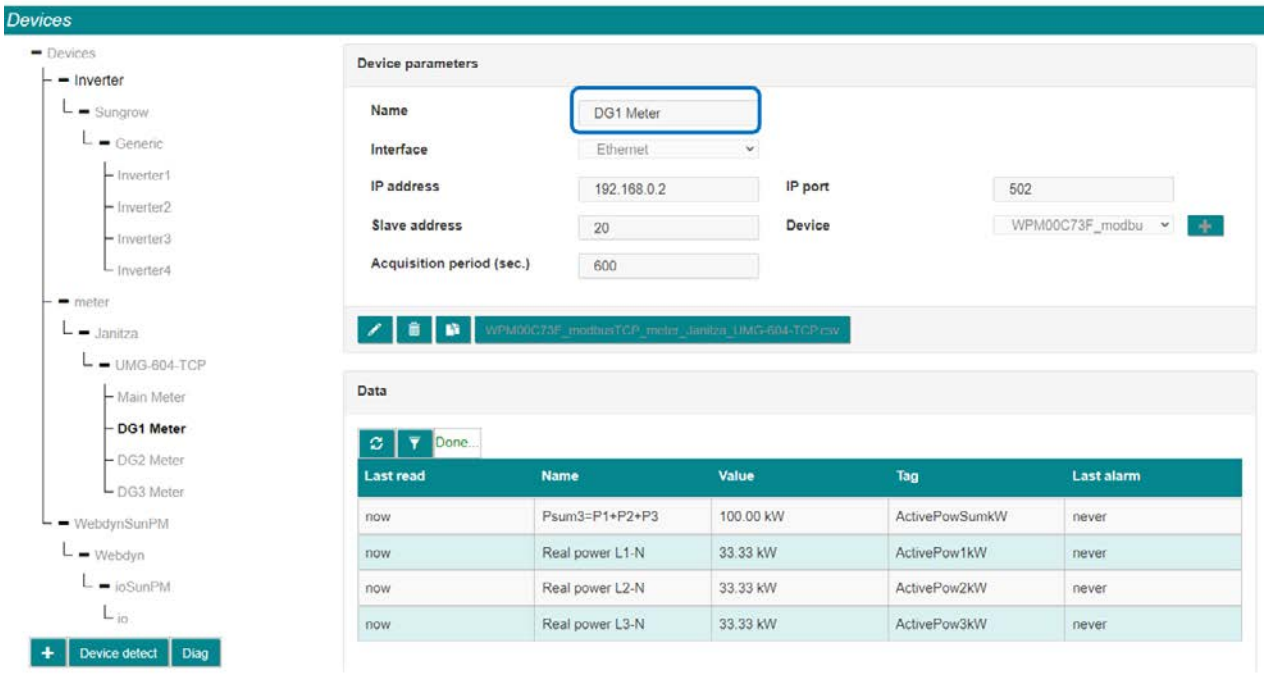
The Meters for generator sets connected to the concentrator must be identified in the concentrator acquisition file (DAQ) to be able to recover their data. Set the Meter Name field (“Name” field, column 3) of the device to “DG1 Meter”, “DG2 Meter”, or "DG3 Meter". The script can manage up to 3 generator sets.

When adding the equipment to the concentrator, simply select the "Device" equipment to obtain the equipment definition file that will be automatically generated by the WebdynSunPM.

: Example of equipment configuration taken from an acquisition file (DAQ):

```
index;interface;name;address;acqPeriod(s);timeout(ms);serialNumber;parameters;manufacturer;model;defFile
IO;;Io;;36000;;;;Webdyn;WebdynSunPM;WPM00C75B _IO.csv
1;SERIAL2;Inverter1;1;600;0;;;Inverter;Generic;WPM00C73F_modbusRTU_Inverter_Sungrow_Generic.csv
2;SERIAL2;Inverter2;2;600;0;;;Inverter;Generic;WPM00C73F_modbusRTU_Inverter_Sungrow_Generic.csv
3;SERIAL2;Inverter3;3;600;0;;;Inverter;Generic;WPM00C73F_modbusRTU_Inverter_Sungrow_Generic.csv
4;SERIAL2;Inverter4;4;600;0;;;Inverter;Generic;WPM00C73F_modbusRTU_Inverter_Sungrow_Generic.csv
5;192.168.0.1:502;Main Meter;10;600;0;;1;meter;UMG-604-TCP;WPM00C73F_modbusTCP_meter_Janitza_UMG-604-TCP.csv
6;192.168.0.2:502;DG1 Meter;20;600;0;;1;meter;UMG-604-TCP;WPM00C73F_modbusTCP_meter_Janitza_UMG-604-TCP.csv
7;192.168.0.3:502;DG2 Meter;21;600;0;;1;meter;UMG-604-TCP;WPM00C73F_modbusTCP_meter_Janitza_UMG-604-TCP.csv
8;192.168.0.4:502;DG3 Meter;22;600;0;;1;meter;UMG-604-TCP;WPM00C73F_modbusTCP_meter_Janitza_UMG-604-TCP.csv
```

Example of equipment configuration using the local HMI:



Variables "ActivePow1kW", "ActivePow2kW", "ActivePow3kW" and "ActivePowSumkW":

In the definition file (DEF) for the Meter device connected to the concentrator, the power variables must be identified and the following tags assigned to them using the device manufacturer's manual:

- Active power of phase L1 in kW: tag "ActivePow1kW"
- Active power of phase L2 in kW: tag "ActivePow2kW"
- Active power of phase L3 in kW: tag "ActivePow3kW"
- Active power of the 3 phases in kW: tag "ActivePowSumkW"

The "Tag" fields are available in column 7 of the device.

Example of power tags taken from a Meter definition file (DEF):

```
modbusTCP;meter;Janitza;UMG-604-TCP
1;4;19020;F32;;Real power L1-N;ActivePow1kW;0.001000;0.000000;kW;4
2;4;19022;F32;;Real power L2-N;ActivePow2kW;0.001000;0.000000;kW;4
3;4;19024;F32;;Real power L3-N;ActivePow3kW;0.001000;0.000000;kW;4
4;4;19026;F32;;Psum3=P1+P2+P3;ActivePowSumkW;0.001000;0.000000;kW;4
```

3) Inverter configuration

This step is normally already completed when the inverter is Modbus and uses a definition file automatically generated by WebdynSunPM.

In each definition file (DEF) for inverters connected to the concentrator, the following tags must be entered:

"Inverter" tag:

In the inverter definition file header, the category name must be entered, which must be identical for all the inverters. The category in the header ("Category" field in column 2) for the device must be called "Inverter".

"cmdPwrPercent" tag:

The power reduction variable must be identified In the inverter definition file. The power reduction variable tag ("Tag" field in column 7) for the device must be called"cmdPwrPercent".

This tag must be identical for all the inverters. If that is not the case, they must be modified so that they are all identical.

"WMaxLim_Ena" tag optional:

The control variable for activating the power change must be identified in the inverter definition file. The power change activation command variable tag ("Tag" field in column 7) for the device must be called "WMaxLim_Ena".

This tag must be identical for all the inverters. If that is not the case, they must be modified so that they are all identical.

Example of category and inverter tags taken from an inverter definition file (DEF):

“Inverter" tag on the category name

"WMaxLim_Ena" tag for the power reduction activation command

```
modbusRTU;Inverter;Sungrow;Generic
...
109;3;5006;U16;;Power limitation switch;WMaxLim_Ena;1.000000;0.000000;;4
110;3;5007;U16;;Power limitation setting;cmdPwrPercent;0.100000;0.000000;%;4
...
```

“CmdPwrPercent" tag for power reduction

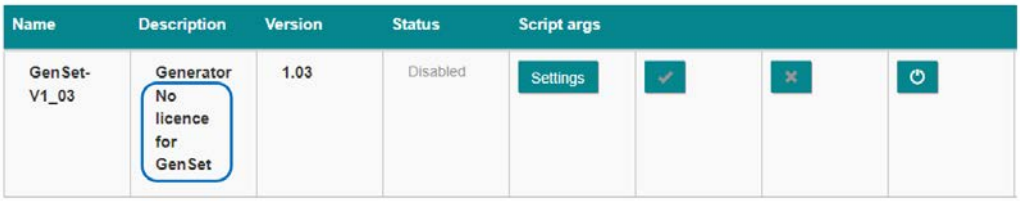
4) Activate the script

A specific button is used to enable and disable:

When the script is disabled, its status is greyed out and “Disabled” is displayed.

When the script is enabled, its status is black and “Enabled” is displayed.

If the script remains "Disabled", an error message is displayed in the script description.



If a "No licence for GenSet" error message is displayed, the licence must be added to be able to enable the script. See importing a licence in the WebdynSunPM manual, section 3.1.2.1.5: "File "<uid>_licence.ini"" or section 3.2.3.1.1: "Import a script or a licence".

Webdyn cannot be held liable for any possible damage caused by the use of a script.

5) Script log

The study of the script logs makes it possible to follow and understand the inverter regulation

Example of photovoltaic regulation with generator sets:

Description of the log values:

- tune: indicates that the regulation is enabled
- DGx Meter:YES: indicates that the generator set energy meters are present

```
2022-12-15 12:56:47 [GenSet-V1_03.luaw 811] tune;DG1 Meter:YES;DG2 Meter:YES;DG3 Meter:YES;src:dg;state:running;
target:210.00;safety:10.00;meterValue:210.00000585937;invPwr:47.599996337891;loop:5.0;wait:0
```

- src:dg: indicates that the main source is the generator set
- state:running: indicates that regulation is in progress
- target:210.00: main source target power
- safety:10.00: main source safety threshold
- meterValue: 210.00000585937: main source total current power, here the generator sets
- invPwr: 47.599996337891: actual percentage of photovoltaic power
- loop:5.0: regulation management time in seconds
- wait:0: waiting time in seconds before the generator sets are started

Example of photovoltaic regulation with the GRID:

Description of the log values:

- tune: indicates that the regulation is enabled
- Main Meter:YES: indicates that the GRID energy meter is present

```
2022-12-15 14:16:02 [GenSet-V1_03.luaw 811] tune;Main Meter:YES;src:grid;state:running;target:100.00;safety:10.00;
meterValue:99.99999609375;invPwr:80.000003125;loop:5.0;wait:0
```

- src:grid: indicates that the main source is the GRID
- state:running: indicates that regulation is in progress
- target:100.00: main source target power
- safety:10.00: main source safety threshold
- meterValue: 99.99999609375: total current power of the main source, here the GRID
- invPwr: 80.000003125: actual percentage of photovoltaic power
- loop:5.0: regulation management time in seconds
- wait:0: waiting time in seconds before the generator sets are started

Example of a photovoltaic regulation problem with the GRID:

Description of the log values:

```
2022-12-15 09:48:09 [GenSet-V1_03.luaw 811] warn;Main
Meter:YES;src:grid;state:error;target:100.00;safety:10.00;meterValue:0;invPwr:0;loop:5.0;wait:0
```

- warn: indicates that there is a problem with the regulation
- Main Meter:YES: indicates that the GRID energy meter is present
- src:grid: indicates that the main source is the GRID
- state:error: indicates that the regulation is in error
- target:100.00: main source target power
- safety:10.00: main source safety threshold
- meterValue: 0: total current power of the main source, here the GRID
- invPwr: 0: actual percentage of photovoltaic power
- loop:5.0: regulation management time in seconds

- wait:0: waiting time in seconds before the generator sets are started

This can be interpreted as an inverter polling problem.