QUICK GUIDE – TR10 IN PERFORMANCE CHECK

Purpose:

Based on current Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz – EEG), the owners of German wind farms commissioned after 1st of January 2018 are obliged to report the produced and potential electricity after 5, 10 and 15 years of operation. This and the complete calculation of the **Site yield** and **Quality factor** are described in the Technical Guideline No. 10 (hereinafter **TR10**).

The Quality factor calculation is a sub-module of the PERFORMANCE CHECK module and includes the **full implementation of the TR10, rev.3.** This quick guide shall guide the user through the process of the analysis.

Outline of Guide:

- 1. Workflow
- 2. Data Import
 - Production data from SCADA
 - Status logs from SCADA
 - Import Sold
- 3. Plausibility
- 4. Site Yield
- 5. Quality Factor and Reports

1. WORKFLOW

The process explained in this quick guide requires the licenses for the modules BASIS, METEO, PERFORMANCE CHECK and TR10.

The workflow of this quick guide is as follows:

- Create new "Existing WTG" objects.
- Download some Meso- and / or Reanalysis data in METEO-Object(s) (optional but recommended).

- Start PERFORMANCE CHECK from the modules menu or use the shortcut in the toolbar.
- Select "Quality factor calculation (TR10)" on the tab "Concept choice".
- Import SCADA data with production, wind speed, wind direction and load this data into the "Existing WTG" objects.
- Import and merge status codes from turbine log files to 10 min. production data.
- Import the sold electricity.
- Evaluate the plausibility of the imported data.
- Calculate not produced fictitious electricity due to events of categories 2 (WTG technically not available), 3 (Einspeisemanagement) or 4 (optimized selling).
 - Create "Consistent wind speed time series" using the tabs "Wind speed correlation" and "Wind speed regression".
 - Create power curves using the tab "Moving power curves".
 - Go to "Site yield → Results" and use the buttons
 "Calculate production" and "Calculate site yield" to get the results.

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102	99,6	34.339,943	32.479,648	0,3665	1.171,085	0,000	141,128	33.116,023
103	99,5	37.771,389	35.695,455	0,4315	1.200,862	0,000	179,140	36.333,948
204	96,7	37.766,976	35.692,013	0,8280	1.147,902	0,000	516,827	36.609,607
205	95,5	37.762,359	35.684,065	0,8671	1.147,013	0,000	628,568	36.710,453
206	93,9	37.757,270	35.675,764	0,8988	1.114,698	0,000	831,671	36.869,690
207	95,5	36.634,405	34.708,558	0,8681	1.123,426	0,000	1.421,883	36.508,789

- Go to the tab "Quality factor", enter the Referenzertrag¹ to the WTG(s). As soon as done, windPRO will calculate the "Quality factor", which is the final result of the whole calculation process.
- Go to the Tab "Report" and generate the report(s) for the grid operator.

¹ Reference production defined for each WTG type and hub height according to the EEG. Can be found in the FGW-shop: https://wind-fgw.de/

2. DATA IMPORT

To run the TR10 analysis (and any PERFORMANCE CHECK analysis in general), you need to import SCADA data, through the following process:

- Prepare the SCADA data as *.csv or *.txt files.
- Create Existing WTG objects (including IDs).
- Start PERFORMANCE CHECK, concept TR10.
- Setup the import filter (Auto detect).
- Pair and load.
- Merge the status logs with the 10 min. based time series.

Prepare the SCADA data as text files

SCADA data must be in a text file as 10 min. values. If your data is in e.g. Excel, the file(s) must be saved as *.txt (TAB separated preferable) or *.csv. The PERFORMANCE CHECK data importer is quite flexible and can handle data in single or multiple files, e.g. one turbine per file; all turbines in one file; one turbine per day, per month etc. in one file.

It is important to have an identifier (ID) of the turbine in the file headers or in a column or in the file names (if one file per turbine). Later this ID will be used to automatically pair the SCADA data with an Existing WTG object.

Create Existing WTG objects (including ID)

Either manually insert an Existing WTG object *, copypaste the position from a spread sheet or download turbine positions directly through the Online WTG Data tool ⁽²⁰⁾. Alternatively, convert New WTG(s) into Existing WTG(s) by using the paste option "Edit object(s) before pasting".

Remember to assign an ID to the WTG object as either Description or User label. It is convenient to name the WTG(s) using the same WTG IDs as the SCADA system uses, so the "Auto pair" function can be used later on.

Import from data files

Start PERFORMANCE CHECK using "Quality Factor calculation" from the tab "Load & Operation".

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As soon as started, create a new session, name it and enter it.

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Inside the session, please select the concept "Quality factor calculation (TR10)" and proceed to the tab "Data".

Import production data from SCADA

The structure of the import filter in the module PERFORMANCE CHECK (no matter on the concept choice) is similar to the METEO-Object. Tip: windPRO is advising the next logical step of yours and proposes it by green coloring.

Files/folders (must have exact sar	ne structure, if differently st	ructured files, add more impor	t filters)	
			Add file(s)	Add folder
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Select "Add file(s)" or "Add folder", select the files (or folder with files) and confirm the selection with "Ok".

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The "Auto detect" option is typically used, when importing the data for the first time. As soon as the import filter is finalized (see next step), it is practical to

save it using the "Save" button. By this, the created import filter setup in the ".pci" format can be used to setup the import filter e.g. in another session very fast.

With no ".pci" file available, the import setup needs to be finalized manually:

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In the example above, 7 files (each contains SCADA-Data of one turbine) are added to the import setup with following data fields:

- Column 3: Date/Time (mandatory)
- Column 5: Wind speed (mandatory)
- Column 11: Production (mandatory)
- Column 19: Wind direction, resp. nacelle position (mandatory)

Following signals are not mandatory for the finalization of an analysis, but not using them causes a deviation to the TR10 and will be documented in the report "Deviations to TR10".

- Cumulative production (see Column 16)
- Temperature
- Air pressure
- RPMs
- Pitch angle

Besides the definition of the signals "inside the files" as per step above, it is also necessary to define where windPRO can find the data for each of the WTG(s), resp. how the WTG ID handling is done. There are several options:

Select WTG-ID loca	tion:
WTG-ID Guide	Advanced -
	Filename Column header Import Setup (Blank ID)
	Advanced Column

In this example, the "Advanced" was used, which allows the user to select e.g. a string from the file name:

	J-IDs.				
Example: Fo WT <numbe Data" as pre</numbe 	r a list of data files R> January 2011.c fix to WTG-ID and '	named "Produc sv" one would e "Space" as delir	tion Data enter "Pre niter befe	a oduction ore and	
Data files:					
101 CSV 102 CSV 103 CSV 204 CSV 205 CSV 206 CSV 206 CSV					
Prefix to WTG	-ID (Optional):				_
Text (or delim	iter) before WTG-ID:				
	iter) after WTG-ID:		•		
Text (or delim					
Text (or delim	ind using entered pat	tern:			

In compliance with the requirements defined in the TR10, the user must decide whether the SCADA data represents the beginning of the period or the end of the period.

Time stamps are logged in:	End of a period 👻
	Beginning of a period
	End of a period
	User defined

For example, does the time stamp "02.10.2018 10:00" represent the interval "09:50 – 10:00" or "10:00 – 10:10".

If you are not sure, please clarify with the WTG manufacturer. If the "End of a period" was selected, the loaded time series are shifted by 10 minutes, so the status logs and the 10 min. time stamps are in line.

As soon as the setup of the import filter has been finished, the "Pair and load" button Pair and load becomes green, which again indicates that the user should proceed this way. When moving "Pair and load", windPRO always notifies the user, if one or more TR10relevant signals are missing:



These signals are necessary for the plausibility check. The assessment can proceed without them too, but their unavailability will be documented in the report.

Use the green Add button to add the "Existing WTG objects" representing the WTG(s) that are going to be the subject of the assessment. In case that the user did a proper setup of the WTG ID, the "Auto pair" button should link exactly one source of the SCADA data (e.g. one file or one column) with exactly one "Existing WTG object" – see in the next figure. In this case, the User labels of each of the "Existing WTG objects" finds exactly one file with the SCADA data with the same name as this "User label" is. The button "Load data" is now available. Use it to import the 10-min SCADA data into the WTG objects.



Before leaving the "Pair and load" window, double check and potentially correct the nominal wind speeds and nominal power outputs for day and night modes. These are used for the calculation of the moving power curves.

The "Use night mode" is activated in default. The correct nominal wind speed and nominal power output of the day / night mode should be defined here manually by the user. The default time for night in Germany is 10PM - 6AM.

The import-concept foresees that the imported time series is in local time with DST (summer- / wintertime) changing. Shouldn't this be the case, please deactivate the checkbox "Time series in local time".

When ready with the setup, click "Load data", so the data are imported into the "Existing WTG objects".

During the import of the data, windPRO checks its consistency. Should there be a time stamp that is not in the regular 10 min. form, windPRO will notify the user and request a corrective measure:



When confirming with "Ok", windPRO will assign this irregular time stamp to the nearest regular one.

It can also happen that there are some duplicates found in the time series, e.g. due to the assignment of the irregular time stamp as per above, when there is already some other data with this regular time stamp. In case some duplicates are found, the user is notified:

Information		
1	Duplicate samples detected for one or more WTG(s). These samples will be deleted automatically and documented in the report.	

The TR10 defines that the chronologically first occurrence shall be deleted (unless the second occurrence fails the plausibility checks).

As soon as the "Pair and load" process is done, the button to the next step, which is the upload of the status logs, becomes green: Setup categories

Import status logs from SCADA

The status logs are separate files logging all specific operational states of a WTG. The main and the most complicated difference in comparison to the production data is the format. The production data are in regular 10 min. format; the status logs are saved in the format "from – to" or "from + duration".

The way to import the status logs in windPRO is similar to the process of the import of the production data described in previous steps. Which means:

- Upload the status logs as well as EinsMan and optimized selling information.
- Define the import filter.
- Pair the data with the "Existing WTG(s)".
- Import the list with assignment of all WTGs and project specific status codes to the TR10 categories.
- Load the data.

ept choice 1	mport setup Pairing to WTG obje	ects Manage status signals Load/review				
Check if data	separator and first line with data	a are correct with "View file". When correct	t, assign "Type" to each column in the	transpos	ad Preview.	
Files/folder	s (must have exact same structur	re, if different structured files, add more im	1port filters)			
C:\Wine	dPRO Data\Projects\TR10 Manual	(2) SCADA ERROR LOGS (+ EINSMAN)\Stat	tus_2015-01-01_2015-12-31 (ohne Ein	nsman).ci	N	Add file(s)
						Add folder(s)
						Demon
						Nettiove
						View file
Time rone	for input-	project properties: (UTC+01:00) Amsterda	am Berlin Bern Rom x			
Header	line: 1					
Header Header First line w Data separ Select WT	line: 1 ith error code: 2 ator: Semicol - G-ID location:	WTG-IDs based on (current selection:		Import setup	p:
Header Header First line w Data separ Select WT WTG-II	Initiality and a second	WTG-IDs based on (WTG-ID Options 101 102 103	current selection:		Import setup Save	p: Load
Header Header Header First line w Data separ Select WT WTG-II Column h	Included Incl. 1 Incl. 1 Incl. 2 Incl.	WTG-ID Options 101 102 103 First data	current selection:	For	Import setup Save mat	convert
Header Header Header First line w Data separ Select WT WTG-II Column h 1	Incused Ine: 1 ith error code: 2 ator: Semicol - G-D location: Guide Column - Header	WTG-IDs based on (WTG-IDs Options 101 102 103 First data 1	current selection:	¥ For	Import setup Save Mat	p: Load Convert
V Header Header First line w Data separ Select WT WTG-E Column In 1 2	Interiore Interi	WTG-IDs based on WTG-ID Options 101 102 103 First data 1 101	current selection: Type	v v	Import setup Save nat	p: Load Convert
V Header Header First line w Data separ Select WT WTG-II Column In 1 2 3	Interiore Interiore Interiore Interiore Interiore Interiore Interior Interi	WTG-IDs based on WTG-ID options 101 102 103 First data 1 101 0.101.2014	current selection: Type Start date	For • d.m	Import setup Save mat	p: Load Convert
V Header Header First line w Data separ Select WT WTG-E Column In 1 2 3 4	Incluses Inc	WTG-3D (bit based on i WTG-3D (ptoms) 101 102 103 First data 101 0.012014 104-726	current selection: Type Start date Start trate	For • • d.m • hom	Import setup Save mat Y	0: Convert
Header Header Header First line w Data separ Select WT WTG-E Column h 1 2 3 4 5	Incluses Inc	WTG-IDs based on WTG-ID options 101102103 First data 1 101.01.2014 0.01.2014	Type Type Start date Start time Primary Error code	For • d.m • hcm	Import setup Save mat y	01.01.21 0
Header Header Header First line w Data separ Select W/D WTG-II Column h 1 2 3 4 5 6 -	Incluses Inst: 1 ith error code: 2 ith error code: 2 ith error code: 2 ith code [Column +] iteader Gode [Column +] iteader Sertemn, Datum Zeate Haspitatuta	WTG-3D (pages) WTG-3D (pages) First data 101 0.0.1.2014 104-72.6 0 2 2	Type Start data Start time Seart time Seart time Seart time	For • d.m • hom • x *	Import setup Save mat Y S	p: Load Convert 01.01.24 10:47:2 0 2
Header Header Header First line w Data separ Select WT WTG-IE Column % 1 2 3 4 5 6 7 0	Incluses Inc	WTG-ID Dated on First data 101102103 1 101 101 0.01.2014 104/726 0 2 Anlage bernet	Type Start date Start time Privacy first code Secondary first code Grand examplian	For • d.m • hom • x • v	Import setup Save mat Y IS	01.01.21 0 2
V Header Header First line w Data separ Select WTI WTG-II Column 1- 1 2 3 4 5 6 6 7 8 8	Incluses Inc	WTG-20 Option 101 102 103 Int 102 103 First data 101 0.0.1.2014 10.472.8 0 2.2 Anioge benett	Current selection: Type Start date Start time Prenary firm code Secondary firms co Crief description	For - d.m - hcm - x 	Import setup Save mat y	8: Convert 01.01.21 10:47:2 0 2

Unlike the import of the production data in 10 min. format, there is no "Auto detect" button available here. The signals must be defined manually using the drop down menu in each line. The format of the defined signals needs to be defined manually, too. "d.m.y" is used for the definition of the date, month and year, "h:m:s" for hour, minute and second. The order of the symbols can be changed, if the format of the data and time in the status logs is different. Similar to the import filter of the production data, the import setup can be saved in a separate ".pci" file for a later use. The last step at this tab is to setup the WTG ID location:

Select WTG-ID location	on:		WTG-IDs based on current selection:
WTG-ID Guide	Column	 WTG-ID Options 	101 102 103

The purpose of the next tab, "Pairing to WTG objects", is again similar to the pairing to the WTG objects by the import of the production data in 10 min. format. windPRO uses the WTG-ID setup to merge the status logs and the "Existing WTG objects".

"Einspeisemanagement and Optimized selling":

The default setup is "EinsMan (resp. Optimized selling) included in the status logs". This means that the events that belong to these categories have an explicit status code directly in the SCADA system. Shouldn't this be the case, you can deactivate the checkbox and upload the data manually from an external source.

EinsMan i	ncluded in status logs				
Check if data	a separator and first line with	data are correct with "View file". V	When correct, assign "Type	" to each column in the tr	ansposed Preview.
Files/folder	rs (must have exact same str	acture, if different structured files,	add more import filters)		
C:\Win	dPRO Data\Projects\TR10 Ma	nual(2) SCADA ERROR LOGS (+ EI	NSMAN)\EisMan154894724	2.csv	Add file(s)
					Add folder(
					Remove
					View file
Time zone	for input: Same as in	the project properties: (UTC+01:0	00) Amsterdam, Berlin, Ber	m, Rom, -	
✓ Header	included				
Header	line: 1				
First line w	with error code: 2				Import setup:
Data separ	rator: Semicol -				Save Load
Column 🗉	Header	First data	Туре	Format	Converted
1	EisMan Nr.	52221		*	
3	EisMan Beginn	10.01.2014 01:44	Start date time	 d.m.y himis 	10.01.2014 01:44:00
6					

The foreseen format of the data is: "Start date and time \rightarrow End date and time" and can be entered either from a *.csv file (or similar) or from a spread sheet via clipboard. The information about EinsMan events is publicly available on the internet on the pages of the Transmission operators (TSO).

Manage status signals

The idea of TR10 is that there is going to be a list of all available status codes for each particular WTG and that each of the status codes is going to be assigned (ideally by an independent external advisor / accredited advisor) to one of the TR10 categories.

Concept choice Import setup	Pairing to WTG objects	Manage status signals Lo	d/review					
Multiplying factor:	Load sta	tus signal options	Nor	mal operation status signa	al-			
Primary status signal: Secondary status signal:	1 Add st 1 Replac Clear	atus signals to existing list xe status signals in existing lis status signals in existing list	t. Nor	Normal operation error description: Normal op				
Load status signals Set the TR10 cate - of a	Delete stat	us signals 🔹 Vie	v categories					
Drag a column header here	to group by that column							
0 status signals defined in cu	irrent session							

The aim of the step in this tab is to merge the status logs uploaded in the previous steps with the library/ list (ideally certified), where all of them are assigned to a certain TR10 category. The data can be either uploaded from the clipboard (using copy-paste e.g. from a spread sheet) or imported from an external file (in *.csv or *.txt format). Another option is to use the categories directly from the status logs, if they were recorded & saved directly by the SCADA system.

An important thing to apply is the "Multiplying factor":



Some manufacturers use the so called "Primary and Secondary status signals". Unfortunately, windPRO

cannot handle such data structure in its native form, as it only can work with single and unique status codes. Therefore, the "Multiplying factor" was introduced. The idea is to multiply the primary error code with some big value, e.g. 1000. windPRO multiplies then each primary status code by 1000 and adds the secondary status code to this number. E.g. a primary status code of 12 and a secondary status code of 2 result in the value 12002, which represents a unique status code for the further process of the analysis.

Import the library with status codes either from the clipboard or directly from a *.csv or *.txt file.

heck if data review.	separator and f	first line with dat	ta are correct with "View file". When	correct, assign "Type" to each column in the tr	anspos				
File: C:\WindPRO D Header included Header line: 1 First line with error code: 2		C:\WindPRO D	Data\Projects\TR10 Manual\3) ERROF	R LOGS LI View file					
			Load error code ontions						
			Add error codes to present list	t of error codes					
		1	Deelage existing error redee a	represented in list helew					
		2	C Replace existing error codes in	epresented in list below					
Data separator: Semicol -			 Clear existing list of error code 	es					
				Import return					
				import Betap.					
				Save					
					00				
Column 🐃	Header		First data	Туре					
Column 🛏	Header Error id		First data 6670	Type <ignore></ignore>	00				
Column 🕨	Header Error id Primary code		First data 6670 0	Type <ignore> Primary status signal</ignore>					
Column 🕨	Header Error id Primary code Secondary cod	le	First data 6670 0	Type <ignore> Primary status signal Secondary status signal</ignore>					
Column 🕨	Header Error id Primary code Secondary cod TR10	le	First deta 6670 0 0	Type <lgnore> Primary status signal Secondary status signal Category</lgnore>					
Column 🛌	Header Error id Primary code Secondary cod TR10 Name	le	First data 6670 0 0 Anlage in Betrieb	Type <1gnore> Primary status signal Secondary status signal Cotegory Status signal description					
Column 🛌	Header Error id Primary code Secondary cod TR10 Name Category	le	First data 6670 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Type <]gnore> Primary status signal Secondary status signal Category Status signal description Type description					
Column 🛏	Header Error id Primary code Secondary cod TR10 Name Category ProjectID	le	First data 6670 0 0 Anlage in Betrieb Normal 5	Type <tpre>clanore> Primary status signal Secondary status signal Category Status signal description Type description <landscience></landscience></tpre>					
Column 🛏	Header Error id Primary code Secondary cod TR10 Name Category ProjectID Type	le	First data 6670 0 0 Anlage in Betrieb Normal 5	Type <tpre> <tpre> type cignore> Primary status signal Secondary status signal Category Status signal description Type description <tpre> typer> disprore> <tpre> typer> </tpre></tpre></tpre></tpre>					
Column 🕨	Header Error id Primary code Secondary cod TR10 Name Category ProjectID Type Compensated	le curtailment	First data 6670 0 0 Anlage in Betrieb Normal 5 false	Type <a href="https://www.spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-spinal-sp</td> <td></td>					

The columns in the file need to be defined in a similar way as for the import of the production data or the status logs. The applied import filter can be saved as *.pci file.

After the import, windPRO informs you about the amount of identified status codes:



Confirming this notification with Ok will close the import of the status codes library and will show you the list of imported status codes:

Multiplying factor:	0 L0	ad status signal optic	65	Normal operation	on status signal:		0				
Primary status sig	sal: 1 000) Add status signals to er	isting list	Normal nearati	n error descripti	 Normal op	eration				
Secondary status	signal: 1 C	Replace status signals i	n existing list								
		Clear status signals in (sisting list								
Lood stats	s signals • Del	ete status signals	View cetego	ries						Display/include: Error	code:Descriptio
Set the TR10 o	ate - of all selected error	codes to	- Updat	2						Import settings	Export setting
Drag a column be	under here in oroun by that	column									
The second second second	la defined in success constant										
Chabut sciencel	Description	Tune description	liner description	TR10 ratesport	Sub ratesport	Tune		Count	0	atonory undata avalana	500
Status segue	Telesciptori	Type Georgeon	over outputy tool	Colores & Brenning	Son constant	1 pps		Cours		ought papers advance	
0	Arrage in betrieb	Normal		Category 0: Norme -		State			0		
	Arridge scarses	Normal		Category 0: Norma *		Clair			0		
2	Anage beret	Normal		Category 0: Norma +		State					
	Abalah Land Central	Nermal		Calegory 0. Norma -		Clair					
	Andere washood Was	d Normal		Calegory 0. Norma -		State					
1001	Anlana partnent - Ster	Parrieta shut down		Category 2: Coorts +		State					
1002	Aninge georget - Sun	Compto shut down		Category 2: Conth +		Ctate					
1003	Anipos pastoont - Parl	k Linscheduled maintena		Category 2: Constr -		State			0		
1004	Anipos nestront - Con	Unscheduled maintena		Category 2: Constr -		State					
1005	Ardage gestegat - Aus	s Environment		Category 1: Constr -		State			0		
1006	Aninge gestoppt - Pari	k Remote shut down		Category 2: Constr +		State			0		
1007	Aninge gestoppt - Pari	k Remote shut down		Category 2: Constr -		State			0		
1008	Anlege gestoppt - Ferr	n Remote shut down		Category 2: Constr -		State			0		
1009	Anlage gestoppt - Zeit	Normal		Category 0: Norma -		State			0		
1010	Anlage gesteppt - Kun	c Remote shut down		Category 2: Constr -		State			0		
1011	Anlage gestoppt - Kun	c Remote shut down		Category 2: Constr -		State			0		
1013	Anlage gestoppt - Parl	k Remote shut down		Category 2: Constr -		State			0		
1014	Anlage gestoppt - Leis	it Normal		Category 0: Norma -		State			0		
1015	Anlage gestoppt - Exte	Normal		Category 0: Norme -		State			0		
1019	Anlege gestoppt - Leis	t Normal		Category 0: Norme -		State			0		

In the example, the list contains 2854 status codes. Only around 100 were activated during the operation of the WTG(s), which is typical. Move to the tab "Load/review" and use the "Load" button. When done, close the "Setup categories" with Ok and move to the next vertical tab.

Setup categories											
Cond	cept choice	Import setup	Pairing to WTG objects	Manage status signals	Load/review						
WTG time	Load	Mar	ual assignment –								
serie	Date time		Status signal	Is status	Status description						
Š											

Import SOLD

The sold data are imported as monthly production data. The current windPRO version does not support the import of a time series (e.g. Lastgänge) as this would not be in compliance with TR10. The first step is to create a new grid connection point:

Add grid connection point

When created, a new line and the "Load Data" button appear in the right window.

formance Che	ck - Profile: TR10 Manual							
pt choice Da	ta 🖉 Site yield Quality factor	Report						
Add e	rid connection point							
		_						
WTG	Grid connection point		Grid connection point	E [MWh]	Correction [%]	Ecorr [MWh]	Load data	
101	Not assigned		Grid connection point 1	0.000	0.00	0.000	Load Data	
102	Not assigned							
103	Not assigned							

Use the "Load Data" button. This will bring you to a table that is expecting the import of monthly produced energy. All are in MWh. You can either manually type the values into the table or use the button "Load data from file or clipboard".

For importing the data from the clipboard or from a file, there is another import mask:

👹 TR10: Grid Connection Point - Im	port Data		- 0	×
Load data from file or d	lipboard Allow sales to b	be 0		
Month		Energy, Sold [MWh]		
Jan 2014				0.000
Feb 2014				0.000
Mar 🔣 Import data				×)0
Apr 2				0
Indy Load from file	C: (WindPRO Data(Projects(TRI	0 Manual(4) SOLD + EING View f	lie	0
Jul 2	Load			0
Aug : 🗹 Header Included				0
Sep : Header line:	1			0
Oct 2 First line with data:	3			0
Nov .	Cominal Desired secondary			0
Jan 2	Semicor · Decimal Separator:			0
Feb :	dd.mm.yyyy			0
Mar : Column 🖮 Header	First data		Туре	10
Apr 2 1 Month	01.01.2014		Month	- 10
May 2 Sold	6347.383		Energy, Sold [MWh]	- 10
Jul 2				0
Aug				0
Sep :				0
Oct 2				0
Nov 2				0
Dec:				10
Feb Ok Ca	ncel			0
Mar 2016]			0.000
Apr 2016				0.000 +
Ok Cancel	1			
2ª Curicer				

The assumption is that the source is a table with just two columns - Month & year and Produced electricity.

3. PLAUSIBILITY

Before it is possible to calculate the time slices, you need to check all of the checkboxes and add a description of the available data and information and a description of the source of the assignment of the status signals to the EEG categories. The checkboxes are declarations of yours in terms that the data was checked for its completeness etc. This is required in the TR10 and will be documented in the report.

۹	Performance Check - Profile: TR10 Manual
Con	cept choice Data 🖉 Site yield Quality factor Report
<	Please check and describe. The results of the plausibility check (chapter 4.5) are included in the report.
Imp	☑ Available data and information was checked for completeness.
ort S	☑ Apart from automized plausibility checks all data was checked for plausibility and manually disabled or corrected where necessary.
CAD/	Description of available data and information:
Time series \$	Manual: Description of available data and information.
SCAD/	The assignment of error codes to EEG categories was done based on the following documents (document name, revision number, date):
V 🖌 Import SOLI	Manual: Description of documents used for the assignment of status codes to TR10 categories.
l o	The operation status of the turbines was checked and compared to the actual obligations imposed under licensing law.
2	Park optimized operation modes were checked and compared to the documentation.
ausit	Calculate time slices Missing data Monthly availability Plausibility
vility	

After this step is finished, please proceed with the button "Calculate time slices". This calculates the total times of each of the EEG categories.

In the next step, you can check the missing data using the button "Missing data".

The TR10 availability calculation was removed in the revision 3. It still can be displayed using the button "Monthly availability", but this is just informative.

Last button at this tab is the "Plausibility". It is not possible to proceed in the analysis until the plausibility of the produced (E_Scada) and sold (E_Sold) yield is verified. The ratio between these must be within the range $\ge 87\%$ and $\le 109\%$.



If one or more months fail this test, the user must decide, which corrective measure shall be applied and comment the reasons for the failure / correction. All these steps are documented in the report.

4. SITE YIELD

Wind speed correlation

The TR10 assumes that as soon as the WTG is not producing, the wind measured by the nacelle anemometer is not reliable anymore, as the nacelle transfer function (NTF) is only valid for normal operation. Therefore, it is necessary to correct wind speeds in nonnormal conditions and fill gaps in the wind speed time series in order to generate a consistent wind speed time series.

Use the button "Calculate" to calculate the correlation of the available sources of wind data with each other. The correlation calculation is performed on a monthly basis like required in TR10.

An overview is then shown as the result. There is a graphical overview on the left side of the window, showing a matrix of the correlations of all signals with each other.

Serformance Check - Profile: TR30 Manual (Rev.3)												×
Concept choice Date 🥝 Site yield Quality factor Report												
Calculate IIIn 2014 - 1 N + 1 Reference database Setup vinc	drection master	Define	normal operation									
Deed and a second se	Correlation: -			Dq	ort		2	show	only	kipan	ded	
	From	то	North	Corre lation	N 5	E N	E	s s	s s	v s	v v	N

Using the button "Reference database" you can add wind data from met masts or online sources, re-analysis or mesoscale data. They have typically the worst correlations but can still be helpful in situations, where no other data sources are available. Proceed to the next vertical tab.

Wind speed regression

As soon as the best correlations are calculated, they need to be applied for the time stamps assigned to category 2 in order to create a consistent wind speed time series.

Aerformance Che	eck - Profile: TR10 M	ersual (Rev.3)							×
cept choice Da	sta 🧭 Site yield	Quality factor	leport						
Wind spe	eed correction	01.01.2014	- 01.01.2019	- Show all data	🙃 🖂 Air densib	v correct			
5	Show time series	Create m	eteo object(s)	Export time series (CSV)					
WTG	v before [m/s]	Δν [%] V af	er [m/s] Replece	ed semples (%)				 	
	7,4	0,6	7,5	100,0					
102	7,4	0,6	7,4	100,0					
103	7,6	0,5	7,6	100,0					
204	7,6	0,5	7,6	100,0					
205	7,6	0,5	7,6	100,0					
206	7,6	0,6	7,6	100,0					
207	7,5	0,5	7,6	100,0					
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Moving power curves

The real-life power curves and the theoretical preassessment power curve are different, and the powers curve can change in time. Use the button "Calculate" to obtain moving power curves for all WTGs.





Result

This tab gives you an overview of the results so far. Click "Calculate production". This step will sum all production produced by the WTG(s) (E_Prod). After this step is done, the button "Calculate site yield" becomes green. As soon as this one is used, you will see further results required by the TR10:

- **E_Prod_skal:** the scaled production, resp. the production of the WTG(s) cleaned by electrical losses,,
- E_EinsMan: fictitious electricity not produced due to the category 3 (constrains by the TSO such as Einspeisemanagement),
- **E_OV:** fictitious electricity not produced due to category 4 (optimized selling),
- **E_Ausf:** fictitious electricity not produced due to the category 2 (WTG unavailable),
- **SE_y:** sum of E_Prod_skal, E_EinsMan, E_OV and E_Ausf.

All results listed in this overview are related to the length of the imported time series. E.g. if 2 years were imported, then the sums represent 2 years. However, it is needed to use 5 years of data in order to be able to compare the SE_y with the Reference yield (Referenzertrag), which is always a 5-years production. The next horizontal tab, Quality factor, scales the results to 5 years.

5. QUALITY FACTOR AND REPORTS

For the calculation of the final result of the TR10, the quality factor, you have to insert the reference yield of the turbine/s calculated after the new reference site specified in EEG. They are published here: <u>https://wind-fgw.de/themen/referenzertraege/</u>.

The final results but also many results of the calculation steps as well as the data basis and processing are documented in a pdf report. You can create this report via the tab Report where you only have to fill some informative text fields. The report fulfills all documentation requirements of the TR10 chapter 8 and the annex including the attestation for the grid operator.