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PLANTS AND TURBINES

1 PLANT VIEW

All plants installed in TMMonitor are shown on top of the program.

Selecting the Plant, you can see the number of turbines it consists of. All gas turbines belong to certain Plant.

Dashboard also shows you a quick view of the gas turbine status.

- Number of gas turbines in the Plant
- Average annual hours of operation and starts
- Inspection history and expected next inspection based on average annual operating hours/starts. This graph will also include a pop up window showing replaced parts at the inspection.
- Alarm for parts under operation, which are getting end of lifetime.

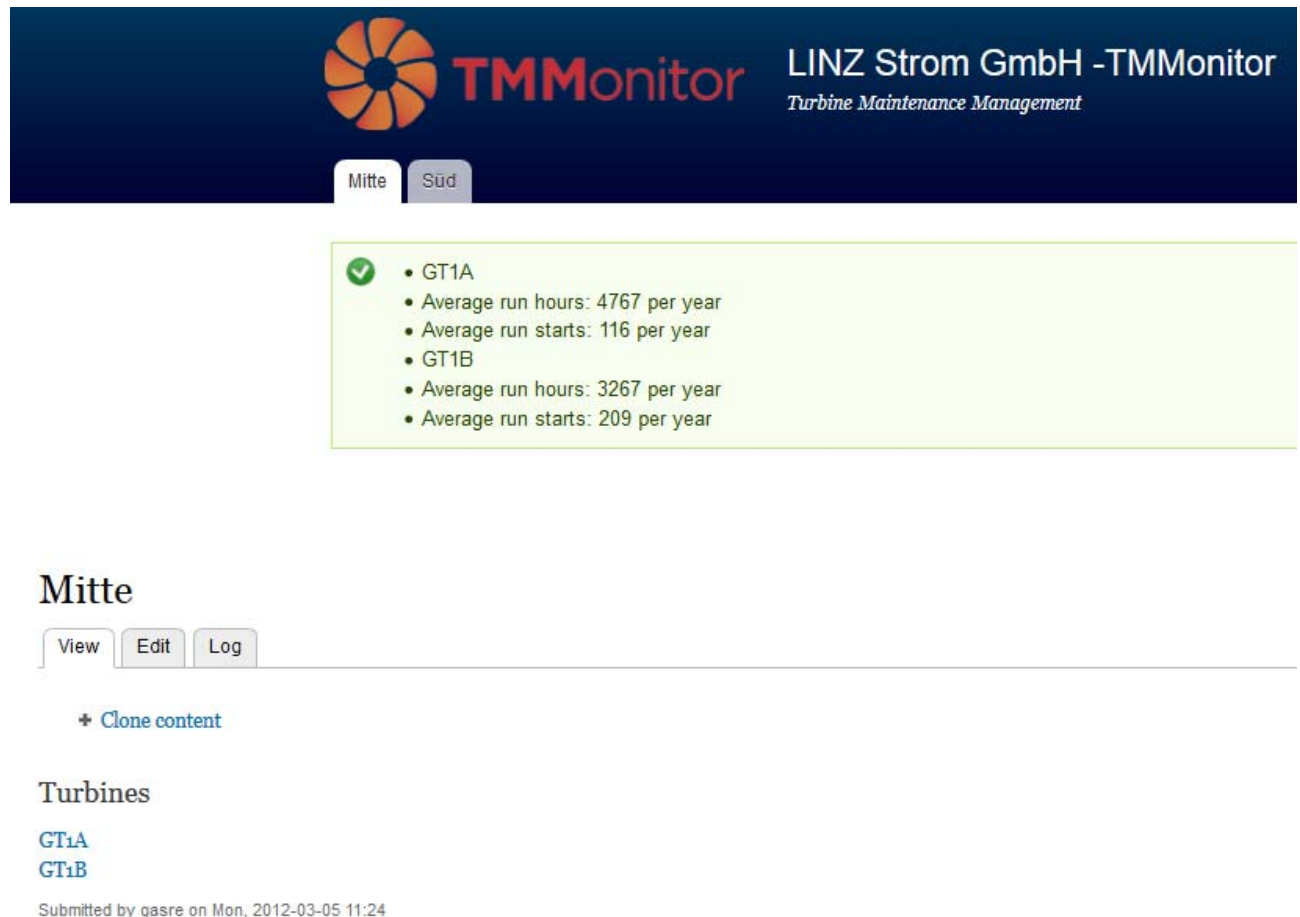


Figure 1. Plant view with a dashboard for important information

2 TURBINE VIEW

You can view the content of each GT by selecting it. Basic information include:

- Plant name: Plant name the gas turbine belongs to
- Manufacturer: Manufacturer of the gas turbine package
- Packager: Packager of the gas turbine Plant
- Serial number: Serial number of the gas turbine

- Type: Type of the gas turbine for example Alstom GT26
- Fuel: Primary and secondary fuel(s)
- Combustion: Type of combustion system. DryLowNOx, diffusion etc..
- GT rating, kW: Gas turbine ISO rating
- Generator voltage
- Factored hours form: Factored hours formula used by the gas turbine when calculating the factored hours from user entered operating data
- Factored starts form: Factored starts formula used by the gas turbine when calculating the factored hours from user entered operating data¹

3 FACTORED HOURS AND STARTS FORMULA

Factored hours/starts formula takes into account different operating conditions by adjusting the real operating hours/starts. The formula is adjustable for each gas turbine separately. Basic formula is following OEM recommendation for calculation of the EOH (equivalent operating hours).

The formula can be edited but requires knowledge of the variables used by the program². If the formula has been edited, the made changes will not affect inspections and their factored hours/starts values that are made prior change of the formula. If the new formula must be taken into account in older inspections as well, all old inspections must be edited and saved once to recalculate their factored hours/starts. It is recommended that the inspections are saved in the order of their date (starting from oldest).

3.1 Common factored hours/starts formula for all turbines

Factored hours and starts formula can be common to all gas turbines. In such case it is located inside the program when the program was created. The common formula is a default formula in case the turbines do not have a formula of their own.

3.2 Turbine specific factored hours/starts formula

Turbine specific Factored hours/starts formula is located in the turbine view. In case there is no formula, common default formula is used.

¹ Factored hours/starts formula is used by the program when calculating part lifetime and repair intervals. Changing the formula, changes FFH/FS calculation method used by the program for parts life estimation. Changes will not affect older inspections unless they are edited and saved again. **See chapter “Factored Hours and Starts Formula.**

² Please consult GASRE

USAGE CALCULATOR

4 USAGE CALCULATOR

- With the Usage Calculator you can see what parts are installed in different gas turbines
- You can see the remaining lifetime prior repair and prior end of lifetime for each part
- You can see how operating hours/starts affect the parts remaining lifetime
- When you enter current operating values³, they will be stored in the system memory and will be available next time you or someone else returns to the site.
- Based on your given operating values, the program calculates the **Factored Fired Hours and Starts**⁴ and updates promptly the remaining lifetime of each part.
- Program also stores user information and date when the operating data was last modified.

- Profile
- Usage calculator
- Turbine Inspections
- Parts
 - End of lifetime parts
- Timeline
- Simulator
- TIL-List
- Create content
- Log out

Usage calculator

GT1 (L1A) GT2 (L1B) GT1 GT2 GT3

Turbine: GT1 (L1A) info

Total Fired Hours
45205

Running hours on Gas Fuel
45205

Running hours on Liquid Fuel Oil
0

Running hours on Peak Load
0

Running hours on Partial load (high Nox)
634

Water/Steam injection factor (1=no injection)
1

Fired Starts Counter

Quick add hours and/or starts

Quick add hours

Quick add starts
0

Part list

Bucket 1st (set 2)	Bucket 2nd (set 2)	Bucket 3rd (set 1)	End Cap 1 (set 1)	End Cap 2 (set 1)
Hours to repair 1865	Hours to repair 1865	Hours to repair 2795	Hours to repair 1634	Hours to repair 1634
Hours to replace 25865	Hours to replace 49865	Hours to replace 50795	Hours to replace 25954	Hours to replace 25954
Starts to repair 458	Starts to repair 458	Starts to repair 1392	Starts to repair 318	Starts to repair 318

Figure 2. Usage calculator shows the current remaining life of parts

5 QUICK ADD HOURS AND / OR STARTS

- To see the effect of factored hours/starts to the lifetime of parts without saving the data, you can use quick add hours tab. By entering hours and/or starts, you can see how the remaining lifetime of parts is affected and how long you can run the turbine prior next overhaul.
- The quick add hours/starts will not be saved into the memory

³ Import module makes it possible to import operating values using excel template **(OPTIONAL MODULE)**.

⁴ Factored Fired Hours/Starts formula is stored for each GT in it's main page. See more at chapter Factored Fired Hours/starts Formula

TURBINE INSPECTIONS

6 TURBINE INSPECTION

With the Turbine inspection you can see inspections made to each turbine including uploaded inspection reports and made TILs.

Main display shows the following information

- Inspection name: inspections can be named freely but we recommend using defined names like BI (borescope inspection), CI (Combustion inspection), HGPI (Hot gas path inspection), MO (Major Overhaul)
- Turbine: name of the turbine
- Year of operation: year as the inspection was performed
- Total fired hours: fired hours at the time when the inspection was performed
- Total starts: Total starts at the time when the inspection was performed
- Factored hours/starts counter: Software calculated **Factored Fired Hours/Starts** ⁵at the time when the inspection was performed
- Factored hours/starts between inspections: Software calculated **Factored Fired Hours/Starts** ⁶between inspections (current inspection versus previous inspection)
- Parts in/out: By selecting parts in/out, you can easily see **what parts was taken out and what installed in operation.** ⁷
- Inspection date: Inspection start date
- Preview: Preview is a quick tool to view the inspection information in a popup window that loads quickly especially for mobile applications
- Edit: A quick link to edit the Inspection
- Separate window is available showing inspection costs (**OPTIONAL MODULE**)
- Separate window is available for pre/post inspection performance (**OPTIONAL MODULE**)

⁵ Factored Fired Hours/Starts formula is stored for each GT in it's main page. See more at Factored Fired Hours/starts chapter

⁶ Factored Fired Hours/Starts formula is stored for each GT in it's main page. See more at Factored Fired Hours/starts chapter

⁷ Software assumes that all parts are taken out. If the same part is both in out and in list, the part was NOT replaced in the inspection. If the part shows up in the out-list but NOT in the in-list, the part was replaced.

Turbine inspections

[Print](#)

Power Plant Turbine

[Show All](#)

Inspection <<	Turbine <<	Year of operation <<	Total Fired hours <<	Total starts <<	Factored Hours Counter <<	Factored Starts Counter <<	Factored Hours btwn Ins <<	Factored Starts Btwn Inspections <<	Parts in <<	Parts out <<	Inspection Date <<	Preview <<	Edit link <<
MO 2012	GT1	2012	92 284h	547	92 284	1 266	7 634	52	Show more	Show more	Wednesday, May 2, 2012 (All day)	Preview	edit
CI 2010	GT1	2010	84 650h	519	84 650	1 214	7 343	147	Show more	Show more	Monday, June 14, 2010 (All day)	Preview	edit
CI 2008	GT1	2008	77 307h	465	77 307	1 067	6 114	13	Show more	Show more	Saturday, June 14, 2008 (All day)	Preview	edit
HGR 2007	GT1	2007	71 193h	457	71 193	1 054	2 575	4	Show more	Show more	Monday, September 3, 2007 (All day)	Preview	edit
mini CI 2007	GT1	2007	68 618h	454	68 618	1 050	5 278	36	Show more	Show more	Thursday, April 26, 2007 (All day)	Preview	edit
CI 2006	GT1	2006	63 340h	442	63 340	1 014	3 676	69	Show more	Show more	Monday, July 31, 2006 (All day)	Preview	edit
mini CI 2006	GT1	2006	59 664h	420	59 664	945	4 000	0	Show more	Show more	Saturday, May 20, 2006 (All day)	Preview	edit

7 VIEWING INDIVIDUAL INSPECTION DATA

By selecting desired inspection, you can view the data of it.

- Inspection info includes general data of the inspection.
- Running information shows main operating data like fired hours, starts, trips at the time of the inspection.
- Inspection costs include any inspection the Client wants to include in inspection history (**OPTIONAL MODULE**). Note that Part repair costs and new Part procurement costs (**OPTIONAL MODULE**) are part of Part information.
- Inspection notes section includes remarks of the inspection and uploaded pictures and files like inspection reports.
- Parts in section show which parts are installed in operation.
- Factored stats shows Factored hours/starts calculated by the software.
- Performance stats: Performance stats stores inspection pre/post performance values that can be viewed in graphical format (**OPTIONAL MODULE**).

CI 2012

[View](#) [Edit](#) [Log](#)

[+ Clone content](#)

Submitted by [gasre](#) on Wed, 2012-05-23 12:56

Inspection info

[Running information](#)

[Inspection cost](#)

[Inspection notes](#)

[Parts](#)

[Factored stats](#)

[Simulator budget](#)

Make real:

Turbine: [GT1B](#)

Price range:

CI

Inspection Date:

Fri, 2012-05-04 (All day)

Inspection duration:

Monday, May 7, 2012 to Thursday, May 24, 2012

Inspection Duration:

408 h

Inspection notes

Responsible TA(s)

TILs implemented

1068-2R1 [nid:693]

11

TIL number

Add

1108-3
1132-2
1153-3
1175-2R2
1178-2R1
1179-2R1
1186-2
1711

Picture

Add a picture

Browse... No file selected. Upload

Files must be less than 256 MB.
Allowed file types: png gif jpg jpeg.

Comments (Edit summary)

B I U

Figure 3. Inspection notes and Service bulletins

File information	Display	Operations
Sappi Kirkinemi 6Fa MO revisioraportti.pdf (129.15 KB) Description MO 2012 report The description may be used as the label of the link to the file.	☒	<button>Remove</button>
NDT_2012.pdf (507.4 KB) Description The description may be used as the label of the link to the file.	☒	<button>Remove</button>
Sanni Kirkinemi 6Fa MO 2012 - snare parts: 20 2 2012.pdf (48.72 KB)		

Figure 4. Add inspection reports

8 SIMULATED INSPECTIONS

Selecting simulated inspections, you can view the inspections created by the User using simulator.

9 ADD NEW INSPECTION

You can create new inspection in two different ways:

- Select create new inspection
- Use simulator for future inspection plans

1. Select turbine to which GT a new inspection will be created
2. The program loads automatically data from the latest inspection made to selected GT. Edit fields based on data you have. You can also clear all fields, pressing "Clear". After you have edited the required fields and selected parts press "Create turbine inspection".

Clone of CI 2012

ViewEditLog

☐ Created by Simulator
If checked this item has been created by simulator

Inspection info *

Running information *

Inspection cost

Inspection notes

Parts

Factored stats

Simulator budget

Inspection *

Clone of CI 2012

Turbine

GT1B

Price range

CI

Inspection Date

2012-05-04

Format: 2014-01-17

Inspection duration

Date

2012-05-07

E.g., 2014-01-17

to:

Date

2012-05-24

E.g., 2014-01-17

Inspection Duration

408

Figure 5. Creating a turbine inspection

PARTS

10 PARTS GENERAL VIEW

At the parts display you can view all parts (sets) and their statuses. If Single Item Module (**OPTIONAL MODULE**) is in usage, Parts will also indicate single items belonging to it.

"End of lifetime parts" and "Simulated Parts" can be seen in a separate window.

10.1 Displayed items

Parts view shows the following information of each Part (set)

- Part name
- Serial number: Shows only part of the serial numbers to make identification easier. To see all serial numbers of part/set, select the part/set.
- Turbine: Indicates what turbines the parts is applicable
- Factored hours/Factored starts: number of hours/starts the part has until **last saved inspection**⁸
- Simulated Factored hours/Factored starts: hours part has been in usage by the simulator for future inspections
- Status: current status of the part (see all available statuses at chapter "part status"). Note also colors used in status.
- User repair interval hours/starts: User defined interval when the part should be repaired
- User replace interval hours/starts: User defined interval when the part should be replaced due to Eon of Lifetime.
- Simulated status: simulated status of the part
- Preview: Preview is a quick tool to view the part information in a popup window that loads quickly especially for mobile applications
- Edit: A quick link to edit the Parts
- Part cost/FH is an **OPTIONAL MODULE**

Show All

	Part <<	Part type <<	Serial numbers <<	Turbine <<	Factored Hours <<	Factored Starts <<	Simulated Factored Hours <<	Simulated Factored Starts <<	Status <<	User Repair Interval Hours <<	User Repair Interval Starts <<	User Replace Interval Hours <<	User Replace Interval Starts <<	Simulated Status <<	Preview <<	<<
☐	CEC (Set 001)	CEC	LN21748, LN21747, LN21750, LN21749, LN2174 6, LN21745 / (4207130, 4207150, 4207120, 4207140, 4207170, 420	• GT1	44403	1042	0	0	Out Not Repaired	8000h	450	48000h	2250		Preview	Edit
☐	CEC (Set 002)	CEC	LN21342, LN21341, LN21346, LN21343, LN21344, LN21345	• GT1	50936	244	0	0	Out Not Repaired	8000h	450	48000h	2250		Preview	Edit
☐	CEC (Set 003)	CEC		• GT1	0	0	0	0	In Operation	8000h	450	48000h	2250		Preview	Edit

Figure 6. Parts general list

10.2 Filtering of Parts

You can filter the parts based on 3 main categories:

- "Compatible with" showing parts applicable to certain turbine
- "Power Plant" located to certain Power Plant
- "Status" based on operational status of the part

⁸ The display does not take into account possible hours of the usage calculator. Only hours until last saved inspection is shown

- “Part type”: Each part has a predefined part type which is used by the program for many purposes

11 INDIVIDUAL PART VIEW AND DATA

By selecting individual part/set you can view its information:

- General shows Part type, purchase price, current status and in which gas turbine the part can be used.
- Initial hours/starts is used for parts that are purchased as used and have previous history. Initial hours/starts are also adjusted by the worst single item, if single item module is used.
- Part info section includes remarks of the part and uploaded files like repair reports.
- Repair/replace info defines the OEM and USER repair and replace limits for the part in hours and starts which is used by the software in various calculations like usage calc.
- Repair prices include any repair cost the Client wants to include in part history (**OPTIONAL MODULE**).
- Single item showing individual items like buckets attached into Part(set) (**OPTIONAL MODULE**).

QR code

All parts include a QR code which makes it easier to access the specific page with your mobile phone or tablet.

If the part data is printed out in boxes at the warehouse, pointing your mobile phone into the box, will open the right web page of the part in question.

Bucket 2nd (3rd set)

View Edit Log

Close context

Submitted by gasre on Fri, 2012-03-30 09:26



Part history

Inspection	Inspected machine	Year of operation	Factored hours between	Factored starts between	Fired hours between	Fired starts between	Remaining	Part repaired
Part initial hours			0	0	0	0		
MO 2007	GT1	2007	0	0	0	0	Replace hours: 72000 Replace starts: 3600	Part installed
BI 2008	GT1	2008	3882	171	3882	159	Replace hours: 68138 Replace starts: 3429	Not replaced
BI 2009	GT1	2009	4500	29	4500	29	Replace hours: 63638 Replace starts: 3400	Not replaced
BI 2010	GT1	2010	3384	40	3384	28	Replace hours: 60254 Replace starts: 3360	Not replaced
BI 2011	GT1	2011	3404	21	3404	21	Replace hours: 58850 Replace starts: 3339	Not replaced
Total	XXXX	9999	15150	261	15150	237		

Part Simulation history

Inspection	Inspected machine	Year of operation	Factored hours between	Factored starts between	Fired hours between	Fired starts between	Remaining	Part repaired
HGPI 2015	GT1	2015	8851	46	8851	46	Replace hours: 63149 Replace starts: 3554	Not replaced
Total	XXXX	9999	8851	46	8851	46		

General

Initial hours / starts

Part info

Part numbers

Repair/Replace info

Repair prices

Single items

Default template:

Part type:
S2B_P68571

Override single item cost:

Status:

In Operation

Compatible with:

GT1
GT3

TIL

12 TIL-LIST GENERAL VIEW

You can view different TILs by selecting TIL list.

By selecting a TIL you can see the details of it and you can edit it by selecting "Edit"

TIL view shows the following information of each TIL

- TIL number
- Description of the TIL
- Compliance Category: indicates which category the TIL belongs to
- Applicable to : Which GT the TIL is applicable to
- Timing: When the TIL should be performed, at the latest
- Implemented: When the TIL has been performed
- One time TIL: Indicates if the TIL is one time only.

12.1 Filtering of TILs

- You can filter the TILs based on 3 main categories:
- "Site" showing parts applicable to certain Site
- "Compliance category"
- "Timing"
- "One time TIL"

12.2 Individual TIL

Individual TIL holds information of its applicability, category and timing,

Also the TIL itself is attached as a pdf file.

TIMELINE

13 TIMELINE

Timeline is a quick rough tool to make estimates for future inspections.

[Home » Timeline](#)

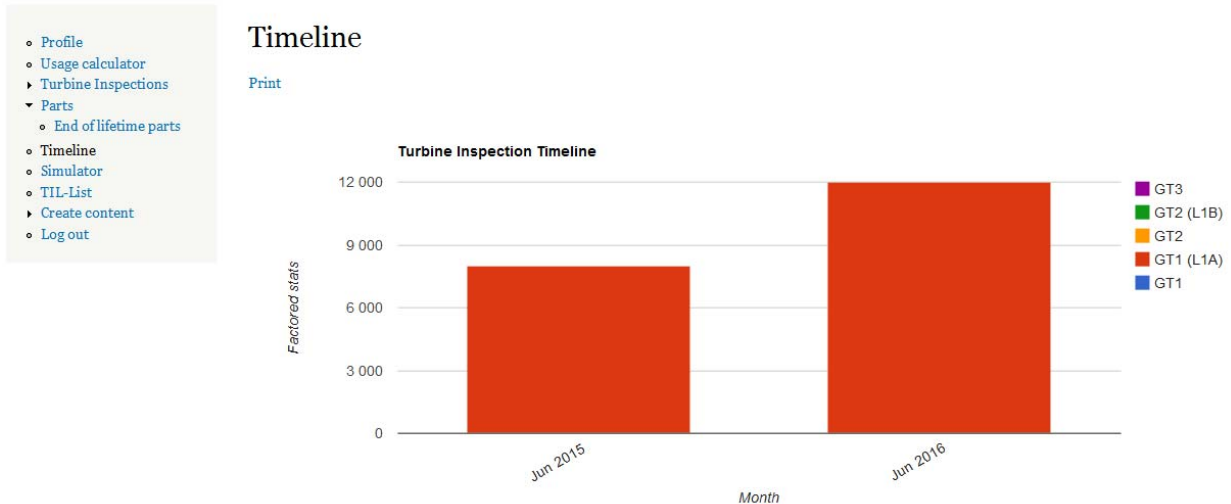


Figure 7. With Timeline, you can make rough estimates for forthcoming inspection

14 HOW TIMELINE WORKS

Timeline checks the parts installed in operation at the latest saved inspection for the selected turbine to be timed. From each installed part, the **User Repair Interval** is stored. Timeline operates the gas turbine based on User given annual hours/starts and proposes an inspection as repair interval is reached. The User given annual operating hours and starts are divided equally to all days of the year. Timeline starts to estimate from the last saved real inspection. Usage calculator values will be taken into account. Timeline do not check all parts applicable to the turbine, only parts installed in operation at the last inspection.

Timeline also assumes that all parts installed into the turbine are replaced according to recommendation for that part (following repair interval). Timeline do not take into account cases where a part has exceeded its recommended repair interval or lifetime.

SIMULATOR

15 SIMULATOR

With the simulator you can make precise future estimation for required inspections.

OPTIONAL MODULES for Simulator are:

- Advanced Suggestion Module that proposes replacement parts based on User given weight factors making selection of parts easier.
- Simulator Budget module that adds budgetary repair/new part costs for selected parts and User selected service cost level. The cost table used by Budget Module for repair and new part costs and service costs (MO, HGP, CI) can be imported from excel using import module.

16 HOW SIMULATOR WORKS

Simulator checks the parts(sets) installed in operation for the selected turbine to be simulated. From each installed part, the limiting factors **User Repair Interval and User Replace Interval** are stored together with part initial hours/starts, previous operating history and current operating hours at the usage calculator. These operating values are compared to the limiting factors of **User Repair Interval and User Replace Interval**.

Simulator operates the gas turbine based on User given annual hours/starts and proposes an inspection if repair interval or lifetime of any installed part is reached. The User given annual operating hours and starts are divided equally to all days of the year. User can now create a simulated inspection and replace the necessary parts and continue simulation.

Simulator uses all parts except parts/sets having status EOL (End of Lifetime). Remember to change the status EOL in case you cannot use the parts anymore.

IMPORT MODULE

17 IMPORT DATA

You can import usage calculator values and budgetary price lists into TMMonitor using predefined excel templates. There are also other import features like single item importer for Clients who have single item module. Data imported must be in the right format.

By selecting a Import, you can see list of possible imports.

TIL view shows the following import features

- Usage calculator value import: Importing of usage calculator operating values
- price item import: Importing of budgetary prices for parts