

END-USER FAULT STATISTICS

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Abstract

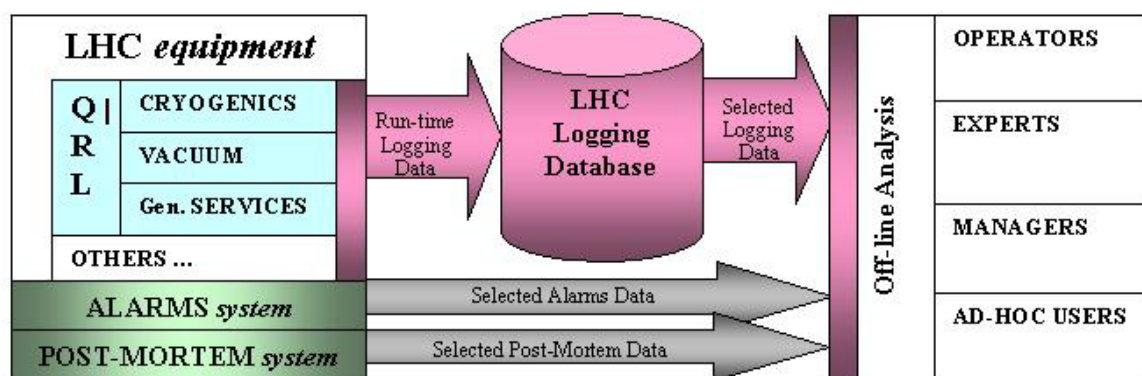
This application is a post-mortem analysis tool for the beam availability of the PS complex for each beam destination.

1. Introduction.

The objective of this application is to provide **post-mortem information** about the different beam statuses depending on their **end-user**.

It plots intensities for a given time window, and sets different background colors according to the delivery of the concerned beam.

Data are extracted from the **LHC Logging System** which has been implemented in 2003, in order to log time series data like Cryogenics temperatures, magnetic field strengths, power dissipation, vacuum pressures, **beam intensities** and positions etc.



For more information about the logging system:
<http://lhc-logging.web.cern.ch/lhc-logging/>

This system uses two databases:

- **The Measurement Database (Meter):**

It logs **raw time series data** with a 2Hz frequency. The data is stored in this database for **7 days** (about 60 million records per day).
Every **15 minutes** the data are derived and sent to the Logging Database.

- **The Logging Database (Timber):**

It contains **derived data** (about 4 million records per day) from the Measurement Database, stored for **long term** (about 20 years).

Several transformers have been added to the logging database, and a beam status logic ('bad', 'good', 'invalid' or 'ignored') has been implemented depending on the destination.

This beam availability logic is processed by 3 FESA devices (PCFS.PSB, PCFS.CPS, PCFS.SPS) considering to the machine of the end-user.

These devices need several informations like the supercycle composition, the type of execution (normal or spare), the beam destination, the cycle stamp, user request state and the value of the line's last transformer to determine the beam status for a specific user.

The different statuses:

- **Bad Status:**
Beam request is ON (as Normal or Spare) but the intensity read by the end of line transformer is smaller than its threshold.
- **Good Status:**
Beam request is ON (as Normal or Spare), the intensity read by the end of line transformer is bigger than its threshold.
- **Invalid Status:**
Transformer and current timestamp are different.
- **Ignored Status:**
User request is OFF.

The following CPS destinations are considered: *EastN*, *EastT7*, *EastT8*, *NTof*, *CNGS*, *FTarget*, *ISOGPS* and *ISOHRS*.

For additional information about the underlying logic and implementation please refer to: https://edms.cern.ch/file/1011980/1/Statistics-for_end-users.pdf

2. End-User Fault Statistics User's Guide.

2.1 Interface.

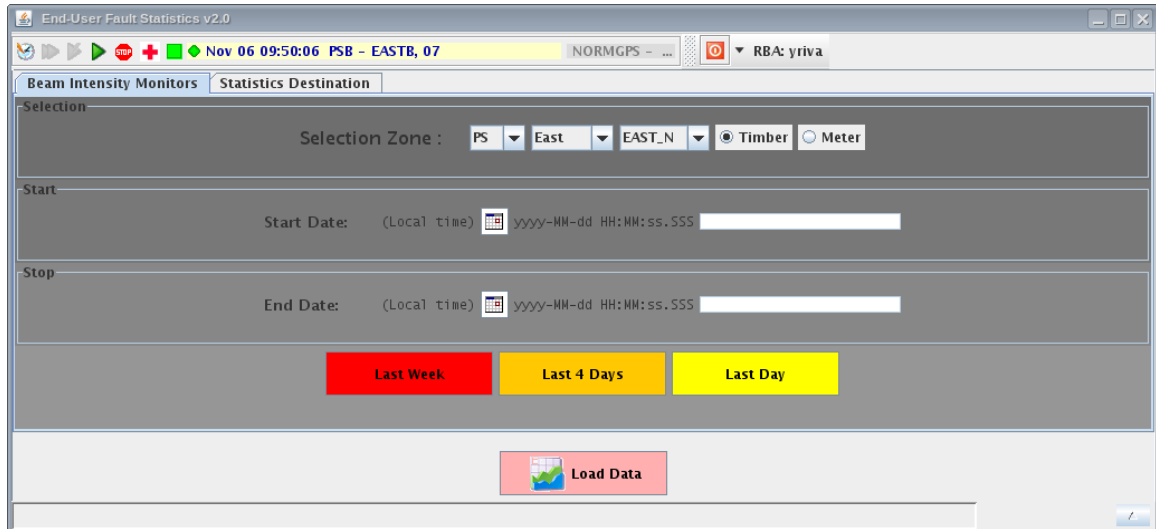


Fig 1. The main window.

On the main window, two tabs give access to two different tools:

- Beam Intensity Monitors
- Statistics Destination

2.2 Beam Intensity Monitors Tab.

This tab provides intensities logged for a destination or a transformer for the selected time window **without considering the beam availability logic.**

Selection Zone Panel:

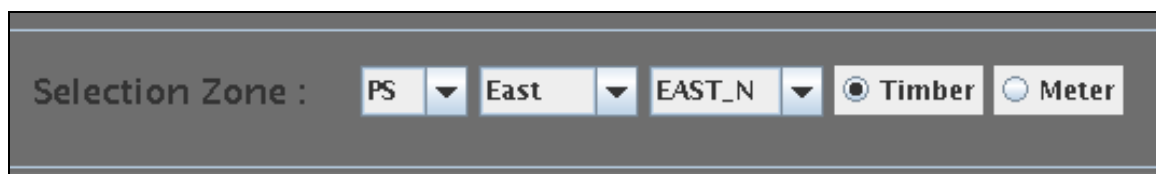


Fig 3. Selection Zone Panel.

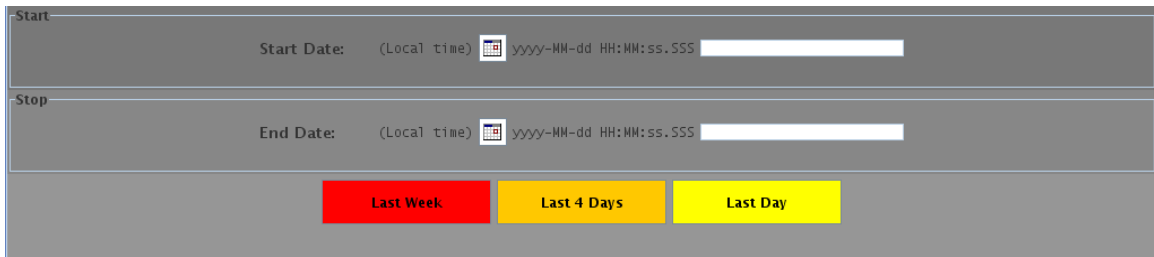
The transformer (or destination) and the database (measurement or logging) could be chosen through this panel.

Here are the different transformers or *destinations* defined for the beam intensity mode:

Machine	Zone	Transformer Destination
PS	East	East_N
		East_T7
		East_T8
	Ntof	Ntof
	TT2	TT2_FTA
	F16	F16.TRA126_SUM
		F16.TRA126_T1
		F16.TRA126_T2
		F16.TRA126_T3
		F16.TRA126_T4
		F16.TRA126_T5
	F61	F61.MSC01
		F61N.MSC01
	FT	FTA.TFA9012
		FTN.BCT468
		FTS.BCT379
		FTS.BCT386
	PS Ring	PR.DCAFTEJE_1
		PR.DCAFTEJE_2
		PR.DCAFTINJ_1
		PR.DCAFTINJ_2
		PR.DCAFTTRA
		PR.DCBEFEJE_1
		PR.DCBEFEJE_2
		PR.DCBEFINJ_1
		PR.DCBEFINJ_2
		PR.DCBEFTRA
	SPS	CNGS
		FTARGET
	ZT	ZT7.MSC01
		ZT8.MSC01

Machine	Zone	Transformer Destination
PSB	LTB	LTB.BCT50
	BI	BI.BCT10.S
		BI.BCT20.1
		BI.BCT20.2
		BI.BCT20.3
	BR	BR.BCT.S
		BR1.BCT
		BR2.BCT
		BR3.BCT
	BT	BR4.BCT
		BT.BCT
	BTM	BTM.BCT
	BTP	BTP.BCT
	BTY	BTY.BCT112
		BTY.BCT213
		BTY.BCT325
	ISOLDE	ISOGPS
ISOHRS		

Date Window Panel:



The Date Window Panel consists of two main sections: a 'Start' section and a 'Stop' section. Each section contains a 'Start Date:' or 'End Date:' label, followed by '(Local time)', a calendar icon, and a text input field for the date in 'YYYY-MM-dd HH:MM:ss.SSS' format. Below these sections are three buttons: 'Last Week' (red), 'Last 4 Days' (orange), and 'Last Day' (yellow).

Fig 4. Date Window Panel.

The time window is defined in this panel.

The **date** and **time** can be chosen directly on a calendar clicking on



Three predefined windows (**Last Week**, **Last 4 Days** or **Last Day**) can be selected using one of the three buttons at the bottom.

Once the intensity and its time window are set the **Load Data** button can be clicked displaying a Number of protons as a function of time like in the example below.

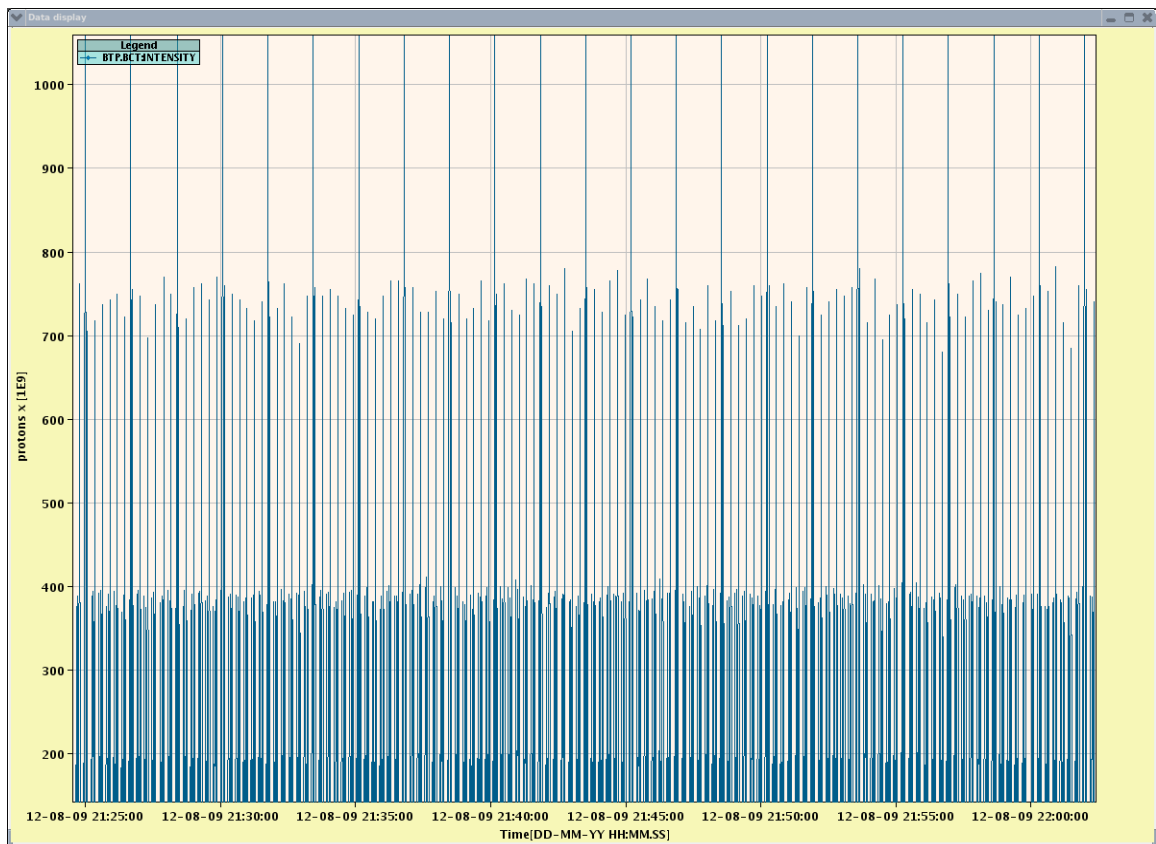


Fig 5. Beam Intensity Monitor graph.

The process time may vary; as a function of the amount of data, if too many data are present in the database for the selected time window, the message “Out of memory” could appear.

2.3 Statistics Destination Tab.

This tab provides integrated intensities logged for a CPS destination or a transformer for the selected time window **considering the beam availability logic**. This tab offers different choices than the Beam Intensity Monitors' one.

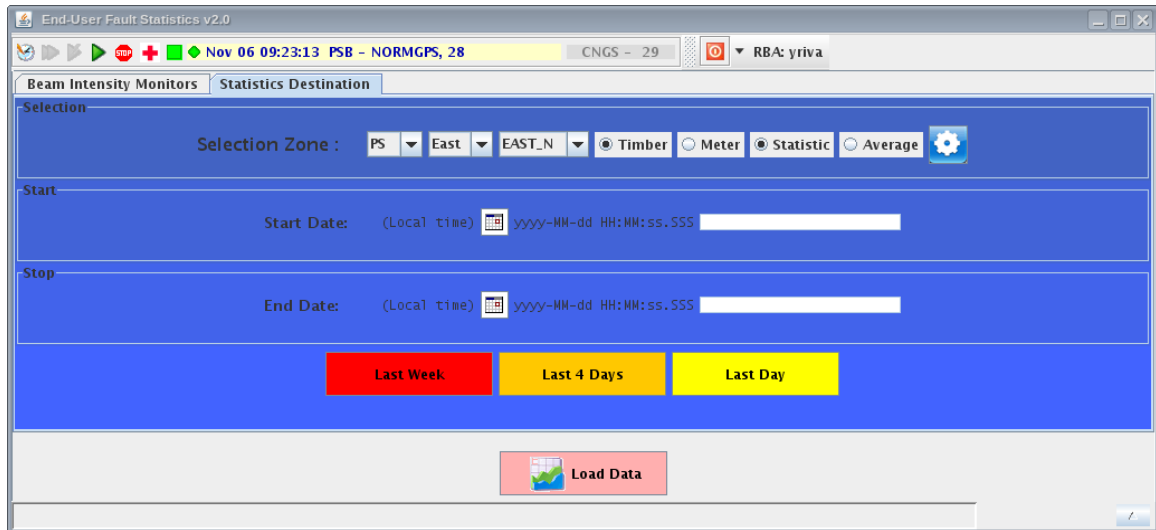


Fig 6. Statistics Destination Tab.

Selection Zone Panel:

The scrolling menu, only offers the **destination** in this tab. The **database** (measurement or logging) can be chosen by the two first radio buttons. **Display mode** is set by the two radio buttons:

- **Statistic display mode:** In this mode 2 plots $f(t)$ are displayed in the same graph:
- **The Destination Integrated Intensity** (the sum of all measured values in the 15 minutes interval).
- **The Sum Intensity:**
$$n = \sum_{i=1}^p n_i = n_1 + n_2 + \dots + n_p$$

Date Window Panel:

This panel is the same as in the Beam Intensity Monitor panel.

2.3.1 Statistics Destination Display Mode.

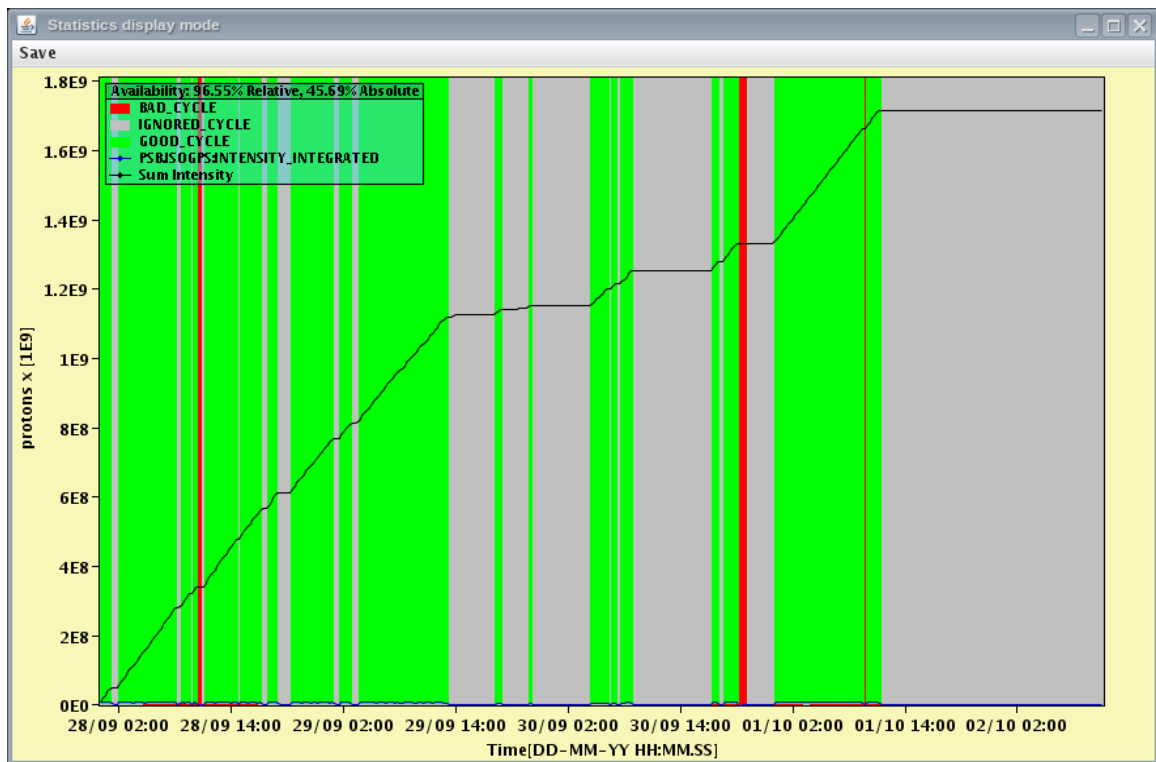


Fig 7. Statistics Destination graph in **Statistic Display Mode.**

In this figure, the Sum Intensity (the graph sets the maximum Y-Axis value as the total sum + 10%) and the Integrated Intensity curve at the very bottom of the graph) are plotted against time. Zooming should be used to see better the Integrated Intensity.

Beam availability is represented by the background colors:

- **Red, Bad Status** (Beam Request is ON, but intensity < transformer threshold)
- **Yellow, Invalid Status** (Transformer Timestamp ≠ Actual Timestamp)
- **Green, Good Status** (Beam Request is ON and intensity > transformer threshold)
- **Grey, Ignored Status** (User request is OFF)
- **White** if the beam was **not in the supercycle** during certain selected times.

Remark: The status corresponds to the predominant status during the 15 minutes logging period.

Additional information can be found in the legend:

- Relative Availability: $\frac{GoodStatusPeriod}{GoodStatusPeriod + BadStatusPeriod} \times 100$
- Absolute Availability: $\frac{GoodStatusPeriod}{OverallPeriod} \times 100$

2.3.2 Average display mode.

In this mode only **one plot** is displayed, the **Destination Average Intensity** (the sum of all measured values in the 15' interval, divided by the number of measured values in the 15' interval) as well as the **Min** and **MAX** values for this 15' interval.

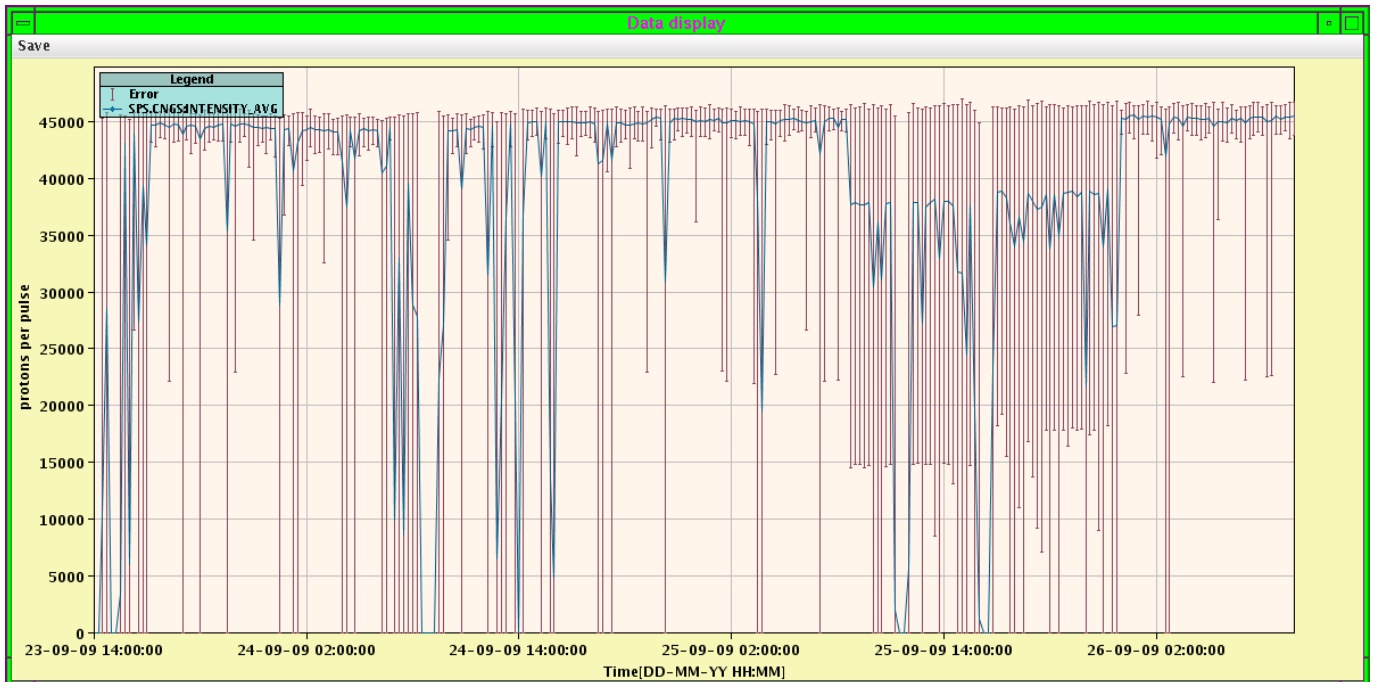
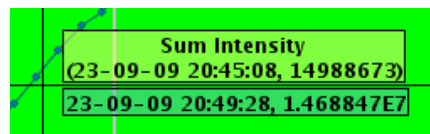


Fig 8. Statistics Destination graph in Average Display Mode.

2.3.3 Graph Tools.

Cursor information is displayed beside to the cursor:
Upper Information: Name of the plot, date and intensity values for the point of the curve closest to the cursor.




Lower Information: cursor's X and Y-Axis values.

A Zoom window function is accessible by left click; right click to make an undo.

A Save function is available in the graph window Save menu. Graphs can be saved in file with **jpg** or **csv** extensions through a Save Dialog Interface.

2.4 Transformers Settings.

All the transformers' thresholds are set through this panel that can be accessed. Each wheelswitch concerns a destination and a tooltip gives the name of the related transformer, (e.g. ISOHRS corresponds to transformer BTY.BCT325). This panel could be accessed by clicking  on the **statistics destination tab** according to the RBAC login.

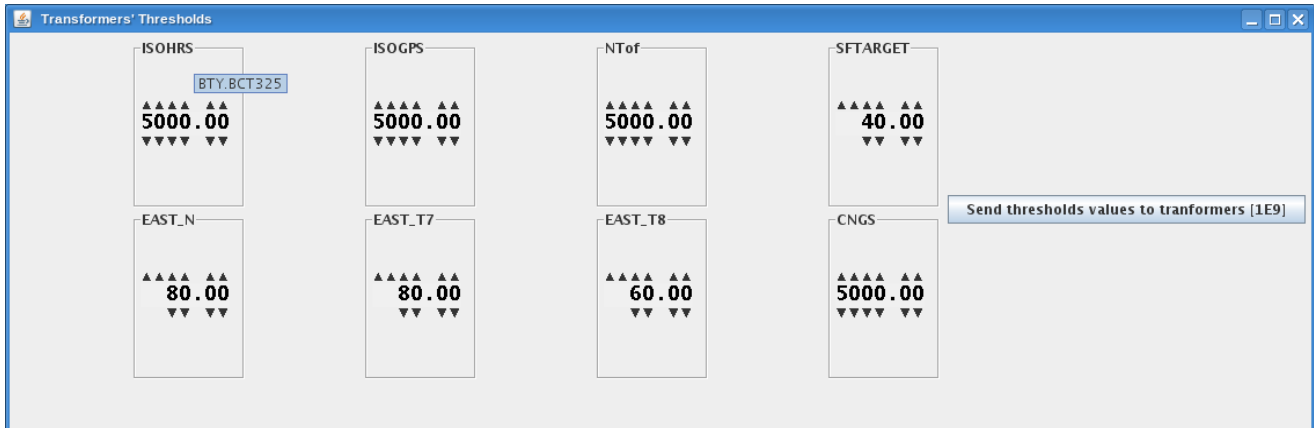


Fig 9. Transformers tab.

As the transformer settings affect the calculation of the destination status and therefore its logged value in the Logging Database, care should be taken when modifying them.