VATT Control System

User manual

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			Sheet

0. Content

1. Document history

Revision 0 2023/03/15 First version of the document.

Revision 1 2024/06/04 Updated version

Revision 3 2025/05/16 Updated version, following the service visit at the end of the first year

2. Abbreviations

- PLC - Programmable Logic Controller
- VATT – Vatican Advanced Technology Telescope
- EMI - Electromagnetic interference
- PCB - Printed Circuits Boards
- PCI - Peripheral Component Interconnect
- UDP - User datagram protocol
- SCADA - Supervisory Control and Data Acquisition

3. INTRODUCTION

These OPERATING INSTRUCTIONS provide basic information necessary to operate the control and visualization system of the telescope. Before starting any operation, the personnel assigned to operate the system must be trained and familiar with these INSTRUCTIONS.

The system controlling the telescope runs on a Beckhoff PLC called “Main PLC”. The Main PLC is powered through an in-line 10kVA UPS. When “lightning shutdown” is called for, the 10kVA UPS, and therefore also the Main PLC, is powered down.

In order to monitor the situation (especially the weather) while the facility is in lightning shutdown, another Beckhoff PLC, called the “Monitor PLC”, is always running. The Monitor PLC is also used to turn the system back on after a lightning shutdown.

4. OPERATING OF THE CONTROL COMPUTER

The “TomPack” visualization or user interface runs on control computers (PC) under the Windows operating system. TomPack requires a physical, USB license key to run. There are three such control comuters:

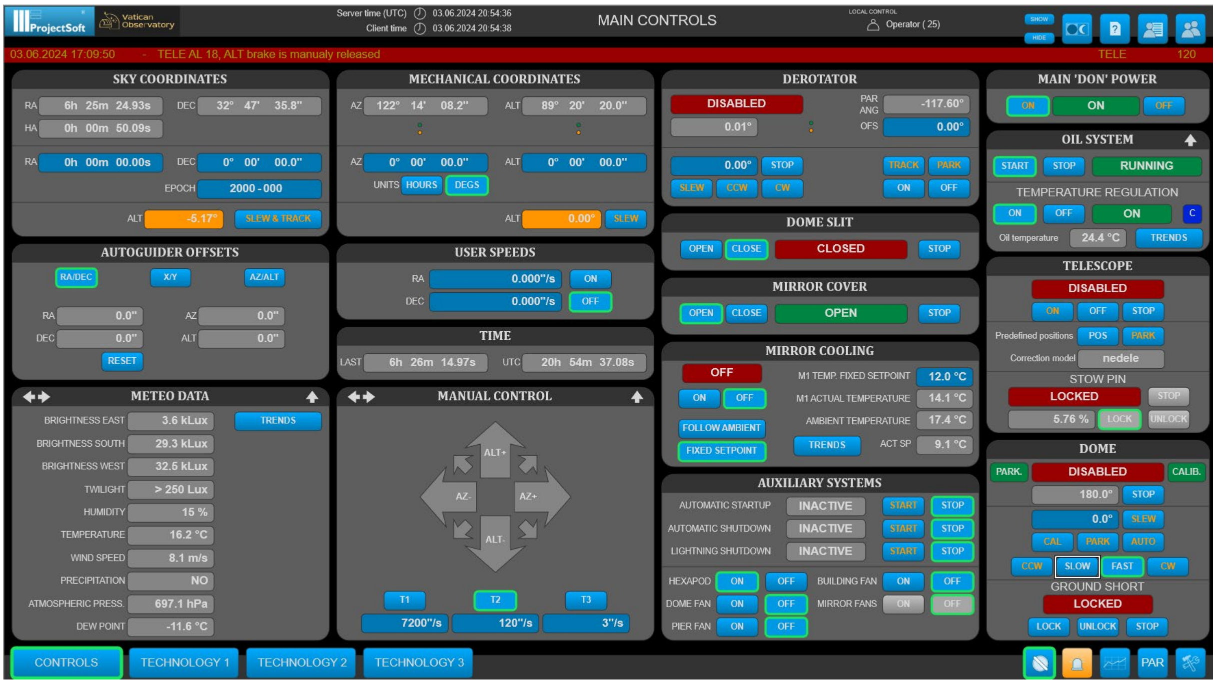
1. 10.0.1.20: PC-VATT-1 in the HP rack in the instrument/server room on level 2; it is on the rack’s UPS, and is powered down in lightning shutdown; this computer is physically connected, via a USB 3.0 optical extender, to the guide camera,
2. 10.0.1.21: PC-VATT-2 in the HP rack in the instrument/server room on level 2; it is on the rack’s UPS, and is powered down in lightning shutdown, and
3. 10.0.1.10: vattsacpc, an Intel NUC located in corner of the instrument/server room on level 2; it is on its own consumer-grade UPS, and always remains powered up.

Users should access the desktop of these control computers using the “remote desktop” software.

For users accustomed to unix-like computers, please note that, unlike unix **remote sessions** of which a given server may host a virtually unlimited number, under MS Windows, only one **remote desktop** is available at any given time on any given server. If one user is running a remote desktop and then another user opens another one on the same remote server, the first user’s remote desktop shuts down. The first user experiences this as an abrupt break that comes without warning.

Note that for TomPack to visualize correctly, the “display scale” on the servers (the three computers listed above) must be 100%. Also, make sure that "Use DirectDraw" is checked in TomPack’s “Configuration”. Only level 999 users (e.g., "Admin"), however, are authorized to change TomPack’s Configuration.

When the application starts, the main control screen appears.



4.1.1 Graphical User Interface Colour Conventions

4.1.1.1 Background Colours in Numerical Boxes

Gray background in a box – values are displayed; the user cannot modify the values.

Blue background in a box – the user can input values here; the values displayed are the last user inputs.

Orange background in a box – used in boxes displaying numerical values; the value displayed is out of bounds (e.g., the Altitude value calculated from the input values of RA and DEC would place the telescope out of its pointing limits; see 5.4.3).

4.1.1.2 Background Colours in Status Fields

Red background in a field – disabled, inactive, locked, closed, etc.

Green background in a field – enabled, active, unlocked, open, etc.

Flashing green background in a field – motion.

Green and red – unknown, stopped, etc.

4.1.1.3 Border Colours in Fields and Buttons

Black border – default.

Green border – active value/state.

Flashing orange border – an active Alarm is associated with this field.

4.1.1.4 Background Colours in Action Buttons

Gray background in a button – button is not active, i.e., the user cannot cause any action by clicking on the grayed-out button.

Blue background in a button – button is active.

4.1.1.5 Colours of Characters in Input Boxes and Action Buttons

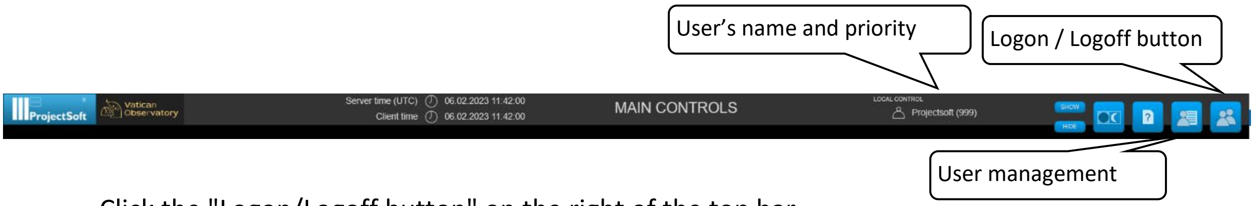
White characters – default.

Orange characters – locked; clicking the box/button displays a window with a list of prerequisites, highlighting the conditions that need to be satisfied so that the box/button unlocks. See also 4.5.3.

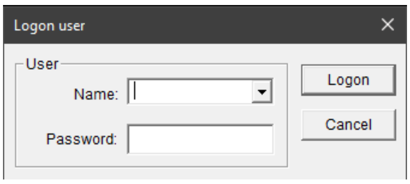
4.2 System controls

4.2.1 Logging on and off

Only authorized persons, logged on using their username and password, can access the software. Follow these steps to log on:



- Click the "Logon/Logoff button" on the right of the top bar.
- The "Logon panel" will appear.



- Click inside the **Name** box and type in the username or select the username from the pull-down menu.
- Then click inside the **Password** box, type in the required password and press Enter or click Logon to confirm. If the procedure is successful, the name of the logged user appears in the top bar. If the procedure was not successful, click on the Password box again and re-enter the password.
- **To log off**, press the **Logoff** button on this panel.

Individual authorized persons have the following access levels and corresponding restrictions to activities within the software (this can be modified on-site according to the specific needs of the customers):

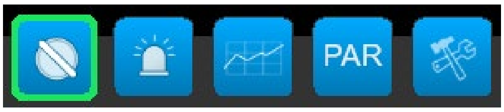
- **PROJECTSOFT** priority 999, no restrictions
- **Admin** priority 999, no restrictions (mtnops pw)
- **pgabor** priority 50, authorized to change selected set values and parameters

- **vattobs** priority 25, the basic level of operation, no authorization to change the above-mentioned parameters

After work session, the user should log off to prevent unauthorized usage!

4.2.2 Screens - Overview

There are several groups, each group consists of one or more screens. Listed from left to right.



Group **CONTROLS**:

Screen **CONTROLS**

Screen **TECHNOLOGY**

Group **ALARMS**:

Screen **CURRENT ALARMS**

Screen **ALARM HISTORY**

Group **TRENDS**:

Screen **TRENDS**

Group **PARAMETERS**:

Screen **TELE PAR 1**

Screen **OTHER PAR 1**

Screen **OTHER PAR 2**

Screen **MODEL**

Group **SERVICE**:

Screen **GENERAL**

Screen **IO DEVICES**

4.2.3 Description of the top and bottom bar

Each screen contains the appropriate drawing or diagram, and the top and bottom bars contain control buttons and important information.

Top bar

The following information can be found on the **top bar:**

- name of the screen
- **name of the logged-on department and operator**
- type of control – **LOCAL/REMOTE**
- server **date and time** (should be UTC)
- client's **date and time**
- lower red line displaying the last active alarm or warning (may not be present)

Buttons (from left to right):

- **SHOW:** show the application frame
- **HIDE:** hide the application frame
- **DAY/NIGHT:** toggle screen brightness
- **HELP:** open this document
- **USER LIST:** open a dialogue to edit user accounts
- **USER LOGON:** log on / off

Bottom bar

Buttons (from left to right):

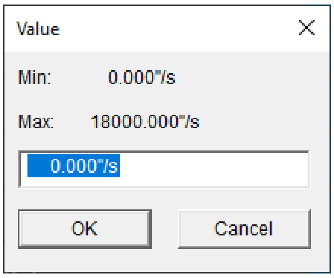
- **BOOKMARKS** for switching between screens
- The button/indicator signals an **ALARM** in the system. In case when no alarm is active, the indicator is blue. If it is flashing orange/blue, there is a non-acknowledged alarm in the system. If it is solid orange, there is an acknowledged alarm in the system.
- The **TREND** button shows the screen with the graph of selected variables.
- The **PARAMETERS** button shows the screen with technical parameters.
- The **SERVICE** button shows the screen with computer status, meteo data (monitor PLC) and IO devices.

4.2.4 Changing the value

- **Only authorized users with specified access levels can change** parameter values, alarm limits, etc.
- To change the value of a parameter move the mouse cursor to the **box of the variable value (light blue).**

  The box will be highlighted.
- Press **ENTER** or **click the left mouse button** to display the **"Value"** input window.

- Use the keyboard to enter the value and press **ENTER** to confirm.
- The value entered must be within the range set by the Min and Max values; values outside this range will not be accepted.
- KNOWN ISSUE: In all data input windows, the values in the input box are shown with three decimal places or less. The value entered can have more than three decimal places, and all of them will be accepted by the system (even though they do not show in the input box).

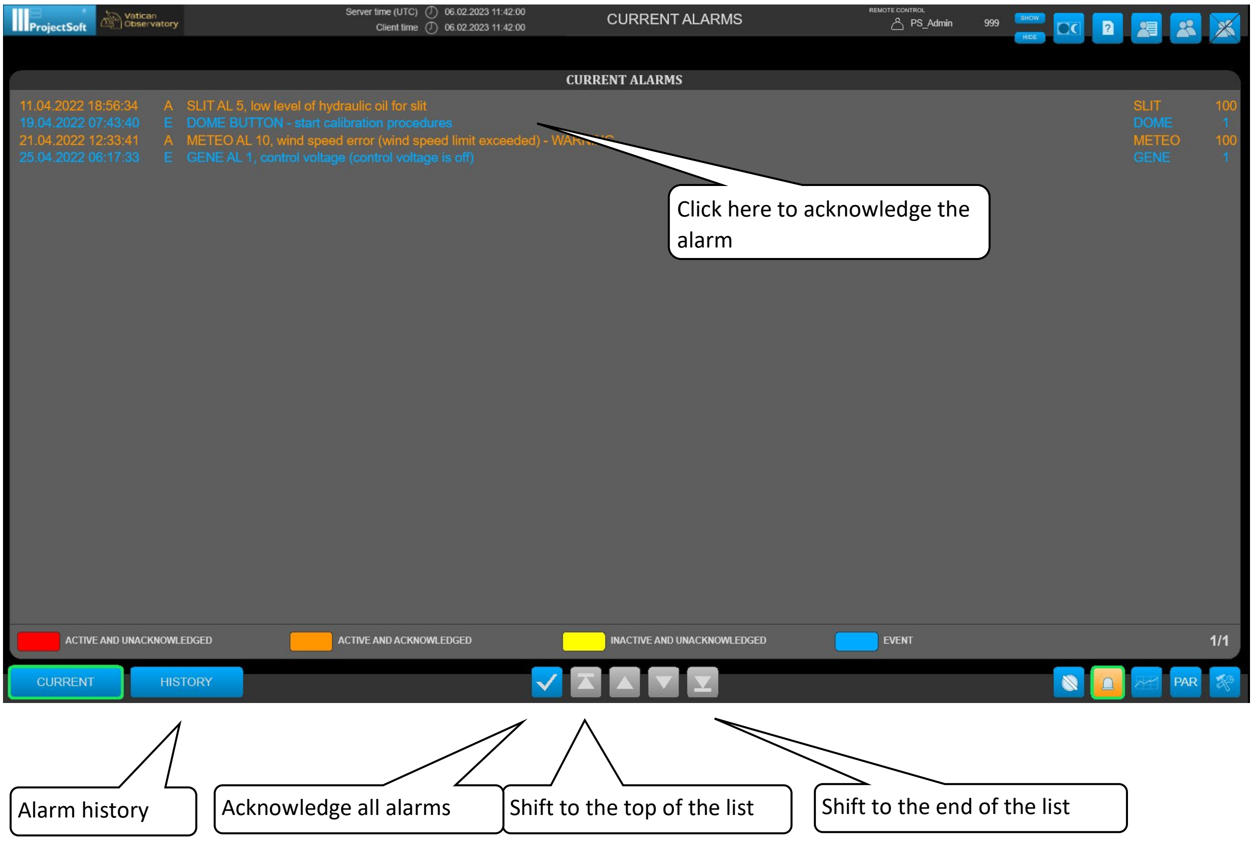
4.3 Alarm messages

Alarm messages notify the operator of existing non-standard conditions in the control system such as drive failures, monitored variables outside working limits, halt of operation due to exceeded control limits, etc.

- In case a new alarm occurs, it is indicated by the **flashing indicator** in the Top bar.

4.3.1 Current alarms

- Select the **ALARM** button in the bottom bar and click to open the **"Current alarms"** screen.
- **Current alarms (i.e., new or persisting alarms) and events** are displayed on this screen.



Individual columns of the table have the following meaning:

- date and time of the occurrence
- alarm status (A - active, + alarm activation, - alarm end)
- description of the issue
- location in the technology where the fault occurred
- value of the alarm variable

Lines are colour-coded according to their status:

- active unacknowledged alarms: red
- active acknowledged alarms: orange
- inactive unacknowledged alarms: yellow

If a new alarm is generated, operators must take action and acknowledge the alarm.

There are two possibilities to acknowledge alarms:

1. Acknowledge **all alarms in the system at one time** - click on the **"Acknowledge all"** button located on the bottom bar. The top bar indicator will stop flashing and turn red, to indicate that acknowledged faults (operators are aware of them) are persisting in the system.

Remark: if the issue is resolved/removed, the indicator turns from red to blue.

2. **Acknowledge only selected alarms** - click on the appropriate alarm line.
   - **UP ARROW** and **DOWN ARROW** buttons in the middle of the bottom bar are used for navigation through the alarm list.
   - **LEFT ARROW** on the left of the lower bar is used to move back to the previous screen.
   - **RIGHT ARROW** on the left of the lower bar is used to move to the screen of alarm history.

4.3.2 Alarm history

- In the alarm history screen, all alarms and events can be displayed along with current alarms.
- **An event** is an issue that **does not have the character of a fault** (log on of an operator, change of an important parameter, etc.) however, it is advisable to monitor it.

Note: acknowledging is not possible in alarm history.

Lines are colour-coded according to their status:

- active non-acknowledged alarms: red
- active acknowledged alarms: orange
- inactive non-acknowledged alarms: yellow
- events: blue

4.3.3 Alarm recordings backup

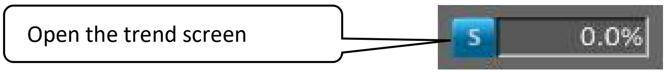
All alarms are saved on the hard disk in the database file (SQLite database with .db extension) divided into weekly periods. This file is located in C:\Users\Public\Documents\TomPack\VATT\HistAlarms\. Generally, history is set to 10 years. After this time, the oldest recordings in the file are automatically deleted and replaced by the newer ones. **Therefore, if you want to archive data for a longer period, it is necessary to back up the file in a period shorter than the pre-set time of 10 years.**
If needed, contact your IT department to solve the files backup.

4.4 Historical trends

The system of historical trends is used to archive measured technological values and display them as charts.

There are two ways of displaying historical trends in TomPack:

- To display the **trend of a specific measured variable**, click on the symbol of the controlled value (the left blue section of the box).

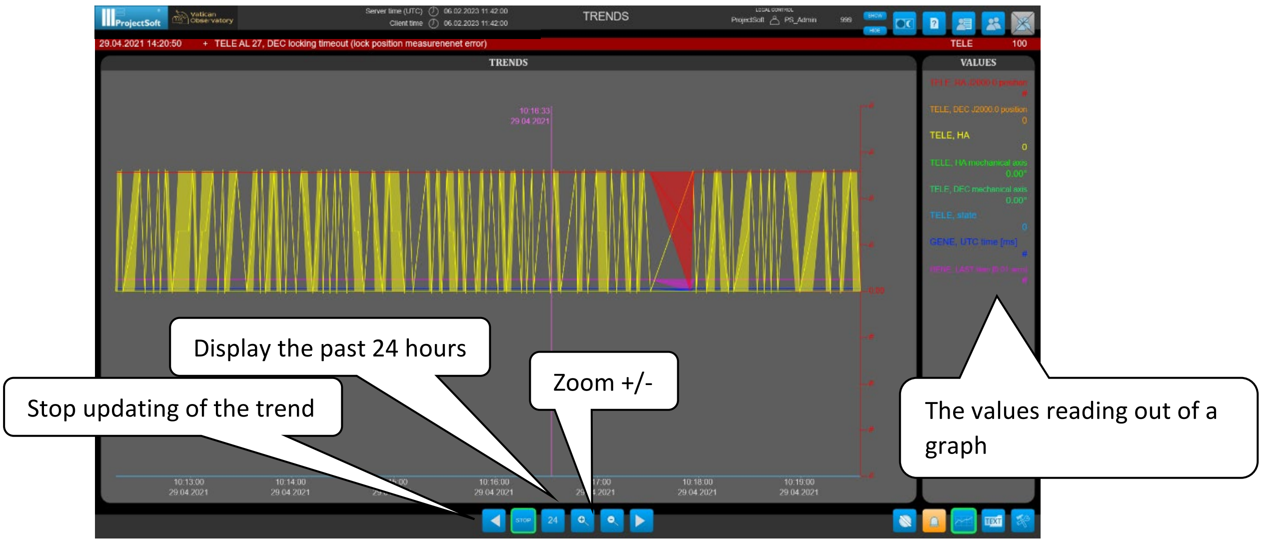


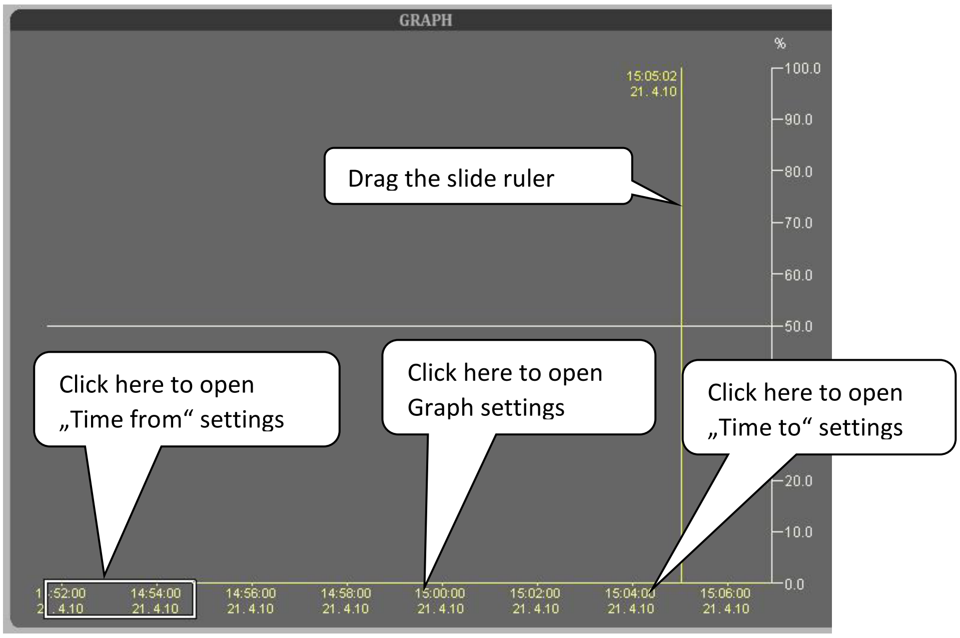
- To display the **summary trend of multiple measured inter-related variables**, click on the **TRENDS** button located on the bottom bar.

- When the trend screen is opened for the first time, the **real-time trend** is always displayed, i.e., the course of the measured variable is continuously updated in real-time.

4.4.1 Reading out of graph

- On the **right** side, next to the graph, **trend variable values are listed**; the value of each trend variable is updated accordingly to the slide ruler position.
- How to **read out values from the graph using the slide ruler**: position the mouse cursor to the "Y" axis, press the left mouse button, hold it, and drag it to the left (back in time).
- Date and time are displayed above the ruler and listed variable values are displayed on the right, as was already mentioned.





4.4.2 Movements in time

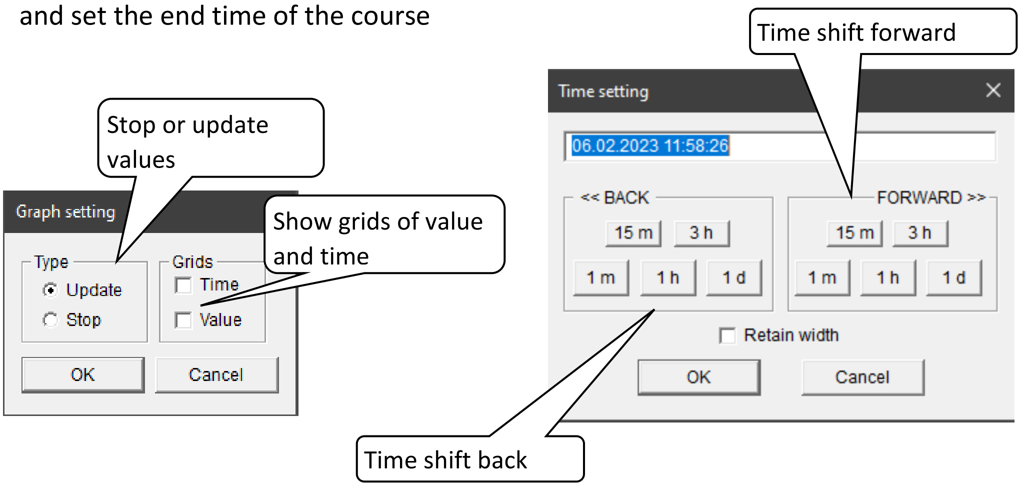
1. Viewing of real-time course

- If you want to change the time range of the displayed variable in real-time, you can use the following buttons located on the right of the graph:
- the **ZOOM+** button to enlarge the time range
- the **ZOOM-** button to reduce the time range
- the **24h** button to display the last 24 hours
- the **STOP OF TREND** button is used to stop updating the graph
- alternatively, the following steps can be used:
- click on the time axis, as shown in the picture, to open the **"Time from setting"** control panel for the time shift
- in this control panel, set the start time of the course either directly by filling in the date and time or by the usage of the buttons for shifting the time
- in this way, the graph will be extended from the current time to the past

2. Viewing the course in the past

- use the **STOP OF TREND** button to stop updating the graph
- as previously, click on the time axis, as shown in the picture, to open the **"Time from setting"** control panel for the time shift and set the start time of the course
- in this way, the graph will be extended to the past
- however, if you want to shift the course back in time while maintaining the same width of the graph, the **"Retain width"** box should be checked

- similarly, if the course has already been shifted to the past and you want to adjust its end, click on the time axis to open the **"Time to setting"** control panel for the time shift and set the end time of the course



4.4.3 Setting graph properties

- click on the time axis, as shown in the picture, to open the "**Graph setting**" control panel for changing graph properties
- in the left part "**Type**", graph updating can be stopped (the same function as the **STOP OF TREND** button)
- in the right part "**Grid**", an auxiliary grid can be displayed for both axes by marking the appropriate checkbox

4.4.4 Trend recordings backup

All trend-monitored variables are saved on the computer's hard disk, where the "TpServer2" application is running (see section 4). The format is the same as for alarms archives and the location of the files is C:\Users\Public\Public Documents\TomPack\MainPLC and C:\Users\Public\Public Documents\TomPack\MainPLC.

The information is stored in the form of databases. The timestamps are in milliseconds since Dec 30, 1899 (the epoch introduced in Lotus 1-2-3 and adopted by MS Excel; in these software systems, however, time is measured in days, not in milliseconds). You can use a Unix Epoch (Millisecond) converter (e.g., www.timestamp.com) as follows: take the timestamp from our database, subtract 2209161600000, and input the result in the converter. (The integer 2209161600000 is the number of milliseconds separating the Lotus 1-2-3 epoch of December 30, 1899, and the Unix epoch of January 1, 1970.)

Files will be stored on the disk for the pre-set time. After this time, the oldest files will be overwritten automatically. Therefore, if you want to archive data for a longer period, it is necessary to back up the file in a period shorter than the pre-set time of 10000 days.
If needed, contact your IT department to solve the files backup.

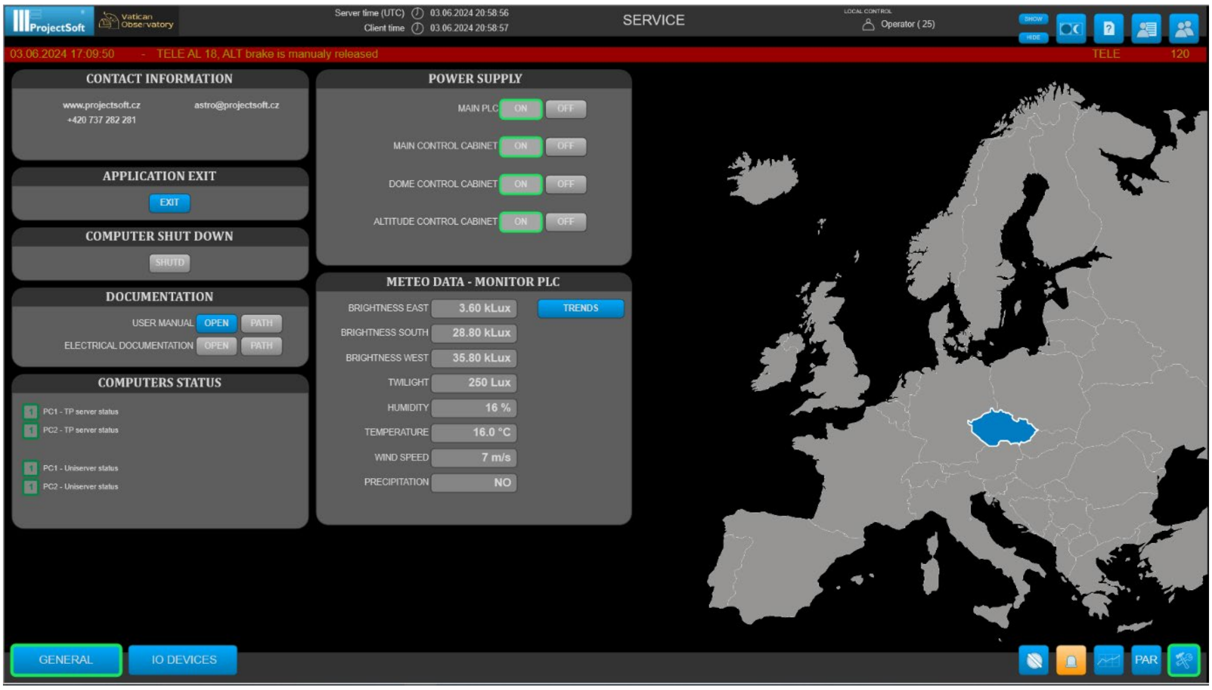
4.5 Service screen

To open the screen, click on the SERVICE button located on the bottom bar.

4.5.1 General screen

This screen consists of:

- Contact information
- Application exit
- Computer shutdown
- Documentation
- Computer status
- Power supply control (see note below)
- Meteo data (from MonitorPLC)



Power Supply Control

To power up/down the control cabinets including the Main PLC, simply use the Main Control Cabinet ON/OFF buttons in the “Power Supply” section of the Service > General screen.

For your reference, the four sets of ON/OFF buttons in that section operate the power switches for the Main PLC, the Main Control Cabinet (MCC), the Dome Control Cabinet (DCC) and the Altitude

Control Cabinet (ALC). When the MCC power is turned off, the whole system is powered down. After turning the MCC power switch off, you may notice after a while that the DCC and ALC power switches are turned OFF, while the Main PLC switch remains in the ON position. This does not reflect the state of the power: The power is cut when you turn the MCC power switch OFF. Turning the MCC power switch OFF causes the power switches for DCC and ALC to assume the OFF position, but the power switch for the Main PLC remains in the ON position (even though the Main PLC receives no power at this point).

NB. Starting the MCC and Main PLC does not activate certain systems (e.g., certain position sensors): the “Main Don Power” must be turned on for that!

Here are some practical consequences:

- After staring the MCC and Main PLC, but while the Main Don Power is still OFF, the Ground Short’s status is “Stopped” because the position sensor is not active yet. Remedy: Click on Ground Short “Lock” (will need Main Don Power ON).
- After staring the MCC and Main PLC, but while the Main Don Power is still OFF, if there is a gust of wind above the permitted limit, the following Alarm will occur: “Slit AL 1: Meteo error (the slit is not closed during bad meteo conditions)”. In fact, the slit may be closed physically but the system will perceive it as “Unknowns” until the sensors tell it otherwise, and that requires Main Don Power to be ON.

Advice: After starting the MCC and Main PLC, turn ON the Main Don Power, make sure that the system becomes “fully aware” of its state. Click the “Close” button for the Dome Slit (turning its state from “Unknown” to “Closed”). Click the “Lock” button for the Ground Short (turning its state from “Stopped” to “Locked”).

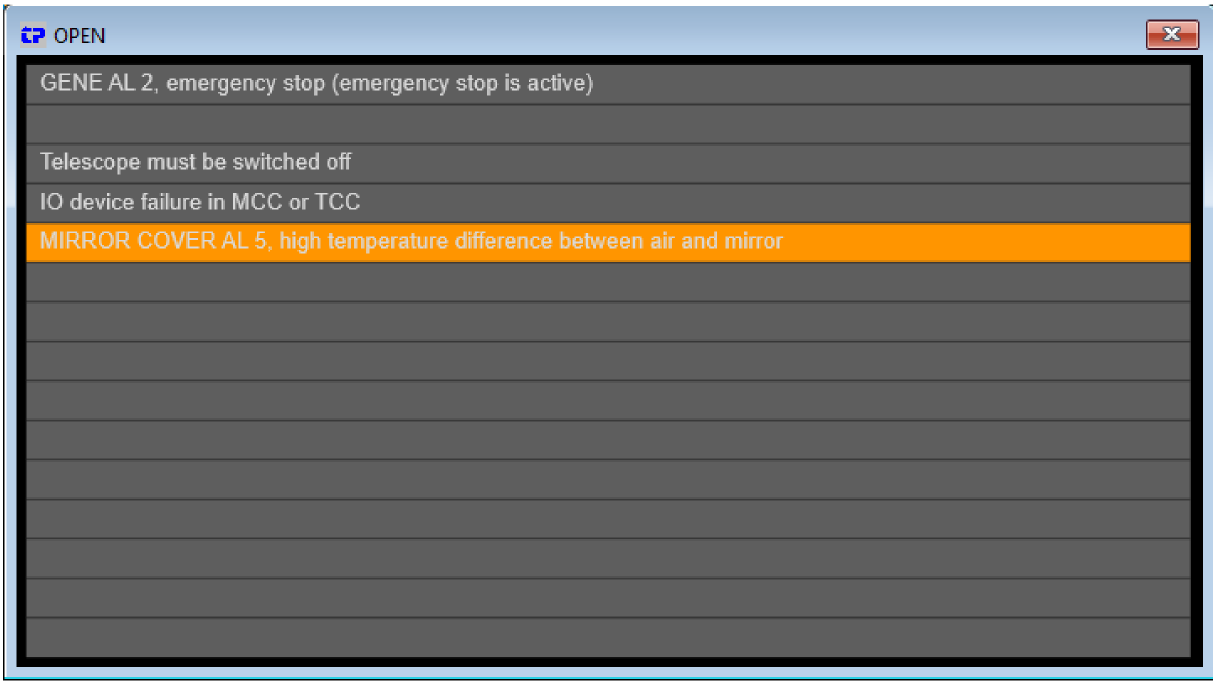
4.5.2 IO Devices screen

Screen with diagnostic data of PLCs and the status of each IO card and device.

4.5.3 Alarm signalization in the screen

When there is an active alarm assigned to a specific part of the system, the border around its state box is flashing orange. To troubleshoot, start by opening the alarm screen and checking all active alarms.

When the color of the text on the button is orange, it means that not all conditions to proceed with that action are met. The user can, however, click the button and a new window with all conditions will be shown. The conditions that are highlighted are not met.



5. CONTROL

5.1 General control

There are two options to control the system: the LOCAL CONTROL mode and the REMOTE CONTROL mode. The mode is selected by the position of the switch on the control box in the control room.

The mode cannot be overridden by software, so be sure to **activate REMOTE MODE before leaving the building**.

5.1.1 Local control

In Local mode, the Main 'Don' Power can be activated only by physically pressing a button on the box in the control room. This provides safety protection, preventing the system from being power up remotely while under Local Control.

5.1.2 Remote control

Normal operational mode. The main power supply can be activated from TomPack. Opening any doors leading to the dome (from the elevator, from the stairwell, and from the west porch leading to the roof) will turn the Main 'Don' power off in this mode. This also applies to the scissor lift (must be down) and the trap door on the ladder leading from the west porch to the roof (must be closed and fully latched).

Main 'Don' Power supplies motors. Not all devices are without power when the Main 'Don' power is off. If you are going to work on an electric device, check that the power is off.

- **ON** button turns on the Main 'Don' Power (only in Remote control).
- **OFF** button turns off the Main 'Don' Power (only in Remote control).

5.2 Oil system

VATT's azimuth bearing is hydrostatic. It uses hydraulic oil under more than 1000 psi of pressure. The two-level pump system imparts considerable Joule heat to the oil, which needs to be evacuated by oil chillers. At high temperatures, the oil's viscosity drops, and at low temperatures, the viscosity rises. The relevant oil temperature is measured in a tank in the basement. The oil in the tank becomes thermally stratified, and the thermometer in the tank may not measure representative values if the oil is kept still. To overcome this, the system runs circulation pump prior to temperature measurements, which homogenizes the oil. The oil system's temperature regulation maintains the oil at (15±1)°C using chillers and heaters.

Keep the oil system's temperature regulation ON at all times, even during the day or when there is no observing due to bad weather, etc.

5.2.1 Oil system states

5.2.1.1 INACTIVE

The oil pumps are inactive.

5.2.1.2 TEMPERATURE CHECK

The system checks that the oil temperature is within required range.

5.2.1.3 STARTING 1

The low pressure oil pump is activated and the system waits until the low pressure switch is activated.

5.2.1.4 STARTING 2

The high pressure oil pump is activated and the system waits until the oil pressure reaches required value for certain period of time.

5.2.1.5 STARTING 3

This state is used for restarting the oil system from the *STAND BY* state. The system is restarted right after the oil pressure reaches required value.

5.2.1.6 STAND BY

The oil pumps are turned off. The system is ready to perform faster start up sequence from this state. If the oil system is not restarted in a certain period of time, it is turned off.

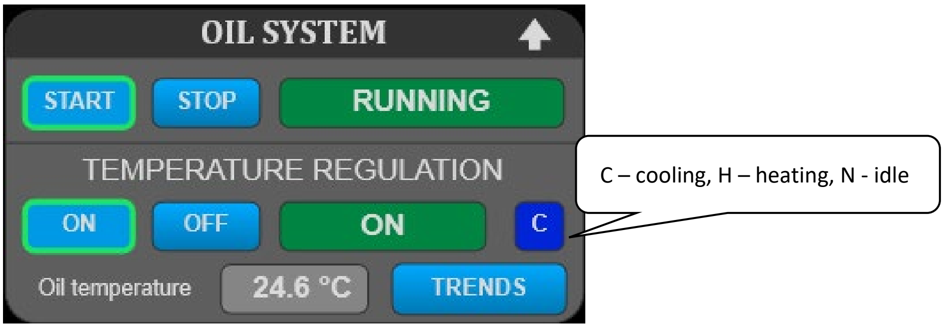
5.2.1.7 RUNNING

The oil system is running correctly, the hydrostatic azimuth bearing is ready.

5.2.1.8 CIRCULATION

The circulation pump is active (while the pumps are not).

5.2.2 Description of controls



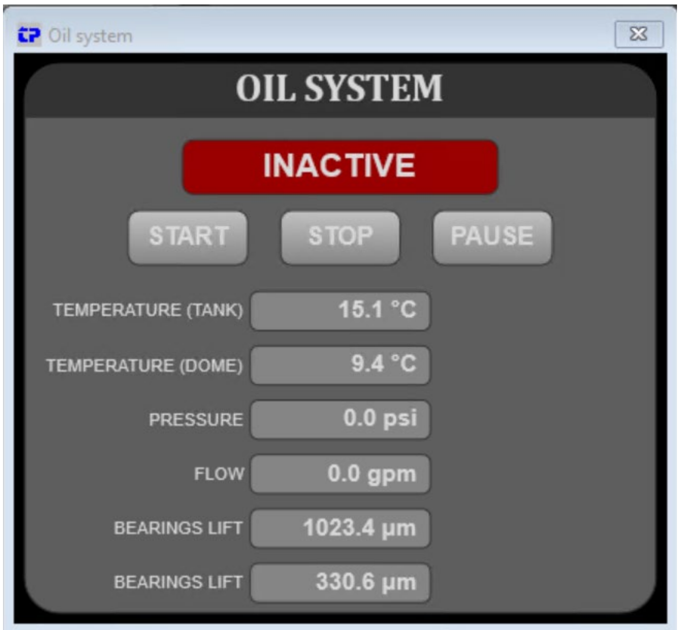
START button starts the oil system.

STOP button stops the oil system.

ON button starts the temperature regulation.

OFF button stops the temperature regulation.

Pop-up window for the oil system (all up-arrows in the top right corners of TomPack fields open pop-up windows)



PAUSE – turn off the high and low pressure oil pumps when "PAUSE" is active, expediting the restarting of the oil system; deactivates the oil system after 10 minutes (parameter #12).

5.3 STOW pin

Only level > 50 users are authorized to control the Stow Pin.

5.3.1 STOW pin states

5.3.1.1 STOPPED

The movement of the STOW pin is stopped and it is not in the locked or unlocked position.

5.3.1.2 LOCKING

The STOW pin is being locked.

5.3.1.3 LOCKED

The STOW pin is in a locked position.

5.3.1.4 UNLOCKING

The STOW pin is being unlocked.

5.3.1.5 UNLOCKED

The STOW pin is in unlocked position and the altitude axis is no longer secured by the STOW pin.

5.4 Telescope

This section discusses primarily the altitude and azimuth axes of the telescope.

5.4.1 Telescope states

5.4.1.1 DISABLED

The Alt-Az servo drives are switched off, meaning the Alt-Az motors halt, and mechanical caliper brakes are engaged (the brakes are powered by springs; they are released pneumatically).

5.4.1.2 DISABLING

The telescope is halted and the servo drives are still powered on for a few seconds. The brakes engage.

5.4.1.3 ENABLING

The power sources for the servo drives are turned on and the system is waiting a few seconds for their initialization.

5.4.1.4 ENABLED

The servo drives are powered on. The motors stand and are held in their actual position by control system regulators. The telescope can be moved using the manual movement function.

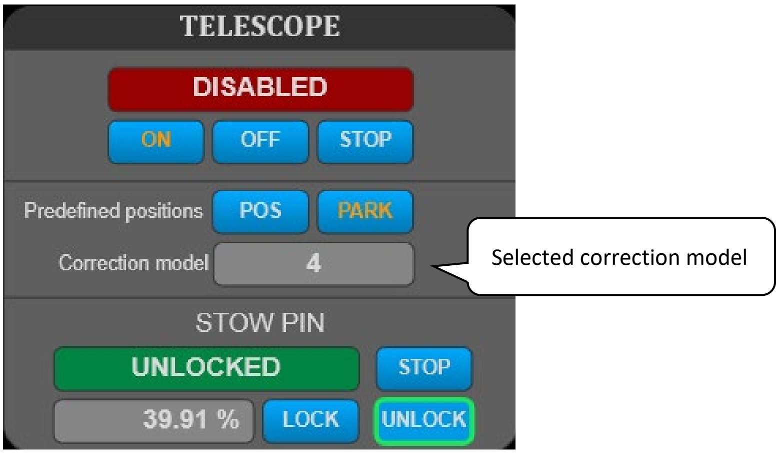
5.4.1.5 TRACKING

The control system uses actual Right Ascension and Declination as required position values and it calculates appropriate mechanical coordinates. This calculation is rectified by aberration, precession, nutation, refraction, and error model. The regulators maintain the telescope position in this requested position.

5.4.1.6 PARKING

The telescope moves to the specified mechanical parking position.

5.4.2 Description of controls



ON/OFF button enables/disables the telescope drives.

STOP button stops the movement of the telescope.

PARK button moves the telescope to the predefined parking position.

POS button opens the window with predefined positions of the telescope.

STOW pin

STOP button stops the movement of the STOW pin.

LOCK button starts the locking of the STOW pin.

UNLOCK button starts the unlocking of the STOW pin.

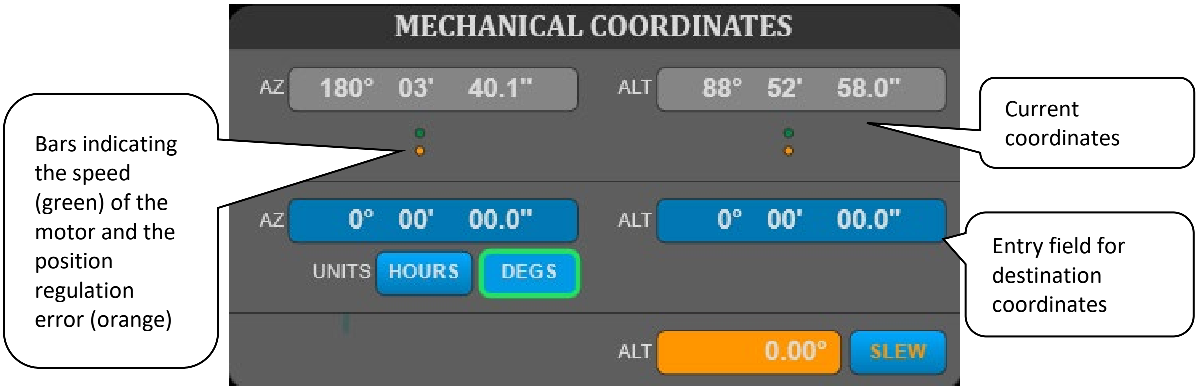
5.4.3 Mechanical Coordinates

The servo drives are powered on. The motors are held in their position by the drives. The telescope can be moved using manual movement functions.

This mode is used for slewing to new mechanical coordinates. Before slewing, the target position is checked. The speeds in both axes are calculated so that both axes arrive at the target destination at the same time. A minimum altitude above the horizon is checked for the slew path. In the case of moving close to the horizon limit an alternative path is calculated.

After slewing to the target position, the telescope control system is switched to Mech mode.

After setting the ALT and AZ coordinates (ALT units are degrees, AZ units are either hours or degrees), click the **SLEW** button and the telescope will automatically slew to the set position.



SLEW button starts the slew to the new target position. After reaching the coordinates, the telescope maintains the requested position.

ALT filed shows the elevation of the telescope for the assigned target coordinates. If the target coordinates are below minimal elevation of the telescope, the filed will have orange background and slewing to the coordinates will be disabled.

5.4.3.1 Coordinate Input

Dialogue windows for coordinate input permit the user to type the digits of the coordinates in their natural order with no additional characters (spaces, colons, etc.) as described below. This applies to degrees, minutes and seconds (ddd mm ss), as well as to hours of angle, minutes of time and seconds of time (HH MM SS; 1 hour of angle is 15 degrees, 1^h=15°, 1 minute of time angle is 15 minutes of arc, 1^m=15’, and 1 second of time angle is 15 seconds of arc, 1^s=15’’). The input method is the same.

In order to input 45°12’34.67’’, type 451234.67 and hit enter. This closes the dialogue window. Check that the system understood the value correctly by inspecting the appropriate blue-background box. Similarly, to input 123°4’1.8’’, type 1230401.8 and hit enter. To input $8^h23^m1.987^s$, type 82301.987 and hit enter. The system interprets the two digits to the left of the decimal point (or the last two digits of the number if there is no decimal point) as seconds, the two digits to the left of those as minutes, and anything to the left of those as degrees or hours.

5.4.4 Sky Coordinates

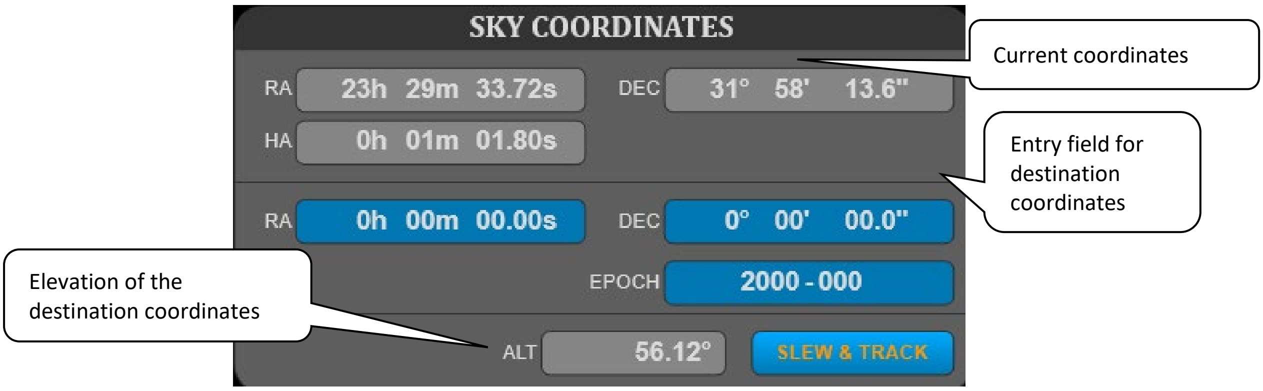
The control system uses actual Right Ascension and Declination as required position values and it calculates appropriate mechanical coordinates. This calculation is rectified by aberration, precession, nutation, refraction, and error model. The regulators maintain the telescope position in this requested position.

This mode is used for the slewing to the new coordinates – Right Ascension and Declination. The appropriate mechanical coordinates of the target position are calculated before the slewing and they are rectified by aberration, precession, nutation, refraction, and error model. The speeds for both axes are calculated so that both axes arrive at the target destination at the same time. A minimal altitude above the horizon is checked during the slewing. In the case of moving close to the horizon limit, the alternative path is calculated.

After slewing to the target position, the telescope control system is switched to the Sky mode.

After setting the RA and DEC coordinates, click the SLEW button and the telescope will automatically slew to the set position.

It is possible to interrupt slewing to the target position by the **STOP** button.



SLEW & TRACK button starts the slew to the new target position. After reaching the coordinates, the telescope continues to track the requested sky coordinates.

EPOCH box is used for setting the epoch of entered coordinates. Epoch cannot be changed while the telescope is tracking.

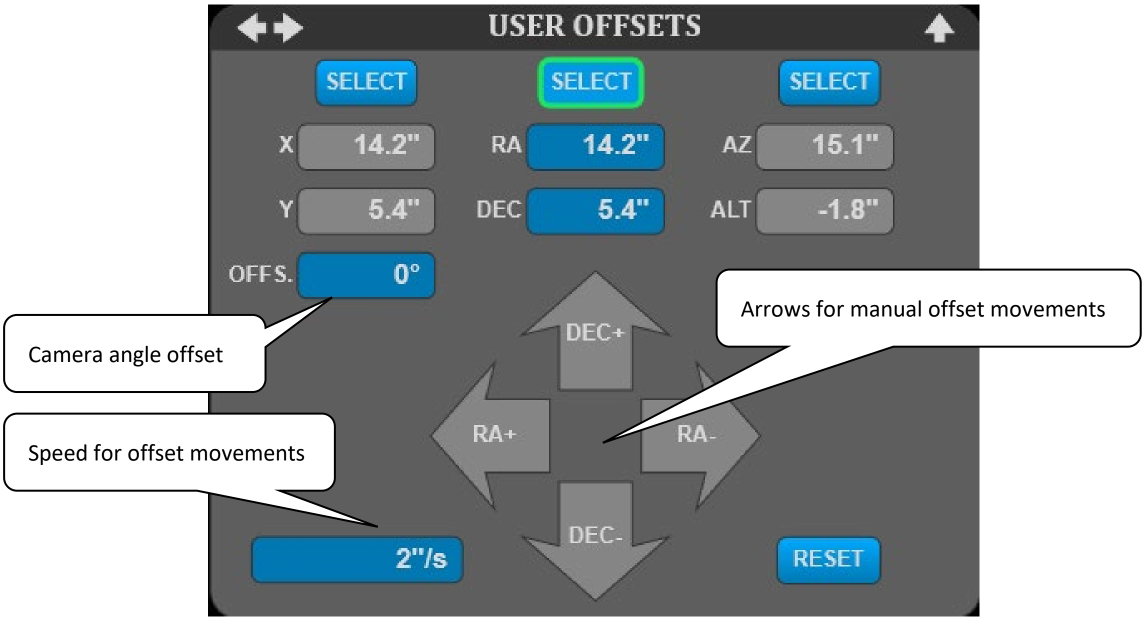
ALT filed shows the elevation of the telescope for the target coordinates (entered in the blue-background boxes; calculating with the Epoch). If the target coordinates are below the telescope's minimal elevation, the filed will have orange background and slewing to the coordinates will be blocked.

5.4.5 Offsets

Offsets are used for compensation of misalignments, for the user's convenience or as a part of the autoguider operation.

5.4.5.1 User offsets

These offsets are entered manually by the observer. The observer has to choose the coordinate system for the offsets. The plate coordinate system (X-Y) should be aligned with the mechanical coordinate system (Alt-Az) using the camera offset angle. (Note that the derotator offset can be used to correct the camera's misalignment physically. The camera angle offset introduced as one of the



User Offsets, can be used when the camera is physically misaligned. If the camera is aligned correctly using the derotator offset, the camera angle offset here should be zero.)

After entering the offsets, the values are transformed to mechanical coordinates. The sky coordinates are not altered.

The words "Offset Active" appear in the Sky Coordinates field to warn the user that user offsets are active.

- **RESET** button sets the offsets to zero, and the telescope reverts to the Sky Coordinates listed in the appropriate field.

5.4.5.2 Autoguider offsets

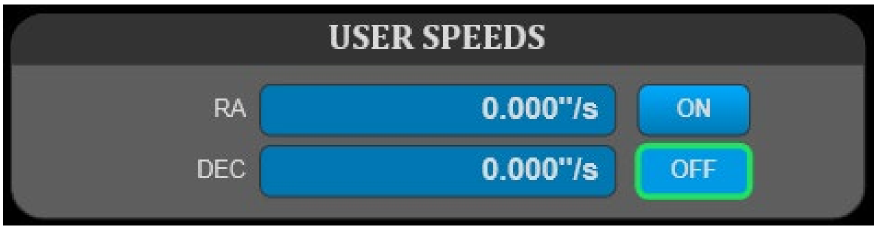
The autoguider tweaks the telescope's tracking by sending commands to the telescope control system. The observer must make sure that the coordinate system in which the autoguider sends the offsets is correct. The two values on the left are the values sent by the autoguider. The two values on the right, always Alt-Az, display how the telescope's control system interprets the autoguider's command.

- **RESET** button resets the offsets to zero, and the telescope's pointing reverts to the Sky Coordinates listed in the appropriate field.

5.4.6 User Speeds

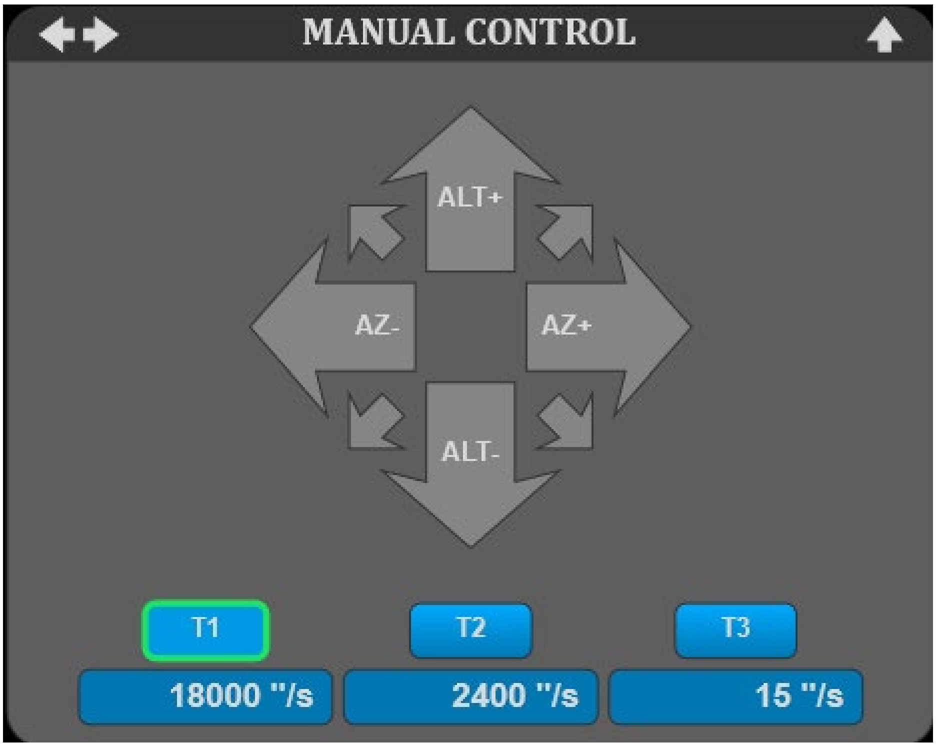
The user's speeds serve for non-sidereal tracking, i.e., tracking objects like near-Earth asteroids and comets.

This function is switched on and off by buttons **ON** and **OFF**.



5.4.7 Manual movements

This virtual paddle is used for movements of the telescope. The Sky Coordinate values are altered accordingly.

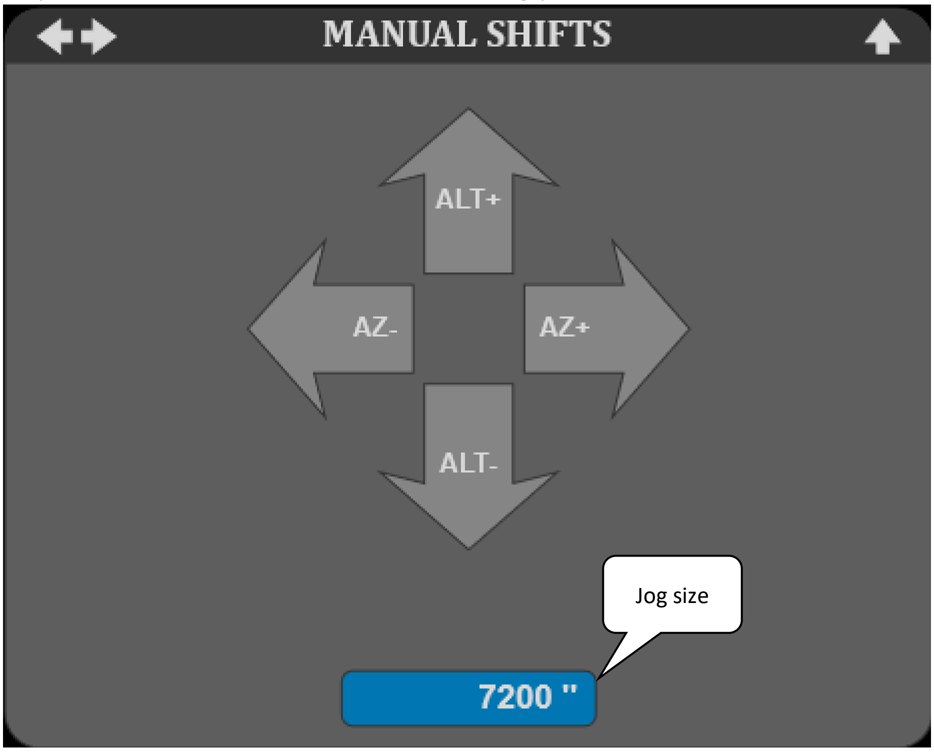


May be used when the software alarm is on and the telescope needs to be moved to the safe position.

- **T1, T2, T3** button selects the speed for manual movement of the telescope.

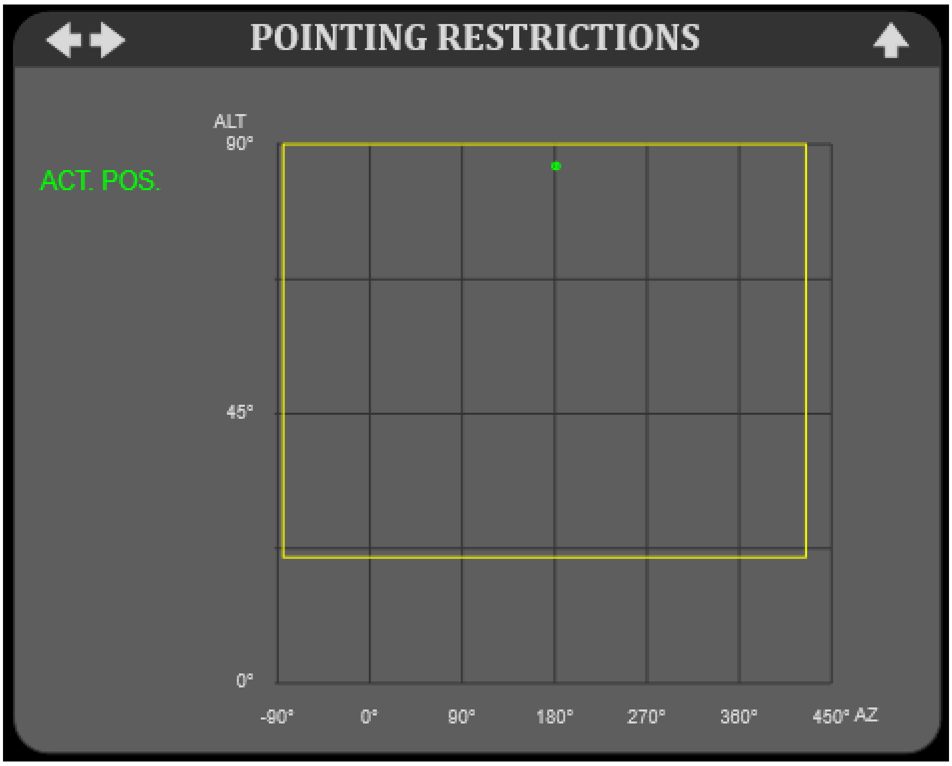
5.4.8 Manual shifts

Used for moving the telescope by a specified distance in selected direction: jog mode of a virtual paddle. The Sky Coordinate values are altered accordingly.



5.4.9 Pointing restrictions

Used for monitoring of the telescope movement, its current ("actual") position, target position etc. The yellow border indicates the telescope's pointing limits.



In the case of the Alarm "TELE AL 9 Pointing restrictions, off", when a pointing limit was breached, and the telescope was disabled, the user should first check what caused the problem. To re-enable the telescope, the user may need to move it back within the allowed range of positions using Manual Controls (the virtual paddle). Use this sequence of steps: 1. Check that personnel and equipment are safe. 2. Turn ON the Software Alarm Bypass (Technology 1 > General). 3. Enable the telescope. 4. Use Manual Controls (Controls screen) to bring the telescope back within the range. 5. Turn OFF the Software Alarm Bypass.

5.5 Correction model

5.5.1 Introduction

A couple of astronomical corrections are implemented in the PLC software. It is mainly annual aberration, precession and nutation when sky coordinates are used. Current precession correction values depend on the epoch of coordinates entered.

The current local apparent sidereal time is computed from current UTC. To use UT1 for more precise sidereal time, the DUT1 correction must be regularly updated by manual input.

5.5.1.1 Overview of the Procedure

Inaccuracies of the mount are corrected using these steps:

1. Measuring the inaccuracies

The user populates a measurement database. It is accomplished by pointing the telescope to stars, fixing the telescope to the reference point of the camera and storing the difference into a text file. *If the telescope uses Main and Reverse positions (i.e., accessible elevation angles cover two quadrants rather than one quadrant; the VATT's elevation axis covers a single quadrant) should be used, but they will result in only one set of coefficients.* To speed up data collection, part of the delivery is a star catalogue of uniformly spread stars of equal magnitude with a minimum of nearby stars for ease of target identification. The user enters the target's X/Y coordinates on the CCD camera and the control system computes the required correction.

2. Computation of the coefficients

The next step is the computation of the coefficients, using the command line program TeleModel. It uses the least square fit of the measured data to compute the values of the coefficients. The User can choose a text file with measured data and a set of computed coefficients. Selection of the coefficients is important for correct and effective computation.

3. Transfer of computed coefficients into the control system

The user enters the computed coefficient into the boxes in TomPack's "Model" screen. The system stores up to 5 sets of parameters. The User may switch between these five models as needed (they may correspond to five different mechanical setups, e.g., involving different telescope instruments).

4. Test of the model

The last step should test the result. The method is the same as step 1, but the necessary correction to reach the reference point of the camera should be in the expected range of the model.

5.5.1.2 Notes

It is possible to merge data from different measurements, but all conditions must be the same! Even a small change of the full optical or mechanical part disallows data merging.

For each optical configuration of the telescope a separate measurement set and coefficient computation is needed. The seven-term approach (Patrick Wallace 2002.SPIE.4848.125W) is successful for most imagers with no or few folding mirrors but it is possible that different optomechanical configurations will require different sets of coefficients, not just different values. In this case, contact ProjectSoft.

It is suitable to perform the preliminary setting of the error model as the first step, measuring only twenty objects. The entire process is then repeated, as described in the preceding paragraph, with the preliminary error model turned on.

The following terms can be currently used:

1. Shift of the zero position in Azimuth axis, IA
2. Shift of the zero position in Altitude axis, IE
3. Nonperpendicularity between Azimuth and Altitude, NPAE
4. Collimation error, CA
5. Shift of the Azimuth axis towards North, AN
6. Shift of the Azimuth axis towards West, AW
7. Tube flexure, TFAA

Name	Azimuth axis influence	Altitude axis influence
IA	IA	0
IE	0	IE
NPAE	tan(alt)	0
CA	1/cos(alt)	0
AN	sin(az)*tan(alt)	cos(az)
AW	cos(az)*tan(alt)	cos(az)
TFAA	0	cos(alt)

5.5.2 Procedure for calculating the coefficients

5.5.2.1 Step 1 - Measuring of the inaccuracies, collecting data

The coordinates can be entered manually on the screen **CONTROL,** or the selected objects can be loaded from a text file, prepared in advance. The pathname of the file can be entered in the correction model window, usually c:\model\stars.dat

The line data format:

The first six characters represent the identification number

RA (hours, minutes, seconds, degrees, arc minutes, arc seconds)

Dec

RA proper motions (seconds and arc seconds per year)

Dec proper motions

Equinox

The file is terminated by the word "END".

Example:

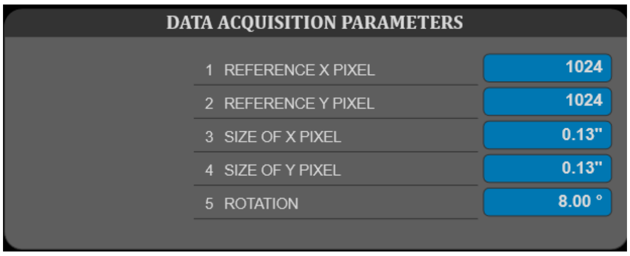
000001 01 33 13.030 -79 55 35.70 +.0126 +.011 2000.0

END

The procedure for data acquisition is as follows:

1. Switch the telescope to **STOPPED** mode.

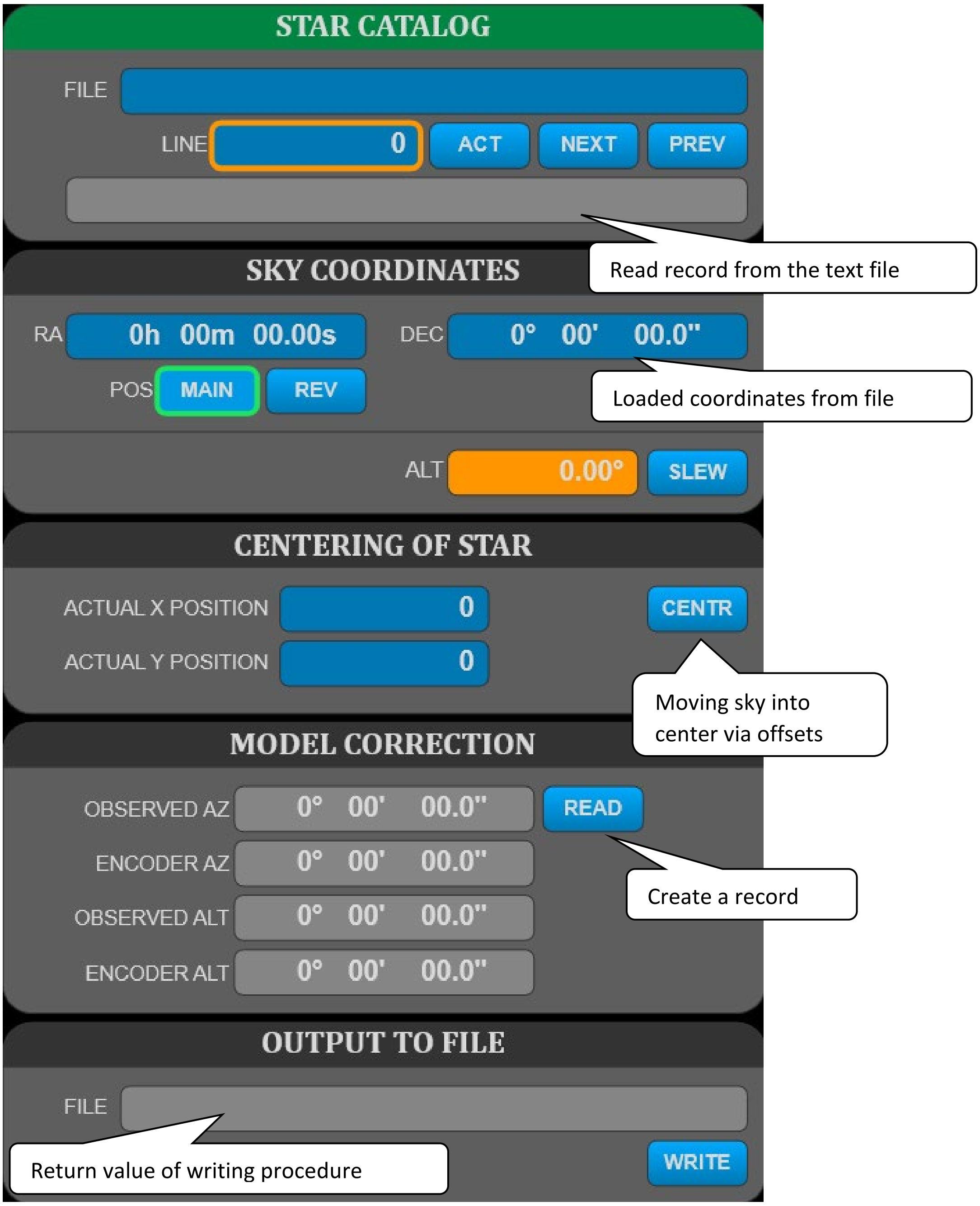
   Check or update the **DUT1** parameter value (“Other Par 1” > “General Parameters” > #9). This value can be obtained in IERS   BULLETIN - A, for example here: https://www.iers.org/IERS/EN/Publications/Bulletins/bulletins.html, section Latest Version, column UT1-UTC, the value from the most recent date. The value can be also negative. Check also data acquisition parameters (on the parameter screen) for fast centering of the star.



2. *Select the Main or Reverse position of the telescope if applicable (does not apply to the VATT).*

3. Reset user offsets

4. Open the Data acquisition window (wrench button on Pointing model panel or DATA ACQ button on Pointing model screen)



- Enter the path to the file with the TeleModel database of stars.
- Start with line 1 (enter 1 into the column LINE).
- To read data from the selected line click the ACT button.
- To read data from the next line click the NEXT button. The line number will increase automatically.
- If the line is read successfully (green OK) then the coordinates and epoch of the star are transferred to Sky coordinates.
- If the coordinates of the star are above the horizon (ELEV. is not yellow) and are not covered by the shutter, click on the SLEW button.
- If the telescope is at the desired position, take an exposure.
- Note that the camera's ouput (fits file) may have axes oriented in the opposite direction than expected in this tool. The remedy is to take the highest value (e.g., 4000; let's call it Xmax), and subtract the pixel number (as given in the fits file; let's call it Xpix), and then input the difference (Xmax-Xpix) into the tool.
- Align the camera using the derotator offset and select the RA/DEC user offsets mode.
- If the star is not at the reference pixel, enter the actual pixel position to the CENTERING OF STAR area and click on the button CENTR. Calculated corrections will be added to actual User corrections and the telescope will immediately change its position. Another possibility is to manually enter the desired correction into CORRECTION values or movement of the telescope using T3 speed and correction mode of the movement.
- Take an exposure.
- Repeat this procedure until the actual position of the star corresponds with the reference pixel. Sufficient accuracy is reached when the star is closer than approximately 1-2 arcsec to the reference pixel.
- If the actual position of the star corresponds with the reference pixel click the READ button.
- If you have a centred sky and observed and encoder coordinates were read click WRITE to write data to the output file. The name of the file is generated automatically in the format model_YYYY_MM_DD.dat. Check if data were successfully written to the file.
- Repeat this procedure by pressing the button READ NEXT until all visible stars from the database are measured

If the telescope has Main and Reverse positions, repeat the whole procedure (using the same stars) for the reverse position of the telescope (not applicable to the VATT).

5.5.2.2 Step 2 - Computation of the coefficients

Command line program TeleModel.exe (usually in C:\model\) should be used for coefficients computation. Its first parameter is the name of the text file with measured data, next parameters are coefficient names to compute.

The result is split into two parts. The first part shows the measured data with the following columns:

AZ	Azimuth axis angle of a measured star
ALT	Altitude axis angle of a measured star
Input d_az	Measured difference in azimuth axis
Input d_alt	Measured difference in altitude axis

Input sqr	Total measured difference (magnitude of the error)
Result d_az	Resulted difference in azimuth axis
Result d_alt	Resulted difference in altitude axis
Result sqr	Total result difference (the expected remaining error)

The second part includes coefficients:

Input RMS	Root mean square of input data
Coeff	Coefficient name
Value	Computed coefficient value
Sigma	Deviation of coefficient value
Result RMS	Root mean square of resulted remaining error

Example: TeleModel.exe model_2025_03_10.dat output.txt ia ie npae ca an aw tf

```
C:\Windows\System32\cmd.exe

d:\!work\Akce\VATT2021\model_vzor>telemodel model_2014_10_02.dat ia ie ca an aw tfaa
TeleModel v4.2 (c) ProjectSoft 2021

                                  Input                       Result
        AZ              ALT        d_az      d_alt     sqr    d_az     d_alt     sqr

  0: 105 14 57.7 +031 47 55.7  -4931.9  -1558.2  4471.9     0.6     49.7   49.73
  1: 235 41 30.2 +043 09 01.2  -5804.8  -1822.3  4610.4     2.5      5.9    6.20
  2: 081 19 25.4 +028 28 10.4  -4936.2  -1379.2  4553.2    -6.1     66.4   66.61
  3: 271 06 45.3 +034 08 29.7  -5599.4  -1635.4  4914.4   -19.0     41.5   44.35
  4: 169 15 15.9 +065 35 27.2  -6390.8  -1721.5  3152.5    65.5    -23.0   35.55
  5: 149 02 40.3 +062 15 03.0  -5837.6  -1631.0  3169.8    57.7    -37.4   46.05
  6: 093 01 04.3 +051 23 05.4  -5173.1  -1261.2  3466.1    17.0    -25.4   27.52
  7: 083 02 45.6 +041 34 52.8  -5025.2  -1263.2  3965.5    -0.2      1.1    1.06
  8: 283 59 09.4 +040 36 23.5  -5826.2  -1442.3  4652.5   -29.9     -3.5   23.00
  9: 277 52 12.5 +047 15 51.6  -6146.3  -1451.1  4416.2   -17.1    -10.5   15.65
 10: 260 08 34.9 +054 15 23.4  -6556.1  -1547.3  4130.6    -1.7    -21.8   21.85
 11: 064 36 05.8 +039 10 46.0  -5068.4  -1145.6  4092.5     1.2     13.4   13.46
 12: 292 03 21.7 +048 34 21.5  -6211.8  -1303.4  4311.9   -24.1    -22.8   27.79
 13: 093 43 57.3 +073 26 52.4  -6529.1  -1102.7  2162.4    38.8    -18.1   21.21
 14: 054 09 54.9 +048 00 48.4  -5265.1   -967.9  3652.7   -16.0    -44.0   45.25
 15: 018 24 08.0 +072 42 05.3  -7891.7   -687.1  2445.1     2.0    -17.3   17.27
 16: 291 39 26.8 +143 48 33.4  -1783.9   -585.8  1554.3     2.7     -0.2    2.15
 17: 063 05 36.2 +141 46 33.1  -2450.7   -348.2  1956.5    25.3     -0.2   19.85
 18: 266 08 02.0 +147 06 05.7  -1896.8   -769.6  1768.8     2.1    -27.3   27.32
 19: 096 01 57.1 +151 23 33.2  -2592.4   -515.1  2333.5    27.8    -54.9   60.12
 20: 003 11 26.7 +114 36 11.4   -420.1   -358.8   399.2   -59.9      5.5   25.54
 21: 341 01 43.8 +116 18 38.5   -253.1   -418.7   433.4   -50.0     10.8   24.65
 22: 277 41 23.9 +124 39 12.6   -696.2   -860.5   947.2   -35.1     32.7   38.33
 23: 266 59 45.1 +134 30 04.4  -1387.4   -891.5  1319.2   -14.2     33.7   35.17
 24: 107 31 22.8 +144 19 08.2  -2554.5   -685.6  2185.3    19.1    -20.5   25.70
 25: 101 38 14.8 +137 52 01.2  -2490.9   -697.1  1974.4     9.7      8.3   10.99
 26: 085 09 22.6 +130 46 58.4  -2347.7   -624.9  1655.9    -1.6     37.1   37.14
 27: 247 20 33.4 +137 20 49.7  -1610.0  -1012.9  1558.3     4.7     13.2   13.65
 28: 114 31 25.0 +136 06 05.6  -2455.3   -838.7  1957.9     5.9     24.1   24.48
 29: 277 24 24.5 +102 45 43.8   4521.4   -937.7  1370.0   -36.3    -53.3   53.90
 30: 235 11 44.6 +129 06 36.9  -1272.2  -1170.1  1418.9     5.4     36.5   36.69

Input RMS:   3062.665

Coeff    Value[''] Sigma['']

  IA    3745.0     8.813
  IE   -1067.6     5.956
  CA    1280.5     5.963
  AN    -502.7     7.658
  AW     108.1     6.170
TFAA     497.9     8.796

Result RMS:    33.109

d:\!work\Akce\VATT2021\model_vzor>
```

5.5.2.3 Step 3 – Transfer coefficient values into the control system

The obtained values should be then typed into corresponding boxes on the parameter screen. Unused coefficients must be zeroed.

5.5.2.4 Step 4 – Test of the model

The last step should prove the validity of the data. The user should repeat the same method as in the case of collecting data for the model. However, the measured corrections should be approximately in the expected range of the model resulted RMS. The newly created database could be then also used for new computation of the coefficients.

5.6 Derotator

In addition to the Alt and Az axes, VATT has a derotator or field rotator axis. It ensures that the instrument's field of view maintains the same orientation while tracking a star field. The appropriate angle of rotation of the derotator is the "parallactic angle" (the angle between the great circle through a celestial object and the zenith, and the hour circle of the object).

To ensure that the camera's field is aligned with sky coordinates (i.e., the plate coordinates X-Y are aligned with equatorial RA and Dec coordinates at the centre of the camera's field of view) use the Mechanical Coordinates SLEW to a position at Az = 180° (and Alt to an arbitrary position 30°-70°; preferably where there is a bright-ish star field). Take a 1 minute exposure with the science camera. The image will show (remember to flip Y in DS9) streaks crossing the field the of view. If the camera is well aligned, the streaks should be horizontal. Examining the slope of the streaks, calculate arctan((y1-y0)/(x1-x0)) in degrees. This should be the derotator offset (or negative?).

5.6.1 Derotator states

5.6.1.1 DISABLED

The servo drives are disabled, meaning the motors stand still and are not braked.

5.6.1.2 READY

The servo drives are enabled and the motors are held in their current position.

5.6.1.3 SLEW

The derotator is moving to a new position.

5.6.1.4 TRACK

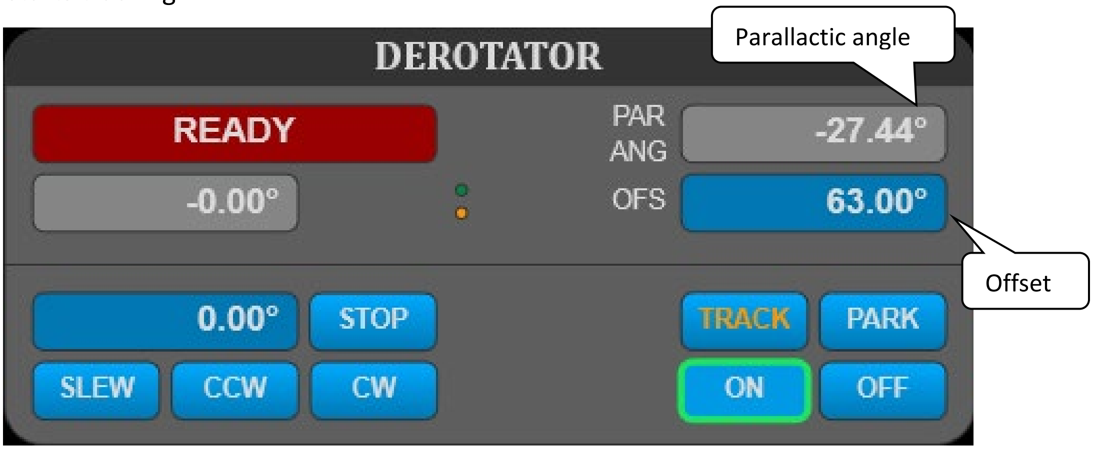
The derotator is tracking the telescope. It rotates to the angle that equals to the sum of paralactic angle and offset.

5.6.1.5 PARK

The derotator is moving to its parking position.

5.6.2 Description of controls

When the derotator is ready, it starts and stops tracking the telescope automatically, when the telescope starts tracking.



ON/OFF – engage/disengage the derotator drives.

SLEW – slew the derotator to the specified position (clockwise rotation, as seen from the top, corresponds to increasing values of the slew angle).

CW/CCW - move the derotator clockwise/counterclockwise (as seen from the top) while the button is pressed.

TRACK – command the derotator to track the telescope, i.e., follow the parallactic angle (+ offset).

PARK – move the derotator to its parking position.

STOP – stop the movement of the derotator.

5.7 Mirror Cover

5.7.1 Mirror cover states

5.7.1.1 STOPPED

The mirror cover is not moving and the position is not defined (the end position signal is not received).

5.7.1.2 OPENING, CLOSING

The mirror cover is opening/closing.

5.7.1.3 OPEN, CLOSED

The mirror cover is open/closed and not moving.

5.7.2 Description of controls

OPEN – start opening the mirror cover.

CLOSE – start closing the mirror cover.

STOP – stop mirror cover movement.

5.8 Dome

5.8.1 Dome states

5.8.1.1 DISABLED

The dome is not moving and is ready to receive control signals.

5.8.1.2 MANUAL CW, MANUAL CCW

The dome is moving in response to manual inputs.

5.8.1.3 AUTO

The dome is in automatic movement mode. The slit of the dome follows the telescope's position.

5.8.1.4 AUTO CW, AUTO CCW

The dome is moving automatically to a new position. The slit of the dome follows the telescope with a certain tolerance specified by the parameter.

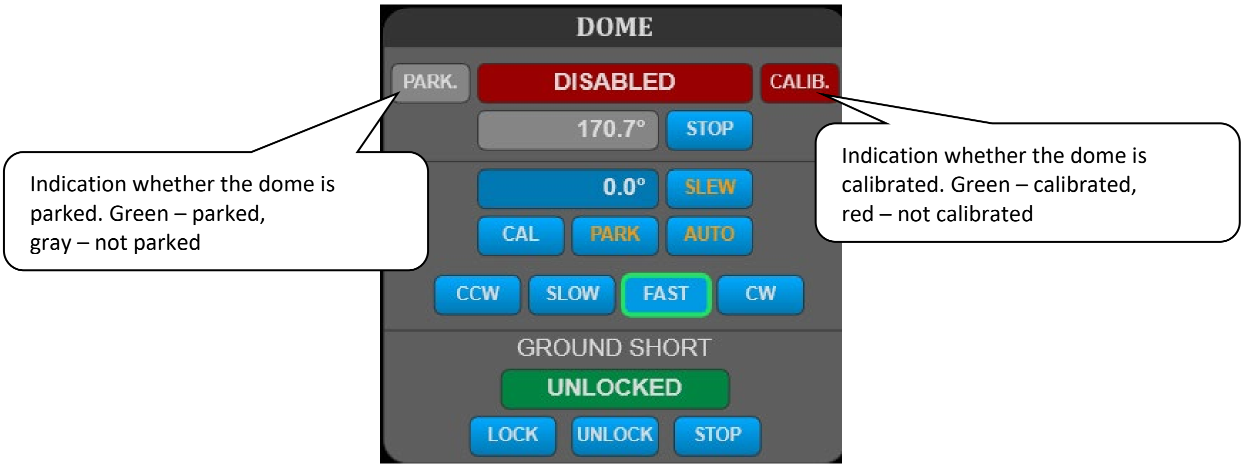
5.8.1.5 SLEW CW, SLEW CCW

The dome is moving to a new position, determined by the azimuth, set by the operator.

5.8.1.6 CALIBRATING

The dome is slewing until it slews over a calibrating sensor.

5.8.2 Description of control



SLEW – start slewing the dome to the requested position.

AUTO – turn on the AUTO mode.

PARK – start slewing the dome to the parking position.

STOP – stop any movement of the dome.

SLOW, FAST – select the dome moving speed.

CW/CCW – move the dome clockwise/counterclockwise while the buttons are pressed.

Ground short

LOCK – lock the ground short.

UNLOCK – unlock the ground short.

STOP – stop the movement of the ground short.

5.9 Dome slit

5.9.1 Dome slit states

5.9.1.1 UNKNOWN

The slit is not moving and is not open or closed.

5.9.1.2 OPENING, CLOSING

The slit is opening/closing.

5.9.1.3 OPEN, CLOSED

The slit is fully open/closed and not moving.

5.9.2 Description of control

OPEN – start opening the slit shutters.

CLOSE – start closing the slit shutters.

STOP – stop the movement of the slit shutters.

5.10 Mirror cooling

ON/OFF – start/stop the mirror cooling system and mirror fans ("cell fans").

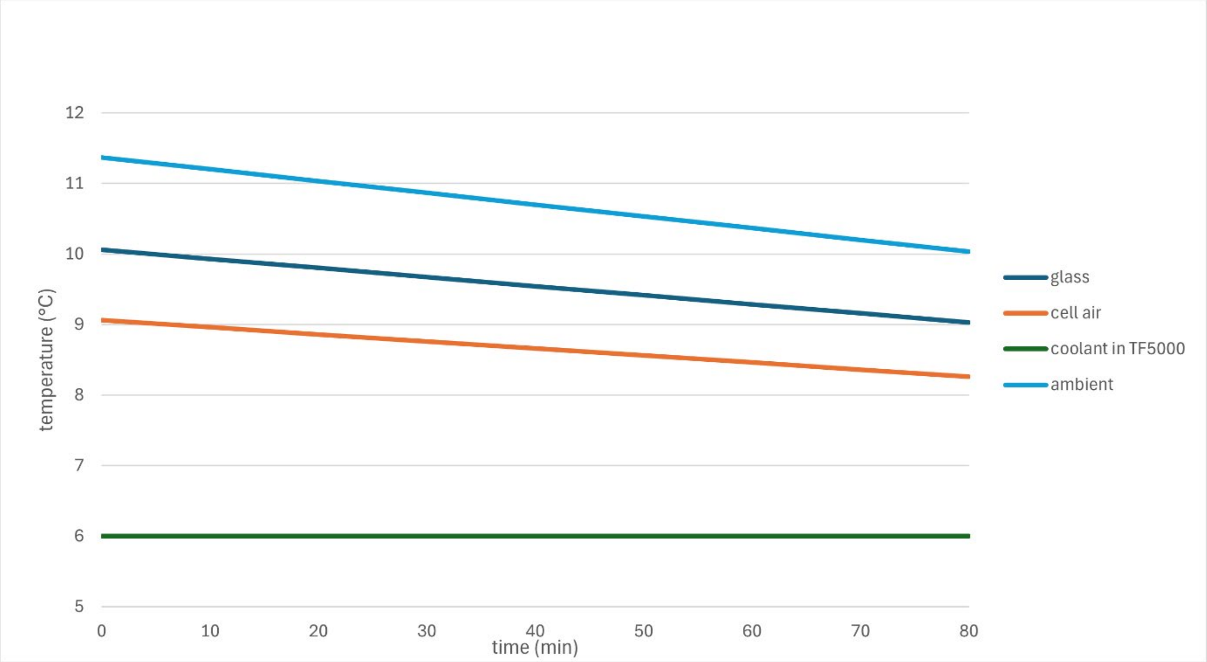
FIXED SETPOINT – select the mode where the temperature setpoint is entered by user.

FOLLOW AMBIENT – select the mode where the temperature setpoint equals the ambient temperature.

The system checks that the temperature of the cooling fluid is above the dew point and the difference between the temperature of the mirror and the temperature of the cooling fluid is not too high (system parameter). The system adjusts the temperature setpoint automatically to reflect these constraints. The top blue-background box shows the user setpoint, while the bottom gray-background box shows the current ("actual") setpoint.

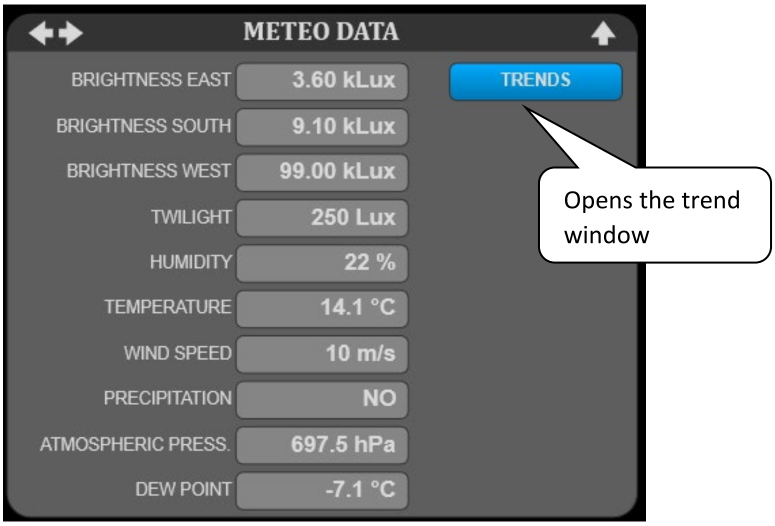
The "Neslab ThermoFlex TF5000 recirculating chiller" by ThermoFisher Scientific has a temperature range +5°C to +40°C (+41°F to +104°F), with a cooling capacity of 5000 W (17,000BTU) at 20°C.

When using fixed setpoint mode, use a low setpoint, e.g., 6°C (plot below). The coolant inside the TF5000 unit will reach this setpoint in ~15 minutes, and then you need to wait (ΔT[°C] / 0.75) hours (the cooling rate of the mirror (glass) is ~0.75°C/hr).



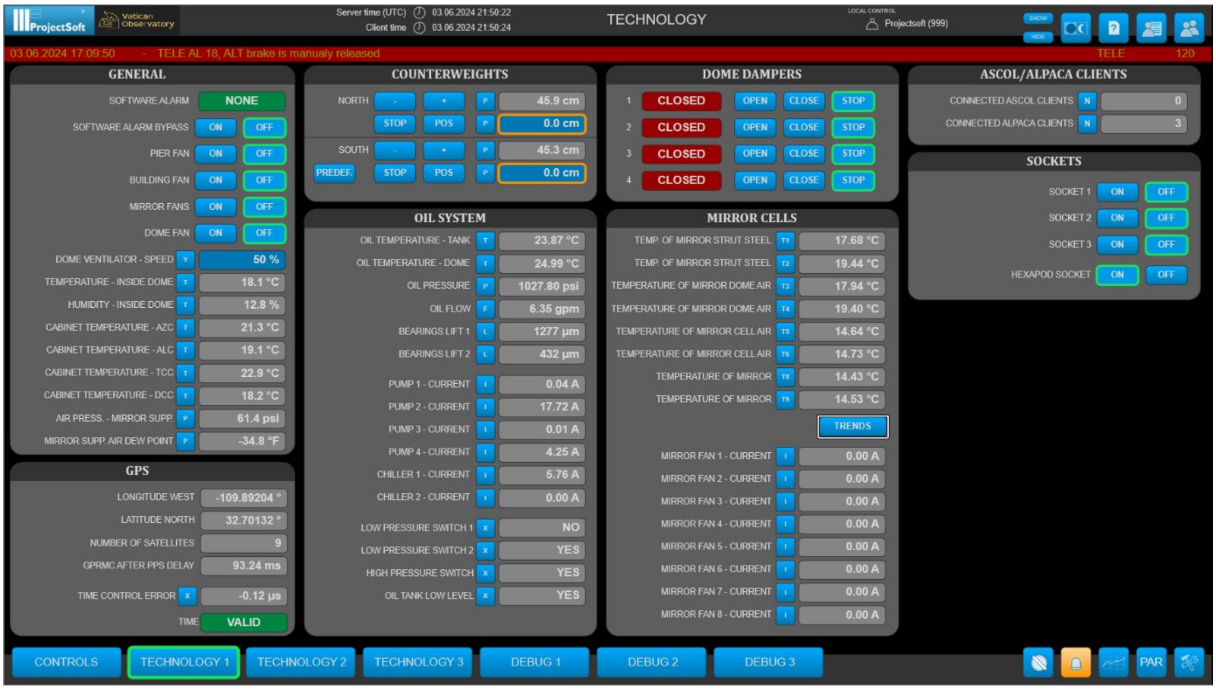
5.11 Meteorological data

Several meteorological values are measured and logged. Their current ("actual") values are shown in the Meteo Data window.



5.12 TECHNOLOGY SCREEN

This screen is used for a more detailed view of some technological systems or to control less frequently used and less important systems.



5.12.1 Counterweights

POS button moves the counterweight to the desired position.

STOP button stops the counterweight movement.

+/- buttons move the counterweight manually.

5.12.2 Dome dampers

OPEN button starts opening the specific dome damper.

CLOSE button starts closing the specific dome damper.

STOP button stops any movement of the specific dome damper.

6. Automated Sequences

There are four automated sequences. The action items within each sequence are listed in the appropriate pup-up window. Each sequence is divided into steps delimited by the completion of certain action items, indicated in **bold**.

6.1 Graphic User Interface Conventions

6.1.1 Critical Action Items

At the beginning of each step, the action items listed are initiated. The sequence does not pass on to the next step unless the **critical action items** are completed. For instance, in the Startup Sequence the action items of Step 1 (below) are all initiated in Step 1. Most of these actions will run their course and be completed independently of others. Step 2 will not start until the critical action item of Step 1, viz., the opening of the shutters on the dome slit, is completed. Once this condition is fulfilled, the Step 1 action items are initiated.

6.1.2 Colour codes

Gray letters – action item not in progress and/or not completed
Flashing green letters – action item in progress
Green letters – action item completed

6.1.3 Action Buttons

START – start the sequence

STOP – stop the sequence in progress

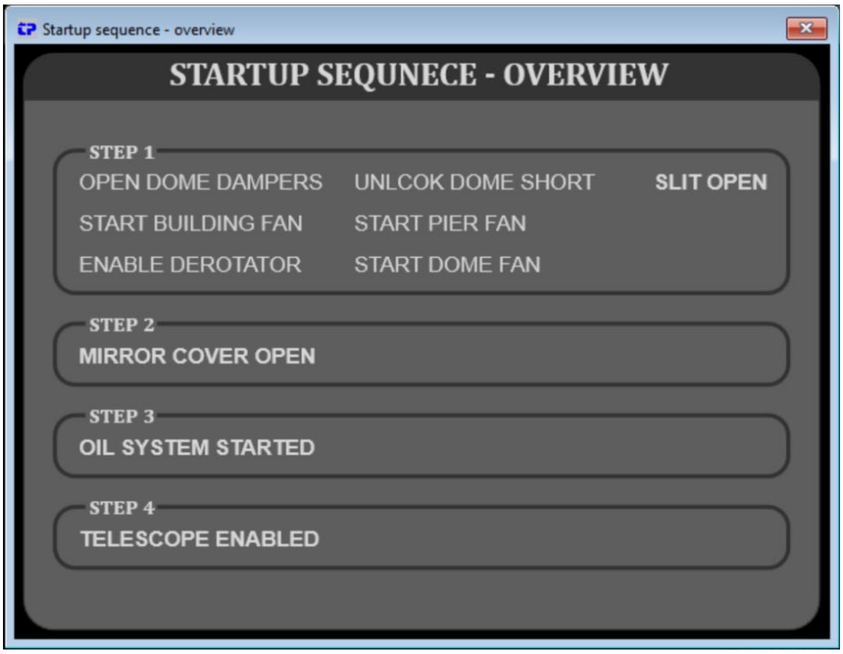
If the user Stops the Sequence, clicking the Stop button, execution will stop safely. The User may choose to perform other actions at this point. Then, as always, clicking the Start button will (effectively) resume the execution of the Sequence, more specifically, it will start the Sequence from the beginning, checking and completing the action items as needed.

6.2 Startup Sequence

This is the listing of the Startup Sequence action items and of their dependencies as it appears in the pop-up window (activated by clicking on the white upward arrow to the right of the status field).

6.2.1 Critical action items:

Step 1: Open dome slit
Step 2: Open mirror cover
Step 3: Start oil system
Step 4: Enable telescope (i.e., Alt/Az drives)



6.2.2 Notes

The Startup Sequence is designed to be very robust. Its philosophy is that the user ought to be able to activate it at (nearly) any point of the telescope's operation. If the telescope is already fully active, the Startup Sequence simply checks the status.

If the telescope's activation is incomplete, running the Startup Sequence will execute all remaining action items completing the telescope startup.

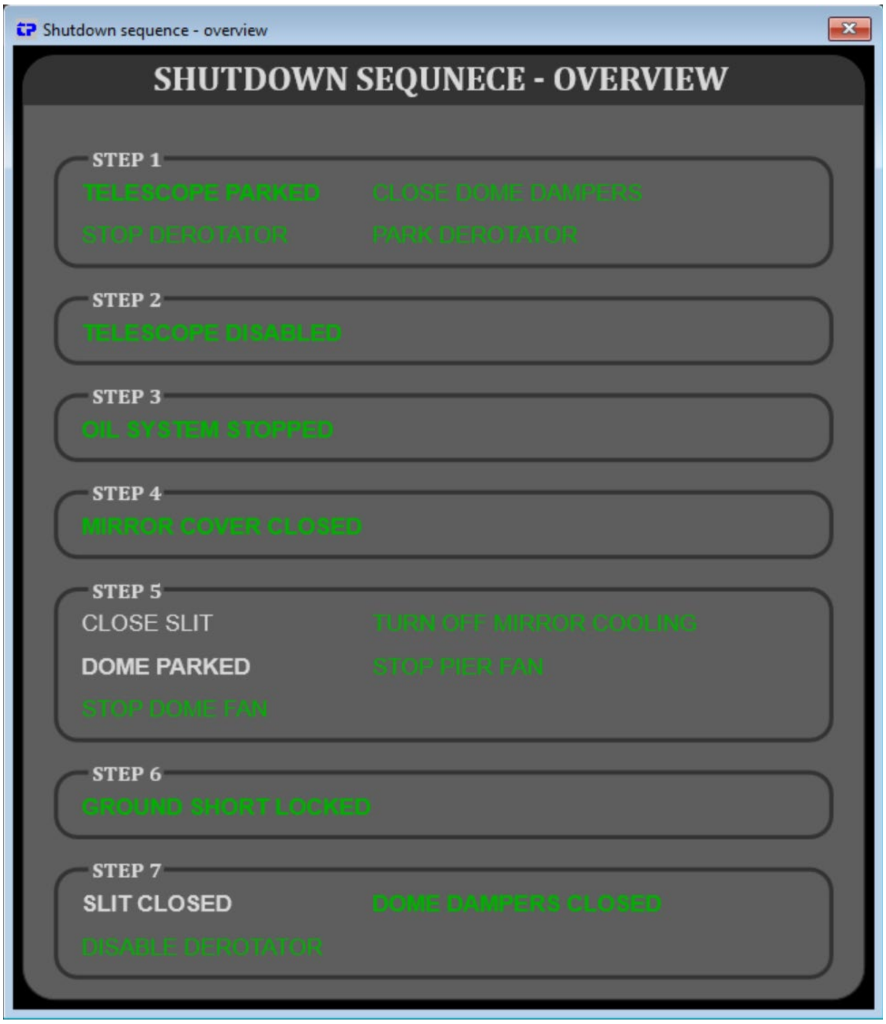
Practical Advice: If you are not sure that everything that ought to be running, is in fact running, remember you can make sure by running the Startup Sequence.

6.3 Shutdown Sequence

This is the listing of the Startup Sequence action items and of their dependencies as it appears in the pop-up window (activated by clicking on the white upward arrow to the right of the status field).

6.3.1 Critical action items:

Step 1: Park Alt/Az axes
Step 2: Disable telescope, i.e., the Alt/Az drives
Step 3: Stop the oil system
Step 4: Close mirror cover
Step 5: Park dome
Step 6: Lock dome ground short
Step 7: Close dome slit shutters and the dome air vent-register dampers



6.4 Fast Shutdown Sequence

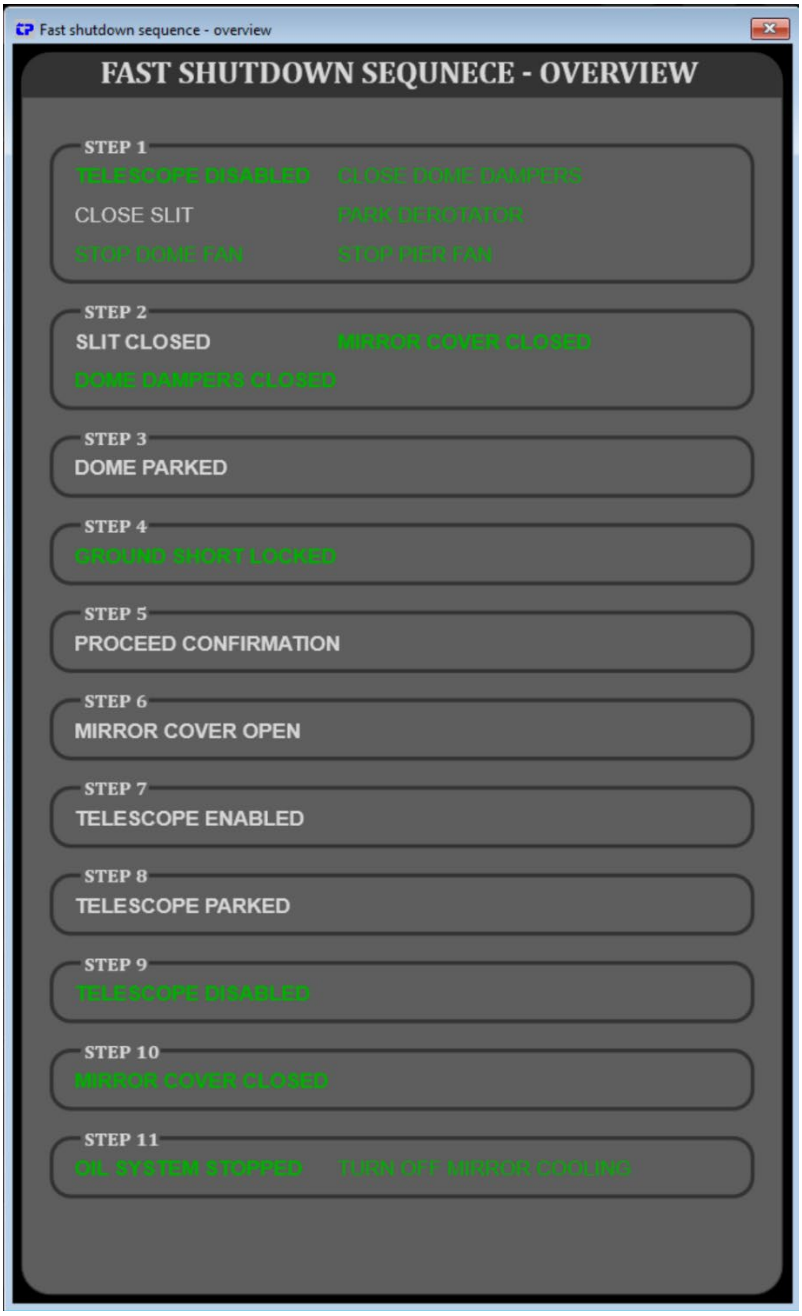
The Fast Shutdown Sequence is invoked by the User or by the System itself primarily to mitigate risks to the primary mirror, e.g., when there is a sudden onset of rain. The Fast Shutdown Sequence proceeds without delay to close the dome slit shutters, the mirror cover and the dome air vent-register dampers. Then it pauses, awaiting user input. The User should inspect the state of the facility at this point. Once all is deemed safe by the User, the Sequence may resume.

If the User does not feel confident that it would be safe to run the Sequence to its completion, the User should consult telescope support staff.

6.4.1 Critical action items:

Step 1: Disable telescope, i.e., the Alt/Az drives (NB. The telescope will *not* be parked at this point!)
Step 2: Close mirror cover, dome slit shutters, and the dome air vent-register dampers
Step 3: Park dome
Step 4: Lock dome ground short
Step 5: Pause and await user input (pop-up window)
Step 6: Open mirror cover (preparing the telescope to be parked)

Step 7: Enable the telescope, i.e., the Alt/Az drives
Step 8: Park the telescope
Step 9: Disable the telescope, i.e., the Alt/Az drives
Step 10: Close the mirror cover
Step 11: Step the Az bearing’s hydraulic system

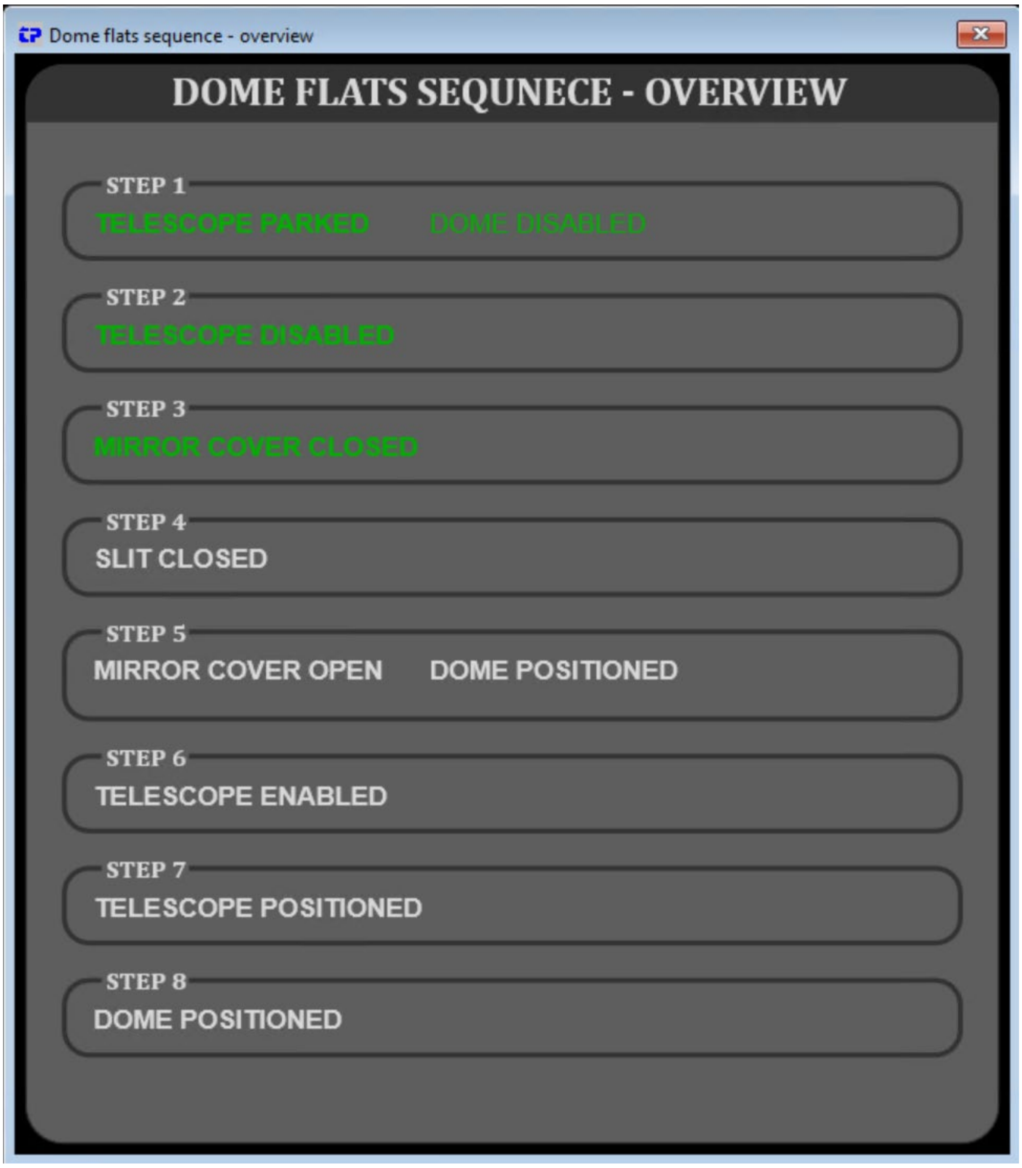


6.4.2 Notes

The Fast Shutdown Sequence (especially if launched by the system itself in response to a weather alarm) may lead to a situation when the telescope is not pointing at zenith and the system is powered down. In such a case, **the User will contact support staff before powering the system up**. **There is a risk to the primary mirror and the mirror cell!**

6.5 Dome Flats Sequence

The Dome Flats Sequence moves the telescope in elevation only, and rotates the dome to bring the dome flats screen, so that the screen is perpendicular to the telescope's optical axis.



6.5.1 Critical action items:

Step 1: Park telescope
Step 2: Disable telescope, i.e., the Alt/Az drives
Step 3: Close mirror cover
Step 4: Close dome slit shutters
Step 5: Open mirror cover
Step 6: Enable telescope, i.e., the Alt/Az drives

Step 7: Position the telescope at Az = 180° and Alt = 30° (Screen “Tele Par 1” > “Telescope Predefined Mechanical Positions” > #2 “Predefined Position 1 – Flats Screen”).
Step 8: Position the dome at Az = 352.5° ((???))

6.5.2 Notes

This Sequence is designed to be launched when the telescope is tracking with the dome slit and the mirror cover open.

After taking the Dome Flats, the User may return to observing by activating the Automatic Startup sequence, or the User may shut the telescope down by activating the Automatic Shutdown sequence.

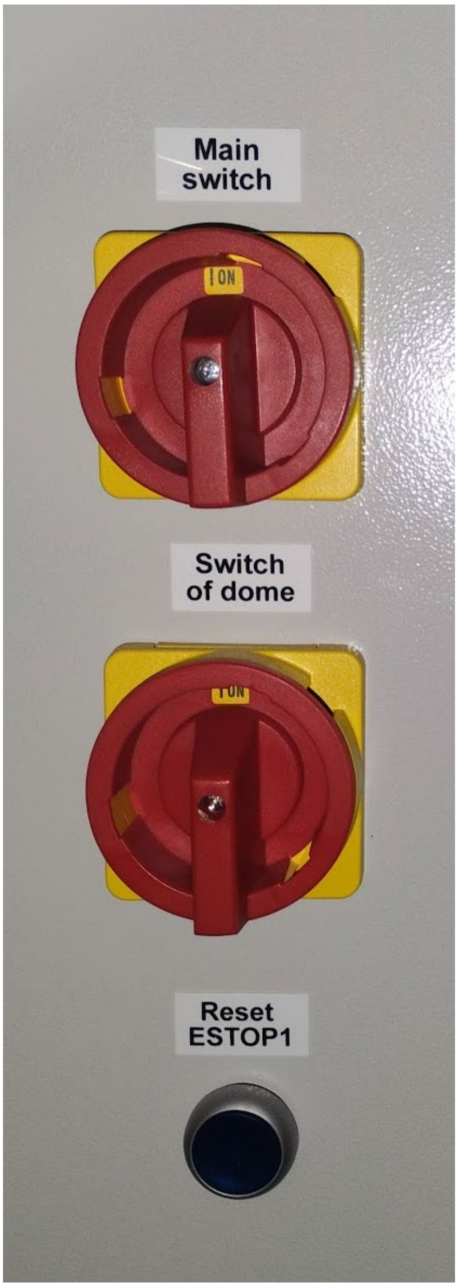
7. Emergency Stops, Safety Switches and Procedures

7.1 Local Mode

Always use Local mode (see 5.1.1) when working in the dome and other critical areas. If you work there while the system is in Remote mode, you are running the risk that another user inadvertently activates a motor or other equipment remotely. Local mode eliminates this risk.

7.2 Lock-Out-Tag-Out System

The Main Control Cabinet (MCC; level 2 or the silo) is equipped with two lock-out-tag-out rotary switches (on MCC's left face). The top one is labeled "Main Switch" and the bottom one is labeled "Swith of Dome".



7.2.1 Main Switch

Physically disconnects power to the Main Control Cabinet (MCC). The MCC supplies clean power to the entire system of the telescope with these exceptions

- Fans: dome, building, pier
- Mirror support system (10kVA UPS directly)
- Servers (rack UPS)

- Monitoring PLC (it has its own UPS)
- Oil pumps, circulation pump, oil chillers
- Air compressors

Bring the telescope into a shutdown state (e.g., completing the "Automated Shutdown" sequence) before you disconnect power by turning the "Main Switch".

After restoring the power (by turning the "Main Switch"), the system takes a minute or two to boot up.

7.2.2 Switch of Dome

Physically disconnects the following power supplies:

- All 48V circuits
- 120V circuits for the Dome Control Cabinet (but the 120V for the power outlet inside the DCC and the remotely-controlled dome lights are independent, powered directly from MCC)

This disconnects all ELMO drives and other systems:

- Altitude drive in the Altitude Control Cabinet
- Derotator drives in the Altitude Control Cabinet
- Azimuth drive in the Azimuth Control Cabinet
- Mirror fans drives in the Tube Control Cabinet
- Dome drives in the Dome control Cabinet
- Power to the dome slit shutters and all other systems powered via the dome slip ring contacts.

7.2.3 Reset ESTOP1

This button is currently not in use. Its intended purpose has to do with the putative link between the Fire Alarm Panel and the telescope control system.

7.3 Emergency Stop

There are several Emergency Stops. Do not hesitate to use them.

The effects of an Emergency Stop include disabling the Alt/Az drives and setting the brakes. They are similar to turning the Main Switch.

Always inspect the facility before resetting the Emergency Stop.

To reset the Emergency Stop, twist the Emergency Stop button to release it. There are instructions on the button itself. Then wait for the system to boot (you can follow the progress in TomPack).

7.3.1 Reset ESTOP2

Go to the MCC. On its left door, there is a "Reset ESTOP2" button. It will be flashing blue. Press the button to allow the bootup sequence to proceed. This added precaution forces users "out of their chair" in the Control Room in the hope that they will act with caution making sure there is no present and ongoing danger posing a hazard to people and equipment.


Supply on
Control voltage on
Emergency stop
Reset ESTOP2