



Welcome!

Webinar #2: SCRIPTS in Thermoflow Programs

- Introduction: Why Scripts?
- Scripts in GT PRO, GT MASTER and THERMOFLEX
- Script Definition
- Managing Script Variables
- Examples
- * Q & A Session

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Support: Meritt Elmasri (U.S. HQ)

Thermoflow Training and Support

- Standard Training
- On-site Training course
- Advanced Workshop
- Webinars when new version is released
- Help, Tutorials, PPT, Videos, ...
- Technical Support

→ Feature Awareness Webinars

Feature Awareness Webinars

1- Assemblies in THERMOFLEX

2- Scripts in Thermoflow Programs

INTRODUCTION: Why Scripts?

- Philosophy of Thermoflow software
- How to interact with Thermoflow programs
 - ELINK
 - ULINK
 - User Defined Components in TFX
 - Adjustment methods, Correction factors,...
 - **Scripts**

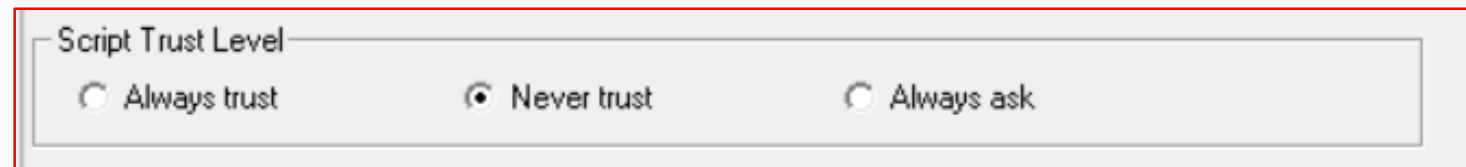
SCRIPTS in:

- THERMOFLEX, Version 23, since 2013
- GT MASTER, Version 24, since 2014
- GT PRO, Version 26, since 2016

SCRIPTS:

Scripting functionality allows users to create and compute custom outputs or to set certain inputs using code written in the scripting language Lua

***Special Note: Scripts can be dangerous. They can link to and run code and other programs that are not immediately visible from the script editing
Do not run a script that you think may contain malicious or harmful code.***



Basic Lua Documentation

THERMOFLEX uses the scripting language Lua, version 5.1.4.

Documentation in → <http://www.lua.org/>

Compiled Windows binaries, libraries, and a code editor

→ <https://github.com/rjpcomputing/luaforwindows>

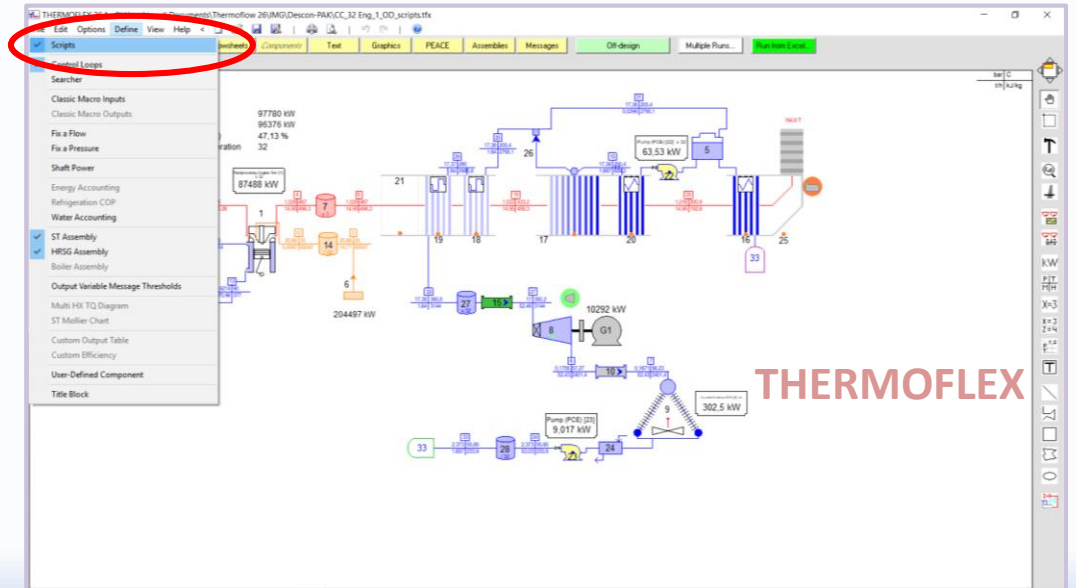
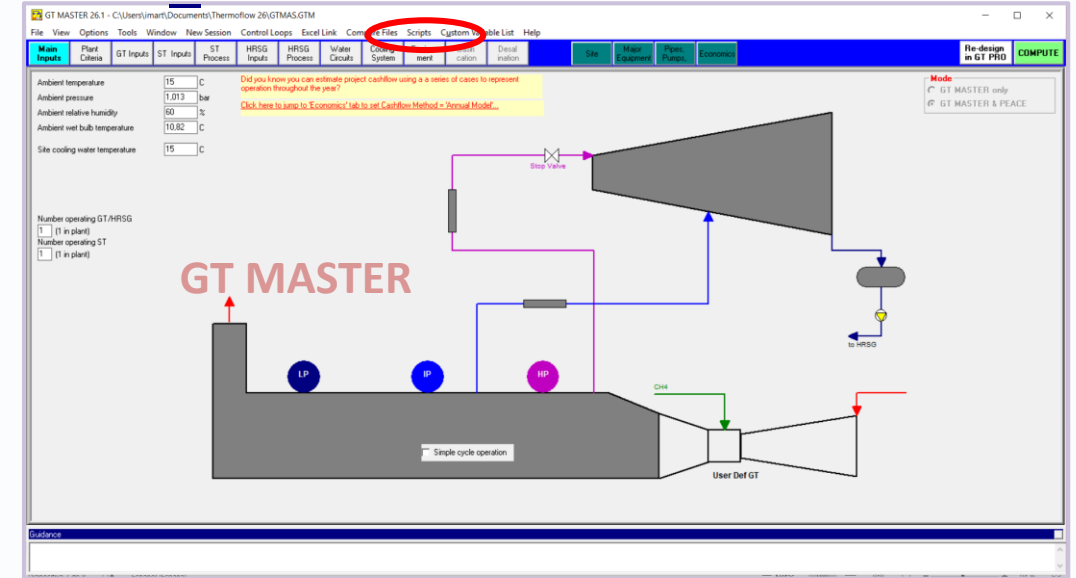
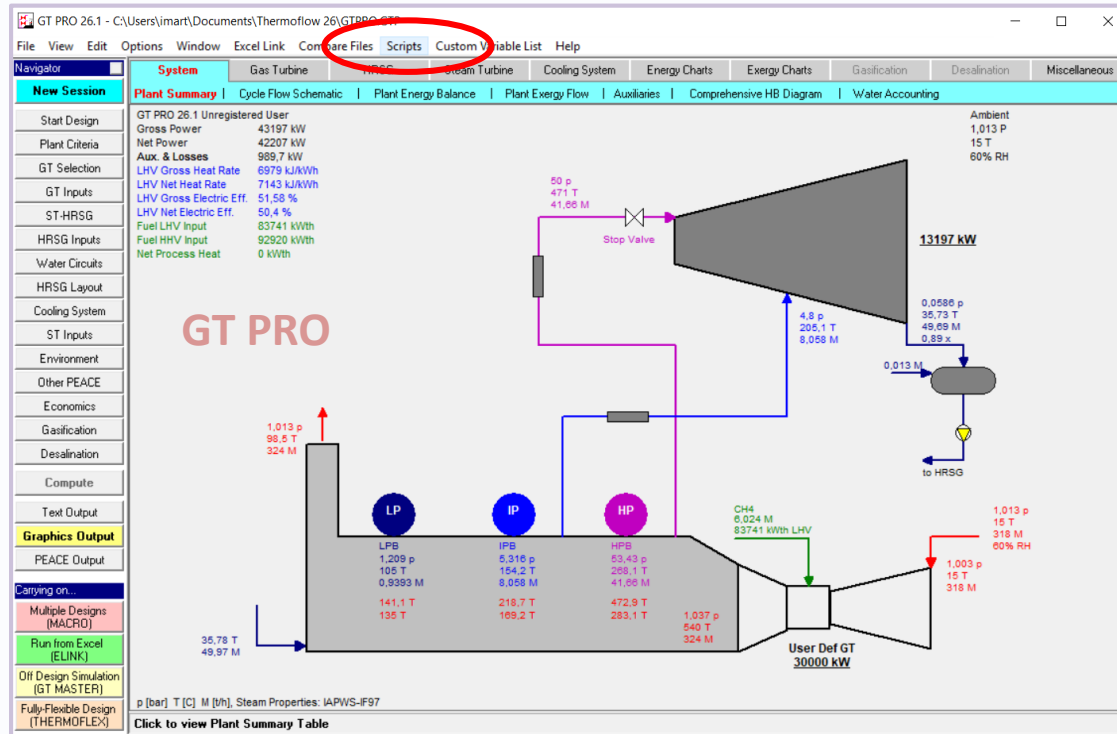
Lua and Lua for Windows available under the terms of the MIT license

→ <http://opensource.org/licenses/mit-license.php>.

Full online documentation for version 5.1:

→ <http://www.lua.org/manual/5.1/manual.html>

SCRIPT Activation:



SCRIPT Definition:

Script Name

Script Body

The screenshot shows the 'Script Manager' window with the 'Define Scripts' tab selected. The 'HPT/HP Sourcing' script is highlighted in the 'Scripts' list. The 'Script Properties' section shows the script has 3 inputs and 2 outputs, and is currently enabled. The 'Script Body' section displays the Lua code for the script, which includes a wrapper function 'TFLua_Main' that initializes output tables and processes input parameters to calculate mass flow rates.

Script Properties:

- Inputs: 3
 - Call Origin
 - Convergence Status
 - sip[1]: HPTX1 blading exit Pressure
- Outputs: 2
 - tfip[1]: Main HP process mass flow (plant total)
 - tfip[2]: 1st HPT bleed substream mass flow (pl)
- Status: Computed successfully
- Enabled: True

Script Body:

```

1  -- Initialize output tables
2  sop = {} -- Script Output Parameters
3  tfip = {} -- ThermoFlow Input Parameters
4
5  -- Start wrapper function
6  function TFLua_Main(CallOrigin, ConvergenceStatus, ...)
7      --[[ This code is automatically generated to place inputs into a local
8         table for ease of use ]]
9
10     local sip = {n=select('#',...),...}
11
12     -- User code begins here:
13
14     -- Pass output values to the script output parameter array
15     if sip[1]>550 then
16         tfip[1]=0 --Main HP process flow
17         tfip[2]=10 --1st HPT sub flow
18     else
19         tfip[1]=10 --Main HP process flow
20         tfip[2]=0 --1st HPT sub flow
21     end
22
23     -- End wrapper function
24 end
  
```

SCRIPT Parameters:

Custom Script Inputs: name, description and Units (TFIP)

Script Inputs from program (GTP-GTM-TFX) : input parameters to be determined by the Script (TFIP)

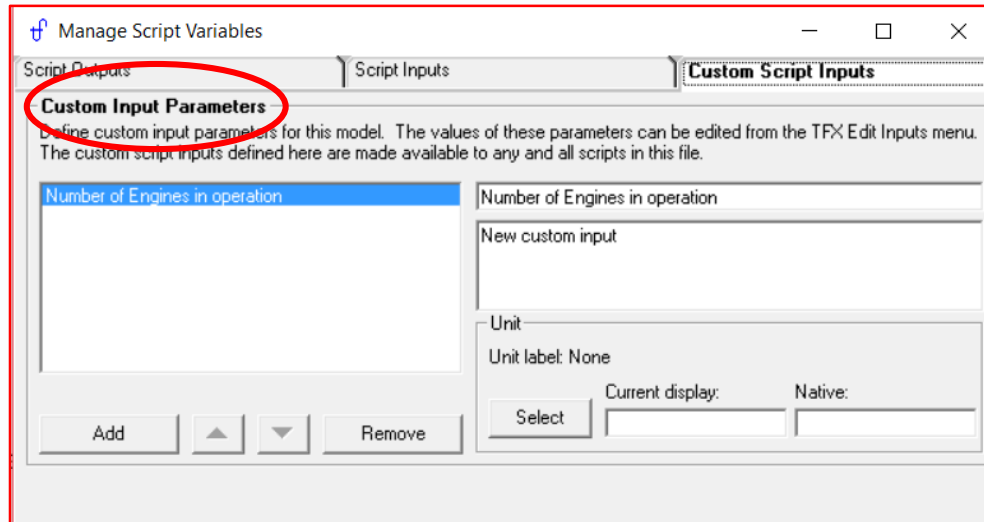
Script Outputs: custom output parameters to be computed by the Script (SOP)

Script Inputs: inputs and outputs from the program required by the Script (SIP)
(Custom Script Inputs must be added here)

→ Caution: notice the difference on Units: “Current display” and “Native”

Unit conversion within the script is left to the user

SCRIPT Parameters:



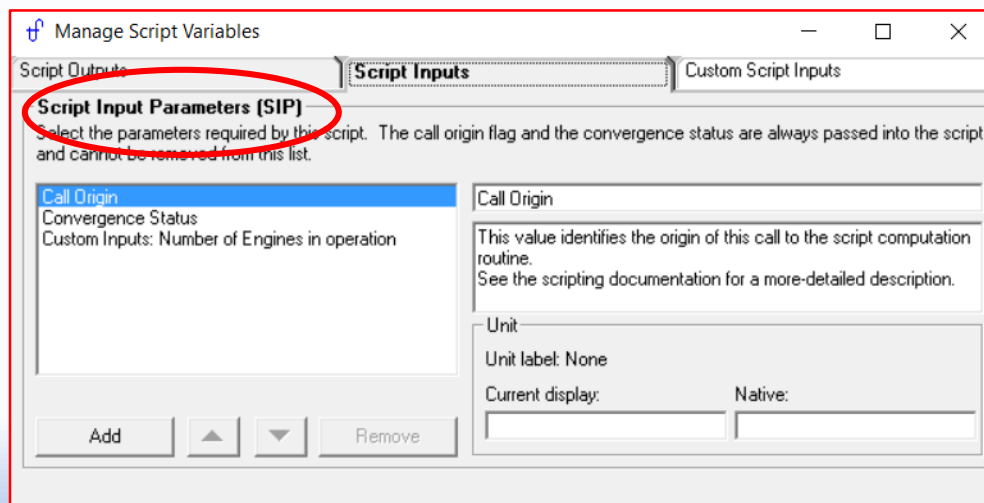
Custom Input Parameters
Define custom input parameters for this model. The values of these parameters can be edited from the TFX Edit Inputs menu. The custom script inputs defined here are made available to any and all scripts in this file.

Number of Engines in operation	Number of Engines in operation
	New custom input

Unit
Unit label: None

Current display: Native:

Add [Up] [Down] Remove Select



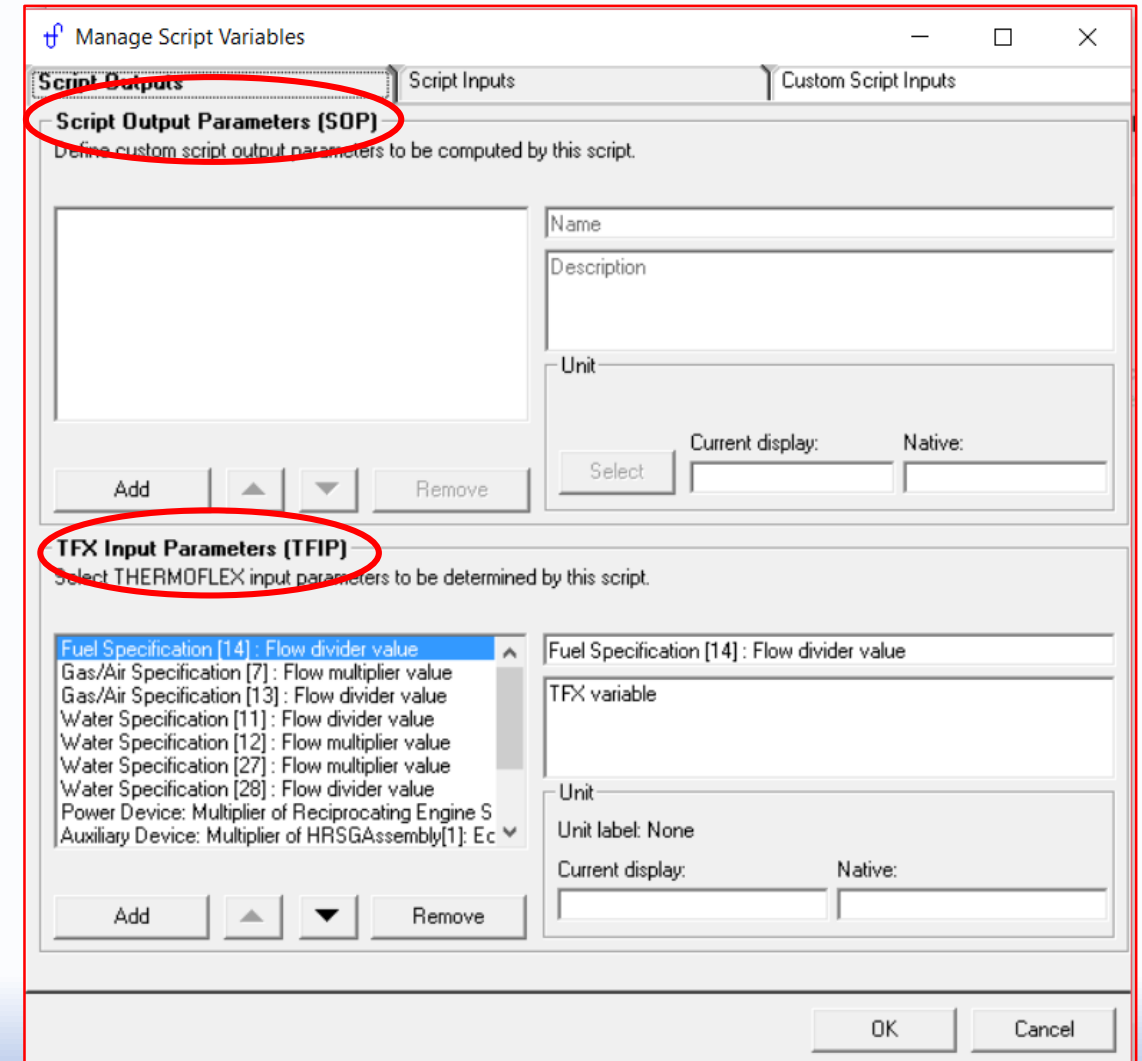
Script Input Parameters (SIP)
Select the parameters required by this script. The call origin flag and the convergence status are always passed into the script and cannot be removed from this list.

Call Origin	Call Origin
Convergence Status	This value identifies the origin of this call to the script computation routine. See the scripting documentation for a more-detailed description.
Custom Inputs: Number of Engines in operation	

Unit
Unit label: None

Current display: Native:

Add [Up] [Down] Remove



Script Output Parameters (SOP)
Define custom script output parameters to be computed by this script.

Name	Description	Unit

Current display: Native:

Add [Up] [Down] Remove Select

TFX Input Parameters (TFIP)
Select THERMOFLEX input parameters to be determined by this script.

Fuel Specification [14] : Flow divider value	Fuel Specification [14] : Flow divider value
Gas/Air Specification [7] : Flow multiplier value	TFX variable
Gas/Air Specification [13] : Flow divider value	
Water Specification [11] : Flow divider value	
Water Specification [12] : Flow multiplier value	
Water Specification [27] : Flow multiplier value	
Water Specification [28] : Flow divider value	
Power Device: Multiplier of Reciprocating Engine S	
Auxiliary Device: Multiplier of HRSGAssembly[1]: Ec	

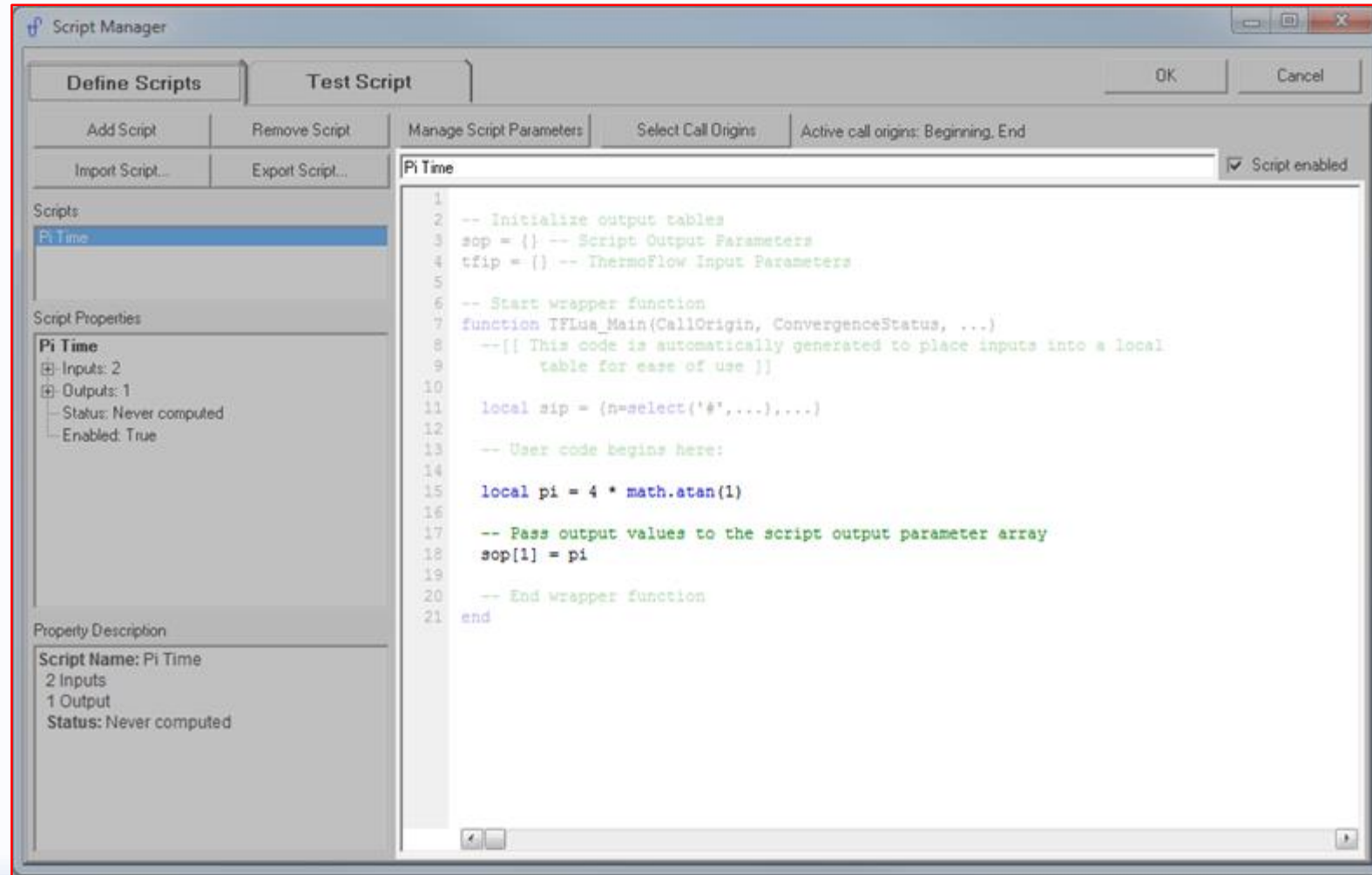
Unit
Unit label: None

Current display: Native:

Add [Up] [Down] Remove

OK Cancel

SCRIPT “Code”:



SCRIPT “Call Origin”

1. **At the beginning of computation** before anything else has been computed

Allows a script to set THERMOFLEX input parameters before beginning the computation.

2. **During the main computation loop**

Allows a script to set inputs during the computation instead of waiting for convergence. This can give a result faster, but is also more likely to make the model unstable.

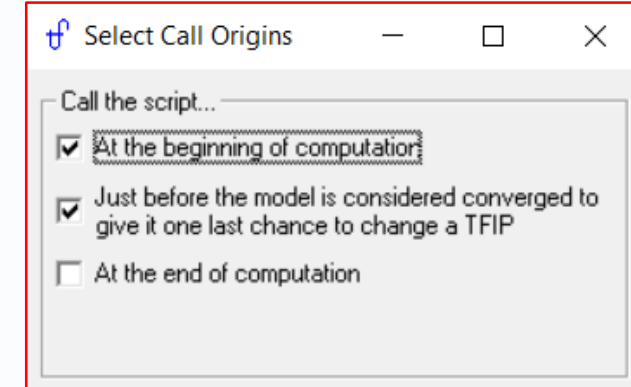
3. **Just before the model is deemed converged** to give the script one last chance to change THERMOFLEX input parameters (TFIPs)

Allows a script to set inputs that change the flow or pressure relational matrices

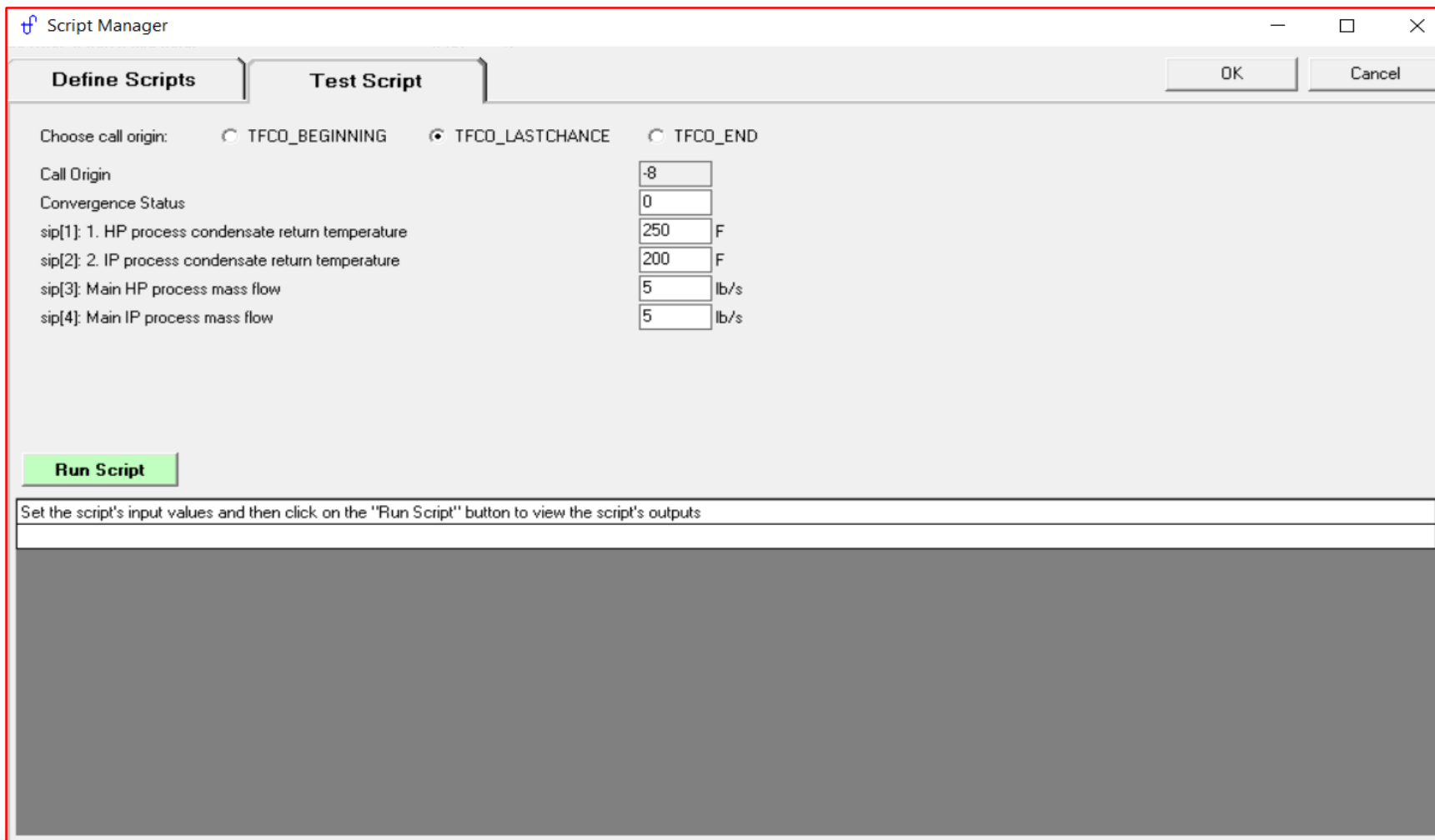
4. **At the end of computation** after all other outputs have been computed

Allows a script to compute custom outputs using the final results of the computation.

THERMOFLEX input parameters are not set at this time. Computation is over, so setting TFIPs to new values at this point would have no effect on the results.



Test SCRIPTS



Script Manager

Define Scripts | **Test Script** | OK | Cancel

Choose call origin: ☐ TFCO_BEGINNING ☒ TFCO_LASTCHANCE ☐ TFCO_END

Call Origin: -8

Convergence Status: 0

sip[1]: 1. HP process condensate return temperature: 250 F

sip[2]: 2. IP process condensate return temperature: 200 F

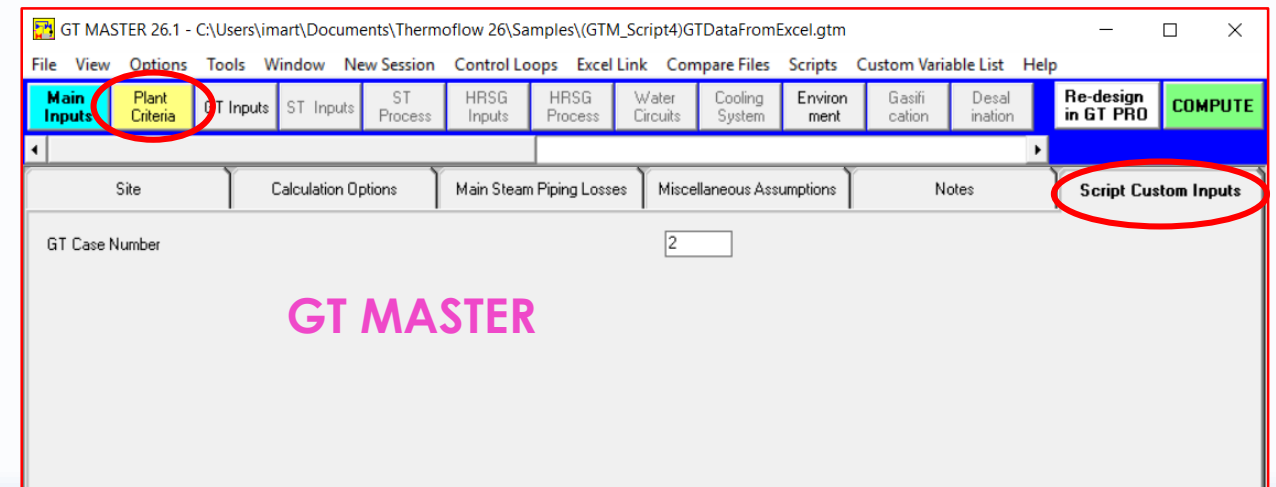
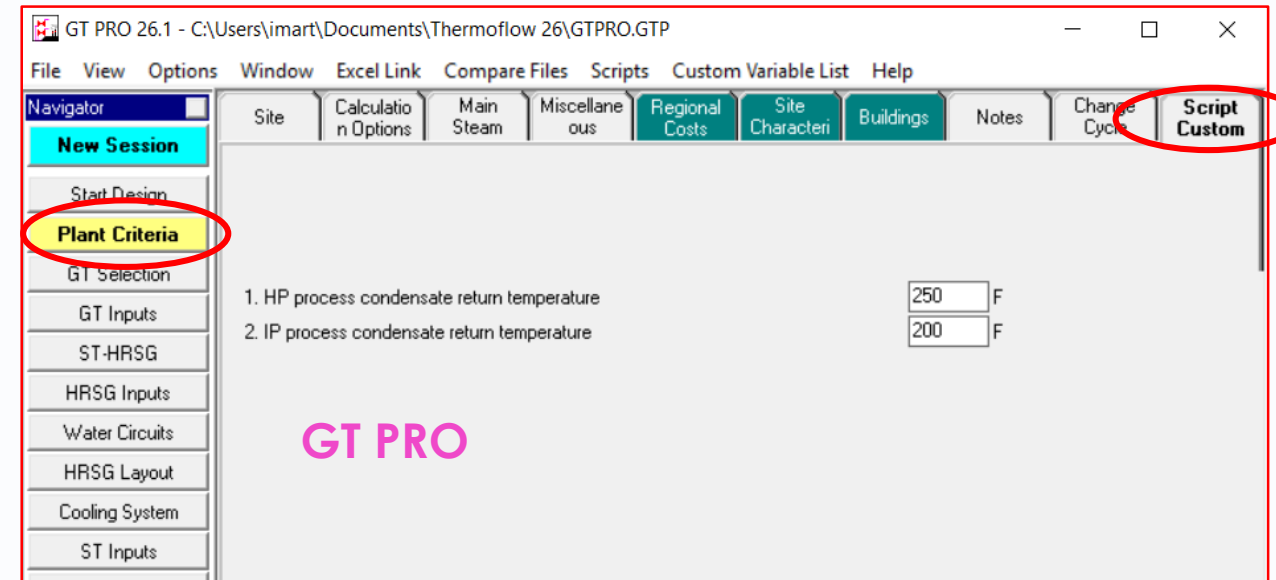
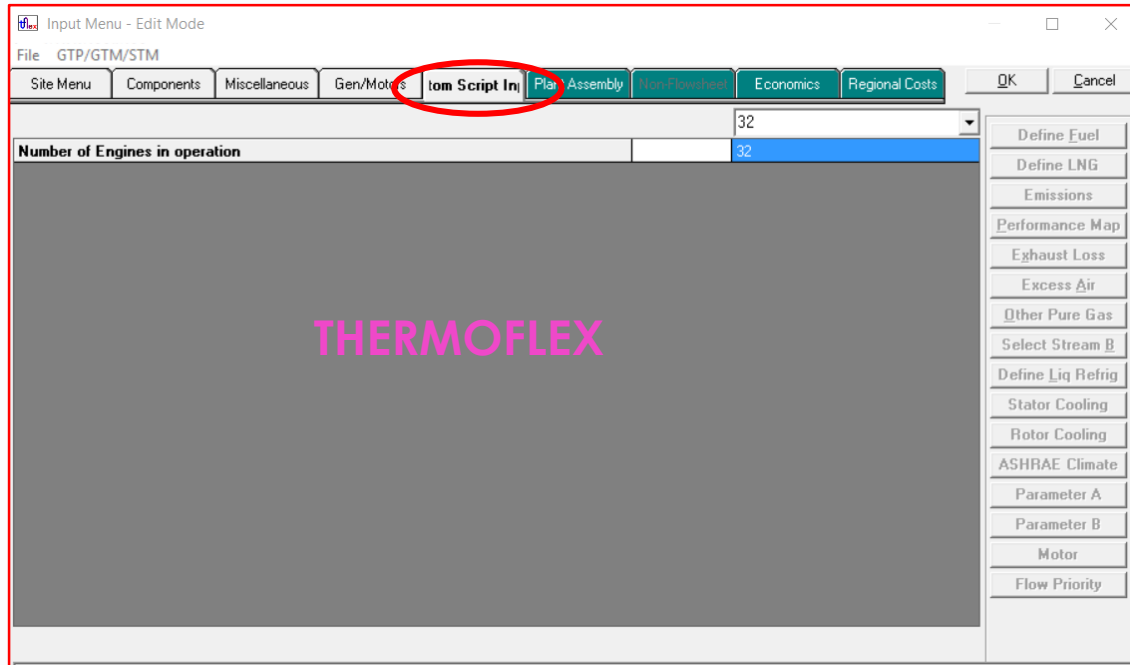
sip[3]: Main HP process mass flow: 5 lb/s

sip[4]: Main IP process mass flow: 5 lb/s

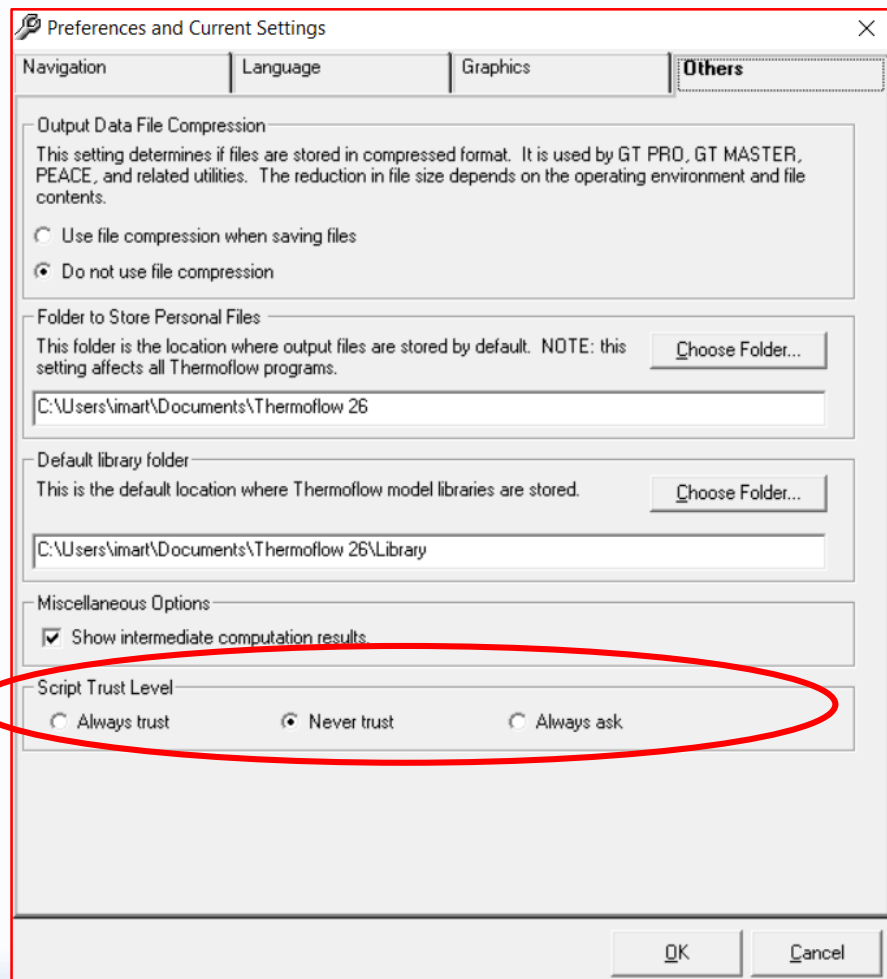
Run Script

Set the script's input values and then click on the "Run Script" button to view the script's outputs

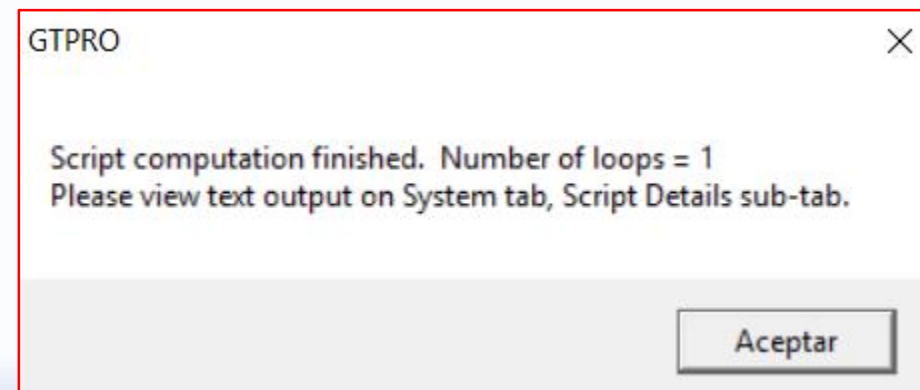
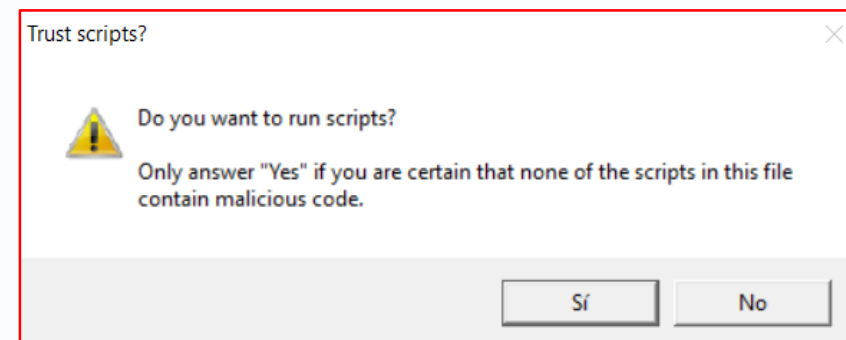
Edit SCRIPT Inputs



Run SCRIPT

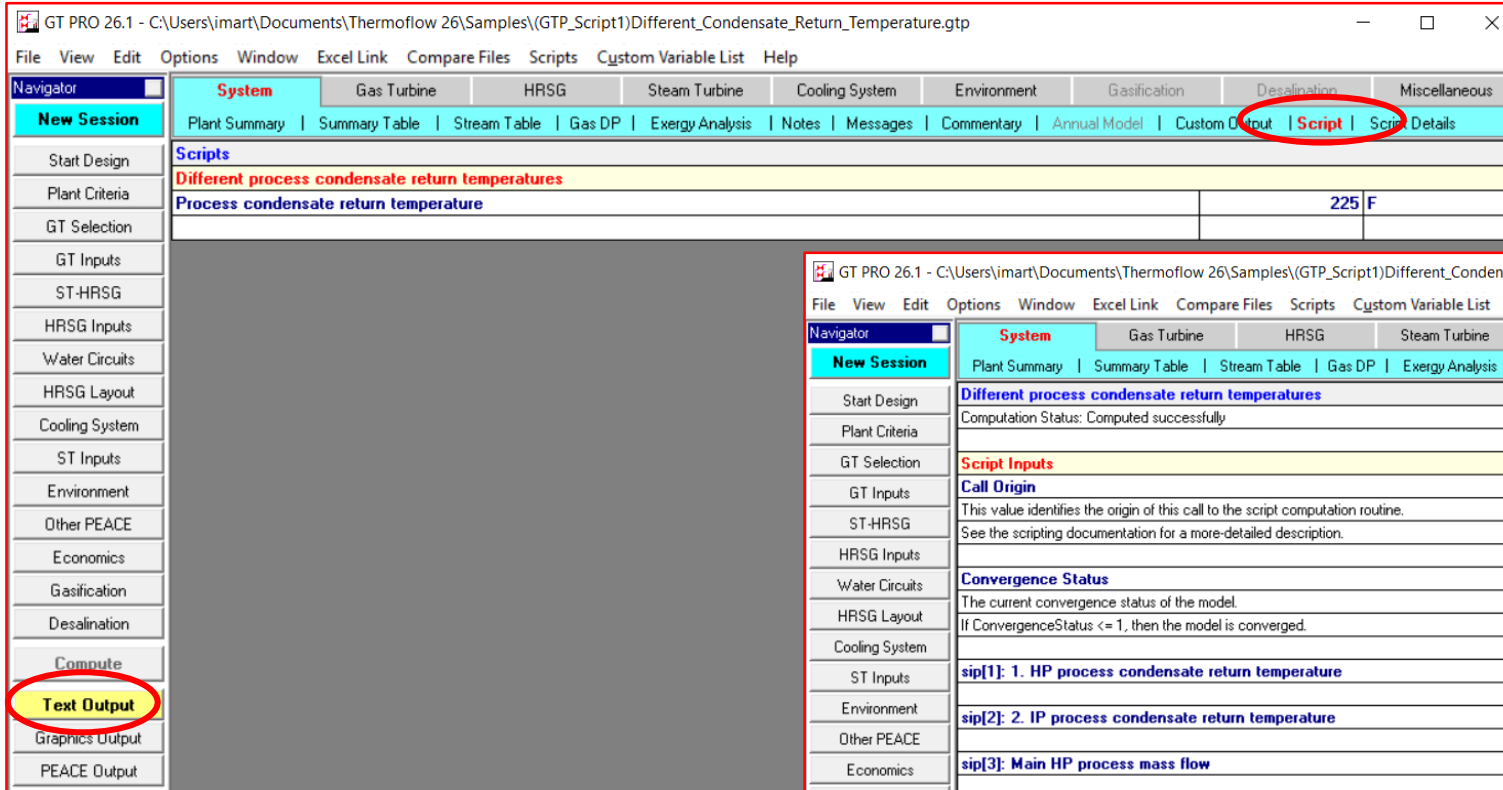


Compute



SCRIPT Outputs

GT PRO – GT MASTER



GT PRO 26.1 - C:\Users\imart\Documents\Thermoflow 26\Samples\GTP_Script1\Different_Condensate_Return_Temperature.gtp

File View Edit Options Window Excel Link Compare Files Scripts Custom Variable List Help

Navigator

New Session

Start Design

Plant Criteria

GT Selection

GT Inputs

ST-HRSG

HRSG Inputs

Water Circuits

HRSG Layout

Cooling System

ST Inputs

Environment

Other PEACE

Economics

Gasification

Desalination

Compute

Text Output

Graphics Output

PEACE Output

System Gas Turbine HRSG Steam Turbine Cooling System Environment Gasification Desalination Miscellaneous

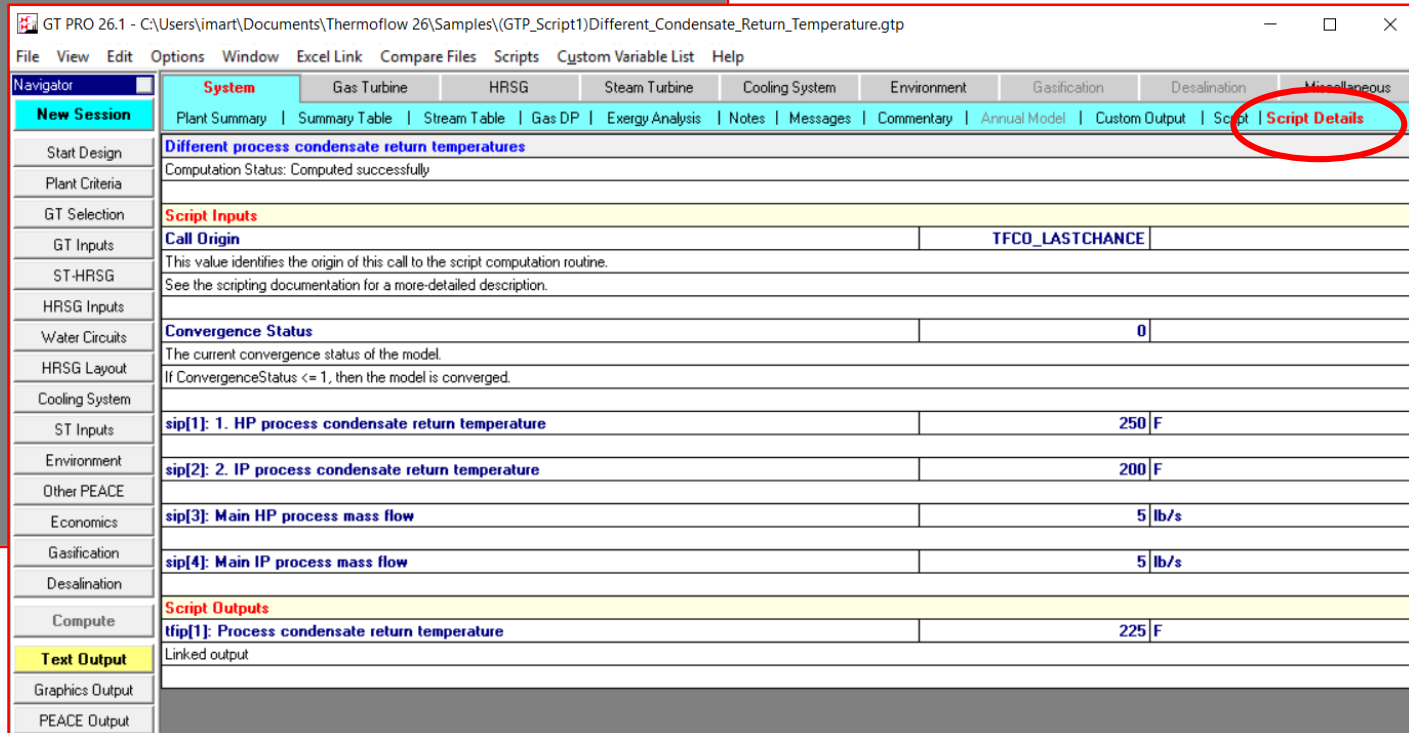
Plant Summary Summary Table Stream Table Gas DP Exergy Analysis Notes Messages Commentary Annual Model Custom Output **Script** Script Details

Scripts

Different process condensate return temperatures

Process condensate return temperature

225 F



GT PRO 26.1 - C:\Users\imart\Documents\Thermoflow 26\Samples\GTP_Script1\Different_Condensate_Return_Temperature.gtp

File View Edit Options Window Excel Link Compare Files Scripts Custom Variable List Help

Navigator

New Session

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Plant Criteria

GT Selection

GT Inputs

ST-HRSG

HRSG Inputs

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Compute

Text Output

Graphics Output

PEACE Output

System Gas Turbine HRSG Steam Turbine Cooling System Environment Gasification Desalination Miscellaneous

Plant Summary Summary Table Stream Table Gas DP Exergy Analysis Notes Messages Commentary Annual Model Custom Output Script **Script Details**

Different process condensate return temperatures

Computation Status: Computed successfully

Script Inputs

Call Origin

TFCO_LASTCHANCE

This value identifies the origin of this call to the script computation routine. See the scripting documentation for a more-detailed description.

Convergence Status

0

The current convergence status of the model. If ConvergenceStatus <= 1, then the model is converged.

Script Outputs

Output 1: 1. HP process condensate return temperature

250 F

Output 2: 2. IP process condensate return temperature

200 F

Output 3: Main HP process mass flow

5 lb/s

Output 4: Main IP process mass flow

5 lb/s

Script Outputs

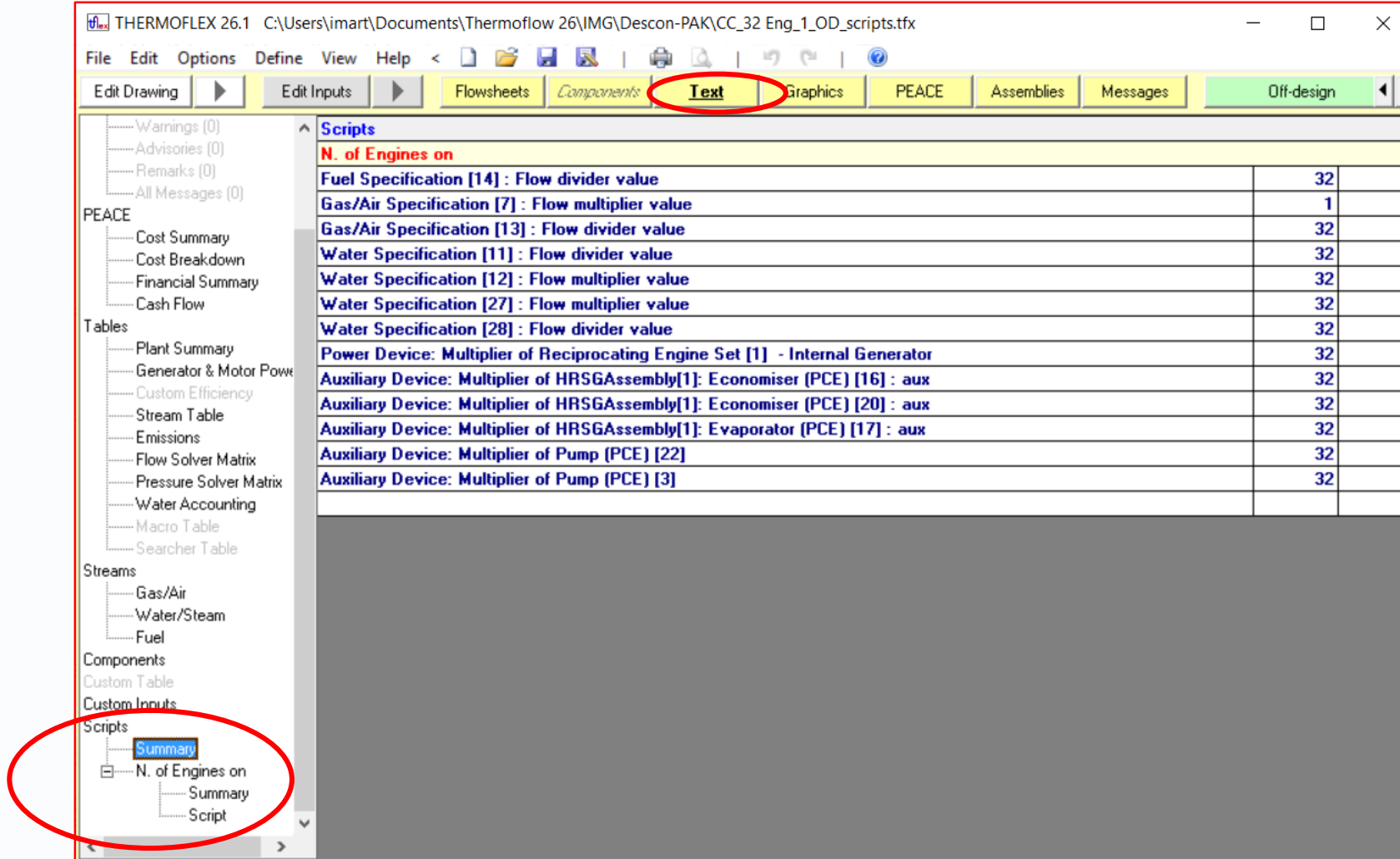
Output 1: Process condensate return temperature

225 F

Linked output

SCRIPT Outputs

THERMOFLEX



The screenshot shows the THERMOFLEX 26.1 software interface. The 'Text' tab is selected in the top menu bar. The left sidebar shows a tree view with 'Scripts' expanded, and 'Summary' selected under 'N. of Engines on'. The main window displays a table of script outputs.

Scripts	
N. of Engines on	
Fuel Specification [14] : Flow divider value	32
Gas/Air Specification [7] : Flow multiplier value	1
Gas/Air Specification [13] : Flow divider value	32
Water Specification [11] : Flow divider value	32
Water Specification [12] : Flow multiplier value	32
Water Specification [27] : Flow multiplier value	32
Water Specification [28] : Flow divider value	32
Power Device: Multiplier of Reciprocating Engine Set [1] - Internal Generator	32
Auxiliary Device: Multiplier of HRSGAssembly[1]: Economiser (PCE) [16] : aux	32
Auxiliary Device: Multiplier of HRSGAssembly[1]: Economiser (PCE) [20] : aux	32
Auxiliary Device: Multiplier of HRSGAssembly[1]: Evaporator (PCE) [17] : aux	32
Auxiliary Device: Multiplier of Pump (PCE) [22]	32
Auxiliary Device: Multiplier of Pump (PCE) [3]	32

SCRIPTS Compatible with

- Multiple Runs
- ELINK
- TFX: “Classic” Macros, Searcher

Import and Export SCRIPTS

Importing: Things that are always preserved

The following properties of an imported script are always preserved:

- Name and body
- Call origins
- Script Output Parameters

Importing: Things that are never preserved

The following properties of an imported script are never preserved:

- Script Input Parameters (sips) that refer to custom inputs
- Custom inputs, file-specific.

Importing: Things that may be preserved

Script Input Parameters (sips) and Thermoflow Input Parameters (tfips) are links to variables in the main program hosting the script. When a script is imported, the script will ask the main program (e.g. THERMOFLEX, GT PRO, or GT MASTER) if its sip and tfip variables are still available in the current file. If they are, the variables will be preserved. If they are not, then the variables will be cleared and the script itself will also be disabled.

This process may not be perfect. It is up to the user to ensure that all of an imported script's sips and tfips have been properly assigned, and to reassign them if necessary.

When importing a script exported from a different program (i.e. importing a script exported from THERMOFLEX into a GT PRO file, or a script made in GT PRO into a THERMOFLEX file, etc.), all sips and tfips will be cleared.

SCRIPTS Samples

GT PRO:

- (GTP_Script1)Different_Condensate_Return_Temperature
- (GTP_Script2)Different_Steam_Export_Prices
- (GTP_Script3)Script_DB_STkW

GT MASTER:

- (GTM_Script1)ExtractionSelector
- (GTM_Script2)ACC_Scheduling
- (GTM_Script3)CustomOutputs
- (GTM_Script4)GTDataFromExcel & (GTM_Script4)GTDataFromExcel.xls

THERMOFLEX:

- (S2-36)Load Scheduling 6-on-1 CC Plant
- (S2-37)Modeling M-on-N Plant Using Scripts
- (S5-22) SolarPV with Gas Turbine Backup using Scripting
- (S5-23) WindFarm with Gas Turbine Backup using Scripting

SCRIPTS Help:

GT PRO: Chapter 24

GT MASTER: Chapter 24

THERMOFLEX: Chapter 3.3

Contact THERMOFLOW Support at info@thermodflow.com