Welcome!

Webinar #16. GTTRAN: Transient Modelling

November 9, 2017

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Presenter: Evgeny Zakharenkov

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Agenda

- Introduction to GTTRAN
- Steady state vs Transient modelling
- GTTRAN inputs and outputs
- Model sample
- Q & A session

Introduction to GTTRAN

- Transient (dynamic) boiler modelling software
- A separate standalone program licensed along with GT MASTER
- Added to GT MASTER for Version 23 (in 2013)

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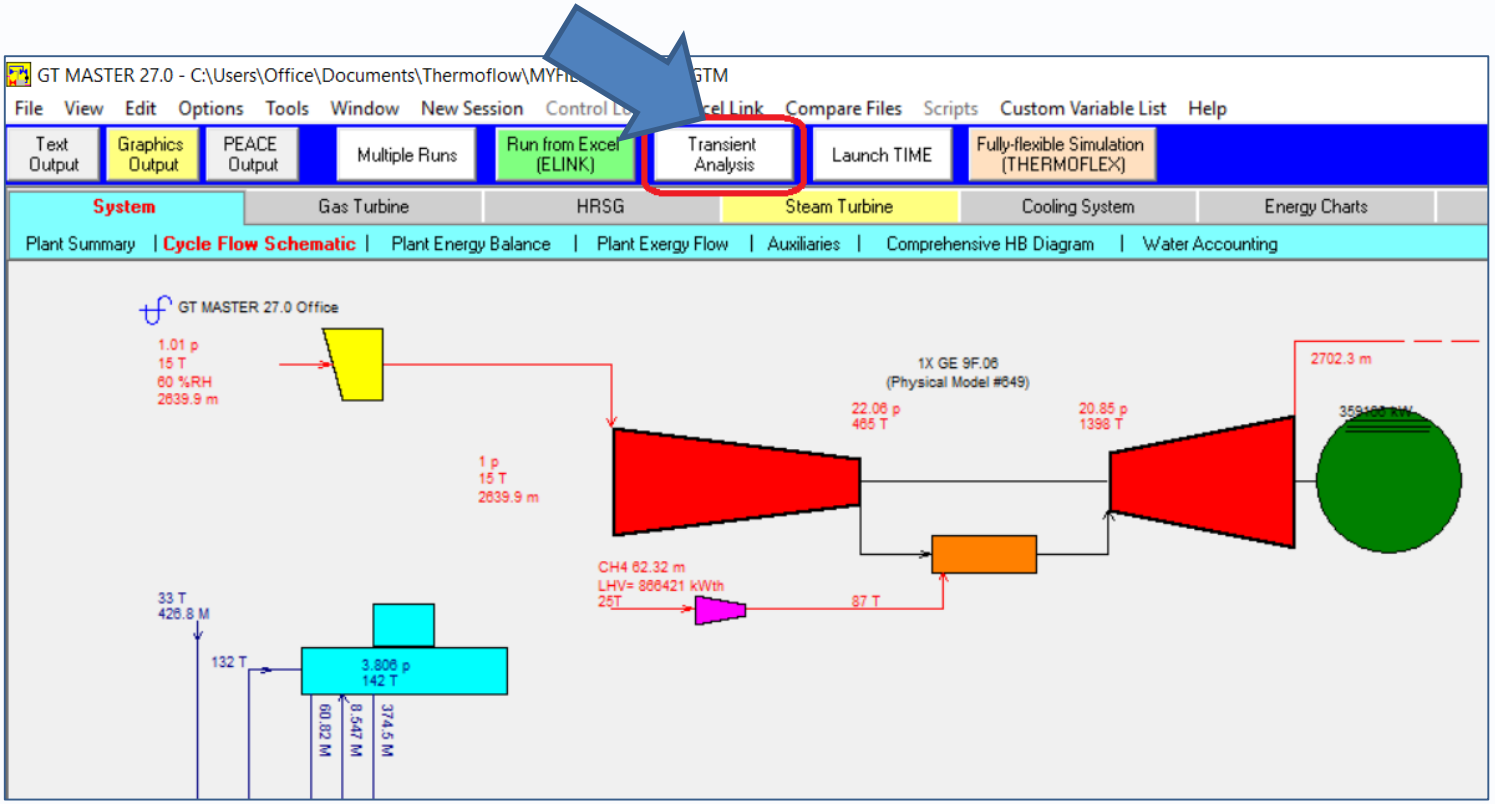
Steady State vs Transient Modelling

	Steady state	Transient
Time dependence	No	Yes
Stored energy simulated	No	Yes
Mass & energy in balance	Always in balance	Not always in balance

General transient modelling application

- Determining plant operating flexibility.
- Developing control strategies for energy optimization purposes.
- Plant startup and shutdown.

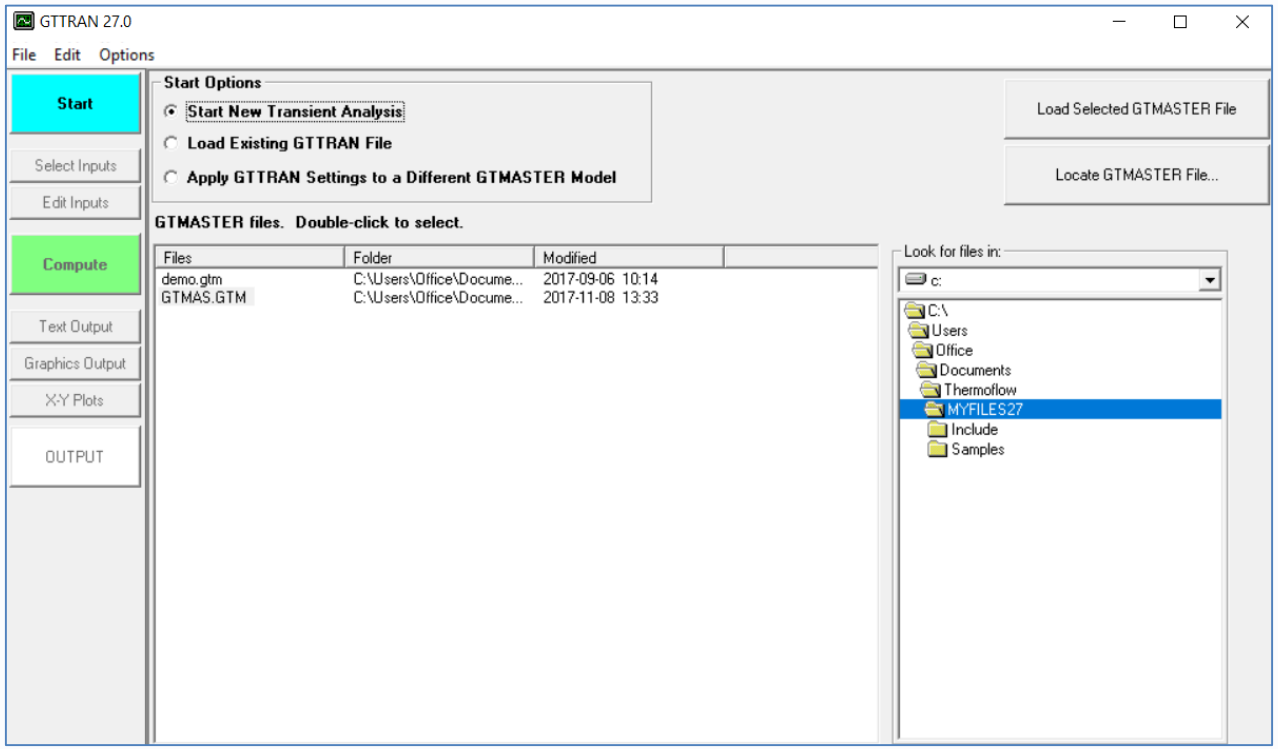
Launching GTTRAN from GT MASTER



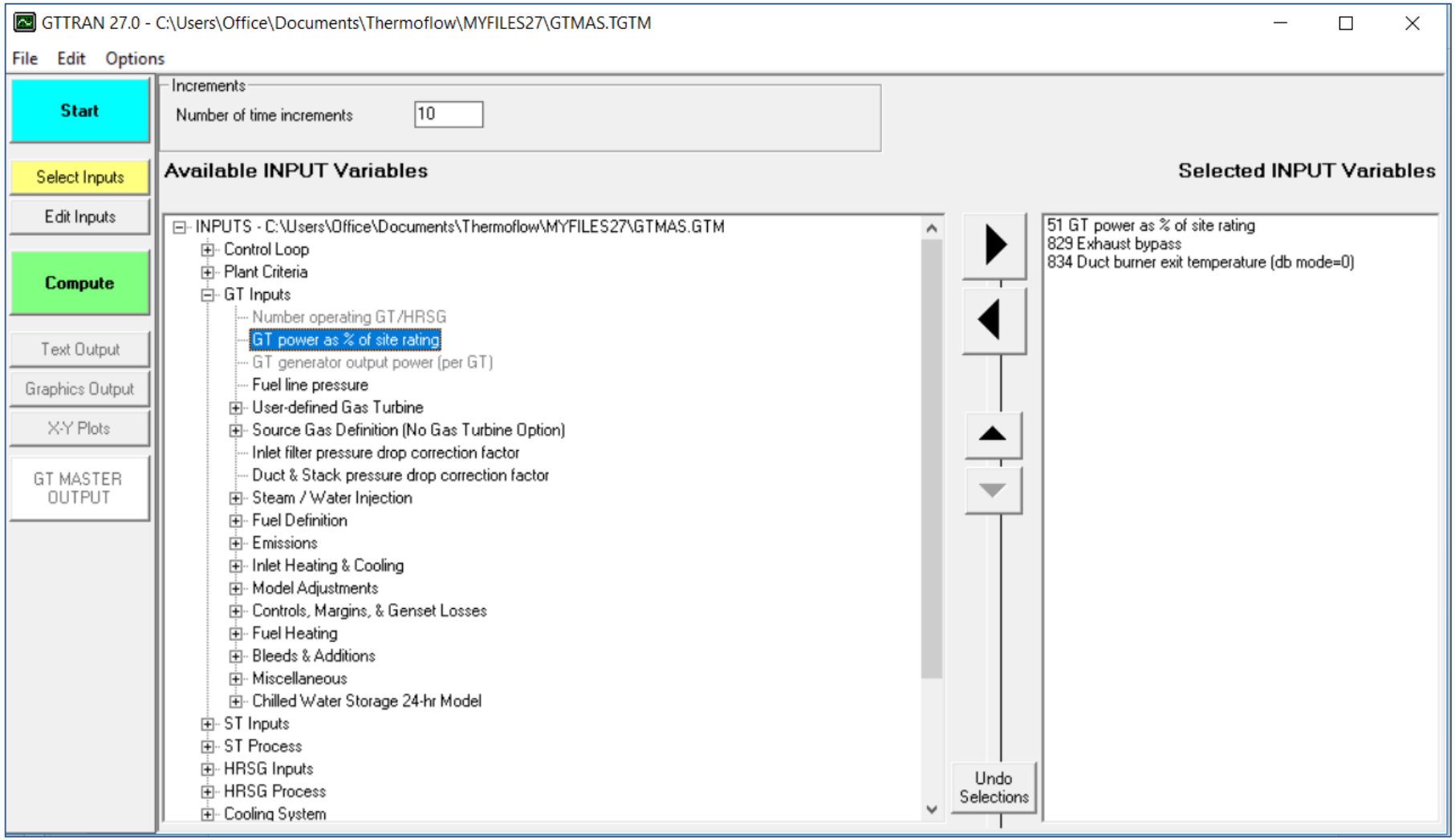
"Transient Analysis" button is available in computed GT MASTER file.

Launching GTTRAN on its own

Windows Start /
All programs



Select Inputs



Edit Inputs

GTTRAN 27.0 - C:\Users\Office\Documents\Thermoflow\MYFILES27\GTMAS.TGTM

File Edit Options

Start

Select Inputs

Edit Inputs

Compute

Text Output

Graphics Output

X-Y Plots

GT MASTER OUTPUT

Transient Inputs | Convergence Settings

Values for time step size, and model inputs can be entered directly on grid below, or by using the selection list and range entries to the right.

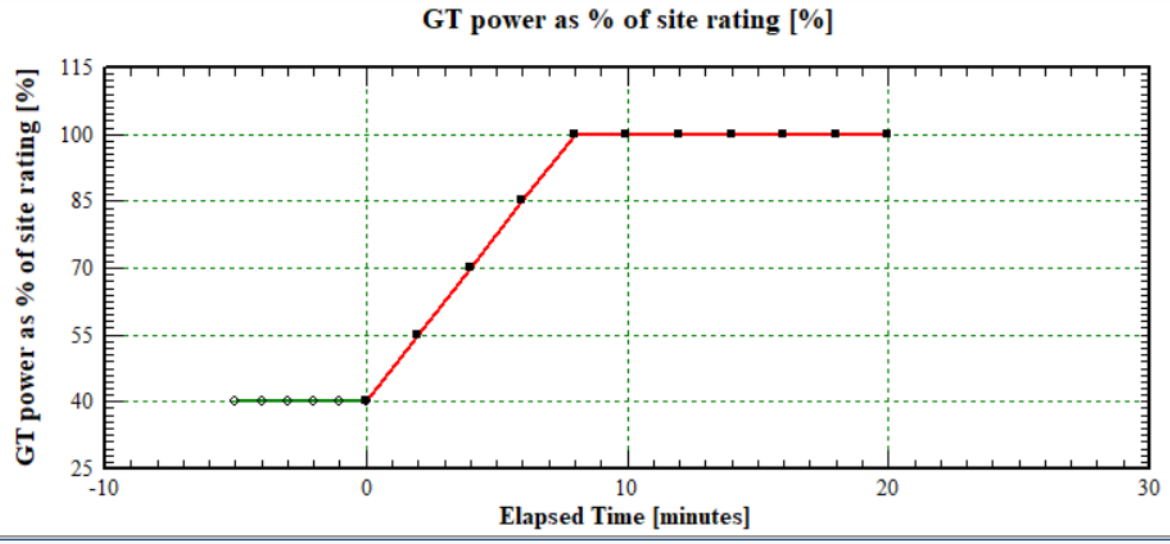
Time increment

Vary from 2 minutes @ case number 1

to 2 minutes @ case number 10

Update table using these range inputs

	Case #	0	1	2	3	4	5	6	7	8	9	10
Elapsed time	Minutes	Initial Condition	2 min.	4 min.	6 min.	8 min.	10 min.	12 min.	14 min.	16 min.	18 min.	20 min.
Time increment	Minutes	N/A	2	2	2	2	2	2	2	2	2	2
GT power as % of site rating	%	40	55	70	85	100	100	100	100	100	100	100
Exhaust bypass	%	0	0	0	0	0	0	0	0	0	0	0
Duct burner exit temperature (db mode=0)	C	0	0	0	0	0	0	0	0	0	0	0



Edit Input notes

- Time interval from 1 to 3 minute is suggested to provide meaningful results.
- Time increments smaller than one minute doesn’t improve accuracy because of the model assumptions.
- Transient (dynamic) response of an operating combined cycle undergoing load changes is in the range of 10 to 30 minutes.
- Initial condition is a steady state GT MASTER run (it can be reset in GTTRAN input)

Outputs

The program computes energy storage in the following:

- Water/steam.
- Heat exchanger tubes.
- Metal fins.
- Drums.
- Boiler’s headers.
- Boiler’s liner/casing.

Outputs

For each time increment, GT MASTER iterates to find the **rate of change in stored energy**, Q_s, for each heat exchanger in the boiler. A time increment is converged when the following are satisfied:

$$SE(t+dt) = SE(t) + Q_s * dt$$

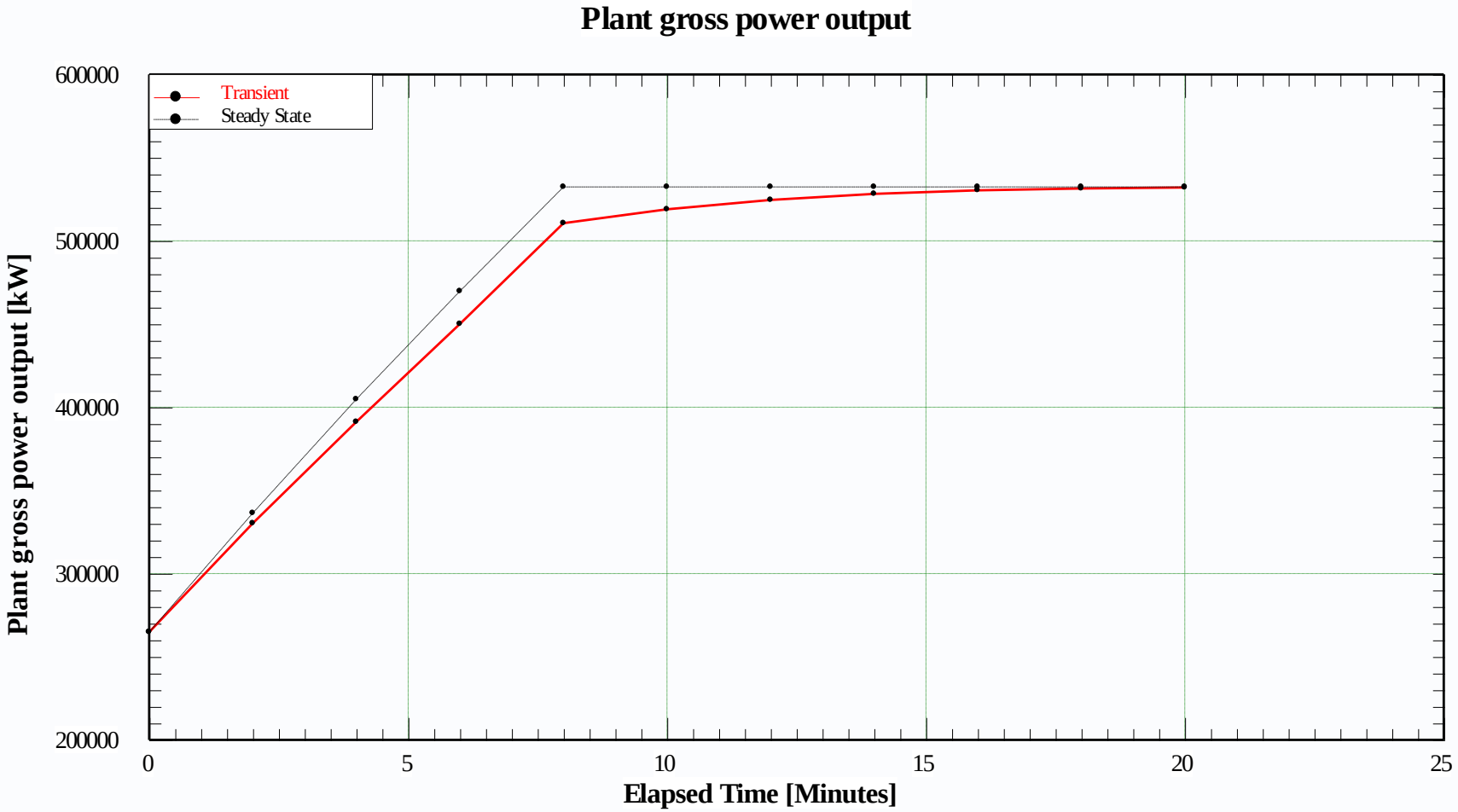
and

$$Q_g = Q_w + Q_s + Q_{loss}$$

where:

dt = Time increment,
$SE(t+dt)$ = Stored energy at time $t+dt$,
$SE(t)$ = Stored energy at time t,
Q_s = Rate of increase in stored energy,
Q_g= Heat transfer rate from gas,
Q_w= Heat transfer rate to water/steam,
Q_{loss}= Rate of heat loss to the surroundings.

Outputs



GTTRAN, Office
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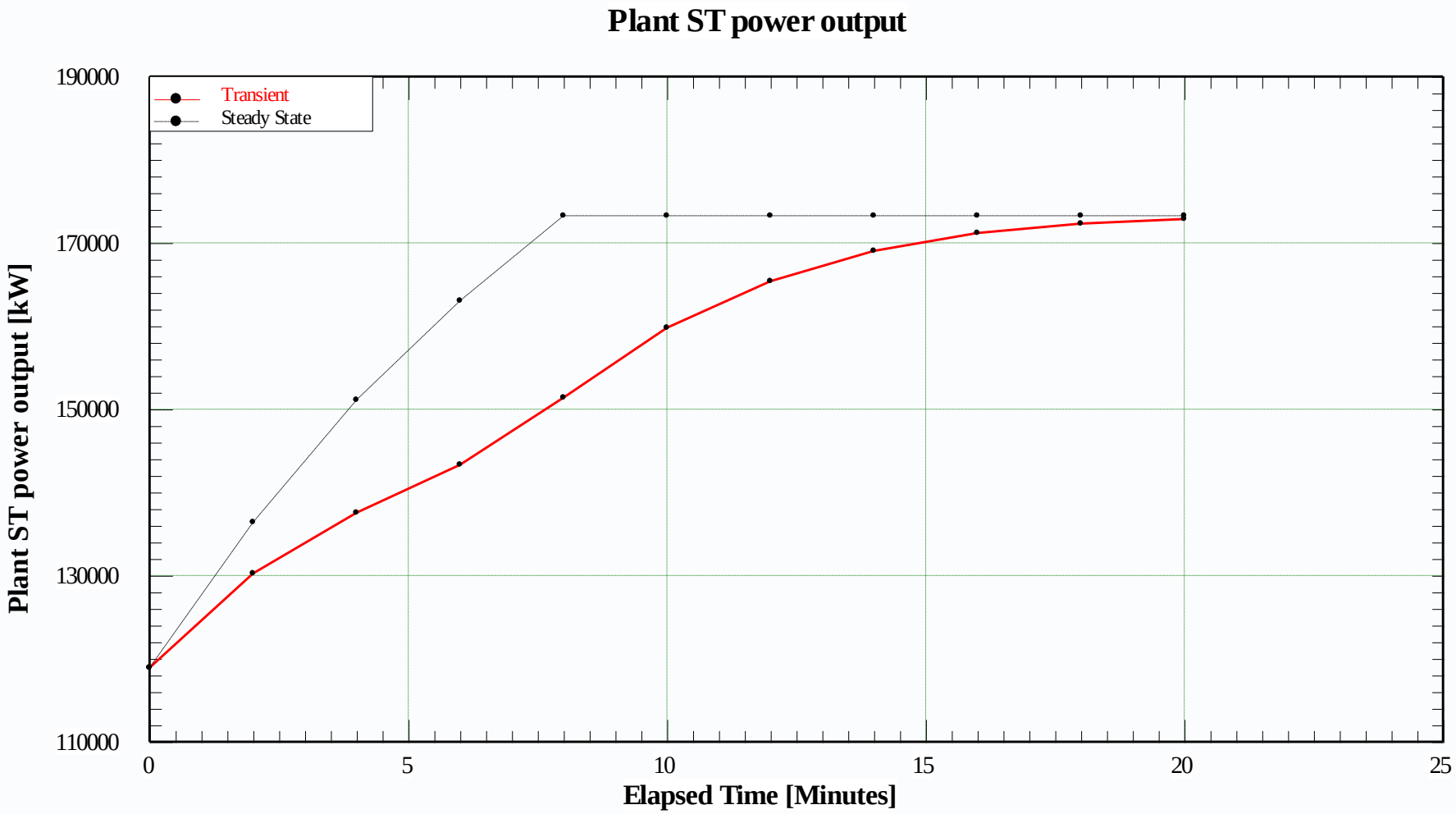
Outputs



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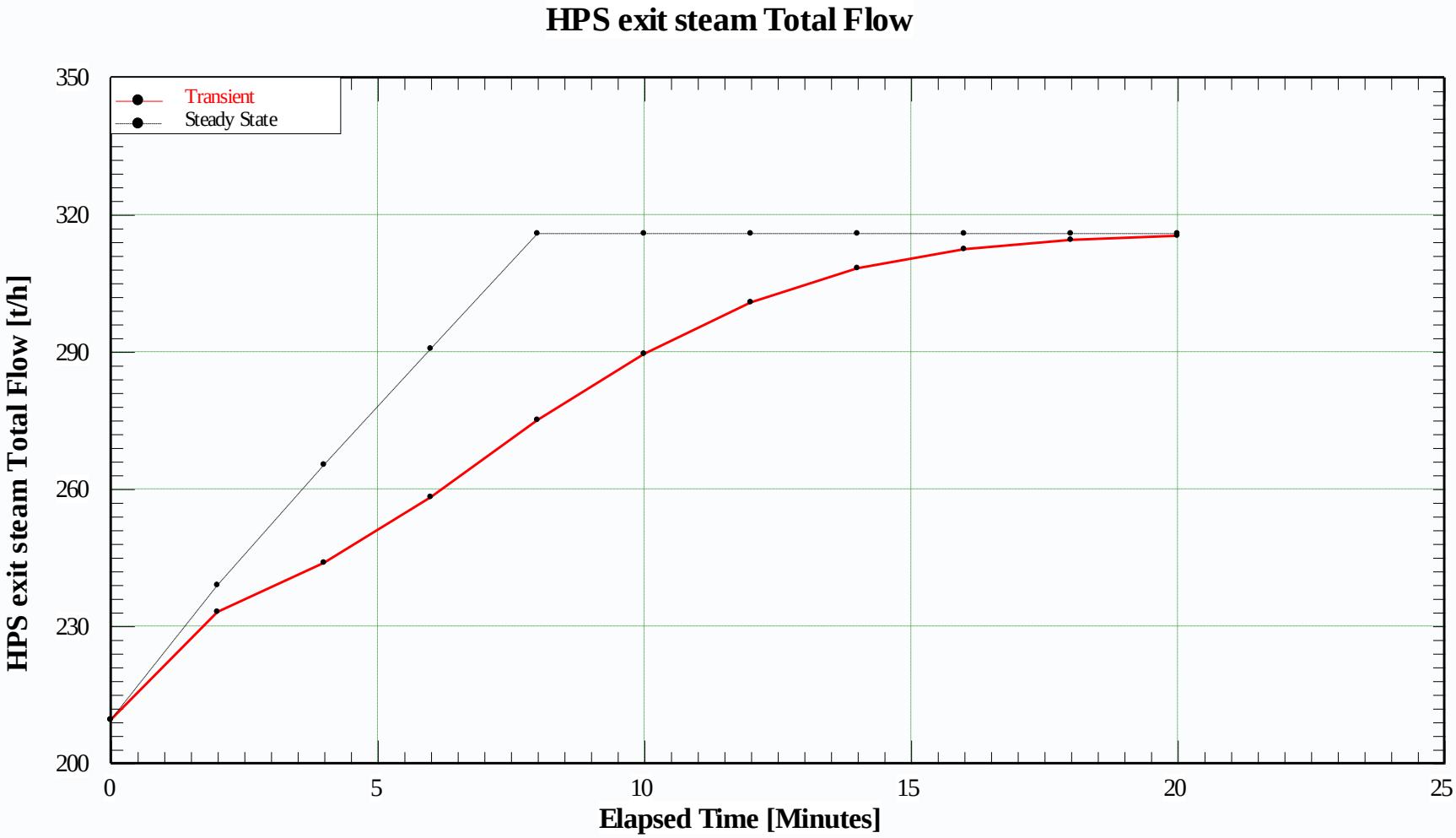
Outputs



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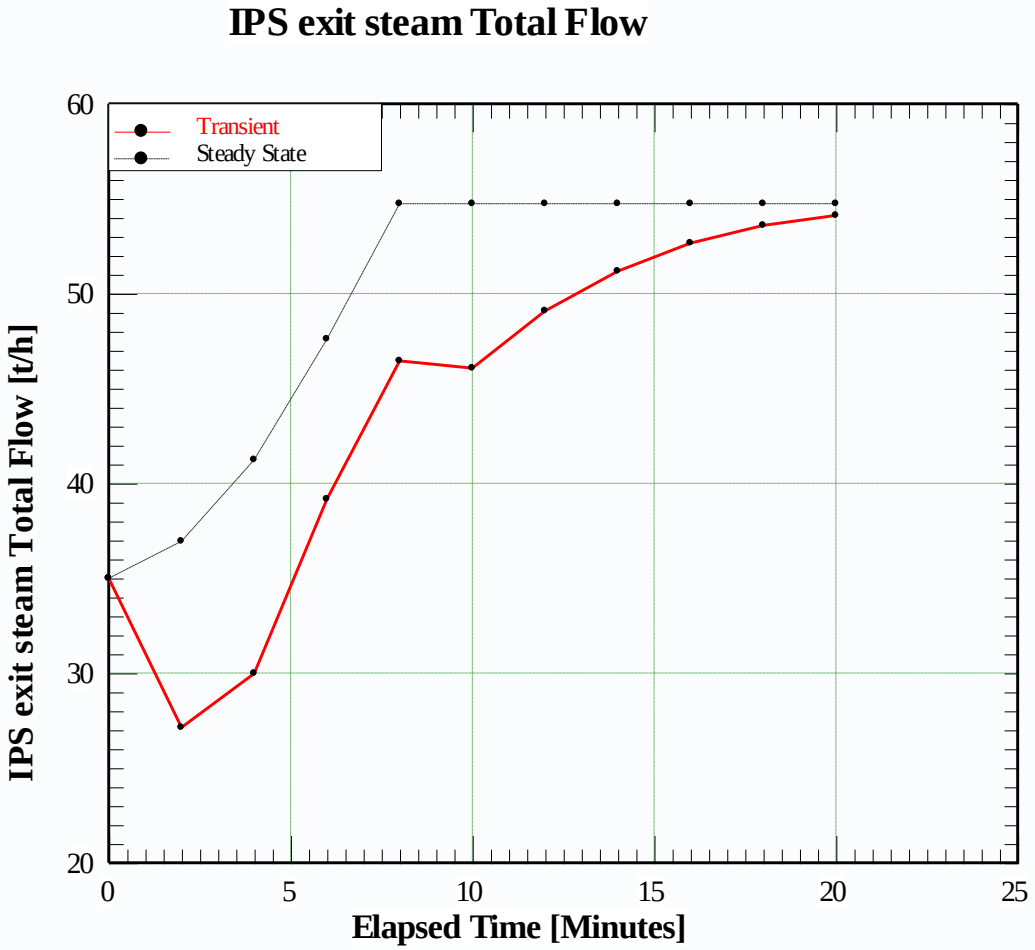
Outputs



GTTRAN, Office
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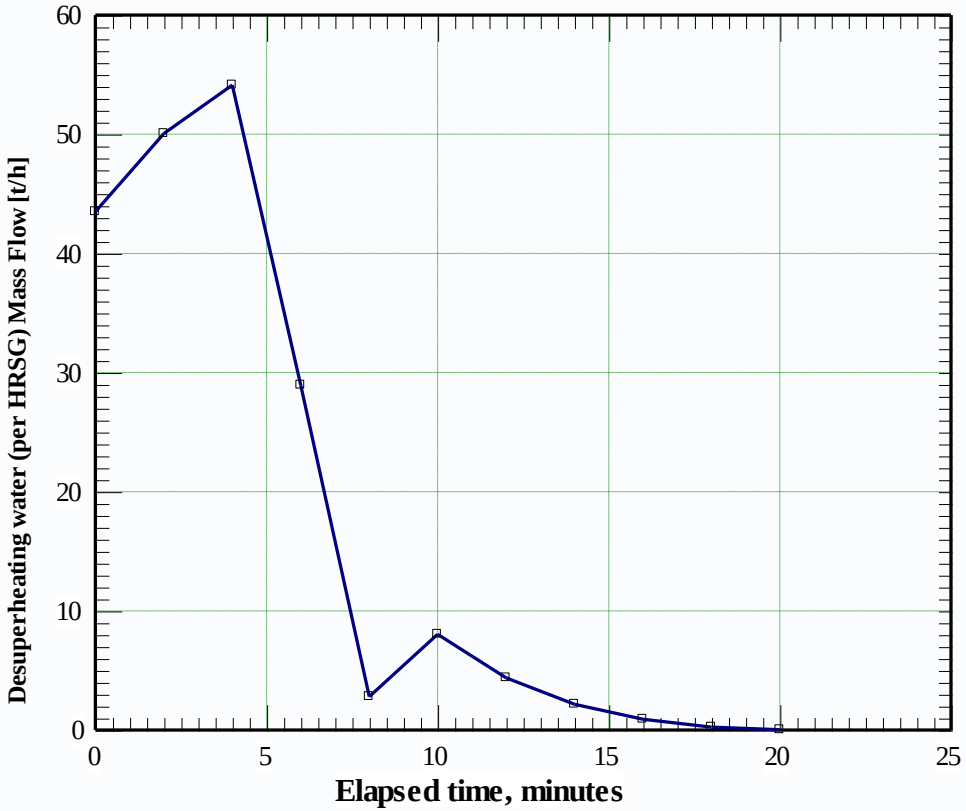
Outputs



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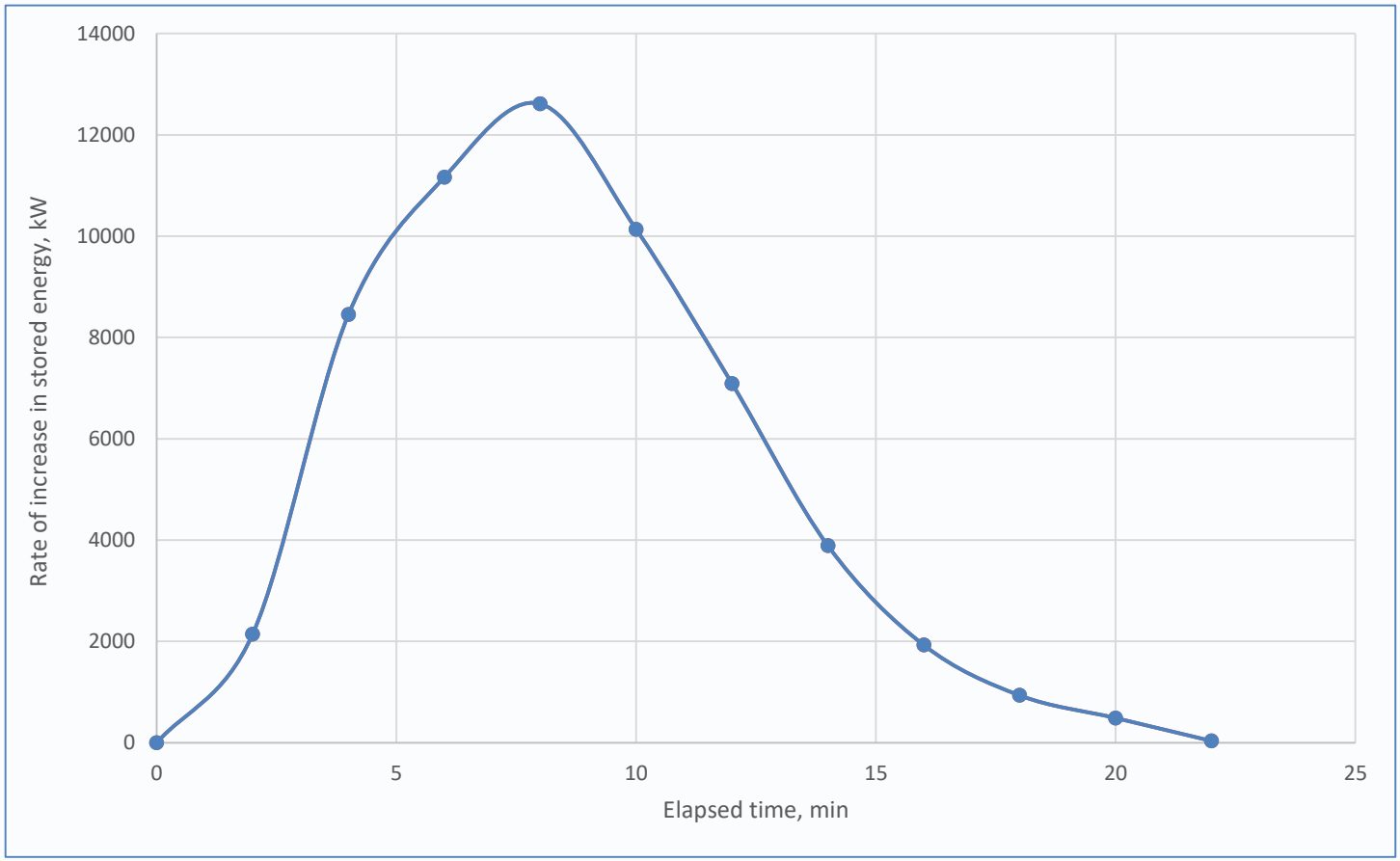
Outputs

HP Evaporator results

Transient HRSG	Unit	0 min	2 min	4 min	6 min	8 min	10 min	20 min	22 min
GT load	%	40	55	70	85	100	100	100	100
Outputs		HPB1	HPB1	HPB1	HPB1	HPB1	HPB1	HPB1	HPB1
1. Heat transfer from gas	kW	63241	72330	81163	89287	96141	95217	89528	89136
2. Heat transfer to water/steam	kW	62926	69828	72303	77678	83048	84606	88596	88658
3. Rate of increase in stored energy	kW	0	2142.6	8456	11165	12614	10137	487.1	34.26
4. Gas temperature entering HX	C	447.8	449.1	452.1	454.6	456.7	459.3	458.4	458
5. Gas temperature exiting HX	C	325.4	327.4	331.9	337.6	343.7	347.4	353.3	353.4
6. Water/steam temperature entering HX	C	320.1	321.3	325.8	330.1	334.6	337	340.3	340.3
7. Water/steam temperature exiting HX	C	319.9	320.6	323.7	328	332.8	336.7	343.3	343.4
8. Total fin weight	kg	106105	106105	106105	106105	106105	106105	106105	106105
9. Average fin temperature	C	331.4	332.9	337	341.9	347.3	351.1	356.7	356.8
10. Total tube weight	kg	102408	102408	102408	102408	102408	102408	102408	102408
11. Average tube temperature	C	319.9	320.6	323.7	328	332.8	336.7	343.3	343.4
12. Stored energy in fins	MJ	20297	20414	20721	21106	21523	21815	22261	22266
13. Stored energy in tubes	MJ	18750	18795	19024	19338	19695	19982	20469	20477
14. Stored energy in HX water/steam	MJ	11487	11514	11652	11847	12076	12265	12601	12608
15. Stored energy in headers	MJ	2503.9	2509.8	2540.1	2582.4	2631.2	2671.2	2740.7	2742.1
16. Stored energy in drums	MJ	27457	27513	27799	28194	28643	29004	29618	29630
17. Stored energy in liner/casing	MJ	1392.4	1398.8	1413.3	1429.4	1445.3	1457.6	1467.3	1466.7
18. Total stored energy	MJ	81888	82144	83150	84497	86014	87195	89157	89190

Outputs

HP Evaporator results



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Q & A session

Please send your questions to the **presenter** in the webinar chat!

For further questions:
zakharenkov@thermoflow.com

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Thank you!