Steam Turbine Series Part 2: Modifying a Steam Turbine Model in THERMOFLEX

Using Steam Turbine Assembly menu to make model match known specifications
Feature Awareness Webinar Series

Thermoflow Training and Support

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17 – Total Plant Cost in THERMOFLEX
18 – Steam Turbine Tuning
19 – Creating Your Own THERMOFLEX Component
20 – Cooling System Optimization
21 – Steam Turbine Modeling Series Part I
22 – Steam Turbine Modeling Series Part II
Modify a Steam Turbine Model: Tasks

- Match Inlet Conditions and other Flows
- Match Pressures
- Match Enthalpies
- Match Power

Iterate as needed
Isolate a Steam Turbine Model: Then & Now

**Before**

- Copy Components
- Build supporting Network

**Now, w/ Catalog**

- Select Components
- Copy to Catalog
- Place in Isolated Flowsheet, Network Already in Place
Modify a Steam Turbine Model: Then & Now

**Before**

- Flows set externally
- P_inlet or A_nozzle at Individual ST Group menus
- Leakages at ST Assembly
- Efficiencies or exit enthalpies at individual ST Group menus or ST Assembly

**Now**

- Set Flows
- All Else
- Revised ST Assembly Menu

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Background:
Solar Rankine Cycle of Part I

New Piece
Already-built Pieces

C
H
E
S
R

HPT
IPT
LPT
ST
CND
HP2
HP1
DA
LP3
LP2
LP1

1800
475
100
300
175
38
12

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In Part I, we began with a Starter Model, representing a prospective system model ...

Part I added a steam turbine and condenser to this model that was already in progress with known main steam supply and assumed FWH train.
Using the ST Assembly Wizard, a new ST was added to that Starter Model. This is where we’ll pick up today.
A closer look at the turbine...
Responding to a request for a proposed turbine to fit these needs, a vendor responds with a heat balance of his own...

Vendor's response:
Expect greater Pexh (1.65 > 1.5 psia)
Need greater flow (290 vs 285 lb/s) for 150 MW
... with some details of packing leakages and exhaust loss.

<table>
<thead>
<tr>
<th>Last stage blade length</th>
<th>29.98 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last stage pitch diameter</td>
<td>85.00 in</td>
</tr>
<tr>
<td>Exhaust annulus area / end</td>
<td>55.60 ft^2</td>
</tr>
</tbody>
</table>
This leaves you with the task of implementing the vendor’s design of the steam turbine, merging it with your developing model.
Adjusting in place leaves a lot of potential conflicts to be wrestled with. The recommended procedure is to make a copy of the subsystem, adjust it all by itself, then bring it back, as an already-designed, finished product in Off-Design.

You could copy to a new file or flowsheet directly, or place a copy in a Catalog.

Copied ST and Splitter 41 to “SolarST_plus”
An advantage of the Catalog is that, when you import that stored sub-model to a new file, it brings with it a full complement of associated elements to support the sub-model on its own.

Opened a new TFX file and selected “SolarST_plus” from Catalog. It comes equipped with Sources and Processes as supporting elements.
The Steps Involved...

- Isolate in a flowsheet free from network. I’ve chosen to push to and pull from a Catalog

- Impose incoming flow conditions, outgoing pressures and flows, check leakages if known, check overall flow match

- Impose whatever’s needed for pressure match

- Set efficiencies or exit enthalpies, set known or assumed exhaust loss

- If all the above is done right, any small remaining disparity in power is due to generator or mechanical losses.

- Convert to Off-Design, compute, then copy modified model back to main flowsheet.
Final Results

Flow increased to 290 lbs.
Removed Process icons;
Inserted Pipe for pressure drop to Condenser.
Retained SRR steam to FW1H.
Set FW1H to accept heating steam pressures.

Gross power 151689 KW
Net power 145220 KW
Plant auxiliary 6499 KW