Data Reduction and 1D Model Calibration

TurboTides' acclaimed data reduction algorithm uses test data or higher-accuracy simulation data (such as 3D CFD results) to generate a calibrated 1D model. Overall stage data, such as pressure ratio, efficiency, or detailed component data, such as pressure and temperature at each station, are used to adjust the default loss, deviation, and blockage models so that the calibrated 1D model can match the data across the performance map. This calibrated 1D base model not only can be used as a fast and accurate model to predict performance of the machine, it also can be used as the basis of future design evolution.

Two sets of data are shown in Figure A1. One set is from 3D CFD results, which is used as input data for 1D data reduction to generate calibrated base model. The other set of data is 1D prediction based on the calibrated model. The two sets of data match accurately across the full map.

Figure A1. The calibrated 1D model matches data accurately across performance map

When the base geometry model is scaled up and down, the new 1D model still gives accurate prediction of machine performance. Figure A2 shows the 1D prediction of a machine that is scaled up to 125% from the base model. In comparison is the full 3D CFD results on the same scaled-up machine. The two sets of data match very accurately across the performance map.

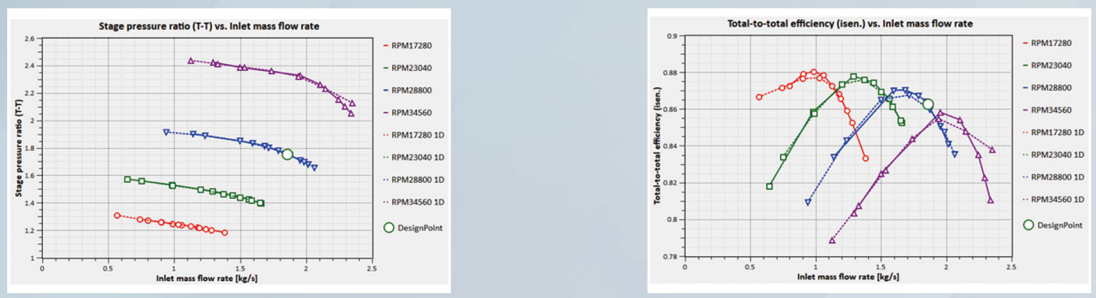

Figure A2. 125% scaled–up 1D model gives accurate prediction that matches CFD results

When the working fluid is changed, or the geometry is modified through some small adjustment (such as impeller trimming, flow-cutting), the new 1D model can still give accurate performance prediction. Figure A3 shows the 1D prediction when the fluid is changed from humid air (base model) to helium (new model). The results are also closely comparable with 3D CFD results.

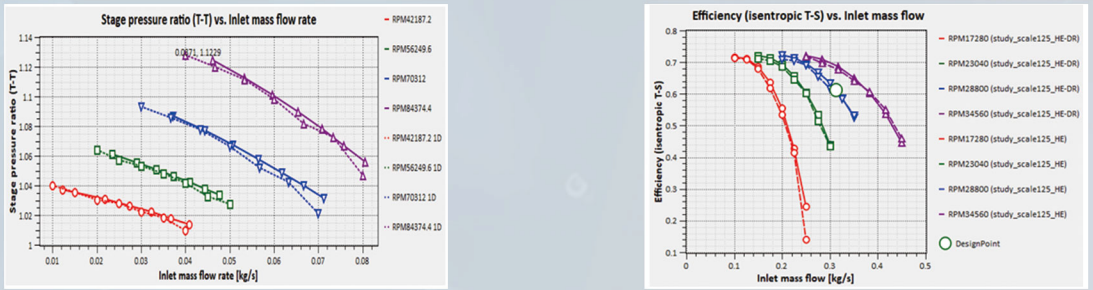

Figure A3. 1D performance prediction with working fluid changed