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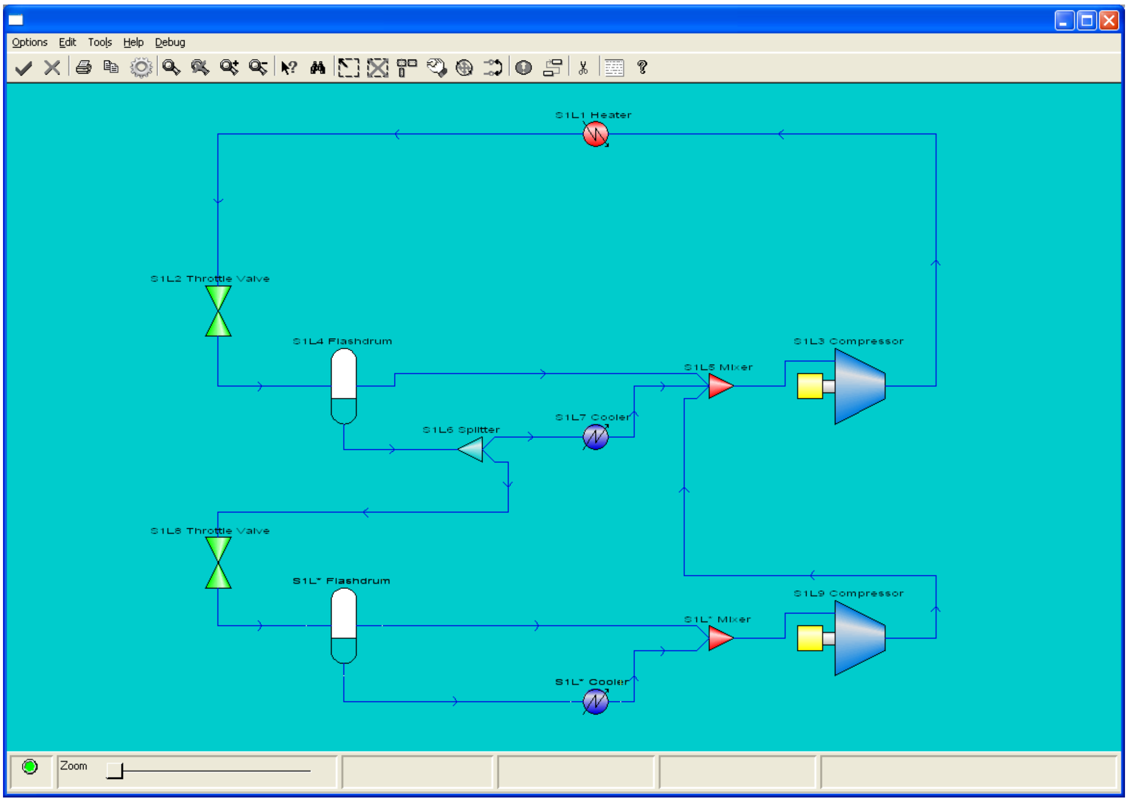
WORK Overview

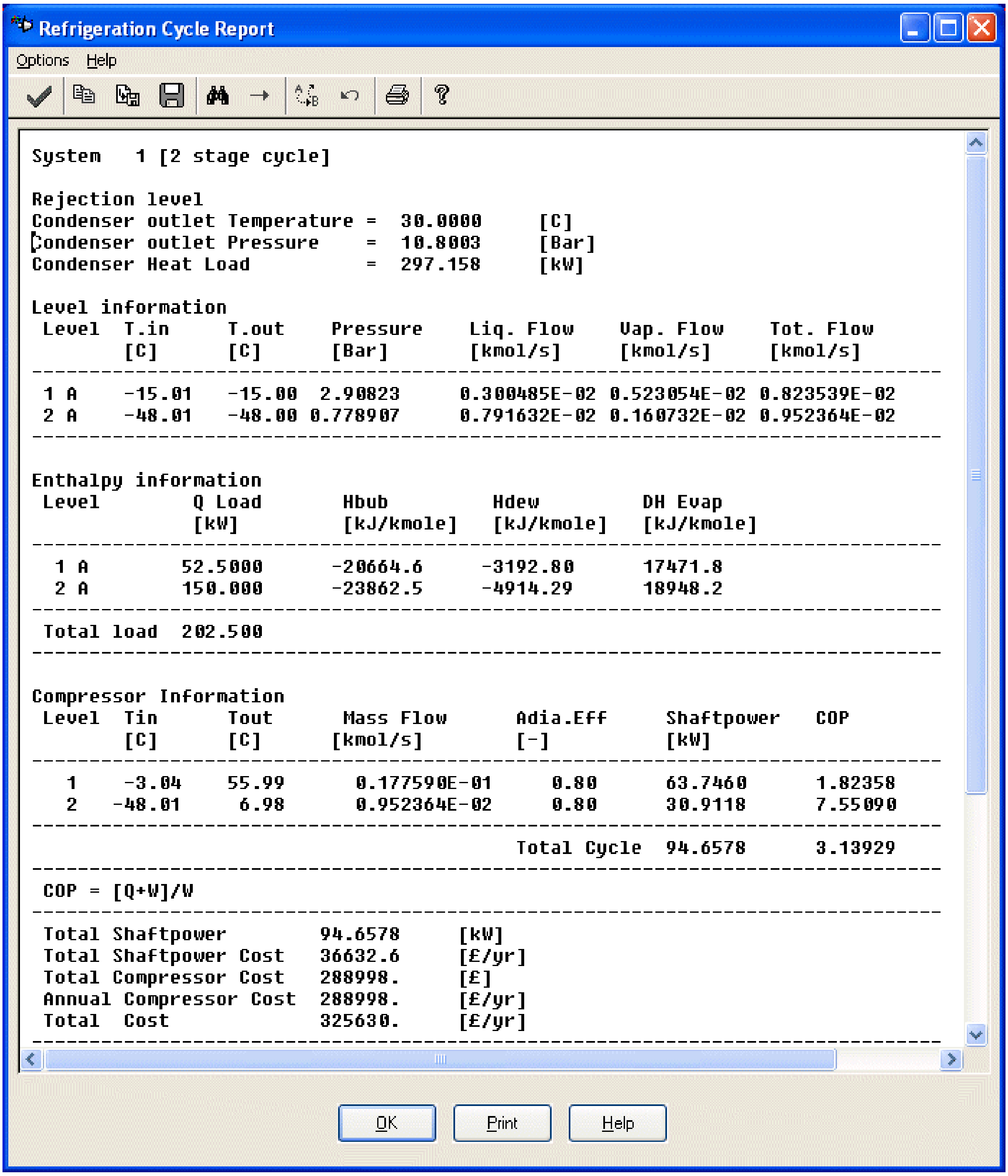
WORK is the software package used for the design of low temperature (sub-ambient) processes. Low temperature processes require heat rejection to refrigeration systems. The result is that the operating costs for such processes are usually dominated by the cost of power to run the refrigeration system. For large-scale systems, multiple levels of refrigeration, cascaded systems and mixed refrigerants are used. Such complex refrigeration systems can be analysed using **WORK**. Cascade and mixed refrigerant systems can be analysed. For mixed refrigerants, **WORK** can be used to optimise refrigerant composition.

- Understanding complex refrigeration systems
- Targeting minimum shaftwork for a low temperature cooling duties
- Optimising the number and temperatures of refrigeration levels
- Targeting minimum shaftwork for cascade refrigeration systems
- Targeting minimum shaftwork for mixed refrigerant systems
- Determining the optimum composition for mixed refrigeration systems

Targeting Low Temperature Systems

WORK can target minimum shaftwork for simple and complex refrigeration cycles. Targets are based on rigorous thermodynamic calculations and have high accuracy when compared with rigorous simulation.





System 1 [2 stage cycle]

Rejection level

Condenser outlet Temperature	=	30.0000	[C]
Condenser outlet Pressure	=	10.8003	[Bar]
Condenser Heat Load	=	297.158	[kW]

Level information

Level	T.in [C]	T.out [C]	Pressure [Bar]	Liq. Flow [kmol/s]	Vap. Flow [kmol/s]	Tot. Flow [kmol/s]
1 A	-15.01	-15.00	2.90823	0.300485E-02	0.523054E-02	0.823539E-02
2 A	-48.01	-48.00	0.778907	0.791632E-02	0.160732E-02	0.952364E-02

Enthalpy information

Level	Q Load [kW]	Hbub [kJ/kmole]	Hdew [kJ/kmole]	DH Evap [kJ/kmole]
1 A	52.5000	-20664.6	-3192.80	17471.8
2 A	150.000	-23862.5	-4914.29	18948.2

Total load 202.500

Compressor Information

Level	Tin [C]	Tout [C]	Mass Flow [kmol/s]	Adia.Eff [-]	Shaftpower [kW]	COP
1	-3.04	55.99	0.177590E-01	0.80	63.7460	1.82358
2	-48.01	6.98	0.952364E-02	0.80	30.9118	7.55090
				Total Cycle	94.6578	3.13929

COP = [Q+W]/W

Total Shaftpower	94.6578	[kW]
Total Shaftpower Cost	36632.6	[£/yr]
Total Compressor Cost	288998.	[£]
Annual Compressor Cost	288998.	[£/yr]
Total Cost	325630.	[£/yr]

Optimisation of Refrigeration Levels

When using multiple refrigeration levels, there are usually trade-offs between the temperature of the levels and their load. As the temperature of each level is adjusted it not only affects its own shaftwork requirement, but that of the other levels also. Multiple levels of refrigeration must be optimised simultaneously. **WORK** allows this to be done based on its high accuracy shaftwork predictions.

Simulation of Refrigeration Systems

WORK allows simulation of simple and complex refrigeration systems. These may have multiple heat levels and multiple compressors. The refrigerant heat loads and temperature levels can be optimised relative to the background process to minimise shaftwork requirement.

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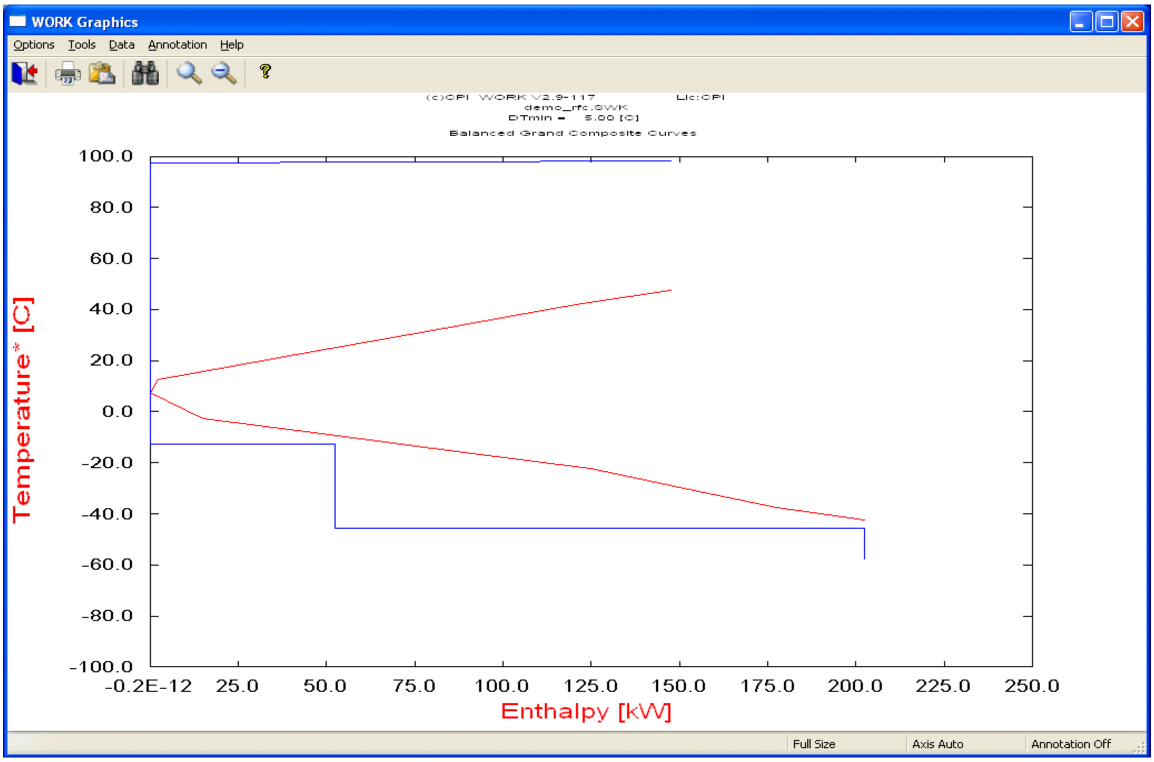
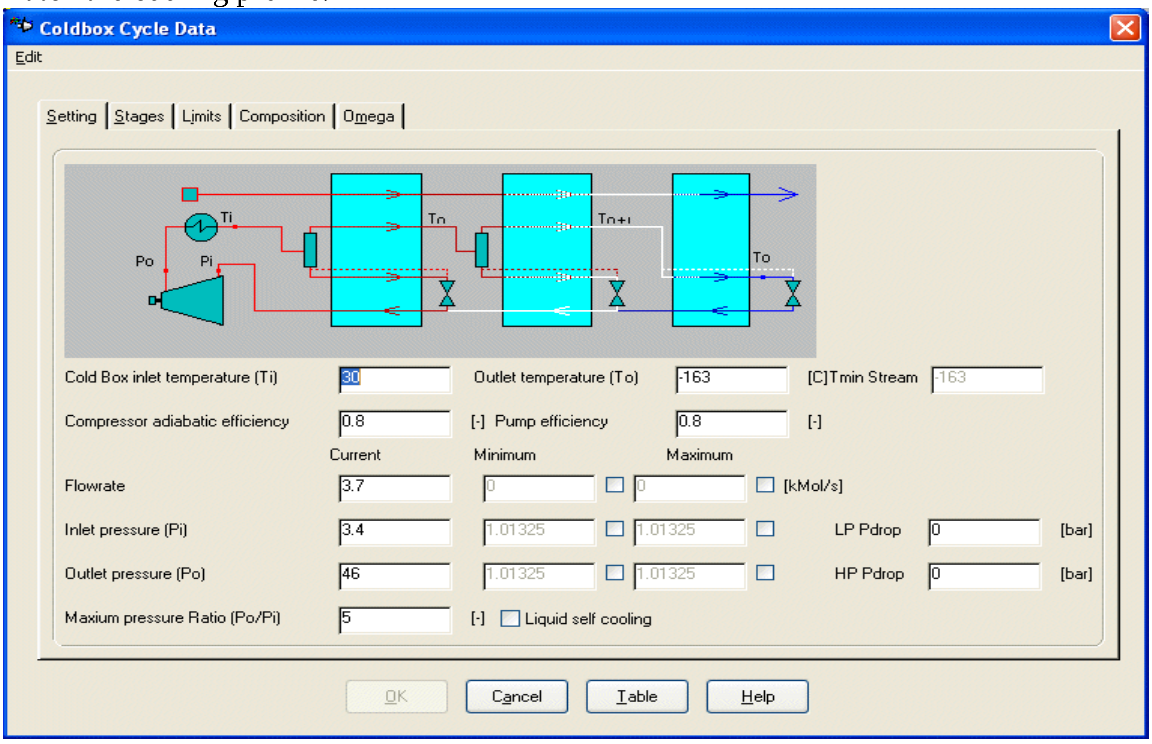
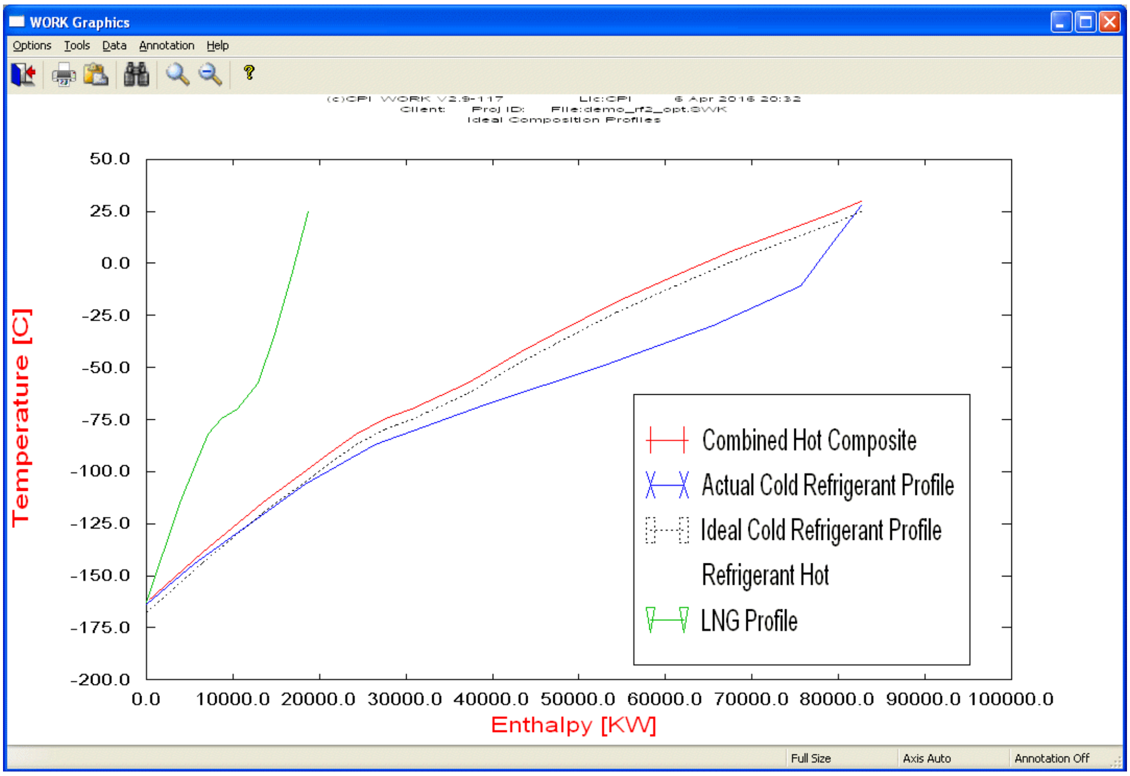


WORK can optimise the composition of mixed refrigerants to minimise shaftwork requirements. This is achieved by optimising the composition of the refrigerant to match the cooling profile.

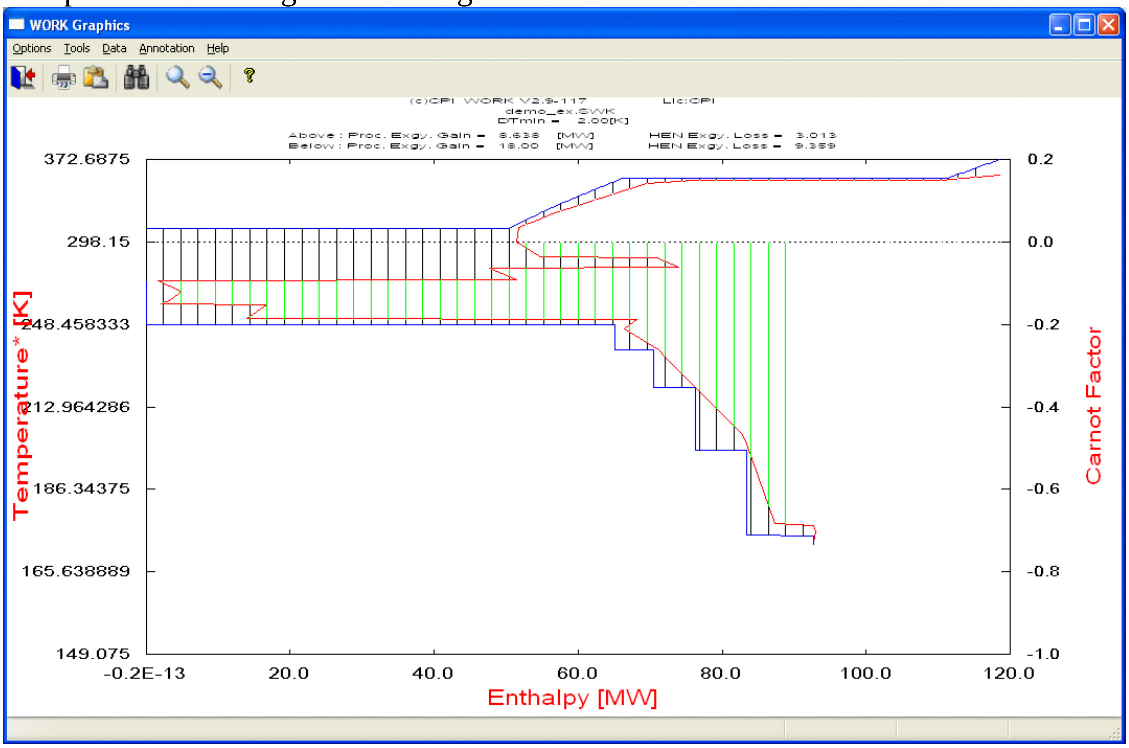


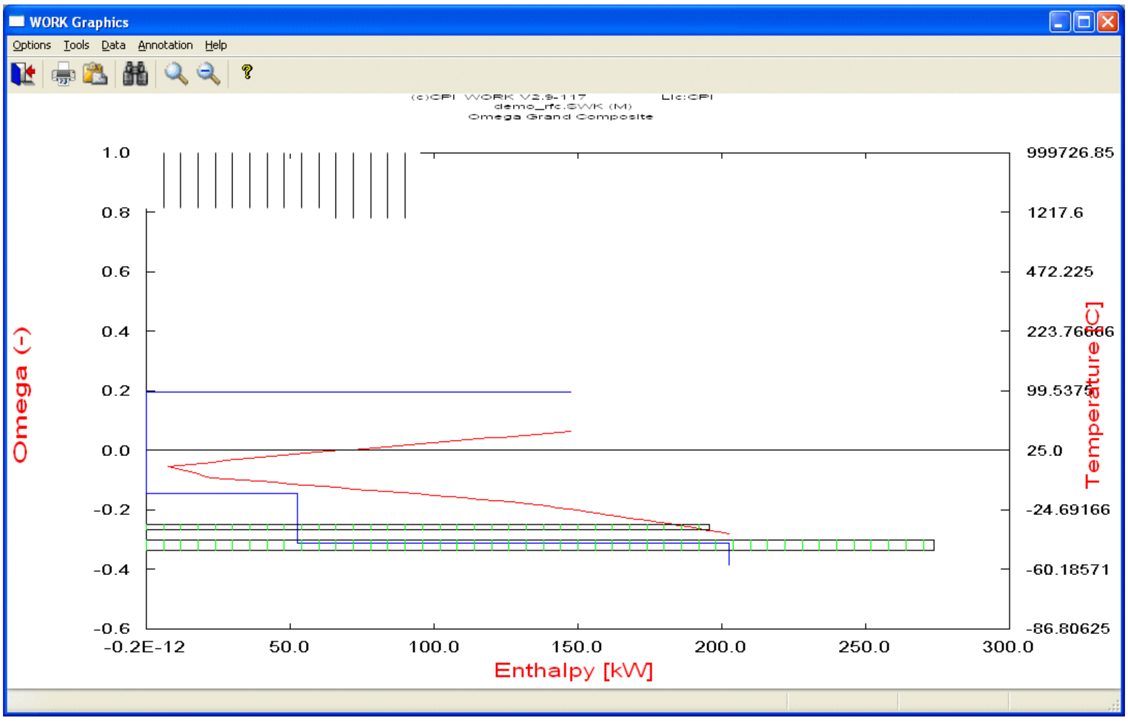
Coldbox cycle configuration



Graphical Representation

WORK allows visual representation of the shaftwork losses in refrigeration cycles. All aspects of the losses can be represented, including both mechanical and thermal losses. This provides the designer with insights that could not be obtained otherwise





Compressor driver selection

Designing power systems involves discrete decisions, not only because of the discrete nature of gas turbines and power plants, but also because of the discrete power demands and arrangement alternatives of the components in the system. **WORK** generates an optimal driver selection given the compressor loads