Overall system performance modeling: Solar thermal cooling/heating of the IW

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PURPOSE OF THE PROJECT

- Extend the previous performance modeling : create a detailed model given the characteristics of the existing devices and the system operation

- Assist the design of the solar thermal system (orientation, insulation thickness of the piping)

- Predict the system energy performance and optimize the system based on different parameters (volume and insulation thickness of a cold/hot storage tank) with TRNSYS

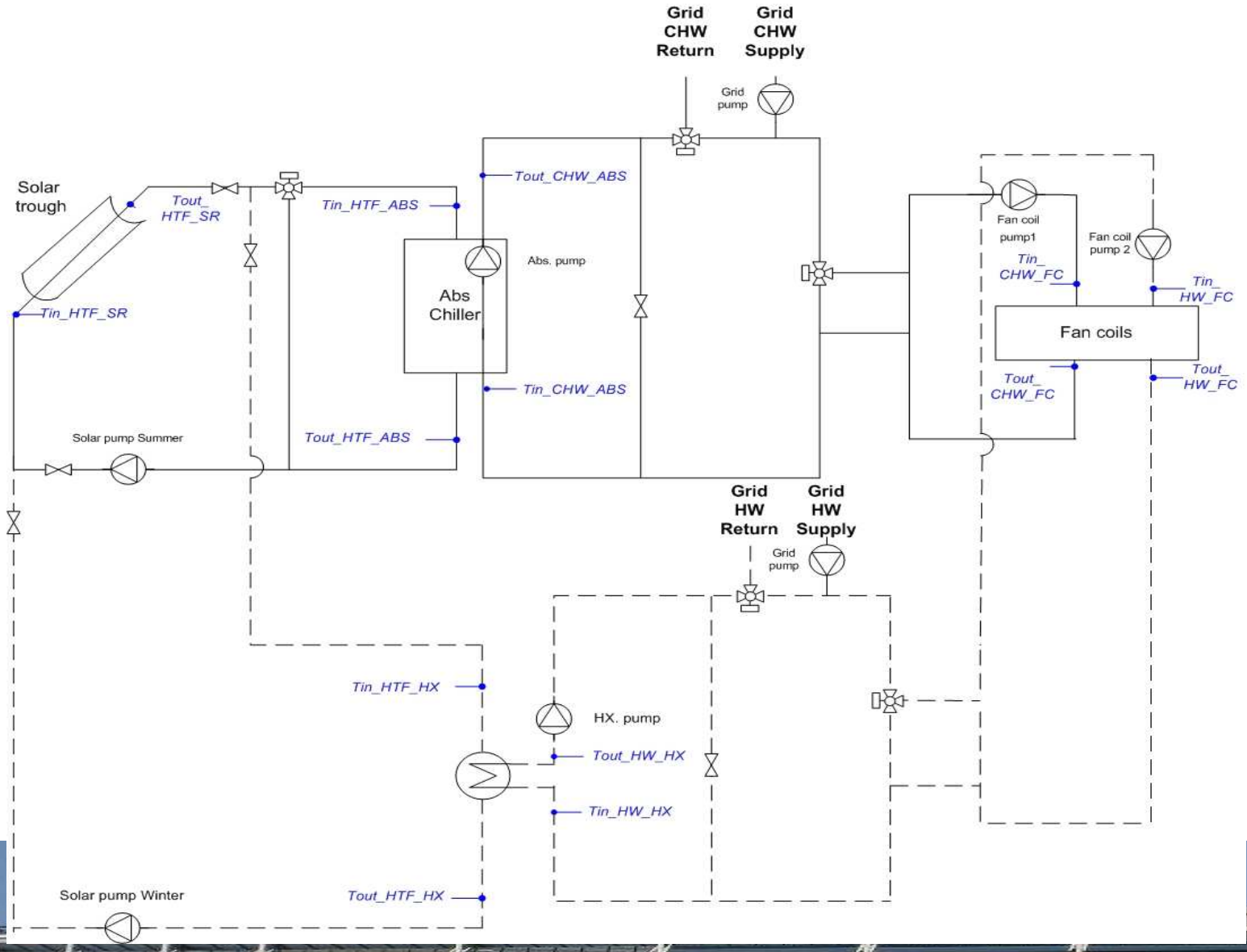
CONTENTS

1- Design of the solar thermal system

2- Optimization of the existing system

1. **System design**
2. System optimization

1. SYSTEM DESIGN



1. **System design**
2. *System optimization*

1. SYSTEM DESIGN

Assumptions :

► *Solar collector :* - parabolic trough (with one axis solar tracking system)

► *HTF in solar collection loop :* Propylene glycol-water mixture (50%)

►*Absorption chiller :* double effect hot water & gas fired

►*Thermal storage :* hot/cold water storage tank (after the solar collection loop)

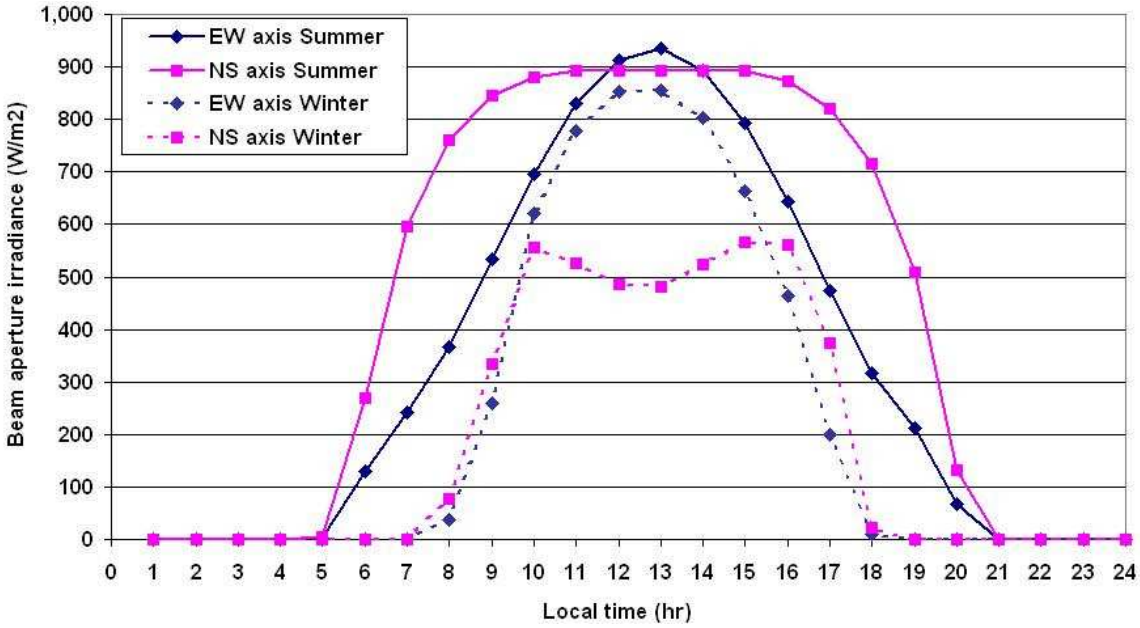
Sensitivity analysis

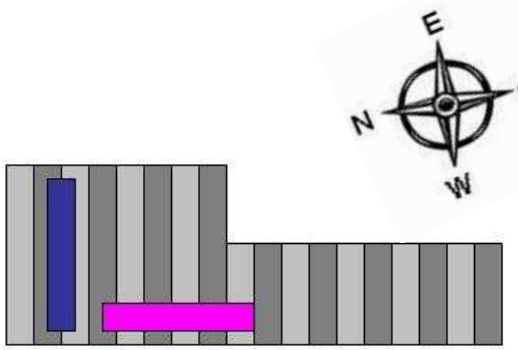
► *Design variables*

- Orientation of the solar trough
- Insulation thickness of the piping
- Volume and insulation thickness of the storage tank

1. SYSTEM DESIGN : orientation of the solar trough (1)

Orientation : Solar trough with NS axis EW tracking vs. EW axis NS tracking



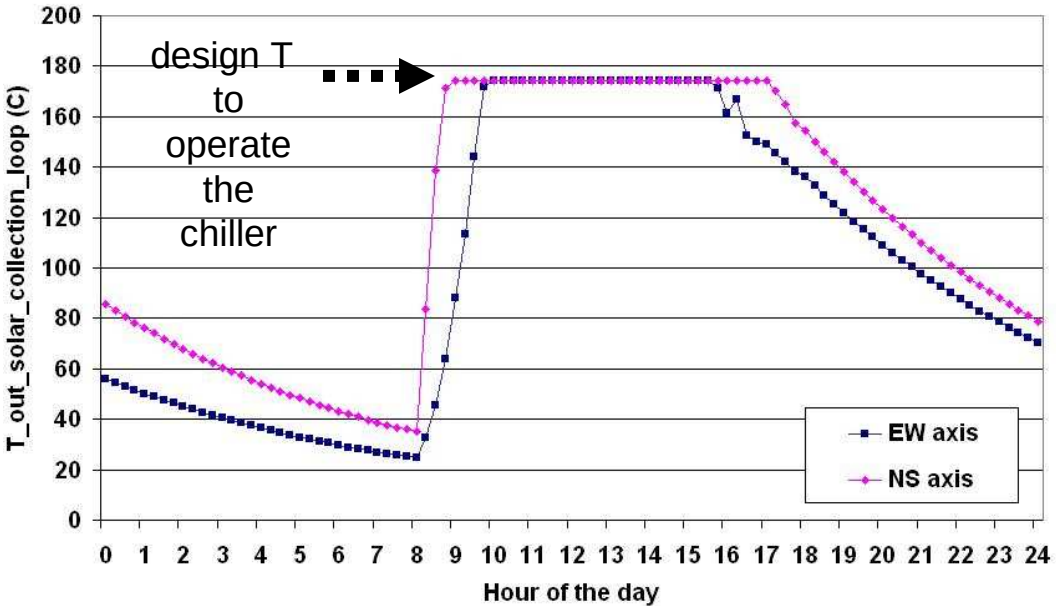


Period	Beam aperture irradiation (kWh/m^2)		Relative difference (%)
	EW axis	NS axis	(NS-EW)/EW
SUMMER	583	726	25
WINTER	304	273	-11
YEAR	887	999	13

1. SYSTEM DESIGN : orientation of the solar trough (2)

Influence of the orientation of the solar troughs on the system performance

Case	A	**B**
Orientation	EW axis	**NS axis**
Insulation thickness of the solar collection loop	3”	**3”**
Volume of the storage tank	-	**-**
Insulation thickness of the storage tank	-	**-**
Solar ratio in summer (%)	37.8	**61.4**
Solar ratio in winter (%)	8.4	**7.5**

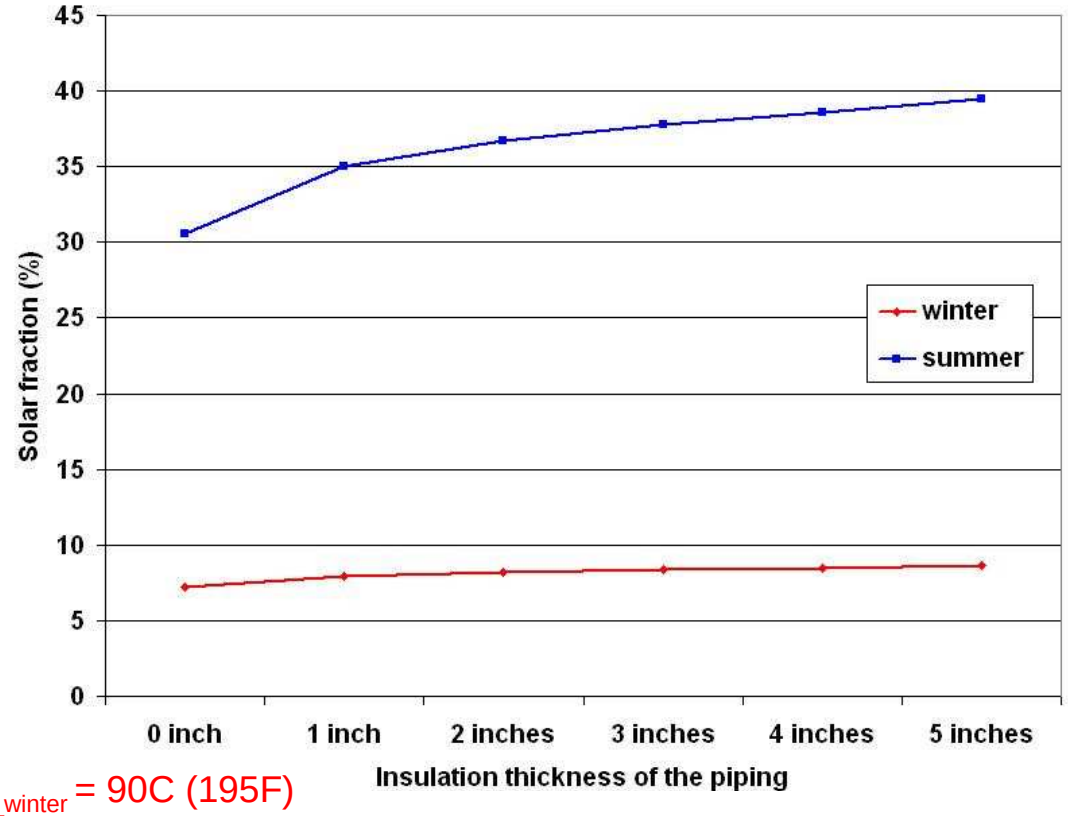


Summer

2. SYSTEM DESIGN : insulation of the piping

Influence of the insulation thickness of the piping on the system performance

Case	C
Orientation	EW axis
Insulation thickness of the solar collection loop	From 0 to 5”
Volume of the storage tank	-
Insulation thickness of the storage tank	-
Solar ratio in summer (%)	30.6 – 39.5
Solar ratio in winter (%)	7.2 – 8.6



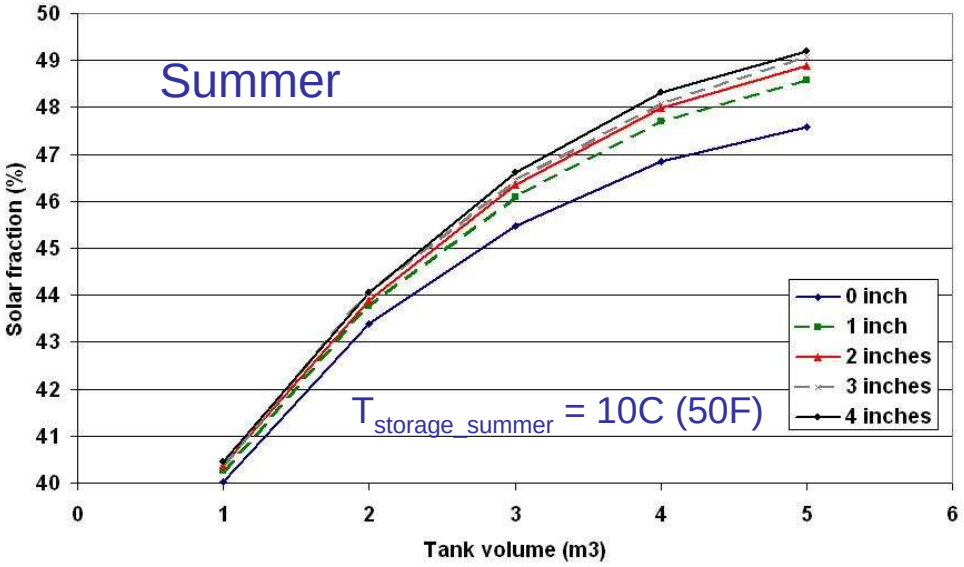
T_{HTF_winter} = 90C (195F)

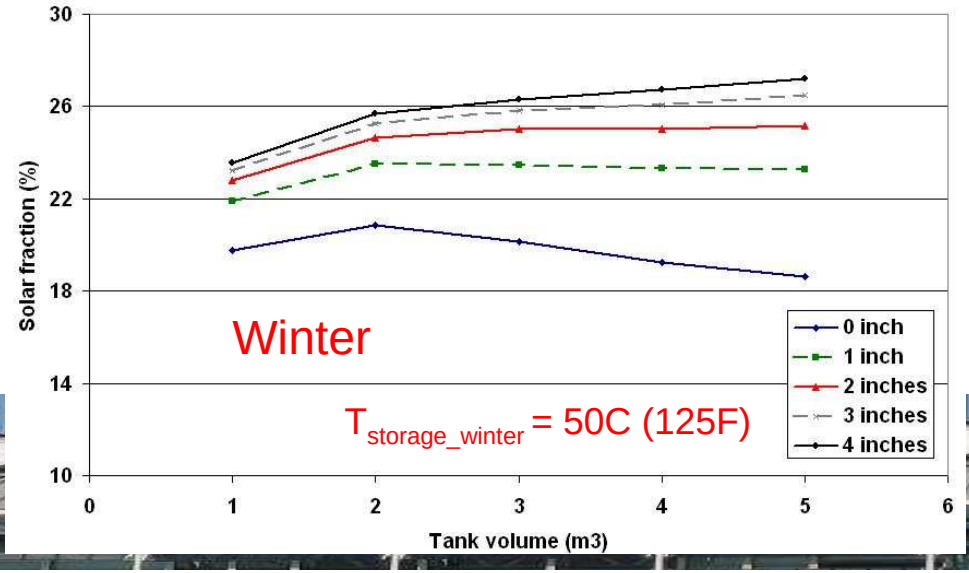
T_{HTF_summer} = 180C (355F)

2. SYSTEM OPTIMIZATION

Influence of the volume and insulation of the storage tank on the system performance

Case	Base case	Case 2
		Influence of the storage tank volume and insulation
Orientation	EW axis	**EW axis**
Insulation thickness of the solar collection loop	3”	**3”**
Volume of the storage tank	-	**From 1 to 5 m³**
Insulation thickness of the storage tank	-	**From 0 to 4”**
Solar ratio in summer (%)	37.8	**40.0 – 49.2**
Solar ratio in winter (%)	8.4	**18.6 – 27.0**





CONCLUSION

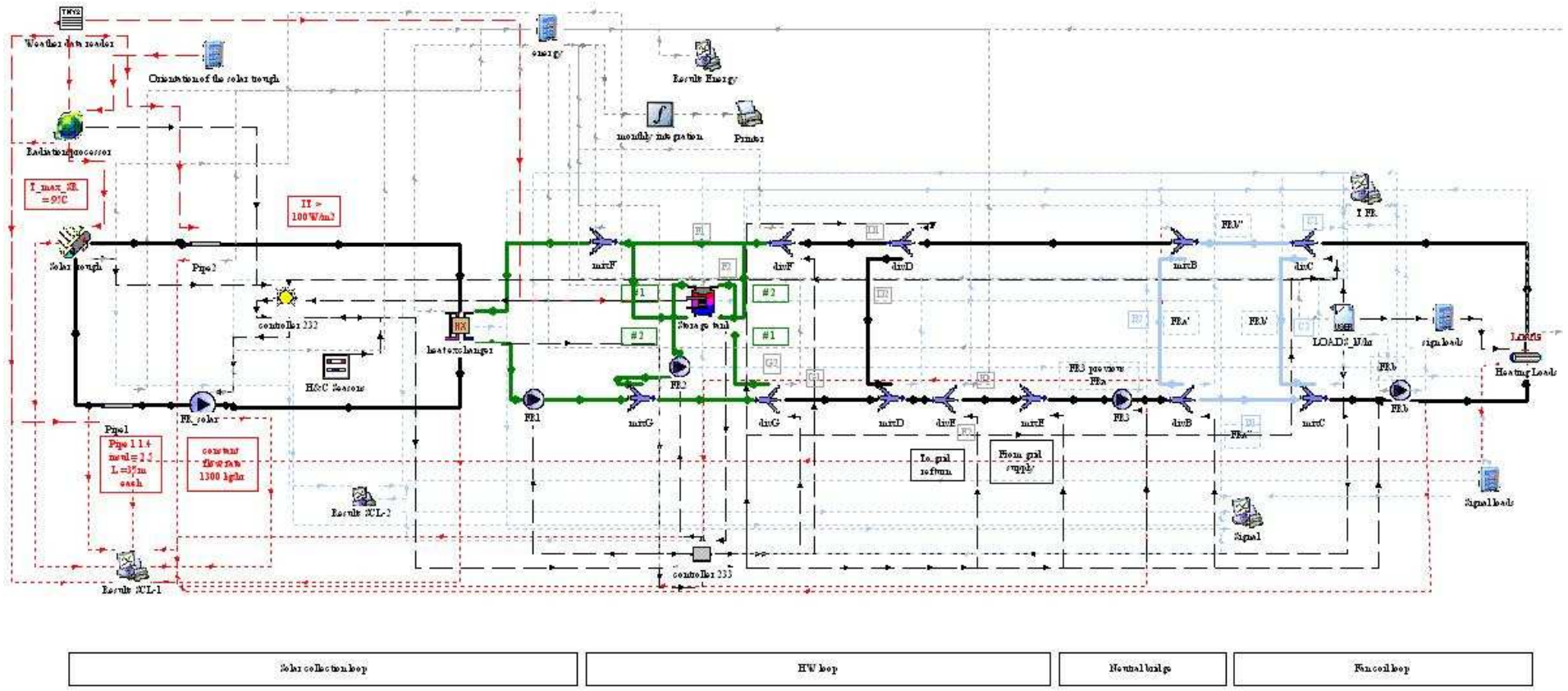
► Existing system performance : Winter =8.4% / Summer = 37.8%
Can be improved up to 27% in winter (around 3MWh) and 49.2% in summer (around 7MWh)

► Creation of a tool to improve the design process based on given building heating and cooling demands

► The existing model can be extended to add characteristics of the heating and cooling supply systems and economical data to model the dynamic of the building and its supply systems and study the life cost savings of the solar thermal system

QUESTIONS ?

Appendix - TRNSYS Model : Winter



Appendix - TRNSYS Model : Summer