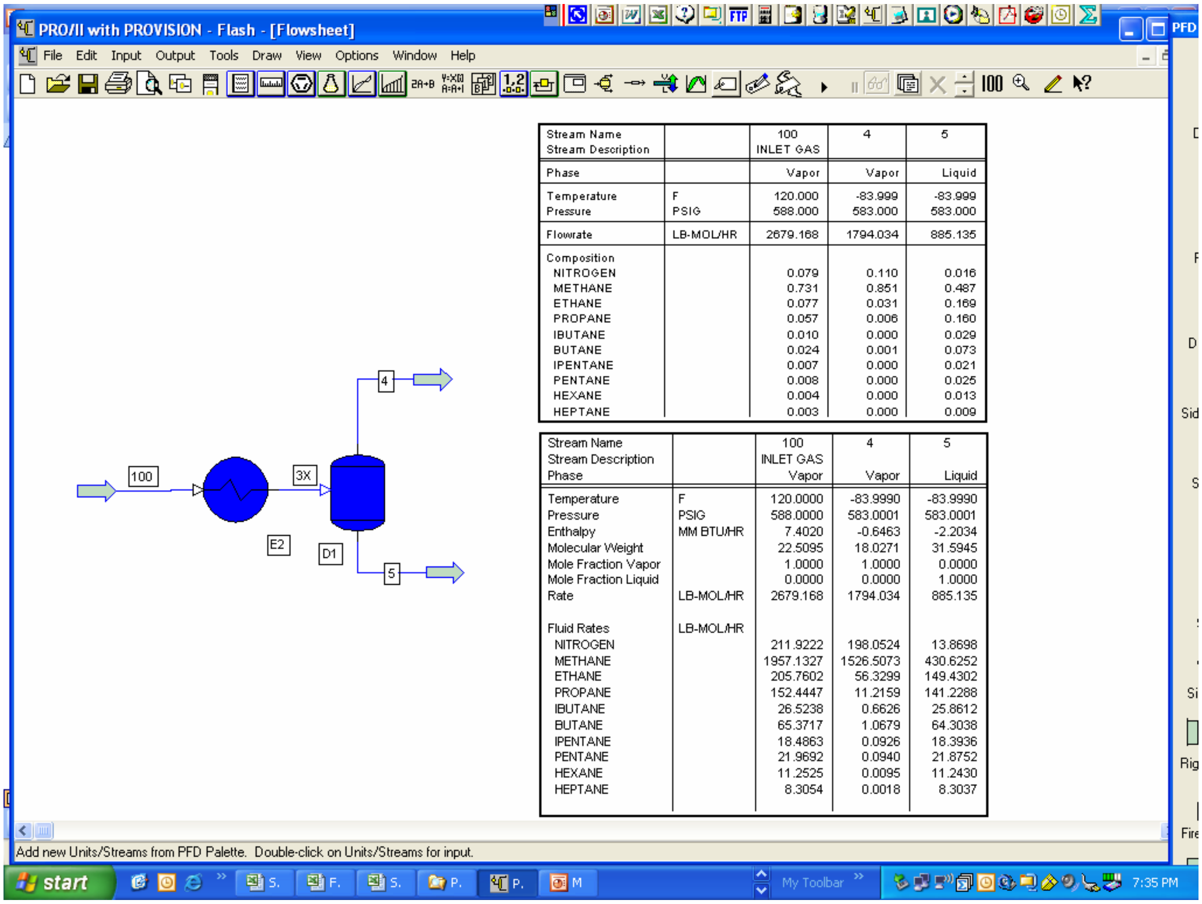
Natural Gas Liquids Separation

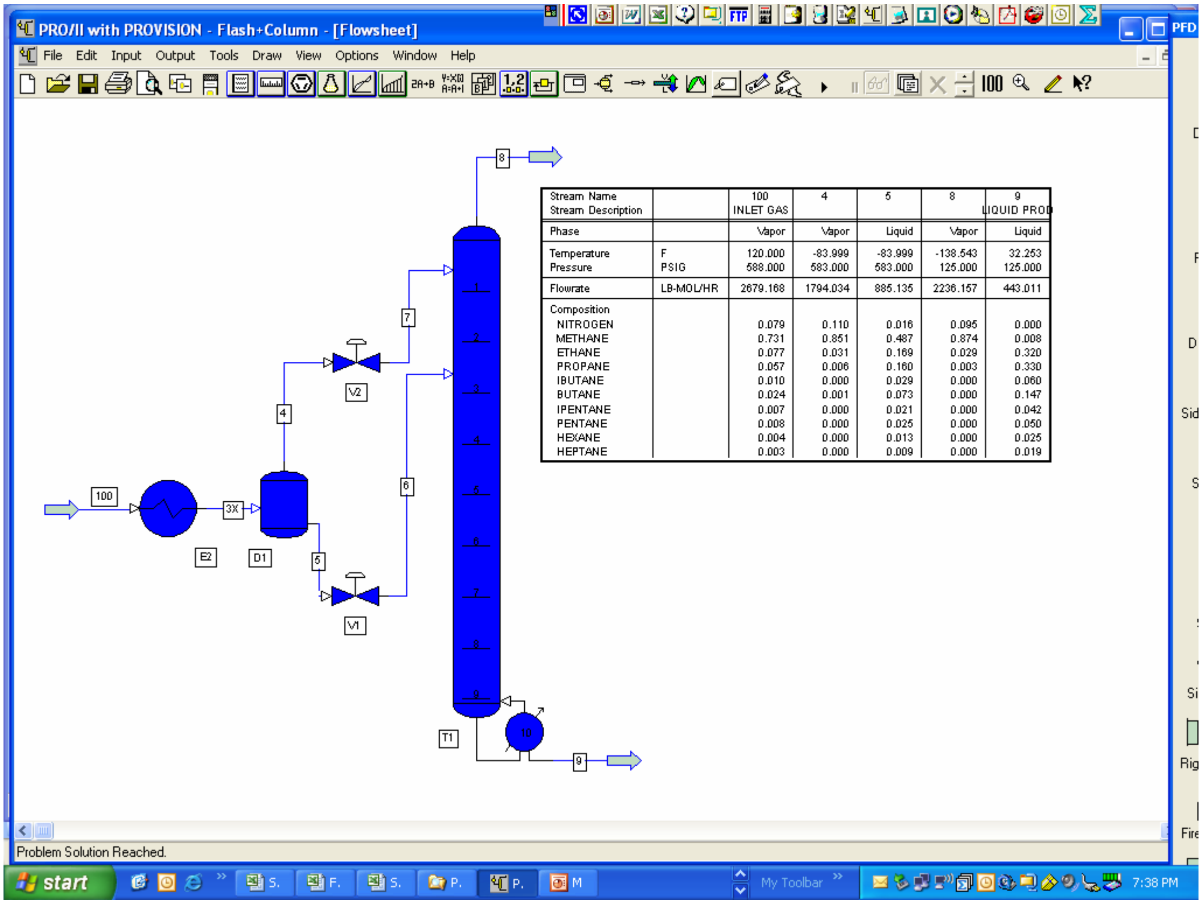
We consider now a method to remove ethane and heavier components from natural gas. We start with a stream of gas and we cool it down with the aim of separating as much methane as possible in a flash unit.



Stream Name / Stream Description		100 INLET GAS	4	5
Phase		Vapor	Vapor	Liquid
Temperature	F	120.000	-83.999	-83.999
Pressure	PSIG	588.000	583.000	583.000
Flowrate	LB-MOL/HR	2679.168	1794.034	885.135
Composition				
NITROGEN		0.079	0.110	0.016
METHANE		0.731	0.851	0.487
ETHANE		0.077	0.031	0.169
PROPANE		0.057	0.006	0.160
IBUTANE		0.010	0.000	0.029
BUTANE		0.024	0.001	0.073
IPENTANE		0.007	0.000	0.021
PENTANE		0.008	0.000	0.025
HEXANE		0.004	0.000	0.013
HEPTANE		0.003	0.000	0.009

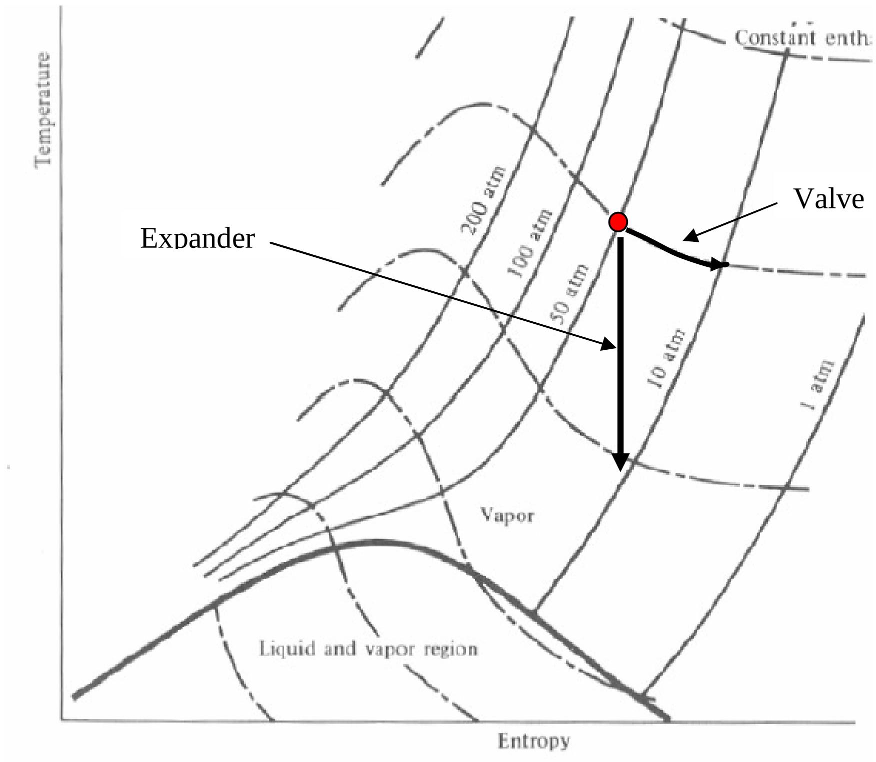
Stream Name / Stream Description / Phase		100 INLET GAS Vapor	4 Vapor	5 Liquid
Temperature	F	120.0000	-83.9990	-83.9990
Pressure	PSIG	588.0000	583.0001	583.0001
Enthalpy	MM BTU/HR	7.4020	-0.6463	-2.2034
Molecular Weight		22.5095	18.0271	31.5945
Mole Fraction Vapor		1.0000	1.0000	0.0000
Mole Fraction Liquid		0.0000	0.0000	1.0000
Rate	LB-MOL/HR	2679.168	1794.034	885.135
Fluid Rates	LB-MOL/HR			
NITROGEN		211.9222	198.0524	13.8698
METHANE		1957.1327	1526.5073	430.6252
ETHANE		205.7602	56.3299	149.4302
PROPANE		152.4447	11.2159	141.2288
IBUTANE		26.5238	0.6626	25.8612
BUTANE		65.3717	1.0679	64.3038
IPENTANE		18.4863	0.0926	18.3936
PENTANE		21.9692	0.0940	21.8752
HEXANE		11.2525	0.0095	11.2430
HEPTANE		8.3054	0.0018	8.3037

We notice that the liquids contain some methane so, we realize that a distillation column might be needed. However, we do not have a refrigerant to provide a reflux of methane. Therefore, we use a column without a condenser. To aid in the separation, we reduce the pressure in the column.

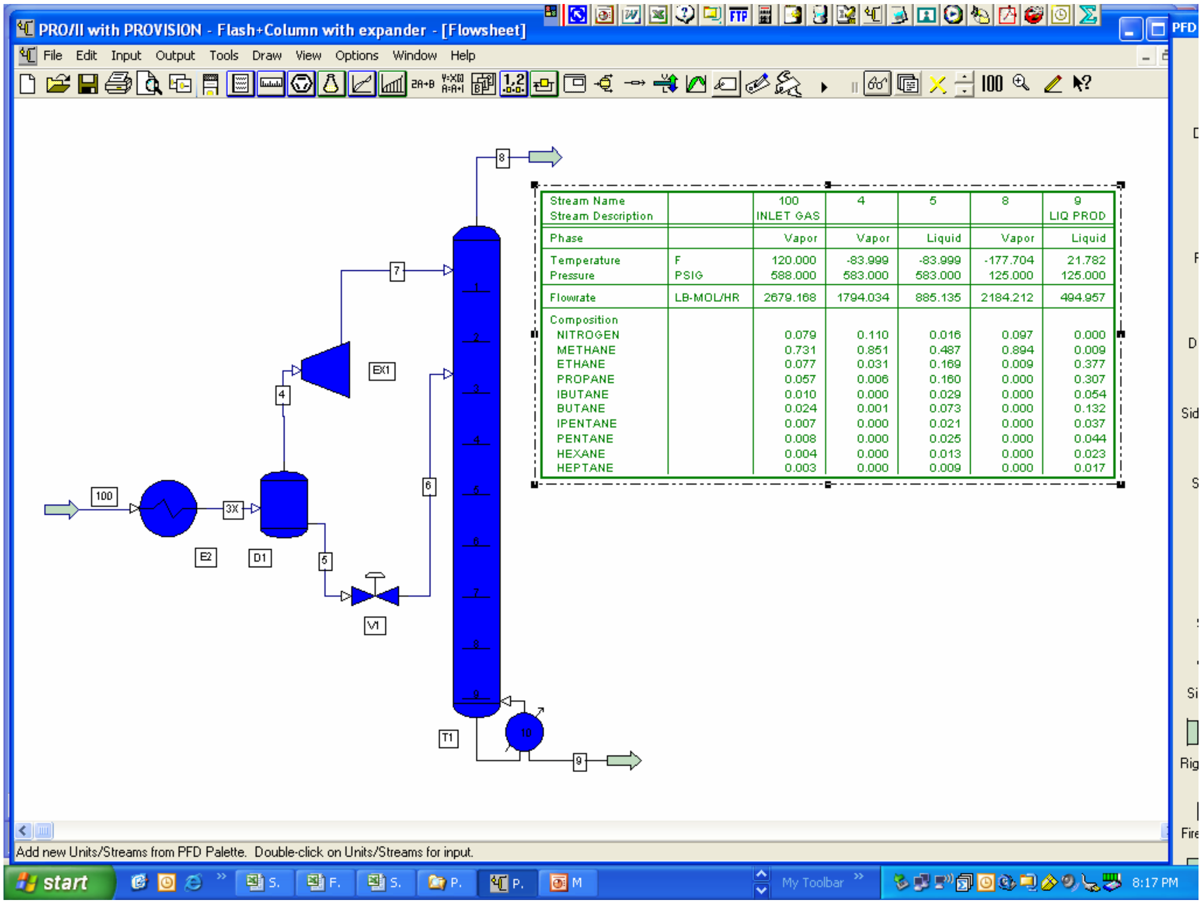


EXERCISE 4-9: Review the column choices and the temperature before the flash. Determine the effect of these variables in the separation.

We notice, however, that the vapor could be actually expanded recovering some work and reducing the temperature. We compare these evolutions using a generic TS diagram. Consider an expansion through a valve (constant enthalpy line; this can be derived from basic thermodynamic laws) and an expansion (isentropic). The final temperature of the latter is always smaller than the one of the former.

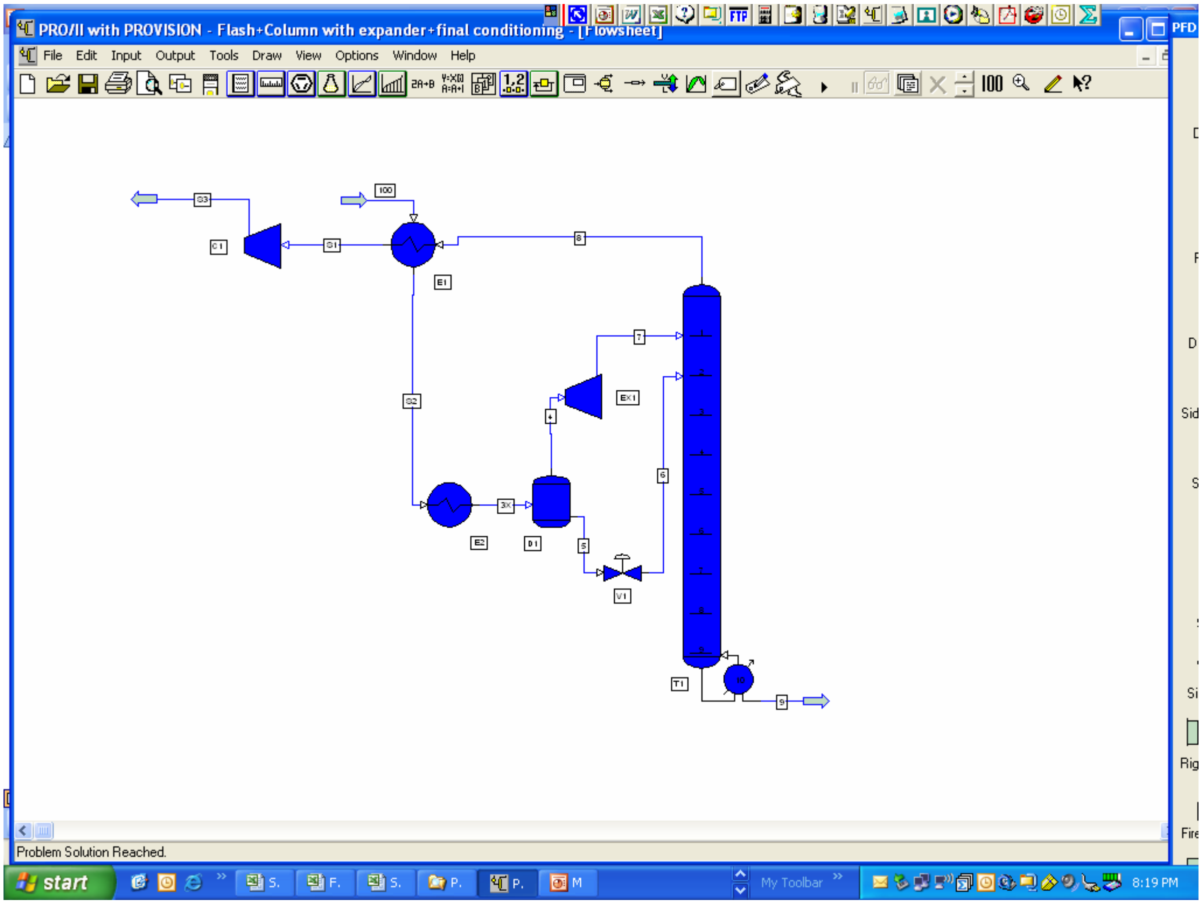


We therefore change the valve for an expander.

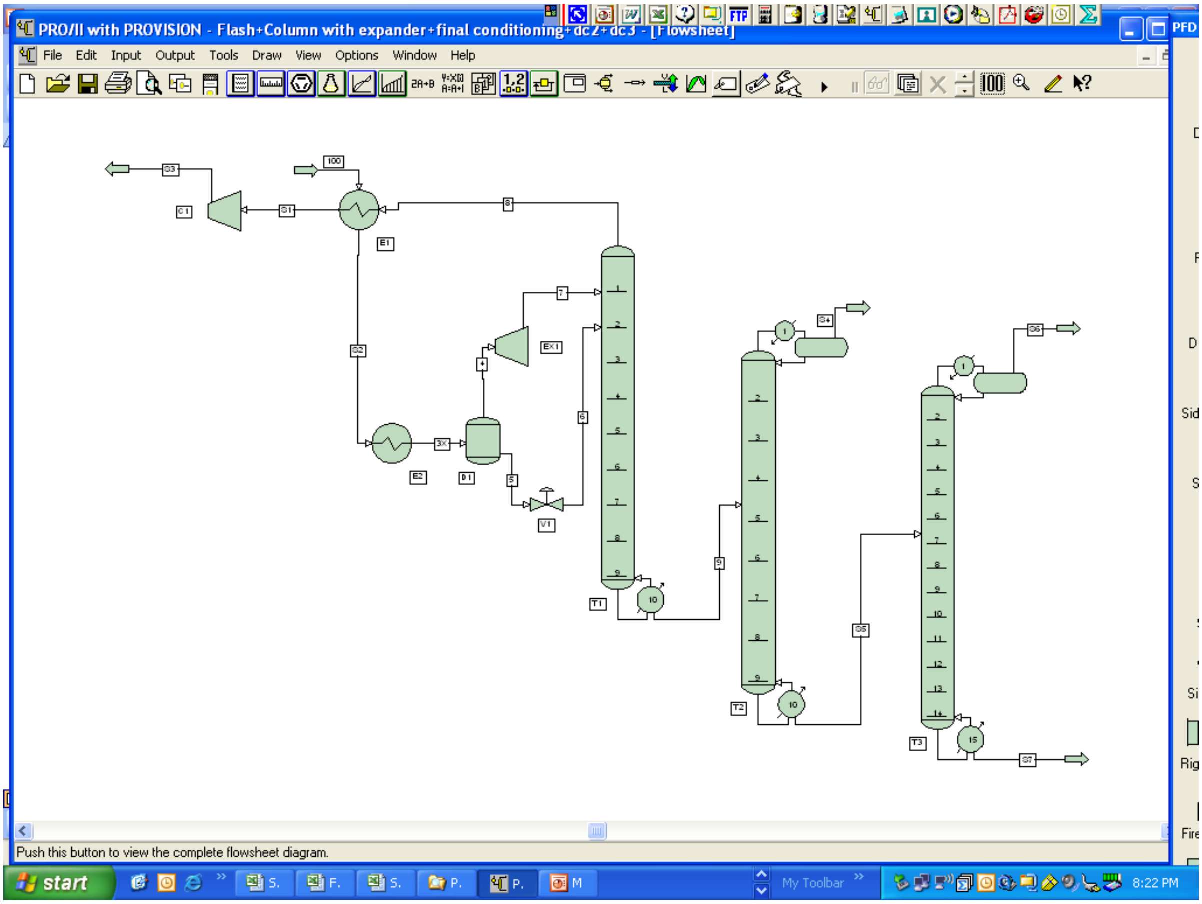


EXERCISE 4-10: Review the column choices and the temperature before the flash. Compare with the column in exercise 4-9. Determine the effect of these variables in the separation.

We now add some conditioning (heat exchange and recompression).

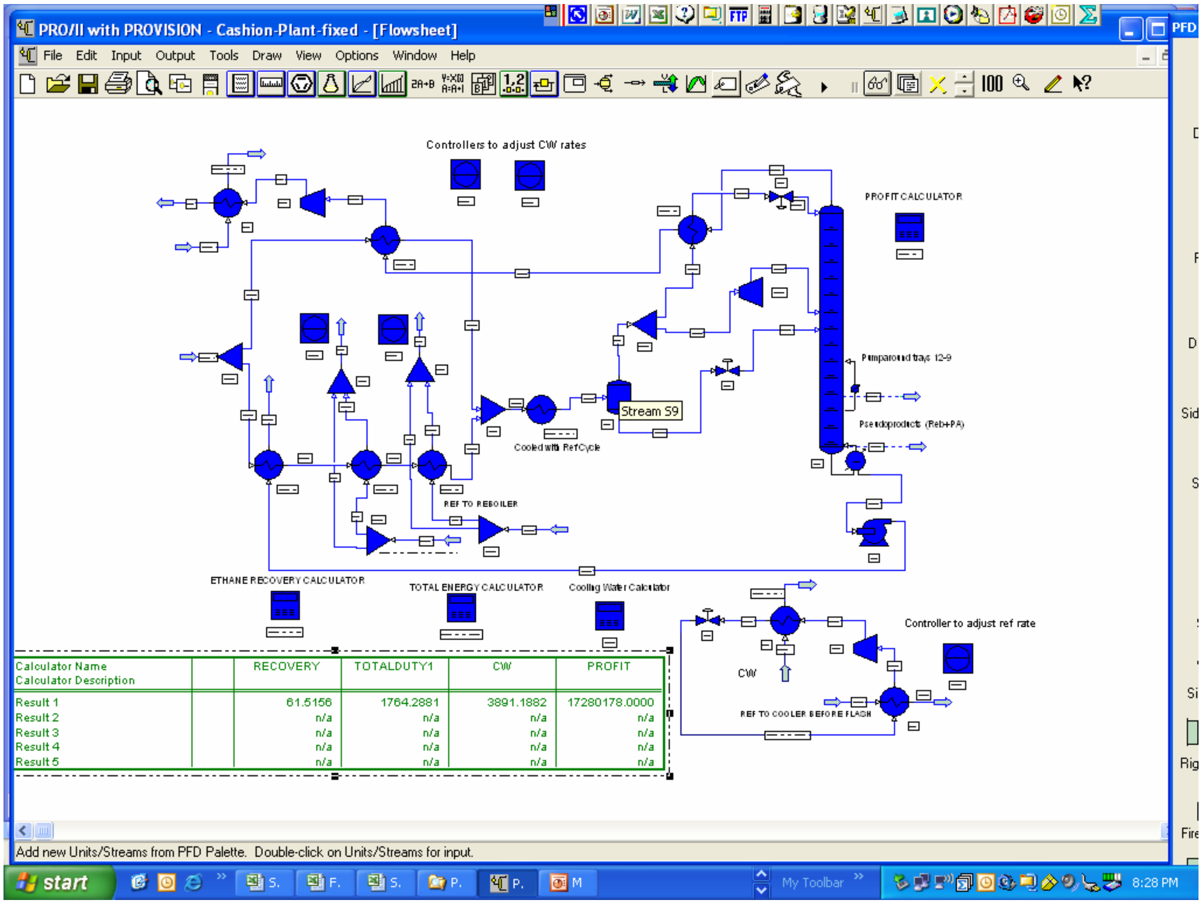


We now add a deethanizer and a depropanizer



EXERCISE 4-11: Set up the simulation with a recovery of liquids as explained. Compare the possibility of recovering propane + butane instead of only propane.

We finally take a look at the flowsheet of a real plant. The instructor will show you the different features of this simulation and the related optimization.



EXERCISE 4-12: Take a simulation result and design a heat exchanger network using the tools learned previously.