

Non Regression tests of ESPSS with EcosimPro 4.4 and EcosimPro 5.0.

Reference [R1]: TN-2110K "Industrial Evaluation of ESPSS v1 on Space Propulsion Systems" Eai-Kci-Me-01 IndustrialEvaluation02_c, 16/12/2008

1 Conclusions

The results of the Priming cases performed with ESPSS 1.0 (and the corresponding PROP_TABLE dated March 2008) in [R1] can be reproduced without any regression using EcosimPro 5.0.

However, this short note shows that using ESPSS 2.6, one can have higher (in perfect fluid) or much higher peak pressure than the one reported in [R1].

- For similar cases of priming as the one of the experiment Cnes-Onera, the use of **perfect** propellant seems to work better than the real fluids because it provides always slightly higher or higher maximum pressure, but not so high as it can do with real fluid.
- The use of real propellant (MMH in particular) may induce almost peaks 50% higher than the observed one.
- It should be recommended for the users to use the perfect fluid.
- Note: In the simulation one shall not use the value of the pressure given by the port (f.P) because that pressure includes the artificial viscosity. Instead one shall use P1 or Pn (total pressure of the last node)

Peak pressure Pn (bar)	Water		MMH		comments
	Perfect	REAL	Perfect	REAL	
Experiment Cnes/Onera [R1]	289	289	257	257	
Simulation [R1]	329	333	265	NA	Perfect is higher but nearer
Check ESPSS1 with Eco5.0	329	333	265	NA	Identical to [R1]
Check with ESPSS 2.6 Eco5.0	364	373	286	387	Perfect is higher but nearer
Check with ESPSS 2.6 Eco5.0 with thermo_table_interp_win32_vc6 of ESPSS2.6 but PropTable of ESPSS 1.	365	373	286	317 (spike at 344, spike for f.P at 408 bar)	About no changes except for real MMH

2 Use of previous release of ESPSS into EcosimPro 5.0

It is still possible to run experiments made under previous ESPSS release on the last EcosimPro 5.0. In order to get success,

- Before opening EcosimPro, the environment variable PROP_TABLES shall be defined with the location of the wanted directory
- Also and thermo_table_interp.lib shall be renamed as thermo_table_interp_win32_vc6.lib

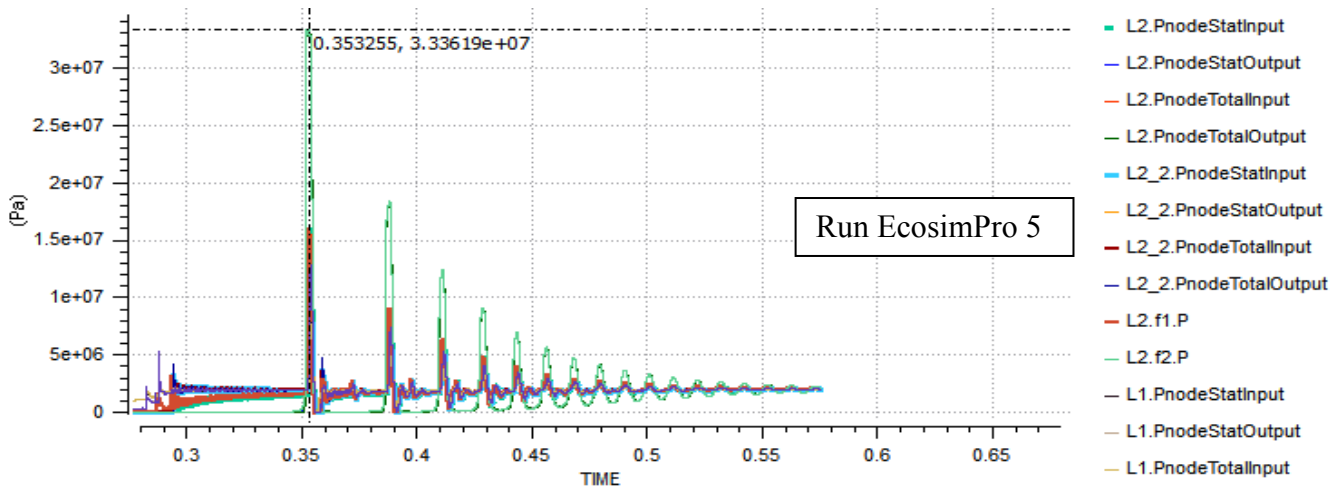
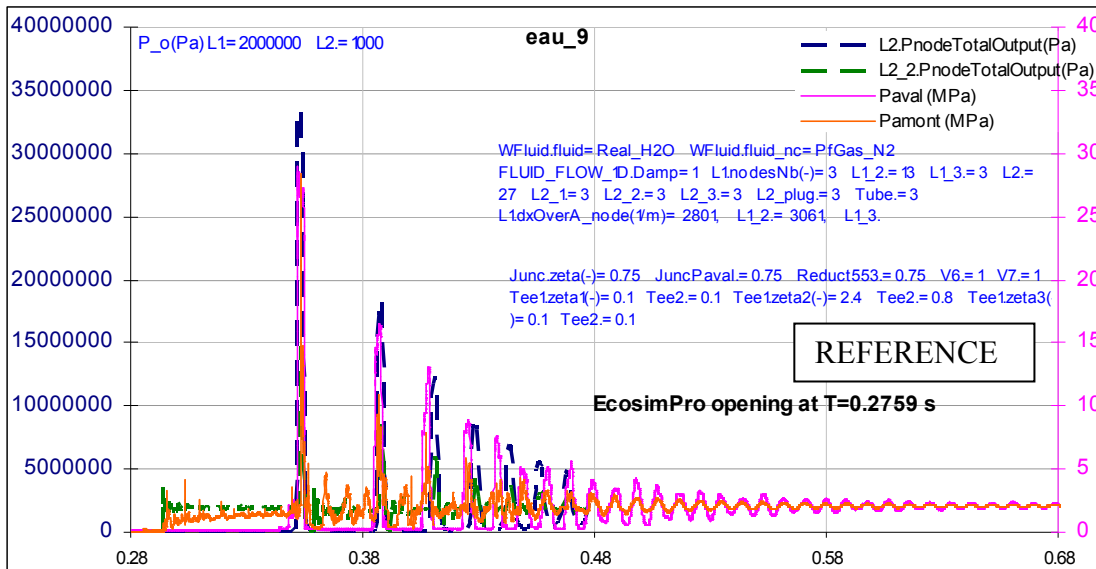
From the TN [R1] one have the following ref. cases:

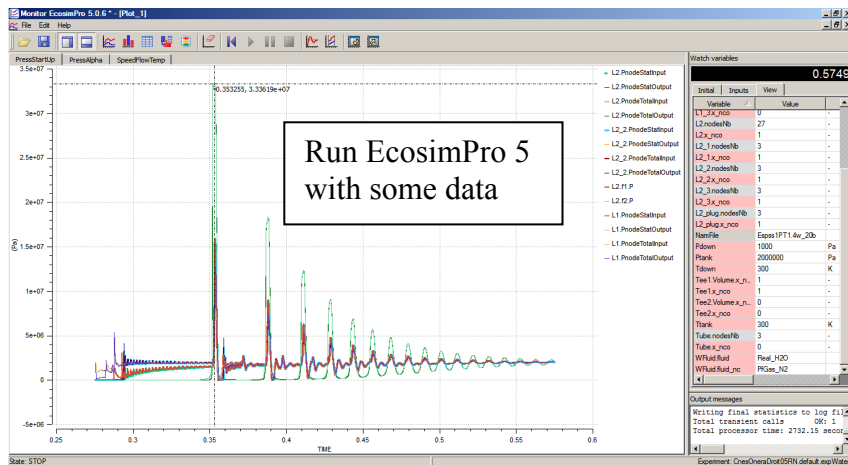
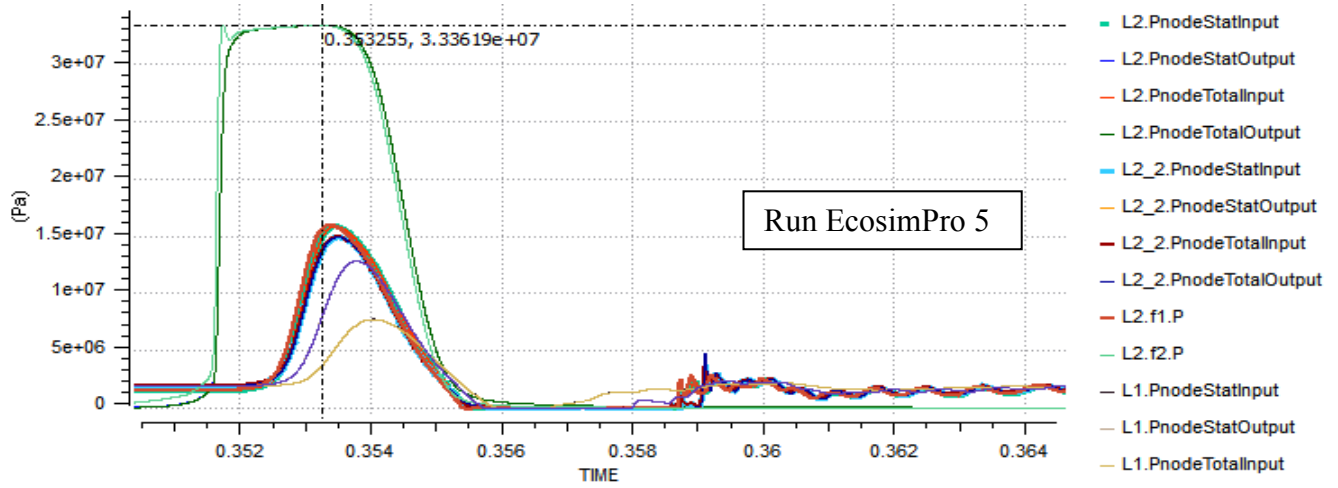
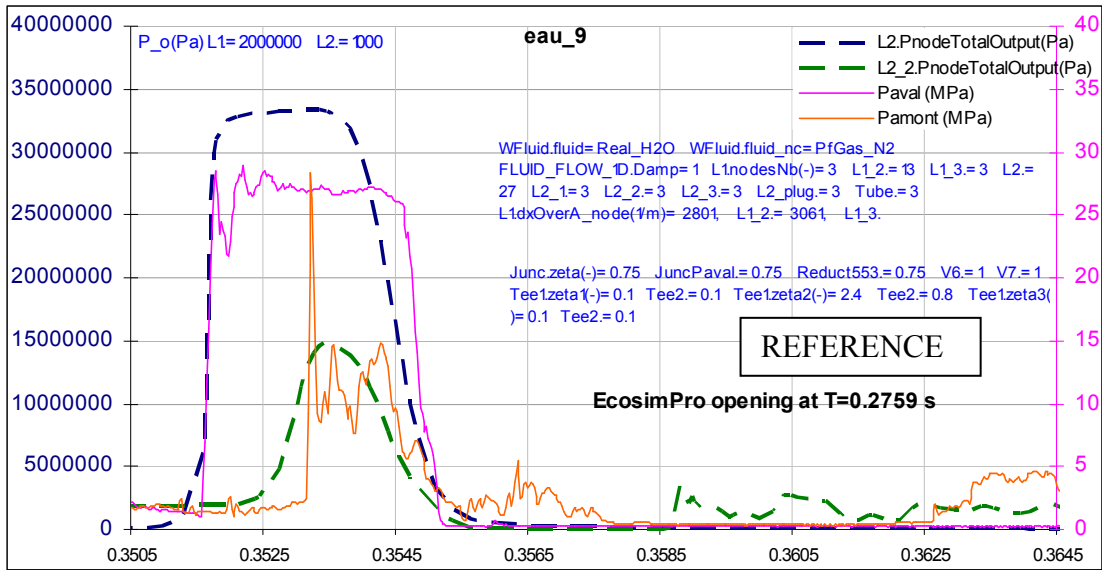
2.1 Case Reference 1: Real water, tank pressure 20 bar and 1000 Pa in the line

Case CnesOneraDroit05.default with the exp expWater

Run in EcosimPro 5.0 of the case CnesOneraDroit05.default renamed

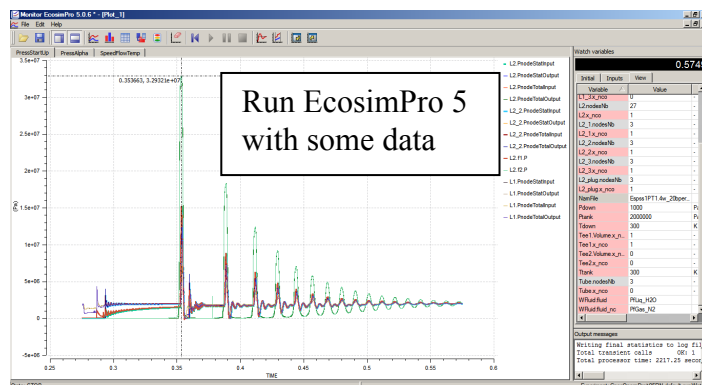
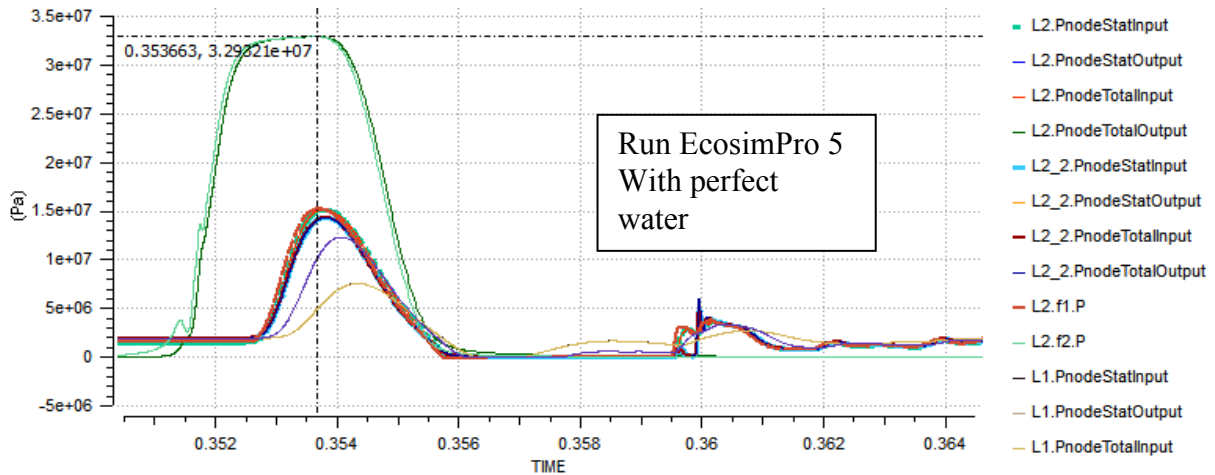
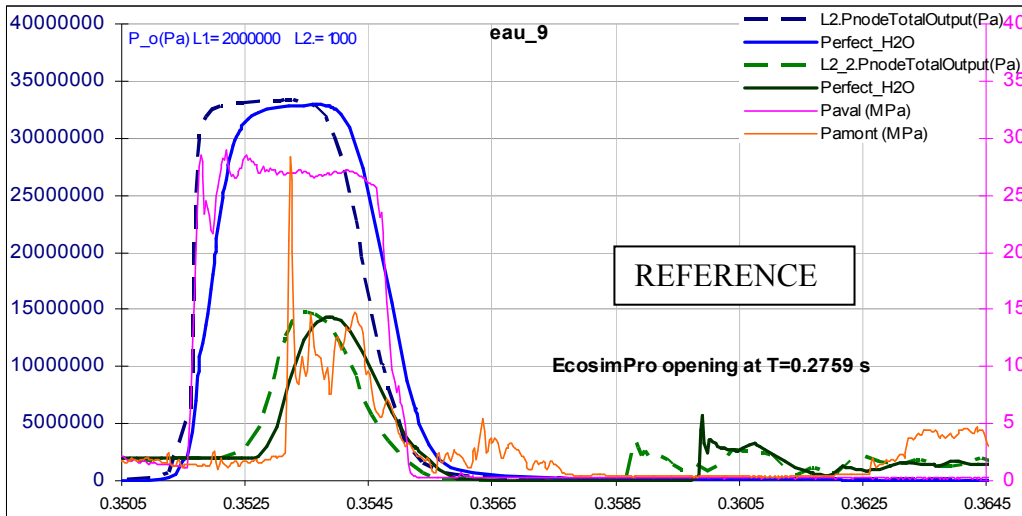
CnesOneraDroit05RN, with the exp expWater renamed expWater1 (with a shift in time by + 0.2759 for comparison with the data of the tests)





Conclusion: for this case reference 1, the simulation results are almost identical.

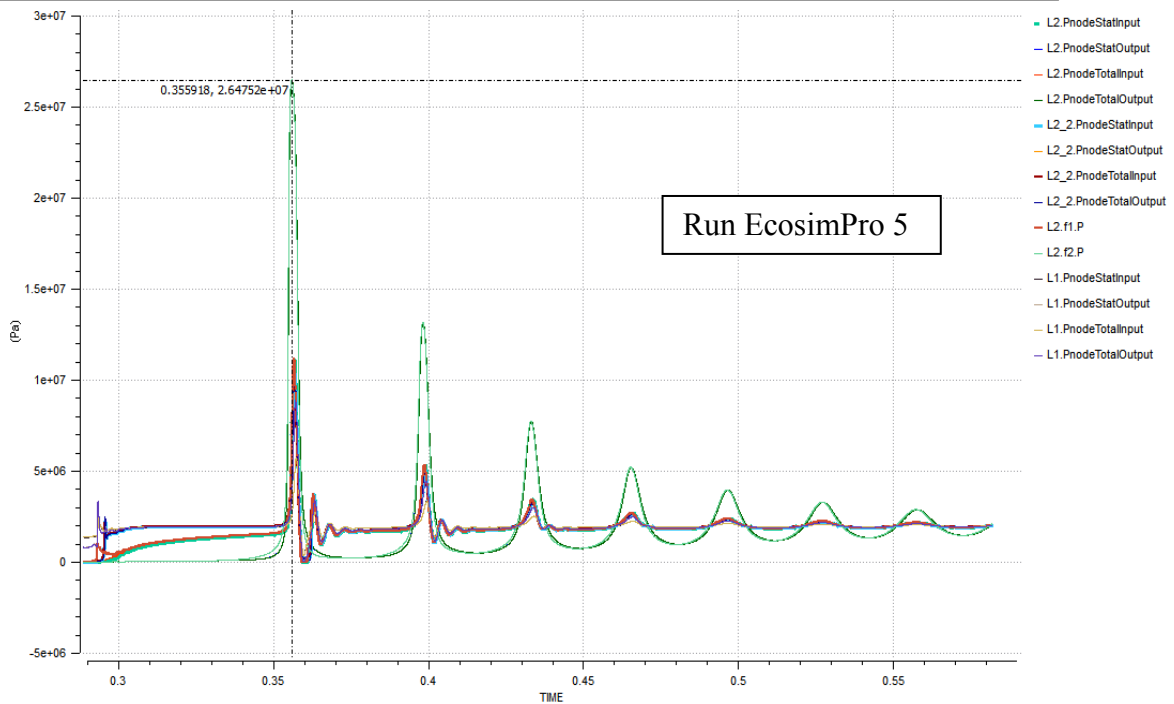
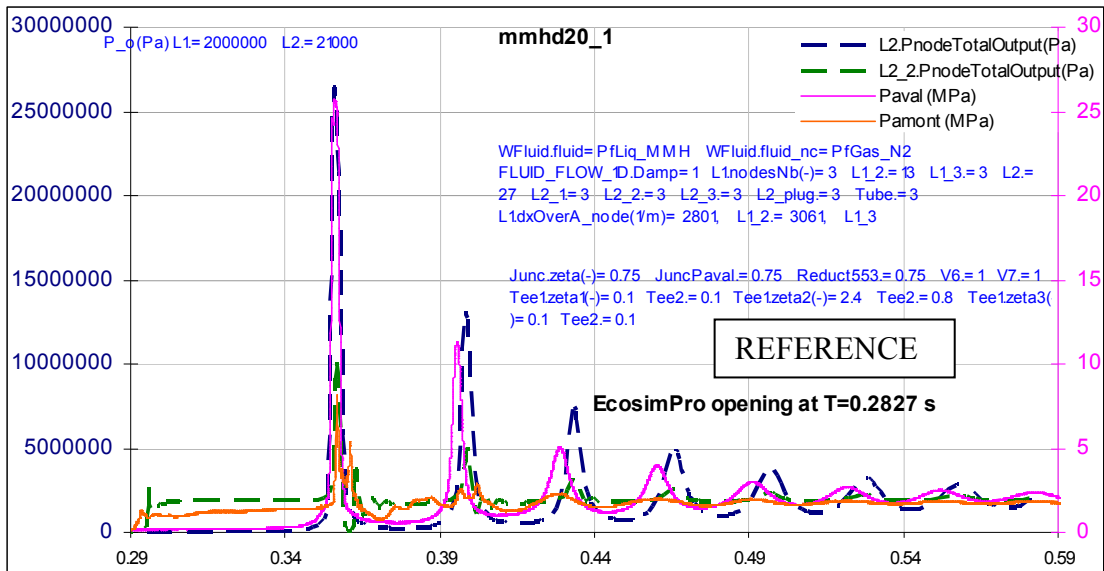
2.2 Case Reference 2: Real and perfect water, tank pressure 20 bar and 1000 Pa in the line



Conclusion: for this case reference 2, the simulation results are almost identical.

2.3 Case Reference 3: Perfect MMH, tank pressure 20 bar and 21000 Pa in the line

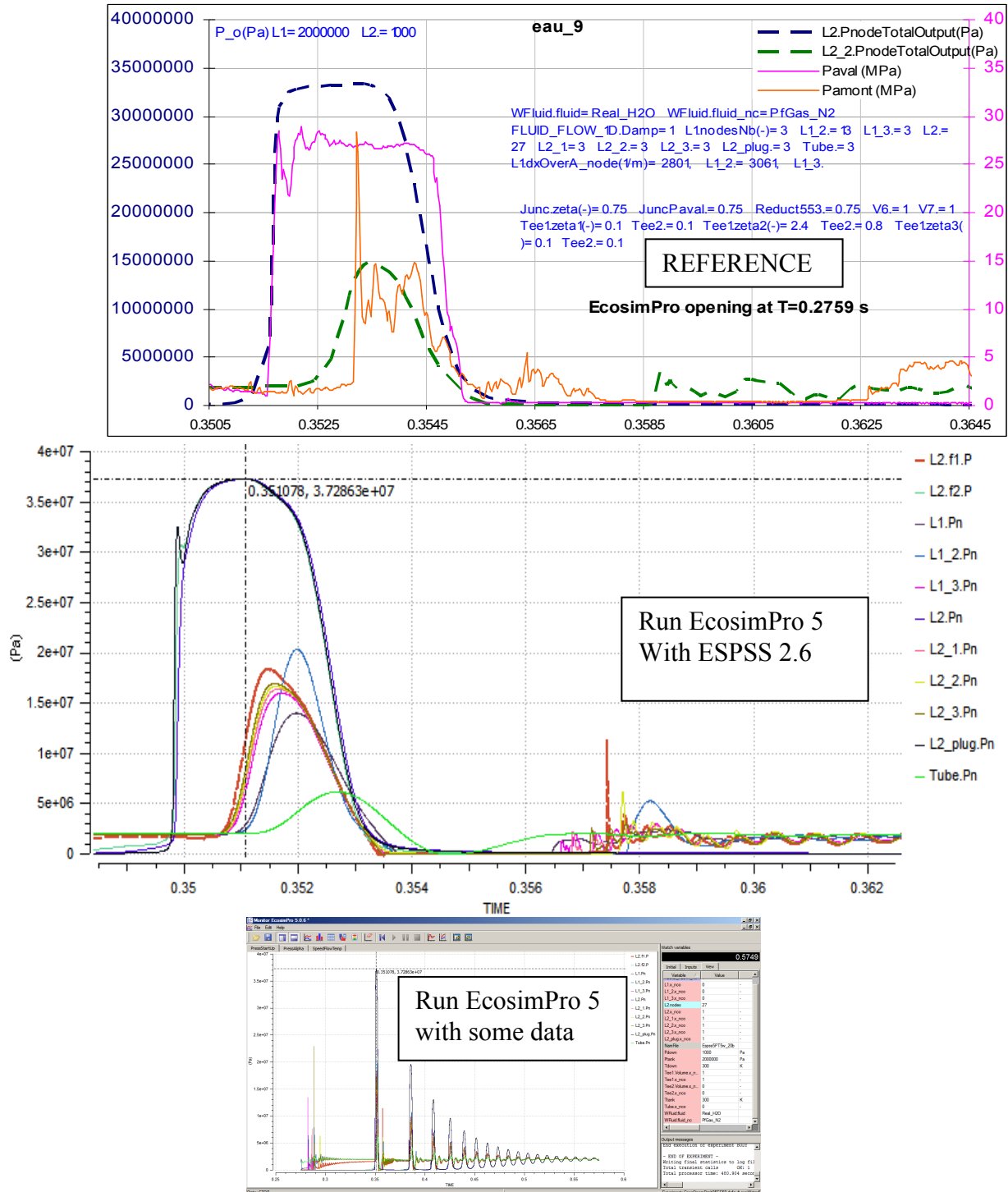
Run in EcosimPro 5.0 of the case CnesOneraDroit05.default renamed CnesOneraDroit05RN, with the exp expMMH renamed expMMH1 (with a shift in time by + 0.2827 for comparison with the data of the tests)



3 REGRESSION ESPSS 1.0 to ESPSS 2.6 for priming

The same case as in chapter 2 are assessed

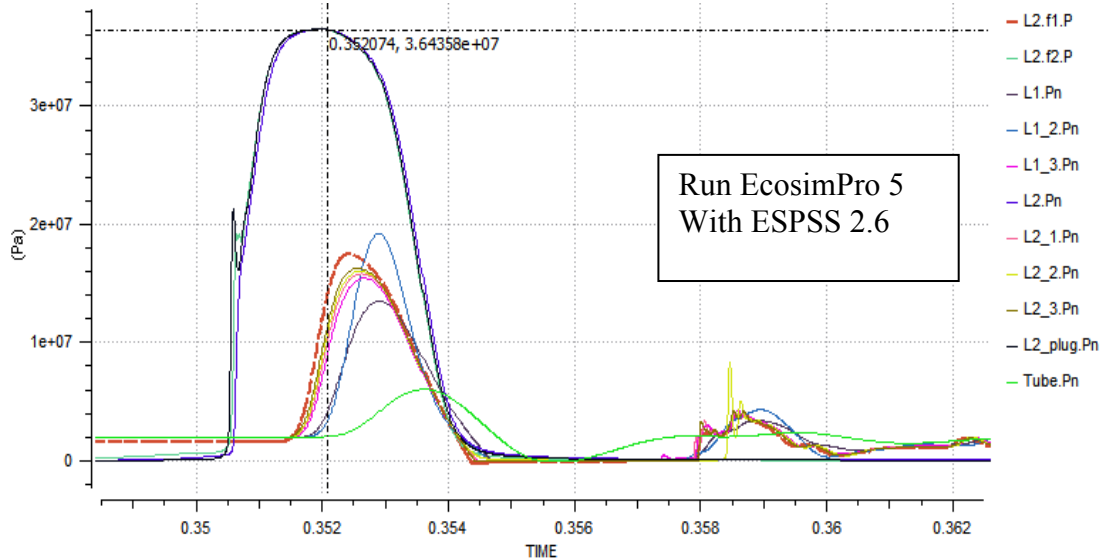
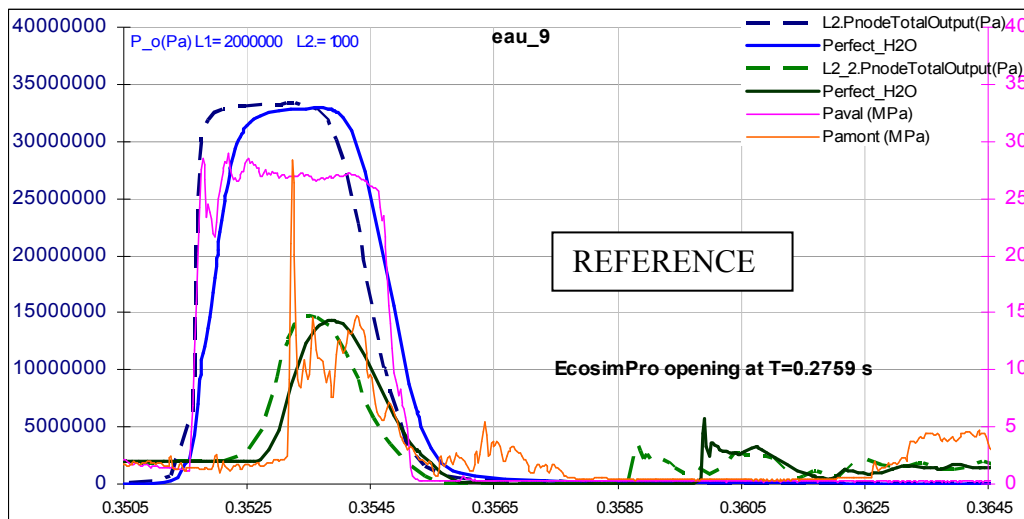
3.1 REGRESSION ESPSS 1.0 to ESPSS 2.6 with real water



The major differences in real water are:

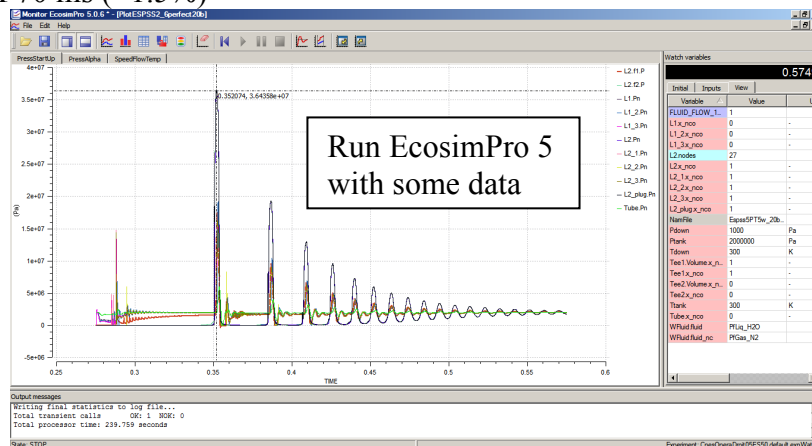
- Increase of the peak from 333 bar to 373 bar, so increase of 11% (while the peak in the experimental data CNES ONERA was already lower about 289 bar): reason unknown?
- Shift in the time by 1.7 ms in advance: that is not a big change for a priming duration of the order of 70 ms (<2.5%)

3.2 REGRESSION ESPSS 1.0 to ESPSS 2.6 with perfect water

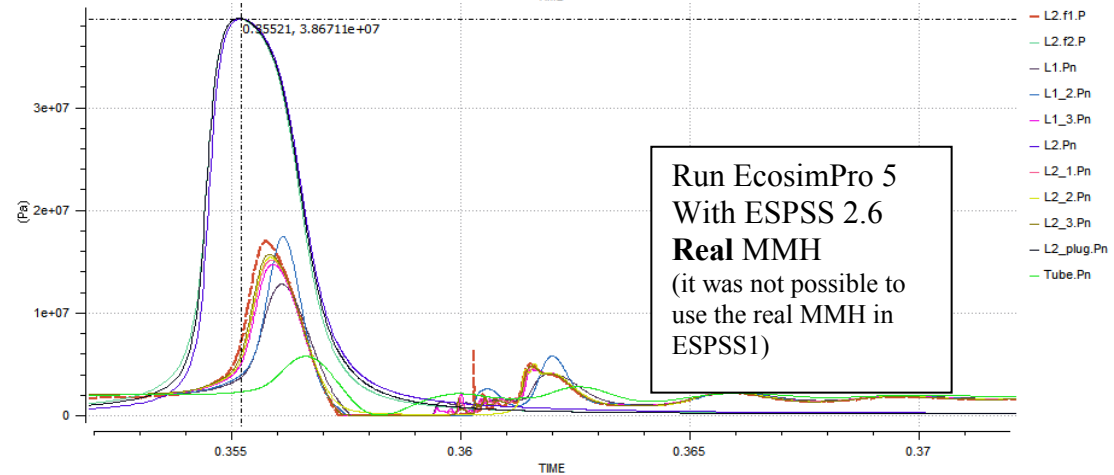
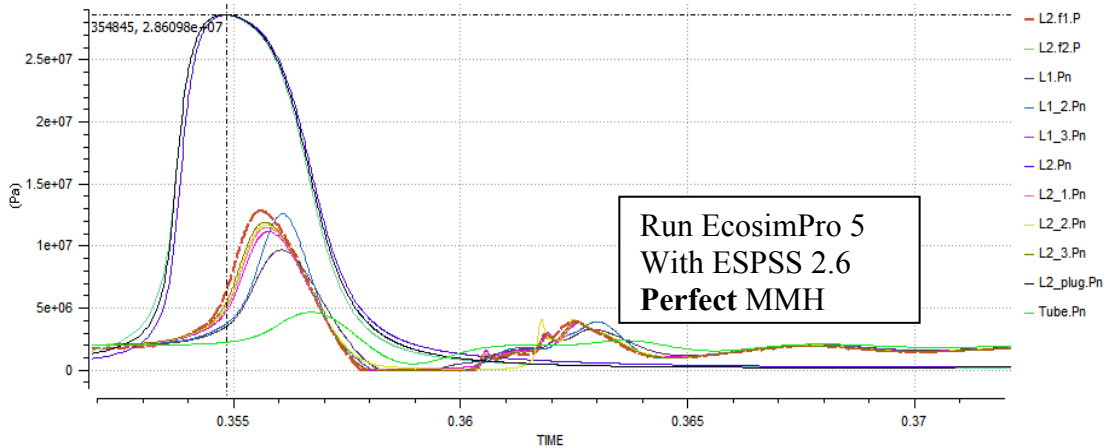
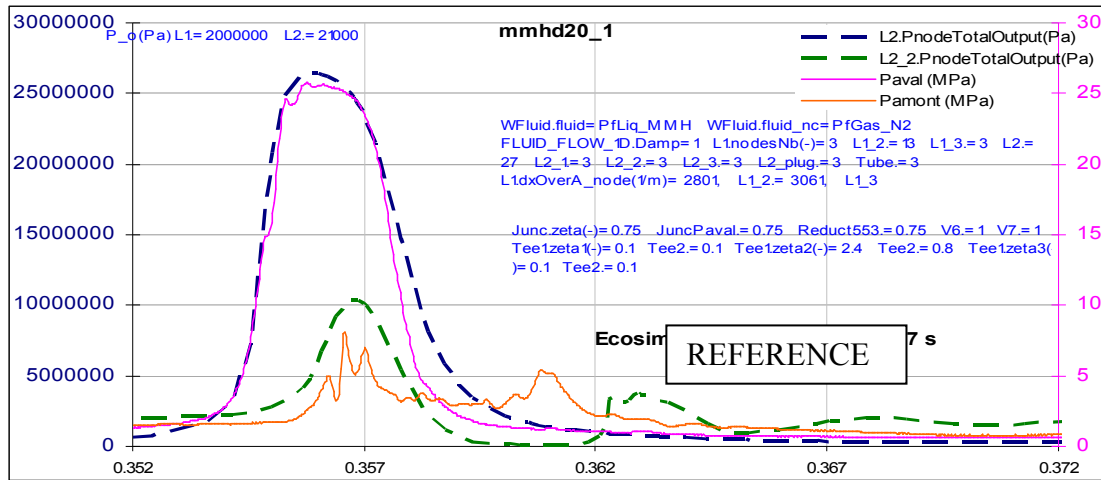


The major differences in perfect water are:

- Increase of the peak from 329 bar to 364 bar, so increase of 10% (while the peak in the experimental data CNES ONERA was lower at about 289 bar): reason unknown?
- Shift in the time by 1 ms in advance: that is not a big change for a priming duration of the order of 70 ms (<1.5%)



3.3 REGRESSION ESPSS 1.0 to ESPSS 2.6 with perfect and real MMH



- Increase of the peak from 265 bar to 286 bar in perfect gas but 387 bar in real MMH, so increase of 8% to +46% (the peak in the test CNES ONERA was at 257 bar): with real MMH the peak is thinner than in experimental data. Reason unknown.
- Shift in the time by less than 1 ms in advance for perfect MMH, no shift noticeable for real MMH.

