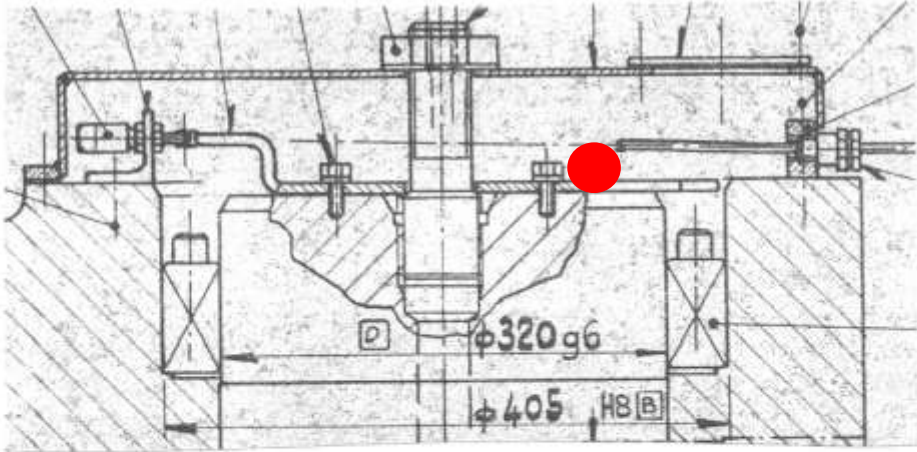
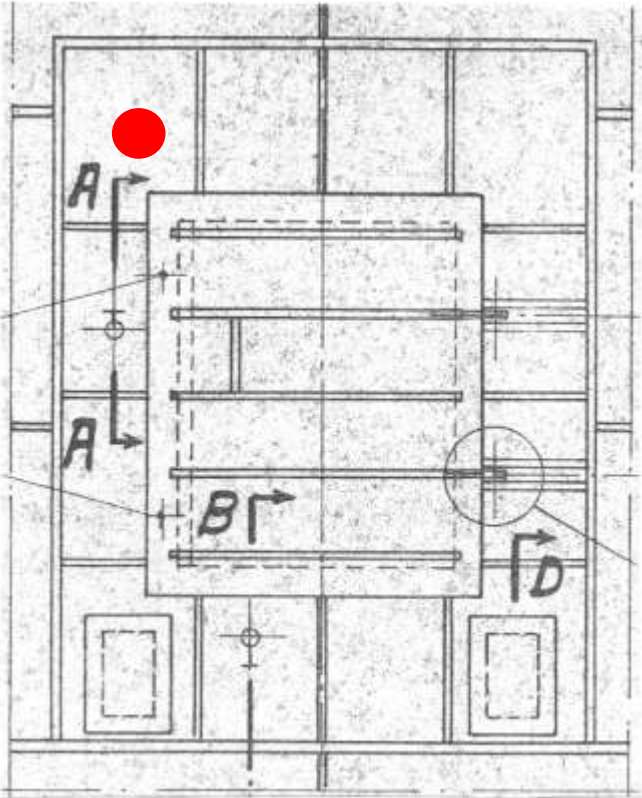
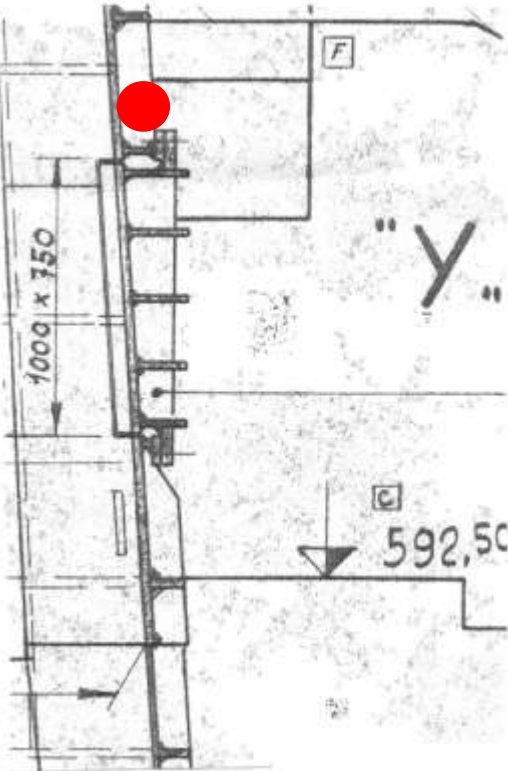


Korto Cavitation Services, Luxembourg
COPEL UHE Foz do Areia
Pilot cavitation test on Unit 2
October 2005
Illustrations



Sensor locations



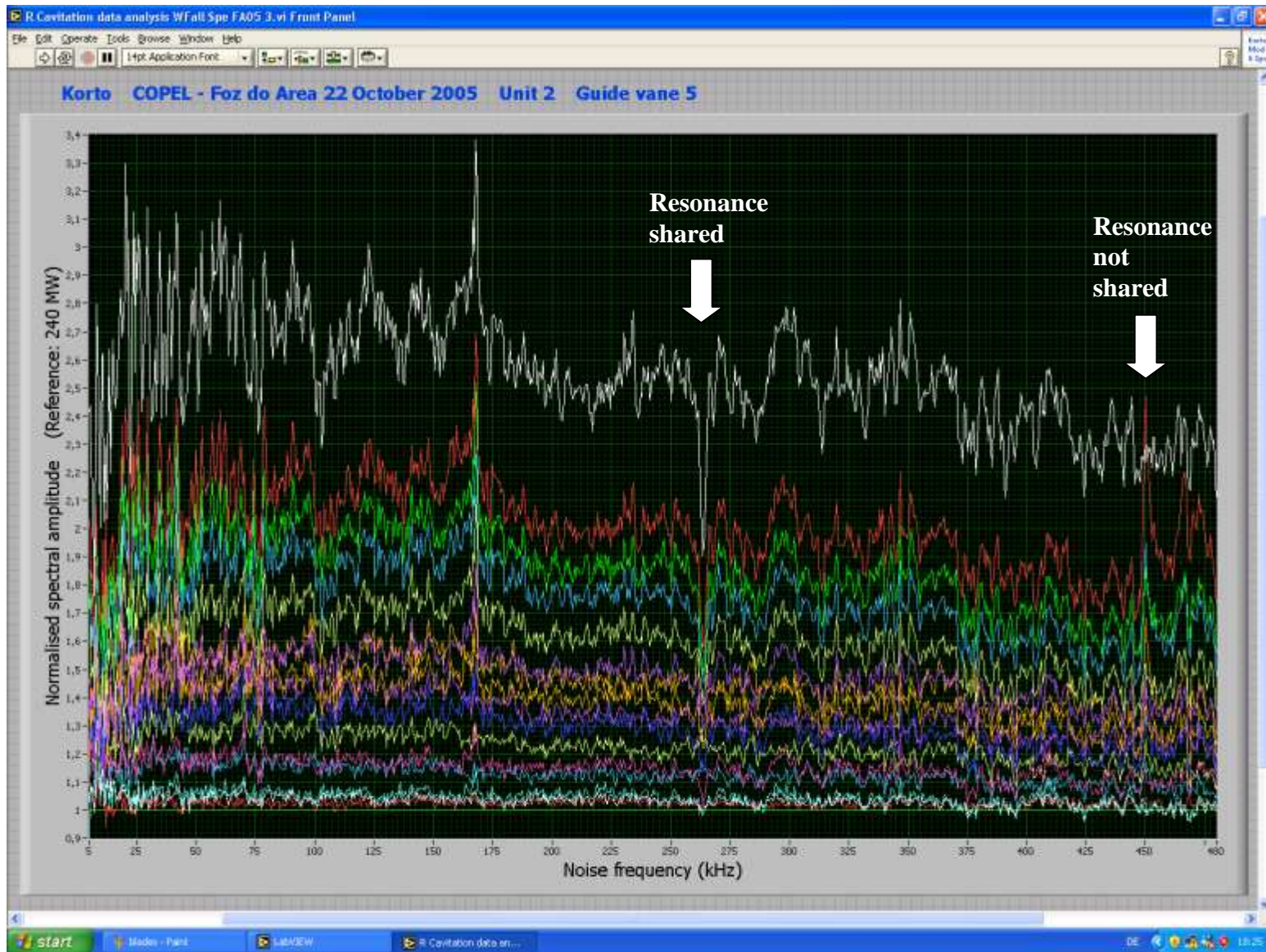


Illustration of the diagnostic procedure

Normalised cavitation noise spectra used for the identification of cavitation mechanisms

Different curves – different power settings

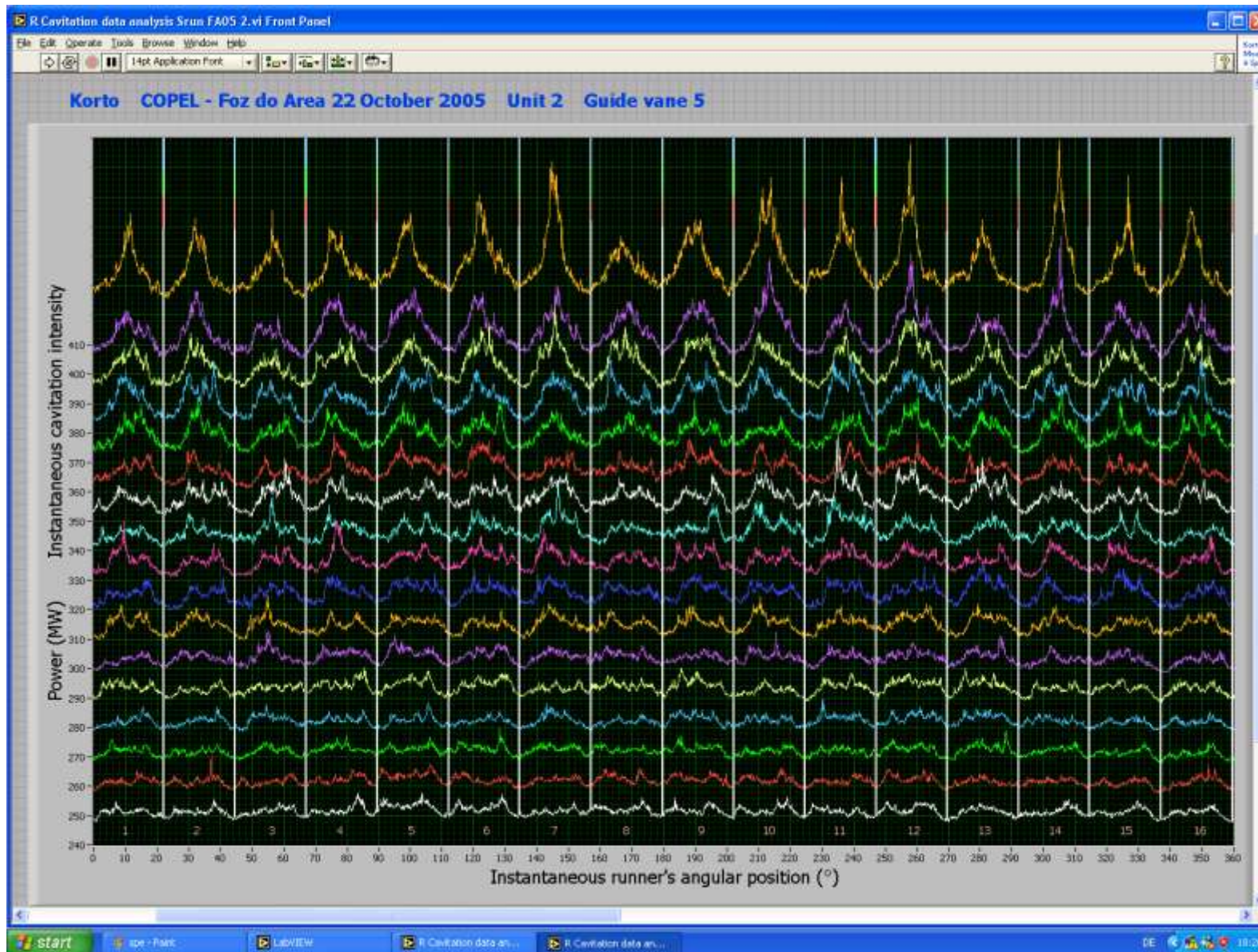


Illustration of the diagnostic procedure

Cavitation modulation curves used to identify contribution of different runner blades

Different curves – different power settings

In a full diagnostic test, such data is collected for all the guide vanes. That yields a full quantitative description of the role in cavitation played by each runner blade and each guide vane.

Also, in a plant with strongly variable head and tail water levels, a series of tests covering the power interval needed is made on several water-level settings.

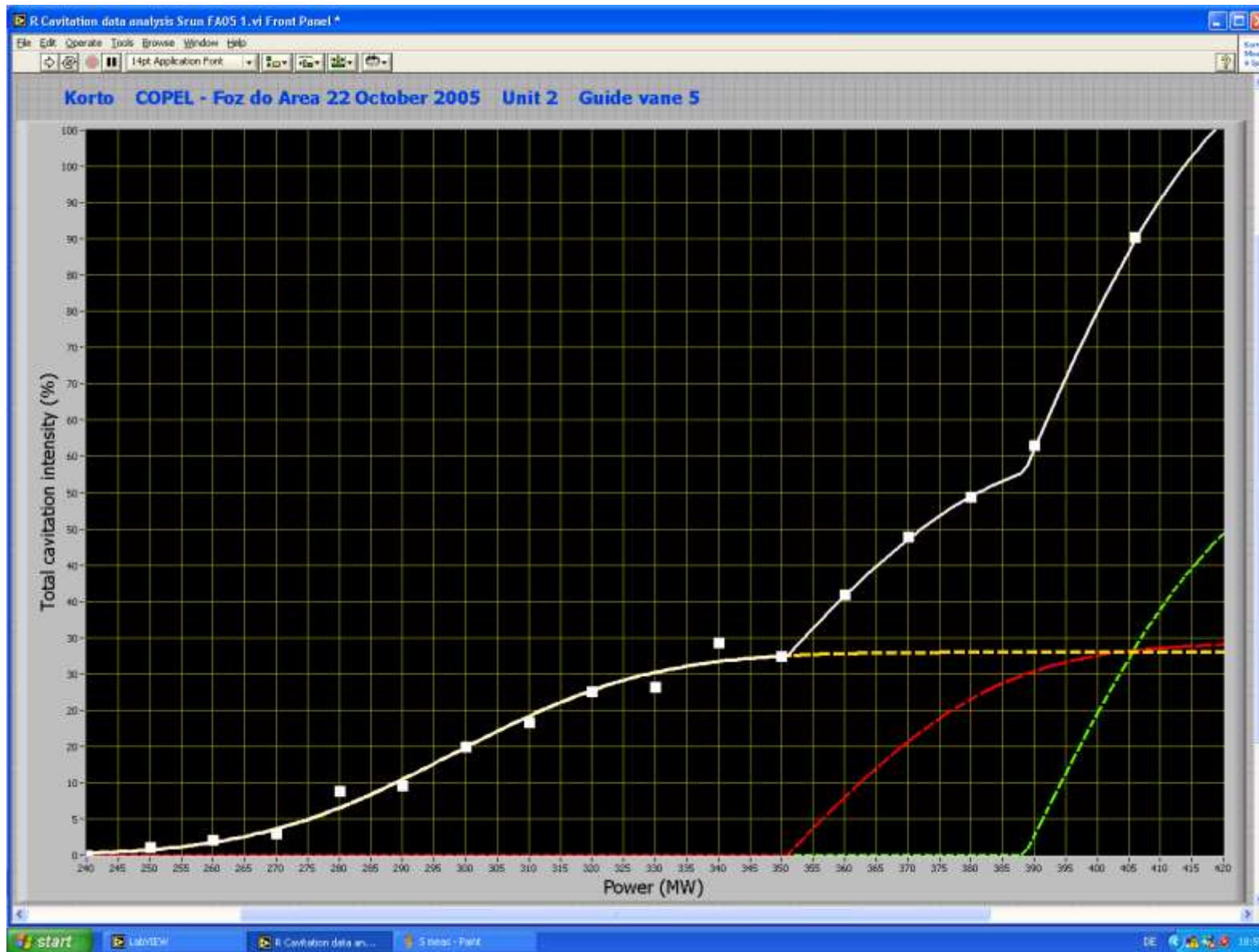


Illustration of one form of the final results of the test

Total cavitation intensity as a function of the turbine power (for one water-level combination)

Dots – Measured values

Curves:

White – All cavitation mechanisms

Coloured – Three cavitation mechanisms found in this turbine

When measurements are made on all sensor locations and all operation conditions needed, such results become quantitative and can be used for:

- Explaining the cause of cavitation and curing it
- Operation optimisation
- Optimisation of the maintenance schedule

Optimal plan of power settings for the full cavitation test

Keeping constant the total power delivered by the plant, both head and tail water levels are kept approximately constant while the needed range of power settings of the tested unit is covered.

Unit undergoing testing	Second unit	Remaining units		Plant total
		First	Second	
245	415	415	415	1490
255	405	415	415	1490
265	395	415	415	1490
275	385	415	415	1490
285	375	415	415	1490
295	365	415	415	1490
305	355	415	415	1490
315	345	415	415	1490
325	335	415	415	1490
335	325	415	415	1490
340	320	415	415	1490
345	315	415	415	1490
350	310	415	415	1490
355	305	415	415	1490
360	300	415	415	1490
365	295	415	415	1490
370	290	415	415	1490
375	285	415	415	1490
380	280	415	415	1490
385	275	415	415	1490
390	270	415	415	1490
395	265	415	415	1490
400	260	415	415	1490
405	255	415	415	1490
410	250	415	415	1490
415	245	415	415	1490