January, 24th, 1997

VIR-REP-LAP-3300-110

Report : Historic of the cleanness of the lower tower prototype. December 1994- January 1997

Authors : The LAPP tower group

Abstract: The lower tower prototype has been operated over 2 years at LAPP. The tower pumping system, the clean air supply, the tower baking were tested as real size prototypes. A mirror introduction scenario has been implemented. Many parts were added or dismounted and replaced. During all these tests we were permanently concerned with the vacuum and dust cleanness of the tower vacuum chamber. We report here the results of the residual gaz analysis and of the dust particle countings performed over the test period. Dust pollutions were measured online with particle counters or integrated on properly exposed Si wafers or mirror samples.

1.Reception tests

November 1994 : A first residual gaz analysis was performed on the SDMS site
December, 1994 : The lower tower prototype arrived at LAPP

Below we report the residual gaz analyser readings in currents for Hydrogen compared to elements 43 and 55 which are charateristic some hydrocarbon contamnent..

date	RGA	lieu	I2	I43	I55	I43/I2	I55/I2
14/11/94	emult off	SDMS	210^{-10}	810^{-11}	510^{-11}	.4	.25
8/12	emult off	LAPP	810^{-12}	1.310^{-11}	910^{-13}	.16	.11

RGA spectrum after its baking.
The result is not very satisfactory as the RGA baking was only partial.

date	RGA	Time	I2	I43	I55	I43/I2	I55/I2
9/12/94	emult off	10 :43	710^{-11}	910^{-12}	210^{-13}	.13	.003
	emult on	*11 :37*	910^{-10}	1.10^{-11}	310^{-12}	*.11*	*.003*

March, 1995 : Reception of the tower clean air flow,
Particle counters, pumping system control command
Installation of valve V71, vacuum instrumentation unit,
Air feeding pipe and tank wet cleaning.

date	RGA	Time	I2	I43	I55	I43/I2	I55/I2
14/03/95	emult off		510^{-11}	910^{-12}	$<10^{-13}$	.18	<.01
22/03	emult off	19 :00	310^{-11}	610^{-12}	1.510^{-12}	.20	.05

2. Pumping system, control command and baking tests

April 3, 1995 : Installation of CETEC valves on the measuring bottles.
April 20 to 27 : First baking at 150C: probably only partial as Hydrocarbon pollution is still present

date	RGA	time	I2	I43	I55	I43/I2	I55/I2
27/04/95	e.off 40ºC	8 :35	$4\,10^{-11}$	$7\,10^{-13}$	$3.5\,10^{-13}$	.017	.009

VAT valves replace CETEC valves.
Measuring bottle baked again.
Macrotorr pump cleaned
May 12 to 22 1995 : New thorough baking.
Most of the regions of interest are now baked.

date	RGA	time	I2	I43	I55	I4/I2	I55/I2
23/05	e.on 25ºC	9 :16	$4\,10^{-9}$	$6.8\,10^{-12}$	$9.9\,10^{-13}$	.002	.0002

Vacuum cleanness is within specifications
Oven within specifications

3. Optics introduction scenario

March 1995 : Reception of the class 100 clean room.
June-July : Optics introductions. Many roughings and ventings .

Dust cleanness is within specifications

4. Permanent pumping system tests

August 17 to : Third baking at 150 ºC,
September : First test of the permanent pumping.
Report: Tower 95-4

date	RGA	time	I2	I43	I55	I43/I2	I55/I2
16/08/95	31ºC		$4.5\,10^{-10}$	$2.9\,10^{-13}$	$1.2\,10^{-13}$	.0006	.00026
25/08	185ºC		$2.3\,10^{-9}$	$4\,10^{-12}$	$5\,10^{-13}$	.0018	.0002
30/08	25ºC		$1.6\,10^{-9}$	$2.7\,10^{-13}$	$<10^{-13}$	few10^{-4}	10^{-4}

End of the lower tower and pumping system reception.

Permanent pumping almost in specifications

5. Reception tests for the separating roof and of the permanent pumping

November 9, 1995 : Cupola send back to SDMS
Installation of the separating roof. Tests, leaks on bellows.
Installation of new windows

February, march 1996 : conductance tesst.

Final pumping system on upper and lower compartments

Separating roof in place

There is a hydrocarbon pollution

date	RGA	Time	I2	I43	I55	I43/I2	I55/I2
/3/96	lower		8.10^{-8}	5.10^{-9}		.06	
9/04/96	upper		2.10^{-9}	9.10^{-11}	3.10^{-11}	.045	.015
7/5/96	lower		3.10^{-10}	4.10^{-12}	$< 10^{-14}$	.013	<.0001
22/5/96	upper		3.10^{-10}	1.10^{-12}	4.10^{-14}	.003	<.0001
	lower		1.10^{-9}	10^{-13}	10^{-13}	.0004	<.0001
11/7/96	lower		2.910^{-8}	$< 10^{-12}$	$< 10^{-12}$	<.0001	<.0001
23/1/9	lower		8.310^{-}	1.110^{-8}	1.210^{-9}	.13	.014

April 24 to may 2, 1996 : New baking, Stopped for problems with compressed air.
End of baking on may 7.
May 15 to 25 : New baking
Summer 96 : Long range test of permanent pumping with separating roof in place

Permanent pumping is within specifications

September 96 : Resume clean introductions with mirrors coated as VIRGO mirrors .

Tower dust cleanness is recovered after wet cleaning

October, november : Alignment tests
December 96 : removal of 2 lateral windows for modifications at SDMS

January 1997 : installation of the final lower cover and of the modified lateral windows.
: installation of new alignment windows.

There is again a hydrocarbon pollution

6. Conclusions.

- Baking has to be total and uniform, i.e all the parts of the vacuum chamber have to be heated at 150ºC

- If total, it has to be performed over a sufficient amount of time, i.e.more than two weeks.

- Dust or vacuum cleanness are easily recovered by wet washing and baking

- Any new piece of equipment requires a baking either in situ or before installation.