

FTU Machine Progress Report 2003

Summary of the machine operation

During 2003, the machine operated at the same high level (about 90% of successful pulses).

The experimental activity started at the end of February but due to vacuum problems the experimental campaign began in April. The problems were ice on a bottom window due to a failure of the heating system. The consequence was a venting of the vacuum chamber and of course a restart of the conditioning procedures.

After summer holidays, there was a one month experimental campaign to test successfully a prototype of the Lower Hybrid wave launcher presently considered for ITER: the Passive-Active Multijunction (PAM).

Regarding the control and data acquisition system we carried out the following activities:

1. Finishing and commissioning of three new serial Linux-based concentrators for the medium level control of FTU PLCs. This activity was carried out in cooperation with a scholarship holder;
2. Porting of the software feedback control from commercial LynxOS Operating System to open source Linux Real Time;
3. Design and prerelease of a standard data mining system on FTU data archive including our interface named "Quaderno di Bordo" (FTU logbook);
4. Finishing and commissioning of the porting of FTU Data Acquisition System software from VAX architecture to Alpha VMS architecture;
5. Security enhancements in FTU network domain to comply with Remote Participation task security requirements. A member of CODAS group is collaborating with RPT;
6. Design and partial implementation of the new Frascati Fusion website, including hyperlinks to subsites devoted to subsections of Frascati fusion community.

On the whole 2003, 1255 shots were successfully completed, out of a total of 1391 performed in 56.5 experimental days. The average number of successful daily pulses was 22.21. Table 1.I reports the main parameters for evaluating the efficiency of the experimental sessions.

Fig. 1.1 reports the source of downtime in 2003. Power Supply is again the greatest cause of delay with about 32%.

Figure 1.2 reports the indicators trend in the last four years. The experimental days Indicator [I(ed)] shows a sharp fall that is due to problems in experimental campaign start. Also experimental time Indicator [I(et)] shows a light decrease due to an increase in Power Supplies delays.

Summary of Machine maintenance

The maintenance of the FTU systems were carried out according to the FTU equipment maintenance schedule. At the end of June and October, the visual inspection of the vacuum chamber with a new telecamera was done; this telecamera is easier to handle for the cameraman who has a direct vision of operations he is doing; furthermore, for its reduced dimensions, it can be put in the vacuum chamber through any vertical or horizontal port. The images were recorded in a computer. Fourteen broken tiles of the toroidal limiter were found out, all recovered and, where possible, replaced.

The loss of oil from the number three bearing of the flywheel generator MFG3 has been completely removed.

New installations and changes

The main installation in 2003 was the new antenna, named PAM, assembled on July.

During the shutdown in the last part of the year the new CO₂ interferometer system for electron density measure was installed. This new diagnostics allows a measure at higher density than the old system and a better reconstruction of density radial outline.

After the positive tests carried out on the new tiles, we decided to replace about one hundred of them distributed almost uniformly on all toroidal sectors, except for 7 and 9 sectors for the diagnostics complexity. These new tiles have a different design of the screw site to overcome rupture problems. Using the remote handling to remove and reassemble the sectors, we could work without dismantling most of diagnostics installed on ports. Whole operation was done according a standard procedure and was closed in expected time.

A new fast valve of Gas Injection Plant (the sixth) was assembled on the machine.

Future activities

The most important activity we are carrying out is the liquid lithium limiter.

The idea to use liquid lithium as plasma facing material in fusion reactors has been proposed since a rather long time to control high heat loads and to ensure the self-regeneration of the plasma facing surface. A conceptual study for a reactor of the ITER-FEAT size has been proposed where liquid Li is used as first wall material for the divertor target plates with CPS (Capillary Porous System) configuration. Very few experiments have been done up to now; all these experiments have obtained very interesting results. FTU can work at the same magnetic field of ITER and can be used to test the liquid lithium limiter under electromagnetic forces arising during a plasma disruption to verify the dimensioning of capillary part thickness. Up to now the calculations are positive and we are implementing an executive project after that a contract will be signed with the Institute for Innovation and Fusion research of Troitsk (Moscow) for the furniture.

Tab. 1.I - Summary of FTU operations in 2003

	Jan.	Feb.	March	April	May	June	July	Sep.	Oct.	Nov.	Dec.	Total	
Total pulses	0	0	205	262	205	173	0	222	324	0	0	1391	
Successful pulses (sp)	0	0	175	248	178	155	0	209	290	0	0	1255	
l(sp)			0,85	0,95	0,87	0,90		0,94	0,90			0,90	
Potential experimental days	0	0	14	10	14	8	0	9	12	0	0	67,0	
Real experimental days	0	0	8,5	10	10	8	0	8	12	0	0	56,5	
l(ed)			0,61	1,00	0,71	1,00		0,89	1,00			0,84	
Experimental minutes	0	0	3137	4819	3842	3389	0	3350	5644	0	0	24181	
Delay minutes	0	0	1893	1433	2327	1467	0	1601	1841	0	0	10562	
l(et)			0,62	0,77	0,62	0,70		0,68	0,75			0,70	
A(sp/d)			20,59	24,8 0	17,80	19,38		26,13	24,17			22,21	
A(p/d)			24,12	26,2 0	20,50	21,63		27,75	27,00			24,62	
DELAY FOR SYSTEM (minutes)													
	Jan	Feb	March	April	May	June	July	Sep.	Oct.	Nov	Dec.	Total	%
MACHINE	0	0	107	303	234	271	0	73	27	0	0	1015	9,6
POWER SUPPLIES	0	0	543	456	330	677	0	517	843	0	0	3366	31,9
RADIO FREQUENCY	0	0	0	141	194	0	0	635	78	0	0	1048	9,9
CONTROL SYSTEM	0	0	282	139	293	110	0	114	236	0	0	1174	11,1
DAS	0	0	67	20	329	167	0	22	114	0	0	719	6,8
FEEDBACK	0	0	86	33	0	0	0	16	34	0	0	169	1,6
NETWORK	0	0	56	0	0	0	0	0	0	0	0	56	0,5
DIAGNOSTIC SYSTEMS	0	0	34	37	213	28	0	6	82	0	0	400	3,8
ANALYSIS	0	0	173	286	586	154	0	148	230	0	0	1577	14,9
OTHERS	0	0	545	18	148	60	0	70	197	0	0	1038	9,8
TOTALE	0	0	1893	1433	2327	1467	0	1601	1841	0	0	10562	100

Fig. 1.1 - FTU delay for system in 2003

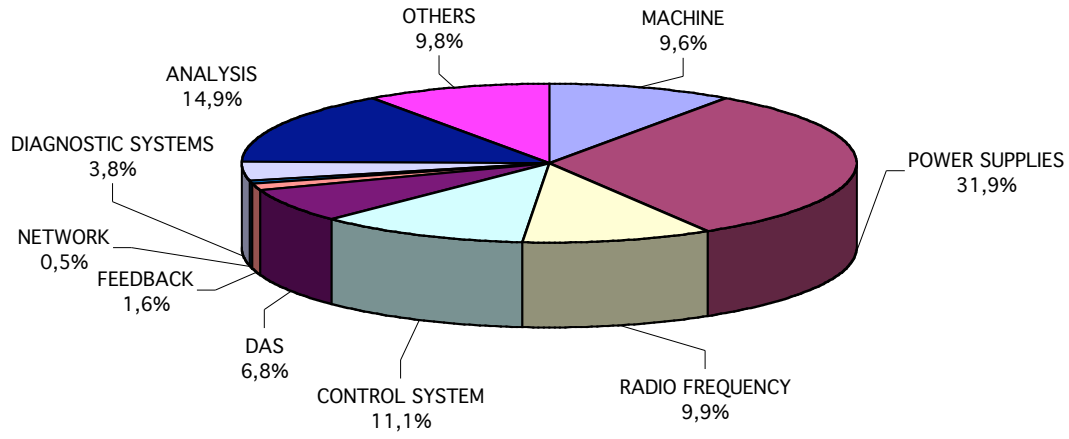


Fig. 1.2 - FTU Indicators trend

