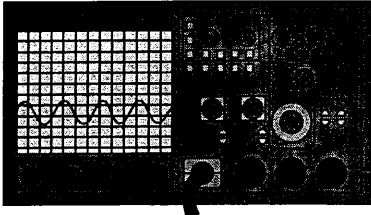


**EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH
ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE**



CERN – PS DIVISION

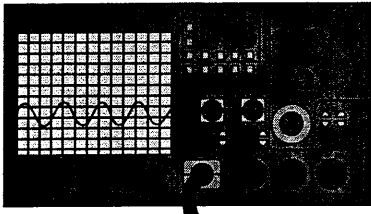
PS/BD/Note 2002-063

REVIEW OF BEAM DIAGNOSTICS SYSTEMS IN PS DIVISION

V. Chohan

Copies of transparencies presented to the PS Management Board

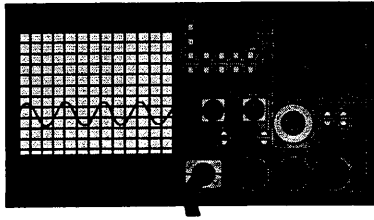
Geneva, Switzerland
19 April 2002



Review Of Beam Diagnostics Systems in PS Division : - Mandate remit

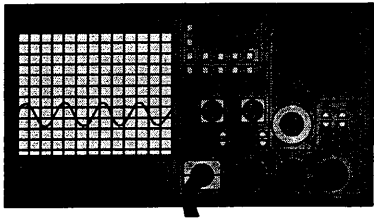
Excerpts from Mandate (JPD :4July2001) :

- ◆ The review should be carried out with the persons responsible for a given machine and its operation as well as with the persons responsible for the instrumentation systems and should cover the following points:
 - *Identify the existing devices and systems* used in terms of measurements and in terms of type of use, i.e routine operation, beam studies and so forth.
 - *Evaluate the pertinence and performance of the systems* with respect to the required beam characteristics - presently and as foreseen in the near future.
 - *Identify redundancies and duplication as well as lack of systems* for particular measurements or needs.
 - *Propose a rationalisation of the systems*, taking into account the routine usage, standardisation and maintenance aspects, rejuvenation, upgrade or construction of new devices as well suppression where applicable.
 - *Attempt to develop collaborative efforts* with other laboratories or industry for the evolution and maintenance of different measurement systems but, taking account the interests of CERN in maintaining knowledge, potential and motivation of in-house staff.
- ◆ ***An initial report on the review process should be presented to the PS Management Board at the end of 2001.***



Review Of Beam Diagnostics Systems: how & what ?

1. **Review Methodology:**
 - *Nomination of Machine Correspondents*
 - *Systems Identification*
 - *Usage*
 - Protons &/or ions, Routine Operation, Machine Experiments & Development
 - *Status*
 - Interlude on Current Issues - PPC Presentation 14Sept2001
<http://psdoc.web.cern.ch/PSdoc/ppc/ppc010914/ppc010914.html>
 - Outstanding Problem Issues
 - New Requests
 - *Identification of Duplication & Redundancy*
2. **Rationalisation:** *(a) launched, (b) under study, (c) further proposals*
3. **Collaboration & outside contracts**
4. **Urgent Remedies**
5. **Discussion**



Accelerator or Areas Correspondents

Excerpts from : MEMORANDUM dated March 2001

To: PS management, group leaders, project leaders and deputies
From :Jean-Pierre Potier

In order to coordinate and rationalise our efforts for all existing accelerators in the PS Division and for the planned ones (LEIR, CTF3), I have asked V.Chohan to act as Accelerator Instrumentation Requirements Co-ordinator. His role will be to collect and discuss the requests arising in the projects or the upgrades or rationalisation possibilities of existing systems prior to a discussion within the BD group for a possible introduction in its work plan.

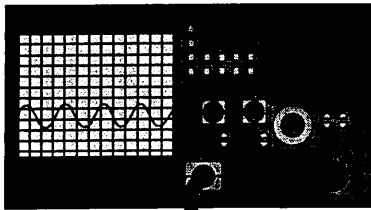
On the accelerator side, for each machine or project correspondents have been agreed by the responsible group leader or by the project leader:

Linac 2 and 3 including the transfer lines to the PSB	R.Scrivens
PSB including the transfer lines toward PS and Isolde	M.Benedikt
PS and the transfer lines toward AD and SPS	M.Giovannozzi
East area and the transfer lines from the PS	R.Steerenberg
AD and its experimental areas	T.Eriksson
Isolde	M.Lindroos
CTF3 preliminary phase	R.Corsini
CTF3 initial and nominal phase	H.Braun
LEIR	M.Chanel

10 Dec 01 – V Chohan

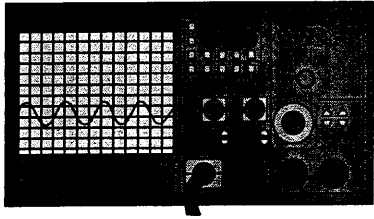
BD Review Interim Oral

4



Existing and Installed Diagnostics Systems (inventory 03/2001)

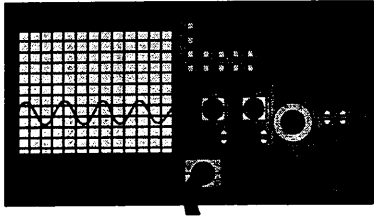
	Location	BT-P	BT-A	BT-DC	WCM	PU-E	PU-M	PU-C	PU-QUAD	PU-SCH	Q-MEAS	MTV	CLM	OTRM	SEM-GRID	MWPC	WS	WS-F	MTARGET	SCRAPER	BSCOPE	BLADE	RGPM	RGLM	BLSM	SYLM	ION-CH	SEM-I	CUP	BLM	SCINT	Σ
1	Linac 2	16					16								10										9						51	
2	Linac 3	10				7									18										1			1			37	
3	PSB Injection and measurement lines	5					24					8			2														8		47	
4	PSB ring	4	8	4	4	136					8				1			8			8	1	1						32		215	
5	PSB - PS transfer line	2				28						5			2														8		45	
6	PSB measurement line	1				4						3			6																14	
7	Isolde line	4				4						7			6														2		23	
8	Isolde														16		56											27		1	100	
9	PS ring	1		1	3	122			2	2	5				6			4	2				2						100		250	
10	TT2 and dump	6			2	8						9			12														8		45	
11	TTL2	1										2																			3	
12	East Hall	1										12	1			14							1					5			34	
13	AD proton injection line (TT2 - target)	2										4			2																8	
14	AD pbar injection line (target - AD ring)	2				10						9																			21	
15	AD reverse injection line (TTL2 - AD ring)	2										4																			6	
16	AD ring			1		63				6	2	2								2			2						2		80	
17	AD pbar ejection line (AD ring - experiments)	1														30												3			34	
18	LIL V				4	1	6					2	2	1	1																17	
19	LIL W				3		13					7			2		2															27
20	EPA ring			1			38				2	2					8									4					55	
21	CLIC Test Facility (CTF)				6		10						3	4														1			24	
	Σ:	58	8	7	22	383	107	0	2	6	14	81	6	5	84	44	66	12	2	2	8	1	6	0	10	4	0	5	32	158	3	1136



Criterion Used in Systems Identification

Decided to base on machine physics needs so, for the Circular Rings for example:

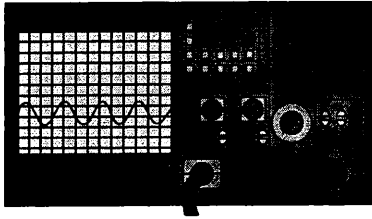
- **Intensity**
- **Position**
- **Size**
- **Other :**
 - **Bunch Shape**
 - **Tune**
 - **Loss Monitors**
 - **Special Systems e.g., Digitizers**
 - **etc**



Systems Identification

Activities launched to date for:

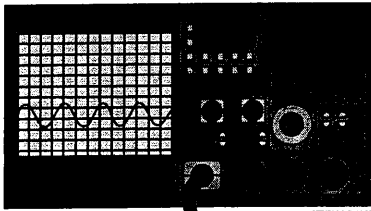
- **Proton & Ion Linacs, including**
 - All the Lines LTE, LTL, LBS, LBE
 - All the lines ITM, ITF, ITH ..
- **PSB**
 - Linac to PSB Inj line
 - 4 PSB Rings
 - Extraction Line BT(incl recomb.), BTP, BTM, BTY
- **CPS**
 - Injection & Extraction Processes,
 - PS Ring
 - TT2
- **East Hall Expt. Area systems**
- **AD**
 - Injection
 - Ring
 - Extraction and Physics lines



Systems Identification cont'd

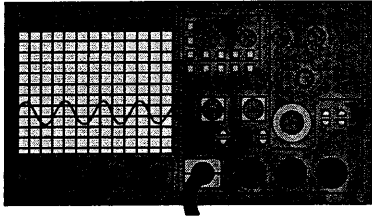
Other Activities in parallel for Projects:

- **LEIR & PIL** : Requirements & BD Implications well defined
- **CTF3 Preliminary**: Definitions, Modifications, installation and bring to operation done in 2001
- **CTF3 Other phases** : Definitions & Requirements in pipeline
- **ISOLDE** : ongoing work



Example Summary of CPS Systems

	Injection	Circulating beam	Extraction	TT2
Intensity	6-turn transformer	DC transformer		TRA126 (CT) TRA203/372/379/386
Position	MSF42 SEM-grids (48/52/54)	CODD	Screen (MTV16)	SEM-fils (257/267/277) SEM-grids (258/268/278) OTR (MTV201) Screens (MTV138/201/218/326/352/374/387/379) WB pickups (208, 228) Couplers (SL)?
Size	SEM-grids (48/52/54)	Flying wire (H54/64,V75/85) Flip target (18-V/65-H)	Screen (MTV16)	SEM-fils (257/267/277) SEM-grids (258/268/278) OTR (MTV201) Screens (MTV138/201/218/326/352/374/387/379)
Other	WB pickup 03 Quad pickup Q measurement BLMs Transverse feedback Acquiris Fast Digitizer	WB pickup 03 Q measurement BLMs Acquiris Fast Digitizer	WB pickup 03 Q measurement BLMs Acquiris Fast Digitizer	



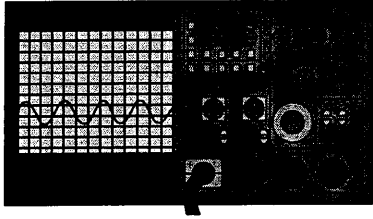
Points emerging from the first round discussion in systems identification

◆ LINAC II & LINAC III

- lots of BD Equipment in Multiple Lines (historical..)
- No Major Issues other than for the Systems already under revision
- BSM & BLVDs are NOT considered for Integration but *BD support in Hardware + troubleshooting essential*

◆ PSB RINGS and LINES

- Emittance Measurement in Rings still not possible – only way is via Measurement Line
- 5 different Systems in Rings installed for emittance m'ment
- ½ turn PU Usage and Application needs non-BD Support + coordination
- PU's in BT line need further attention
- ISOLDE Line & 5 new PU's DESIRED



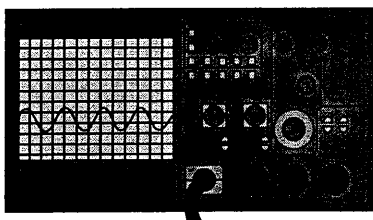
Points emerging from the first round discussion in systems identification

◆ CPS Ring Systems

- Emittance M'ment & Flying Wire in PS Issues
- CODD replacement by PSB type Normaliser Solution *feasible* if all current CODD usage (Inj, ABS etc) issues are resolved
- New CT Beams & fast DGTZ + Excitation

◆ TT2 Systems

- Emittance for LHC beams marred by electron Cloud problems on Sem-fils
- OTR prototype & further development like as in TT10 (SPS) to *standardize Emittance M'ment*
- Position PU's & SPS installations in TT2



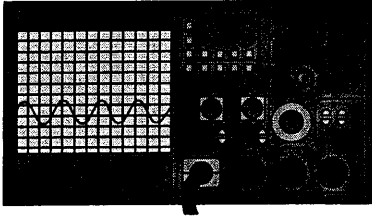
Points emerging from the first round discussion in systems identification

◆ East Hall Area Systems

- No serious problem Issues
- MWPC with full Control & Display capability is a major wish

◆ AD & Expt. Beam Lines

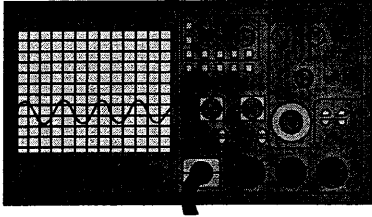
- Tune Measurements on Ramps and flat tops using DRX system should become operational
- Position PU's are highly desirable in physics beam lines
[10 Horiz & 10 Vert ?]



Rationalization Aspects: Launched

- **Fast Transformers in all Beam Lines, BT, BTP, BTY, TT2, TTL , nTOF etc**
 - Sample-hold ,Integrator technique with same electronics already implemented over last few years as a major standardization using same VME ADC MPV908
 - Apply same for LEIR to PS line for 3 fast Transformers

- **PS Closed Orbit System Using Normaliser Techniques**
 - PSB , PS, future LEIR all would have similar systems –
[conceptually even AD but modules have factor 10 better resolution..]
 - Would reduce hardware complexity like in today's CODD (since '96 with new rf harmonics in PS)
 - Diversity in electronics heavily reduced +
{ interchangability of modules PSB, PS, LEIR hoped for }
 - Closed Orbit Software aspects simplified in the long run while Inj. Oscillations treatment implemented differently

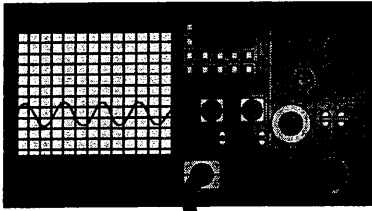


Rationalisation Aspects : Under Study

- **Standardize Electronics for all Wire based Devices (and signals using integration) in PS , East Hall, Isolde etc , i.e.,**
 - Sem-Grids+Sem-Fils
 - MWPC's
 - Silicon Stripline detectors
 - Etc.. BLM's ?

-Working Group set up...

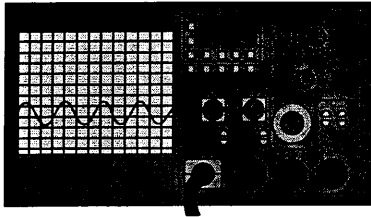
-Console level standardization also desirable. *Something on these lines already done for MWPCs(East Area & AD) & Semgrids & Toposcope in recent years*



Rationalization Proposals:

1. **Emittance Measurements in PSB & PS Rings:**
 - **Adopt same system as in PSB for PS**, (ie., after the Flying Wire systems in PSB start working in 2002)
 - PS system hardware is old (1994) , approaching obsolescence and software written is complex with fitting & Eh / Ev evaluation in rt-task !! However, this project would need detailed study - Implementation time would be long

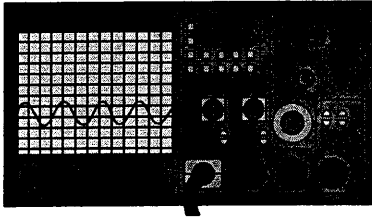
2. **Emittance Measurement in TT2 Line**
 - Present Semgrids/Semfils have electron cloud problems for LHC beams and have long-term maintenance to be considered together with complexity/diversity of devices, so
 - **Adopt SL techniques used in TT10 using OTR Screens**
 - 1 prototype already installed in TT2 & gave successful results
 - Further devices installation at 'treble' type MTV stations under study (cables exist) but some crucial points need to be resolved like:
 - diaphragm control vs. use of filters
 - purchase image intensifier and new cameras
 - CCD radiation protection ideas..
 - ☹ **LIMITATIONS:** ≥ 14 GeV beams , AD Test beams dead anyway?...
 - ☺ **ADVANTAGES:** WOULD SETTLE DISCUSSIONS < SL-PS > PERMANENTLY & AD Prod. beams Eh- Ev could also be measured same way



Rationalization Proposals cont'd:

3. **Transfer Line Pickup Systems Development & standardization**
 - *Adopt techniques used in PSB-to-PS BTP line , ie., Base-line-restitution, auto-calibration, Digitising with High sample rate ADC's etc*
 - Need to purchase ≥ 200 MHz Sample-rate Digitizers (VME, PCI?)
 - Need Software Development Effort
 - *This approach would solve 'NEW' Requirements for ISOLDE, AD , LEIR lines with possible application in CTF3*

4. **Undertake study & uniformise electronics for Linac2 Pickups using standard techniques**
 - Present 8 Magnetic PU's 'Schindl type' use trafo for sum signal to 'normalise'



Collaboration & Contracts

With SL Division

◆ *For Beam Current TRANSFORMERS*

- LHC Beam Current Transformers Review done in Nov2001 (PS-BD/note 2001-014)

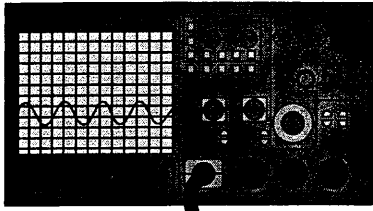
- Four DC-BCTs for 2 LHC Rings to be supplied by PS/BD with industrially purchased &/or CERN built devices

- 1 Fast-BCT from SL (LHC-type , low-droop, intensity-per-bunch) in TT2 for LHC use will be available via SL control system for PS use. We have negotiated that an analogue output from this device will also be available to us for our use i.e., we envisage usage for Continuous Transfer operation where our existing device (TRA126) is getting very fragile

- We envisage future joint Maintenance Contract feasibility for transformers with 'Bergoz' components

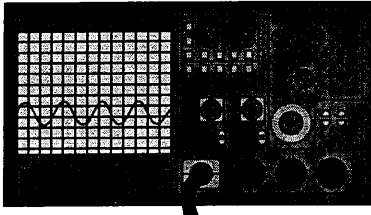
◆ *For Other Systems:*

- *MWPC's, TV monitors etc...*



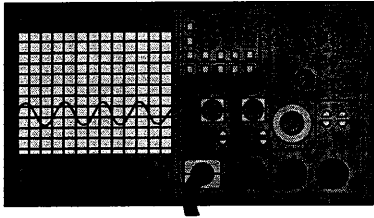
Collaboration & Contracts cont'd

- ◆ ***Maintenance or development Contracts for Pickups***
 - We have sensors and sensor mechanical drawings
 - For all currently known 'new' requirements (AD Beam Lines, ISOLDE, or LEIR-PS line) , sensor design 'known' or easily adaptable & so drawings exist or need some modifications
 - For front-end electronics we have a vast in-house investment
 - Maintenance contracts with outside firms (e.g. Bergoz) feasible *only if we purchase front-end electronics from them*
 - Trade-off between keeping in-house front-end electronics knowledge or 'outsource' like done for specific accelerators, e.g., the big light-source machines(SLS, etc)
 - Ongoing INFN -Frascati collaboration for Pickup Systems development in further phases of CTF3

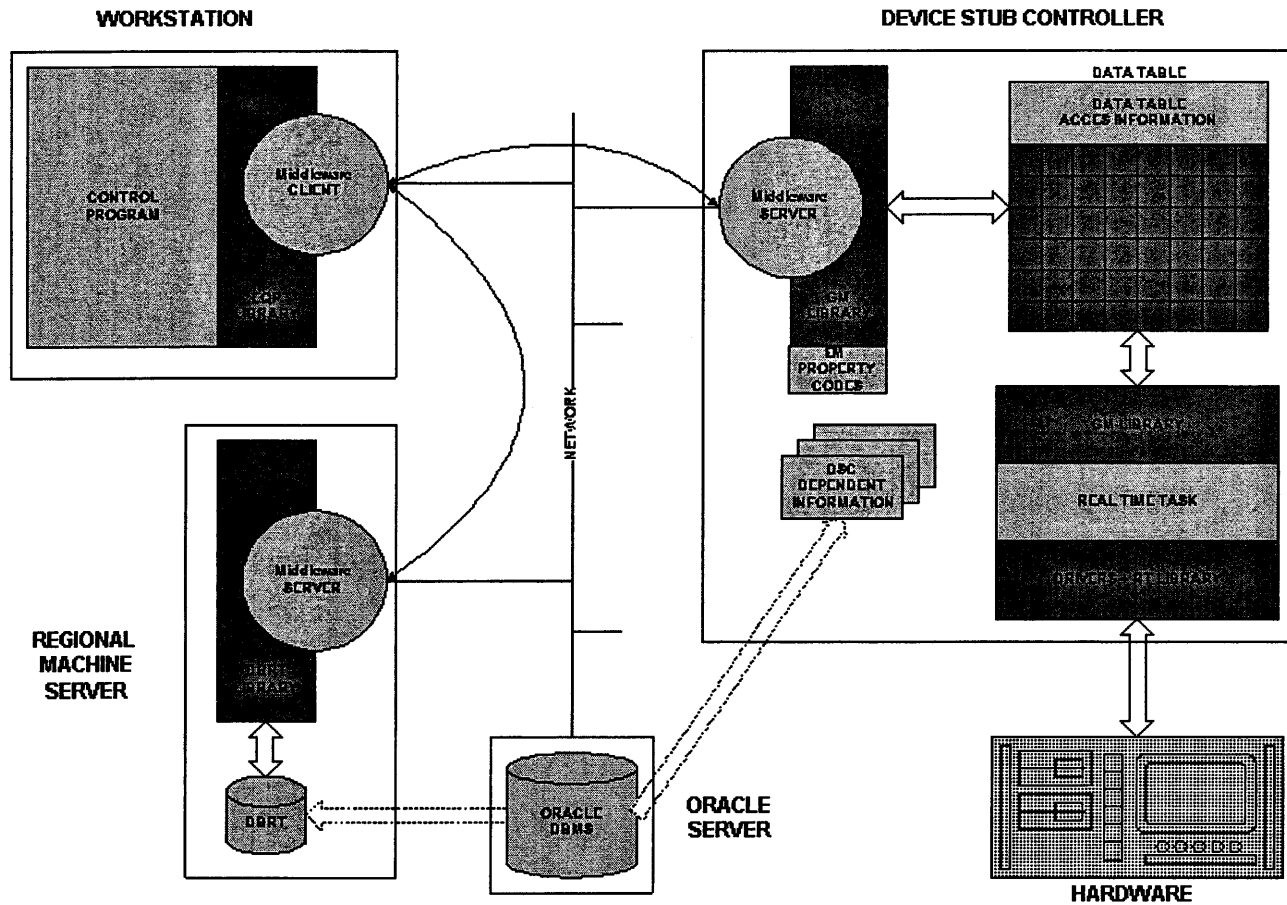


Possible Remedy for the FE Software bottleneck

- ◆ **Software bottleneck in front-end systems is not new: Management has been informed since early nineties**
- ◆ **Modern complex systems need modern tools and software is inherent and all encompassing - needing software persons of certain calibre**
- ◆ **Base-level 'software design' is very important – however, since years we have only taken “ quick, fire-fighting = pragmatic ” approach so in the same vein,**
- ◆ **Urgent problems can be solved by :**
 - **Task oriented teams (without respecting existing section/group structures for the completion life-time of a given task)**
 - **Money - ~ 150 KCHF /yr will permit 1 software engineer hire on a special industrial contract. IT Division contacts would permit such approach whereby we can squeeze such person(s) for next TWO years(2002/3) before new contract has to be passed thro' FC.**

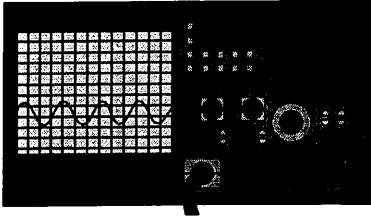


Reminder on Controls Architecture, where we fit our Diagnostics Systems & Who does what.....



“1991 Work MODEL for Getting a new device working operationally”

- What BD Group does is the RT Task only in this complex Layout ..!! (apart from Sensor itself)
- OP Group does Applications at Workstation level
- CO Group looks after the Rest !



Review further steps..

Apart from continuing Identification and equipment improvement, availability , upgrade etc,

- (a) tackle Duplication & Rationalise,**
- (b) CLASSIFY needs per machine in categories or orientation based on:**

- 1. LHC beams Related including LEIR**
- 2. SPS-CT and CNGS related**
- 3. East Hall Expt. Beams related**
- 4. ISOLDE Related**
- 5. AD Related**
- 6. CTF3 Related**

**PRIORITY WILL THEN HAVE TO BE CLEARLY AGREED UPON
& would influence COMPOSITION OF TASK TEAMS AND
hence realistic DEADLINES defined, so good PLANNING IS A
MUST for OPTIMAL use of staff**