EDMS: 889885

AB/PO equipment review and Stand-by service description for the power converter operation.

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ATC-ABOC days, 23 January 2008

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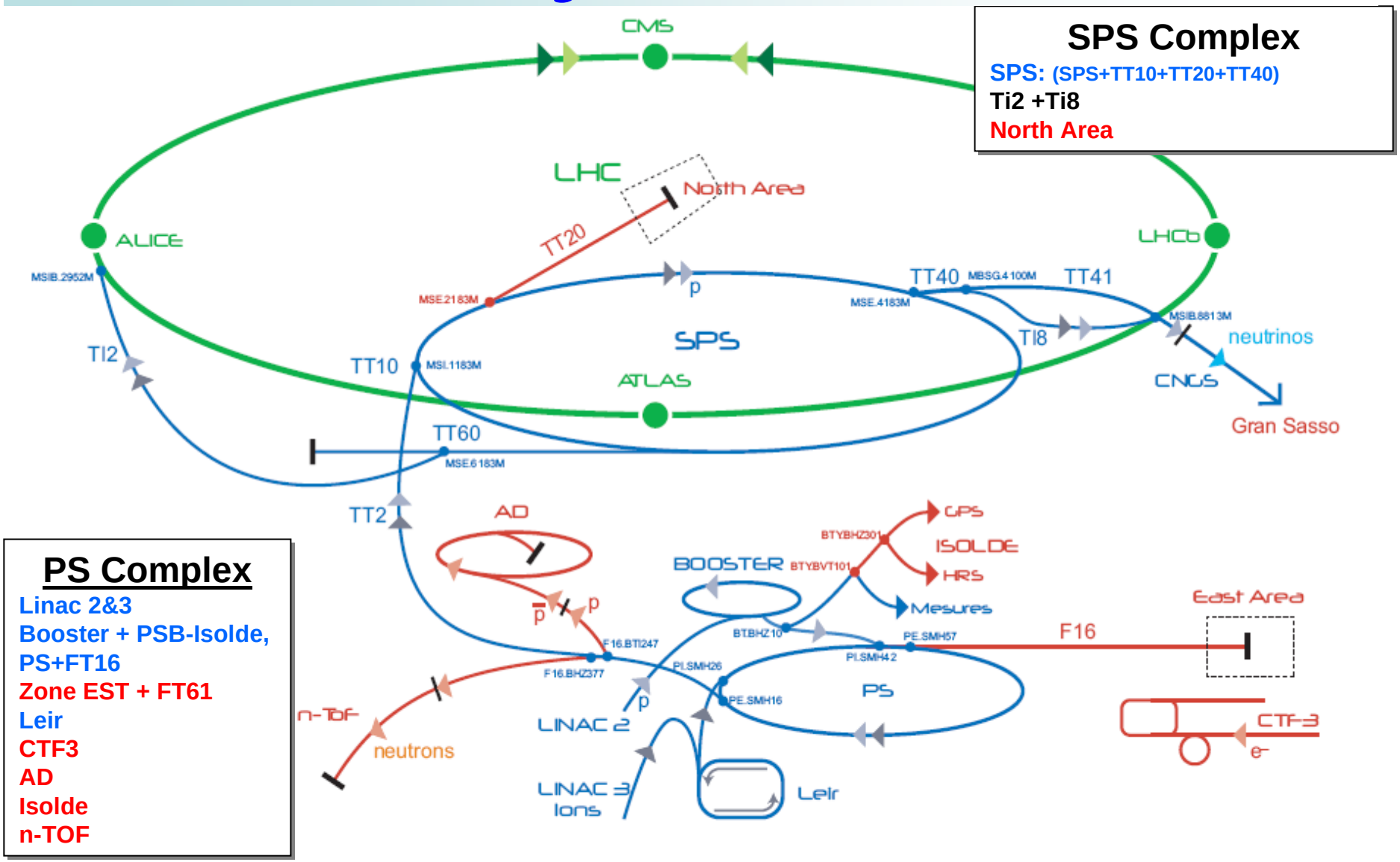
AB/PO equipment review
and
Stand-by service description for the power converter operation.

1. Statistics: MTTR, MTBF,,…
2. Equipment review: spare parts, consolidation,…
3. Stand-by service organization
4. AB-PO Maintenance Methods Service

Statistics: AB-PO e-logbook



Statistics : The e-logbook interface

LogBook 2003

LogBook Infos Mot de passe Documentation

Statistics are directly extracted from the "e-logbook" filled by any person who makes an intervention on equipment in operation.

PIPO = Piquet AB/PO

Form View NUM

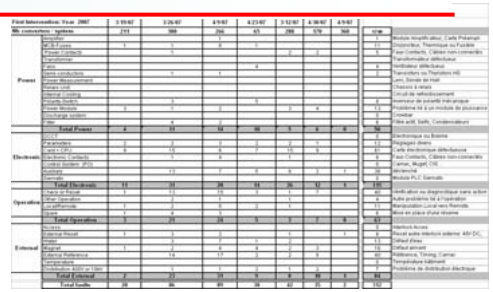
start | 4 Internet ... | CERN Phone... | 512MO (E:) | Microsoft Po... | 4 Microsof... | FileMaker Pr... | LogBook 2003 | Type to search | 13:51

Statistics: Summary of PIPO interventions

2007		Linac 2&3	Booster + PSB-Isolde	PS + FT16	Zone Est + FT61	CTF3	AD	Total PS	SPS North Area	SPS + Transferts	Total SPS	
First Intervention: Year 2007		12/03/2007	12/03/2007	26/03/2007	02/05/2007	19/03/2007	07/05/2007		14/05/2007	10/04/2007		
Nb convertisseurs / System		211	380	266	65	305	170	1397	313	425	738	
Power	Amplifier			1				1			0	Module Amplificateur, Carte Préampli
	MCB-Fuses	1	1	10	1			13	1	5	6	Disjoncteur, Thermique ou Fusible
	Power Contacts		1			2	2	5		1	1	Faux Contacts, Câbles non-connectés
	Transformer							0	1	1	2	Transformateur défectueux
	Fans				4			4	2	1	3	Ventilateur défectueux
	Semi-conductors		1	1				2		2	2	Transistors ou Thyristors HS
	Power Measurement							0		1	1	Lem, Sonde de Hall
	Relais Unit							0	1		1	Chassis à relais
	Internal Cooling							0			0	Circuit de refroidissement
	Polarity-Switch		4		5			9	8		8	Inverseur de polarité mécanique
	Power Module	3		4		3	4	14		1	1	Problème lié à un module de piussance
	Discharge system			2				2			0	Roue libre recuperation, Sparkgap, Crowbar
	Filter		5					5		2	2	Filtre actif, Selfs, Condensateurs
	Total Power	**4**	**12**	**18**	**10**	**5**	**6**	**55**	**13**	**14**	**27**	
Electronic	DCCT									1	1	Electronique ou Bobine
	Parameters	2	2	3	2	2	1	12	10	1	11	Réglages divers
	Card + CPU	9	16	6	7	15	9	62	41	5	46	électronique défectueuse
	Electronic Contacts		1			1		2	9	8	17	Faux Contacts, Câbles non-connectés
	Control System (PO)			4				4	9	5	14	Camac, Mugef, CIS...
	Auxiliary		14	7	5	8	2	37	6	4	10	Alim. auxiliaire, Disjoncteur BT déclenché
	Siematic									1	1	Module PLC Siematic
	Total Electronic	**11**	**33**	**20**	**14**	**26**	**12**	**117**	**75**	**25**	**100**	
Local Reset	Check or Reset	1	13	15	3	1	7	40	34	24	58	diagnostique sans action
	Other Operation		2	1		1		4	4	5	9	Autre problème lié à l'opération
	Local/Remote	1	2	5	2	1		11	1	5	6	Manipulation Local vers Remote
	Spare	1	4	3				9		4	4	Mise en place d'une réserve
	Total Reset	**3**	**21**	**24**	**5**	**3**	**7**	**64**	**39**	**38**	**77**	
External	Access									8	8	Interlock Acces
	External Reset	1	3	2		1		8		2	2	Reset autre interlock externe: 48V DC,
	Water		3	7	1	2		13	7	1	8	Défaut d'eau
	Magnet	1	2	5	4	2	3	17	2	6	8	Défaut aimant
	External Reference		14	17	2	2	5	40	3	6	9	Référence, Timing, Camac
	Temperature										0	Température bâtiment
	Distribution 400V or 18kV		1	1	2	1	2	8	1	11	12	Problème de distribution électrique
	Total External	**2**	**23**	**32**	**9**	**8**	**10**	**86**	**13**	**34**	**47**	
Total faults		**20**	**89**	**94**	**38**	**42**	**35**	**322**	**140**	**111**	**251**	

Statistics: Summary of PIPO interventions

PIPO interventions	PS Complex		SPS Complex	
	Nb	%	Nb	%
Power fault	55	17%	27	8%
Electronic Fault	117	36%	100	31%
Local Reset	64	20%	77	24%
External fault	86	27%	47	15%
Total Interventions	322		251	



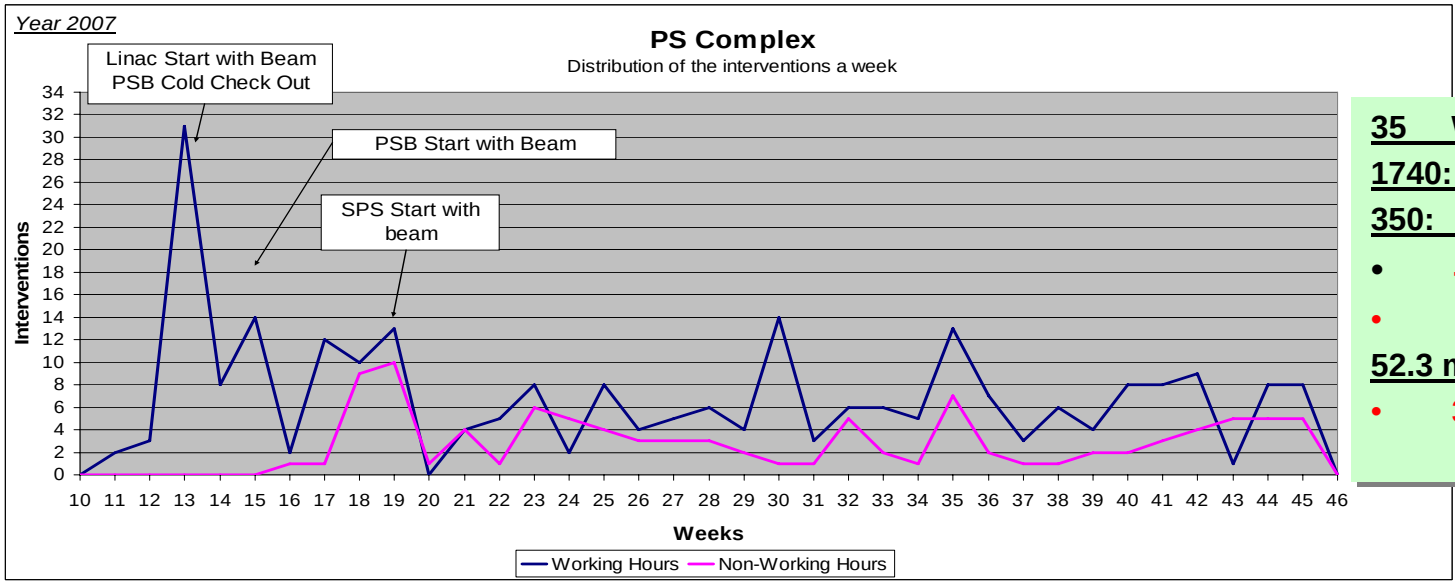
Converters internal faults

Faults due to context or environment considerations

Remarks:

- Electronic Faults: ~30%, represents the main source of the Converter faults.
  - ✓ SPS Complex: The replacement of the electronic crates of the North Area Converters will reduce significantly the number of interventions.
  - ✓ PS Complex: ~ 40 supply modules have to be changed and electronic cards generate a lot of interventions. (to be evaluated)
- Local Reset: ~25%, After a CCC call, PIPO went to the site, check and restart the power converter after a local Reset or without any action. Improved remote control interface would allow more remote resets by CCC or PIPO
- External Faults:~25% To be efficient, CCC must have a better remote diagnostic system.

Statistics: Distribution of the interventions along the year



2007

35 Weeks of exploitation

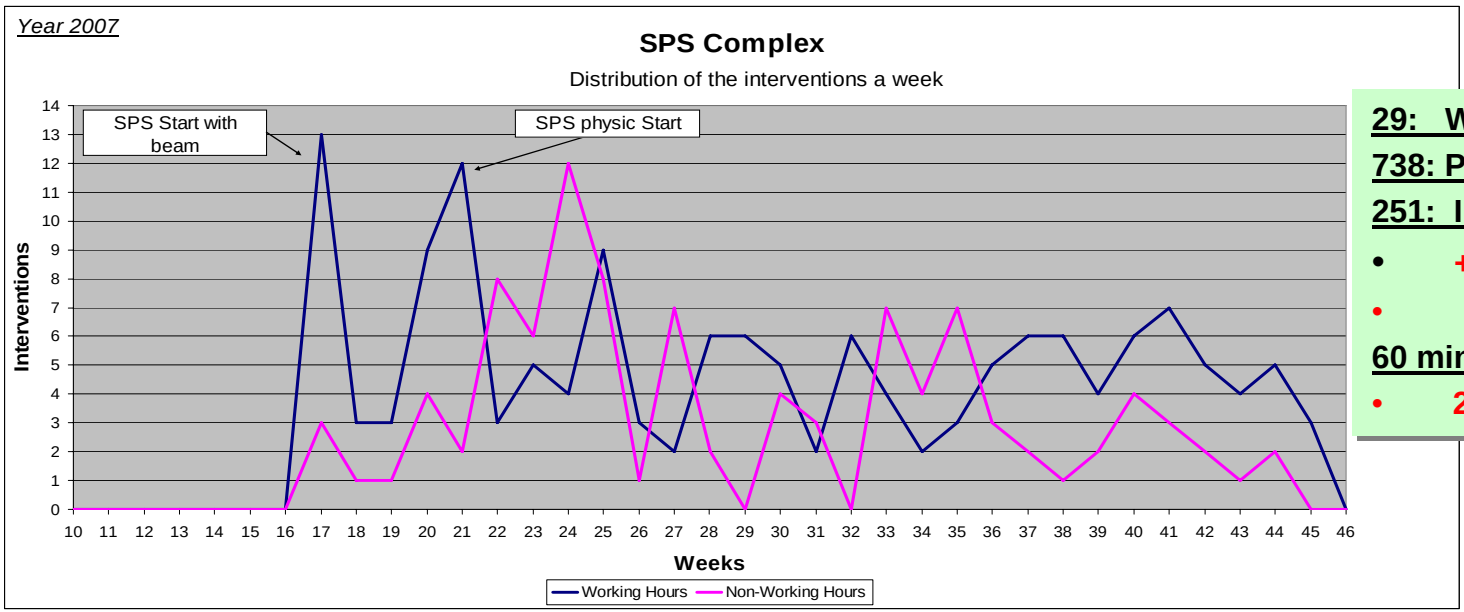
1740: Power converters

350: Interventions:

- **- 25,5% (07/06 ratio)**
- **250 WH & 100 NWH**

52.3 min: MT/Intervention:

- **305 hours / 350 Interv.**



29: Weeks of exploitation

738: Power converters

251: Interventions:

- **+7 % (07/06 ratio)**
- **151 WH &100 NWH**

60 min: MT/Intervention:

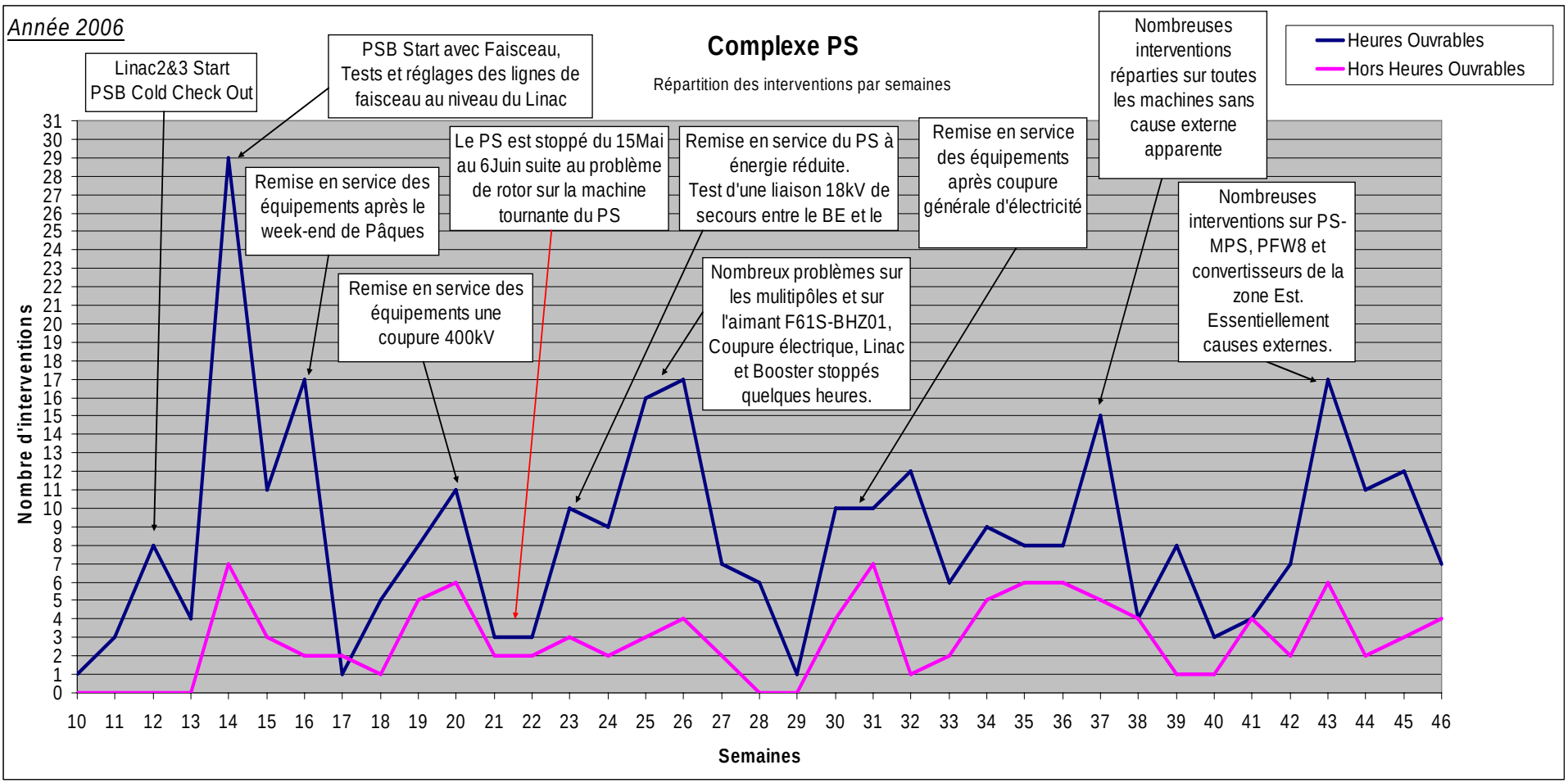
- **251 hours / 251 Interv.**

WH – Working Hours

NWH – Non-Working Hours

Statistics: Distribution of the interventions along the year

For comparison: Year 2006



Statistics: MTBF evolution since 2004 (without 2005)

MTBF Calculation (Hours)	a) Linac 2&3				b) Booster + PSB-Isolde				c) PS + FT16			
	MTBF Conv.	MTBF Total	Conv. Faults	Context Faults	MTBF Conv.	MTBF Total	Conv. Faults	Context Faults	MTBF Conv.	MTBF Total	Conv. Faults	Context Faults
Year 2007	82037	61528	15	5	49248	24901	45	44	38472	15553	38	56
Year 2006	75662	44354	17	12	40226	20479	56	54	34592	10330	43	101
Year 2004	73623	56300	13	4	80890	44297	23	19	19055	13101	66	30

MTBF Calculation (Hours)	d) Zone Est + FT61				e) CTF3				f) AD			
	MTBF Conv.	MTBF Total	Conv. Faults	Context Faults	MTBF Conv.	MTBF Total	Conv. Faults	Context Faults	MTBF Conv.	MTBF Total	Conv. Faults	Context Faults
Year 2007	12545	7923	24	14	55726	41131	31	11	42613	21915	18	17
Year 2006	14723	5745	16	25	70226	48768	25	11	21244	11848	29	23
Year 2004	17056	7995	15	17					16592	14088	45	8

MTBF Calculation (Hours)	g) North Area				h) SPS + Transferts			
	MTBF Conv.	MTBF Total	Conv. Faults	Context Faults	MTBF Conv.	MTBF Total	Conv. Faults	Context Faults
Year 2007	15451	9712	88	52	56231	19757	39	72
Year 2006	10502	6677	103	59	110257	32158	21	51
Year 2004			0	0			0	0

Right
To be followed
Too Low

MTBF Calculation (Hours)	Total PS Complex (a+b+c+d+e+f)				Total SPS Complex (g+h)			
	MTBF Conv.	MTBF Total	Conv. Faults	Context Faults	MTBF Conv.	MTBF Total	Conv. Faults	Context Faults
Year 2007	47645	25620	171	147	29985	15172	127	124
Year 2006	44160	19936	186	226	32424	17182	124	110
Year 2004	33003	22277	162	78			0	0

Long MTTR Risks: LHC Injectors

MTTR Risk	Machine	Equipment (Fonction)	Action	End of Action
6 Months to 1 Year	PS	**Main Power System: Siemens Motor-generator** (PS Main Magnets)	**Consolidation in course:** Replacement of the rotating machine and rectifiers by a new 60 MW power system, with capacitive energy storage, called POPS. **Until 2010:** In case of major event on the rotating machine (Rotor or stator), the rectifiers can be fed by a 13 MVA transformer connected to SPS 18 kV. LHC cycles can be done but the LHC will be filled in 60' instead of 20'. The others physics progam will be very limited.	Startup 2010
> 1 Month to 3 Months	SPS	**Main Power Converters** (SPS Main Magnets)	**TS/EL Consolidation:** 18 KV cables for SMD power converters are weak. SPS is working with 12 SMD for 450GeV cycles (on 14 installed). The two spare converters can not always be used together due to earth balancing of the magnets. In some case, when an 18kV cable is broken, not all second fault can be covered by the second spare.	See talk session 5
1 to 2 Weeks	SPS	**BA6 MSE & MST**	**Action possible:** If major problem in one of both converters, the time required to connect manually the spare is around 2 weeks. Profit of an existing spare converter 24 kA by installing a commutating switch (~80KCHF)	To be defined
	Linac 3	**Brukker** (Solenoïde/Quad for ITL and ITM)	**Consolidation foreseen:** Replacement of 12 power converters by standard AB/PO type with spares.	Startup 2009
	Linac 3	**Jagger** (Quad on IA1 and ITF)	**Consolidation foreseen:** Restoring the spare converter and buying spare parts.	Startup 2009
	Linac 3	**Ocem 850A 20V dc (4 units)** (Bending ITF Line)	improve spare parts situation	2008
1 Day to 1 Week	Linac 2	**Oltronix** (Quad Tank 1)	**Consolidation in course:** replacement of 33 (of 80) Power-Converters by new ones and spare parts will be increased.for the remaining ones.	Startup 2008
	Booster	**Multipoles Converters System**	**Consolidation in course:** replacement of all the Booster Low Energy Correctors System.	Startup 2010
	PS	**Gamma transitions**	**Consolidation in course:** 6 new power converters will be installed: * Triplets: 3 Converters (2 + 1 Spare) (Done) * Doublets: 3 Converters (2 + 1 Spare)	Startup 2007 Startup 2008
	PS	**PS Auxiliary power converters**	**Consolidation in course:** Replacement of 12 power converters used in a PS machine for orbit correction, multi-turn extraction and slow extraction: 8 converters and 2 Spares will be installed for the startup 2008. 4 converters will be installed for the startup 2009.	Startup 2008 Startup 2009
	TT2 line	**Auxiliary power converters**	**Action in course:** Reorganazing of the 269 Building to manage 1 cabled spare by type of converters	2009

Long MTTR Risks: Experimental areas

MTTR Risk	Machine	Equipment: Fonction	Action	End of Action
1 to 2 Weeks	AD	All power converters	**Recommendation:** The majority of the AD power-converters are old and complex. Spare parts and documentation are missing. Thus installations are difficult to support. In this state, AD can be exploited up to 2010 if additional spare parts are supplied. ~100kCHF. If AD had to remain operational during some years after 2010, a consolidation is required.	To be defined
	CTF3	Klystrons Modulators, Solenoïd and Focals	**Recommendation:** Initial strategy was to use a maximum of existing (old) converters. These old power converters are difficult to support. If CTF3 had to remain operational after 2010, a consolidation is required.	To be defined
1 hour (but Low MTBF)	SPS	**North area Power Conveters:** (Dipole and quadrupole of the transfert lines)	**Consolidation foreseen**: The converters are 30 years old and their electronics generates a lot of faults without gravity which leads to a very low MTBF (~7000h). The replacement of the electronics shall be foreseen in the coming years.	2011?

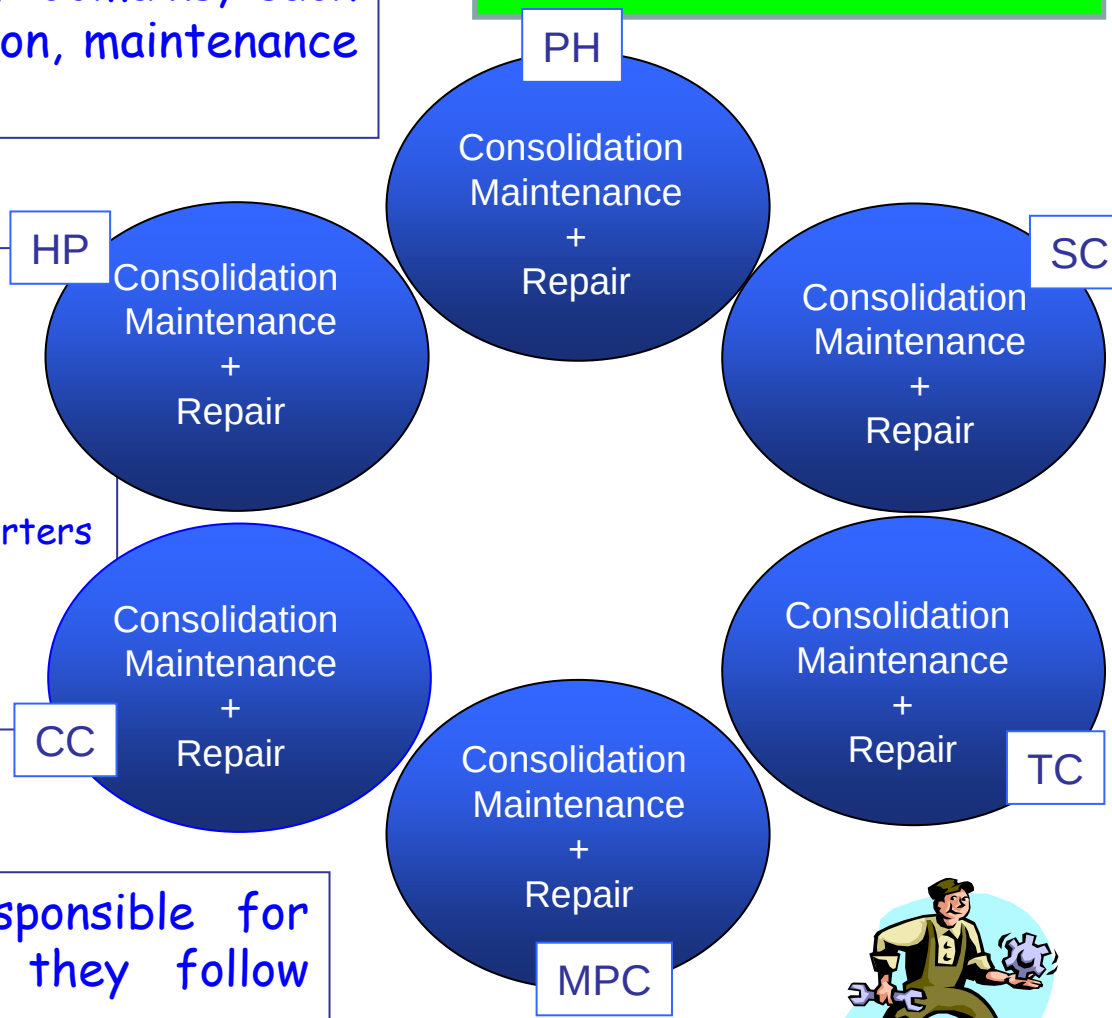
Operation and maintenance: AB/PO organization

This sharing of tasks promotes feedback from maintenance to design and vice versa

- According to their technology domains, each section follows the consolidation, maintenance and repair of its facilities.

AB/PO Technology domains

- PO-TC: Thyristor Converters
- PO-MPC: Main Power Converters
- PO-PH: Pulsed and High Voltage Converters
- PO-SC: Switch Mode Converters
- PO-HP: High Precision Measurement
- PO-CC: Converter Control

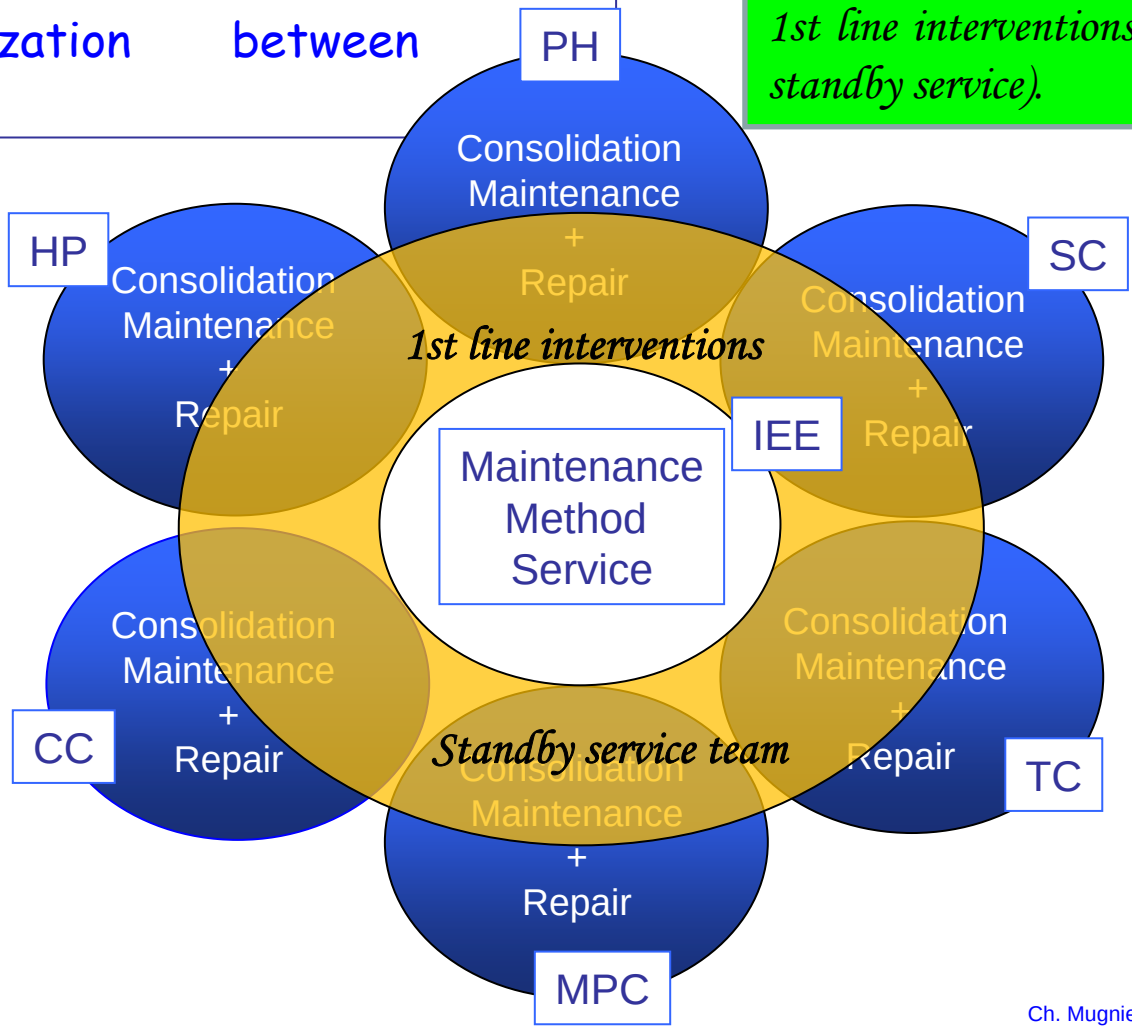


- The designers are also responsible for equipment operation, which they follow everyday.

Operation and maintenance : AB-PO organization

- Standby service team (members are coming from all the sections) is responsible for the 1st line interventions on all the systems.
- Cross-fertilization between sections

The "Maintenance Method Service" gives logistic support for the operation and maintenance (database, e-logbook, spare part managements,…) and coordinates the 1st line interventions (management of the standby service).



The AB-PO Stand-by service

It's a team !

- Formed by technicians that have a good knowledge of the power converters and of their operational environment.
- It may be asked to intervene 24h/24h, on call by the CCC control room, to put back into operation any defective installation as soon as possible.
- Only one phone number by intervention area (3 in total)

The AB-PO stand-by service:

Experience and training of the PIPO technicians

The PIPO technician is:

- Issued from one of the PO sections,
- An expert on the equipments developed by his section,
- A generalist in all other installations,

The "piquet" activity of a technician:

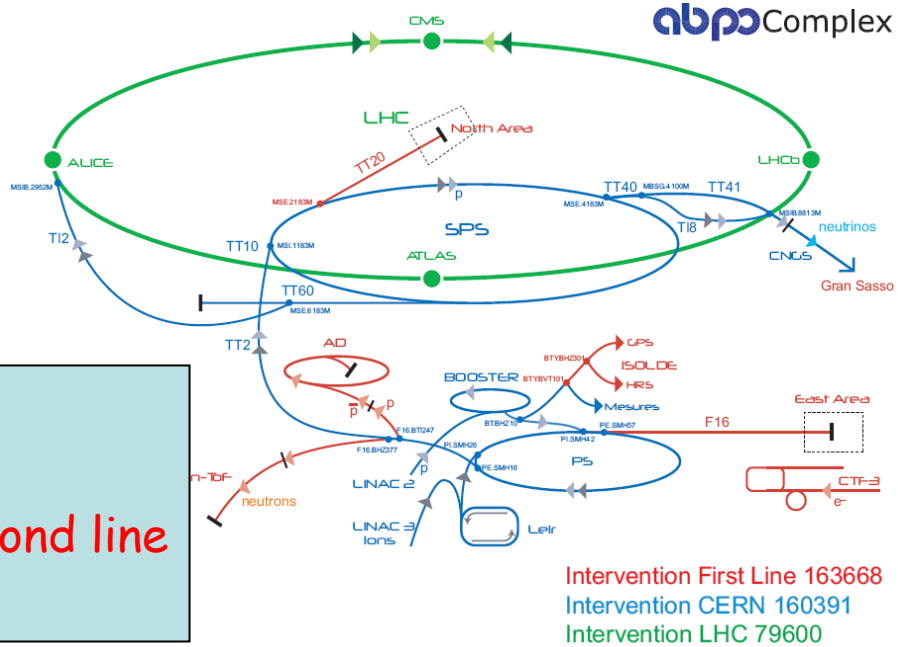
- Is a second duty,
- Represents approximately 1/3 of his time, which is spent on training and interventions.

The shutdown training of the "piquet":

- Consists of specific training actions given by the different equipment experts, to:
  - Refresh their knowledge,
  - Keep them informed of the novelties.

The 3 PIPO teams

The "global CERN complex is shared by 3 AB-PO "Piquet" teams



PIPO EA's (FSU AB-11):

Sector: Experimental Areas
Team: 7 techn. + 3 Eng. In second line
Call: 163668

PIPO Injectors (CERN Staff):

Sector: LHC injectors
Team: 8 technicians + on-call experts
Call: 160391

PIPO HC (CERN Staff):

Sector: LHC
Team: 8 technicians + on-call experts
Call: 79600

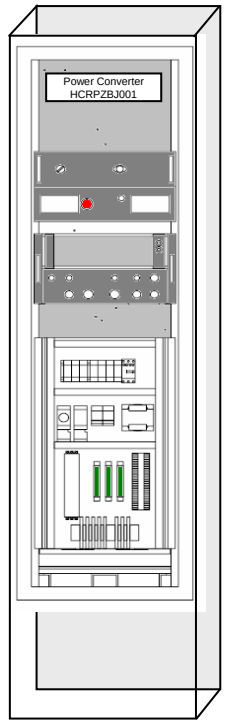
Maintenance methods service

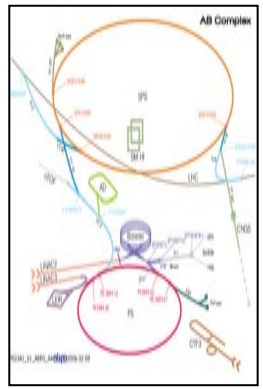
A logistical support for the first-line interventions

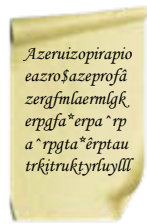
- To give the first-line technicians the right tools to be able to put back in service a defective installation as soon as possible,
- Facilitate the interventions on the field, keeping them more efficient and safe

For any request of intervention, the "piquet" technician shall be able to:

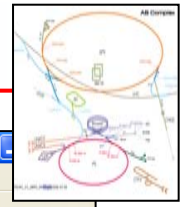
- *localize quickly the faulty equipment,*
- *access to its historic,*
- *access to all related documentation,*
- *find quickly the right spare parts,*
- *find easily the name of the expert to call for support,*







The AB-PO equipment data-base



Report - Microsoft Internet Explorer

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Address http://webh02.cern.ch/Converters-Databases/net/equipments/report.aspx?Complex=CNGS&ID_Specialist=164&Power_Supplies=ON

Google Search 4 blocked Check AutoLink AutoFill Options

Equipments List - 48 record(s) - Complex=CNGS&ID_Specialist=164&Power_Supplies=ON

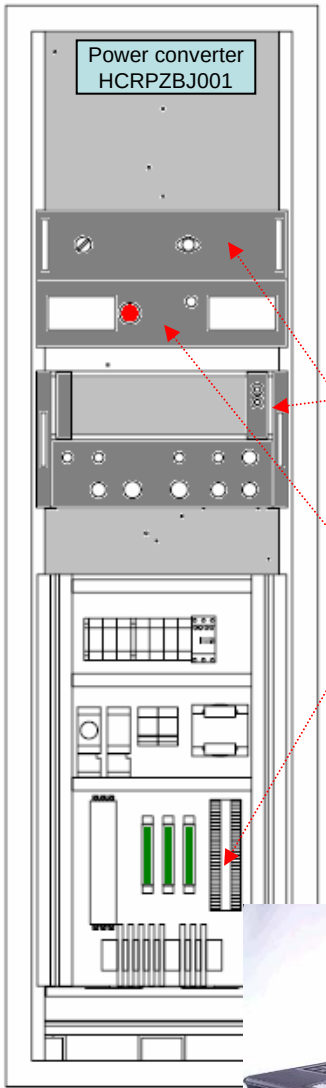
Complex	Machine	Eqp Name	Status	Building Name	Building Number	Room	Eqp Type	Model	Eqp Code	CERN Serial Number	Manufacturer Serial Number	Installation Date	Comments	Position	Holder	Responsible1	Responsible2	Piqu Phon
CNGS	CNGS (TT41)	COD-019702	Spare	BB4	921	Hall	CONVERTER	Ncod	HCRPJAH000	00019702		26/11/2004		RA 0418		Yves Jacquemard	Loic De Oliveira	16039
CNGS	CNGS (TT41)	COD-019707	Spare	BB4	921	Hall	CONVERTER	Ncod	HCRPJAH000	00019707		26/11/2004		RA 0418		Yves Jacquemard	Loic De Oliveira	16039
CNGS	CNGS (TT41)	COD-019709	Spare	BB4	921	Hall	CONVERTER	Ncod	HCRPJAH000	00019709		08/02/2006		RA 0418		Yves Jacquemard	Loic De Oliveira	16039
CNGS	CNGS (TT41)	COD-027789	Spare	BB4	921	Hall	CONVERTER	Ncod	HCRPJAH000	00027789		26/11/2004		RA 0418		Yves Jacquemard	Loic De Oliveira	16039
CNGS	CNGS (TT41)	MDGH4102	Installed	BB4	921	Hall	CONVERTER	Ncod	HCRPJAH000	00019711		26/11/2004		RA 0417		Yves Jacquemard	Loic De Oliveira	16039
CNGS	CNGS (TT41)	MDGH4106	Installed	BB4	921	Hall	CONVERTER	Ncod	HCRPJAH000	00019698		26/11/2004		RA 0417		Yves Jacquemard	Loic De Oliveira	16039
CNGS	CNGS (TT41)	MDGH4108	Installed	BB4	921	Hall	CONVERTER	Ncod	HCRPJAH000	00019706		26/11/2004		RA 0417		Yves Jacquemard	Loic De Oliveira	16039
CNGS	CNGS (TT41)	MDGH4112	Installed	BB4	921	Hall	CONVERTER	Ncod	HCRPJAH000	00019697		26/11/2004		RA 0417		Yves Jacquemard	Loic De Oliveira	16039
CNGS	CNGS (TT41)	MDGH4114	Installed	BB4	921	Hall	CONVERTER	Ncod	HCRPJAH000	00019705		26/11/2004		RA 0417		Yves Jacquemard	Loic De Oliveira	16039
CNGS	CNGS (TT41)	MDGH4118	Installed	BB4	921	Hall	CONVERTER	Ncod	HCRPJAH000	00019704		26/11/2004						
CNGS	CNGS (TT41)	MDGV4103	Installed	BB4	921	Hall	CONVERTER	Ncod	HCRPJAH000	00019682		07/02/2006						
CNGS	CNGS (TT41)	MDGV4105	Installed	BB4	921	Hall	CONVERTER	Ncod	HCRPJAH000	00019681		26/11/2004						
CNGS	CNGS (TT41)	MDGV4109	Installed	BB4	921	Hall	CONVERTER	Ncod	HCRPJAH000	00027820		26/11/2004						
CNGS	CNGS (TT41)	MDGV4111	Installed	BB4	921	Hall	CONVERTER	Ncod	HCRPJAH000	00019710		26/11/2004						

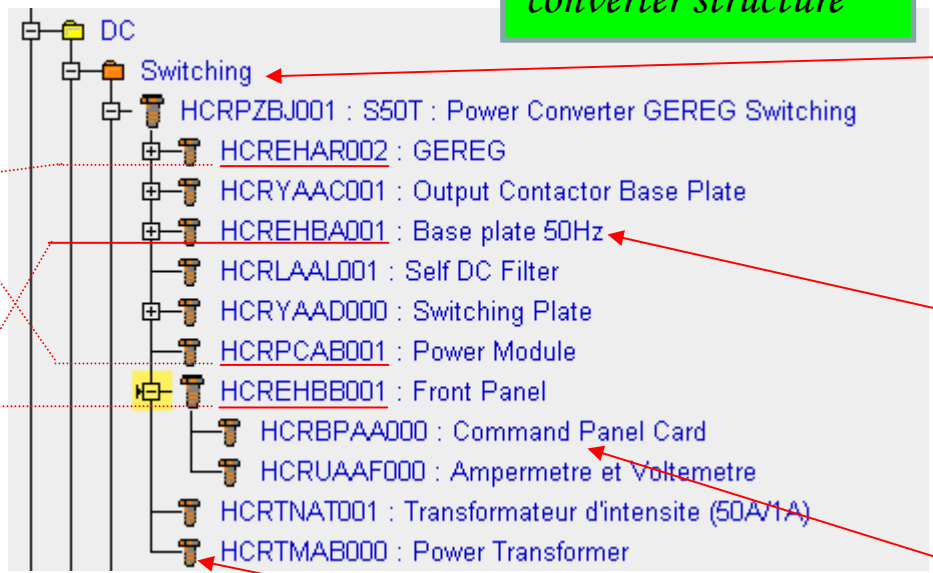
start 3 Internet Exp... CERN Phone Book 512MO (E:) Microsoft Power... Inbox - Microsof... FileM

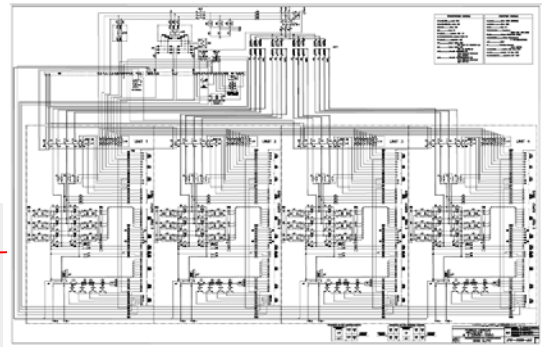
Operational documentation

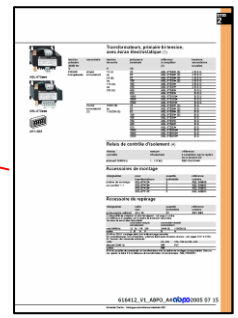
This Equipment code is given for each type of equipment or component.

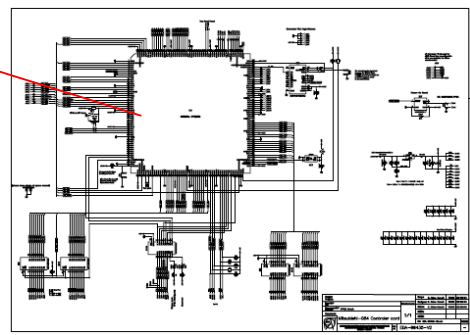
An EDMS tree represents the power converter structure







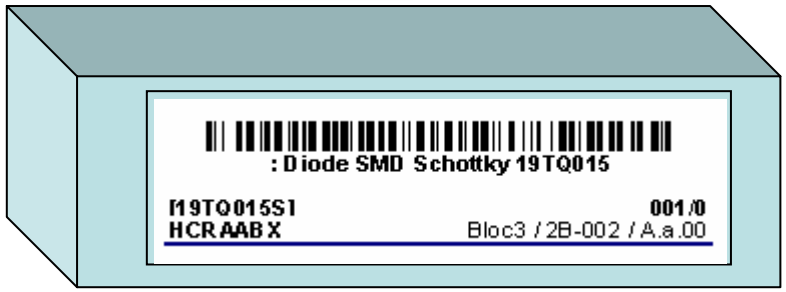




All AB-PO operational documentation can be extracted from EDMS and stored in a USB -Key

The spare parts: codification

One code of each type of component



Auxiliary operational spare parts storage

- All the equipment spare parts in the PS and SPS complex buildings have been inventoried

- 5900 type references / 55000 components identified and stored,
- Components are visible and manageable from the e-catalogue and the e-LogBook

The main operational spare parts storage

- 1400 type references
- 17900 components

Local management system installed

E-catalog AB-PO: example

Spares_Search - Microsoft Internet Explorer

File Edit View Favorites Tools Help

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Address http://webh02.cern.ch/Converters-Databases/net/spares/search.aspx Go Links

Sous familles incluses

- Familles
  - Composants
  - Carte électronique
    - Carte de mesure
    - Carte Mère/Fond de panier
    - Commande d'impulsion
    - Communication/Reseaux
    - CPU
    - DAC
    - DC/DC
    - DCCT
    - FGC/MUGEF
    - Free Wheel
    - Interface
    - Interlock/Diagnostic
    - LOOP
    - Carte Mémoire
    - Carte Multi-fonction
    - MDAC/ADC

Famille sélectionnée : MDAC/ADC

- 0312P : ADC 16 Bit
- 24425P : MDAC-ADC-IO
- 24771P : MDAC/ADC Interface
- 3079P : Fast ADC 16 bits
- 5113 : ADC 14 Bits
- 5960 : 14 Bits ADC Buffer
- EDA-00329 : Multi-Analog
- LEP 680 5012 100 : ADC

Fiche d'identité de la pièce sélectionnée :

24425P
MDAC-ADC-IO

Executions : 0 : base ; 1 : avec IC6B=TL062 ; 2 : avec IC6A=ISO113 ; 3 : avec Timbre 25425P ; 4 : avec TL062 et R7=R9=10K

Job: 24425 EDA: HCRBSBS
Réparation: 19 - 1-025 Réparation FL

Carte électronique-MDAC/ADC-


VERSION : C


VERSION :E

Ordre de Tri: Réf / Désignation

Ci-dessous vous pouvez écrire 'texte%' pour rechercher quelquechose commençant par 'texte' ou '%texte%' pour rechercher quelquechose contenant le mot 'texte'

Référence
Désignation
Code EDMS (HC)
Machine
Equipement
Lieu
Fabriquants
Caractéristiques

Seulement les pièces ayants une quantité

Stock

Versions	Execution	Batiment	Lieu	Qte	Seu Min
000/00C/00E	Standard	19	1-025 Réparation FL	12	0
00C/00E	3 : MINIDISCAP	19	1-025 Réparation FL	0	0
000/00C/00E	Standard	19	1-025 Testé FL	0	0
00C/00E	3 : MINIDISCAP	19	1-025 Testé FL	25	0
000/00C/00E	Standard	19	1-025 à tester FL	26	0
00C/00E	3 :	19	1-025 à	0	0

Done Local intranet

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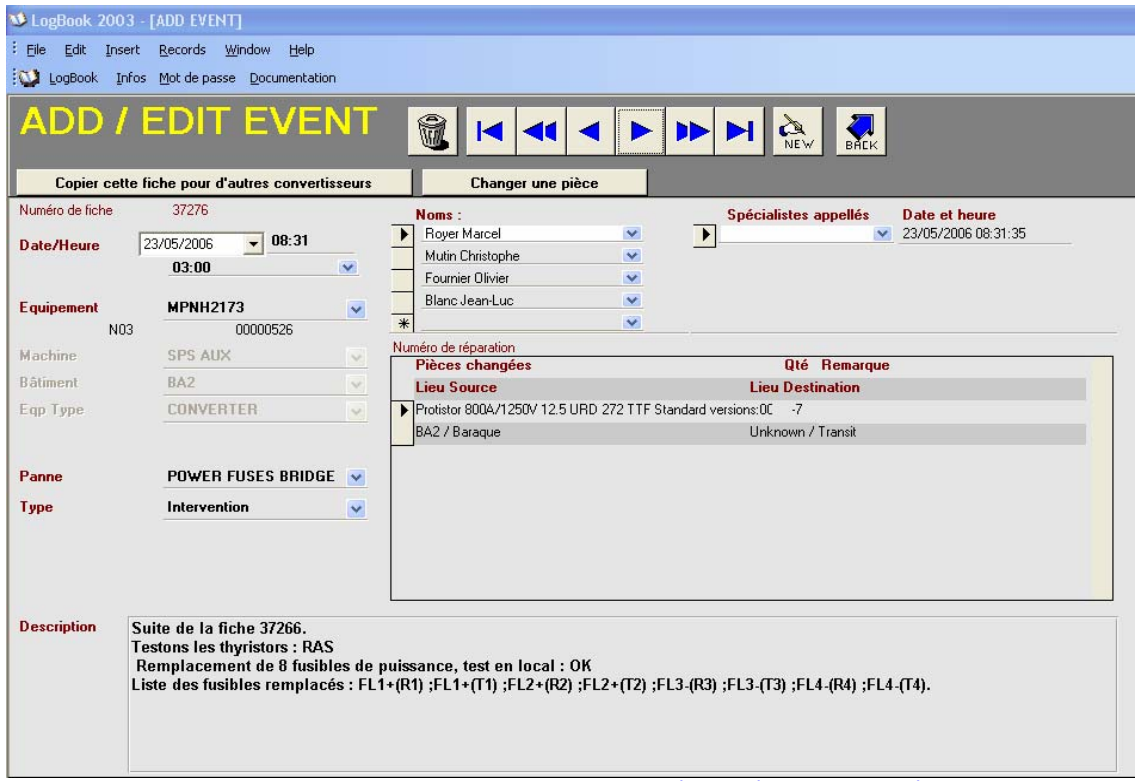
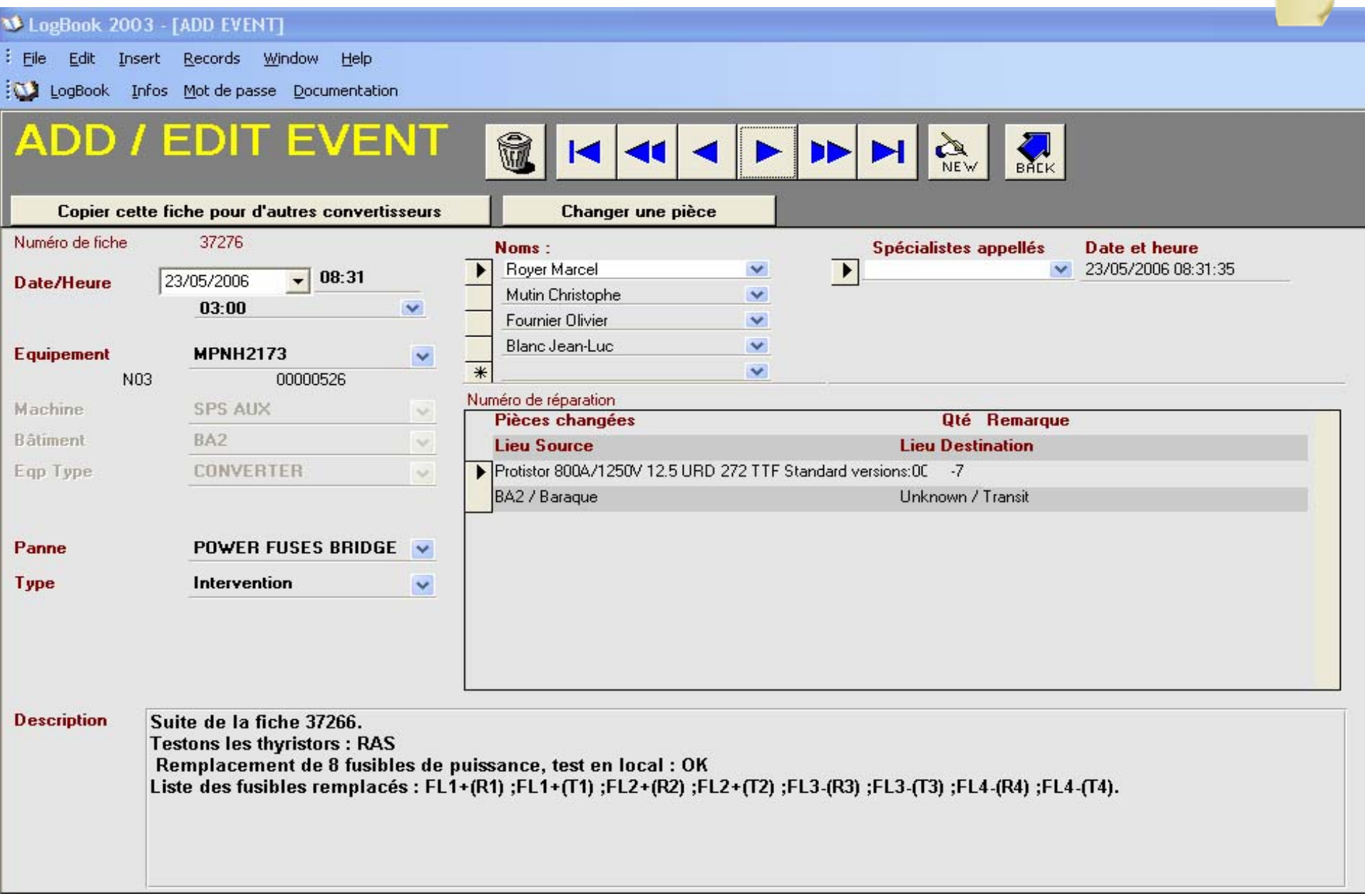
E-logbook AB-PO : The logbook intervention sheets

- They are checked and discussed, one-by-one, at the "piquet" meetings held every Monday morning.
- Each expert receives automatically an E-mail whenever an intervention sheet is created, concerning an equipment under his responsibility,
- They can be filled and accessed from the web,

Logbook AB-PO



E-logbook AB-PO : recording form



Conclusions

1. – Appropriated diagnostic tools for the MTTR/MTBF monitoring have been put in place (MTTR: ~1h, MTBF depending on the CERN complex area)

2. – Vast consolidation plan has been launched to mitigate long MTTR's, but until 2010, the PS rotating Machine represents the highest MTTR risk.

3. – According to the large number of interventions by year, Stand by service ("piquet") was a choice. PIPO is organized by 3 teams, sharing the different areas of the CERN complex;

4. - Spare parts are centralized an managed across the different machines and converter technologies.

5. – Maintenance method service is responsible for the tool developments and operation organization.