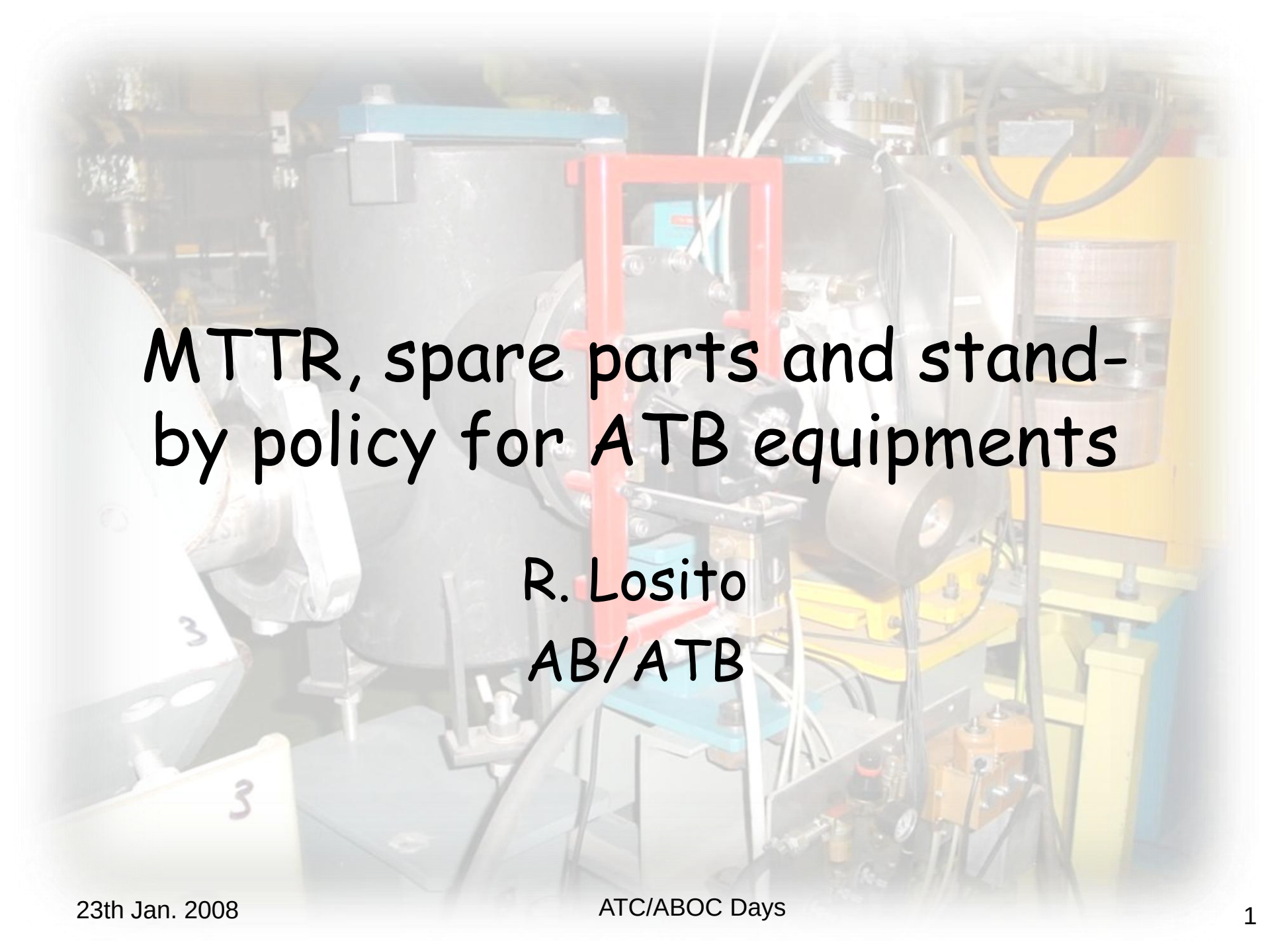

MTTR, spare parts and stand-by policy for ATB equipments

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AB/ATB

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Outline

- Status of mechanics and spares
- Status of controls and spares
- Stand-by policy
- Conclusions

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Spares for the LHC injector chain

Acronym		*short description*	Installed	Spares	Risk
Linacs					
	LTB.SLx	Collimators	4	1?	12
	Itx.SHx	Slits	12	1?	3,6
	Stripping foil	Stripper	1	-	3,6
Booster					
	PPM	Sieve	1	-	3,6
PS					
	Int. Dump 47 + 48	Internal Beam dumps	2	1?*	2,7
	Ralentisseur	Beam dump	1	-	5,4
PS complex					
	xSTPx	Stoppers	20	1 per type	1,8 - 6
TT2					
	Stripping foil	Stripper	1	1	3,6
AD					
	DR.SHV1305	Scraper	1	?	0,6
LEIR					
	Absorber	Pb absorber/stopper	1	-	1,8
	EI?.SLH01?	Slits	2	-	3,6
SPS					
	BRCx	Collimators	3	-	8,4
	TBSE	Transfer line stopper	3	1	8,4
	TBSJ	Injection beam dump	1	-	8,4
	TBSM	First turn stopper	1	-	8,4
	TCE	North extraction collimator	1	1 (old)	8,4
	TCSC	Collimator	2	1	8,4
	TED	Transfer line dump	5	1	8,4
	TIDH	Low energy beam dump	1	1	8,4
	TIDP	Momentum scraper	1	-	8,4
	TIDVG	High energy beam dump	1	1 (old, Ti foil)	8,4

(objects without drawings / documentation or inventory to be done)

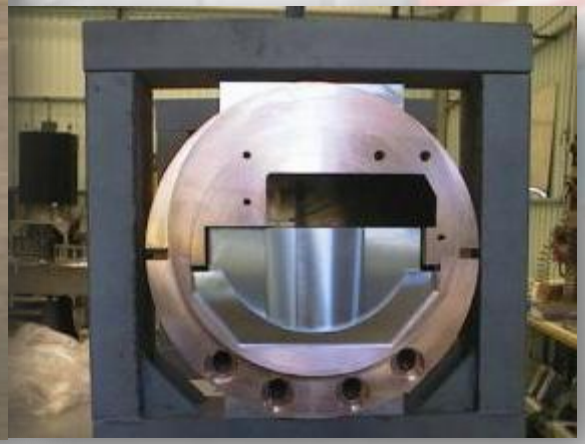
*Vacuum leak on Dump 48, under investigation

Dump family

SPS Inj. Stopper
(TBSJ)

SPS Collimator
(TCE)

SPS Internal Dump
(TIDVG)
Core Assembly



PS Internal dump (48)

"Dumps"

Similarities: Very robust, designed for dumping (LEP times or before), heavy

Risk of failure: medium

Failure: PS dumps: Vacuum or water leak, motorisation (recently)
TED: Water leak, switches
Other dumps: Water or vacuum leak

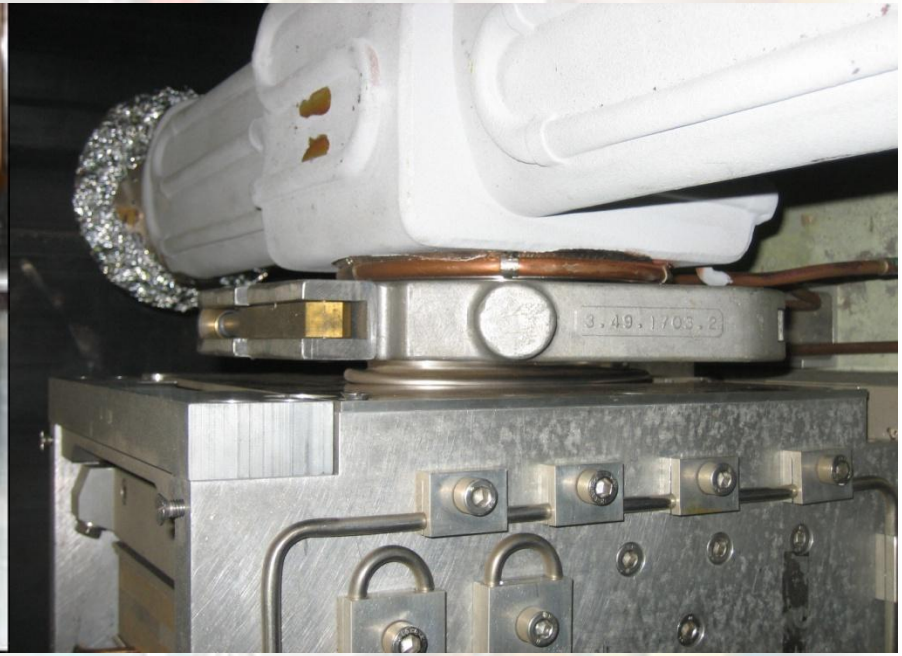
Strategy: Replace object, no intervention for repair (radiation level)

MTTR(replace): 2 days

Spare TIDVG to be upgraded (consolidation), no final design spare, PS dump to be analyzed

Acronym	*short description*	Installed	Spares
Dump family			
Int. Dump 47 + 48	Full beam dump transfer lines	2	X
TBSJ	Injection beam dump	3	1
TED	Transfer line dump	5	1
TIDH	Low energy beam dump	1	-
TIDV	High energy beam dump	1	-
TIDP	Momentum scraper	1	1 core
TCE	Extraction collimator	1	
TCSC	Extraction collimator	2	1
Ralentisseur	Beam dump	1	-

PS Dump 48



"Stoppers"

Similarities: Movable devices, robust design, interlock chain for access

Risk of failure: medium

Failure: Pneumatic jacks, Read-out (switches), vacuum leaks.

Strategy: Replace object, limited intervention on pressurized air and switches, preventive maintenance and monitoring

MTTR: 1.5 days

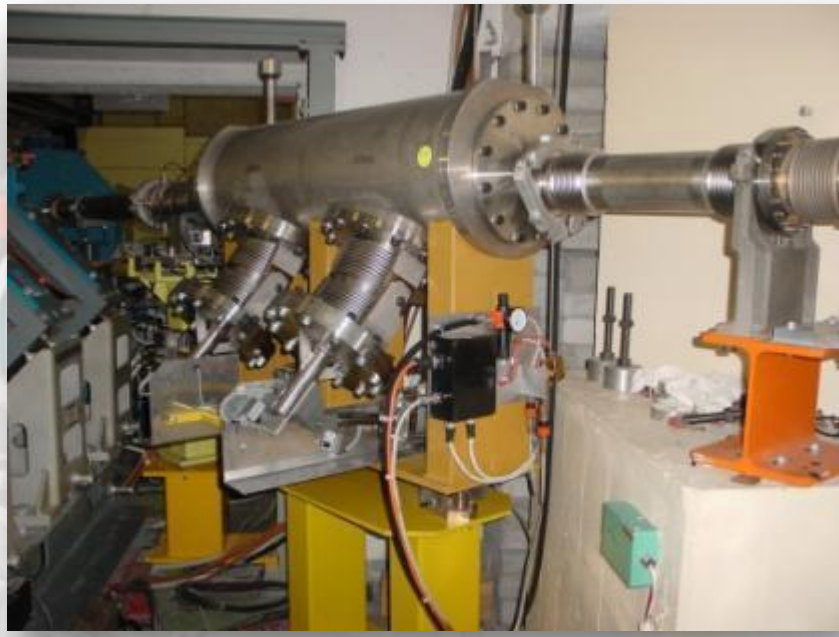
Switch plate prepared for quick exchange (has to be upgraded for 60% of old stoppers)

Acronym		*short description*	Installed	Spares
Stoppers				
	xSTPx	Safety stoppers (slow, fast, single, double, small)	30	1 per type
	TBSE	Transfer line stopper	3	1
	TBSM	First turn stopper	1	-

Stopper family

SPS Transfer line Stopper (TBSE)

PS slow Stoppers xSTPx



SPS 1st Turn Stopper (TBSM)

"Collimators and slits, others"

Similarities: Movable devices, robust design, small

Risk of failure: medium

Failure: Pneumatic jacks or Read-out (switches), vacuum leak, mechanics

Strategy: Replace object, limited intervention on pressurized air or motorisation and switches, preventive maintenance and monitoring

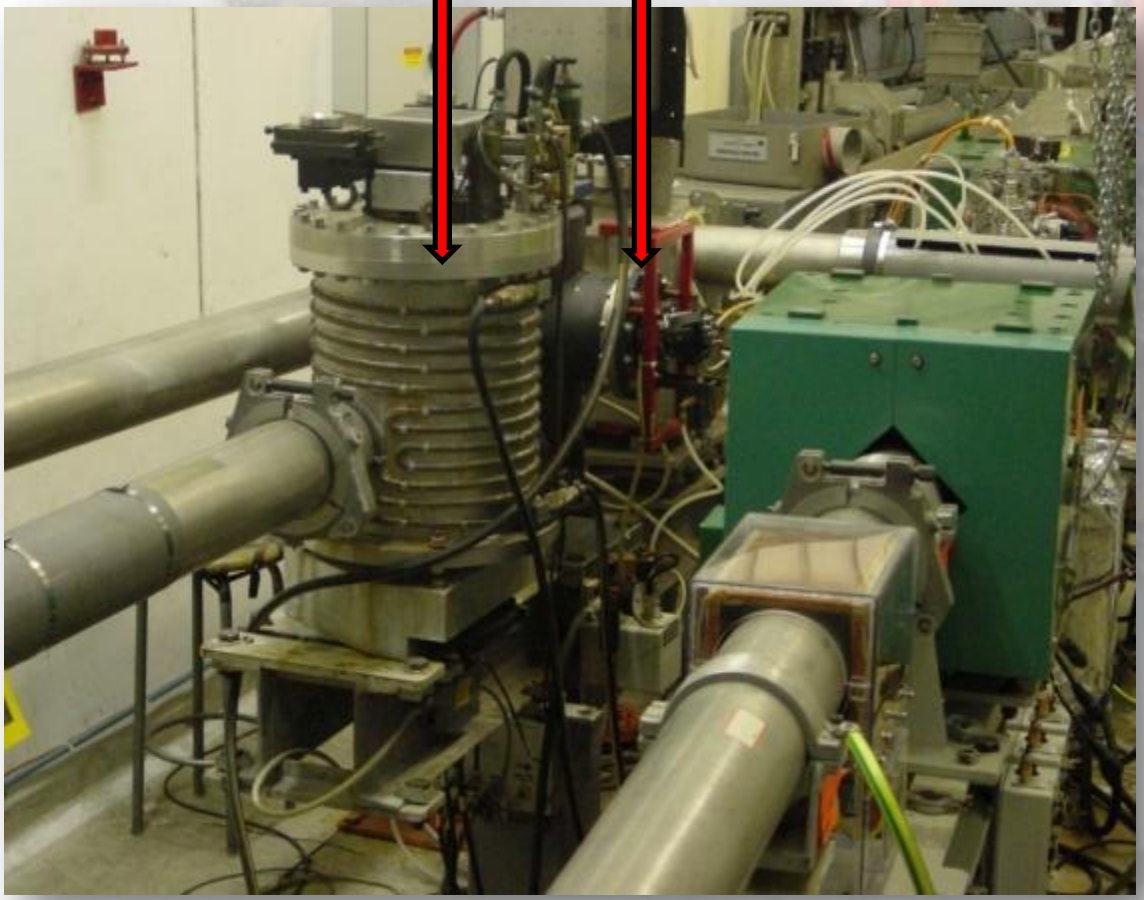
MTTR: 1 day

Acronym		*short description*	Installed	Spares
Collimators and slits				
	BRCx and LTB.SLx	Collimators	7	1
	EIx.SLH01x and Itx.SHx	Slits	14	1
	Absorber	Pb absorber/stopper	1	-

Acronym		*short description*	Installed	Spares
Sieve, scrapers, stripper				
	PPM	Sieve	1	- (recommended by APC)
	DR.SHV1305	Scraper	1	1
	Stripping foil	Stripper (TT2/Linac3)	2	1/-

Special

Sieve and fast stopper



Pb absorber/stopper

North Area Beam Obstacles – AB/ATB

Description	Types	# Installed			Repair time	Impact in case of failure
		TCC2	Others	Total		
Absorbers	XABS XCIO XCON XTGU		9 7 9 1	9 8 11 1	~ 1 day	Beam line stopped or reduced beam performance
Collimators	XCHV XCSV/H XCLD	2 7	7 17 3	9 24 3	~ 1 day	Corresponding beam stopped or limited functionality
Dumps	XTDX XTDV		2 5	2 5	~ 1 day, ~1 week	Can be compensated by reconfiguration of the access system
Tilter	XTIO		1	1		Presently not in use
MicroColls	XCRT		2	2	~ 1 week	Primary beam in H8 excluded
Splitter	XSPL	1		1	1 year	No spare available! No ions possible in H2 (NA61)
Beam Acceptance - Colls	XTAX	12	5	17	1 year	No spares, renovated 2001-2003 Block beam line

With the exception of XTAX, Microcollimators and XTDV's, spares are available and can be installed in 1 day. Extra time for cool-down required if in TCC2, affecting the whole North Area.

North Area Beam Obstacles – AB/ATB

- Mechanics of beam obstacles not in bad shape
  - The most critical items, XTAXs recently renovated
- Spare elements exist or can be made in reasonable delays
- Failures and interventions typically stop the corresponding beam line.
  - Can be absorbed with re-scheduling and good will from the experiments
- Failures in elements located in the upstream part of the beam lines or in TCC2 imply switching off the whole North Area for the time of the intervention
  - Plus the cool-down time if in TCC2

East Area

Description	Types	Installed	Repair time	Impact
Stoppers	STP	10	~2 weeks	East hall beams stopped *)
Collimators	MCH, V	9	~ 2 weeks	East hall beams stopped *)
Marguerites		3	~ 1 day	1 beam stopped (3 for North target)

Both the T7 and North branch marguérites are broken and must be repaired during the shutdown (BI + ATB)

DIRAC has asked for a spare T8 marguérite to be prepared (BTV → AB/BI)

*) Intervention requires opening of the roof and intervention by crane
Stops all East Area beams

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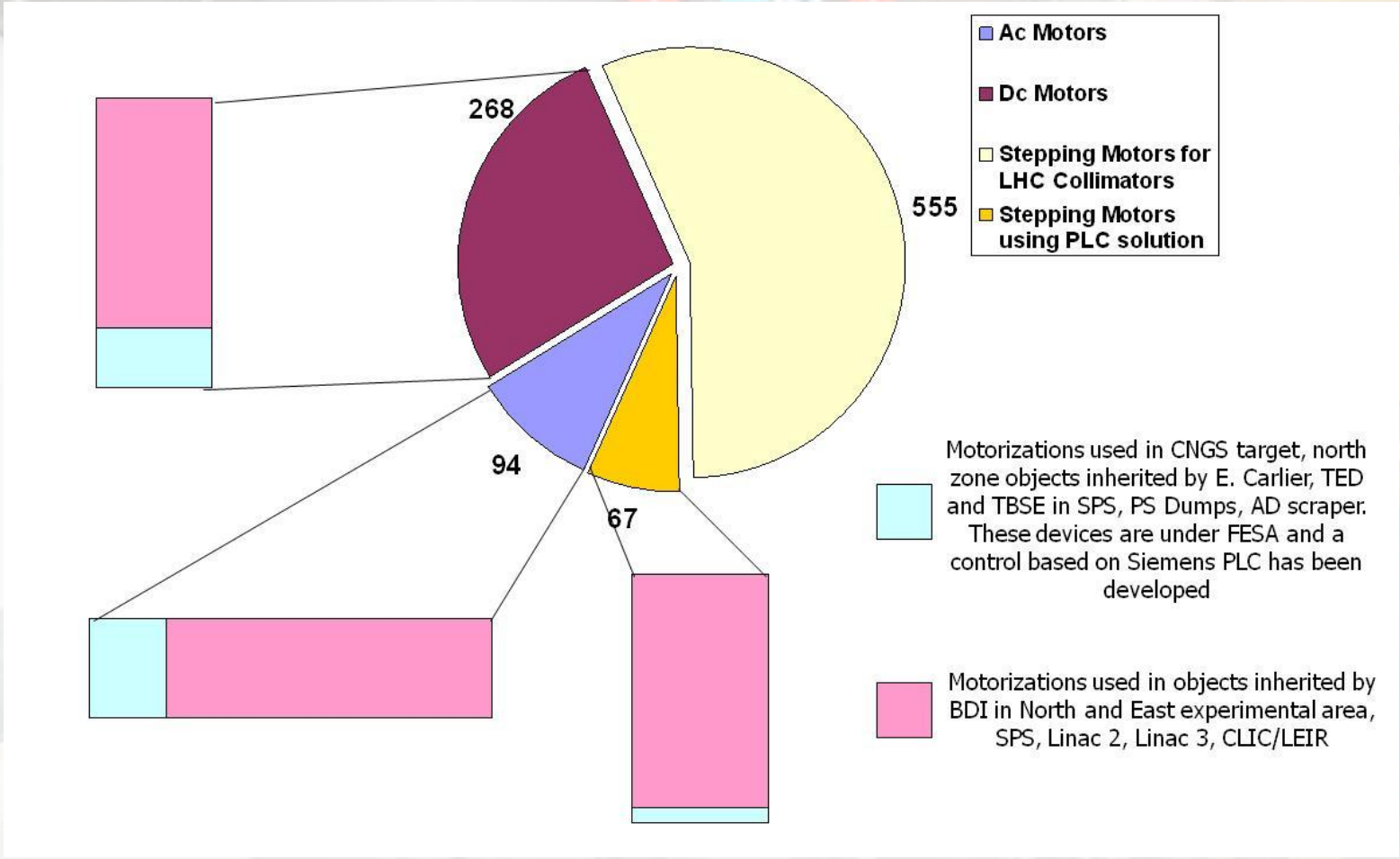
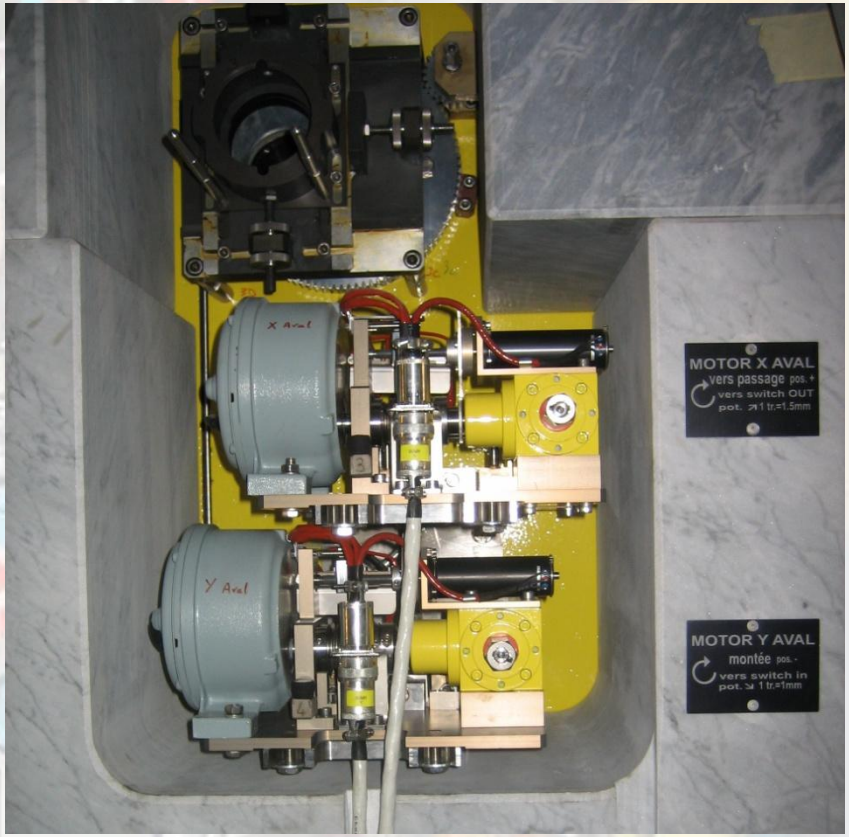
Status: controls



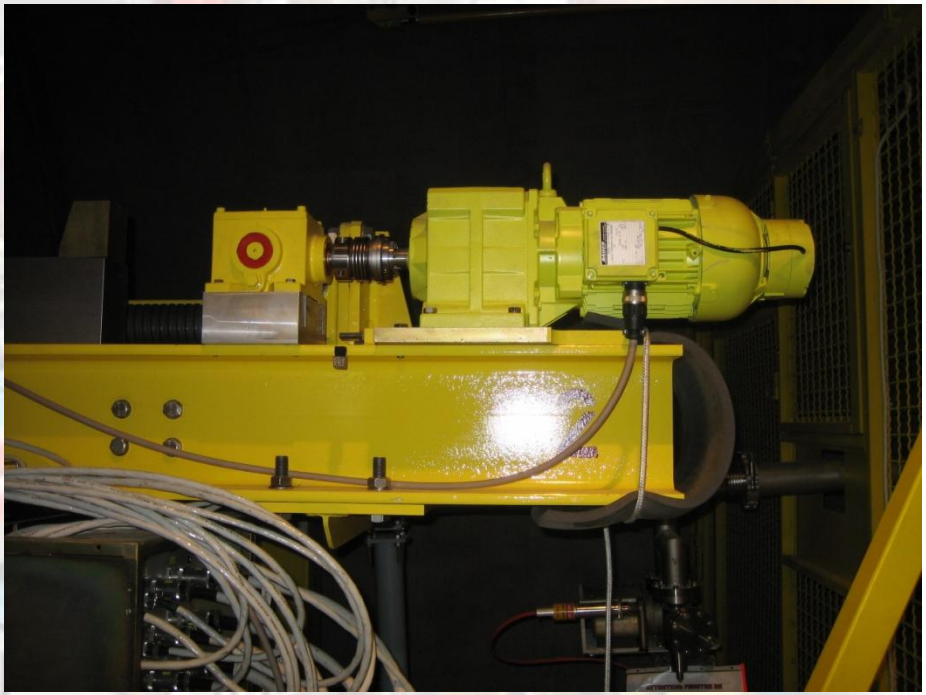
DC Motorization

- based on a DC motor with the positioning feedback ensured by a rotary or linear potentiometer.
- Used in CNGS target, T2, T4, T6, T10, TIDH, TIDV, TIDP, TBSJ

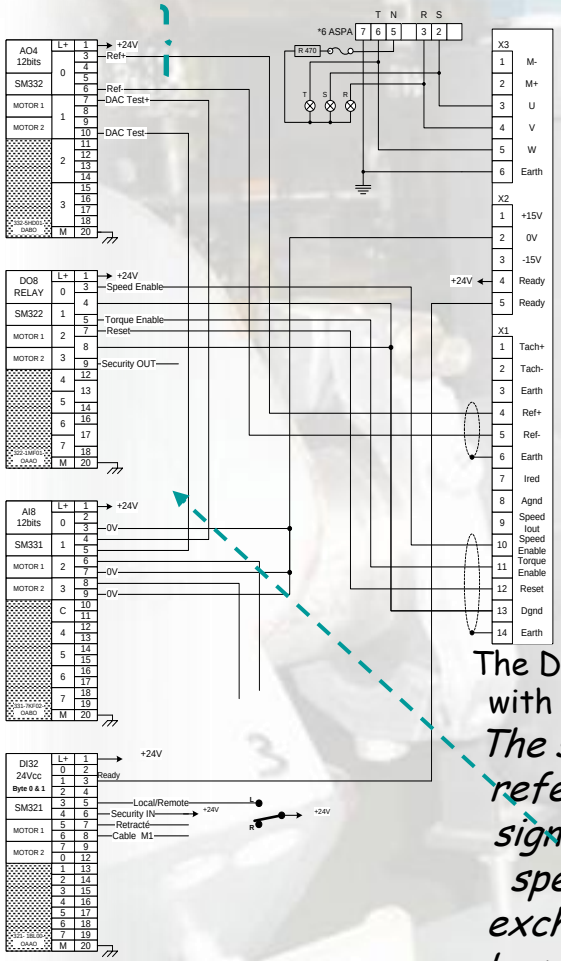


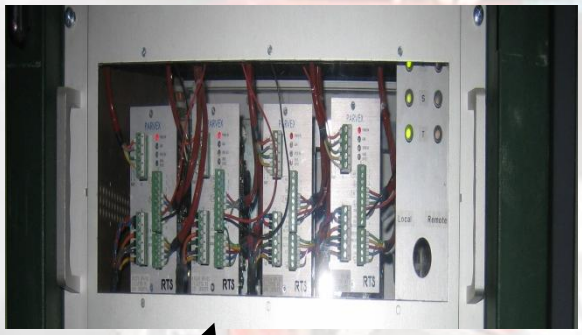
AC Motorization

- based on a AC motor generally with or without (In/Out) position feedback.
- Used for heavy loads (shieldings, dumps…)

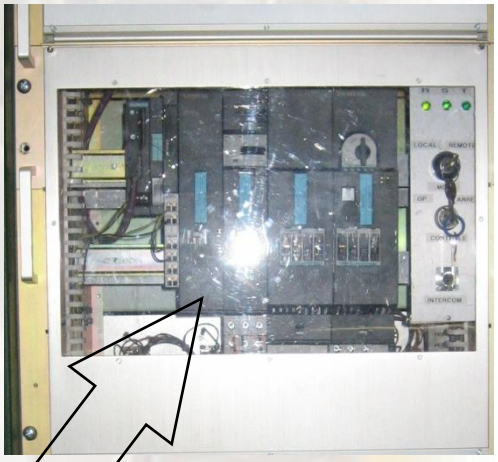


Siemens Control Solution:

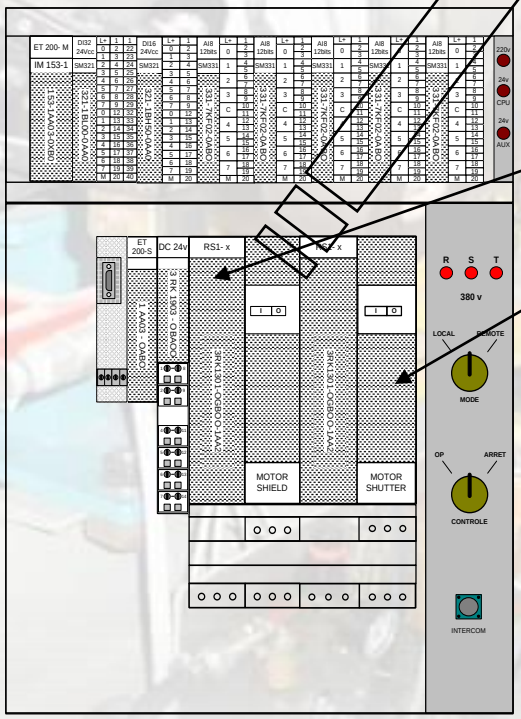




Parvex RTS



The DC motors are controlled with PI drivers Parvex RTS The speed and/or torque reference, the enabling signals and the current speed and torque are exchanged with the PLC by means of DO, AI and AO modules.



The AC motors are controlled with the Siemens AC starter modules RS1-x

Spares

- For equipment in SPS, transfer lines and CNGS up to 30%
- Synergy with BT (same motors and controllers)
- Controls electronic recent, we can buy additional spares if needed.

Equipment in North and East experimental areas

Inventory: 76 AC Motors
213 DC motors

AC and DC Motors

The motors are controlled by a CERN-made module called the Position Controller on a CERN-made field bus called the Equipment Bus. For the AC motors there is an additional power chassis.
In the Equipment where objects move only in IN/OUT position the control of these motors is integrated in a system based on PLC. The PLC controls a module called the Motor Driver for the DC motors and a power chassis for the AC motors.

Spare parts

In theory enough (all those dismounted in the West area by BI), but integration into CCC controls no more supported by AB/CO (only Alistair knows how to do it!). Need to be renewed (Siemens solution), but no consolidation budget available (>1MCHF).

Equipment in SPS, Linac 2, Linac 3, LEIR

Inventory: 63 stepping motors

Control solution for Stepping Motors

- Scrapers and collimators in SPS LSS5
  - 12 stepping motors and 10 position read-out resolvers in total, controlled with a MIDI electronics, from SPS building BA5
- 25 "Slits" in Linac, 24 in Linac 3 and 4 in CLIC and LEIR
- Old system G64

Spares

- MIDI (SPS and LEIR): shared with BI
- LINACS: no spares: to be consolidated during 2009, new solution (based on "CO standard solution") operational in 2010 (subject to availability of additional staff from consolidation budget).

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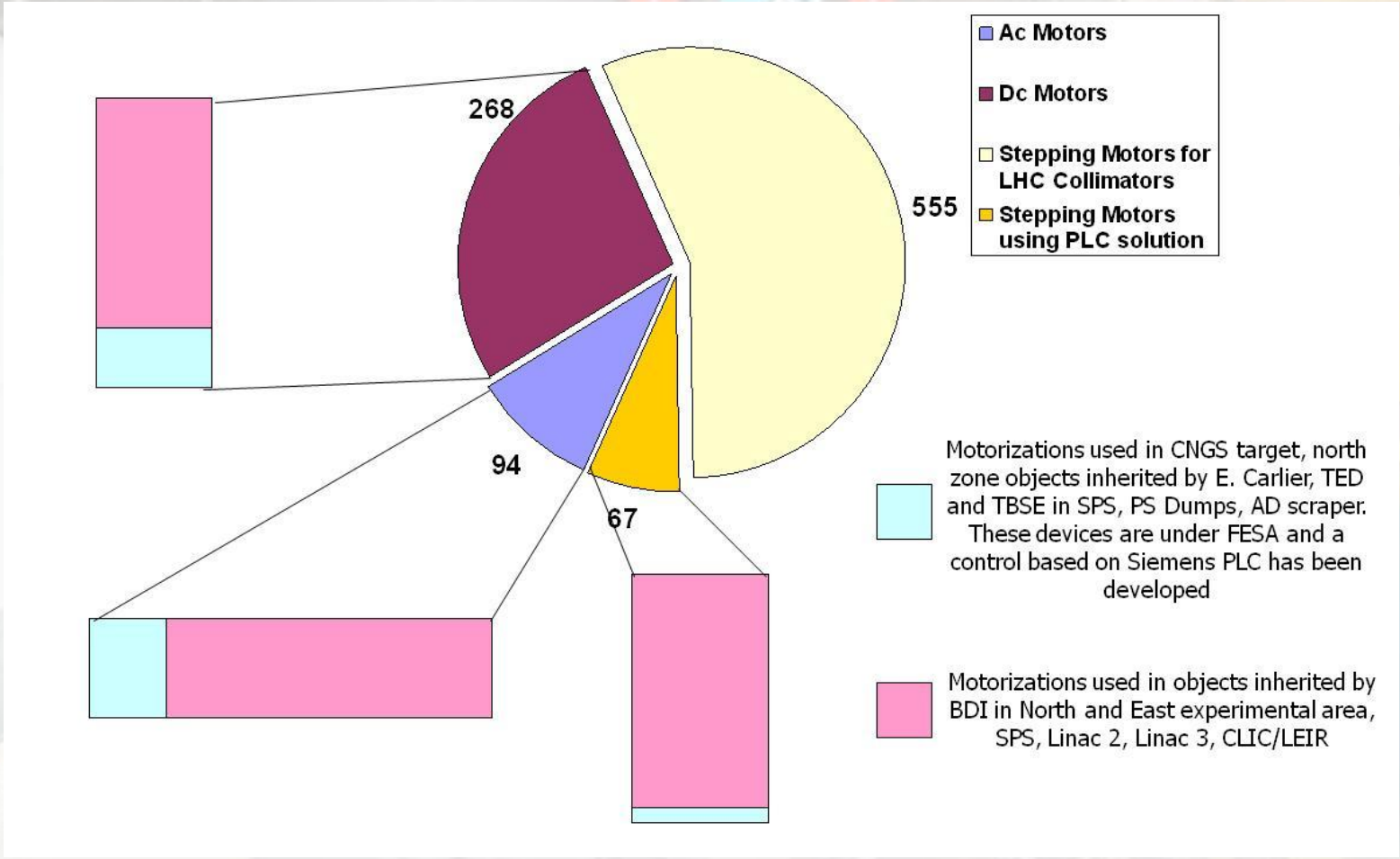
Stand-By Policy

- ATB has no stand-by service
- We do not foresee to have one: number of calls/year 10÷20/year per team (mechanics/electronics). Mostly minor problems.
- Main reasons of calls:
  - Beam stoppers blocked (compressed air or electrical)
  - Failing end-stroke Switches
  - Problems of connectivity to equipment or alarms/interlocks. Often during start-up.
- To be re-assessed after LHC start-up?

Status: controls



Conclusions (1/3)

- Situation under control in SPS & transfer lines but:
  - TIDVG to be modified or re-designed
- Situation not under control in PS complex:
  - Objects obsolete
  - Limited knowledge of their status and limits
  - Consolidation will improve most urgent problems.
  - On long term, better knowledge should be built to ensure compatibility with circulating beam
  - Side effect of consolidation: people now use the objects increasing the risk of failure!!!

Conclusions (2/3)

- Situation not under control in PS complex:
  - PS Dumps: no more spare?
  - Sieve: spare recommended by APC, under discussion for consolidation program.
  - Safety elements: consolidation budget will be made available in 2008.

Conclusions (3/3)

- Situation not under control in Experimental Areas:
  - Mechanics ok
  - Controls obsolete, only Alistair knows how to keep them alive
  - Budget to renew hardware too high for consolidation (>1.5 MCHF, <5kCHF/axis)
  - CO (Alistair) should continue to support the SL-equip and Equipment bus till a solution ($) is found.