LS2 Asset Management for BE/RF

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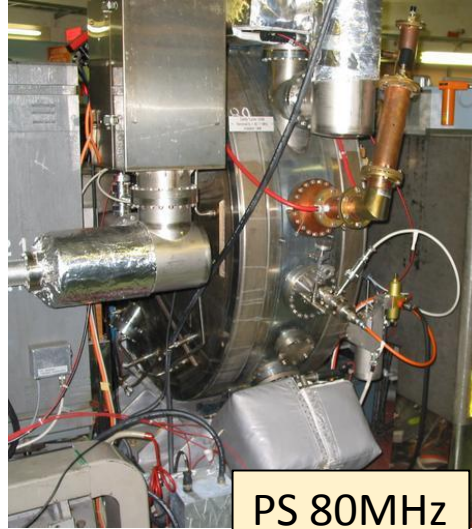BE AMF Annual Meeting 07.11.2019

Outline

- BE/RF assets

- Experience with asset management
  - Tracking of assets
  - Interventions and planned maintenance
  - Documentation
  - Ongoing developments

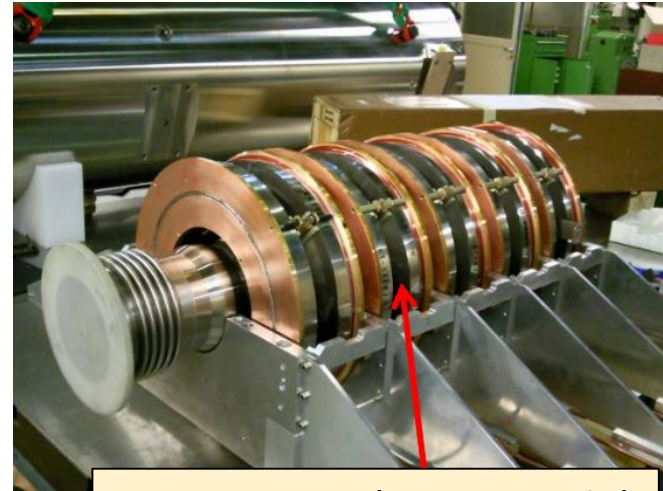- Potential future developments and improvements

- Conclusions
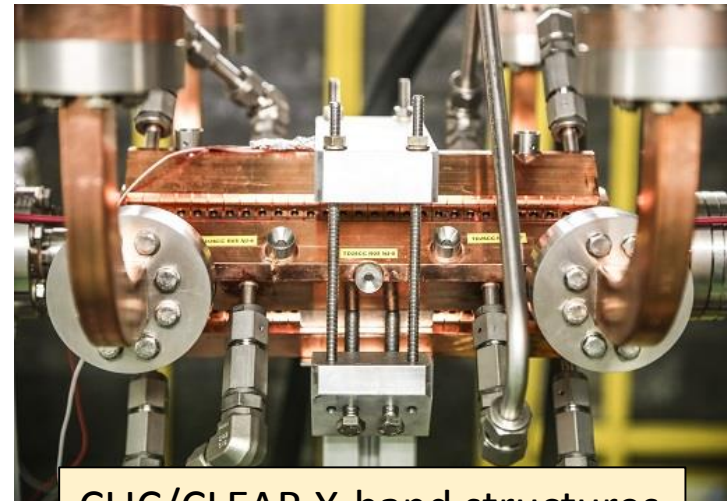
Cavities: normal conducting

LINAC4

PS 80MHz

PSB FineMet (LIU upgrade)

SPS Travelling Wave

CLIC/CLEAR X-band structures

Cavities: superconducting
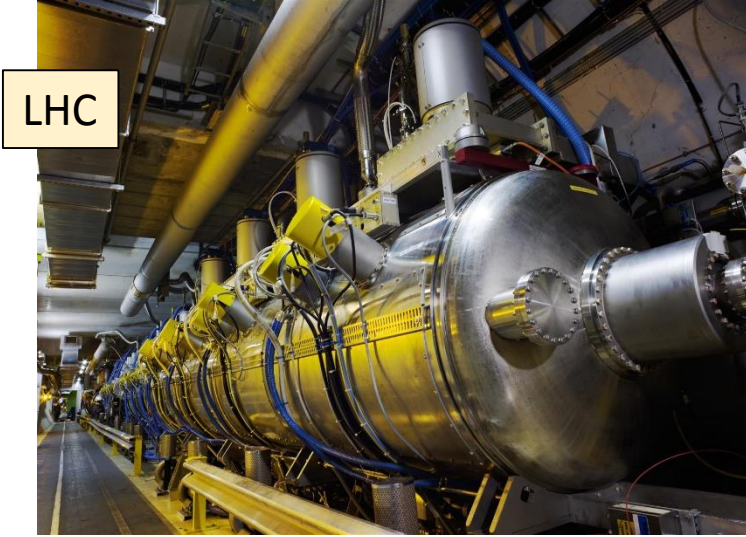
LHC
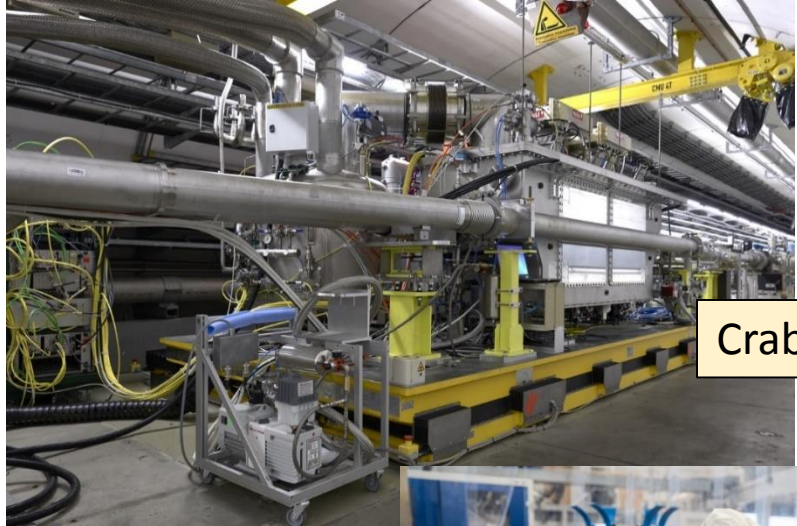
Crab cavities

HIE-ISOLDE

SRF R&D

Amplifiers: tubes
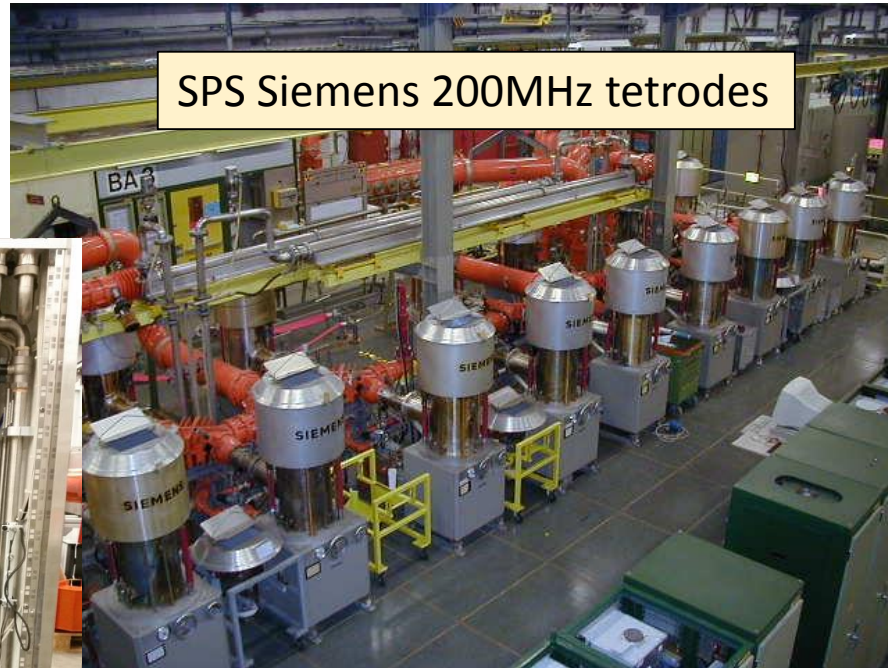
SPS Siemens 200MHz tetrodes

SPS 200MHz tetrode

SPS 800MHz IOT
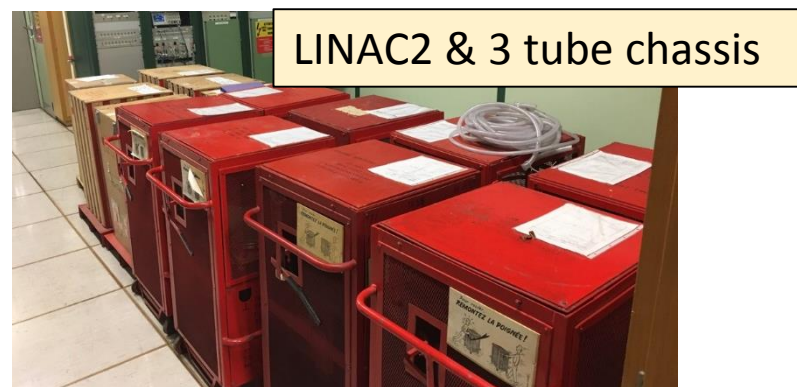
LINAC2 & 3 tube chassis

LHC transverse damper

Amplifiers: klystrons

LINAC4 352 MHz klystrons
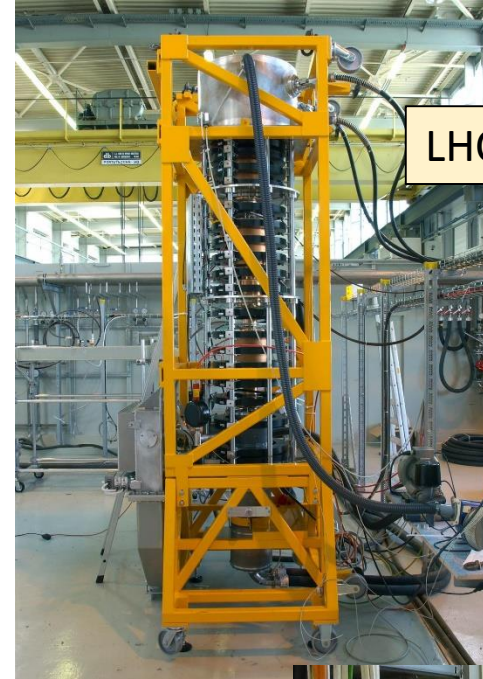
LHC 400MHz klystron
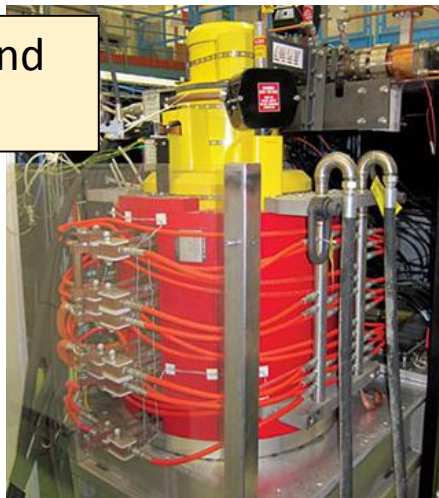
CLEAR 50MW X-band (12 GHz) klystron

LHC HV bunker

Amplifiers: solid state
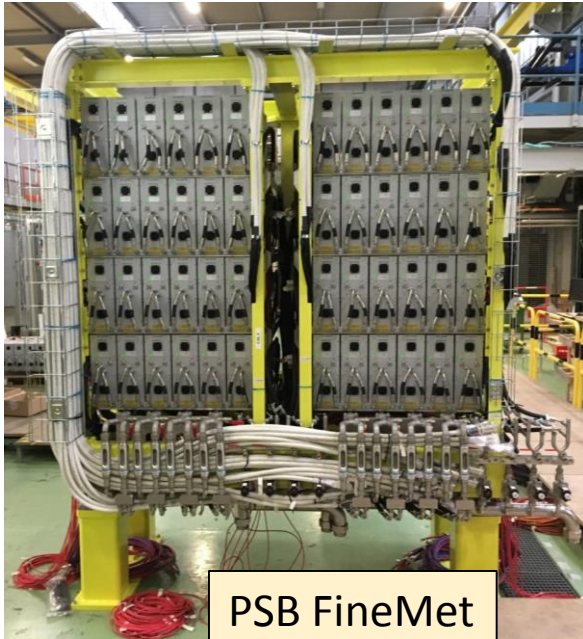
PSB FineMet

LINAC4 Debuncher

SPS 200MHz LIU upgrade

Electronics and controls

PSB LLRF electronics
(RF and FPGA)

LHC LLRF Faraday cage
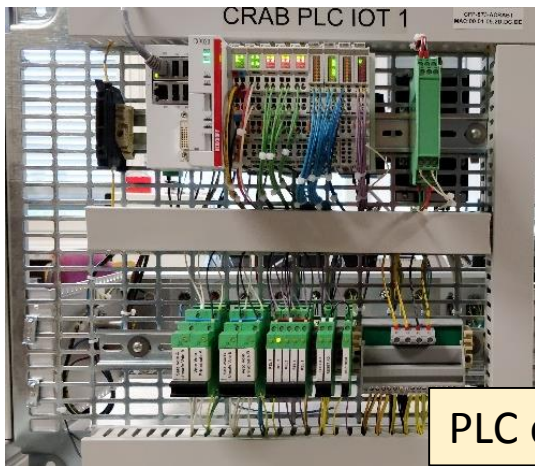
PLC controls
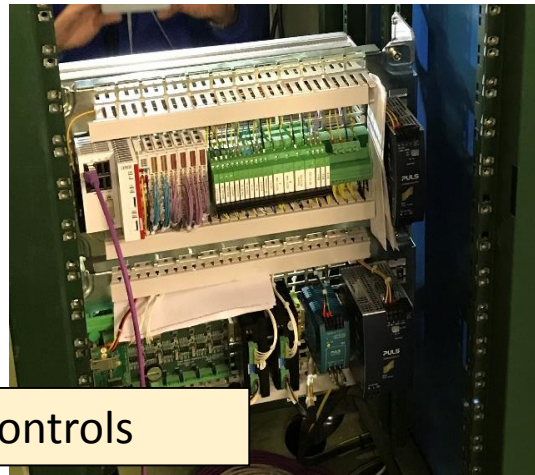
Also…

- Kickers, RF distribution (waveguides & coaxial lines, circulators & combiners)
- RF equipment test stands
- Spares & components
- Software
  - controls & acquisition, software and firmware development tools, electromagnetic and beam simulations
- Documents and drawings (EDMS, CDD)
- In general: small numbers of pieces, large number of different types
- Numbers:
  - Assets registered in Infor: 71 651
  - Functional positions in Layout: 2 624
  - EIS Functional Positions in Layout: 52

Experience with Asset Management

- Major construction projects using MTF (and Layout):
  - Linac4 RF structures (including tuners but not RF couplers)
  - HIE-ISOLDE cavities and cryomodules
  - CLIC X-band structures
  - HL-LHC Crab cavities and cryomodules
  - LHC cavities and cryomodules
    - Continues to be regularly updated with new test data
  - New LHC spare cavities

Structure very static and difficult to rectify mistakes

Too heavy for the few pieces we have

Assures information survival when colleagues leave, new ones arrive

We could have used it for production but much faster with Excel sheet

We are not industry, we do small series and prototypes, we don't build LHCs every day

Essential tool to have single point of entry for documentation, links to EDMS etc.

Very practical when new (younger) colleagues arrive

Experience with Asset Management

- Large assets not in MTF or EAM
  - FineMet cavity production
  - Cavities, amplifiers, power couplers, tubes and klystrons, HV components, modulators, loads

- Spares management
  - Small numbers of spares, but for many different systems
  - Major items such as tubes, couplers, power transistors, power supplies, electronic modules
    - lists of stock, spares for operation, mostly in shared Excel sheets, either on DFS or accessible via web pages
    - responsibility of each system expert to ensure sufficient spares, and know where to find them
  - Tubes procurement common between PM, IS and LRF sections
  - Small components and consumables usually managed ad hoc

Documentation

- EDMS (linked to MTF)

- Wikis (more dynamic than EDMS)

- DFS shared files (responsibility of each equipment expert)

- Drawings:
  - For new material, in CDD
  - Lots of old equipment (cavities 20/30 years old), sometimes have to manufacture parts
  - often drawings missing (especially in-kind contributions), had to be recreated

Preventive maintenance

- Tubes
    - Finite lifetime (operation hours)
    - Scheduled replacement managed using Excel

- Klystrons
    - Finite lifetime but variable
    - Run until degradation indicates replacement/repair
    - LHC klystrons rotated with spares (wear spreading)

- Solid state amplifiers
    - PSB FineMet amplifiers:
        - expected to have few years lifetime before performance degradation warrants transistor replacement
    - SPS LIU Tales towers:
        - replace failed amplifier modules (expect maximum 1 per week)
        - redundancy allows scheduled intervention

Current developments

- Kiosk application for SRF parts management in building 252
    - Consumables and parts: flanges, nuts etc.
    - Assets:
        - specific tooling
        - instruments (calibration dates)

- Working with INFOR to
    - match assembly drawing's BOM with the part management DB
    - define workflows, interplay between Infor EAM and MTF
        - assembly of parts into assets
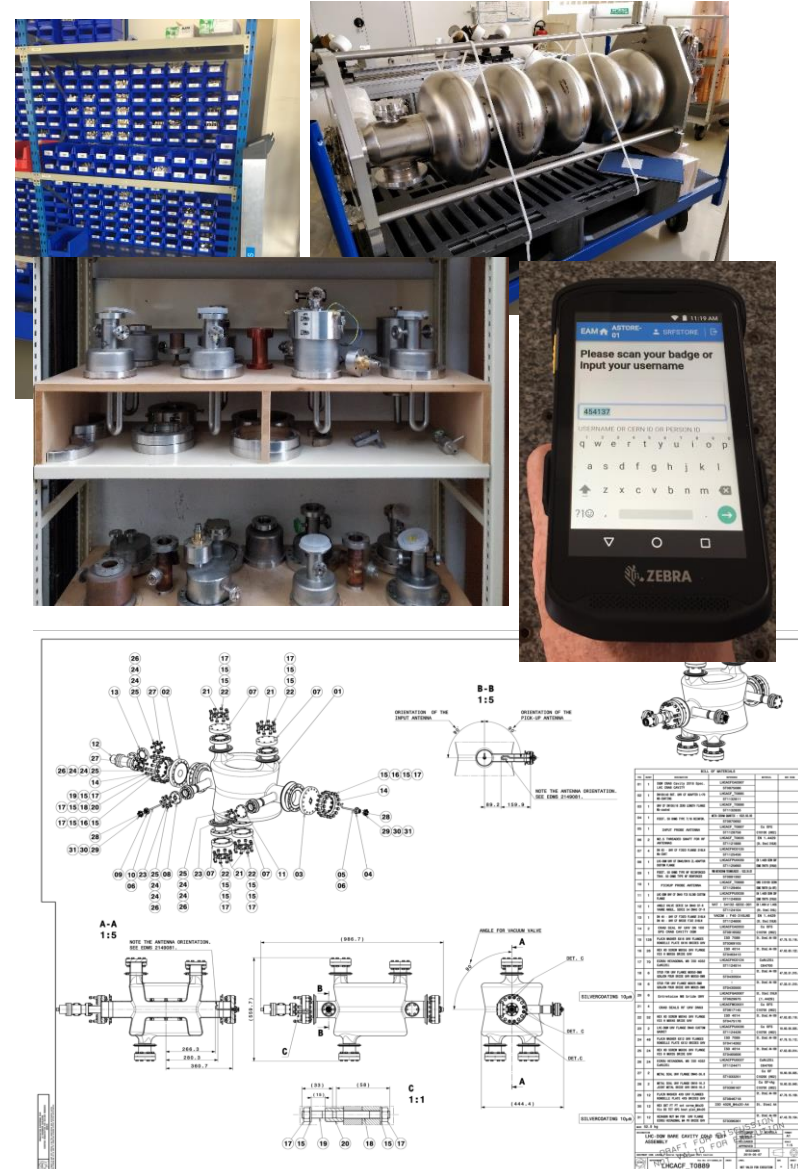
Current developments

- IS section also in process of putting kiosk application in place for management of stores
    - Mechanical pieces, tubes, consumables, transistors etc.
    - 1 store in 5 different buildings
    - Hope to have building 151 up before end of year

STORE BE/RF-IS

151

361

152

193

359

Armoire No XX

A1-1 / A1-2 / A1-3	A2	A3	A4

B1	B2-1 / B2-2	B3	B4	B5	B6

C1	C2	C3	C4

D1	D2-1	D2-2	D2-3	D2-4
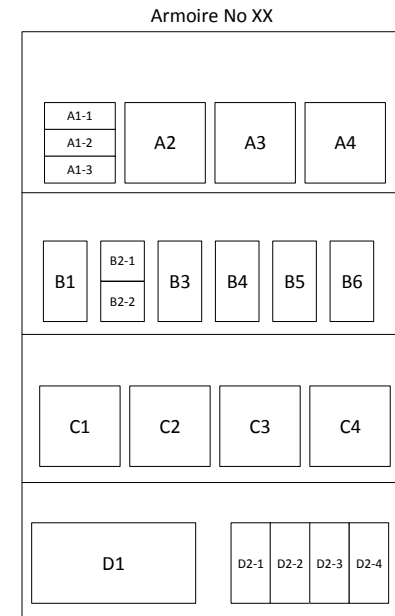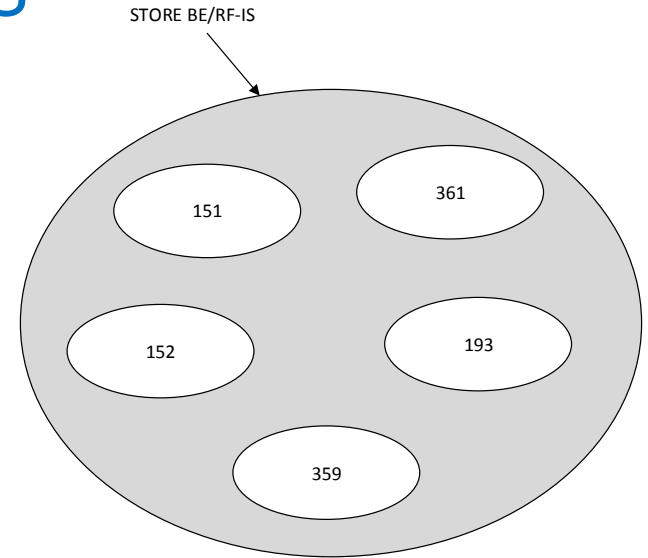
Potential future developments

- Interest in tubes management application (PM, LRF and IS sections)
  - Replace diverse Excel spreadsheets for tube lifetime tracking and preventive maintenance
  - Live data on tube operation hours from PLCs?

Could start soon: 2020 ?

- Interest for solid state amplifier tracking
  - Linac 4 DB Elettronica amplifier modules
    - 5 power modules x 4 palettes x 6 racks
      - Lifetime installation and tracking, planned maintenance
  - PSB FineMet amplifiers
    - 144 solid state amplifiers
    - Mounted on cavities – radiation environment
    - Tracking of transistor gain and bias current adjustment
    - Preventive maintenance (transistor replacement)
  - SPS 200 MHz Thales SSPA towers
    - 2500 amplifier modules in 32 towers
    - Test data in 1500 Excel files from manufacturer
    - No preventive maintenance,
    - But: tracking of failures, long-term correlations
  - Live data on amplifier performance?

Too early now, as need to get experience with new systems. From 2021 ?

Potential future developments

- PM section: Large pieces (cavity, waveguide, other large items)
  - Currently in Excel file linked to photo gallery
    - images are important!
  - Person who created it has left CERN
  - Interest in migrating this information to Infor

PHOTOS	NOM ARTICLE	PLACE	EMPLACEMENT	BAT	QTE	DATE D ENTREE	DATE DE SORTIE	DEMANDEUR	TRIE
	outillages troley ampli 400 MHz driver	T08BPBT	CALVO-17	879	1 palette	01/07/2016			uppsala fred
	WG COUDES ET SOUFFLET 800 MHz	T07BPBT	CALVO-18	879	1 palette	01/07/2016			
	HYBRIDE COMBINER 704 MHz	C50ASTE	CALVO-19	879	2	01/07/2016			
	TROLEY AMPLI 400 MHz	C50ASTE	CALVO-20	879	1	01/07/2016			uppsala fred
	WG 800 MHz 1x1m ET 2x2m	T15BPBT	CALVO-21	879	1 + 1	01/07/2016			
	TROLEY AMPLI 200 MHz WB	T11DPBT	CALVO-22	879	1	01/07/2016			
	PIED CAVITE 200 MHz	H33	R7485	133	3	27/06/2016			
	SIEMENS NEW AMPLI PIECES	H33	R7000	133	2 PALETTES	27/06/2016	20/03/2018	seb	
	MAQUETTE 3D SIEMENS / PHILIPS	H33	R7226	133	1 PALETTE	27/06/2016			A JETER
	HYBRIDE COMBINER 250 Kw	H33	R7226	133	1	27/06/2016			
	WG WR2300 FLEX+CC VARIABLE	H33	R7363	133	1 PALETTE	27/06/2016			
	PALONNIER CAVITE 800MHz	L66CSBT	CALVO-23	879	1				
	LIGNE TEST COUPLEUR 200MHz	B22ASBT	CALVO-24	879	1				
	LIGNE RF - ADAPTATEUR D230	XXXXXXXXXX	CALVO-25	879	1 PALETTE		????/2017 A VERIFIER		
	ADAPTATEUR D230	P650GPBT	CALVO-26	879	1 PALETTE				
	ADAPTATEUR 3/8'' - D230 PINCES + MANCHETTE AIR	XXXXXXXXXX	CALVO-27	879	1 PALETTE		????/2017 A VERIFIER		
	RACCORD TUYAUX CHARGE 550K	P53FPBT	CALVO-28	879	1 PALETTE				
	COUDE D230 / COUDE COUPLEUR CAVITE 200MHz	XXXXXXXXXX	CALVO-29	879	1 PALETTE		????/2017 A VERIFIER		
	COUDE SPINNER D345	N53EPBT	CALVO-30	879	3				
	CIRCULATEUR CRAB CAVITY	T01ASBT	CALVO-31	957	2		sortie le 11/09/17		transfer au BA6
	CAVITE 800MHz + SUPPORT CAVITE	L66DSBT	CALVO-32	879	1				

Potential future developments

- Interest from CS and FB sections in kiosk application for spares and parts management
  - electronic boards (LLRF, control)
  - PLC parts
  - High-value, long lead-time components such as FPGAs

Conclusions & final remarks

- Some/most large projects using MTF

- Other asset management (spares, maintenance) using a variety of methods (usually Excel)
  - works well in most cases
  - but recognition that this is somewhat fragile

- Increasing interest in using Infor EAM for specific applications
  - Spares and stock management
  - Management, tracking and preventive maintenance of tubes and amplifier modules

- "Pilot projects" to assess the return from time invested

- Ideally would have a specialist in the group to help with definition and implementation