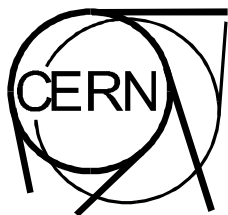


**E072/ST-HM**

**A dynamic maintenance strategy to meet  
the requirements of the LHC installation**

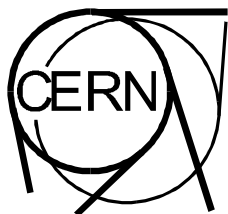
**ST Workshop 2003**

**- Oliver Böttcher -**



## **Contact E072/ST-HM**

- ◆ **Topic: Maintenance of Industrial Transport and Handling Equipment (IT-3049/ST)**
- ◆ **Put in place 01.10.2002**
- ◆ **Contractor: Cegelec, Spie, Fenwick-Linde**
- ◆ **Volume: 4'346'900 CHF**

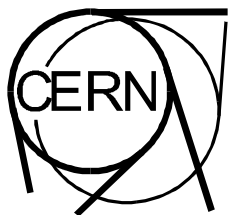


# E072/ST - Equipment

- ◆ ~840 equipment items for prev.+corr. maintenance
- ◆ ~1650 items only for corr. maintenance

List No.	Family Name	Type	Description	Number of Items	
				prev. + corr. maintenance (listed)	only corr. maintenance (not listed)
1	<b>Hoisting equipment (HHL)</b>	PR	PONTS ROULANTS	317	0
2		PA	PALANS	91	~800
3		R	PALONNIERS	5	~100
4	<b>Acces (HHB)</b>	PO	PORTES MOTORISEES	10(34*)	0
5		BA	BARRIERES	3	0
6	<b>Lifts (HHA)</b>	LV	ELEVATEURS, PLATEFORME ÉLÉVATRICE	71	0
	<b>Horizontal Transport Vehicles (HHR)</b>	RH	REMORQUES	0	~38
7		TH	TRACTEURS CESAB	14	0
8		TL	TRACTEURS WIEDEMANN	111	0
		TP	TRANSPALETTES	0	~400
		VE	VEHICULES ELECTRIQUES	0	~38
9 a)+b)		CH	CHARIOTS ELEVATEURS	146	~280
10	<b>Monorail (HHT)</b>	MS	AIGUILLAGES, RAIL & GAINES	39 + 30 km rail	0
				<b>841</b>	<b>1656</b>

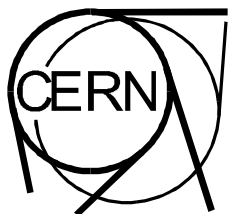
Date: 27/03/2002



## Contact E072/ST-HM

### ◆ **Speciality:**

- **Result orientation** based on new equipment **priority classification** for different service quality demanded (MTBF, MTTR)
- **Contractors responsibility** was raised – the **complete maintenance program strategy** was done with the bid (based on equipment and result descriptions)
- **A dynamic strategy** was implemented – **strategic equipment will be prepared on demand** before heavy utilisation to improve the reliability during the defined period

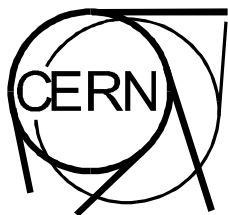


## Result description (I)

- ◆ Definition by Maintenance Service Levels (MSL) – French Norms X60-010 (§4.4)

MSL	1	2	3	4	5
Desc.	simple preventive and corrective maint.	trouble-shooting + standard replacement	identification + diagnosis of breakdowns + repairs	all supporting work for prev. + corr., adjustments of measurement tools	renovation + rebuilding, replacement of important installations
E072/ST	X	X	X	X	Option

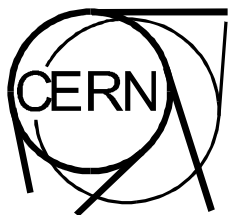
- ◆ Service requested under E072/ST



## Result description (II)

◆ **Priority and service intensity definitions (table used in specification IT-3049/ST)**

Definition of classification	Description of maintenance service
	<i>“The Contractor shall provide a maintenance program that guarantees...”</i>
<b>“Priority 1”</b> includes all equipment that is used very frequently (> <b>28 hours per week</b> ).	... heavy use, detailed information about running condition, wear and overall situation constantly updated and supervised during work periods.
<b>“Priority 2”</b> includes all the equipment that is frequently used (> <b>4 hours &lt; 28 hours per week</b> ).	... normal operation. The equipment condition shall be documented. Priority changes to priority 1 have to be taken into consideration.
<b>“Priority 3”</b> includes all the equipment that is used less frequently (< <b>4 hours per week</b> ).	... general readiness, conformity to safety regulations and prevention of corrosion with a minimum program. The equipment condition shall be documented. Priority changes to priority 2 have to be taken into consideration.
<i>“A tailor-made maintenance plan must be drawn up for all equipment by taking into account the equipment</i>	
Table 2: Table used to describe the intensity of the requested maintenance service	



## Result description (IIIa)

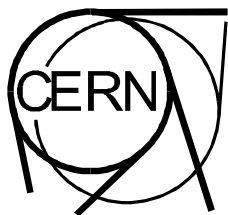
### Results described with Performance Indicators

For fixed equipment (cranes, hoisting gears, etc.):

Priority Class	MTBF (hours)	MTTR (hours)	AVAILABILITY (%)
1	450	4	99
2	450	8	98
3	240	12	95

(effects remuneration)

- **MTBF**, defined as runtime of an equipment between two failures.
- **MTTR**, defined as time between breakdown announcement and end of repair work.
- **AVAILABILITY (%)**, defined as  $MTBF / (MTBF + MTTR)$ .



## Result description (IIIb)

### Results described with Performance Indicators

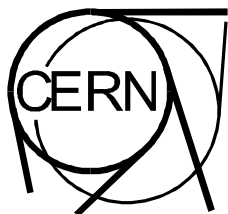
For mobile equipment (electric vehicles etc.):

Priority Class	AVAILABILITY (%)	MTTR (hours)
1	90	4
2	90	8
3	75	12

(effects remuneration)

- **AVAILABILITY (%)** =  $\frac{\text{n}^\circ \text{ of equipment operative}}{\text{n}^\circ \text{ of total equipment}} \times 100$
- **MTTR**, defined as time between announcement of urgent repair and end of repair work.



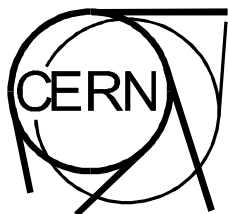


# Contractors responsibility (I)

- ◆ Information to define the maintenance program  
Inventory lists and performance definitions (exemple)

Pos.	Equipment code	Description	Building	Manufacturer	Construction year	Span m	Lifting height m	Load Capacity T	supplementary hoisting gear	FEM Class MECANISM	Remarks	Priority
1	HHLPR-0049	Pont bipoutre THOMAS 10T	M100	THOMAS	1995	10	4.96	10		M5		1
124	HHLPR-0575	Pont monopoutre DEMAG 7.5T (BàB)	P927	DEMAG	1985	18	5	7.5		1Bm		2
214	HHLPR-0197	Pont bipoutre SOCO CER 20T (BàB)	M925	SOCO CER	1981	4	22.52	20		2m		3

Equipment family	Priority	Runtime	Performance needed		
			Availability	MTBF	MTTR
<i>(reference Annex F)</i>	<i>Class</i>	<i>hours/week</i>	<i>% (of total equipm.)</i>	<i>runtime-hours</i>	<i>hours</i>
List 1 - Pont Roulants	1	> 28		450	4
	2	> 4 < 28		450	8
	3	< 4		240	12

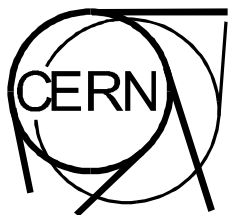


## Contractors responsibility (II)

- ◆ The contractor has established the maintenance program completely on his own

<b>List 1 - Overhead travelling cranes</b>				<b>Service proposed first year for EP(1)</b>					
				<b>Priority 1</b>		<b>Priority 2</b>		<b>Priority 3</b>	
<b>No.</b>	<b>Routine Codes (MSL 1 - 4)</b>	<b>Time estim. (h)</b>	<b>Price (kCHF)</b>	<b>No. of Interv.</b>	<b>Total price (kCHF)</b>	<b>No. of Interv.</b>	<b>Total price (kCHF)</b>	<b>No. of Interv.</b>	<b>Total price (kCHF)</b>
1	PR No. 2	7.5	0.270	2	0.540		0.000	1	0.270
2	PR No. 3	15	0.540	1	0.540	1	0.540		0.000
3	PR analzse	21	0.763	0.33	0.252		0.000		0.000
	Total Budget for prev. maintenance (per year and equipment item of priority 1, 2 or 3)	av./h	0.036	3.33	1.332	1.00	0.540	1.00	0.270

(red means contractors input)

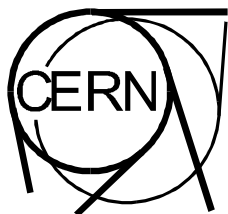


## Contractors responsibility (IIIa)

- ◆ The calculation of the preventive maintenance program had been completed by the cost for Corrective Maintenance

<i>(reference Annex F)</i>	<i>Priority Class</i>	<i>Number items</i>	<i>Prev. Maint. per item (kCHF)</i>	<i>Prev. Maint. per priority (kCHF)</i>	<i>Interventions planned</i>	<i>Corr. Maint. per priority (kCHF)</i>	<i>Corr. Maint. (h)</i>
List 1 - Overhead Travelling Cranes	1	50	1.332	66.584	166.5	3.200	88.9
	2	136	0.540	73.430	136.0	4.800	133.4
	3	131	0.270	35.365	131.0	5.600	155.6
List 10 - Monorail - Switches, Rail	2	39	0.100	3.500	39.0	0.600	1.7
Number of items		841		233.820	1246.6	23.829	809.6

*(red means contractors input)*

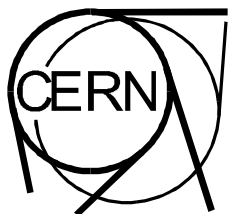


## Contractors responsibility (IIIb)

- ◆ The Calculation for Cost for Corrective Maintenance on Equipment that has no preventive maintenance

<i>Description</i>	<i>Family</i>	<i>Number of equipment</i>	<i>Total Cost Corr. Maintenance per family (kCHF)</i>	<i>Total (h)</i>
Palans	L	800	31.800	883
Palonniers	L	100	4.800	133
Remorques	R	38	0.200	12
Transpalettes	R	400	6.300	378
Vehicules electriques	R	38	1.200	72
Chariots elevateurs	R	280	4.400	264
Number of items for that only correctiv maintenance is foreseen:		1656	48.568	1743

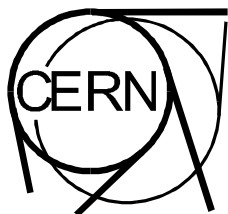
*(red means contractors input)*



# Dynamic Strategy

- ◆ Cranes with strategic importance can be prepared especially for intensive utilisation periods (yellow fields)

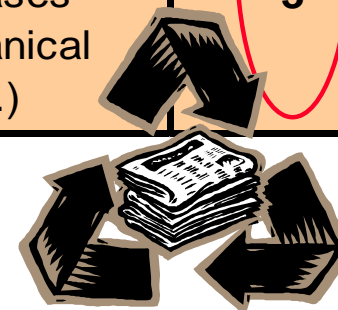
<i>Prev. Service</i>		<i>Priority 1</i>	<i>Priority 2</i>	<i>Priority 3</i>		
<i>Routine Codes</i>	<i>Time estim. (h)</i>	<i>(Intensive Utilisation)</i>	<i>(Normal Utilisation)</i>	<i>(Low Utilisation)</i>		
PR No. 2	7.5	2		1		
PR No. 3	15	1	1			
PR analyse	21	0.33				
<i>No of Cranes</i>		50	136	131	<i>Total (h)</i>	<i>%</i>
<i>Total (h)</i>		750	2040	982.5	3772.5	77
<i>Flexible resources (h)</i>		1096.5			1096.5	23
					4869	100

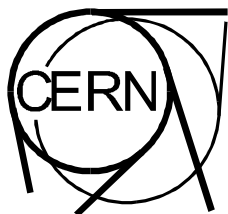


# Dynamic Strategy

## ◆ Overview Ages of Crane Equipment

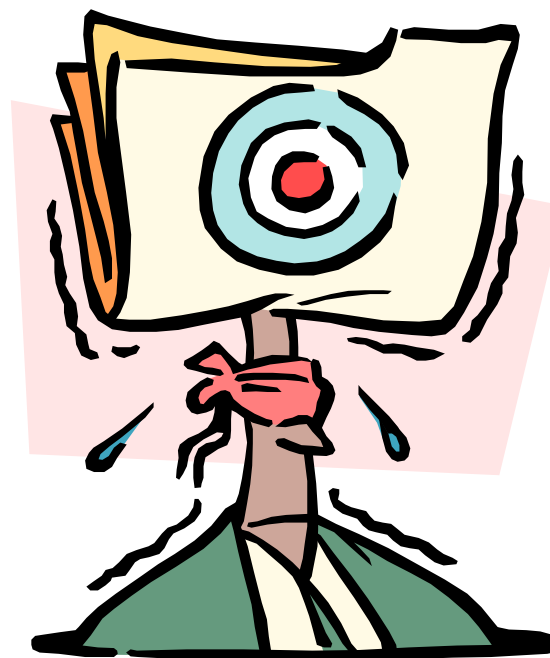
Age	325	100%	Requirements for Maintenance Service	Priority 1
0 - 2	20	6.2	Trace and eliminate faults on equipment or environment - Guarantee service	20
3 - 5	3	0.9	Trace and eliminate faults on equipment or environment - advanced quality problems	3
6 - 10	6	1.8	Requires only standard maintenance service	3
11 - 15	36	11.1		11
16 - 20	43	13.2		9
21 - 25	41	12.6	Requires advanced maintenance service (problems on sensitive components, spare parts organisation etc.)	7
26 - 30	74	22.8		6
31 - 35	54	16.6		7
36 - 40	26	8.0	Requires advanced service and in cases renovation works on almost all mechanical components (reducer, motors etc.)	3
41 - 45	12	3.7		
46 - 50	10	3.1		

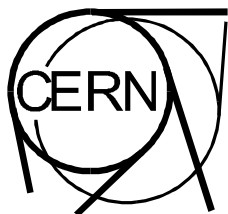




# Conclusion

- ◆ **E072/ST is prepared to compete the requirements of the LHC installation projects**
  - **Result orientation**
  - **Contractors responsibility**
  - **Dynamic maintenance strategie**



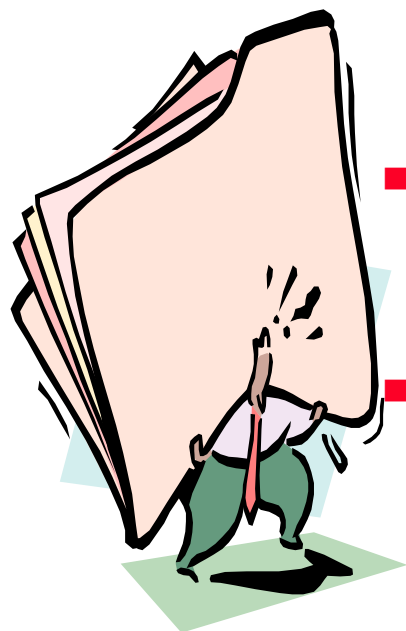


# Conclusion

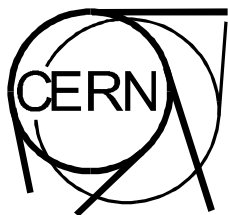
◆ **But we have still to improve a lot of things**

...

- **Interfaces and communication to the users  
(where are the actual priorities?)**
- **Proactivity instead of reactivity  
(what problem could come up in project xy?)**
- **Result orientation has to be cultivated  
(when is a break-down service, a preventive intervention completed?)**







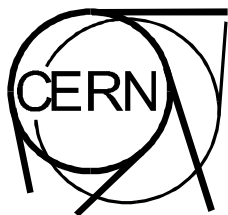
# Conclusion

◆ **At least we reached already quite a bit**

...

- **Planning attitude and good communication**
- **Partnership based on transparency in prices and committed objectives for the service**



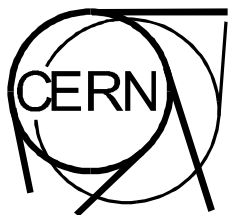


# Conclusion

- ◆ **Personal Statement (1):**
  - « Break with the forfait strategy within service contracts! »

*The specification needs more energy but ...  
... this helps not to regard the contractor as a slave  
anymore!*





# Conclusion

## ◆ Personal Statement (2):

- « Dynamic strategy helped to economise 20% of the contract volume! »

*Preparation of the equipment before heavy utilisation makes sense ...*

*... or do you bring your old car still every 15'000 km to the garage?!*

