CV Consolidation and Upgrade of Infrastructure

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IEFC Workshop 2011 - 24th March 2011

« CONSOLIDATION and UPGRADE PLANS for the INJECTOR COMPLEX »

Thanks to: M Batz, Y Body, S Deleval, G Peon

Outline

- ✓ Analysis on CV equipment
- ✓ General planning (theory and real)
- ✓ Resources needed
- ✓ Details on some projects for 2013
- ✓ Conclusions

How to define a planning

Installation dates, life expectancy

Risk calculation matrix

Technical requirements (upgrade vs replacement)

Resources (need vs availability)

Draft planning

Match users' need planning

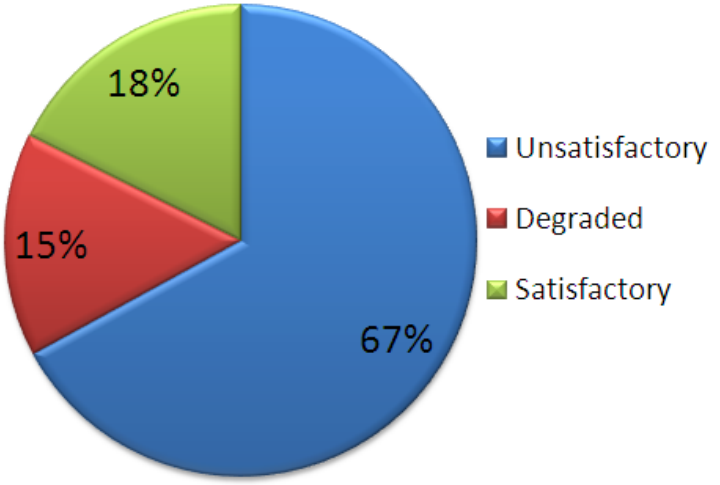
Planning proposal

Some assumptions…..

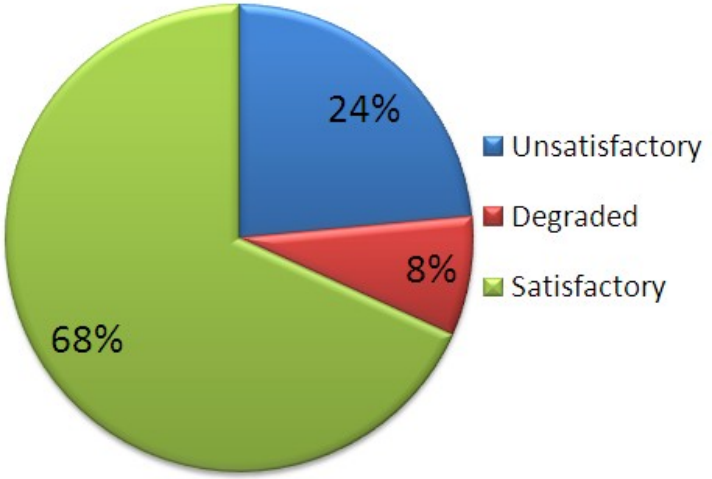
- Work on injectors (consolidation, upgrade) has to be consistent with LHC planning.
- LINAC 2 is not taken into account at present since it is foreseen to decommission it in the coming years.
- Due to the 4 years' frequency of long shutdown it is no more possible to split a work into two LSs as previously foreseen in a few cases.
- Time span between LSs has become quite important: worsening of conditions might severely affect reliability.

Technical facilities PS area

- Installation conditions:
  - Satisfactory
  - Degraded
  - Unsatisfactory



- Running conditions:
  - Satisfactory
  - Degraded
  - Unsatisfactory



(report by Sophia Audit, contract E094)

Installation dates CV plants

	PS (centre anneau, aimants PS)	PSB	L3	LEIR	SPS
Cooling towers	1995	1998	1999		2001
Pumping station - raw water	1995	1998	1994		2000
Pumping station - demi water	1995	1998	1999	1999	1978
Distribution network ED	1960	1970	1999	1990	1978
HVAC – AHU tunnel	1958	1972	1993	-	2001
HVAC bldgs or other premises	1960/1969	1972	1976	1987	1978
Chilled water production stations	1999	2000	1999	-	2001
Chilled water distribution network	1958/2004 (a)	2000	1958	-	2001
Compressed air production	1960				1978 (b)
Compressed air distribution	1960	1970	1976	1990	1978
Raising systems	1977	1970	1970	1970	1974

(a) Tunnel ring
(b) Compressors in 2001

Poor conditions, some defects/repairs needed, acceptable conditions

In some cases….

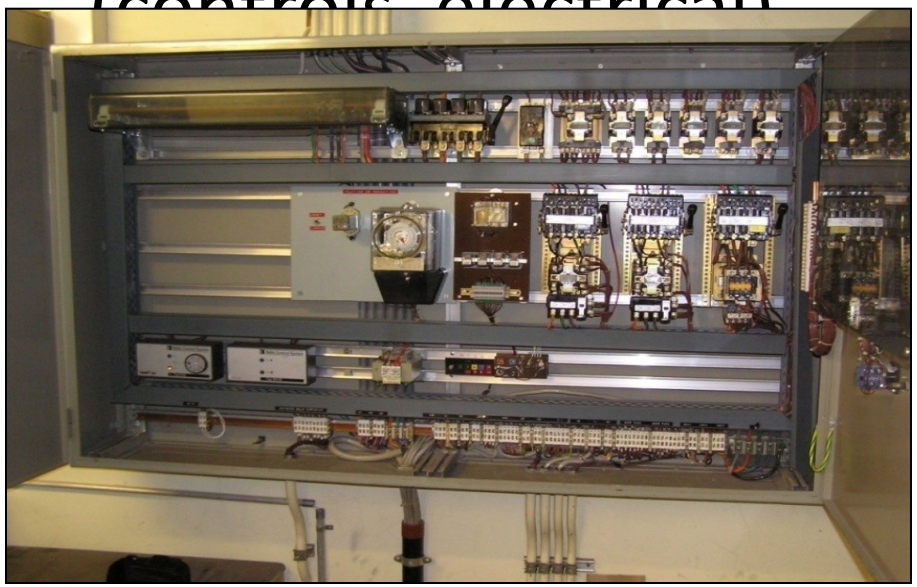
….. although equipment is working correctly

✓ obsolescence

✓ new rules, standards

(controls, electrical)

(P22)



Risk analysis

- Risk score:

$R_s = P \times \max(I_o; I_r; I_f; I_s)$

  - I_o Impact on scientific objectives
  - I_r Impact on CERN's reputation
  - I_f Financial impact of failure
  - I_s Safety impact in case of failure
- Weighted Risk Score:

$R_{s'} = R_s \times \Sigma i$

Risk matrix (weighed score)

	PS (centre anneau, aimants PS)	PSB	L3	LEIR	SPS
Cooling towers	9	6	3.9		4.2
Pumping station for raw water	6	6	6		6.3
Pumping station demi water	6	6	3.9	2.6	4.2
Distribution network ED	6	4	3.9	3.9	5.6
HVAC – AHU tunnel	12 (Constantly degraded mode)	9	5.85	-	4.2
HVAC bldgs or other premises	0.6	6	5.85	3.9	0.6
Chilled water production stations	4	4	2.6	-	2.8
Chilled water distribution network	8	6	5.2	-	2.8
Compressed air production	6				4.2
Compressed air distribution	6	6	6	3.9	2.8
Raising pumps	4	4	2.6	2.6	6.3

From the combination of *the conditions of installations* plus *the value in the risk matrix*, the theoretical planning for the consolidation should be as follows:

Consolidation planning (theory)

	PS (centre anneau, aimants PS)	PSB	L3	LEIR	SPS
Cooling towers	2013				2013 (*)
Pumping station for raw water					
Pumping station demi water					
Distribution network ED					2013 (**)
HVAC – AHU tunnel	2013		2013	-	
HVAC bldgs or other premises	2013		2013	2013	
Chilled water production stations				-	
Chilled water distribution network	2013		2013	-	
Compressed air production					
Compressed air distribution	2013	2013	2013	2013	
Puisards	2013	2013	2013	2013	

(*) primary loop modifications, legionella and concrete structure / (**) safety valves

Consolidation planning (theory)

	PS (centre anneau, aimants PS)	PSB	L3	LEIR	SPS
Cooling towers	2013	2017	2017		2013 (*)
Pumping station for raw water	2017	2017			
Pumping station demi water	2017	2017			
Distribution network ED	2017	2017			2013 (**)
HVAC – AHU tunnel	2013	2017	2013	-	
HVAC bldgs or other premises	2013	2017	2013	2013	2017
Chilled water production stations		2017		-	
Chilled water distribution network	2013	2017	2013	-	
Compressed air production					
Compressed air distribution	2013	2013	2013	2013	
Puisards	2013	2013	2013	2013	

(*) primary loop modifications, legionella and concrete structure / (**) safety valves

Consolidation planning (theory)

	PS (centre anneau, aimants PS)	PSB	L3	LEIR	SPS
Cooling towers	2013	2017	2017		2013 (*)
Pumping station for raw water	2017	2017	2021		
Pumping station demi water	2017	2017	2021	2021	
Distribution network ED	2017	2017	2021	2021	2013 (**)
HVAC – AHU tunnel	2013	2017	2013	-	
HVAC bldgs or other premises	2013	2017	2013	2013	2017
Chilled water production stations	2021	2017	2021	-	
Chilled water distribution network	2013	2017	2013	-	
Compressed air production	2021				
Compressed air distribution	2013	2013	2013	2013	2021
Puisards	2013	2013	2013	2013	2021

(*) primary loop modifications, legionella and concrete structure / (**) safety valves

Consolidation planning (theory)

	PS (centre anneau, aimants PS)	PSB	L3	LEIR	SPS
Cooling towers	2013	2017	2017		2013 (*)
Pumping station for raw water	2017	2017	2021		>2025
Pumping station demi water	2017	2017	2021	2021	2025
Distribution network ED	2017	2017	2021	2021	2013 (**)
HVAC – AHU tunnel	2013	2017	2013	-	2025
HVAC bldgs or other premises	2013	2017	2013	2013	2017
Chilled water production stations	2021	2017	2021	-	2025
Chilled water distribution network	2013	2017	2013	-	2025
Compressed air production	2021				>2025
Compressed air distribution	2013	2013	2013	2013	2021
Puisards	2013	2013	2013	2013	2021

(*) primary loop modifications, legionella and concrete structure / (**) safety valves

But....

- In case that not all resources are available in due time, the planning has to be distributed over several long shutdowns – inconsistency!
- The proposed dates take into account the LHC program and the consolidation plan as known today.
- For major interventions, from the design (all needs defined) to the start of the work, more than 1 year has to be taken into account: the decision on what to do and on technical requirements has to be taken well in advance (in particular where new staff has to be appointed).

Proposed planning

	PS (centre anneau, aimants PS)	PSB	L3	LEIR	SPS
Cooling towers					2013 (*)/ 2017 (**)
Pumping station for raw water					
Pumping station demi water					
Distribution network ED					2013(***)
HVAC – AHU tunnel	2013				
HVAC bldgs or other premises					
Chilled water production stations					
Chilled water distribution network	2013		2013		
Compressed air production					
Compressed air distribution					
Puisards					

(*) concrete structure / (**) primary loop modifications, legionella / (***) safety valves

Proposed planning

	PS (centre anneau, aimants PS)	PSB	L3	LEIR	SPS
Cooling towers	2017	2017			2013 (*)/ 2017 (**)
Pumping station for raw water	2017	2017			
Pumping station demi water	2017	2017			
Distribution network ED	2017	2017			2013(***)
HVAC – AHU tunnel	2013	2017	2017	-	
HVAC bldgs or other premises		2017	2017	2017	2017
Chilled water production stations		2017			
Chilled water distribution network	2013	2017	2013		
Compressed air production					
Compressed air distribution	2017	2017			
Puisards		2017			

(*) concrete structure / (**) primary loop modifications, legionella / (***) safety valves

Proposed planning

	PS (centre anneau, aimants PS)	PSB	L3	LEIR	SPS
Cooling towers	2017	2017	2021		2013 (*)/ 2017 (**)
Pumping station for raw water	2017	2017	2021		
Pumping station demi water	2017	2017	2021	2021	2021
Distribution network ED	2017	2017			2013(***)
HVAC – AHU tunnel	2013	2017	2017	-	
HVAC bldgs or other premises		2017	2017	2017	2017
Chilled water production stations	2021	2017	2021	-	
Chilled water distribution network	2013	2017	2013	-	
Compressed air production	2021				
Compressed air distribution	2017	2017	2021	2021	
Puisards	2021	2017	2021	2021	2021

(*) concrete structure / (**) primary loop modifications, legionella / (***) safety valves

Proposed planning

	PS (centre anneau, aimants PS)	PSB	L3	LEIR	SPS
Cooling towers	2017	2017	2021		2013 (*)/
Chilled water distribution network	2013	2017	2013	-	2025
Compressed air production	2021				>2025
Compressed air distribution	2017	2017	2021	2021	2025
Puisards	2017	2017	2017	2017	2017

SEVERAL PROJECTS DELAYED IN NEXT 10 YEARS (?)

(*) concrete structure / (**) primary loop modifications, legionella / (***) safety valves

Resources (staff + money)

	Run	LS1	LS + run	Run	Run	LS2	LS + run	Run	Run	LS3	LS + run
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
FTE	3	2.8	0.5	X	5	6	4	X	3	3	2
MCHF	0.6	4.5	0.4	X	2	14	1.6	X	1.6	12.3	1.5

Machine upgrades

At present we have received very few indications of modifying existing functionalities: cooling powers and operational needs are not expected to change even where an upgrade is foreseen. Work will mainly consist of:

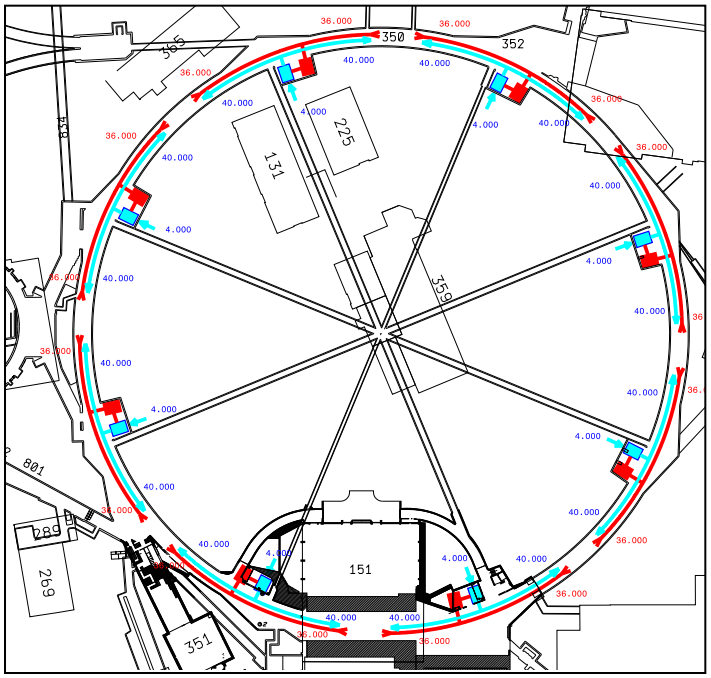
- Dismantling existing equipment, civil engineering work for new configuration, install new equipment (including control), commissioning and running in.
- New buildings to build (PSB, SPS)?

The intervention on the system implies a total stop of the stations, no cooling/ ventilation possible during the work phase.

PS ventilation 2013

In addition to standard replacement:

- 8 systems + smoke extraction;
- Create access to AHUs during operation?
- Distribution ducts in tunnel ok
- Dismantling: confinement of ventilation locals, showers….
- Asbestos (radioactive) waste disposal?



Work duration: 12 months

Cost: 3’000 kCHF

Needed staff: 2 FTE over 3 years presently not covered (getting late!)

Underpressure (PSRWG outcome)

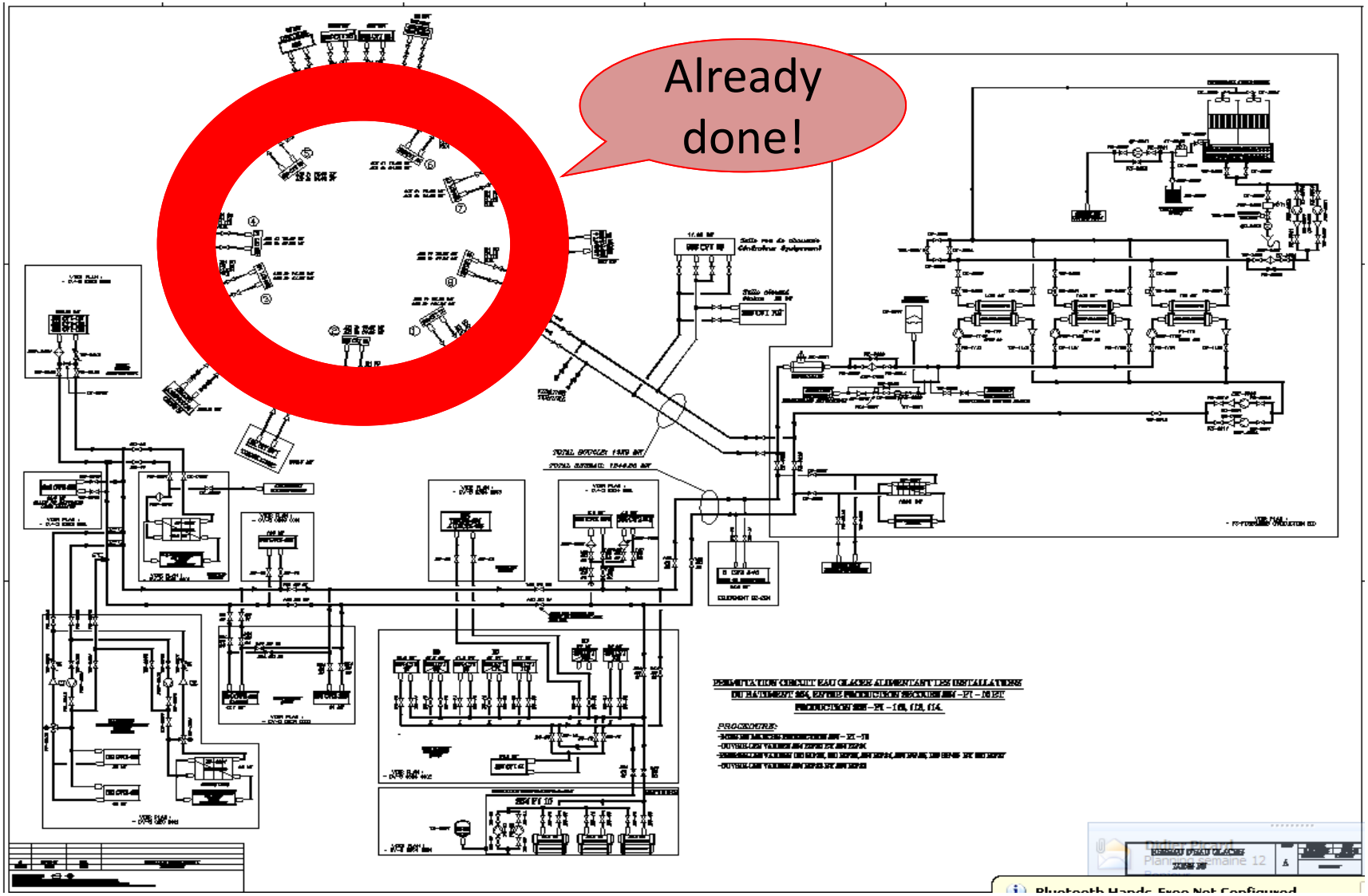
A reversal of the ventilation system of the PS… cannot be envisaged in the PS…

Two costly alternatives are available:

•identifying all components where air cooling is critical and bringing fresh air to the location with help of ducts. A second set of ducts would remove the air to the release point. …..it is not guaranteed that sufficient place is available in the PS.

•making all accesses to transfer and radial tunnels, all doors, and all other locations in the PS air tight. This would represent a major civil engineering project. Likely during its course, other untight locations would be discovered which are at present negligible. The successful outcome of the effort could not be ascertained.

PS Chilled water distribution 2013



PS Chilled water distribution 2013

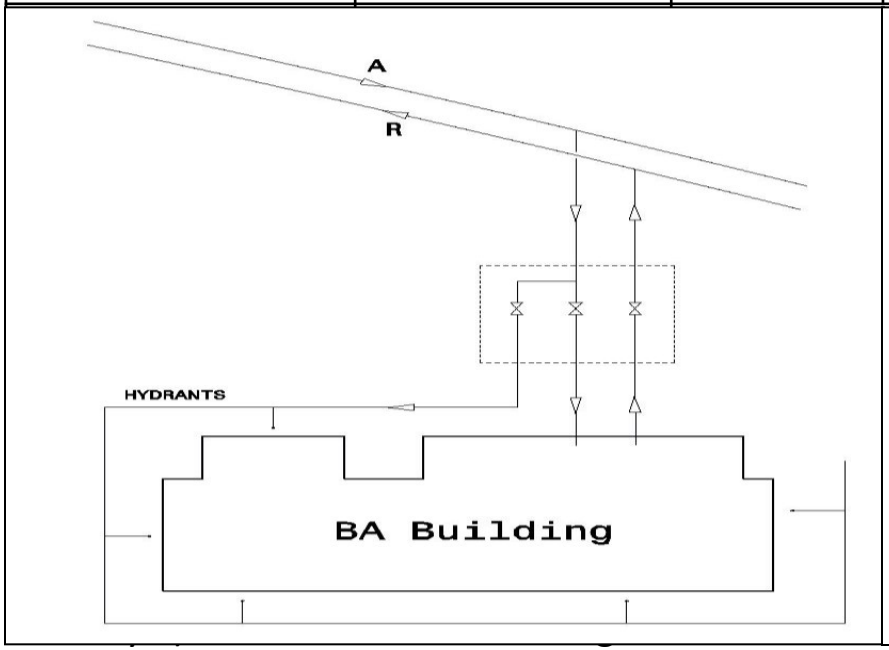
- Mainly to ventilation units.
- Asbestos present in pipes

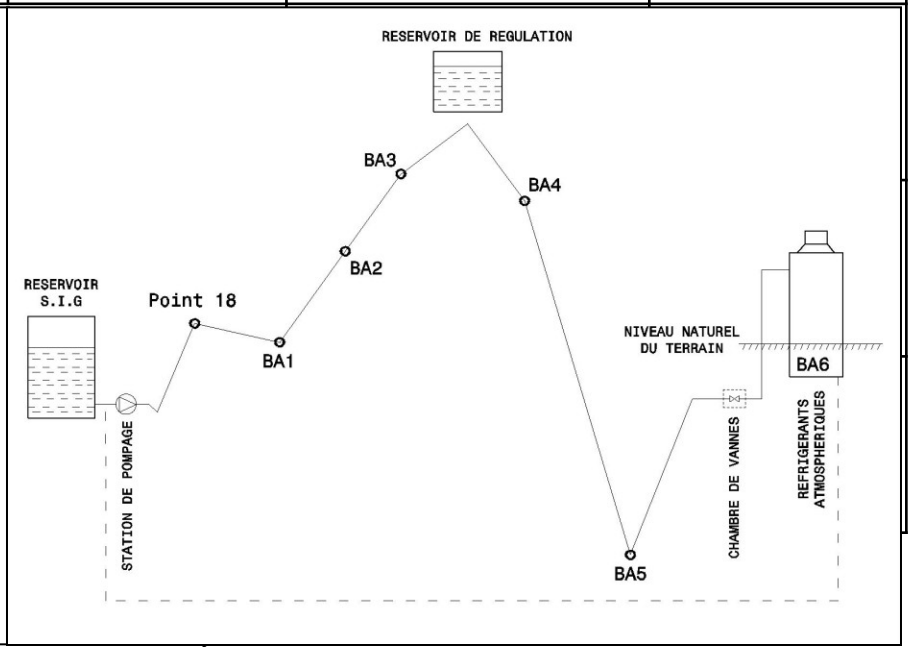
lagging – confinement!

- Work at height (hall 150…)
  - impact on crane, scaffolds?
- Work duration: 10 months
- Cost: 800 kCHF
- Needed staff: 2 FTE over 2 years presently not covered!

Urgent SPS consolidation

Action	Concerned system	Empty circuit	Work duration	BAs concerned	Year
Replacement valves before BAs	Primary loop	Partially	2 months/BA	All, sequence	2013(with line 2)
Fire fighting disconnectors	Primary loop	Partially	2 months/BA	All but BA1 and BA3, sequence	2013 (with line 1)





Urgent SPS consolidation

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Fire fighting disconnectors	Primary loop	Partially	2 months/BA	All but BA1 and BA3, sequence	2013 (with line 1)
Concrete refurbishment	Cooling towers, bldg 863	10 wks total stop + 6 months partial stop		None	2013
Tunnel safety valves replacement	Demineralized water network	Yes	2 wks/BA	All	2013
Modifications for legionella risk	Primary loop	Inside buildings	1 month/BA	All, sequence	2017

To avoid similar intervention in the future, annual tests and manoeuvring of valves (manual, safety…) have to be foreseen to guarantee their functionality.

SPS Upgrade

- No requests received up to now…..
- New RF in BA3 (TWC 200 MHz): possible scenarios
  - New building
  - New cooling circuit for new equipment
  - Modification existing cooling circuit (tunnel)
- Amount and staff need to be defined

Conclusions

- The consolidation plan on such a long term foresees interventions on almost all CV systems.
- Biggest issue is to match resources with real needs.
- Proposed planning is “reasonable” but very tight.
- Major impact on other activities in the same complex during work phase
- Long period of unavailability of CV systems (work + commissioning + running in).
- Situation in evolution, planning shall change accordingly.

THANK YOU FOR YOUR ATTENTION

Standard life expectancy

Pumps : 20 years

Pipes: 40 years

Self cleaning filters : 25 years

Heat exchangers: 30 years

Chillers: 15 years

Actuated valves : 25 years / manual valves: 30 years

Check valves: 25 years

Expansion vessels: 30 years

Variable frequency drives: 15 years

Electrical cubicles: 25 years

Instrumentation: 15 years

Air compressors: 15 years

Fans: 30 years

Motorized dampers: 25 years