



ARCON – RAMSES Bridge

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**on behalf of the ARCON to RAMSES Bridge
Joint working group SC and AB**

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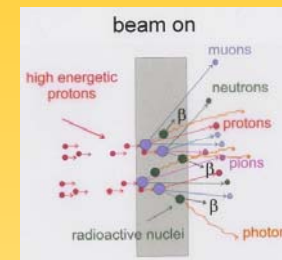
Radiation monitoring



Safety Commission

Introduction

The operation of accelerators involves beam losses, this more than ever as machines operate at higher intensity.



CERN has the legal obligation to protect the public and the people working on site from any unjustified exposure to ionising radiation !

The Safety Commission uses a radiation monitoring system to assess and to limit radiation risks as well as to control the release of radioactivity.



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The ARCON – RAMSES Bridge



Content of the presentation

- **ARCON overview**
- **ARCON issues**
- **ARCON risk analysis**
- **RAMSES overview**
- **The bridge**
- **Resources for the bridge**
- **Conclusion**



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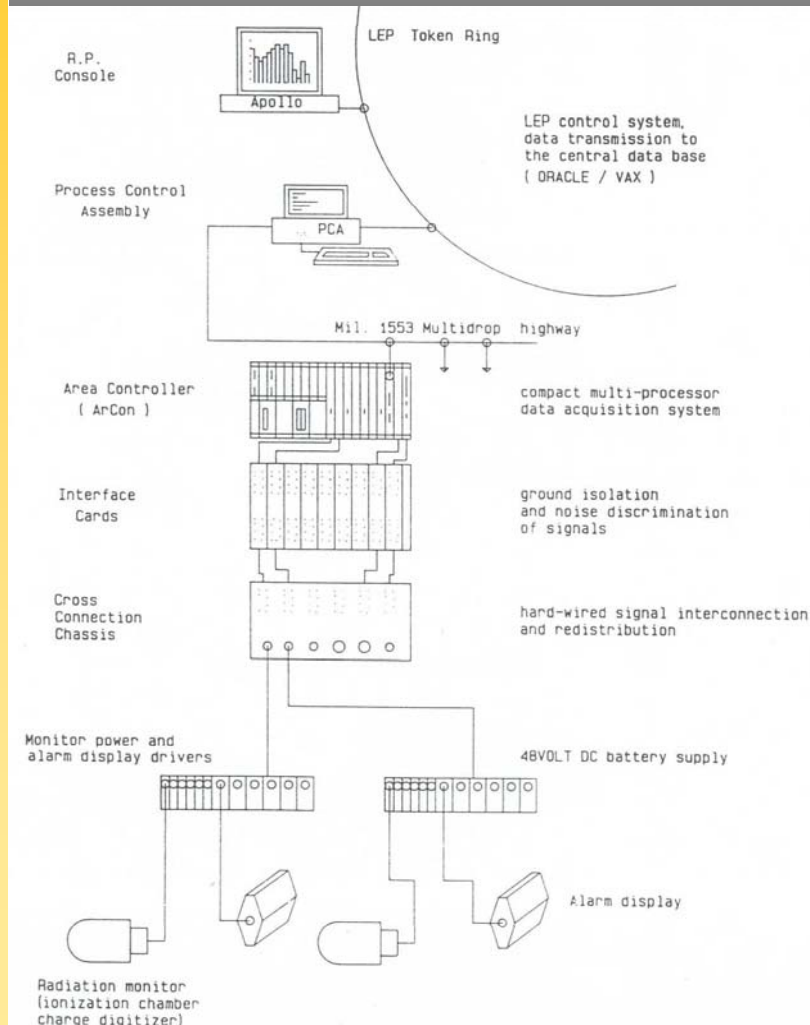
The ARa CONtroller - ARCON



Overview - Main functions

- ◆ **Monitoring radiation variables (local and remote display)**
 - Permanent real-time monitoring of ambient dose equivalent rates and ambient dose equivalents in the working environment (underground accessible areas, on the surface and in the environment)
 - Permanent real-time measurement of radioactivity in released gases and fluids (radioactive nuclides)
 - Permanent measurement of induced activity during accelerators stop/shutdown
- ◆ **Alarm functions (local and remote)**
 - Generate radiation alarms based on ambient dose equivalent rates and ambient dose equivalents
 - Generate interlock signals
- ◆ **Long term permanent data logging**
 - Measured values with only 1 value per hour (average dose rate)

Overview - Main features



Present radiation monitoring system of the PS complex and the SPS

- CERN development in the 80's for LEP
- VME Bus (CPU 68040)
- OS9 (Operating system)
- MIL1553 (field bus)
- Up to 64 counting inputs (current pulses)
- Maximum distance 2 km (monitor to controller)
- Up to 60 status inputs
- Up to 64 status outputs

Main ARCON dates:

- 1989: Commissioning at LEP
- 1990 to 1994: Deployment on rest of CERN
- 1995: Diskless version – Ethernet link

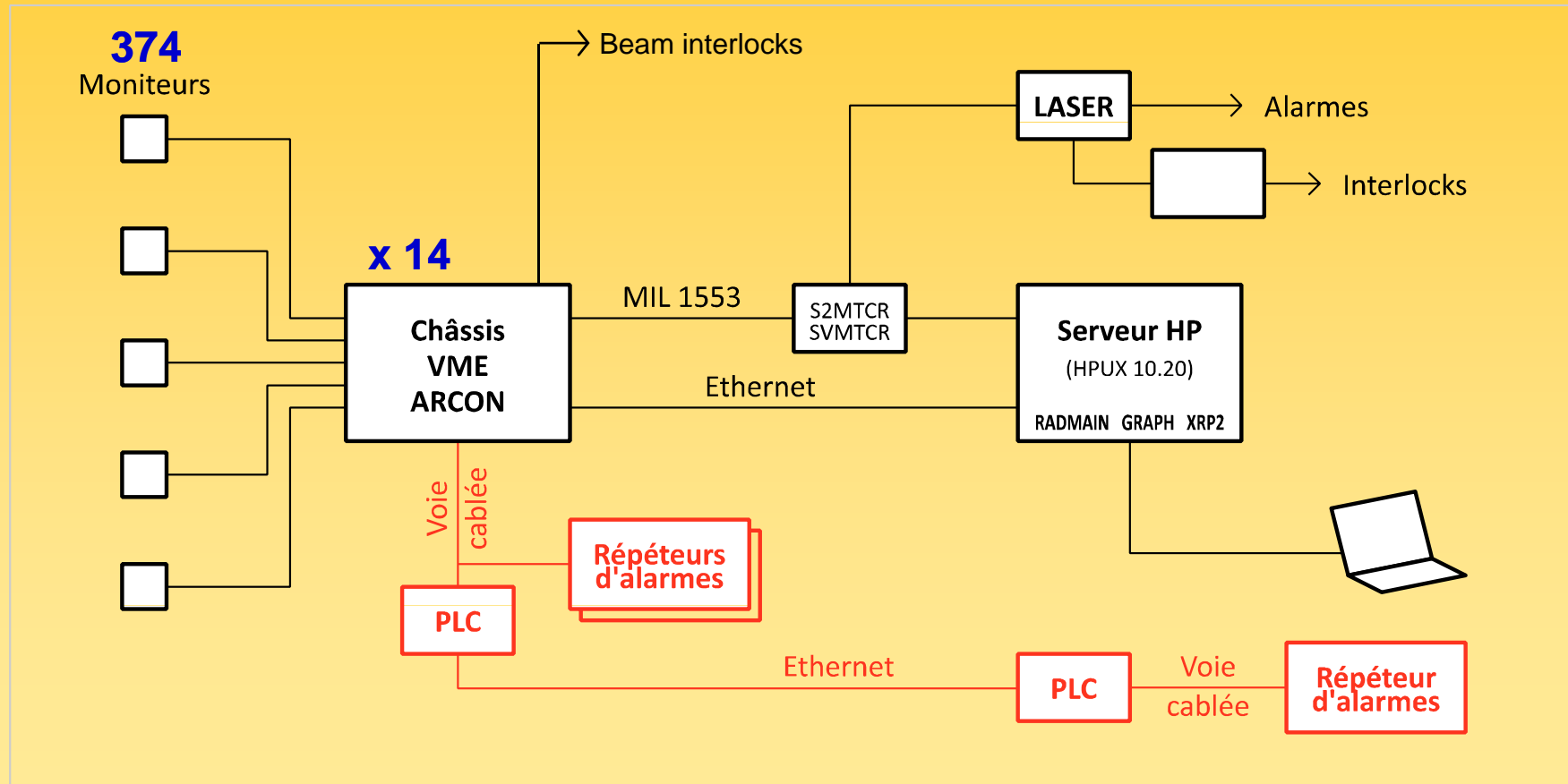


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ARCON overview



Present architecture





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ARCON overview



Technologies and components



RP monitors



VME chassis



Environmental monitors



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ARCON Issues



Ageing system and technologically obsolete → increase of breakdowns

- **Lack of spare parts** (include monitors for radiation and environmental protection)
- **VME chassis not to CERN standard** (difficult to maintain, electronic boards and components are no longer produced, ~ 20 years old)
- **Microware OS9 no more supported**
- **Supervision system: no more maintenance from HP for HP10.20 operating system and hardware for HPSLZ18 server** (not possible to migrate to a newer OS)
- **MIL1553** (not fully compliant to standard, difficult to maintain, few experts)
- **Applications difficult to maintain, no possible evolution** (rely only on 1 expert)
- **Not compliant with current standards for radiation protection instrumentation** (auto diagnostic, safety integrity level)
- **Loss of expertise** (personnel retirements, documentation not up to date)
- **Very manpower intensive system**

The availability and reliability of a radiation monitoring system for the PS and SPS complexes is of prime importance for the future operation of LHC



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ARCON Risk Analysis



Result of the analysis [R1]

- Definitive unavailability of the ARCON monitoring system
→ risk score = 20/20 as of April 2009
- Failure of a «critical monitor»* → Beams interruption
→ risk score = 15/20 when there are no more spare parts
- Failure of electronic boards of ARCON controllers
→ risk score = 10/20 when there are no more spare parts
- Failure of an environmental monitor
→ risk score = 8/20 there are no more spare parts !
- Software failure
→ risk score = 8/20

* Monitor which breakdown involves the interruption of the circulating beams in the zone concerned

Risk Analysis performed according to the methodology prescribed in the Executive Management Directive related to the CERN Risk Management System (EDMS 832542)



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RAMSES overview



- ✓ **RAMSES provides CNGS and has started to provide the LHC with an integrated **R**Adiation **M**onitoring **S**ystem for the **E**nvironment and **S**afety covering acquisition, transmission, logging and display for the LHC in it's entirety (machine, experiments and experimental areas).**
- ✓ **The system is already incorporated into the CERN Control Center for accelerators and will soon be available within the experimental control rooms.**
- ✓ **Other CERN machines and experimental areas were taken into consideration within the technical specification for future usage and expansion of the system. RAMSES was at the beginning planned for all CERN facilities, however for budget reason the implementation was restricted to LHC.**





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RAMSES overview



Main functions

- ◆ **Monitoring radiation variables (local and remote display)**
 - Idem as the ARCON (slide 4)
- ◆ **Alarm functions (local and remote)**
 - Generate radiation alarms based on ambient dose equivalent rates and ambient dose equivalents (**SIL-2 for local alarm**)
 - Generate interlock signals (**SIL-2**)
 - Generate technical alarms (**failsafe system**)
- ◆ **Long term permanent and reliable data logging**
 - Measured values (**according to measuring time, 1s to 3600s, 0.1s steps**)
 - **Events** (radiation alarms, interlocks, system fault alarms, technical alarms)
 - **System configuration** (historic of changes)

Application of the IEC 61508 standard for the overall project management
Compliant to applicable international standards for RP instrumentation



RAMSES Project CONCEPT ARCHITECTURE

Created by: The RAMSES team



CERN
Integration Modules

LASER and DIP server



CERN HCI clients

CCC clients



SC clients



WEB CERN HCI client



WEB expert client



Internet

Acronyms

HCI: Human Computer Interface
 CCC: Common Control Center
 MCR: Meyrin Control Room
 SC: Safety Commission
 LASER: LHC Alarm Server
 DIP: Data Interchange Protocol

RAMSES
Software Infrastructure

Wireless configuration client



Engineering and configuration workstation



Central Supervision Servers



CERN HCI/WEB server



Measured Data/events and configuration database



SC expert HCI



RAMSES
Monitoring Stations



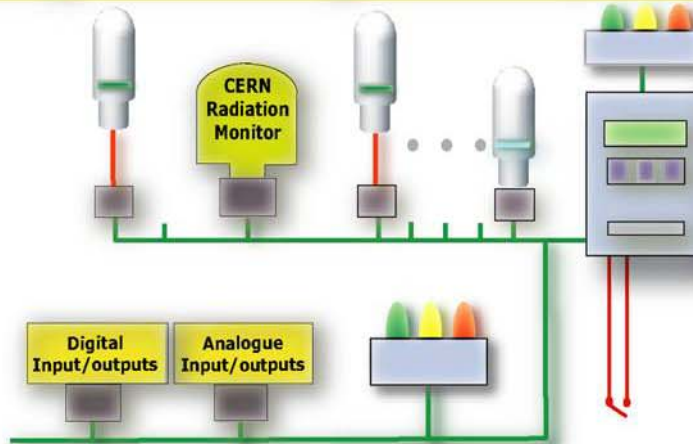
Integrated meteorological Station



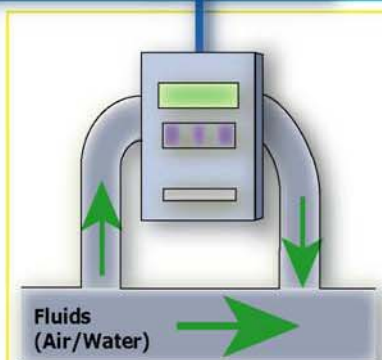
Integrated Monitoring Device

- Hand & foot monit.
- Picomur
- Site gate monit.
-

Integrated monitoring station



Radiation monitoring, alarms and interlock station



(It includes measurements of non-radiation parameters like water temperature, pH, etc.)

Radioactivity in fluids monitoring station



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The ARCON – RAMSES Bridge



How to prevent potential stoppage of CERN accelerators including LHC in the coming years due to ARCON unavailability?

This was the “raison d’être” of the joint working group
SC and AB formed in mid 2007

~~Ideal solution → Replace the ARCON by RAMSES → RAMSES II project~~

But not possible due to 4 - 5 years for implementation

As it is URGENT to take action an intermediate solution has been worked out, the bridge, consisting in 3 subprojects (SP) :

- Improving the availability of spare parts (SP-1)
- Migrating ARCON supervisory system to RAMSES (SP-2)
- Extending the RAMSES to replace critical monitors (SP-3)



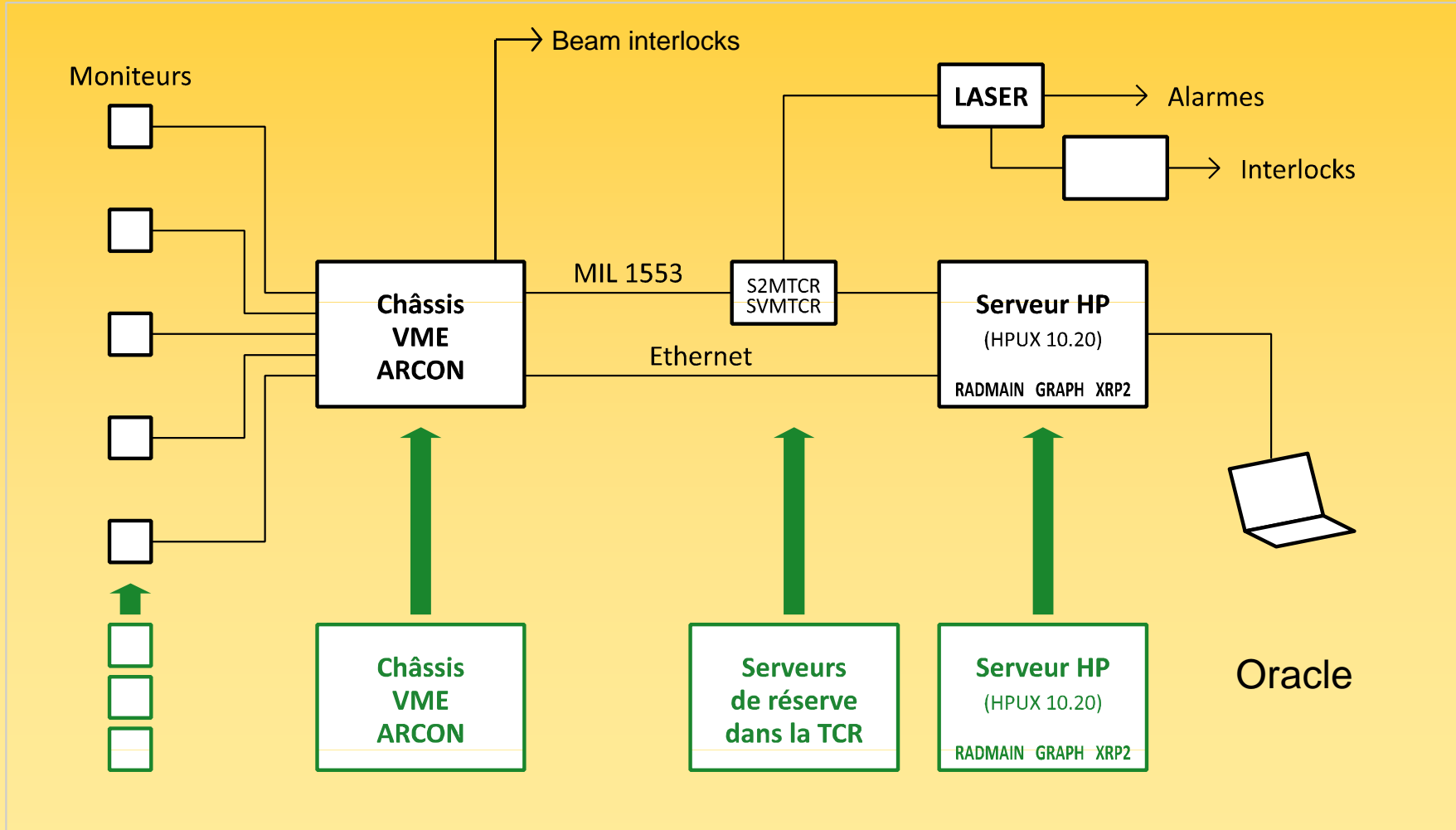
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The Bridge



SP-1: Improving the availability of spare parts





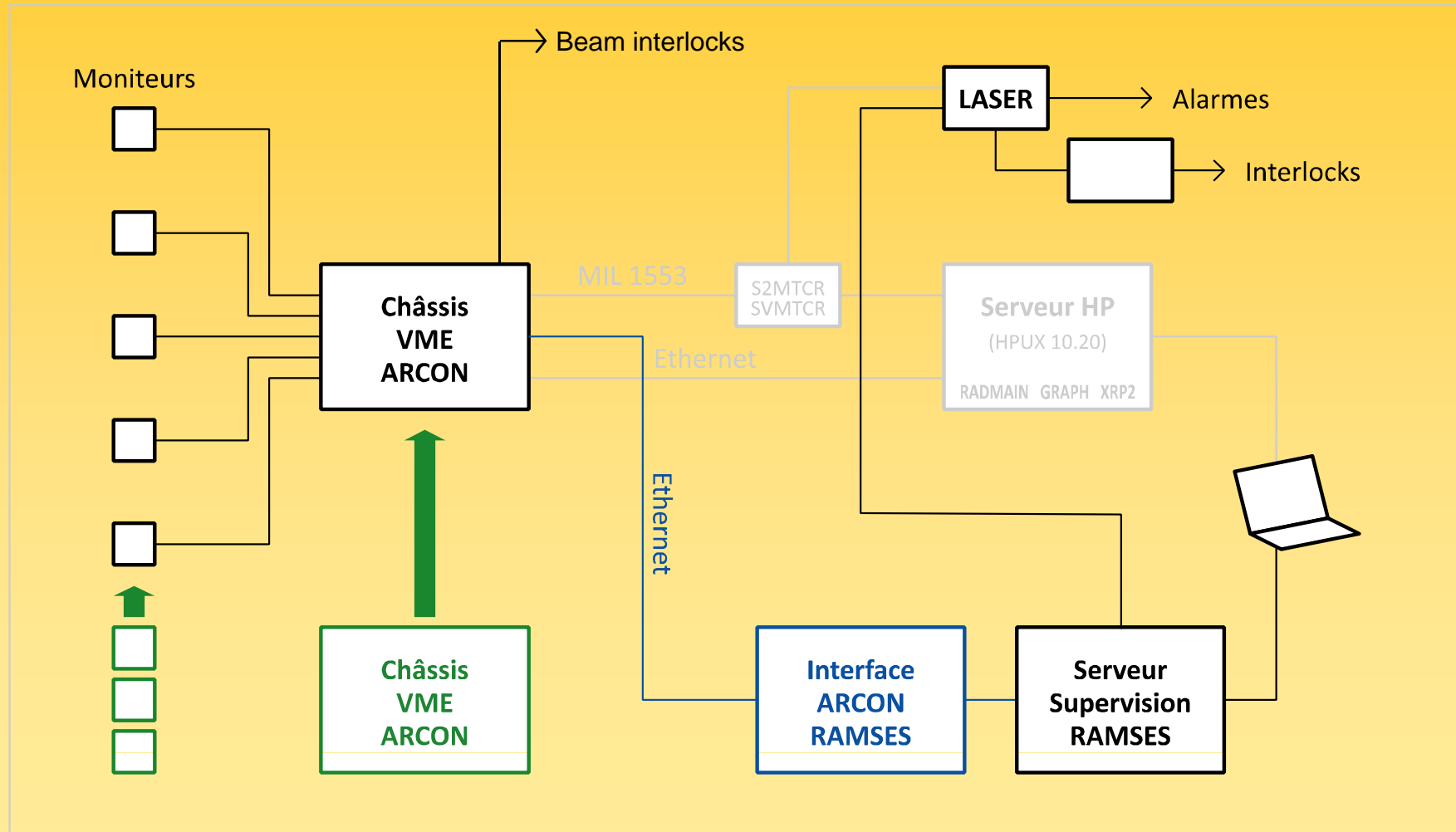
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The Bridge



SP-2: ARCON – RAMSES interface





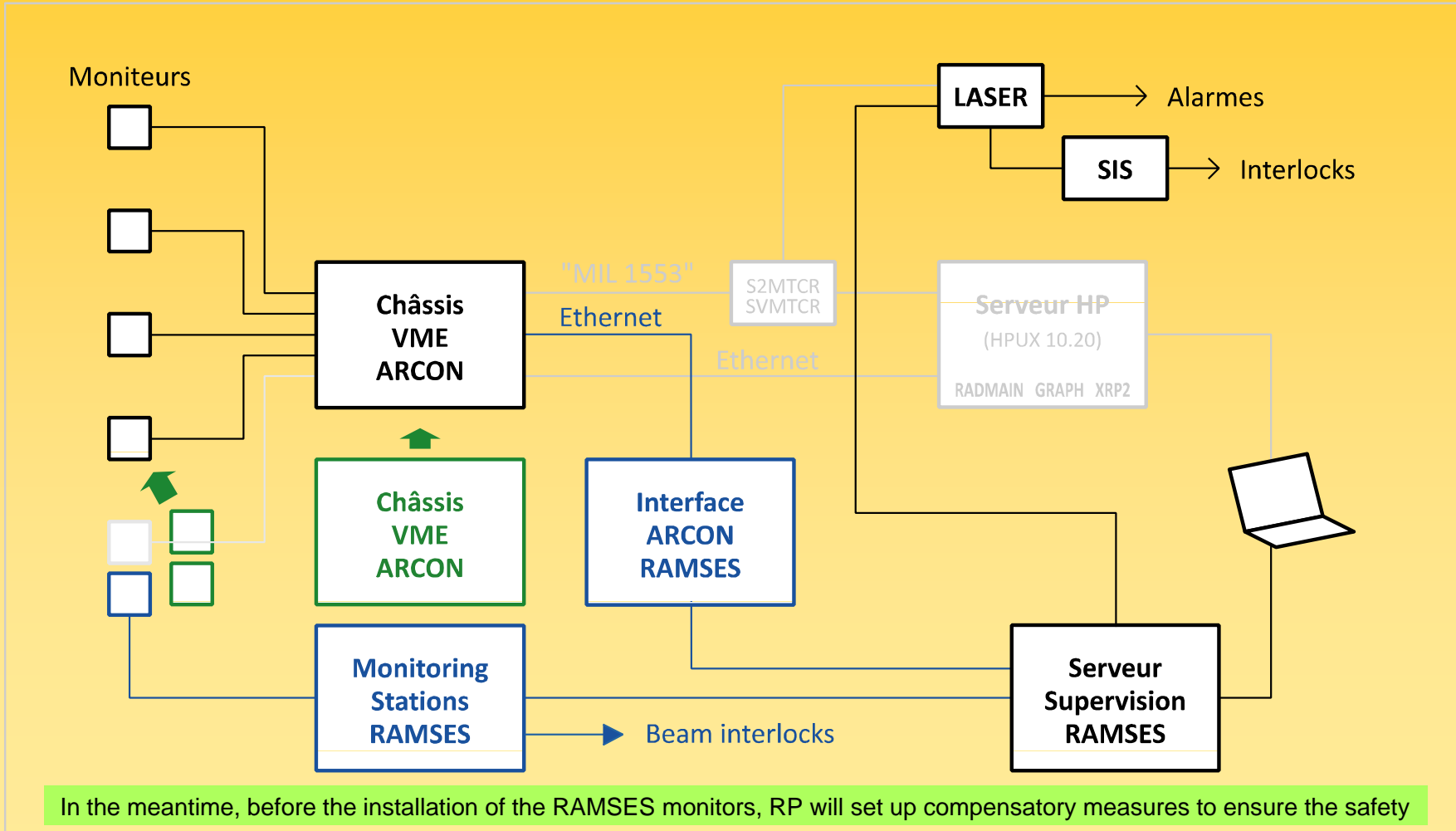
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The Bridge



SP-3: Limited RAMSES deployment





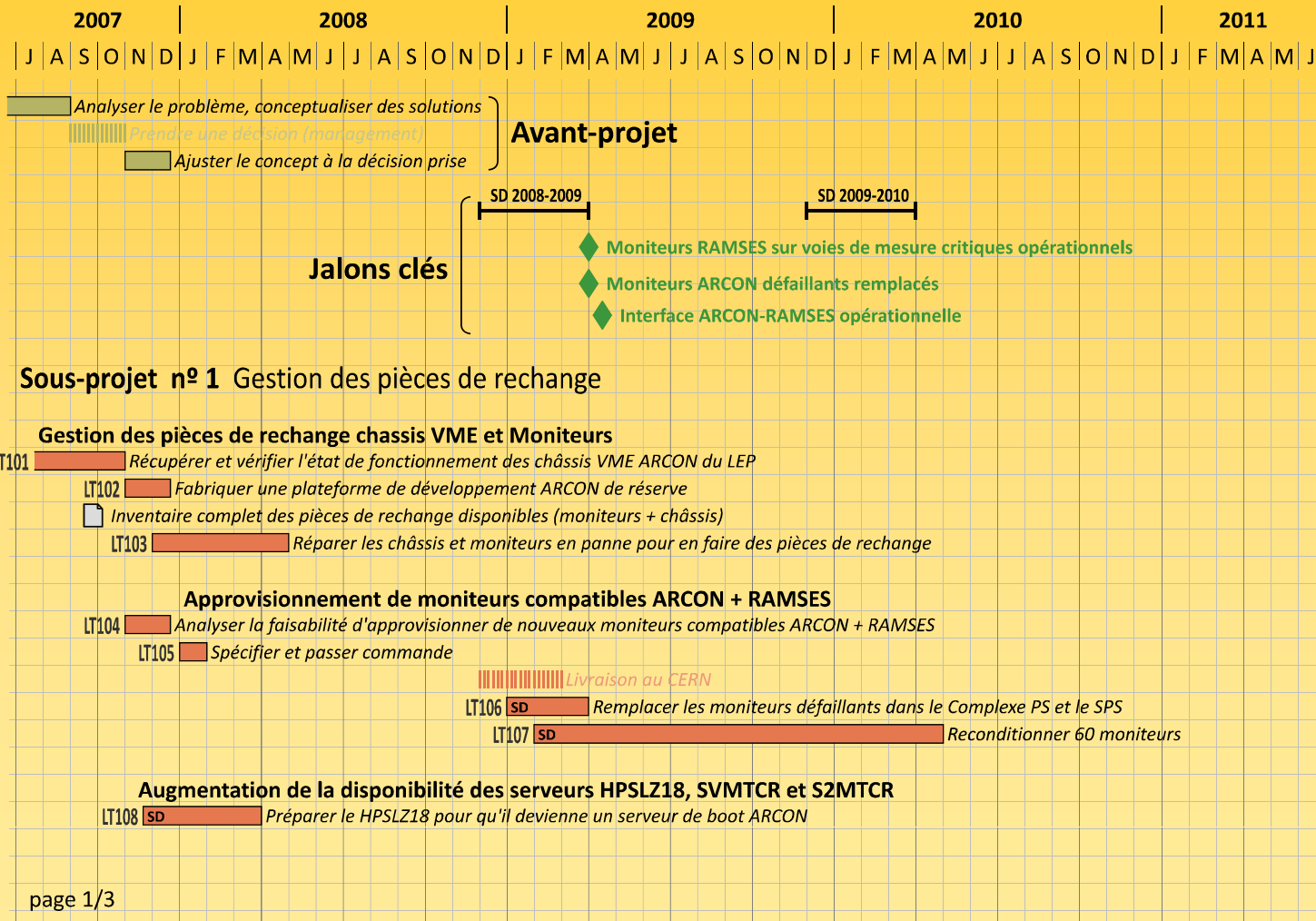
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The Bridge



Implementation planning SP-1





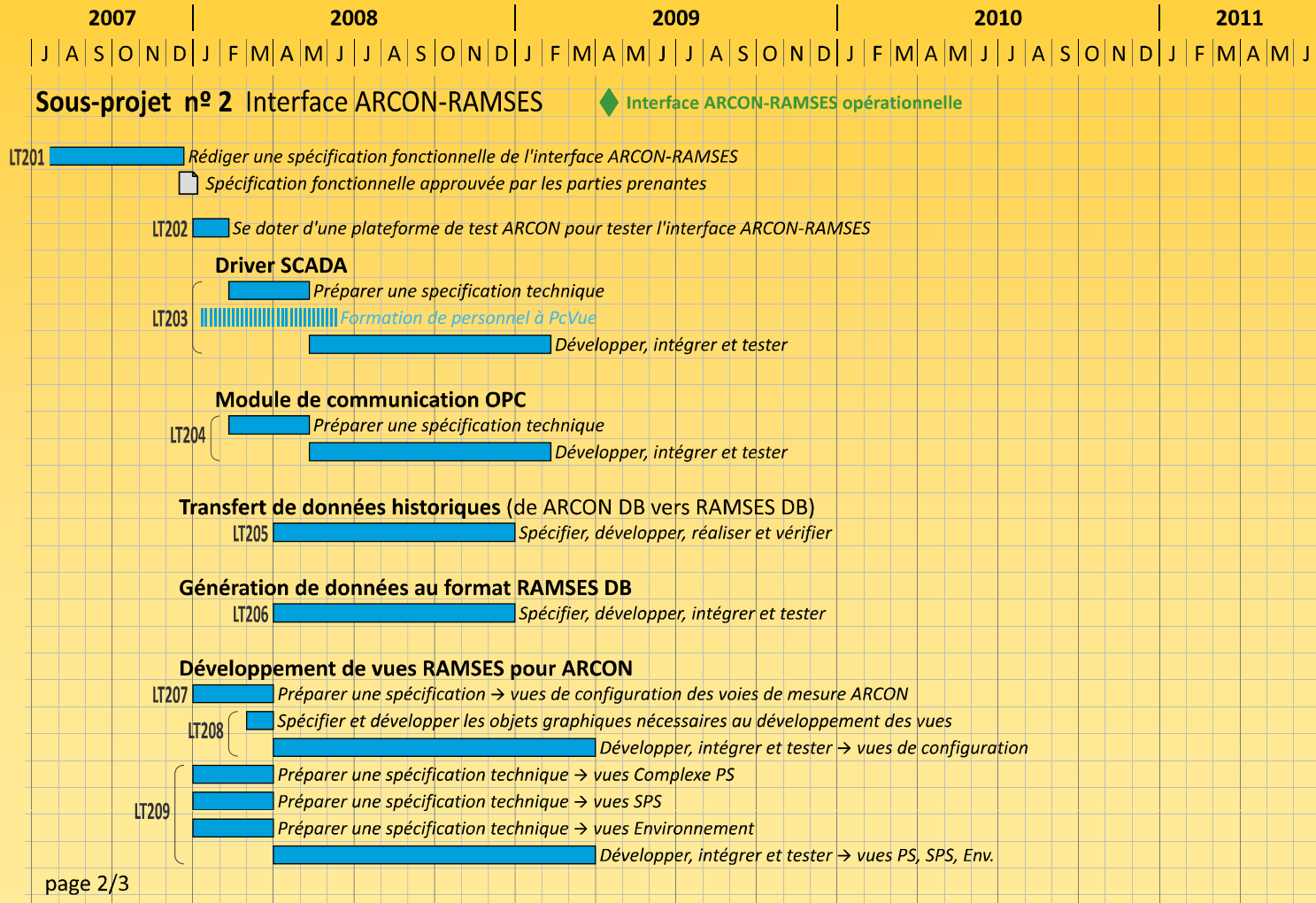
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The Bridge



Implementation planning SP-2



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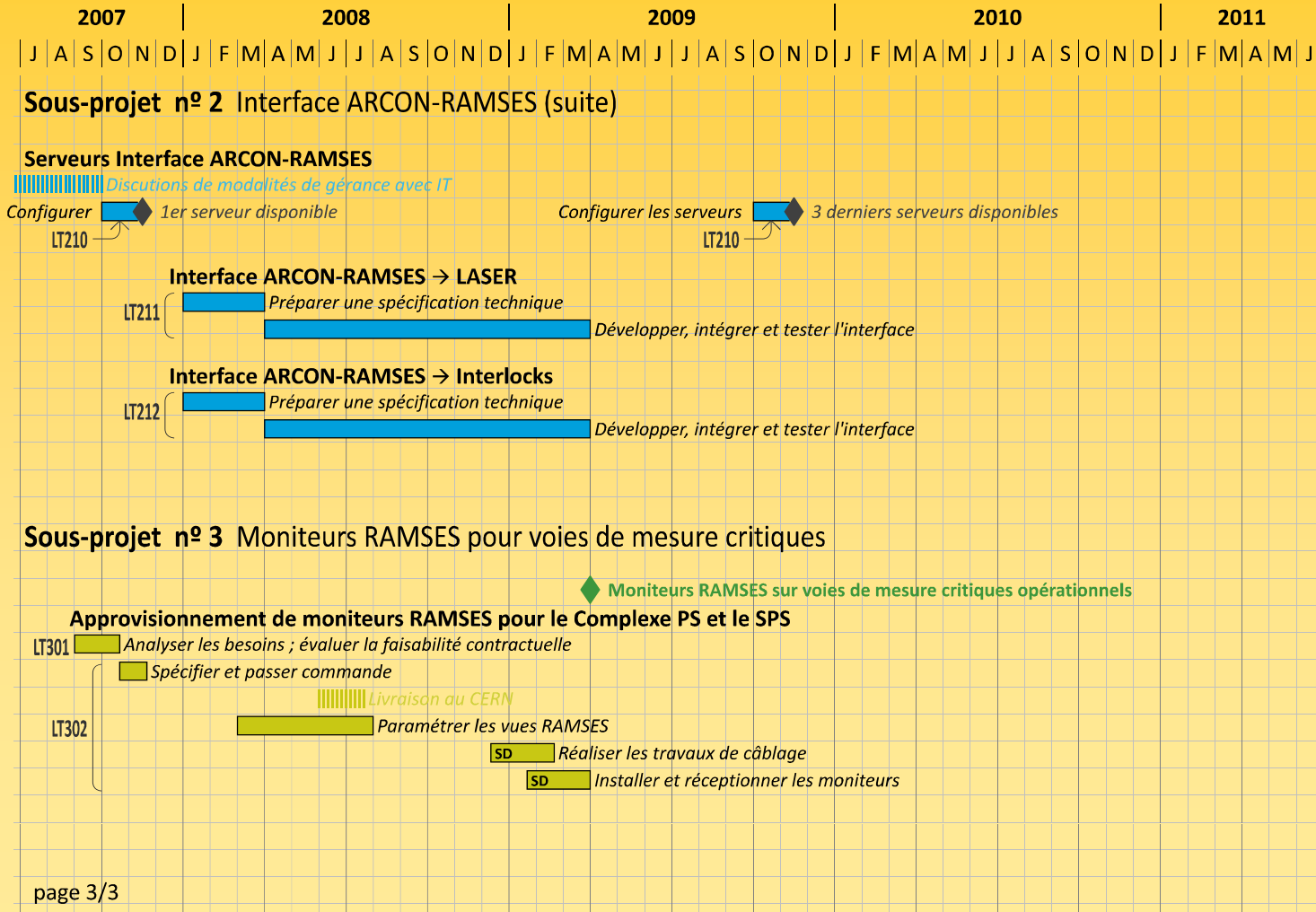
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The Bridge



Implementation planning SP-3





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The Bridge



Safety Commission

Estimated Resources

- Materiel : **2.35 MCHF** (2008-2010)
 - Monitors procurement (SP-1 and SP-3)
 - Software development (SP-2)
- Manpower*: **1.4 MCHF** (~3 persons.years 2½ years)

Total cost : 3.75 MCHF

* Qualified and experienced personnel



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The ARCON to RAMSES Bridge



Conclusion

- ❑ **Intermediate solution that allows:**
 - **ARCON to continue the radiation monitoring of CERN's accelerators and experimental areas,**
 - **To conceive an advanced monitoring system (within the RAMSES framework) and to install it.**
- ❑ **The bridge will increase the ARCON reliability and reduce its MTTR (Mean Time To Repair),**
- ❑ **The bridge will have paved the way, preparing for the transfer towards RAMSES (RAMSES II project),**
- ❑ **~ 1 MCHF of the bridge cost is recoverable for the RAMSES II project (both hardware and software).**
- ❑ **Urgent actions must be taken using the existing RAMSES contract, which include;**
 - **Organisation of contractual and financial aspects within CERN.**
 - **Organisation with contractors and 3rd parties for the supply of monitors and equipment.**



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THANKS for your attention

The ARCON to RAMSES Bridge

“ Ce Bridge constitue la première phase d’un programme de remplacement complet du système de surveillance radiologique du complexe PS et du SPS, Projet RAMSES II ”

References:

[R1] SC and AB joint working group, *Fiabilisation et remplacement partiel du système de monitoring radiation du complexe PS et du SPS*, EDMS 874703 (2007)