WP4 QA & QC Status, Risks & Documentation

EDMS: 2170645
v1.0

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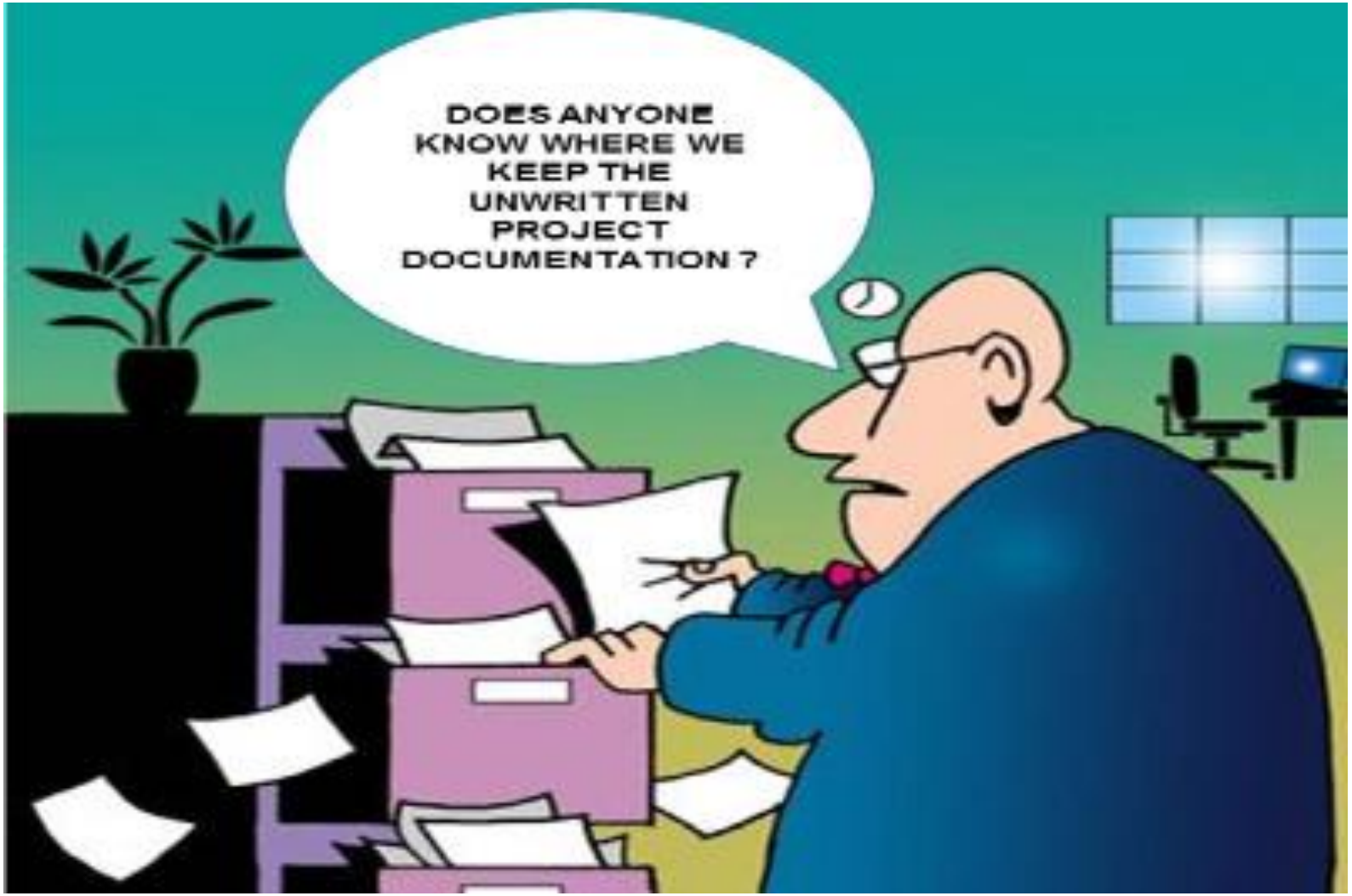
HL-LHC Quality, Configuration, Risk and Sourcing Office

21 June 2019 International Review of the Crab Cavity system design and production plan for the HL-LHC

Outline

1. HL-LHC Quality - Recap
2. CC SPS - PoP for HL-LHC Quality
3. Good practices, Lessons Learnt and Industrialization
4. LHC Cryomodules – A global challenge
5. Risk Management
6. Summary

What use to happen at the end of the projects other



Why is not the case for WP4

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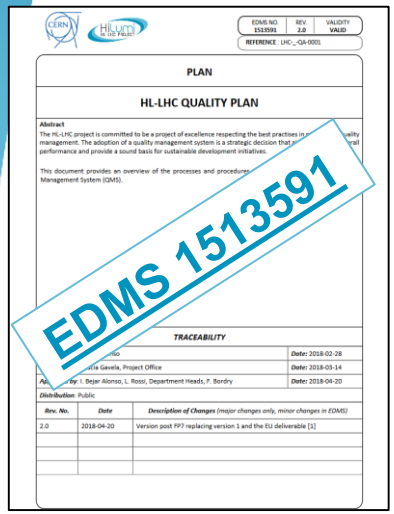
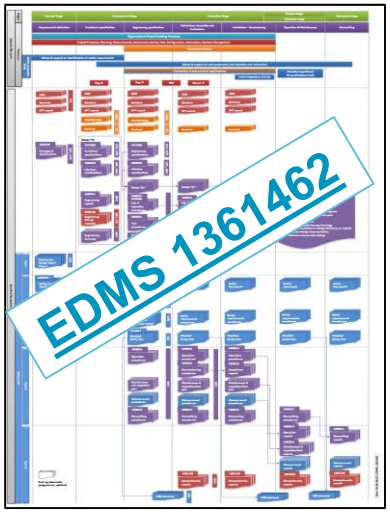
HL-LHC Quality – The pillars & The pragmatic approach

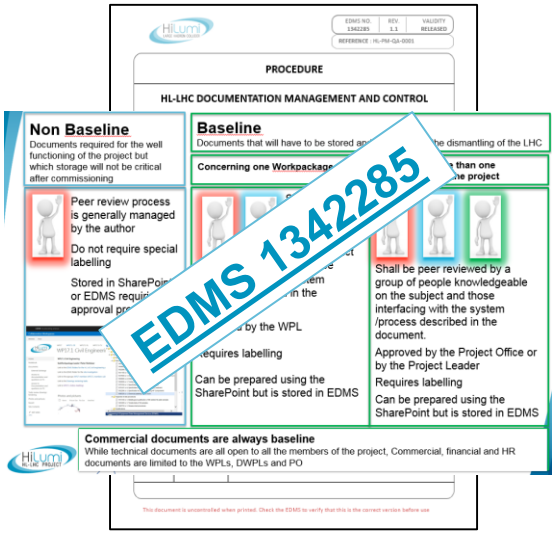
HL Quality Plan



Baseline Docs.



Doc. Management & Control



Tools for HL

EDMS

MTF Equipment Management Folder

CDD

SharePoint

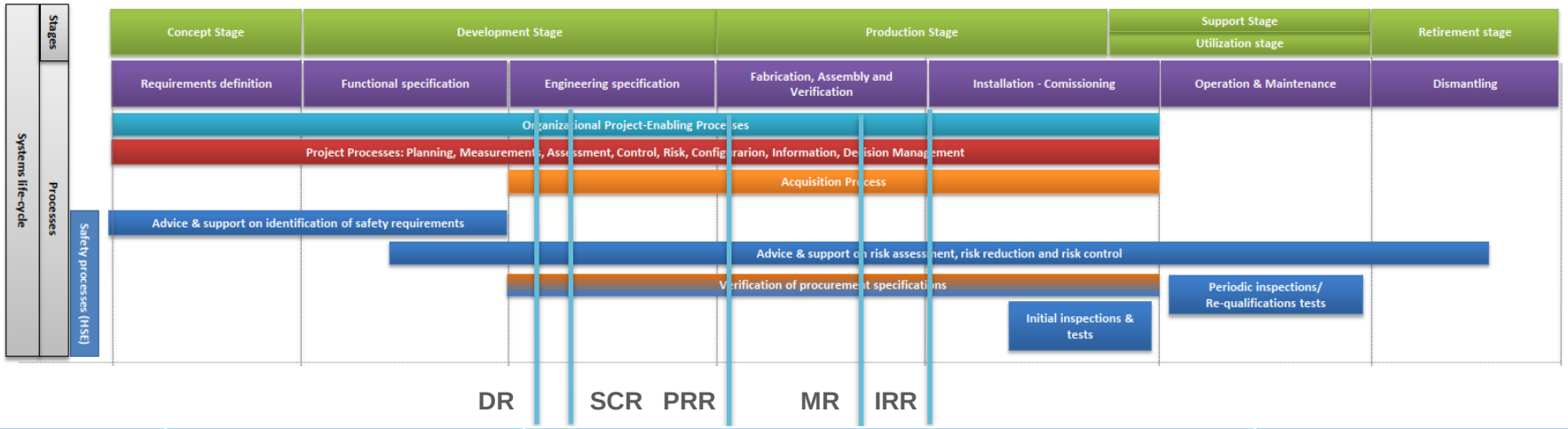
indico

The Pragmatic Approach: All HL-LHC Deliverables shall be compatible with the HL-LHC Quality plan

1. Hardware baseline documentation to be stored in **EDMS**
2. Fabrication records in **MTF**
3. Project information accessible to all **“Hilumiers”**
4. Corporate image when representing the project

HL-LHC Follow up – Reviews

HL-LHC Life-Cycle: Reviews at project level to ensure the adequate tracking and project execution.



What?	When?	Why?	How?
DR Design Review	Along the design phase and once the design is 'mature enough'	To ensure that the Design is adequate for the intended use of the equipment	Committee (CERN + externals) One or Two days presentations
PRR Production Readiness Review	Right before starting the production	To ensure we are ready to start the production (clear definition and interfaces, procurement of sub-components, documentation, planning ….). SEE MANDATE: EDMS 1892005	Committee (CERN). One day presentations
MR Manufacturing Review	Along the production phase	To ensure that the Manufacturing drawings and the MIP have been issued and validated, traceability and quality systems have been established, allowing a systematic follow-up and record of the manufacturing and quality control steps SEE MANDATE: EDMS 1907344	HL-LHC Quality Officer + WPE audit on paper or on site internal/companies / collaborations production
IRR Installation Readiness Review	Prior to start the Installation and Commissioning	To check that manufacturing has been fully completed, that quality controls have been performed, that installation /assembly drawings have been issued, and that adequate installation and commissioning plans have been established	Committee (CERN). One day presentations
SCR Specification Committee Review	Before dispatching the TS to firms for tenders whose Cost Estimation > 200kCHF	Review of tendering documents so as to ensure that CERN Procurement Rules are complied with and the quality of the documents is 'good enough'	SC Chairman + HL-LHC Quality Officer + Procurement audit the tender documents

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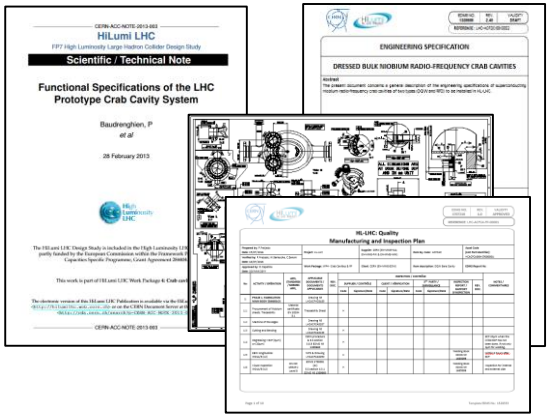
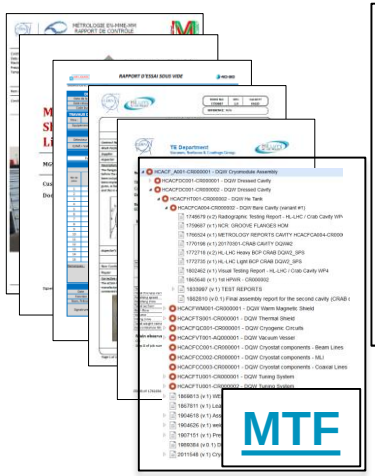
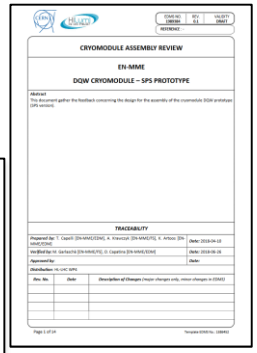
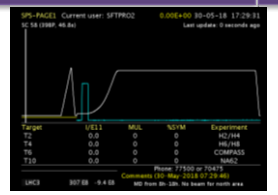
CC SPS – The full HL-LHC life-cycle

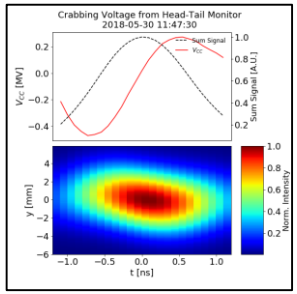
Concept Stage	Development Stage		Production Stage	Support Stage / Utilization stage		Retirement sta
Requirements definition	Functional specification	Engineering specification	Fabrication, Assembly and Verification	Installation - Comissioning	Operation & Maintenance	Dismantling

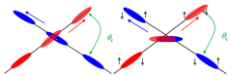


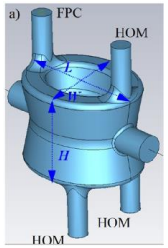


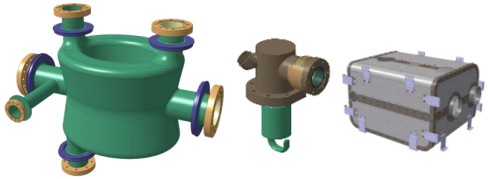


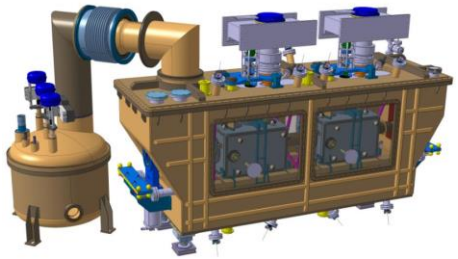


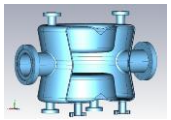


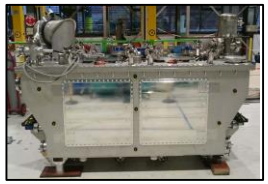


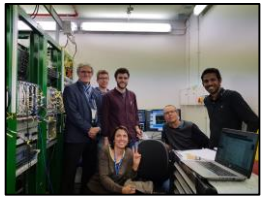


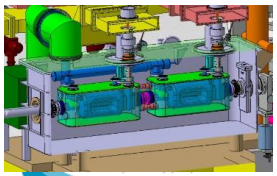


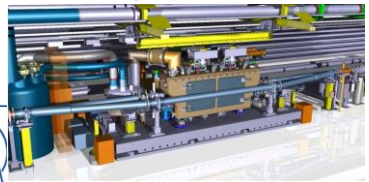












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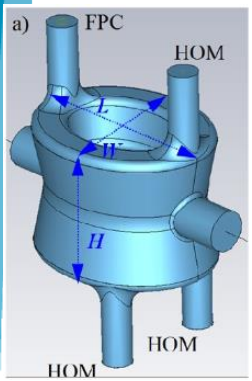
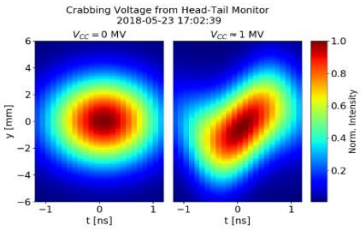
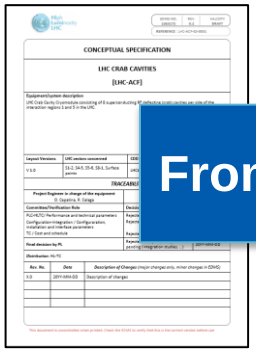
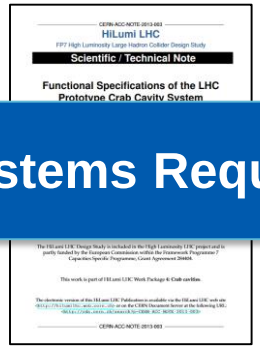
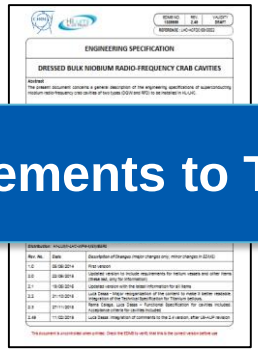


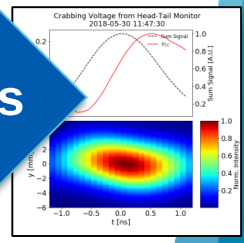


2011	2012	2013	2014	2015	2016	2017	2018









From Systems Requirements to Technical Solutions & Products

Challenge Achieved!!!!

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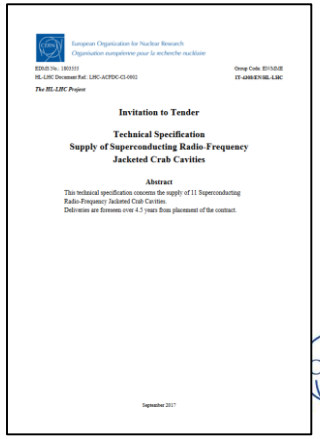
Good practises & lessons learnt

- SPS Cavities successful Test for the first main HL-LHC Object in an operational machine (SPS)
- Full project life-cycle. From **Concept** to **Operation**. Evolution of documentation accordingly
- Experience with SPS cavities has allowed:
  - Knowledge Acquired for CERN & Partners (Design, Manufacturing, Processing and Operation)
  - Know-how to be transferred for **Industrialization**
- Benchmark not only for Technical Matters but also for Quality & Documentation needs
- It is important to start documenting from **Day 1** to avoid lose of information and keep traceability
- Same Approach and Requirements to be followed for the LHC CC Cryomodules (Applicable to **All the Stakeholders**)

Industrialization of Crab Cavities

- Industrialization of the Crab Cavities already in place
- Industrial manufacturing this type of cavities for first time ever (DQW & RFD)
- Complex manufacturing and Tight Requirements (See M. Garlasche talk – day 1 of the review)
- Requirements set in the IT-4308 (Drawings, MIP, Procedures, etc.). The Vendor is in line with HL-LHC Quality Policy and providing the documentation by using CERN Tools. Close Follow-up by CERN
- Documentation being provided by US-AUP from the Vendor for the AUP RFD Prototype following CERN Quality Policy. Pre-series and Series production same approach.


European Organization for Nuclear Research
Organisation européenne pour la recherche nucléaire

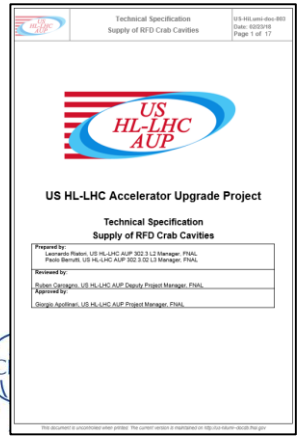
Invitation to Tender

Technical Specification
Supply of Superconducting Radio-Frequency
Jacketed Crab Cavities

Abstract

This technical specification concerns the supply of 11 Superconducting Radio-Frequency Jacketed Crab Cavities.
Deliveries are foreseen over 4.5 years from placement of the contract.

September 2017


Technical Specification
Supply of RFD Crab Cavities

US HL-LHC AUP

US HL-LHC Accelerator Upgrade Project

Technical Specification
Supply of RFD Crab Cavities

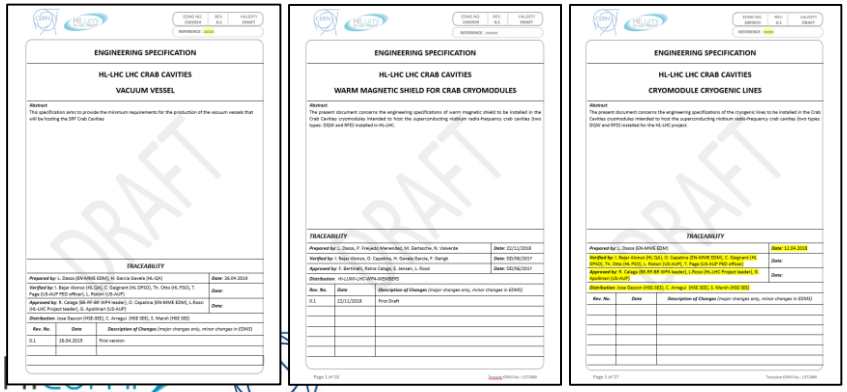
SPS DQW Cavity

LHC DQW Cavity

LHC RFD Cavity

Industrialization of Crab Cavities

- DQW HOMs & Pick-ups in-house production at CERN
- Procurement/Manufacturing for main cryomodule components by Collaborations (UK & Canada) in agreement with CERN Requirements (not only technical but also documentation). Engineering Specifications are being issued for this purpose
- Some components of the Cryomodules will be provided by CERN (Beam Screen, RF internal lines, instrumentation…). In house production plus Industries (mainly materials)
- HPRF Systems – Collaboration BINP is being setup (See E. Montesinos talk). Russian Industry already identified


ENGINEERING SPECIFICATION
HL-LHC LHC CRAB CAVITIES
VACUUM VESSEL
TRACEABILITY
ENGINEERING SPECIFICATION
HL-LHC LHC CRAB CAVITIES
WARM MAGNETIC SHIELD FOR CRAB CRYOMODULES
TRACEABILITY
ENGINEERING SPECIFICATION
HL-LHC LHC CRAB CAVITIES
CRYOMODULE CRYOGENIC LINES
TRACEABILITY

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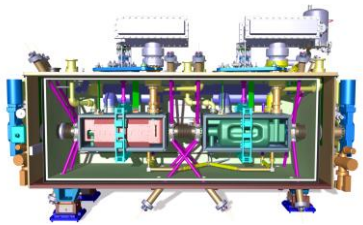
From Do-It-Yourself to Do-It-Together

System architecture for LHC



- RF systems and crab cavities (WP4)
  - RF superconducting crab cavities
    - LHC Cavities (**ACF**)
      - Cryomodule (**ACFGA**)
        - Cryomodule Assembly (**ACF_A**)
          - Cryomodule components (**ACFCC**)
            - Cryogenic circuits (**ACFQC**)
            - Thermal shield & MLI (**ACFTS**)
            - Vacuum Vessel (**ACFVT**)
            - Warm Magnetic shield (**ACFWM**)
            - Alignment Monitoring System (**ACFAM**)
            - Support and Alignment System (**ACFAH**)
            - RF internal lines (**ACFRL**)
          - Dressed cavities (**ACFDC**)
            - Bare cavities (**ACFCA**)
            - Helium vessel (**ACFHT**)
            - Tuning system (**ACFTU**)
            - HOM couplers (**ACFHC**)
            - Cold magnetic shield (**ACFCM**)
            - Pick-up antenna (**ACFPU**)
          - Instrumentation (**ACFIS**)
          - *Beam Axis (XYZ)*
            - Vacuum valves (**VVG**)
            - Cold –Warm Transitions (**ACFVW**)
            - Inter Cavity Chamber (**ACFVC**)
            - Beam Screen (**ACFVS**)
      - External supports (**HACF**)
      - General Tooling (**ACF_T**)
        - Forming Tooling (**ACFFT**)
        - Machining Tooling (**ACFMT**)
        - Welding Tooling (**ACFWT**)
        - Clean Room Tooling (**ACFCT**)
      - RF services (**ACFSV**)
        - LLRF & Fast Controls (**ALL**)
        - RF racks (**AY**)
        - Slow controls (**AS**)
        - Transmission lines (**ACFWG**)
        - Main coupler - FPC (**ACFMC**)
        - RF Pick-ups (**APW**)
        - Amplifiers (**ACFA**)
          - Amplifier Tetrode (**ACFAA**)
          - Amplifier IOT (**ACFAB**)
          - Amplifier Solid State (**ACFAC**)
          - Amplifier 2nd Generation IOT (**ACFAD**)
          - Amplifier 2nd Generation SSPA (**ACFAE**)

- LHC
  - Harmonic system
    - 200 MHz
    - 800 MHz
  - Wide-band feedback system

LHC CC Cryomodules – A Global Effort

LHC DQW CRYOMODULES	PRE-SERIES DQW (1 cryomodule)				SERIES DQW (4 cryomodule)				LHC RFD CRYOMODULES	PRE-SERIES RFD (1 cryomodule)				SERIES RFD (4 cryomodules)			
	DESIGN	FABRICATION	ASSEMBLY	VERIFICATION	DESIGN	FABRICATION	ASSEMBLY	VERIFICATION		DESIGN	FABRICATION	ASSEMBLY	VERIFICATION	DESIGN	FABRICATION	ASSEMBLY	VERIFICATION
Bare Cavity	CERN	CERN - Industry (RI)	-	CERN	CERN	CERN - Industry (RI)	-	CERN	Bare Cavity	AUP / CERN	AUP	AUP	AUP	AUP / CERN	AUP	AUP	AUP
Jacketed Cavity	CERN	CERN - Industry (RI)	CERN - Industry (RI)	CERN	CERN	CERN - Industry (RI)	CERN - Industry (RI)	CERN	Jacketed Cavity	AUP / CERN	AUP	AUP	AUP	AUP / CERN	AUP	AUP	AUP
HOM & Pick-ups	CERN	CERN	-	CERN	CERN	CERN	-	CERN	HOM & Pick-ups	AUP / CERN	AUP (JLab)	AUP (JLab)	AUP (JLab)	AUP / CERN	AUP (JLab)	AUP (JLab)	AUP (JLab)
Cold Magnetic Shield	UK	UK Contrib. under discuss.	CERN - Industry (RI)	-	UK	UK Contrib. under discuss.	CERN - Industry (-)	-	Cold Magnetic Shield	AUP / CERN	AUP	AUP	-	AUP / CERN	AUP	AUP	-
Tuning System	CERN	CERN - Industry (-)	CERN	CERN	CERN	CERN - Industry (-)	CERN/UK	CERN / UK	Tuning System	CERN	CERN - Industry (-)	CERN / CANADA	CERN / CANADA	CERN	CERN - Industry (-)	CERN / CANADA	CERN / CANADA
FPC	CERN	CERN	CERN	CERN	CERN	CERN	CERN/UK	CERN / UK	FPC	CERN	CERN	CERN / CANADA	CERN / CANADA	CERN	CERN	CERN / CANADA	CERN / CANADA
Dressed Cavity	CERN	CERN	CERN	CERN	CERN	CERN	CERN/UK	CERN / UK	Dressed Cavity	AUP / CERN	AUP	AUP / CANADA	AUP / CANADA	AUP / CERN	AUP	AUP / CANADA	AUP / CANADA
Vacuum Vessel	CERN / UK	CERN - Industry (-)	CERN - Industry (-)	CERN - Industry (-)	CERN / UK	UK	UK	UK	Vacuum Vessel	CERN / UK	CANADA	CANADA	CANADA	CERN / UK	CANADA	CANADA	CANADA
Warm Magnetic Shield	CERN / UK	CERN - Industry (-)	CERN	CERN	CERN / UK	UK	UK	UK	Warm Magnetic Shield	CERN / UK	CANADA	CANADA	CANADA	CERN / UK	CANADA	CANADA	CANADA
Thermal Shield	CERN / UK	CERN	CERN	CERN	CERN / UK	UK	UK	UK	Thermal Shield	CERN / UK	CANADA	CANADA	CANADA	CERN / UK	CANADA	CANADA	CANADA
Cryogenic Circuits	CERN	CERN	CERN	CERN	CERN	UK	UK	UK	Cryogenic Circuits	CERN	CANADA	CANADA	CANADA	CERN	CANADA	CANADA	CANADA
Coaxial Lines	CERN	CERN	CERN	CERN	CERN	CERN	UK	CERN / UK	Coaxial Lines	CERN	CERN	CANADA	CERN / CANADA	CERN	CERN	CANADA	CERN / CANADA
Beam Screen	CERN	CERN	CERN	CERN	CERN	CERN	UK	CERN / UK	Beam Screen	CERN	CERN	CANADA	CERN / CANADA	CERN	CERN	CANADA	CERN / CANADA
Instrumentation	CERN	CERN	CERN	CERN	CERN	CERN/UK	CERN/UK	CERN / UK	Instrumentation	CERN	CANADA	CANADA	CERN / CANADA	CERN	CANADA	CANADA	CERN / CANADA
Cryomodule Assembly	CERN	CERN	CERN	CERN	CERN	UK	UK	CERN / UK	Cryomodule Assembly	CERN	CANADA	CANADA	CERN / CANADA	CERN	CANADA	CANADA	CERN / CANADA

Current discussion on-going – To be updated accordingly!

Where we are today

- Bare Cavity Spec. Drawings (DQW and RFD) updated and approved. ECRs issued and approved (following HL-LHC ECR procedure) with changes from SPS Cavities
- Dressed Cavities and Cryomodule Models/Drawings being issued (See T.Capelli talk)
- Engineering Specifications circulated for final approval (Dressed Cavities) and/or under internal circulation for review (Cryomodule and Cryomodule equipment)
- DQW Jacketed Cavities Series industrialized and followed by CERN. Documentation being issued by the Vendor (see N.Valverde talk)
- RFD Jacketed Cavity prototype industrialized and followed-up by US-AUP. Documentation being provided by AUP from the Vendor (see L.Ristori talk)
- CERN Tools are being used for Collaborations and Industries

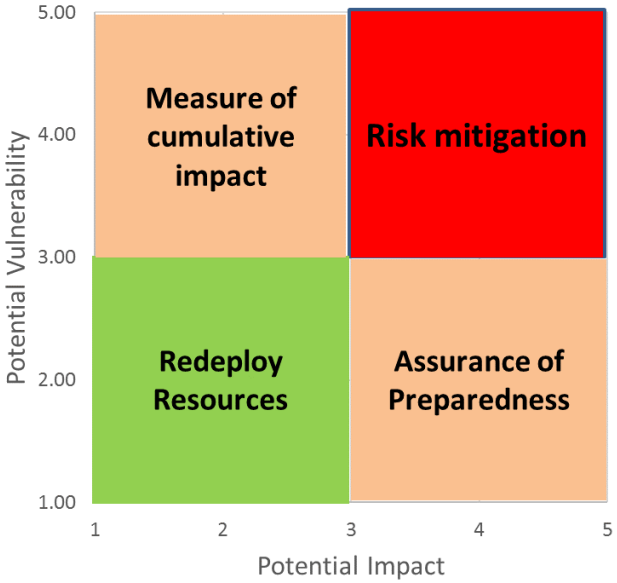
Some Key Reference Documents

- **Specification Drawings Bare Cavities**
  - **DQW Bare Cavity:** LHCACFCA0367 v.AD - EDMS 1835386 — Released
  - **RFD Bare Cavity:** LHCACFCA0002 v.AE - EDMS 1406869 — Released
- **Engineering Specifications**
  - **Dressed Cavities:** EDMS 1389669 v2.49 (It includes cavities, He Tank, CMS, HOMs) — Under Approval
  - **Cryomodule:** EDMS 2043014 v0.1 — In Work
  - **Cryomodule components:** WMS, Vacuum Vessel, Cryolines (FPC, RF Lines, TS will come soon) — In Work
  - **Dressed RFD Cavities FRS from AUP:** EDMS 1806220 v1.0 — Released
- **Safety Documentation (See Luca Dassa Talk)**
  - **Guidelines for compliance with CERN Safety Requirements for cryomodules:** EDMS 2043016 v1.0 — In Work
  - **Guidelines for compliance with CERN Safety Requirements for cryomodule components and dressed cavities:** EDMS 2046056 v1.0 — In Work
  - **Guidelines for compliance with CERN Safety Requirements for cryomodules components independently:** Under preparation — In Work
- **Technical Specifications for Procurement**
  - **Supply DQW Jacketed Cavities:** EDMS 1803555 v1.0 — Released
  - **Supply of Nb sheets and plates for CC Series:** EDMS 1772799 v0.3 — HL Engineering Check
  - **Supply of Nb plates for HOMs (RFD Proto y DQW pre-Series):** EDMS 2171005 v0.1 — In Work
  - **Supply of Nb plates for HOMs (DQW Series):** To be prepared
- **Manufacturing Records SPS Cryomodule and all the components integrated within it: HCACFGA001-CR000001**

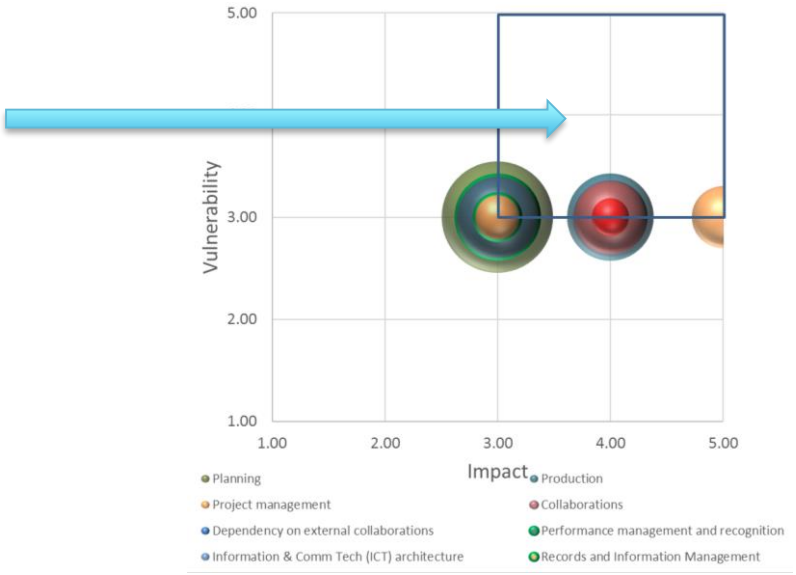
Outline

1. HL-LHC Quality - Recap
2. CC SPS - PoP for HL-LHC Quality
3. Good practices, Lessons Learnt and Industrialization
4. LHC Cryomodules – A global challenge
5. **Risk Management**
6. Summary

Main Risks



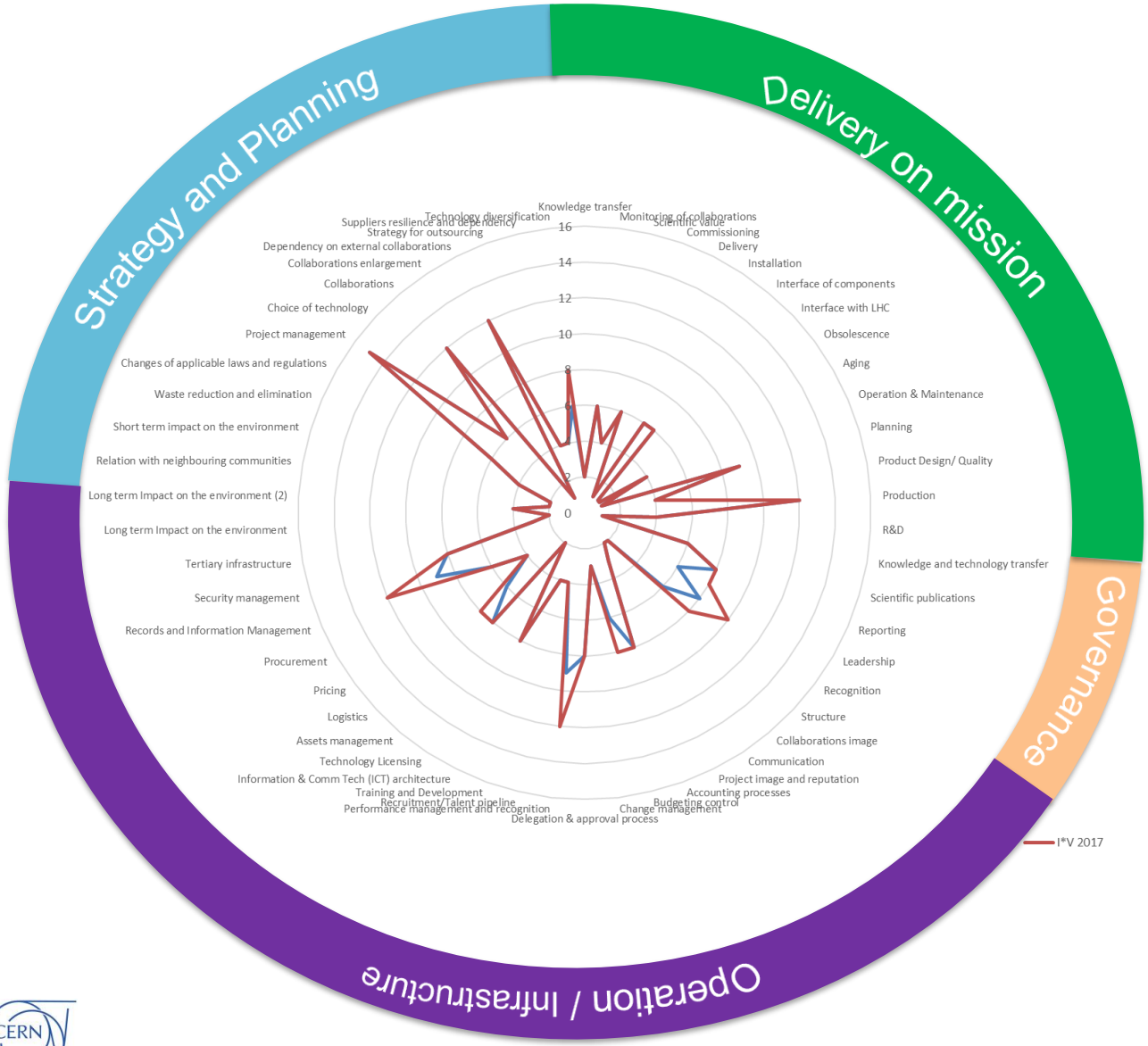
Identified Risks to be tackled



Risk assessment in place for the project since 2017. Yearly exercise driven by Isabel Bejar (HL-LHC Quality, Configuration, Risk & Sourcing Officer)

- Risk identification
- Risk analysis
- Risk evaluation
- Risk treatment
- Risk monitoring and review
- Risk communication

Main Risks


Strategy and Planning
Delivery on mission
Governance
Operation / Infrastructure
Knowledge transfer
Monitoring of collaborations
Scientific value
Commissioning
Delivery
Installation
Interface of components
Interface with LHC
Obsolescence
Aging
Operation & Maintenance
Planning
Product Design/ Quality
Production
R&D
Knowledge and technology transfer
Scientific publications
Reporting
Leadership
Recognition
Structure
Collaborations image
Communication
Project image and reputation
Accounting processes
Budgeting control
Change management
Delegation & approval process
Performance management and recognition
Recruitment/Talent pipeline
Training and Development
Information & Comm Tech (ICT) architecture
Technology Licensing
Assets management
Logistics
Pricing
Procurement
Records and Information Management
Security management
Tertiary infrastructure
Long term Impact on the environment
Long term Impact on the environment (2)
Relation with neighbouring communities
Short term impact on the environment
Waste reduction and elimination
Changes of applicable laws and regulations
Project management
Choice of technology
Collaborations
Collaborations enlargement
Dependency on external collaborations
Strategy for outsourcing
Suppliers resilience and dependency
Technology diversification
16
14
12
10
8
6
4
2
0
I*V 2017

Main changes on the impact and vulnerability

General positive evolution due to the SPS test and maturity of the collaborations.
Some of the changes from 2017 to 2018:

- The impact of *Leadership* decreased from 4 to 3. The project is well defined now, and there is more margin.
- The impact of *Recognition* decreased from 5 to 4. Nevertheless, it might increase again since there is only one expert per machine.
- The impact of *Structure* decreased from 4 to 3. The project is well defined now, and there is more margin.
- The impact of *Budgeting control* decreased from 4 to 3. The WP knows the budget very well. There is a continuous reporting in the PMS meetings.
- The impact of *Performance management and recognition* decreased from 4 to 3.The action set in 2017 was very effective.
- The impact of *Logistics* decreased from 4 to 3. The problem was partially solved in 2018. The WP is working to address the issue of the transportation.
- The impact of *Records and Information Management* decreased from 4 to 3. The action set in 2017 was very effective.
- The impact of *Technology diversification* decreased from 4 to 3. The process is close to the end, next year we will have the crab cavities.

Action Plan 2018

IxV	Risk ID	Risk	Description	Actions	Comments
15	47	Project management	Mainly based on the problem to integrate information coming from the collaborations. Difficult to evaluate if there are risks that are coming until they are presented in official meetings.	2017 Today there are bi weekly meetings following the development and the periodic personnel meetings to control and identify any risk. 2018 The following action will be implemented from 2019: -Maintain the action.	-The action set in 2017 was effective. -The risk remains because the project with the collaborations just started. -Up to now, the communication has been very fluent. The meetings on the labs allow to detect conflicts early enough. -Issues are reported in the PSM. Some of them have to be treated at project level. -Availability is a critical point.
12	14	Production	Failure on the production of components for the accelerators. Interface of equipment during assembly. Issues during the assembly of components. Wrong production speed. Management of the priorities. Stop of LHC due to a magnet issue for example and HL-LHC magnets need to be tested at the same time. Bankruptcy of the company that was awarded the contract	2017 Close follow-up of the production by CERN personnel for the CERN DQW production and by the FERMILAB team for RFD. Already using MTF for the follow-up of production issues. 2018 The following action will be implemented from 2019: - Maintain the action. - By spring: Identify a person who be helped by Nuria, and will do the MTF job.	-The action set in 2017 was effective. - Technical specifications for the remaining components are going to be finished in 2019.

Action Plan 2018

IxV	Risk ID	Risk	Description	Actions	Comments
12	49	Collaborations	Risk in change on the scope of the contributions of the research institutes collaborating today in the project. Risk of failure on the development of their contribution.	2017 If there is a change of scope, CERN is able to act as a backup to retake the production. 2018 The following action will be implemented from 2019: - Maintain the action.	- The action set in 2017 was effective. -The risk remains because the project with the collaborations just started. Up to now, the communication has been very fluent.
12	51	Dependency on external collaborations	Risks of over dependency on external collaborations.	2017 If there is a change of scope, CERN is able to act as a backup to retake the production. 2018 The following action will be implemented from 2019: - Maintain the action.	- The action set in 2017 was effective. - For all the critical components, there is either CERN as back up, or another collaboration that possible could replace it. -Zanon has been chosen for the production of the crab cavities. There is redundancy for the production of cryostats (UK, CANADA, CERN)

Action Plan 2018

IxV	Risk ID	Risk	Description	Actions	Comments
9	38	Records and Information Management	All risks related to records and information management, including insufficient personnel for documentation follow-up mainly for collaborations.	2017 Active training of all people involved in the production and centralization of the follow-up by CERN tools. 2018 The following action will be implemented from 2019: - Maintain the action.	- The action set in 2017 was effective. - Full traceability in EDMS and MTF
9	29	Performance management and recognition	The risk exist because most part of the people have a lower time allocation that they need to but at the same time the persons have all the time allocated the time required for accomplish their task.	2017 Active communication with the Group Hierarchy. 2018 The following action will be implemented from 2019: - Maintain the action as after all the effort for the SPS installation is important that is understood that if the effort is not maintained there will be delays.	-The action set in 2017 was effective. - All departments contributed to the success of the SPS crab cavities installation.
9	12	Planning	There is the planning of the different subcomponents and we have to integrate all them and this increase the complexity of the planning.	2017 The US production planning is integrated in the master plan and the same will happen with the future collaborations. 2018 The following action will be implemented from 2019: - Maintain the action.	- The action set in 2017 was effective. - The UK and Canada planning are integrated.

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Summing up

- **Quality Policy** and **Documentation Requirements** are well defined for the whole Project (**HL-LHC QP** compatibility for **All Deliverables**)
- CC SPS as a good example of **team working**, **commitment** and **global effort** to achieve the goals (1 + 1 > 2). Basis for the future
- Same Approach, level of documentation and traceability to be followed for the HL-LHC production. It is a proven **worth effort**.
- Challenges ahead:
  - **Industrialization** on-going
  - **New Stakeholders** (welcome!!)
  - **LHC Requirements** and boundary conditions. **Integration**
  - **Communication** and **Coordination** among parties as a key asset for **Success**
- Risk assessment yearly performed. It demonstrates that the identified WP4 risks are **Under Control (Effective Actions).**
- HLPO will continue providing **Support** to the WP including Collaborations and Industries

Thanks to all those that are contributing to make it possible!...

but it's not over, actually it's about the beginning!

Back-up Slides

A worldwide E-Group (and still growing up)

E-group: *HI-LUMI-LHC-WP4-MEMBERS (Static)*

Settings | Owner, Admin & Privileges | **Members** | Email Addresses | Email Properties | Blacklist | Audit Information

Filter members

Add me | Export members

E-group Members

Goto 1-2 Page Size: 100 Apply | Delete Members | Edit Comments

	Name	Type	Login	Email	Comments	
☐	HI-LUMI-LHC-WP4-CERN	e-group				
☐	HI-LUMI-LHC-WP4-EXTERNAL	e-group				

CERN

Fermilab

Jefferson Lab

BERKELEY LAB
Lawrence Berkeley National Laboratory

KEK-JAPAN

LANCASTER UNIVERSITY

SLAC
NATIONAL ACCELERATOR LABORATORY

The Cockcroft Institute
of Accelerator Science and Technology

US HL-LHC AUP

Science & Technology Facilities Council

TRIUMF

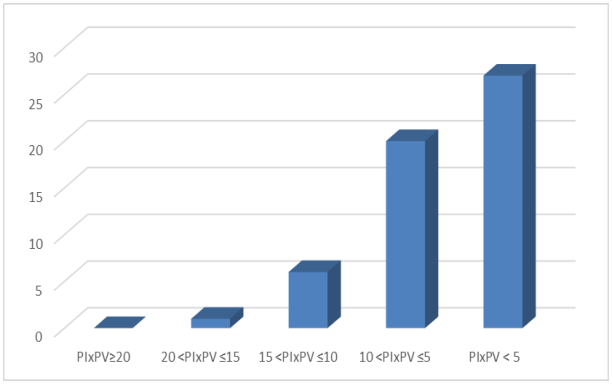
Институт ядерной физики имени Г. И. Будкера СО РАН

HiLumi HL-LHC PROJECT

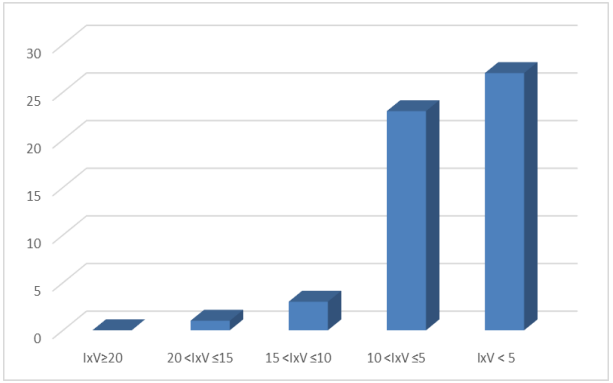
CERN

Evolution of risks

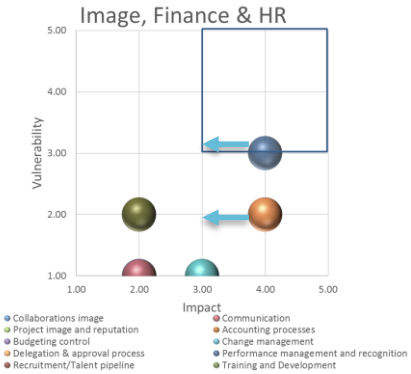
2017



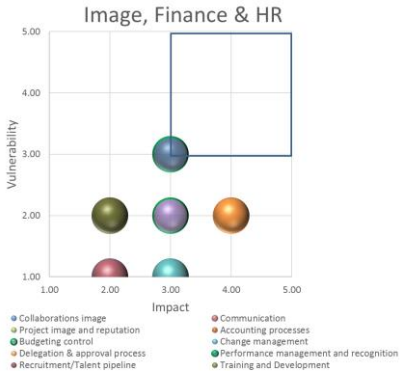
2018



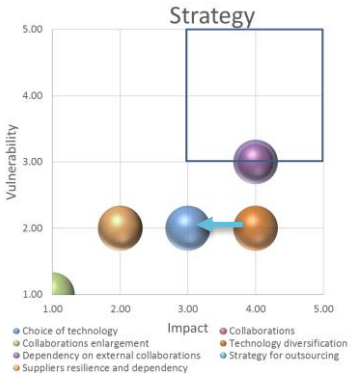
2017

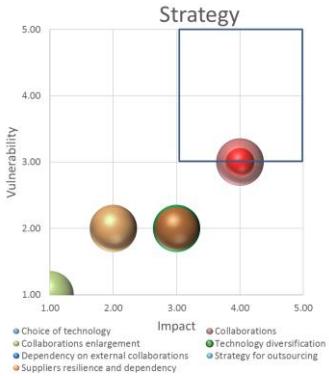


2018



Budgeting control and *Performance management and recognition* impact has decreased 1.00





Technology diversification impact has decreased 1.00

The Project Baselines

- A Baseline is a set of attributes at a point in time.
- It serves as a basis for defining change.
- HL –LHC maintains Scope, Schedule and Cost Baselines.
- Our TDR is our present Scope Baseline
- Our MS Planning is our present Schedule Baseline
- Our MTP is our present Cost Baseline

The three together are our **Configuration Baseline**

What is a change

When I'm modifying the Baseline

- I'm going to do something differently from what I described in detail in the TDR.
- I'm not going to respect the maximum time allocated in the Master Schedule for one of the phases.
- I need extra funds to pay for an object that was in the baseline and can not be funded by internal reorganization of the budget for the **same** equipment

If you have a doubt contact the Project Office

Tracing change / when tracing and how

- It is not considered a change when **moving from a concept to a functional or technical specification.** This evolution is part of the normal live cycle and will be covered by a new version of the conceptual specification (for example moving from v 1.0 to 1.1) or by a functional or technical specification.
- Changes in the schedule that **do not affect the critical path** do not need a HL-ECR or a decision report. When the change is motivated by a delay the Project office together with the WPL will analyse it to understand the cause. The PO will prepare a decision report if considers useful to trace and share the findings.
- Modifying the profile of expenditure or moving M to P expenditure if not a change in the baselie. Changes to the budged are traced by memorandums issued by the Project Budged Officer in all cases

Who analyses the change

When a **change is internal to the WP and not affecting the Baseline** the WPL:

- analyses it.
- fills the Template for Decisions report that contains the analysis and the reason of the desired decision.
- sends the report to PO and the TCC secretariat that adds it to the AOBs of the next TCC for final review.

When a **change affects several WPs or the Baseline**:

- the requester WPL informs the PO (HI-LUMI-LHC-PO@cern.ch) who will evaluate the request and will provide the WPL the required support documents
- The PO will fix with the TCC chairman the date for the discussion.
- The final approval will be given in the TCC.

When a **change affects the LHC machine** an ECR is submitted using the normal LHC ECR circuit. All are discussed in the TCC before being sent to the LMC

What template I use

Changes not affecting the configuration Baseline

The Template for Decisions Reporting will be used to trace decisions for an existing type of component or on components that are evaluated for the Baseline. Typically will be used to formalize a technical decision between several options, an internal re-scheduling not affecting the baseline or a revaluation of the cost, a technical decision to be shared.

Changes affecting the configuration Baseline

The Template for HL-LHC ECR will be used to trace decisions and actions that will come from changes on components already in the configuration Baseline

Changes affecting the present LHC

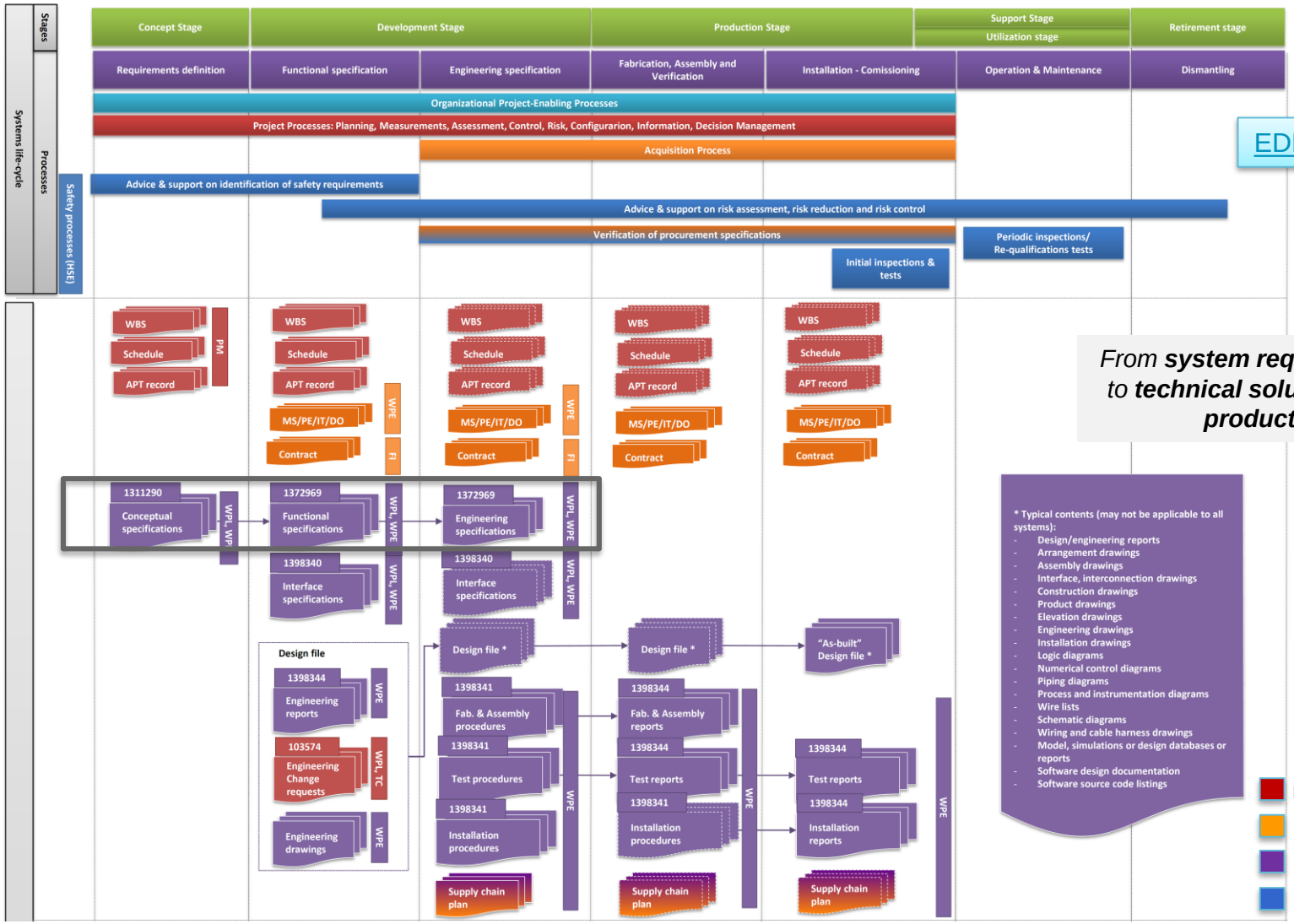
The LHC ECR template will be used to trace changes in the present LHC machine and follows the normal LHC ECR.

Pre analysis to help on the decision process

To ensure or at least to help the "objectivity of the decision" exists a template to help to put the pros and cons based on the SWOT analysis

The rebaselining exercises are the moment used to consolidate the changes in the different documents/baselines

Long term documentation (1/2)



EDMS #1361462

*From **system requirements** to **technical solutions** and **products***

Long term documentation (2/2)

Safety File

Links to already existing documentation will be made, whenever required